Chapter 11 Aircraft noise

Summary of key findings

This chapter presents a summary of the nature and extent of likely short-term (year 2033), mid-term (2040) and long-term (year 2055) aircraft noise impacts associated with the preliminary airspace and flight path design (the project). It presents a comprehensive suite of noise metrics and supporting information to help all stakeholders understand the potential implications of single runway operations at WSI.

Individuals interested in information about proposed flight paths and aircraft noise can refer to this chapter, Chapter 7 (The project) and Technical paper 1: Aircraft noise (Technical paper 1). The Aircraft Overflight Noise Tool is available online at https://www.wsiflightpaths.gov.au/. This tool shows proposed flight paths and expected noise impacts on the community.

The findings of the assessment in relation to social amenity, world heritage and National heritage values and human health have been considered in Chapter 18 (Social), Chapter 23 (Matters of National Environmental Significance) and Chapter 20 (Human health) respectively.

Nature of noise

Individuals show varying sensitivity to noise. The Draft EIS assessment of aircraft noise is based on measures outlined in *AS 2021:2015 Acoustics – Aircraft noise intrusion – building siting and construction* (AS 2021), the National Airports Safeguarding Framework and Commonwealth Department of Transport and Regional Services (2000) '*Expanding ways to describe and assess Aircraft noise*'. These guidelines emphasise the challenge of communicating the complex nature and extent of aircraft noise and advocate using several different measures to aid interpretation of predicted noise exposure levels. While this EIS has used a range of measures for describing noise exposure, it is important to note that aircraft noise impacts could also be experienced by individuals outside the areas depicted by the various noise exposure contours. Individuals and communities newly exposed to aircraft noise are likely to show an enhanced sensitivity to changes in the noise environment.

Background and method

The aircraft noise study area (study area) was comprised of a nominal 45 nautical miles (83 kilometre (km)) radius from WSI to capture the areas most likely to be affected by noise from aircraft using the WSI flight paths. The assessment considered the likely impacts of aircraft overflights over the 3 assessment years: 2033, 2040 and 2055 to reflect the change in noise impact as airport traffic increases.

In practice, noise impact will also depend on the airport operating strategy adopted by air traffic control. The 5 proposed runway modes of operation (RMOs) as presented in Chapter 7 (The project) were the basis of runway operating scenarios which were modelled to generally cover the geographical extent of potential impacts of aircraft noise. Results were generated as a suite of information including charts, contour maps and tables and then analysed to assess and compare the significance of the projected noise exposure results.

The noise impact assessment undertaken for this Draft EIS has adopted a conservative approach by assessing and modelling aircraft types based on those currently in service, without taking account of any future reductions in aircraft noise emissions which may occur over time due to technological advancements. The assessment excludes any considerations of overflight by existing operations at Sydney (Kingsford Smith) Airport, Bankstown and Camden Airports or RAAF Base Richmond.

Existing environment

Most parts of the Sydney Basin including Western Sydney currently experience some level of daily aircraft overflight. Aircraft noise from existing Sydney Basin operations is audible but has not been quantified as part of this assessment. The Sydney Basin is also overflown by aircraft transiting from outside the area to a mix of domestic and international destinations. These operations have not been considered in the assessment, but were perceptible based on the ambient noise monitoring presented to support this assessment.

There are a variety of acoustic environments within the WSI study area, ranging from urban areas such as Penrith's central business district, to rural areas that are largely removed from human-induced noise and the natural environments of the Greater Blue Mountains Area (GBMA).

Consideration through design

Increased levels of overflight of areas in proximity to WSI and under its proposed flight paths is an unavoidable consequence of the introduction of new aircraft operations at WSI.

Preliminary airspace design development has been guided by Condition 16 and the 12 Airspace Design Principles of the Airport Plan as detailed in Chapter 6 (Project development and alternatives). The impact of aircraft noise on the surrounding community has been minimised to the extent practical by directing aircraft away from overflying populated areas and visually sensitive areas where possible (whilst prioritising operational safety).

The assessment assumes the use of continuous descent approaches, which minimise the use of engine thrust by pilots. Continuous descent operations are used at a variety of other airports and are embodied in the preliminary airspace design provided by Airservices Australia.

Impact assessment

The key findings from the assessment may be summarised as follows:

- As the single runway approaches capacity in 2055, over a 24-hour period, between 7,000–12,200 residents may experience 5 or more aircraft noise events above 70 dB(A) which can lead to in an indoor sound level of 60 dB(A) when windows are opened (enough to disturb conversation). The number of residents affected by different levels of aircraft noise depends on the runway operating scenario adopted. Comparison of the 3 key scenarios indicates that while there is limited variability of noise exposure levels in close proximity to WSI, the choice of runway operating strategy has a more pronounced effect on communities further away.
- The use of an alternative suite of proposed WSI day and night flight paths results in a level of respite and noise being shared to some areas impacted by the proposed higher traffic volumes of WSI day operations and a significant reduction in dwelling and population counts during WSI night operations, particularly when the Reciprocal Runway Operation (RRO) mode can be applied.
- Residential and rural-residential areas to the immediate north-east and south-west of WSI, located on extended runway alignment, and close to the proposed arrival flight paths and initial departure turns will be subjected to a significant and unavoidable level of noise exposure.

Options for noise mitigation

Increased exposure to aircraft noise in areas in the vicinity of WSI and under its proposed arrival and departure flight paths will be an unavoidable consequence of aircraft operations at WSI.

Approaches to mitigating aircraft noise generally focus on reducing noise emissions from the aircraft themselves, planning flight paths and airport operating modes in a way that minimises potential noise and environmental impacts (the focus of this Draft EIS), and implementing land use planning or other controls to ensure that future noise-sensitive uses are not located in noise-affected areas.

External to the design, New South Wales (NSW) Government planning controls have been in place for several decades and have to the extent practical prevented incompatible noise sensitive developments around WSI. It is expected that future land use planning around the proposed airport would be influenced by final long term Australian Noise Exposure Forecast (ANEF) contours once flight paths and operating modes are finalised and approved.

Subject to relevant considerations such as aircraft safety, all practicable opportunities for mitigating noise impacts will be considered in finalising the flight paths and aircraft operating procedures for the proposed airport.

Various operating strategies for managing aircraft noise will have differing impacts on different populations, particularly at night, when greater airspace flexibility and lower demand permits the use of different runway modes of operation and flight paths. This could be achieved by prioritising, when operationally possible, night-time flights over wedges of low-density rural land and natural areas to the south-west, west and south of WSI. However, it is noted that these areas could be more noise sensitive than urban areas experiencing similar levels of noise exposure.

11.1 Introduction

This assessment considers noise produced by aircraft during departure and arrival at the airport (aircraft noise). Aircraft noise includes the noise generated:

On departure:

- from the point at which an aircraft commences its departure roll
- proceeds along the runway to the point of leaving the ground
- climbs into the air and departs the vicinity of the airport up to an altitude of around 20,000 feet (6 kilometres (km)).

On arrival:

- from the point at which an aircraft approaches the vicinity of the airport at an altitude of around 20,000 feet (6 km)
- descends to the runway
- touches down
- slows down along the runway to the point of exiting onto a taxiway
- uses reverse thrust if that is required to slow the aircraft down on the runway.

The separation of these noise sources from other on-ground sources such as engine ground start-ups and runs, aircraft taxiing and aircraft at the terminal is consistent with the noise classification in the *Airports (Environment Protection) Regulations 1997*. Ground-based noise from such sources was considered in the Western Sydney Airport – Environmental Impact Statement (2016 EIS) and is outside the scope of this assessment.

The full assessment is provided in Technical paper 1. The proposed flight paths are provided in Chapter 7 (The project) and their development and finalisation is described in Chapter 6 (Project development and alternatives).

There are adjustments required to Sydney Basin operations prior to the opening of WSI in 2026 to facilitate its new flightpaths and airspace. These are described in Chapter 8 (Facilitated changes) and associated impacts (including aircraft noise) are assessed in Chapter 21 (Facilitated impacts).

Cumulative impacts, including the changes to noise levels arising from the project in relation to on-ground noises such as road, rail and industry are described in Chapter 22 (Cumulative impacts).

11.1.1 Assessment years

The assessment years for aircraft noise exposure are:

1. **2033** – representing the early years of airport operation, when single runway operations handle up to 10 million annual passengers and around 81,000 air traffic movements per year
2. **2040** – representing an interim year of operation, when single runway operations handle around 15 million annual passengers and around 107,000 air traffic movements per year
3. **2055** – representing aircraft noise impacts as the single runway approaches capacity, when single runway operations handle around 37 million annual passengers and around 226,000 air traffic movements per year.

These assessment years informed the selection of operational scenarios for consideration as discussed in Section 11.5.6.

In each year, noise exposure is predicted for the day period (5:30 am to 11 pm) and night period (11 pm to 5:30 am). The reasoning for these hours of operation is provided in Chapter 7 (The project) and explained further in the context of other noise metrics in Section 11.5.5.

11.2 Understanding aircraft noise

11.2.1 Nature of noise

Sound is a vibration that propagates as an acoustic wave through the air. It is transmitted to the human ear where such waves are received and processed by the brain as a sound or noise.

The loudness of a sound depends on its sound pressure level, which is expressed in decibels (dB). Most sounds we hear in our daily lives have sound-pressure levels in the range of 30 dB(A) and 90 dB(A), where (A) is an adjusted dB reading (A-weighted sound level) to account for the varying sensitivity of the human ear to different frequencies of sound.

The daytime background indoor sound level in a typical home is about 40 dB(A) and the average noise level of conversation is about 60–65 dB(A). Typical aircraft noise levels measured by Airservices Australia's Noise and Flight Path Monitoring System (NFPMS) are between 65 dB(A) and 95 dB(A), collected daily from noise monitors strategically located around communities close to Australian airports (refer to Section 11.8.2.3).

Figure 11.1 shows the A-weighted decibel (dB(A)) noise levels for a range of common situations and the comparison with spot aircraft departure noise levels for a typical aircraft (A320-200/B737-800).

Two to 3 decibels is the minimum change in sound level that most people can detect, while every 10 dB(A) increase in sound level is perceived as a doubling of loudness. Additionally, individuals may perceive the same sound differently and may be more or less affected by a particular sound.

The frequency of a sound is what gives it a distinctive pitch or tone – the rumble of distant thunder is an example of a low frequency sound and a whistle is an example of a high frequency sound. The human ear is more sensitive to high frequency sounds.

Most environmental sounds contain a broad range of frequencies. While middle to high frequency sounds tend to annoy most people, low frequency noise from aircraft-induced rattling, rumbling or vibration can also cause annoyance. Sound waves travel out equally in all directions from their source. This is like the way ripples travel when a rock is thrown into a calm pond. As soundwaves travel away from a source, they become less intense as the energy is spread out over an ever-increasing area and absorbed by the atmosphere. Higher frequencies are absorbed at shorter distances, while lower frequencies can travel further before they are absorbed. As a result, an aircraft can sound different depending on how far away it is flying. For example, a distant jet aircraft is often heard as a low frequency rumble. The amount of noise created varies according to the way in which an aircraft is flown, even for identical aircraft.

Experience has shown that many factors can influence an individual's response to aircraft noise, including:

- the specific characteristics of the noise (for example, the frequency, intensity and duration of noise events) and the time-of-day noise events occur
- background noise levels, and whether background noise is natural, industrial, desirable (for example, bird song) or undesirable (for example, road traffic)
- their personal circumstances and expectations about the number, frequency, loudness and timing of noise events
- their individual sensitivities and lifestyle (for example, whether they spend a lot of time outdoors, work from home or sleep with a window open)
- their reaction to a new noise source (in the case of a new airport or new runway) or to changed airport operational procedures
- their understanding of whether the noise is avoidable and their notions of fairness, and
- their attitudes towards the source of the noise (for example, general views about aviation activities and airports).

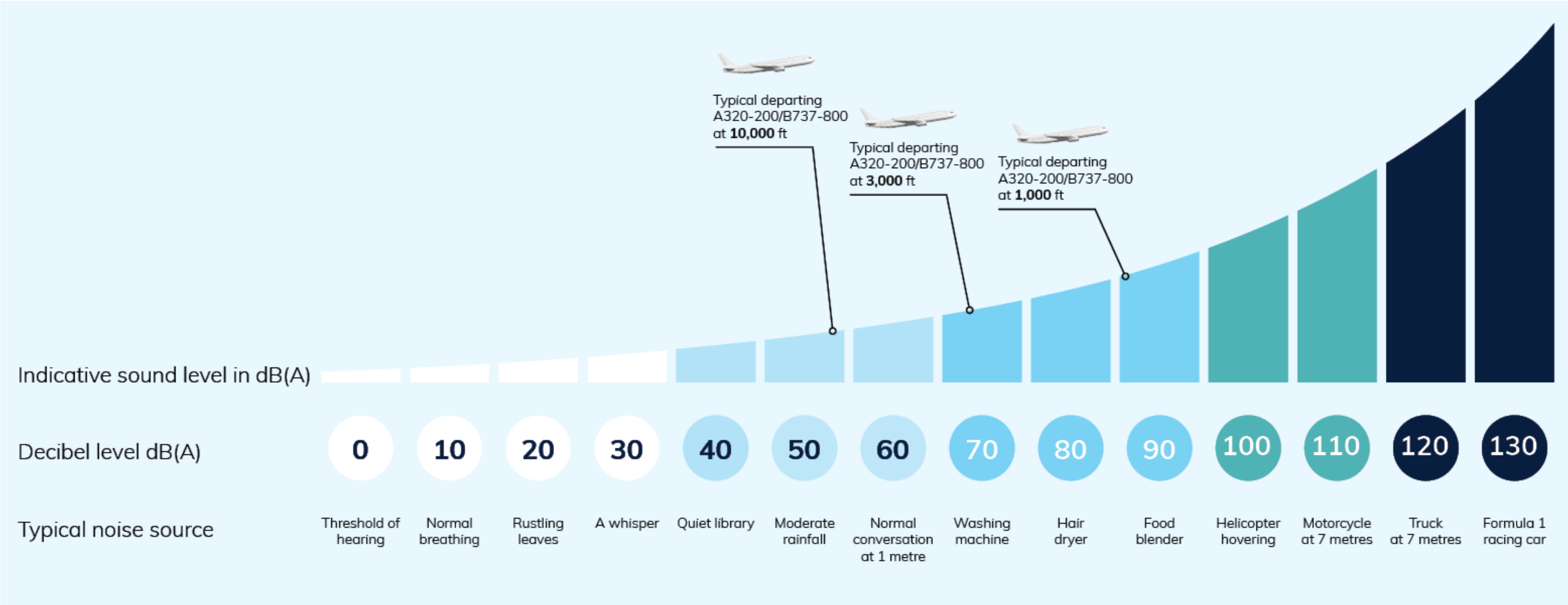


Figure 11.1 Indicative A-weighted decibel noise levels in typical situations

11.2.2 Sources of aircraft noise

Aircraft noise is the sound emitted through the operation of aircraft, as depicted in Figure 11.2. It is induced primarily by the engines (or propellers) and when air passes over the fuselage (the aircraft's body) and its wings. This causes friction and turbulence, which make noise. This is exacerbated when the landing gear, and control surfaces (such as ailerons and elevators) are in use.

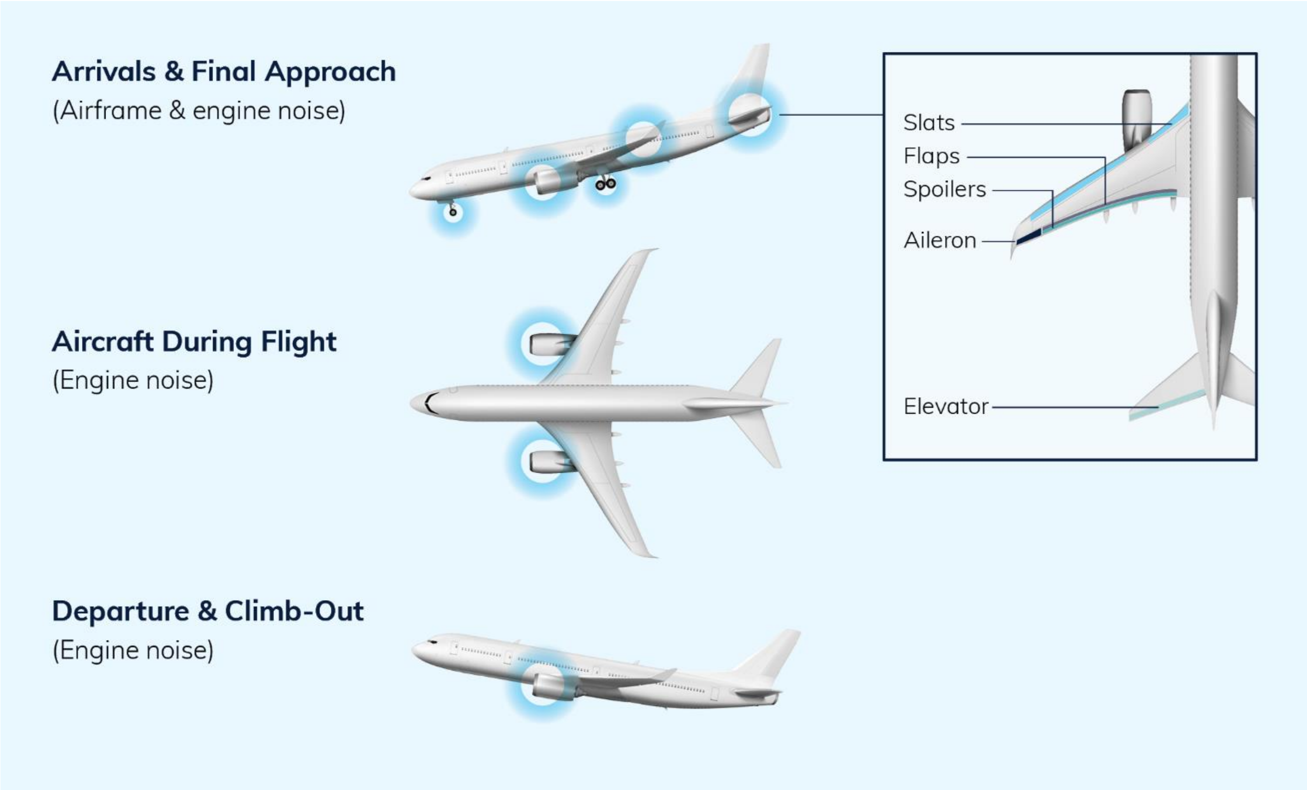


Figure 11.2 Aircraft noise sources

The level of noise heard from a plane during take-off, landing and during flight can vary. Aircraft noise is influenced by a range of factors, including:

- type and size of aircraft
- the weather, including season, wind and cloud cover
- the height of an aircraft above the terrain
- changes in engine thrust.

Generally, noise from departing aircraft is louder than from that of an arriving aircraft. Long range heavy, widebody jet aircraft such as the Boeing B747 with a full payload (including fuel) climb more slowly than smaller jet and non-jet aircraft and therefore can be heard at higher noise levels for longer. On approach, arriving aircraft are operating at a lower altitude further out from the airport which may cause noise impacts at large distances from the runway. On landing, aircraft apply lower engine power (thrust) settings and are likely to be less noisy than on departing.

11.3 Legislative and policy context

There are no legislative criteria for the evaluation of aircraft noise in Australia. The relevant legislation, standards and assessment guidelines considered for the noise assessment include:

- *Airports Act 1996* (Cth) (Airports Act), specifically Condition 16 of the Airport Plan
- Air Navigation (Aircraft Noise) Regulations 2018
- Annex 16: Environmental Protection – Volume I Aircraft Noise (International Civil Aviation Organization (ICAO)) (ICAO, 2017)
- AS 2021:2015 Acoustics – Aircraft noise intrusion – building siting and construction (AS 2021:2015) (Standards Australia, 2015)
- ANEF system (endorsed by Airservices Australia)
- Balanced Approach to Aircraft Noise Management (ICAO Balanced Approach) (ICAO, 2010)
- Civil Aviation Safety Authority (CASA) regulatory standards
- Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)
- Environmental Management of Changes to Aircraft Operations standard (NOS) – AA-NOS-ENV2.100 Version 18: Effective 1 July 2022) (Airservices Australia, 2022b)
- National Airports Safeguarding Framework principles and guidelines (NASF Guidelines) (DITRDCA, 2012)
- NSW Noise Policy for Industry (NSW EPA, 2017)
- State Environmental Planning Policy (Precincts – Western Parkland City) 2021 (NSW) (Western Parkland City SEPP)
- Sydney (Kingsford Smith) Airport and Associated Airspace – Long Term Operating Plan (LTOP) (Airservices Australia, 1996).

The assessment was designed to address the EIS Guidelines and have due regard to the requirements of Airservices Australia's NOS. The relevance of the Airports Act and the EPBC Act to the project is described in Chapter 5 (Statutory context) and the application of international and Australian national standards and recommended practices is explained throughout the assessment. The ICAO Balanced Approach is of relevance as outlined in the following section. The responsibilities for aircraft noise as per Section 11.3.2 provides the broader context for managing airport related noise at civilian airports.

11.3.1 ICAO Balanced Approach to Aircraft Noise Management

As outlined in Table 11.1, ICAO is a specialised agency of the United Nations and is responsible for establishing the global regulatory framework for the safety of international civil aviation. This includes minimising the adverse environmental effects of civil aviation activities, including aircraft noise. The ICAO Balanced Approach was adopted in 2001 and consists of 4 principal elements as presented in Figure 11.3.

Noise management element	Description
Reduction of noise at source	Aircraft noise certification and international standards and recommended practices (SARPs) for aircraft noise
Land using planning and management	Compatible land use planning in the vicinity of airports
Noise abatement operational procedures	Controlling the use of runways and flight paths adjusting procedures for take-off, approach and landing
Operational restrictions	Restrictions on aircraft types and time of operation

Figure 11.3 ICAO's Balanced Approach to Aircraft Noise Management

The ICAO Balanced Approach identifies the noise occurrences at a specific airport and analyses various measures available to reduce noise which can be classified into the 4 principal elements. The goal is to address noise problems at each airport individually. This is done by using objective and measurable criteria to identify and select the most cost-effective noise-related measures that will achieve maximum environmental benefit (ICAO, n.d.).

The 4 principal elements are further explained in Section 11.8.2. Of these, the first principal element – reduction of noise at source – is relevant to the noise assessment as described in Section 11.3.1.1) and the third principal element – noise abatement procedures – is relevant to the operation of WSI as described in Section 11.8.2.2. The second and fourth principal elements are not directly relevant to this assessment.

Further information on the ICAO Balanced Approach is found in Section 7.1 of Technical paper 1.

11.3.1.1 Reduction in noise at source

The Air Navigation (Aircraft Noise) Regulations 2018 enact the ICAO noise emissions control standards for aircraft using airports in Australia.

Most operations at WSI are likely to be short haul domestic and regional routes served by narrow-body (single aisle, twin engine) jets from the Airbus 320 and Boeing 737 families. Over the past 60 years, aircraft have reduced their noise output by around 75 per cent when compared to the first-generation jet aircraft like the Boeing B707 and B727 jets. It is, however, difficult to predict future reductions in aircraft noise exposure from low noise variants because this is primarily the role of original equipment manufacturers, for example, Airbus and Boeing.

Aircraft types assessed and modelled for this EIS are based on those currently in service. This is considered a conservative approach, as even without further technological advances, it is reasonable to assume that aircraft projected noise levels around WSI would decrease over time as quieter new generation aircraft make up a greater proportion of the fleet mix.

Key future trends in aircraft type and movements at WSI are summarised in Chapter 2 (Strategic context and need) and further information on improvements in aircraft technology is provided in Section 11.4 of Technical paper 1.

11.3.2 Responsibilities for aircraft noise

Several organisations manage aircraft noise as summarised in Table 11.1. These include those who regulate and set standards for aircraft noise, manage noise through aircraft design or fleet management, or control the impact of noise through land use planning.

Table 11.1 Responsibilities for managing airport related noise at civilian airports

Organisation	Summary of responsibilities on aircraft noise
Regulators	
ICAO	• Works with member states, including Australia, to develop international standards and recommend practices for national aviation regulations. • Sets strict aircraft noise standards which aircraft built today are required to meet.
CASA	• Must maintain, enhance and promote the safety of civil aviation under the *Civil Aviation Act 1988.* • Must exercise its powers to ensure that the environment is protected from the effects of, and associated with, the operation and use of aircraft.
Airservices Australia	• Responsible for managing the aircraft movements at the airport. • Under the *Air Services Act 1995*, must exercise its powers and perform its functions in a manner that ensures that, as far as is practicable, the environment is protected from the effects of, and the effects associated with, the operation and use of aircraft. This includes the requirement to: • prepare and publish noise abatement procedures • publish information on aircraft movements, runway and track usage and noise impacts using a range of noise descriptors • conduct noise monitoring in communities surrounding Australian airports • manage noise complaints and enquiries through the Noise Complaints and Information Service.
Australian Government: Aircraft Noise Ombudsman	Conducts independent reviews of Airservices Australia management of noise-related activities. Reviews include those related to: • community consultation processes for aircraft noise • the presentation and distribution of noise-related information.
Minister for Infrastructure, Transport, Regional Development and Local Government	Has specific responsibilities relating to the management of overflight noise, for example, the development of national airspace and air traffic management policies.

Organisation	Summary of responsibilities on aircraft noise
Aircraft fleet management	
Aircraft and engine manufacturers	Design and manufacture new aircraft that comply with ICAO noise standards.
Airlines and aircraft operators	Responsible for maintaining aircraft fleets and engines that meet ICAO noise standards and implementing noise abatement principles for flight operators, where applicable.
Land use control	
Airport Lessee Company (ALC) – Western Sydney Airport Company Limited (WSA Co).	• Is the airport lessee and operator. • Required to prepare the airport masterplan, including publication of an ANEF and an environment strategy to manage noise impacts.
State government and local councils	Regulate land use planning and development in the vicinity of airports.
Community forums	
Community Aviation Consultation Group (CACG)	Supports effective engagement between Airport and Commonwealth, State and Local government agencies on strategic planning issues, including land use and aircraft noise impacts.

11.4 Avoidance and minimisation of impacts

Aircraft noise in the vicinity of flight paths is an unavoidable consequence of aircraft operations. The design process to date has focused on minimising the impact of aircraft noise on residents and sensitive areas through continuous assessment, consultation, and ongoing design development.

The 2016 EIS provided a high-level noise assessment based on indicative flight paths for WSI. Submissions raised concerns on the uncertainties of aircraft noise exposure contours and the potential for, and effectiveness of noise mitigation and management measures. The potential for aircraft arrivals to be processed in high-traffic areas by sequencing them to the runway in a structured manner over a common merge point (known as a 'point-merge' concept) was also of concern. To address this, the Airport Plan set out 12 Airspace Design Principles that the design process is required to follow. The principles were informed by and reflect community and industry feedback on the 2016 EIS, including that aircraft arrivals will not converge through a single merge point over any single residential area.

As outlined in Chapter 6 (Project development and alternatives), flight paths have now been further developed to a preliminary design guided by Condition 16 and the 12 Airspace Design Principles, which included noise considerations. This has included minimising the impact of aircraft noise on the surrounding community by directing aircraft away from overflying populated areas and visually sensitive areas where possible (while prioritising operational safety) and opportunities for RRO) mode of operation (refer to Chapter 7 (The project)).

Compared to the 2016 EIS, the noise assessment for this EIS presents a new suite of noise metric descriptors based on the preliminary airspace design, to be meaningful to both residents and decision-makers, and to allow stakeholders to come to an understanding of how the noise environment will change with the project. It also updates and expands on potential mitigation measures.

Management and mitigations would continue to be refined and developed as part of future phases (refer to Section 11.8).

11.5 Methodology

11.5.1 Overview

The methodology for the assessment of aircraft noise is detailed in Chapters 8 and 9 of Technical paper 1.

The methodology involved:

- determining an appropriate study area for the assessment of aircraft noise (Section 11.5.2)
- considering significance/compliance criteria and identifying noise sensitive areas (Section 11.5.3)
- characterising the current ambient noise environment across Western Sydney and the Blue Mountains, including background noise levels and current noise exposure from aircraft operating in the Sydney Basin (Section 11.6)
- selecting an appropriate suite of noise metrics to determine aircraft noise levels associated with the project (Section 11.5.4)
- calculating noise exposure forecasts using the chosen noise metrics for a range of scenarios (Sections 11.5.6 to 11.5.8)
- correlating the above noise exposure forecasts with the potential impact on the identified noise sensitive areas and using qualitative and quantitative descriptors of potential impact due to the implementation of the project (Section 11.7).
- consideration of reasonable and feasible management and mitigation measures (Section 11.8).

The aircraft noise assessment considers:

- the flight path, its lateral and vertical profile and the nature of the terrain overflown, the level of precision assumed for visual, instrument or satellite-based navigation
- the typical operating aircraft, jet or non-jet, size and weight category and whether the operation is a departure or arrival
- stage lengths (a measure of distance to destination for departing aircraft) as classified in the United States Federal Aviation Administration (US FAA)'s Aviation Environmental Design Tool (AEDT) (Version 3e) and calibrated with actual noise monitoring measurements (refer to Section 11.5.6.2), fuel loads on departure and take-off weight, engine thrust settings and vertical profiles
- the frequency of use and time of day (day or night definitions and weightings depending on the metric involved)
- the proximity of noise sensitive areas.

11.5.2 Study area

The study area is defined as an approximate 45 nautical miles (83 km) radius from WSI to capture areas that are most likely to experience a direct impact from the noise of aircraft using WSI's flight paths at a level and frequency that could be considered disruptive.

There are existing flight paths and aircraft activity already in operation over the study area, with associated aircraft noise impacts (refer to Section 11.6).

This study area is considered appropriate for this noise assessment and EIS Guideline requirements. Not all the study area would be overflown or otherwise affected by WSI flight paths or changes to existing flight paths. This would be determined by factors such as elevation, flight path spread and associated single event noise levels.

11.5.3 Significance/compliance criteria

Quantitatively evaluating aircraft noise exposure is complex because its significance is influenced by many factors. Section 11.5.4 presents a suite of metrics that describe aircraft noise, designed to be meaningful and understandable to both residents and decision-makers, allowing all stakeholders (airlines, airports, communities, regulators, consultants) to understand the likely resulting noise environment. As outlined in Section 11.3, while there is no legislative criteria for the evaluation of aircraft noise in Australia, accepted industry practice is to consider changes within the defined (or selected) ANEC, N70 24-hours, N60 night and N60 24-hour contour levels. These metrics assist in assessing impacts, but the resulting forecasts from the application of these metrics do not, of themselves, require any responsive action to be taken.

The noise assessment considers these metrics in Section 11.5.4 in absolute terms and in terms of 'soundscape' (the acoustic environment as perceived by humans, in context) change. For a completely new airport like WSI, this will primarily be done in terms of comparison to ambient noise measurements.

To help evaluate the significance of aircraft noise impacts, project-specific qualitative criteria have been developed. They are described and applied in Chapter 18 (Social) and Chapter 20 (Human health), which considers the impacts of noise emissions on the community, as well as Chapter 16 (Biodiversity), Chapter 17 (Heritage) and Chapter 23 (Matters of National Environmental Significance) with respect to biodiversity and heritage impacts.

11.5.4 Noise metrics

There are a number of metrics to describe aircraft noise, each being useful for a different purpose. A few are included in national regulatory standards such as AS 2021:2015. 'Number (N)-above' contour levels, have developed from the NASF Guidelines and from the (then) Commonwealth Department of Transport and Regional Services (2000) '*Expanding ways to describe and assess Aircraft noise*' (Department of Transport and Regional Services, 2000). This discussion paper was in response to the reliance on the ANEF system in the EIS for the proposed third runway at Sydney (Kingsford Smith) Airport (Federal Airports Corporation (Australia), 1990). The NASF Guidelines also recognise the merits of using a range of noise criteria.

The impact of aircraft noise is dependent on a number of factors, of which 3 key ones are:

- nature of noise events (intensity, tonal content, spectrum and duration)
- frequency of events
- time of events (time of day or seasonality).

The selection of metrics used to assess aircraft noise for the project are described in Table 11.2. The degree to which a noise metric considers and describes each of the above factors is classified as 'Yes' or 'No'. Time periods are defined in Section 11.5.5.

Table 11.2 Family of noise metrics used in the assessment

Metric	Noise event	Frequency	Time	Description
N70	Yes. Trigger level based on Maximum Sound Level	Yes. Number of events over a given period (5, 10, 20, 50, 100 events)	Yes. 24-hours	'Number (N)-above' contour levels (for example N70 and N60) are used to map noise 'zones' around an airport. They describe aircraft-noise impacts by the number of noise events that exceed a certain noise level (threshold). For example, N70 contours represent the number of aircraft noise events with L_{Amax} that exceed 70 dB(A) (refer to Figure 11.4). N-above contours are an example of cumulative event descriptors which provide an assessment of the sustained exposure to aircraft noise. The N70 contours are typically used to assess day-time noise impacts. An outside noise event of 70 dB(A) (such as aircraft flyover) can lead to in an indoor sound level of 60 dB(A) when windows are opened (enough to disturb conversation). Night-time sleep disturbance potential is often assessed with N60-night-time contours. These define areas where an outside noise event results in an indoor maximum sound level of 50 dB(A) with windows open, or 40 dB(A) with windows closed. A 50 dB(A) maximum noise level is considered close to the point at which someone sleeping may wake up. N-above contours can be calculated for different periods, indicating the average number of events experienced in that time block, for example N70 (24-hours). N70 and N60 values of 5 or more events are considered appropriate for describing aircraft noise in areas currently experiencing aircraft noise, as well as areas which would be newly affected by aircraft overflights. This assessment has taken a more conservative approach and applied an N60 (night) value of 2 or more events at its lowest threshold (refer to Table 11.6). N70 and N60 can be readily understood as they describe the number of events exceeding a certain noise level (threshold) at a given location, where the threshold represents a level above which impacts would be expected (for example, conversation interrupted). These metrics do not, however, show the intensity of noise to be experienced at that location from individual flyovers. That is, 2 different locations may have the same N70 value but be exposed to different noise exposure levels (for example, 70 dB(A) to 75 dB(A) in one location and 80 dB(A) to 85 dB(A) in another location closer to an airport). N70 and N60 metrics are therefore limited in their ability to communicate high noise levels, such as those near airports. Metrics that more explicitly portray the number of aircraft movements (such as flight path movement charts) may also be more effective for communicating aircraft noise impact as over time individual aircraft events have become quieter but the frequency of movements has increased. Locations beyond each noise contour boundary may still be subjected to noise exposure from aircraft overflights. Even at low exposure levels, individuals may still experience annoyance, because individual reaction to aircraft overflight noise is highly subjective (refer to Section 11.2).
N60	Yes. Trigger level based on Maximum Sound Level	Yes. Number of events over a given period (2, 5, 10, 20, 50, 100,200 events)	Yes. 24-hours and night	

Metric	Noise event	Frequency	Time	Description
ANEF / ANEC	Yes. Cumulative exposure considers profile of aircraft noise (level, duration, tonal content)	Yes. Cumulative exposure considers number of events	Yes. Average day metric which applies a penalty to movements between 7 pm and 7 am.	Australia has adopted the ANEF / ANEC system for land use planning around airports, which describes the cumulative aircraft noise for an 'annual average day'. The system does not illustrate the day-to-day variation in noise exposure that is associated with airport operations. The ANEF was developed from social surveys of annoyance surrounding airfields. ANEF is limited in its applicability to an assessment of changing aircraft noise levels because: • previous assessments of aircraft noise in Australia have demonstrated that the ANEF system does not adequately describe people's reactions to a change in aircraft noise, such as that associated with a new runway or airspace design • it is not used outside Australia, and not generally used in describing the findings of overseas research, such as that described in the health impact assessment in Chapter 20 (Human health). The ANEF system is therefore primarily used to assess land-use planning implications of an airport operation (refer to Section 11.5.4.1). An ANEC is a noise exposure chart produced for a hypothetical future airport usage pattern. ANEC contours are calculated using the same methods as ANEF contours, but have not been formally endorsed. They use indicative data on aircraft types (both jet and non-jet), aircraft operations and flight paths and are generally used in environmental assessments to depict and compare noise exposure levels for different flight path options. While this metric is not meant to capture the extent of the area that could be exposed to noise levels that could trigger a community reaction, it does identify areas where population is more likely to be impacted by aircraft noise.
$\mathbf{L_{Amax}}$	Yes. Maximum sound level for various aircraft types	No	Yes. Assessed for day, and night to reflect the flight paths in use during these periods	$\mathbf{L_{Amax}}$ is the highest noise level from an aircraft noise event, measured in A-weighted decibels (dB(A)). It is an example of a single event descriptor as it denotes the maximum level of noise predicted at a location during a single overflight of a particular aircraft occurring at any time (refer to Figure 11.4). This can be depicted geographically as single event (L_{Amax}) contours. While L_{Amax} is effective in communicating the noise level of aircraft events, it fails to communicate other information about aircraft noise, such as the frequency of events, and is only useful when combined with supplementary information (for example N-above metrics).

Metric	Noise event	Frequency	Time	Description
L_{Aeq}	Yes. Average Sound Level	Yes. Cumulates all noise events to determine the average	Yes. Assessed for day, evening and night	**L_{Aeq}** is used for both the intrusiveness noise level and the amenity noise level. This metric represents the level of average noise energy for each assessment period (day/evening/night) and takes account of noise peaks and fluctuations (refer to Figure 11.4). This descriptor is most widely correlated with the subjective effect of noise (Miedema and Vos, 2004).
Flight path movement charts	No	Yes. Focus is on the number of overflights	Yes. Assessed for day and night	Flight path movement charts indicate the aircraft movements on each path, segment or group of paths for a nominated time (day or night). They give a general and easily-understood picture of the pattern of aircraft noise exposure, but not their noise level. Combined flight path movement charts show those areas that may be impacted by a combination of arrival and departure operations. Together with single-event (L_{Amax}) noise contours, flight path movement charts are often used to describe aircraft noise in areas that are more remote from airports, for which N70 and related contours may be less meaningful.
Proportion of respite	No	Yes. Proportion of days without overflights	Yes. Respite is assessed for day, evening and night	Figures showing respite (where 'respite' is the proportion of days without overflight) at specific noise sensitive areas (refer to Section 11.5.8) are based on whether these areas are directly overflown or within one km of a flight path corridor. This provides greater focus for assessment of respite in specific rural, rural residential, and urban communities.
Respite charts	No	Yes. Percentage of days without movements on specific flight path	Yes. Respite is assessed for day, and night	Respite charts (where the term 'respite' is described as the absence of operations to or from a particular runway end) show the percentage of days and nights when little or no aircraft movements are expected on a specific arrival or departure flight path. Respite charts show those areas under flight paths combining arrival and departure operations for both runway ends. Respite charts are a useful indicator in areas where noise exposure is highly variable, generally due to meteorological variability, and airport operations can be flexibly managed. This is less relevant for the single runway development at WSI, where there is the absence of a second runway to support respite, meaning at most points around the airport there will be relatively few days with no overflights.

Figure 11.4 highlights the relationship between various metrics as described in Table 11.2. Further details on the noise metrics are in Section 8.3 of Technical paper 1.

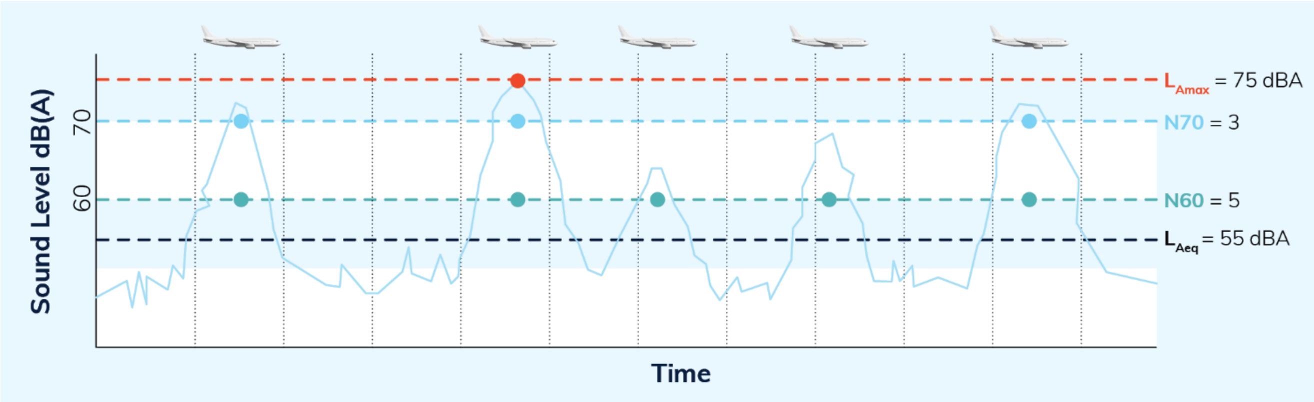


Figure 11.4 Relationship between different noise metrics

In the generic overflight sequence depicted above, the results for each metric would be as follows: L_{Amax} 75 dB(A), L_{Aeq} 55 dB(A), N70: 3 events, N60: 5 events. This shows that N60 and N70 metrics include overflights that will exceed 60 dB(A) and 70 dB(A) sound levels respectively. It also reinforces that an L_{Aeq} value as an averaging metric can be significantly exceeded in noise levels by individual overflight events across the day.

11.5.4.1 ANEF and ANEC

AS 2021:2015 provides guidance on the acceptability of certain types of development, in terms of the ANEF level in the area as shown in Table 11.3. For example, residential development is considered “acceptable” in areas with ANEF lower than 20, “conditionally acceptable” in areas with ANEF between 20 and 25, and “unacceptable” in areas with ANEF greater than 25. In “conditionally acceptable” areas the AS 2021:2015 recommends that new buildings should incorporate acoustic treatment to achieve specified internal noise levels.

Table 11.3 AS 2021:2015 – Acceptability Based on ANEF Zones (in conjunction with Table 3.3 of AS 2021:2015)

Building type	ANEF zone of site		
	Acceptable	Conditionally acceptable	Unacceptable
House, home unit, flat, caravan park	Less than 20 ANEF[1]	20–25 ANEF[2]	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25–30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF[1]	20–25 ANEF[2]	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF[1]	20–25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF[1]	20–30 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25–35 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30–40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Notes from AS 2021:2015:

1. The actual location of the 20 ANEF contour is difficult to define in aircraft flight paths.
2. Within 20 ANEF to 25 ANEF, some people may find that the land is not compatible with residential or educational uses. Land use authorities may consider that the incorporation of noise control features in the construction of residences or schools is appropriate.

The NSW planning framework takes a precautionary approach to residential land use for WSI operations, which includes requirements under the Western Parkland City SEPP on the application of the ANEF (refer to Section 11.8.1.2 and Chapter 14 (Land use)).

An indicative long term, dual runway ANEC for WSI is provided in the Airport Plan and in Western Parkland City SEPP. An updated ANEC is presented in this chapter for single runway operations (refer to Section 11.5.6.3). The status of the ANEC/ANEF for WSI is further described in Chapter 5 (Statutory context) and Chapter 14 (Land use).

11.5.5 Time periods

The ANEF system defines 2 periods: 7 am to 7 pm and 7 pm to 7 am. Noise during the latter is weighted (by a penalty of 6 decibels) to account for the increased sensitivity during the period referred to as 'evening/night' by the ANEF definition. These standard time periods for the calculation of ANEC (an ANEF related metric) have been adopted here.

Time periods for aircraft noise using N-above and other metrics are commonly expressed differently to the ANEF system. For the purpose of this assessment these metrics are presented as day (5:30 am to 11 pm), and night (11 pm to 5:30 am) periods. Noise during the latter is not weighted by a 6 decibel penalty in terms of N-above. It is acknowledged that for other airports the hours 11 pm to 6 am have typically been selected for the N-above night metrics, as per the NASF Guidelines. The reason for the selection of these different hours of operation for WSI is related to the availability of specific night-time flight paths and runway operating modes, and is further explained in Chapter 7 (The project).

An evening period (7 pm to 11 pm) has been distinguished for the projected average sound level (L_{Aeq}) assessments at noise sensitive areas. The assessment of an evening and night-time period corresponds with periods of time that noise is generally more disturbing (as more sensitive activities typically occur, such as socialising, relaxing and sleeping). These periods also reflect when most residents are at home and noise is more intrusive due to lower background noise levels.

11.5.6 Noise modelling

The noise modelling process calculated values for the chosen noise metrics for relevant scenarios, using information and projections from a number of sources. The noise modelling process is depicted in Figure 11.5 and described in the following sections. Full details are provided in Section 8.4 of Technical paper 1.

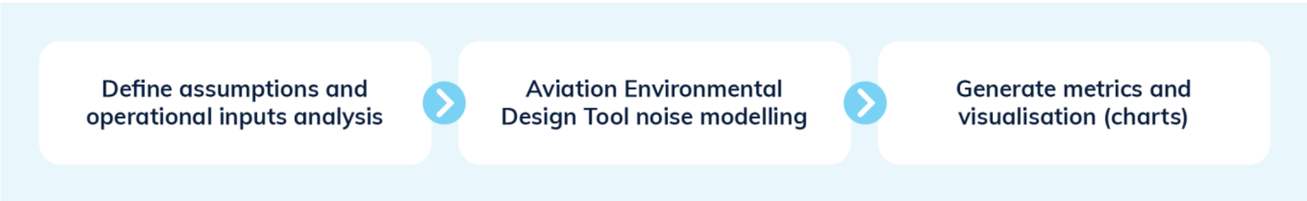


Figure 11.5 Noise modelling process

11.5.6.1 Assumptions and operational inputs analysis

This first step of the process defined the assumptions required for the AEDT noise model. It analysed the various runway modes of operation against the historic meteorological data set and the projected flight demand (forecast) schedules to assign each operation to a runway (05/23) and flight path (arrival and departure by day and night). This step also determined the operating scenarios for noise modelling. Detailed information on the assumptions is provided in Chapter 9 of Technical paper 1.

Runway modes of operation

The 3 runway modes of operation are presented in Chapter 7 (The project) – runway modes 05, 23 and reciprocal runway operations (RRO). Chapter 7 (The project) also includes the criteria that need to be met for the application of RRO.

The operating scenarios (described below) indicated the selection criteria of each runway mode of operation and consider meteorological conditions (MET) by time of day. This in turn determined runway availability and then runway usage (percentage of annual aircraft movements for Runway 05 versus Runway 23). Based on the runway allocation, the route to or from an origin or destination airport and aircraft category or type determined the flight path allocation. Figure 11.6 depicts the process of allocating a WSI operation to a runway and flight path.

Figure 11.6 Process to allocate a WSI flight operation to a runway and flight path

Operating scenarios

A preliminary macro assessment was conducted by modelling 7 runway operating scenarios to determine the scenario selection for noise modelling (refer to Figure 11.7). The selected scenarios were modelled to create a maximum outer envelope (composite of contours for selected scenarios) of potential impacts of aircraft noise for each assessment year (2033, 2040 and 2055).

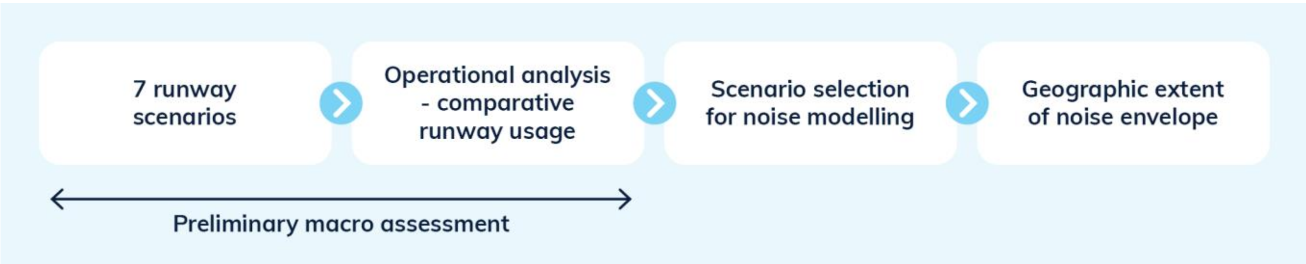


Figure 11.7 Process to create scenarios and model noise envelopes

The 7 runway operating scenarios are outlined in Table 11.4. The terms 'preference' or 'prefer' was given to where, if wind conditions, and traffic demand allows, a particular runway mode of operation (mode) would be used to move aircraft as efficiently as possible while reducing the noise impact over certain residential areas (refer to Chapter 7 (The project)).

Table 11.4 Allocation of runway mode of operation by scenario

Scenario	Runway mode of operation
1	No preference (day) and no preference (night) (No preference)
2	No preference (day) and prefer RRO (night)
3	Prefer Runway 05 (day) and prefer RRO (night) (Prefer Runway 05)
4	Prefer Runway 23 (day) and prefer RRO (night) (Prefer Runway 23)
5	Prefer Runway 05 (day) and prefer RRO (night) Limited Peak-Time Change
6	Prefer Runway 23 (day) and prefer RRO (night) Limited Peak-Time Change
7	Preference Runway 23 during non-peak, no preference during peak (day) and preference RRO (night)

These scenarios were used in the preliminary macro assessment to compare runway availability, runway directional usage (the percentage of annual aircraft movements for Runway 05 versus Runway 23) and runway end noise exposure for all the operating scenarios.

Notably:

- the different scenarios varied in terms of runway direction during the day (Figure 11.8)
- during the night, the RRO mode made the assessment by runway direction less relevant and moved the focus towards a comparison of the runway end exposure to aircraft movements (Figure 11.9)
- a range of sensitivity tests were completed as discussed in Section 11.5.6.2, including a variation to Prefer Runway 05 and Prefer Runway 23.

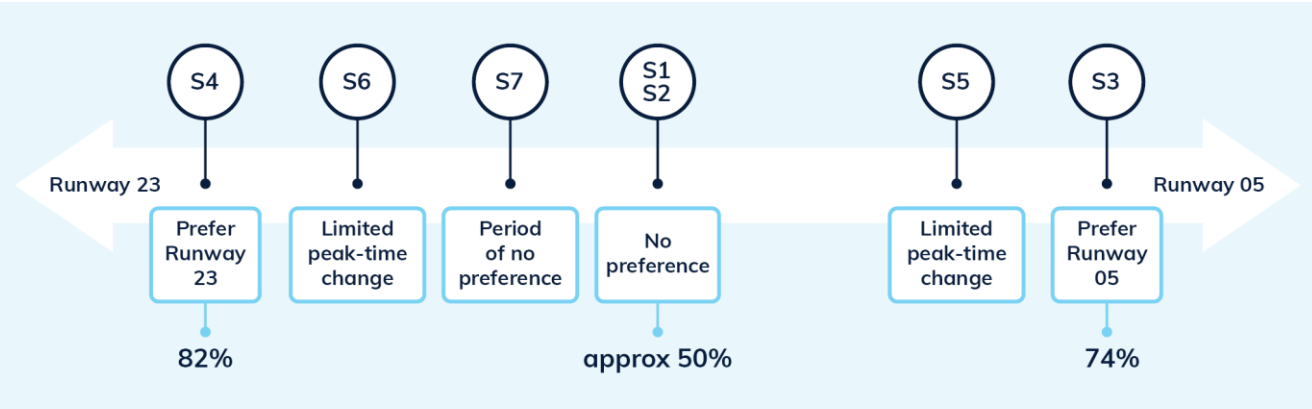


Figure 11.8 Runway direction by scenario (day)

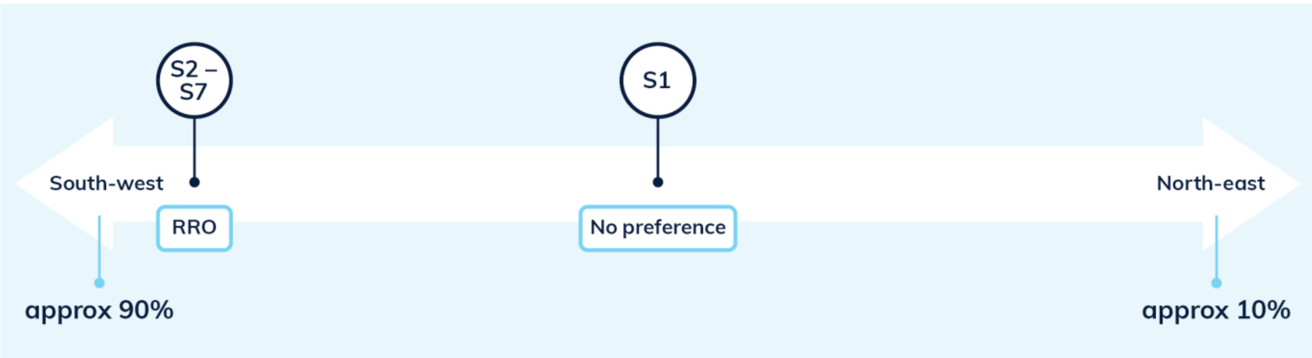


Figure 11.9 Runway end usage by scenario (night)

As shown in Figure 11.7, the results of the preliminary macro assessment determined the operating scenario selection for noise modelling.

The selected operating scenarios used in noise modelling were:

- **Scenario 1** – No preference
- **Scenario 3** – Prefer Runway 05
- **Scenario 4** – Prefer Runway 23.

The reasons for selection of these scenarios were based on the runway modal splits for the operational scenarios detailed in Section 8.4.2 of Technical Paper 1. In summary:

- Where no preference was given to a runway mode (No preference), runway use was balanced (approximately 50 per cent on both Runway 05 and Runway 23) in terms of runway direction and runway end exposure. This indicated that both runway ends are exposed to a similar proportion of arrivals and departures on an annualised basis.
- During the day, the outer bounds of runway usage (and by implication the extents of the noise exposure contours) was defined by Prefer Runway 23 for both arrivals and departures (82 per cent of aircraft movements in the Runway 23 direction) and Prefer Runway 05 (74 per cent of runway movements in the Runway 05 direction). However, both runway ends would experience a balanced exposure based on total movements. This indicated that Prefer Runway 05 and Prefer Runway 23 would primarily vary in terms of bias for the type of operation (arrival or departure), not in terms of total movements.
- During the night:
  - Prefer Runway 05 and Prefer Runway 23 introduced the RRO mode – arrivals on Runway 05 and departures on Runway 23. Hence, while runway direction was generally balanced across the night, runway-end usage indicated that almost 90 per cent of night-time movements would operate over the south-west end of the airport, on an annualised basis.
  - No preference provided a comparison case if RRO mode was not adopted or was unavailable due to weather conditions or traffic demand.
- The 4 other scenarios fell somewhere between the outer bounds in terms of runway use.

This assessment assumed that for scenarios 2–7 the RRO mode could be sustained across the night when weather conditions (that is, wind, precipitation) are suitable. However, as demand grows over time and approaches the RRO capacity limits (represented by years 2040 and 2055), availability and usage of RRO will be more limited. This would in turn progressively increase the proportion of movements at the north-east end of the airport.

The constraints on the use of the RRO mode and how this could be mitigated is explained in Section 7.4.1.3 of Chapter 7 (The project)). For this assessment, the implications of noise exposure due to the inability to apply RRO is modelled by the No preference scenario. This is complemented by sensitivity testing (refer to Section 11.5.6.2).

The composite noise contours associated with the chosen suite of scenarios (together with the sensitivity testing) provide a level of confidence around a geographic extent of potential impacts. This shows the flexibility in the design and enables operating scenarios to be tailored as part of detailed design and finalisation of the selected airspace design.

Further explanation on this process is provided in Sections 9.2 and 9.4 of Technical paper 1.

Other operational inputs

The other key data inputs used in the noise model are outlined in Table 11.5 below. Details are provided in Chapter 9 of Technical paper 1.

Table 11.5 Key data inputs for the noise model

Input	Description
Forecast schedules for each assessment year	The average weekly schedule for both the Northern Summer (NS) and the Northern Winter (NW) schedule seasons as projected by WSC Co. These include the number of aircraft operations, the aircraft types which would operate, time of operation (both arrival and departure time) and port of origin or destination for each operation. The average weekly schedules were “annualised” by taking the relative proportions of days in the NW schedule season and the NS schedule season to create a table with 365 days’ worth of aircraft movements.

Input	Description
Meteorological data	10 years of Bureau of Meteorology data from 2012 to 2021 from the Badgerys Creek weather station. This included data on temperature, headwind, humidity and barometric pressure. The meteorological conditions are an important consideration to determine the long-term average and variation of runway usage and mode of operation, aircraft performance and noise emissions.
Aircraft types	Based on the forecast schedules. While most aircraft have a direct aircraft noise modelling profile, some aircraft have an equivalent model with adjusted noise levels. This is especially applicable to new aircraft types that have yet to be included in the AEDT database. The standard aircraft types used in the calculations are summarised in Chapter 2 (Strategic context and need). This includes a comparison of aircraft classes.
Stage lengths	Noise level on departure as calculated for various stage lengths for each aircraft type. There are 9 stage lengths from WSI as classified in the AEDT, that is, stage 1 from 0 to 500 nm (926 km) from WSI (for example, to Melbourne) to stage 9 over 6,500 nm (12,038 kilometres) from WSI (for example, to Dallas). Longer flights generally require aircraft to carry more fuel on departure, increasing take-off weight and therefore requiring a higher thrust and more gradual ascent. This means longer flights typically produce higher noise levels than shorter flights. In contrast, noise emissions of arriving aircraft are generally independent of the distance flown. This is because minimal thrust is required with much of the noise on arrival generated by the airframe interacting with the air.
Flight profiles and procedures	Aircraft procedures and associated profiles for each aircraft in the fleet mix. The profile combines altitude, thrust and speed and results in a sound level being emitted and received on the ground. To develop customised profiles so the noise model could be calibrated based on actual recorded noise levels, aircraft profiles were modified, regardless of the destination's default Aviation Environmental Design Tool stage length, so typical departures reflected the noise profile for that aircraft type recorded at selected airports from the Airservices Australia's NFPMS (refer to Section 11.8 for further information on Airservices Australia's NFPMS).
Flight paths	Flight paths as presented in Chapter 7 (The project). As discussed in Chapter 3 (Introduction to airspace), actual paths diverge from nominal standard arrival routes or standard instrument departure routes due to meteorological conditions, requirements for aircraft separation, and other variable factors. In modelling aircraft noise on any specified flight path, a dispersion either side of the centreline in space was specified based on data from other airports. The purpose of the flight path analysis was to identify the paths associated with specific types of aircraft operations. This allowed the noise emissions to be predicted for each of the scenarios.
Terrain data	Used to account for variations in altitude above ground level. The height of terrain relative to the aircraft altitude determines the distance between the noise source (aircraft) and the receivers on the ground. This is particularly relevant for flight paths over the Blue Mountains and the impact assessment on biodiversity and natural heritage values. The line-of-sight blockage feature (shielding of receivers from a noise source) was not considered.

11.5.6.2 Aviation Environmental Design Tool

The second step of the noise modelling process was the conduct of noise modelling using the latest Version 3e of the AEDT noise model, produced by the US FAA. The model includes aircraft overflight noise together with departure noise, landing and reverse thrust noise when the aircraft is on the runway.

A single AEDT noise model was created for each selected operating scenario chosen as part of the operational scenarios pathway (Figure 11.7).

Sensitivity analysis

An iterative process was undertaken to review sensitivity of different parameters and their significance in impacting outcomes of the modelling process. This included conducting sensitivity tests on a variation to Prefer Runway 05 and Prefer Runway 23 for periods when prevailing wind conditions would support operations using the runway in one direction across an entire day (reflecting the highest intensity of overflight). That is, when either Runway 05 or Runway 23 is used 100 per cent of the time (day and night). These tests have been termed 'unidirectional' scenarios.

While the use of RRO described above would significantly reduce the occurrence of unidirectionality (for Prefer Runway 05 and Prefer Runway 23), review of historical wind data shows that under a No Preference scenario, unidirectionality could occur approximately 34 per cent of the time (refer to Section 8.1.2 of Technical paper 1).

These tests were incorporated into the generation of noise metrics (Section 11.5.6.3) and the impact assessment (Section 11.7).

Other sensitivities tested included seasonality (temperature and weather), fleet mix (Airbus A320neo versus Airbus A320ceo), aircraft calibration (Standard AEDT profiles versus calibrated profiles), day of the week (weekday versus weekend splits), and the use of hold down procedures (level hold downs at specific altitudes (ranging between 4,000 ft (1.2 km), and 15,000 ft (4.5 km) to keep aircraft below both Sydney (Kingsford Smith) Airport and other WSI aircraft).

The single most important variable in the sensitivity analysis was the flight schedule which includes the number of movements. There was a material impact identified from the sensitivity analysis with aircraft calibration, which supported the calibration of modelled aircraft noise levels using actual noise monitoring measurements at Brisbane, Perth and Melbourne airports. The impact from the use of operational procedures such as hold downs could be perceptible for specific aircraft types (single events) but the communities impacted by hold downs would be the same communities that are already impacted by continuous climb operations. Further information on the sensitivity analysis is available in Section 9.8 of Technical paper 1.

11.5.6.3 Generation of noise metrics and charts

The final step in the noise modelling process generated the suite of noise metrics and charts described in Section 11.5.4 to assess the aircraft noise from the project. These are as described in Table 11.6.

In relation to this step:

- the L_{Aeq} metric was used to generate a location based metric at each noise sensitive area, to compare with noise monitoring sites (refer to Section 11.6.2). No contours were generated using this metric
- unidirectional scenarios (all movements on Runway 05 or all movements on Runway 23) were included for N70 (24-hour) metric only.

Table 11.6 Generation of noise metrics

Noise metric	Input	Output
N-above contours	Assessment years 2033, 2040 and 2055 for the 3 scenarios (No Preference, Prefer Runway 05 and Prefer Runway 23). Unidirectional scenarios for N70 (24-hour). Based on a typical average day for aircraft movement numbers but considered seasonal variations associated with different wind patterns.	Standard contours for each scenario: • N60 (24-hour) for 10 and over events • N70 (24-hour) for 5 and over events • N70 (unidirectional) for 5 and over events (dashed blue lines) • N60 (night) for 2 and over events • composite contours.
ANEC contours	Assessment years 2033, 2040 and 2055 the 3 scenarios (No Preference, Prefer Runway 05 and Prefer Runway 23). Average annual day movements.	ANEC 20, 25, 30, 35 and 40 contours for each scenario Composite contours.

Noise metric	Input	Output
L_{Amax}	11 typical aircraft types (across large wide-body jets, narrow-body jets and non-jets). Based on destination and different flight paths used for arrivals and departures at each runway end for day, night and RRO.	L_{Amax} contours (60, 65,70,75, 80, 85 and 90 dB(A)) for each aircraft.
Flight path movement charts	Assessment years 2033, 2040 and 2055 for the 3 scenarios (No Preference, Prefer Runway 05 and Prefer Runway 23). 10 years of meteorological data (2012–2021).	Flight movement charts showing the number of movements on each flight path, segment or group of flight paths for day and night. Shows average, maximum and minimum daily (or nightly) movements on each combination of flight paths.
Proportion of respite	Assessment years 2033, 2040 and 2055 for the 3 scenarios (No Preference, Prefer Runway 05 and Prefer Runway 23).	Figures and tables showing the projected portion of respite (days without overflights) at noise sensitive areas for day, evening and night.
Respite charts	Assessment years 2033, 2040 and 2055 for the 3 scenarios (No Preference, Prefer Runway 05 and Prefer Runway 23).	Respite charts showing the percentage of days and nights when no aircraft movements are expected on a specific arrival or departure flight path. Shows average daily (or nightly) movements, daily range of movements and percentage of days without movements.

11.5.6.4 Modelling limitations

Noise modelling inherently relies on assumptions, which are either averaged or simplified for modelled purposes. This assessment has involved the careful selection of key assumptions including supporting analytics of forecast schedules, use of long-term meteorological data, use of a range of noise metrics to reflect a range of perception factors, undertaking of sensitivity variations, and clear description of anticipated air traffic levels and variations from future aircraft operations at WSI. These aspects combine to provide information that best reflects what the community may experience in the vicinity of WSI, when operations commence and progressively increase over the coming decades.

While aircraft have their noise levels on take-off and landing certified by an internationally sanctioned process, the actual operating conditions and human factors means that no 2 aircraft on any day will follow the exact flight path (in both vertical and lateral extents). The amount of aircraft noise created is also influenced by ground or surface reflections and localised weather conditions. Other than lateral extents (dispersion) none of these factors are accounted for in the modelling at that level of detail.

The noise contours and metrics predict noise exposure, not annoyance level. Community or individuals' reactions to noise exposure will vary and cannot be represented by the metrics. Some generalisations can be made about how exposure to a particular level of noise might affect populations (for example 20 ANEF, N70 for indoor conversation disturbance, N60 for night-time awakenings) but it is only the ANEF that has any link to annoyance (refer to Table 11.2). The metrics are meant to inform community stakeholders about the likely exposure and possible variations. It is now well accepted that a range of non-acoustic factors (for example, the number of arrivals or departures on a specific or the period of respite) also play a role in how individuals will respond to different noise events.

Further detail on modelling limitations is provided in Section 8.14 of Technical paper 1.

11.5.7 Population and dwellings

An estimate of the number of people and dwellings potentially impacted by aircraft noise was assessed based on N-above contours, L_{Amax} and ANEC contours criteria as described in Section 11.5.4.

As outlined in Section 11.6, the surrounding areas of WSI are already subject to aircraft noise from existing operations associated with other Sydney Basin airports, which has not been quantified in this assessment. The population and dwellings potentially exposed to aircraft noise are therefore assessed solely on new traffic introduced by operations at WSI and do not consider current broader Sydney Basin airspace uses. Chapter 21 (Facilitated impacts) specifically addresses the nature of impacts associated with the change from the current airspace operations to future airspace operations ahead of WSI's planned opening in 2026.

Population and dwelling counts were sourced from Australian Bureau of Statistics (ABS) 2021 census data (ABS, 2022). The assessment was undertaken by overlaying the different contours over census data using GIS software.

The assessment provides a population and dwelling count for assessment years 2033, 2040 and 2055 for 3 scenarios, as well as a cumulative count based on a worst-case composite contour of the 3 operating scenarios.

11.5.8 Noise sensitive areas

Noise sensitive areas are defined as specific sensitive receivers or geographic points that were selected to report on the maximum sound level and are representative of either a residential area, or a non-residential land use that is sensitive to noise – for example, a recreational area, hospital, school, library, church etc. Recreational areas 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 noise sensitive areas specified for the project across the Western Sydney region are depicted in Figure 11.10. These are comprised of:

- recreational areas and noise-sensitive receivers defined in the 2016 EIS
- additional sensitive areas within a 15 km radius from WSI (residential and public buildings)
- additional sites up to 50 km in rural areas and Blue Mountains urban areas where aircraft noise is more likely to be noticeable due to the lower ambient soundscape
- ambient noise monitoring sites (29 in total) (refer to Section 11.6.2).

Projected changes in the ambient noise environment surrounding WSI that would be subjected to overflight by WSI operations were calculated using a series of assessments for all noise sensitive areas – projected average sound level (L_{Aeq}), projected maximum sound level (L_{Amax}); and average sound level variation for each noise monitoring site (defined in Section 11.6.2). These involved the expected change in noise exposure being calculated by comparing the ambient/background noise data collected at the 29 noise sensitive areas (refer to Section 11.6.2) with the projected noise from WSI aircraft operations.

Each assessment was undertaken for the 2033, 2040 and 2055 assessment years, across day (5:30 pm to 7 pm), evening (7 pm to 11 pm) and night (11 pm to 5:30 am) for 3 operating scenarios and a series of maps generated.

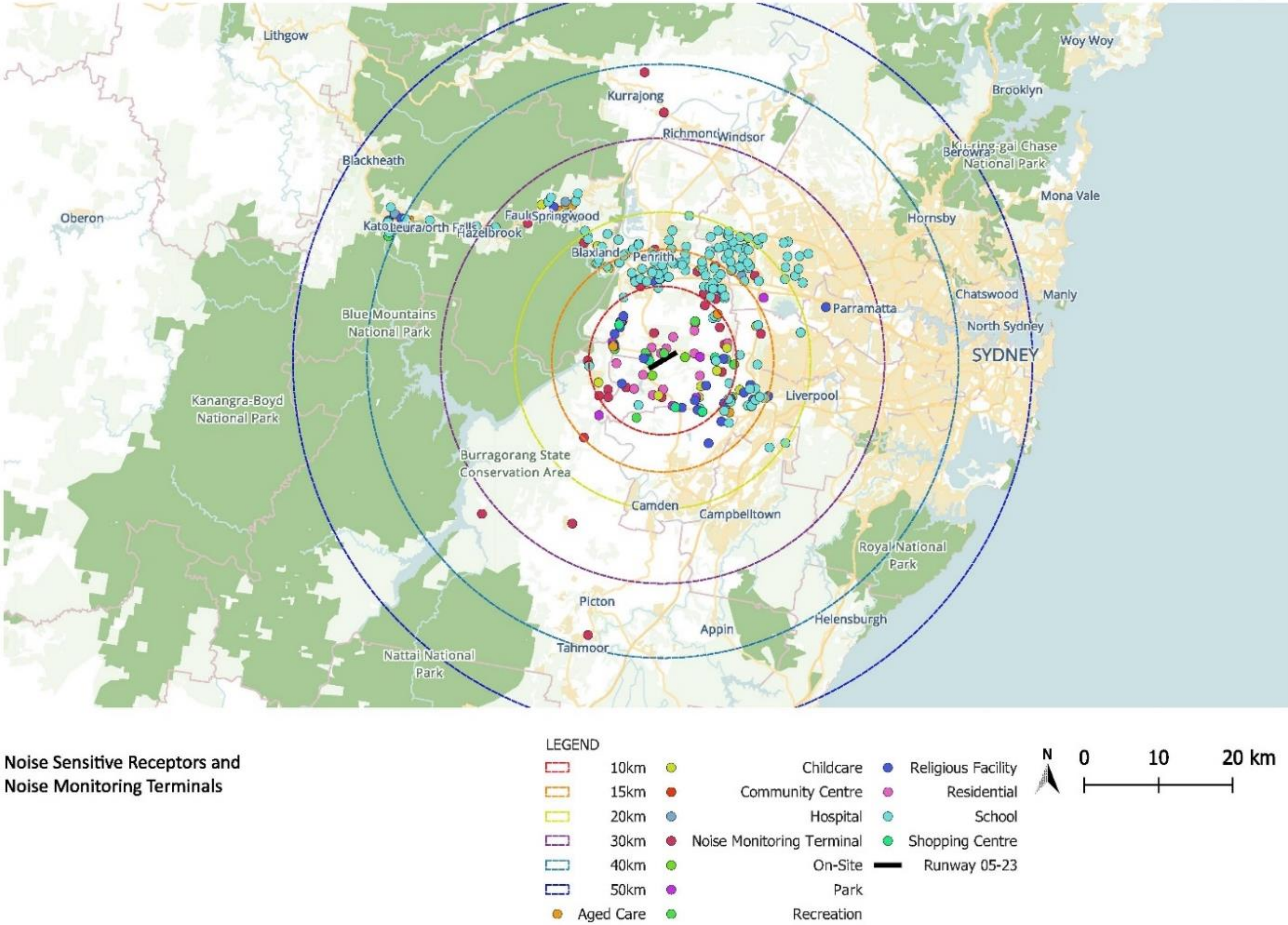


Figure 11.10 Noise sensitive areas including noise monitoring sites

A series of graphs (examples provided in Section 11.7.3.1) were produced by correlating projected average sound level (L_{Aeq}) with projected maximum sound level (L_{Amax}) to identify noise sensitive areas likely to be more impacted by aircraft noise, by assessment year, by time of day and by operating scenario. Individual graphs were produced for suburbs, schools, hospital, aged care and childcare facilities; religious and community centre facilities and shopping malls, parks and recreation. Absolute sound levels are based on the preliminary airspace design as well as projections of the fleet mix across the various flight paths. Changes to the maximum sound level over time would be driven by the actual fleet mix using each track.

An assessment of the proportion of respite was also undertaken at each noise sensitive area (refer to Table 11.2 and Section 11.7.3.2). This was based on direct overflights, or flights within a one km width from a flight path corridor, regardless of sound level.

11.6 Existing environment

There are a variety of noise environments within the study area. This section describes the existing noise environment based on current land uses and presents the results of the project noise monitoring.

11.6.1 General existing noise levels

Background (low level constant noise) and ambient (noticeable) noise environments range from urban environments such as the centres of Campbelltown, Fairfield, Liverpool and Penrith (located within 15 to 20 km of the site of the airport (Airport Site)) to rural environments and the natural environment of the GBMA that are largely removed from human-induced noise.

Although WSI is a completely new airport, the surrounding areas are already subject to aircraft noise. This is from the existing operations of Sydney (Kingsford Smith) Airport, Bankstown and Camden Airports, and RAAF Base Richmond. According to Airservices Australia reporting for movements at Australian airports, in calendar year 2019, more than 700,000 aircraft movements were recorded at Sydney (Kingsford Smith) Airport, Bankstown and Camden Airports in the Sydney Basin airspace (Airservices Australia, 2019) (refer to Chapter 4 (Project setting)).

Most of the land within and immediately surrounding the Airport Site comprises low density rural residential and agricultural land uses. To the north-east and east of the Airport Site are the localities of Badgerys Creek, Kemps Creek and Mount Vernon. The villages of Luddenham and Wallacia lie immediately west of the Airport Site and the villages of Silverdale and Warragamba are located south-west in the vicinity of Greendale. The development of the Aerotropolis associated with WSI will bring significant change in the nature of the surroundings.

In terms of natural values, the Badgerys Creek riparian corridor defines the eastern boundary of the Airport Site and the GBMA is located 8 km to the west. Lake Burragorang, a man-made lake created by Warragamba Dam, and major water supply for Sydney is located to the south-west.

The existing network of roads serving WSI includes Elizabeth Drive, The Northern Road and Badgery’s Creek Road. Additional road infrastructure is to include the M12 Motorway and associated connections.

It is useful to understand the various receiving environments to consider the emergence (or otherwise) of aircraft noise events above the ambient noise environment. Representative average background and ambient noise levels for various areas are shown in Table 11.7. The perceived prominence of aircraft noise events is partly dependent on those events becoming distinct from the ambient noise environment.

Table 11.7 Ambient and background recommended amenity noise levels (based on NSW EPA, 2017[1])

Receiver category	Description	Recommended amenity noise level (L_{Aeq}) dB(A)			Typical existing background noise levels (RBL) dB(A)		
Residential		**Day**	**Evening**	**Night**	**Day**	**Evening**	**Night**
Rural residential	An area with an acoustical environment that is dominated by natural sounds, having little or no road traffic noise and generally characterised by low background noise levels. Settlement patterns would be typically sparse.	50	45	40	<40	<35	<30
Suburban residential	An area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has evening ambient noise levels defined by natural environment and human activity.	55	45	40	<45	<40	<35
Urban residential	An area with an acoustical environment that is dominated by 'urban hum' or industrial source noise, where urban hum means the aggregate sound of many unidentifiable, mostly traffic and/or industrial related sound sources; has through-traffic with characteristically heavy and continuous traffic flows during peak periods; is near commercial districts or industrial districts, or any combination of the above.	60	50	45	<45	<40	<35

Other	Description	Recommended amenity noise level (L_{Aeq}) dB(A)	Typical existing background noise levels (RBL) dB(A)
Hotels, motels, caretakers' quarters, holiday accommodation, permanent resident caravan parks		5 dB(A) above the recommended amenity noise level for a residence for the relevant noise amenity area and time of day	N/A
School – internal	Noisiest 1-hour when in use	35[2]	N/A
School – external	Noisiest 1-hour when in use	45	N/A
Hospital – internal	Noisiest 1-hour when in use	35	N/A
Hospital – external	Noisiest 1-hour when in use	50	N/A

Other	Description	Recommended amenity noise level (L_{Aeq}) dB(A)	Typical existing background noise levels (RBL) dB(A)
Place of Worship – internal	When in use	40	N/A
Passive Recreation	Area reserved specifically for passive recreation (e.g., national park)	50	N/A
Active Recreation	Area reserved specifically for active recreation (e.g. golf course)	55	N/A
Commercial Premises	Commercial activities being undertaken in a planning zone that allows commercial land uses	65	N/A

1. While the amenity noise levels were extracted from NSW EPA (2017), it broadly reflects the levels of AS1055:1997, which has since been superseded by AS1055:2018.
2. In the case where existing schools are affected by noise from existing industrial noise sources, the acceptable L_{Aeq} noise level may be increased to 40 dB $L_{Aeq(1hr)}$

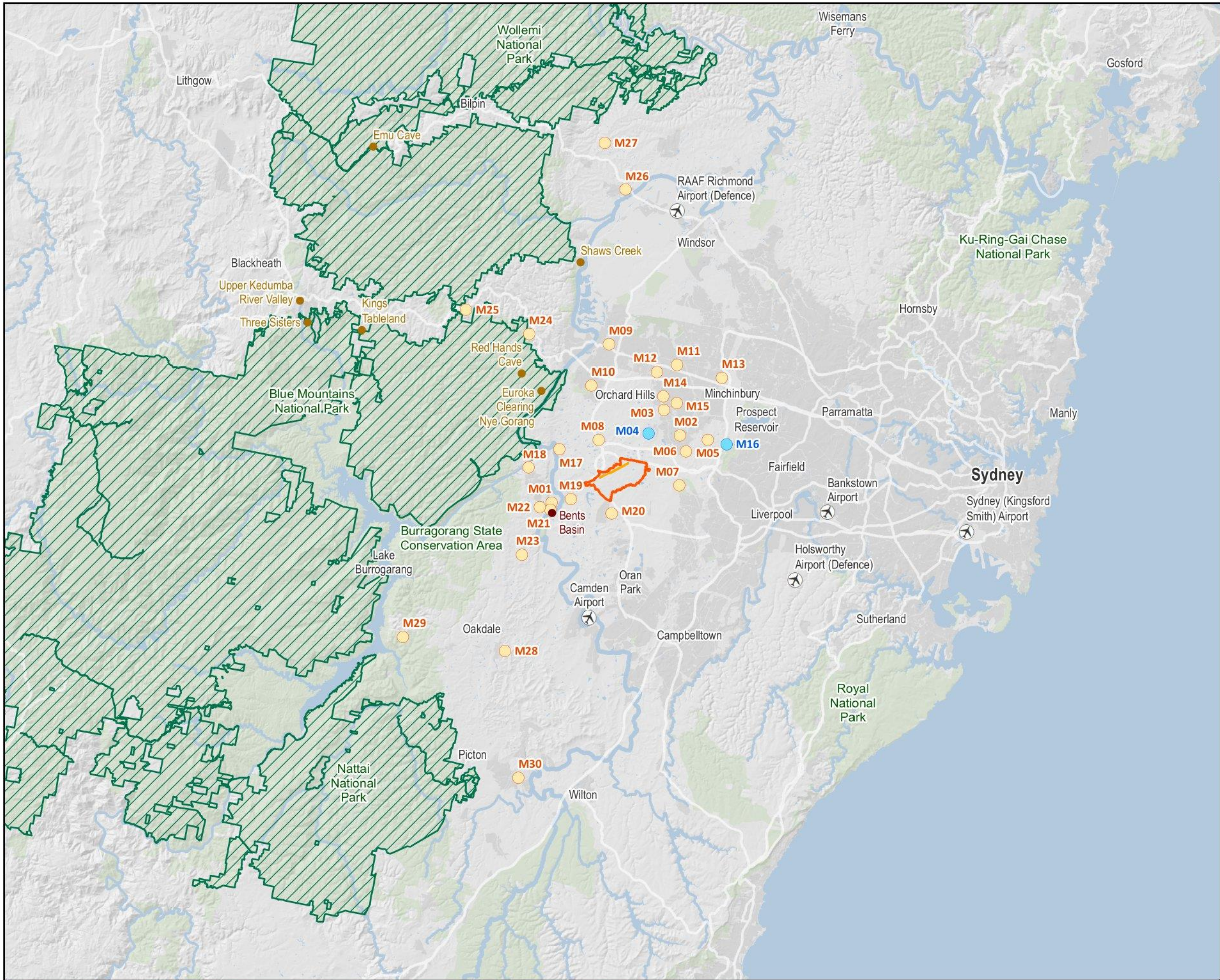
11.6.2 Project existing noise levels

Noise monitoring using noise loggers was conducted from August to October 2022 to establish background and ambient noise levels in areas surrounding WSI. There were 29 noise loggers installed to continually measure ambient sound levels for a 2-to-4-week period. Unattended and attended measurements were taken at the same locations; attended measurements were taken for 1-hour periods to qualify the noise environment at each unattended location.

Figure 11.11 shows the location of the ambient noise monitoring sites. These sites were chosen to characterise background noise levels, including from aircraft operating inbound to and outbound from Sydney Basin airports and the current ambient noise environment across Western Sydney and the Blue Mountains.

Figure 11.11

Ambient noise survey locations (noise monitoring sites)



Legend

- WSI Runway
- Western Sydney International (Nancy-Bird Walton) Airport land boundary
- Greater Blue Mountains World Heritage Area
- Aboriginal Places raised during consultation (NPW Act)
- Site of Aboriginal significance

Noise logger location

- Commercial
- Residential

0 10 20 km

Coordinate system: GDA 1994 NSW Lambert

Scale ratio correct when printed at A4

1:600,000 Date: 8/08/2023

Data sources: - DITRDC, DCS, Geoscience Australia
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Airbus,USGS,NGA,NASA,CGIAR,NCEAS,NLS,OS,NMA,Geodatastyrelsen,GSA,GSI and the GIS User Community

Table 11.8 presents the average and background noise levels for the various environments. The noise metrics used are:

- L_{Aeq} – as defined in Table 11.2
- RBL – the overall background noise level for each assessment period (day/evening/night) measured over the entire monitoring period (as outlined by the NSW Noise Policy for Industry (NSW EPA, 2017)).

The levels shown in Table 11.8 are considered typical for the relevant areas.

Table 11.8 Average and background noise monitoring locations and levels

ID	Area	Average noise level L_{Aeq} (dB(A))			Background noise level RBL (dB(A))		
		Day[1]	Evening	Night	Day	Evening	Night
M01	South West Departure (Wallacia)	58	49	43	33	32	27
M02	North East Departure	63	47	44	36	37	36
M03	North East Runway	67	53	53	47	45	39
M04	Twin Creeks	49	47	45	34	35	33
M06	Mount Vernon	51	53	50	37	49	42
M07	Kemps Creek Nature Reserve	58	45	45	36	37	32
M08	Luddenham	62	59	58	47	45	39
M09	Penrith	52	46	42	36	36	33
M10	Glenmore Park	57	51	46	39	39	30
M11	Oxley Park	72	47	44	36	38	32
M12	St. Marys	57	50	44	37	37	31
M13	Rooty Hill	54	47	46	38	40	36
M14	St. Clair	57	45	49	37	36	29
M15	Erskine Park	59	51	43	39	36	33
M16	Sydney Int. Equestrian Centre	55	51	50	45	45	40
M17	Wallacia	53	49	45	40	34	26
M18	Warragamba	51	46	46	36	41	41
M19	Greendale	49	50	45	31	38	33
M20	Bringelly	52	48	44	34	39	34
M21	Bents Basin	63	51	47	36	44	38
M22	Silverdale	51	48	44	34	36	32
M23	Werombi	58	47	45	30	36	30
M24	Blaxland	50	42	42	33	32	26
M25	Linden	51	45	43	35	36	28

ID	Area	Average noise level L_{Aeq} (dB(A))			Background noise level RBL (dB(A))		
		Day[1]	Evening	Night	Day	Evening	Night
M26	North Richmond	53	47	41	40	35	26
M27	Kurrajong	51	44	44	36	37	34
M28	The Oaks	56	48	44	29	36	32
M29	Lake Burragorang	46	42	44	25	27	24
M30	Tahmoor	56	46	48	40	39	38

1. Day, evening and night-time periods relate to those of the NSW Noise Policy for Industry (NSW EPA, 2017), defined as day – the period from 7 am to 6 pm Monday to Saturday or 8 am to 6 pm on Sundays and public holidays; evening – the period from 6 pm to 10 pm; night – the remaining periods.

The results found the existing ambient noise environment is mostly dominated by road traffic noise which is audible at nearly all locations emanating from a combination of relatively busy roads including the Northern Road, Elizabeth Drive and Badgerys Creek Road, up to the Western Motorway (M4), Westlink (M7 Motorway). There is also a hierarchy of other connector and local roads which carry varying levels of traffic.

Aircraft noise from existing Sydney Basin operations is audible (refer to Section 11.6.1) but has not been quantified. Furthermore, the Sydney Basin is also overflown by aircraft transiting from outside the area to a mix of domestic and international destinations. These operations have not been considered in the assessment, but were perceptible based on the ambient noise monitoring presented in Table 11.8.

The data sheets from each noise monitoring location including the characteristics of the noise environment are included in Appendix E of Technical paper 1. The key characteristics of the noise environment at select noise monitoring sites (including from any observed aircraft flyovers) have been summarised in the following paragraphs to represent the different receiving environments. Note that the levels in Table 11.8 refer to average noise levels over the assessment period (per table note 1). The observed aircraft flyovers noted below are short-term observations between 30 seconds and one minute, which do not contribute in a meaningful way to the levels in Table 11.8.

Location M01 is situated in a rural residential area of Wallacia, as typified by low background noise levels with occasional traffic passbys on local roads. The local noise environment was dominated by natural sounds, with cicadas audible during evening periods, and birds audible during the night periods. Several aircraft passbys were observed overhead at this location with maximum noise levels observed to be in the order of 35 to 58 dB(A) for durations of 30 seconds and one minute during the day, evening and night-time periods.

Measurements conducted at Sydney International Equestrian Centre (M16) indicated a background acoustic environment typical of a suburban area, due to constant traffic on the nearby M7 Westlink Motorway. Ambient noise sources also included various animal and insect sounds. Aircraft were observed at a distance with a maximum sound level in the range of 47 dB(A) to 54 dB(A) for up to one minute passbys during the day, and aircraft overhead observed during evening and night periods for between 30 seconds to a minute in the range of 50 to 61 dB(A).

Observations at the Bents Basin Road Picnic Area (M21) identified aircraft noise levels in the range of 36 to 60 dB(A) for passbys between 30 seconds to one minute during the day, and between 43 dB(A) and 57 dB(A) during the evening period. The background noise environment was typified by distant traffic during the day, cicadas during the evening and night-time periods, typical of a suburban residential environment.

Measurements taken in suburban areas such as Penrith (M09) suburban areas were found to be affected by suburban traffic noises, with several aircraft flyovers observed between 30 seconds to 1 minute up to with maximum levels of 38 dB to 59 dB(A) during the day period. Evening and night time ambient levels were influenced by local traffic and suburban hum, with no flyovers observed.

Measurements at Erskine Park were made at location M15, located in the vicinity of some industrial land uses. Noise levels at this location were found to be dominated by local industrial noise activities, local traffic and occasional mechanical plant noise from adjacent residences. Aircraft were observed during the day period at this location however levels were not sufficient over ambient noise to quantify over other sources. During the eventing period one passby of up to 49 dB(A) was observed for approximately 1 minute. Noise levels are dominated by other noise sources at this location.

Background noise levels were measured at Twin Creeks (M04) active recreation area. The noise environment was found to be dominated by natural sounds, with occasional vehicle passbys audible on local roads. Several flight passbys were noted, with maximum levels between 43 and 54 dB(A) for durations up to 30 seconds during day time periods. During evening periods, several aircraft flybys were observed but not quantifiable over background noise levels associated with wind, natural noise and insect noise.

The ambient noise levels are used when considering the impact of WSI aircraft-noise levels on populations and dwellings.

The degree of likely change in noise at each location/sensitive area is presented by the series of projected average sound level variation figures in Appendix D of Technical paper 1.

Changes to social amenity due to noise is represented by charts in Appendix D of Technical paper 1 and summarised in Section 11.7.3.1. These charts reflect those suburbs and schools most likely to be affected by higher average sound levels and higher noise levels from an aircraft noise event. This is done by correlating projected average sound level (L_{Aeq}) with projected maximum sound level (L_{Amax}).

How aircraft noise is experienced is provided in Section 11.2.

11.7 Assessment of impacts

This section presents the key results of noise predictions based on WSI aircraft operations for each assessment year (refer to Section 11.1.1). It also presents the key results of metrics that are not informed by assessment years.

The full set of charts and noise contours are found in Appendix B and C respectively of Technical paper 1.

11.7.1 Noise levels over 24-hours

Aircraft noise exposure over a full day can be described by the number of aircraft noise events with L_{Amax} that exceed 60 or 70 dB(A), or N60 or N70 (refer to Table 11.2).

Individual figures for N60 and N70 (24-hour) contours for 2055 operating scenarios represent the differences in aircraft noise impacts between these scenarios at these thresholds as the single runway approaches capacity.

The composite scenarios (made up of the different scenarios) provides a worst-case scenario based on noise being shared (using full suite of possible runway modes of operation (which RRO is part)) rather than the consistent use of a single operating strategy or runway allocation scenario.

N60 and N70 (24-hour) contours are supported by population and dwelling counts of each operating scenario as well as a cumulative count based on a worst-case composite scenario.

Dwelling counts are not presented here because the number of affected dwellings were found to follow a similar trend to population counts. Full details of the population and dwelling counts assessment are found in Section 9.6 of Technical paper 1.

11.7.1.1 N70

The key findings are depicted by:

- For 2055 – calculated N70 (24-hour) noise contours for each of the 3 operating and unidirectional scenarios – shown on Figure 11.12 to Figure 11.15.
- For 2055, 2040 and 2033 – composite scenario N70 (24-hour) noise contours comprised of the 3 operating scenarios plus unidirectional scenarios for each assessment year – shown on Figure 11.16, Figure 11.17 and Figure 11.18 respectively.

The hard shaded blue line depicting 5–9 movements is the limit of exposure to at least 5 movements per day under one of the 3 operating scenarios. Once the hard dark unshaded blue line is reached, this becomes the 10 movements per day threshold.

Unidirectional scenarios (where all movements are either all Runway 05 or all Runway 23) are described in Section 11.5.6.2. The dashed blue line is the only line assessing solely the unidirectional scenarios. This shows the additional area that could be exposed to at least 5 movements above 70 dB(A) if all movements were in one direction only on a given day.

Geographical extent

As the single runway approaches capacity at around 37 million annual passengers (2055), the extent of predicted noise impact is at its greatest (refer to Figure 11.12 to Figure 11.14.

The key findings for 2055 are:

- The No Preference and Prefer Runway 05 scenarios results in greater impact on residents in densely-populated areas to the north-east of the Airport Site, with a predicted 5 to 9 events per day above 70 dB(A) over more densely-populated areas around St Clair and reaching north to Claremont Meadows.
- In comparison, the Prefer Runway 23 scenario is predicted to result in an impact of less than 5 events per day in these areas and the predicted impact would be greater in less densely-populated areas to the north of Horsley Park.
- To the south-east of the runway, additional N70 = 5–9 contours for the Prefer Runway 05 and Prefer Runway 23 scenarios 'lobe' toward the rural residential areas around Wallacia and south toward Greendale compared to the No Preference scenario. This is due to the use of RRO. The Prefer Runway 05 scenario also results in slightly higher predicted impacts (N70 = 5-9) in the Burragorang State Conservation Area to the south-west of the Airport Site compared to the other scenarios.

For the early years of operation at around 10 million annual passengers (2033), N70 contours extend well beyond the runway ends (Figure 11.18). The N70 = 5 contours extends approximately 6 km to the north, 11.5 km to the north-east and 13.5 km to the south-west of the runway. With the application of Prefer Runway 05 or Prefer Runway 23 scenarios (which use RRO), the contours also form 'lobes' toward Wallacia and south toward Greendale compared to No preference scenario. These lobes do not extend into major population centres.

The unidirectional scenarios (all movements on Runway 05 or all movements on Runway 23) show the typical worst-case day, when either mode is required to be used 100 per cent of the time (day and night). The most noticeable aspect of the inclusion of these scenarios (depicted separately for 2055 in Figure 11.15 and in the composite scenario for 2040 and 2033 (Figure 11.17 and Figure 11.18 respectively) is that generally the difference between the noise impact on average versus worst-case day is limited. This is due to the single runway system which reduces the potential runway modes of operation compared to a multi-runway system airport.

2055 scenarios (other than composite)

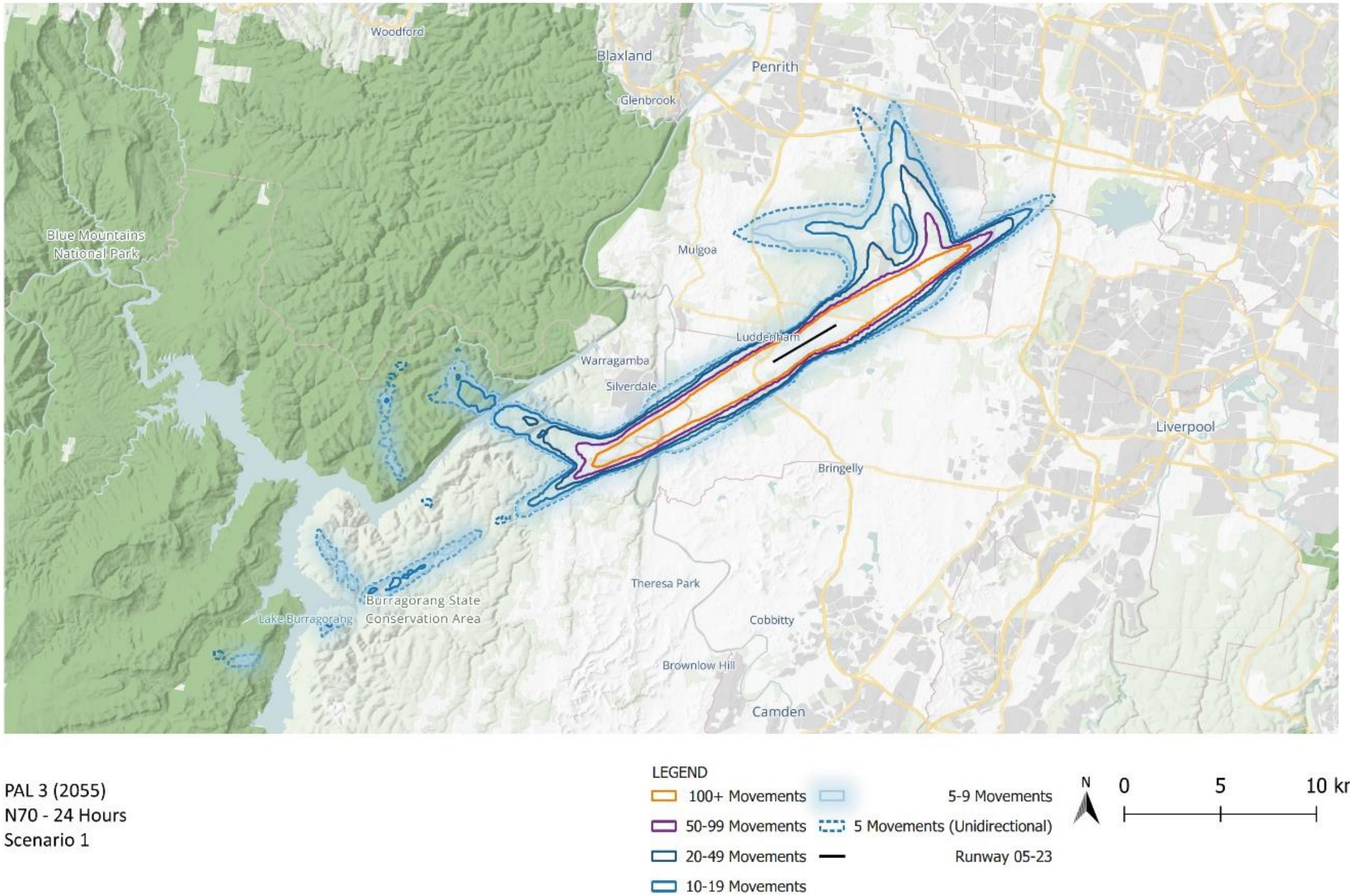


Figure 11.12 N70 noise contours – 24-hours – No preference – 2055

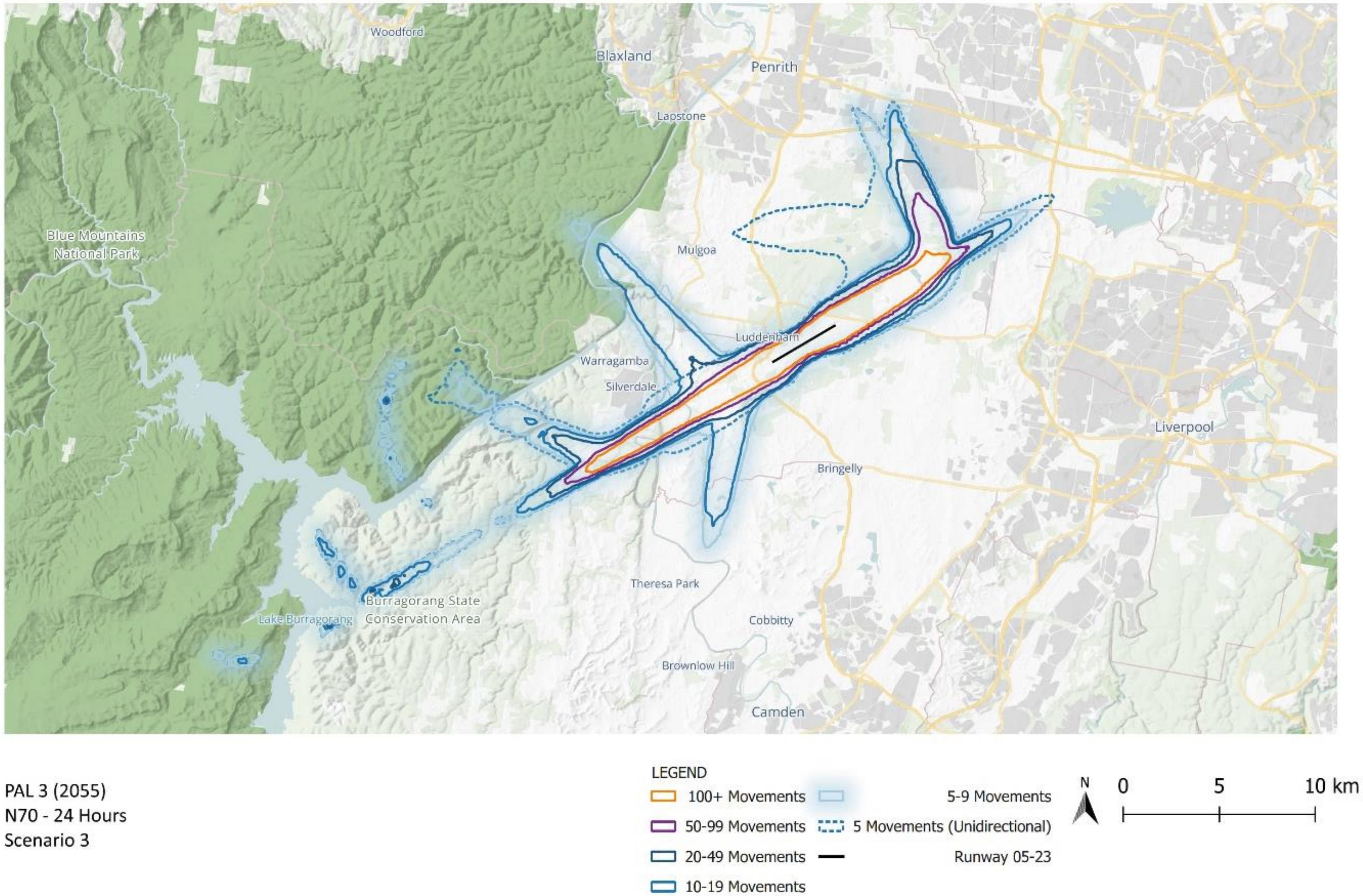


Figure 11.13 N70 noise contours – 24-hours – Prefer Runway 05– 2055

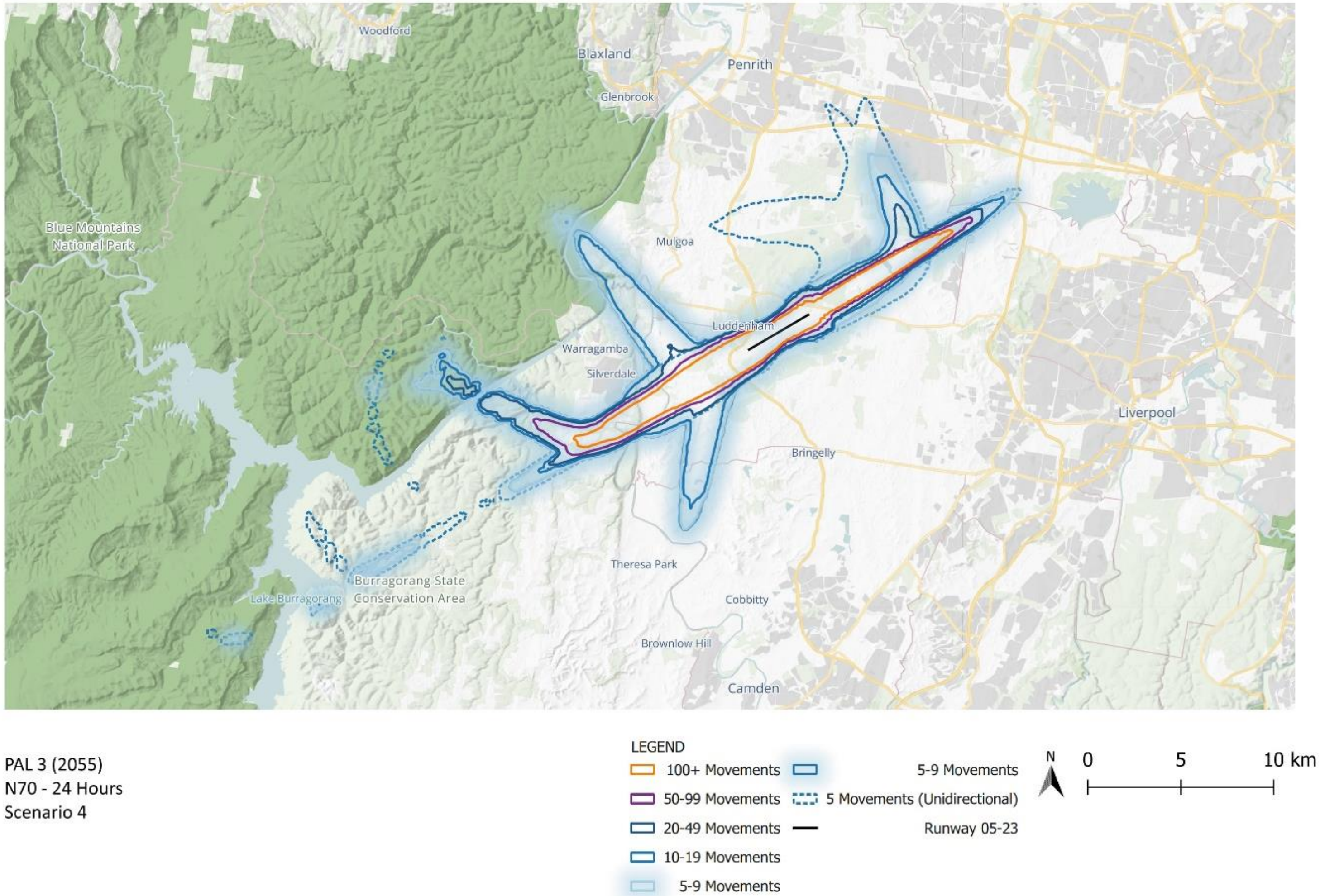


Figure 11.14 N70 noise contours – 24-hours – Prefer Runway 23 – 2055

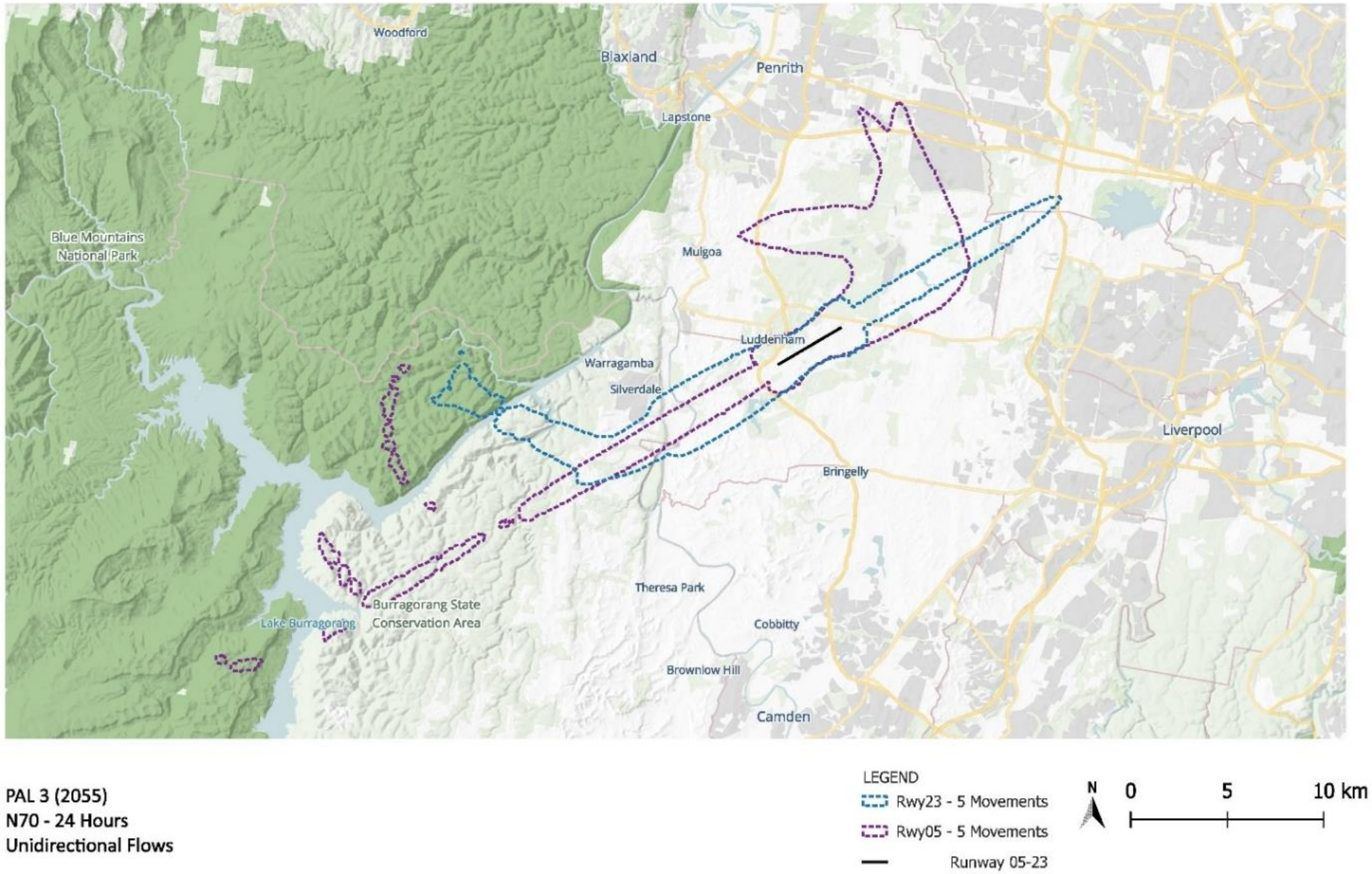


Figure 11.15 N70 noise contours – 24-hours – Unidirectional scenarios – 2055

Composite scenarios

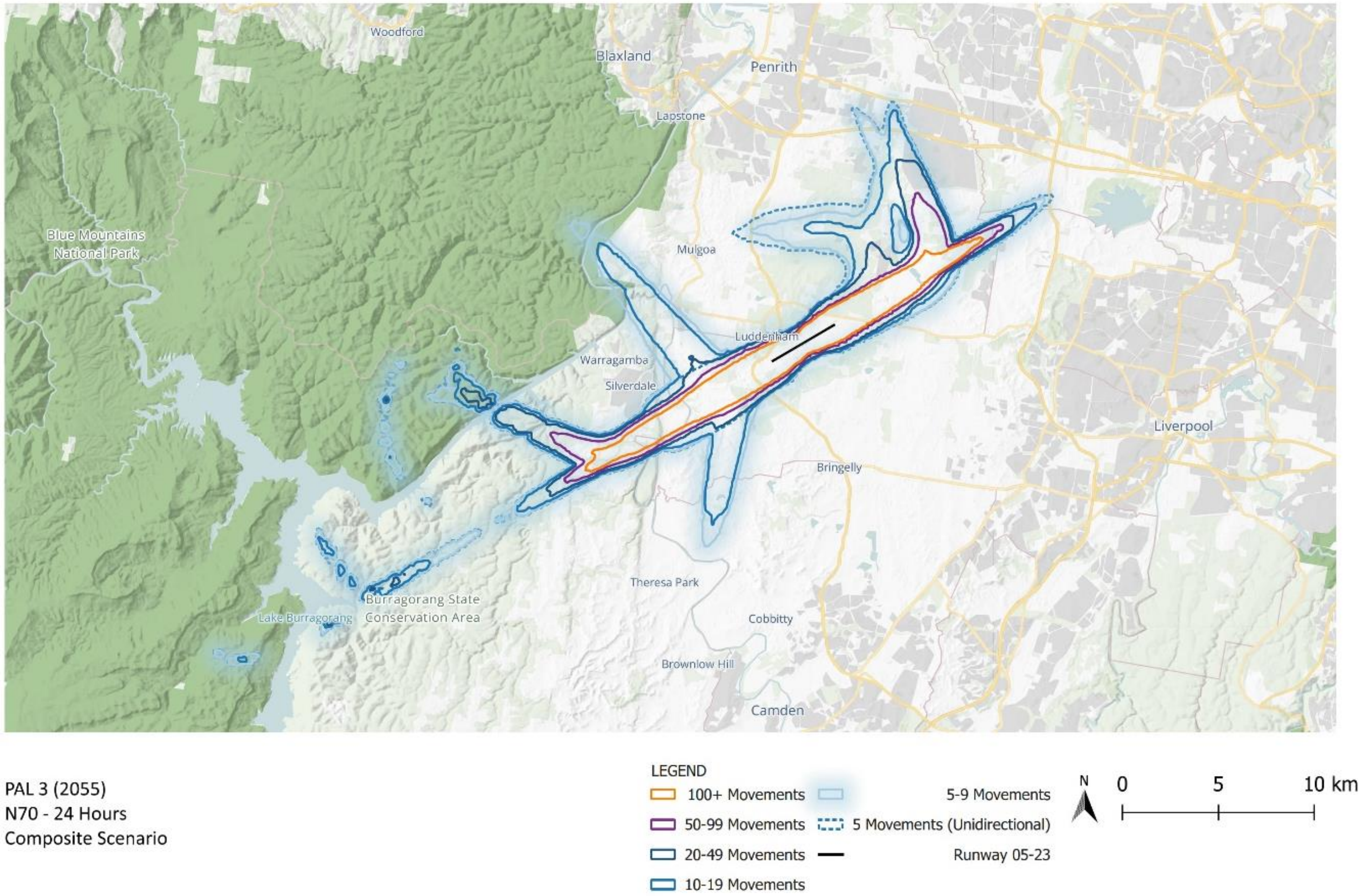


Figure 11.16 N70 noise contours – 24-hours – composite scenario – 2055

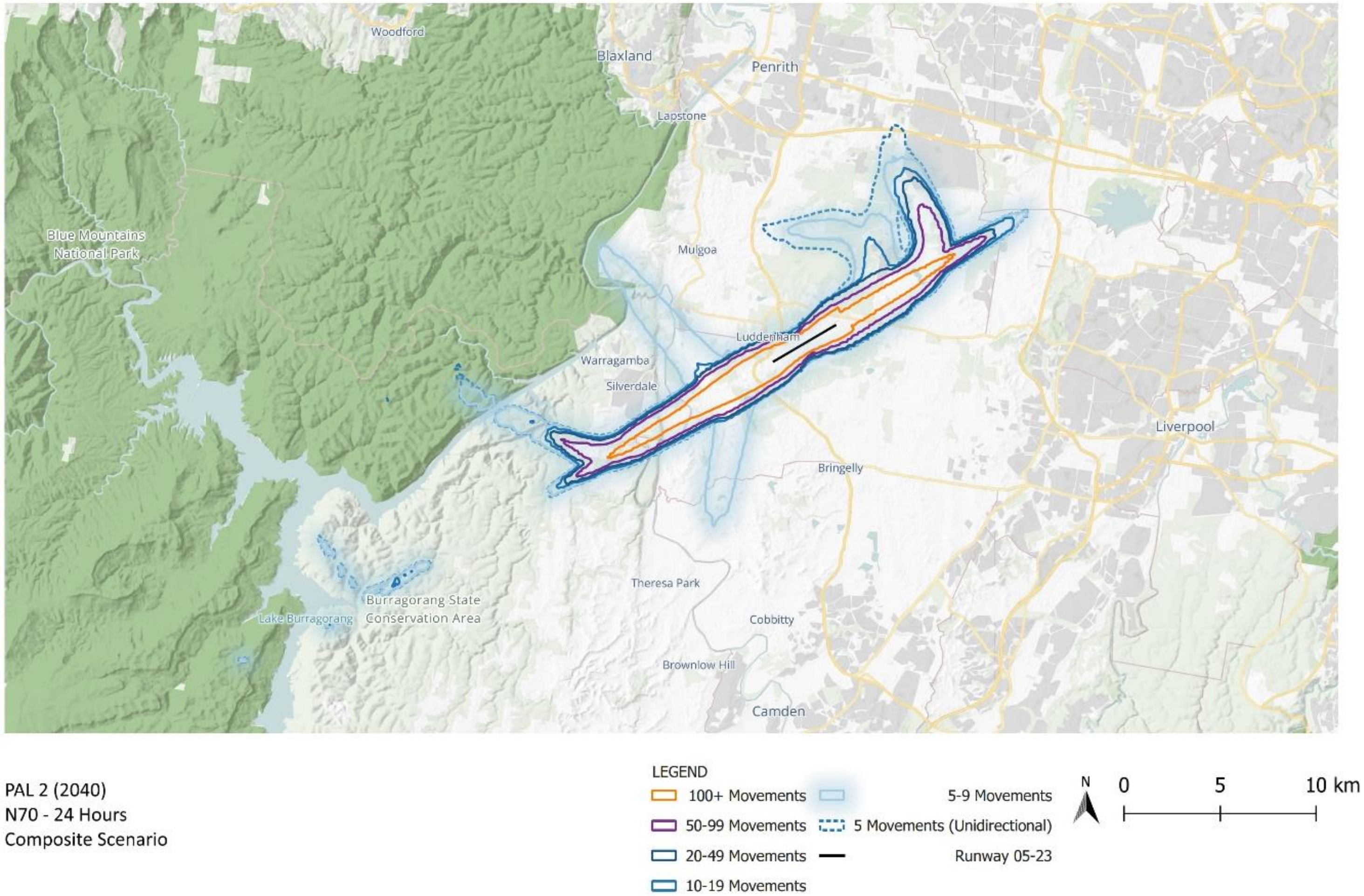


Figure 11.17 N70 noise contours – 24-hours – composite scenario – 2040

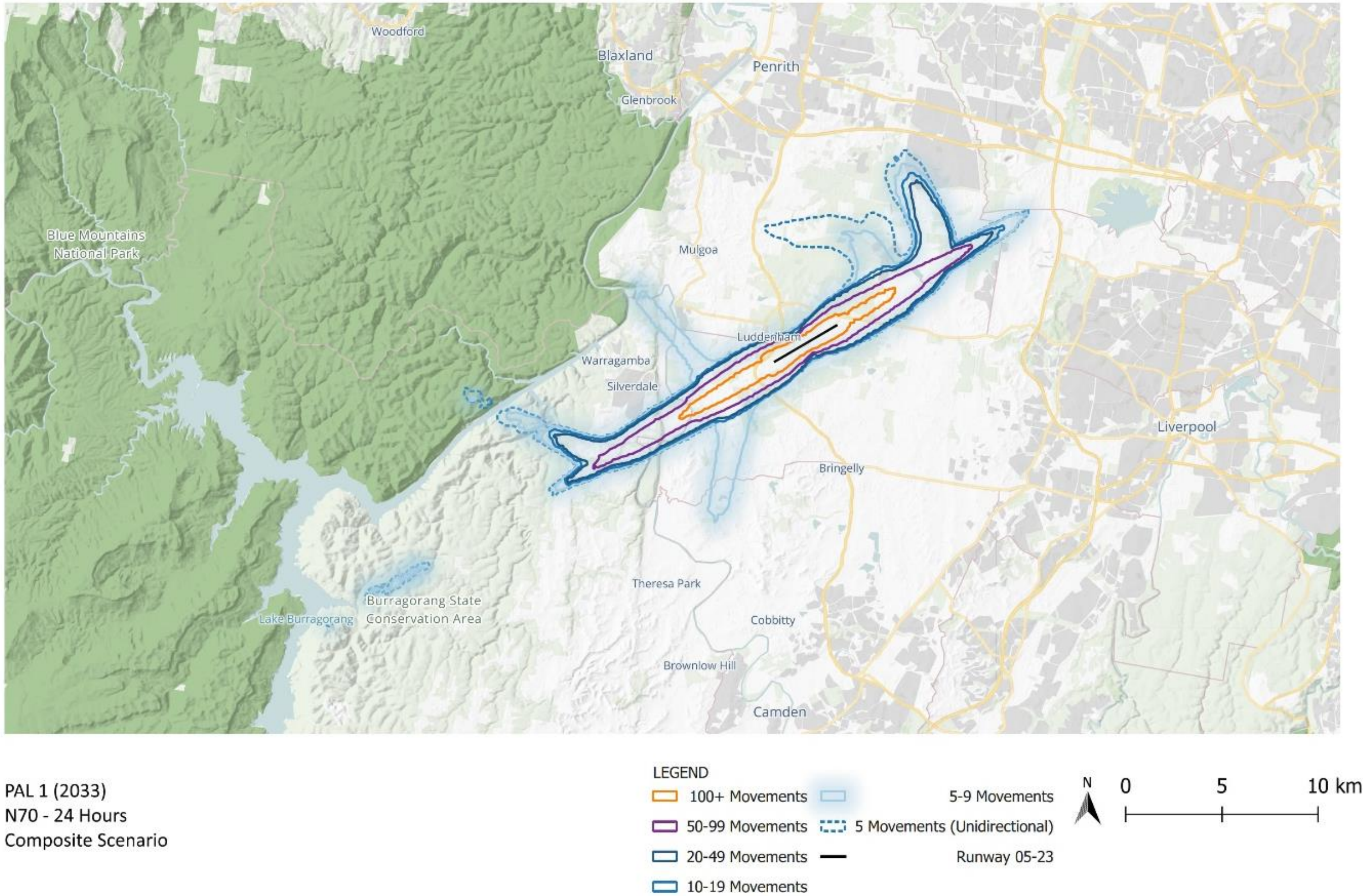


Figure 11.18 N70 noise contours – 24-hours – composite scenario – 2033

Population and dwelling counts

The assessment of population and dwellings exposed to an average of more than 5 daily movements above 70 dB(A) reflects disturbance associated with noisier events that can impact a normal conversation, even in urban areas. Figure 11.19 highlights the growth in population likely to be exposed to different thresholds of aircraft noise events exceeding 70 dB(A) over a 24-hour period as WSI operational demand increases from 2033 to 2055.

The results show Prefer Runway 23 scenario (with RRO operations at night) has the lowest number of people impacted by various noise event thresholds. While other scenarios initially expose up to 5,000 people to at least 5 noise events above 70 dB(A) per day, growing to over 12,000 people by 2055, Prefer Runway 23 scenario minimises the number of people exposed to 5 N70 or above noise events to approximately 7,000 people by 2055, approximately the same level that can be expected to the composite scenario at the earlier year of 2040.

Prefer Runway 05 scenario shows increased population exposure to an average of 5 daily movements above 70 dB(A) in the communities of St Clair and Kingswood. Those same communities would see a decrease under Prefer Runway 23 scenario, as well as in St Marys.

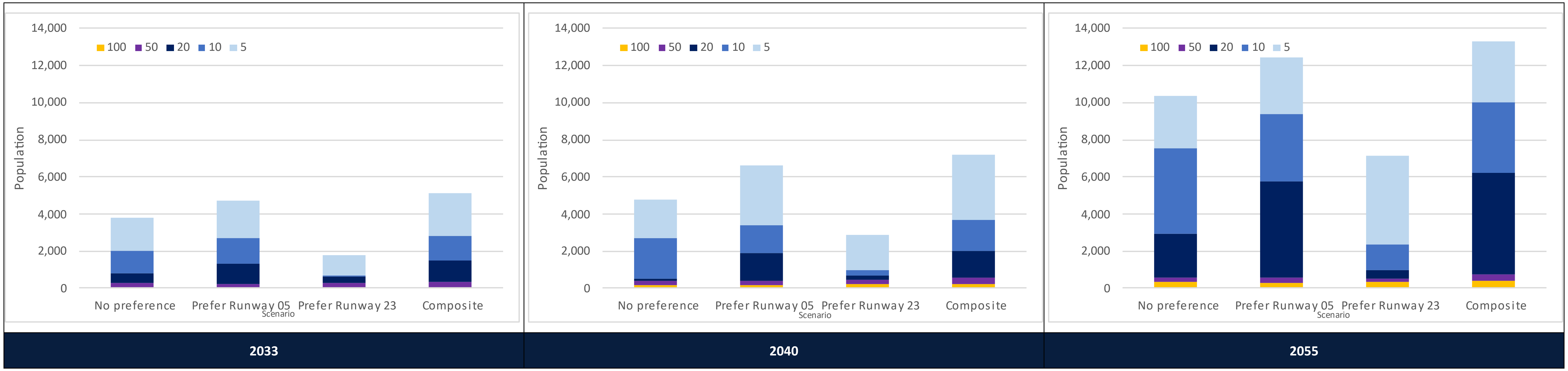


Figure 11.19 Population counts – N70 24-hour contours for all scenarios

11.7.1.2 N60

The key findings are depicted by:

- For 2055 – calculated N60 (24-hour) noise contours for each of the 3 operating scenarios – shown on Figure 11.20 to Figure 11.22
- For 2055, 2040 and 2033 – composite scenario N60 (24-hour) noise contours comprised of the 3 operating scenarios for each assessment year – shown on Figure 11.23, Figure 11.24 and Figure 11.25 respectively.

Geographical extent

As the single runway approaches capacity at around 37 million annual passengers (2055) (refer to Figure 11.20 to Figure 11.22), the extent of predicted noise impact based on N60 (24-hour) contours is at its greatest. N60 contours extend well beyond the runway ends, north towards Penrith, north-east towards St Marys and north, west and south-west into the Blue Mountains National Park. The N60 = 10–19 contours extend approximately 46 km to the north-west of the runway centre, 27 km to the north-east and 46 km to the south-west of the runway ends. With the application of Prefer Runway 05 scenario the N60 = 10-19 contours extend over Blaxland and Penrith whereas with Prefer Runway 23 or No preference scenarios these contours do not affect these areas to the same extent.

2055 scenarios (other than composite)

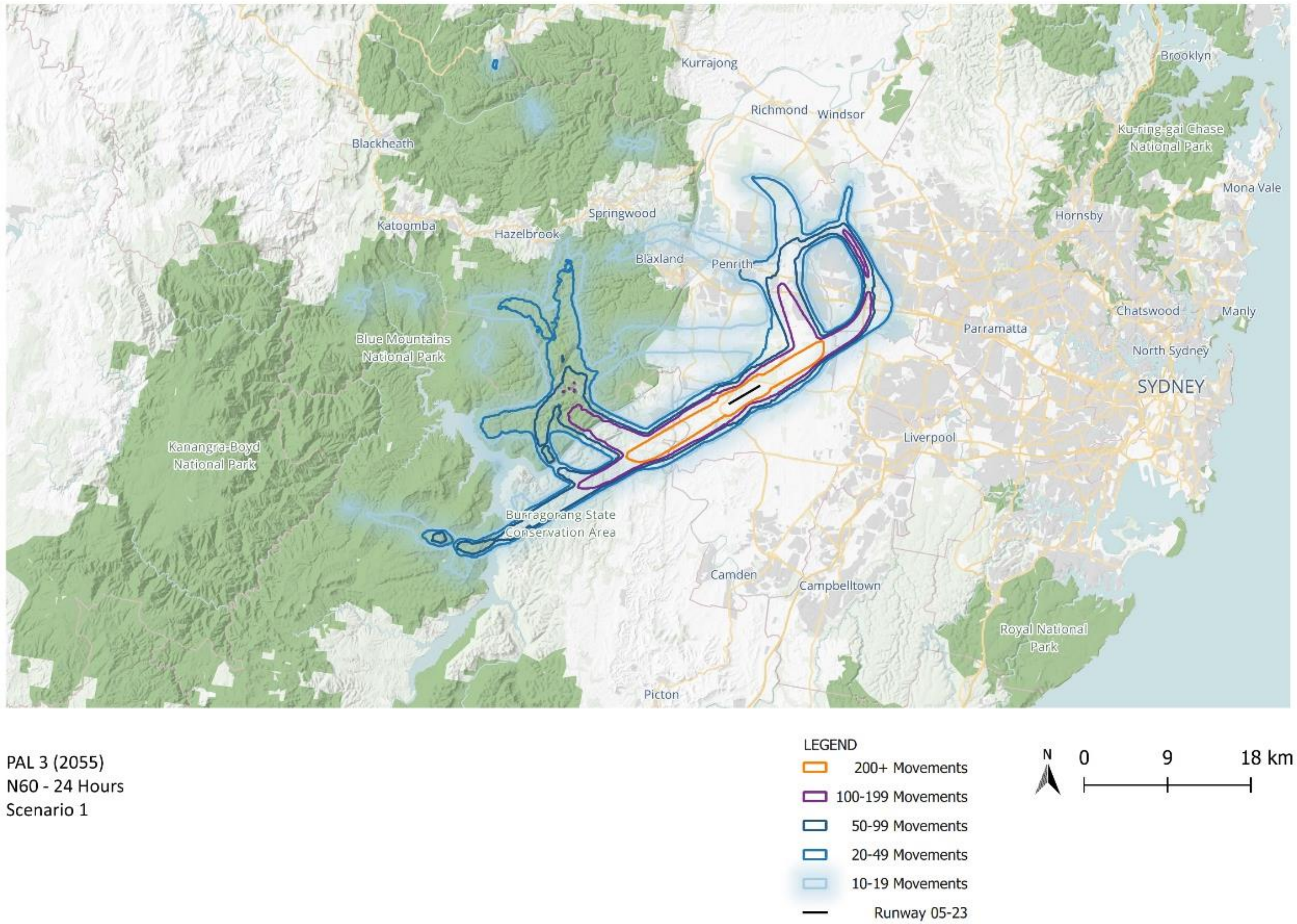


Figure 11.20 N60 noise contours – 24-hours – No preference – 2055

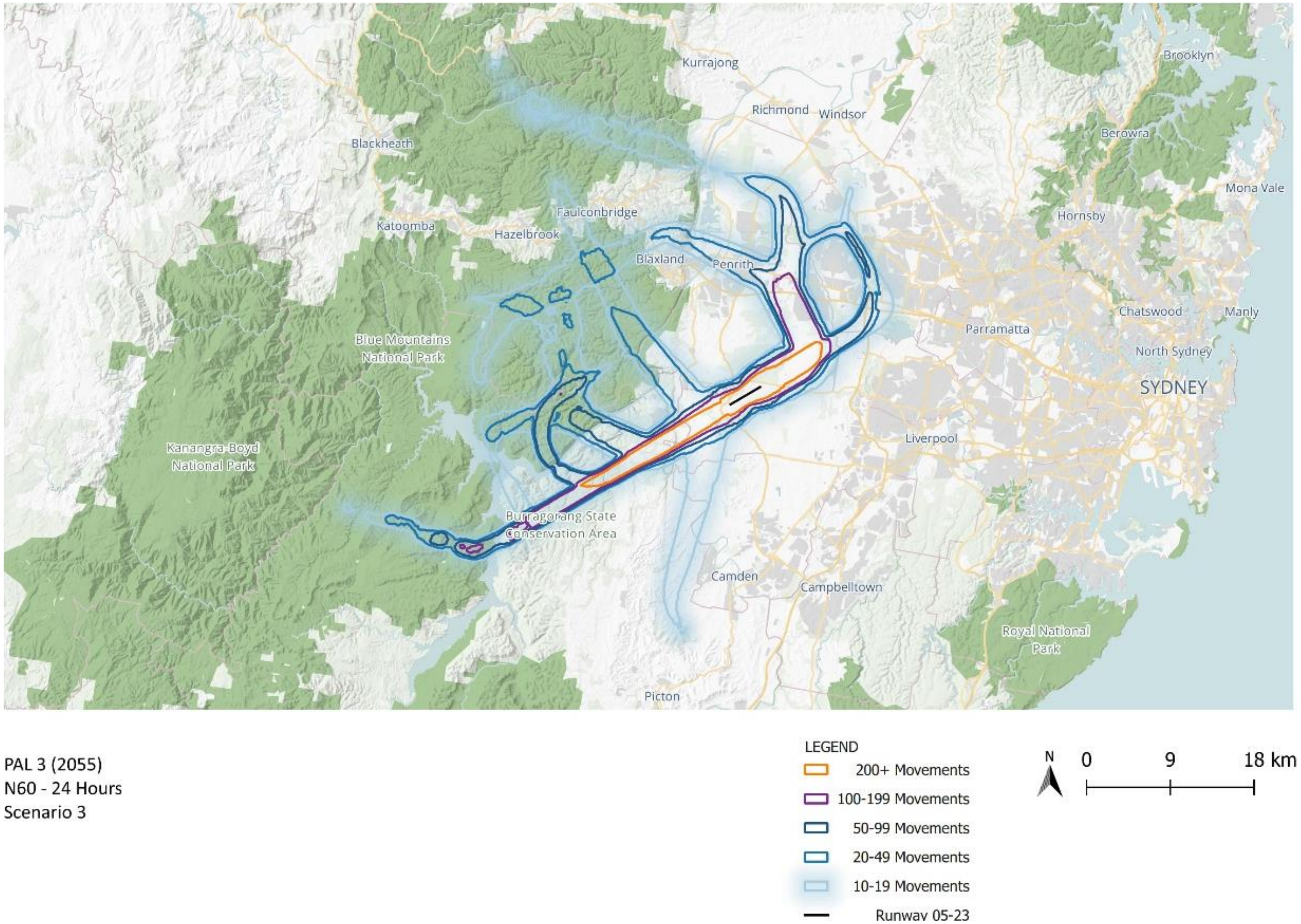


Figure 11.21 N60 noise contours – 24-hours – Prefer Runway 05 – 2055

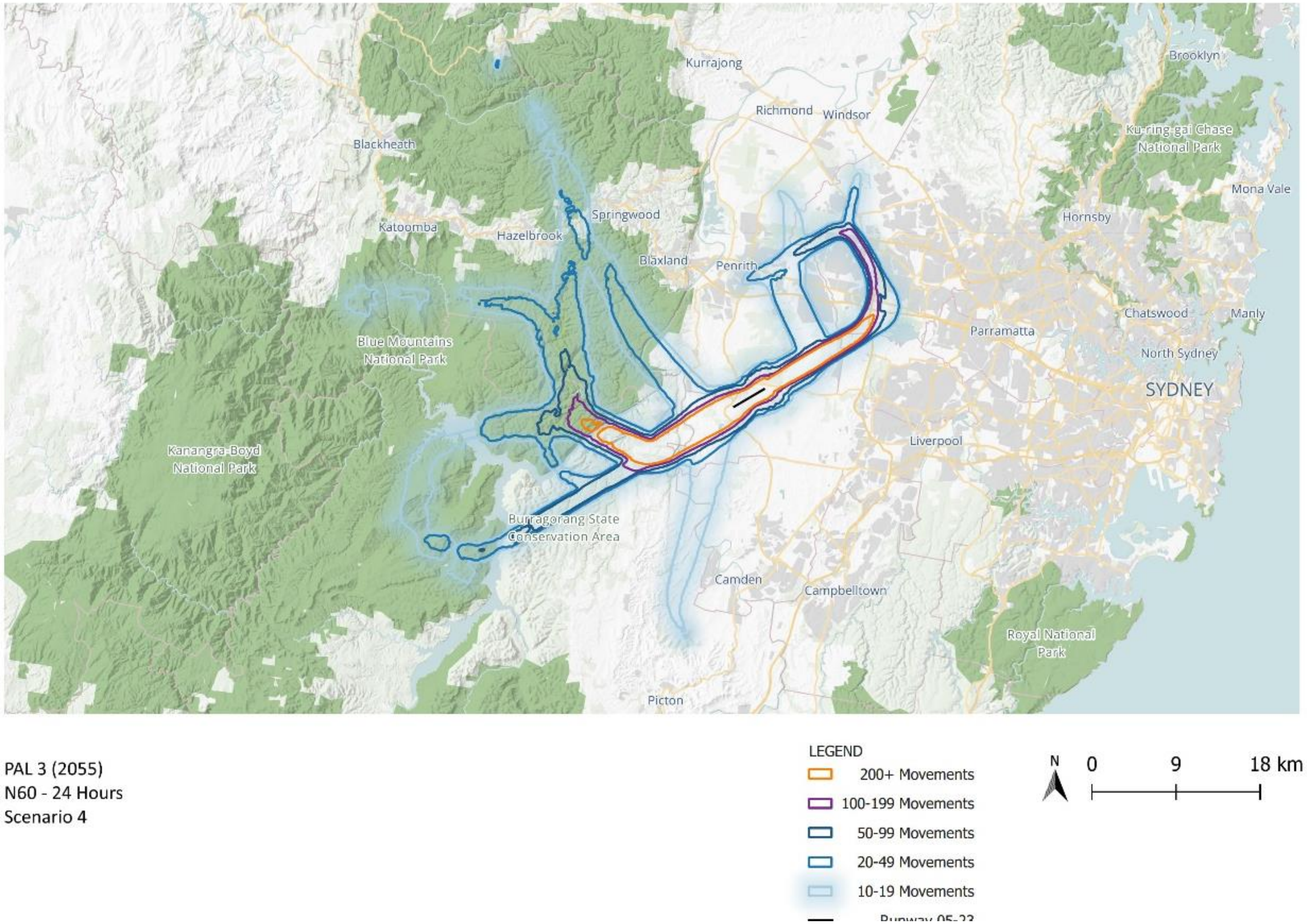


Figure 11.22 N60 noise contours – 24-hours – Prefer Runway 23 – 2055

Composite scenarios

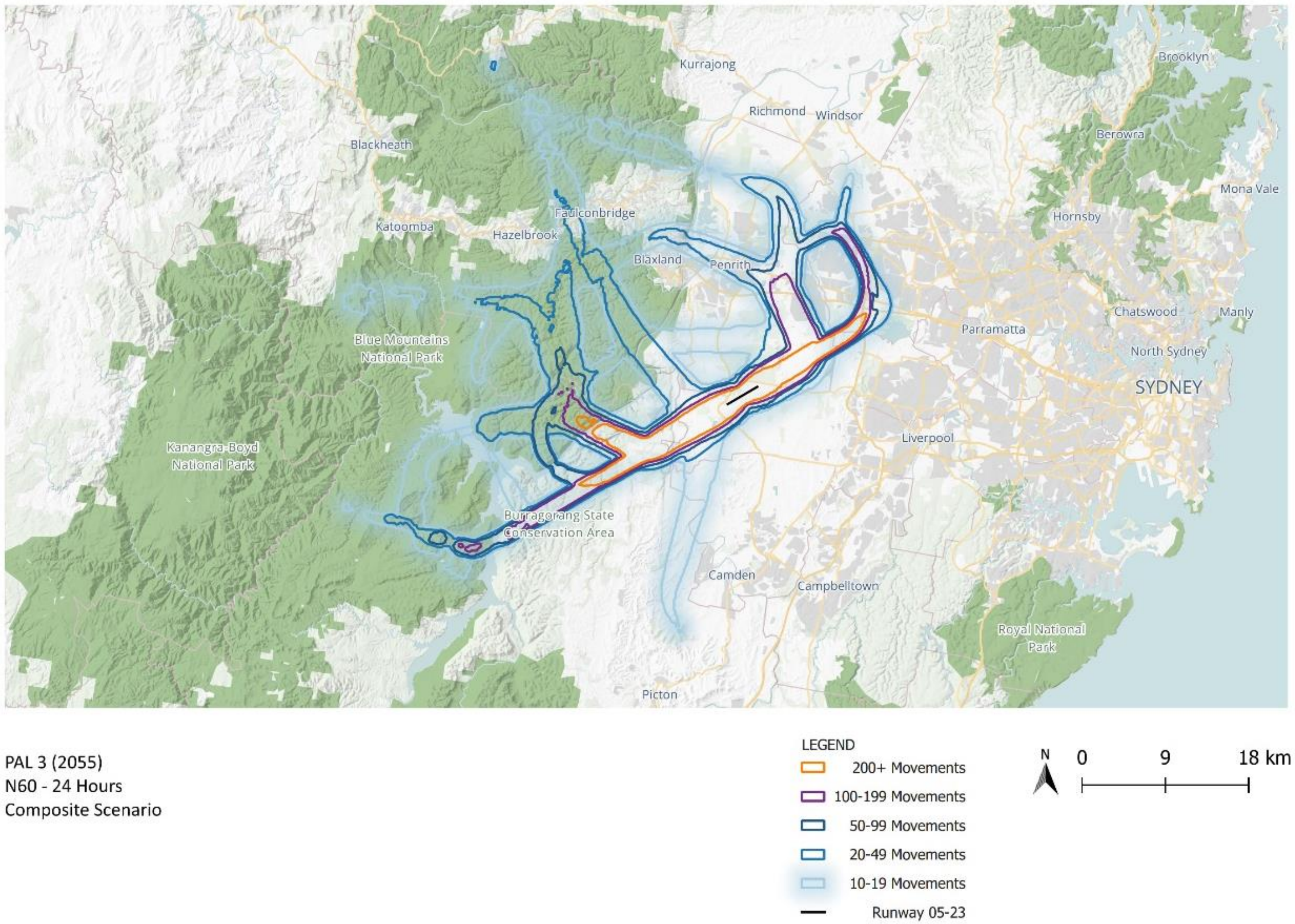


Figure 11.23 N60 noise contours – 24-hours – composite scenario– 2055

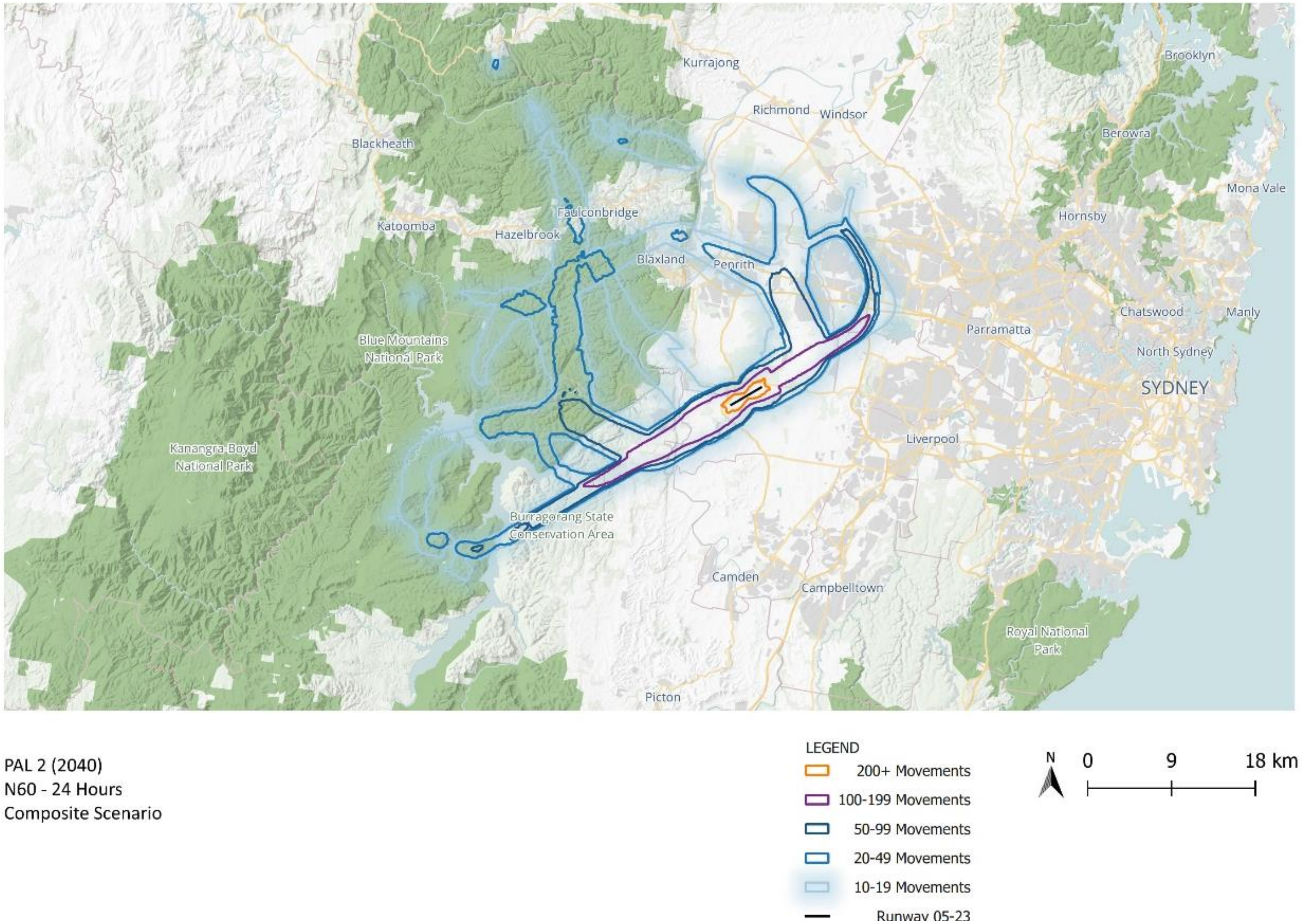


Figure 11.24 N60 noise contours – 24-hours – composite scenario – 2040

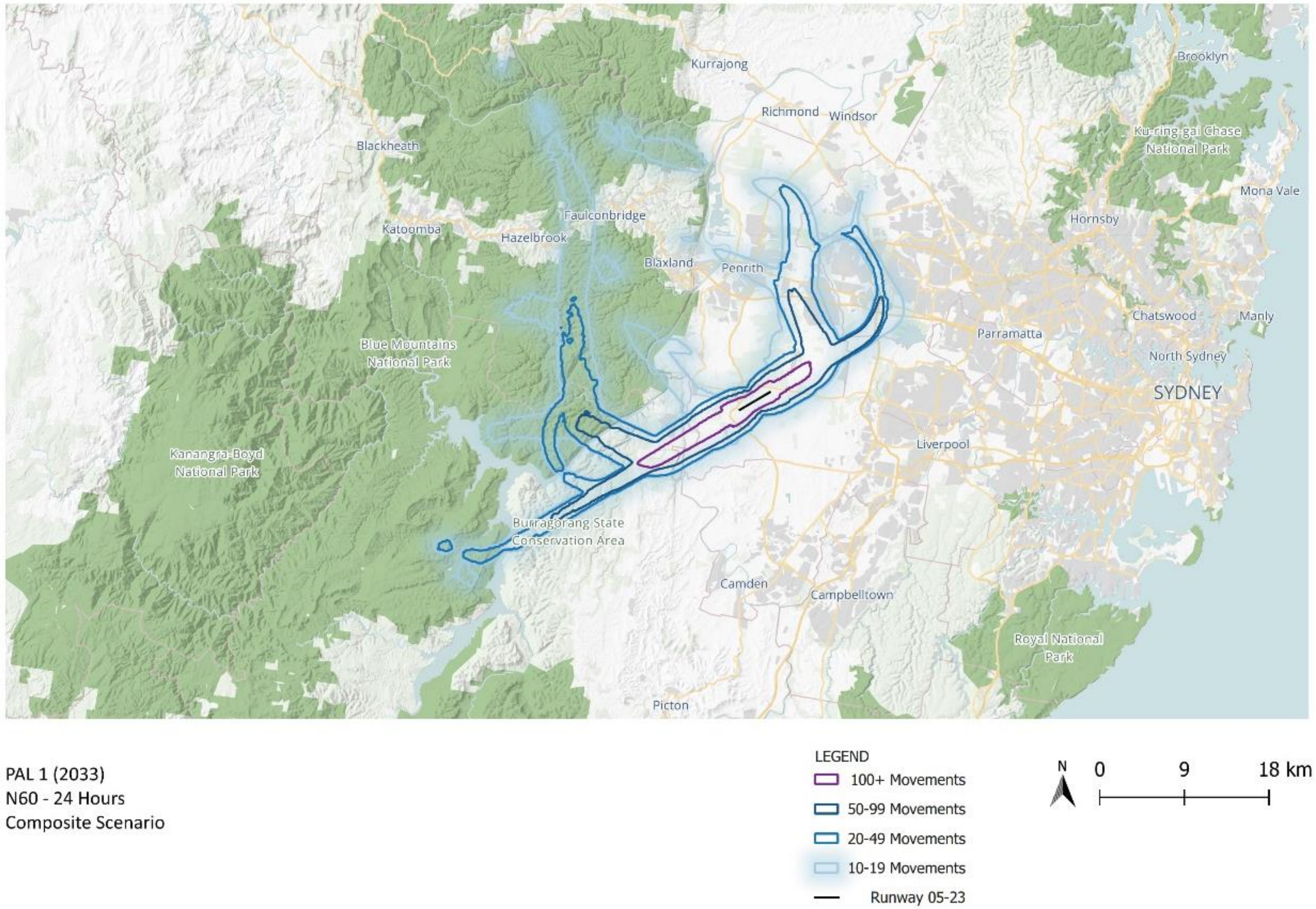


Figure 11.25 N60 noise contours – 24-hours – composite scenario – 2033

Population and dwelling counts

The assessment of population and dwellings exposed to an average of more than 10 daily events above 60 dB(A) reflects disturbance associated with the frequency of events, especially in rural areas where movements will be more noticeable at a lower noise threshold. Figure 11.26 highlights the growth in population likely to be exposed to different thresholds of aircraft noise events exceeding 60 dB(A) over a 24-hour period as WSI operational demand increases from 2033 to 2055.

Similar to the N70 24-hour contours, Figure 11.26 shows that for N60 24-hour contours, Prefer Runway 23 scenario (with RRO operations at night) has the lowest number of people impacted by various noise event thresholds.

While other scenarios expose over 150,000 people to at least 10 noise events above 60 dB(A) per day in 2055, Prefer Runway 23 scenario decreases the number of people exposed to approximately 114,000 by 2055, lower than the numbers that can be expected under other scenarios at the early year of 2040.

While Prefer Runway 05 scenario (with RRO operations at night) would an increased noise exposure compared to No preference scenario in 2033 and 2055, Prefer Runway 23 scenario would reduce exposure to at least 10 daily movements above 60 dB(A) for the communities of Penrith, Emu Plains, Colyton, Erskine Park, Jordan Springs, Cambridge Park and Blaxland.

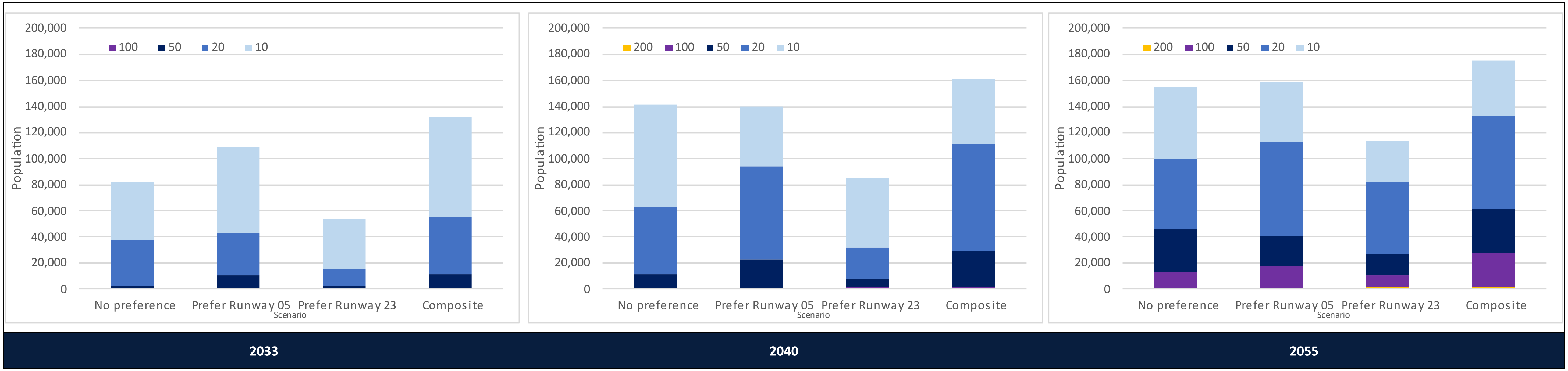


Figure 11.26 Population counts – N60 24-hour contours for all scenarios

11.7.2 Night-time noise levels

The number of noise events exceeding 60 dB(A) (N60) has been used to describe the impact of noise at night. N60 values have been predicted for the night-time period 11 pm to 5:30 am.

The key findings are depicted by:

- For 2055 – calculated N60 (night) noise contours for each of the 3 scenarios – shown on Figure 11.27 to Figure 11.29.
- For 2055, 2040 and 2033 – composite scenario N60 (night) noise contours comprised of the 3 operating scenarios for each assessment year – shown on Figure 11.30, Figure 11.31 and Figure 11.32 respectively.

Geographical extent

At night, the No preference scenario is predicted to have a greater impact on built-up areas around St Marys (up to Hassal Grove). The Prefer Runway 05 and Prefer Runway 23 scenarios (both with RRO) are operationally identical but could behave differently during the transition between day and night and would have less impact on these built-up areas and a greater impact on rural residential areas around Greendale and Silverdale. The Prefer Runway 05 and Prefer Runway 23 scenarios extend south of the runway to east of Picton. By 2055, all scenarios would impact areas of Luddenham to the north of the runway (up to 49 noise events per night).

The number of night-time noise events in densely populated areas could be reduced by use of RRO where available. As demonstrated in Figure 11.28 and Figure 11.29, this would result in no built-up residential areas being exposed on average to more than 9 events per night above 60 dB(A).

2055 scenarios (other than composite)

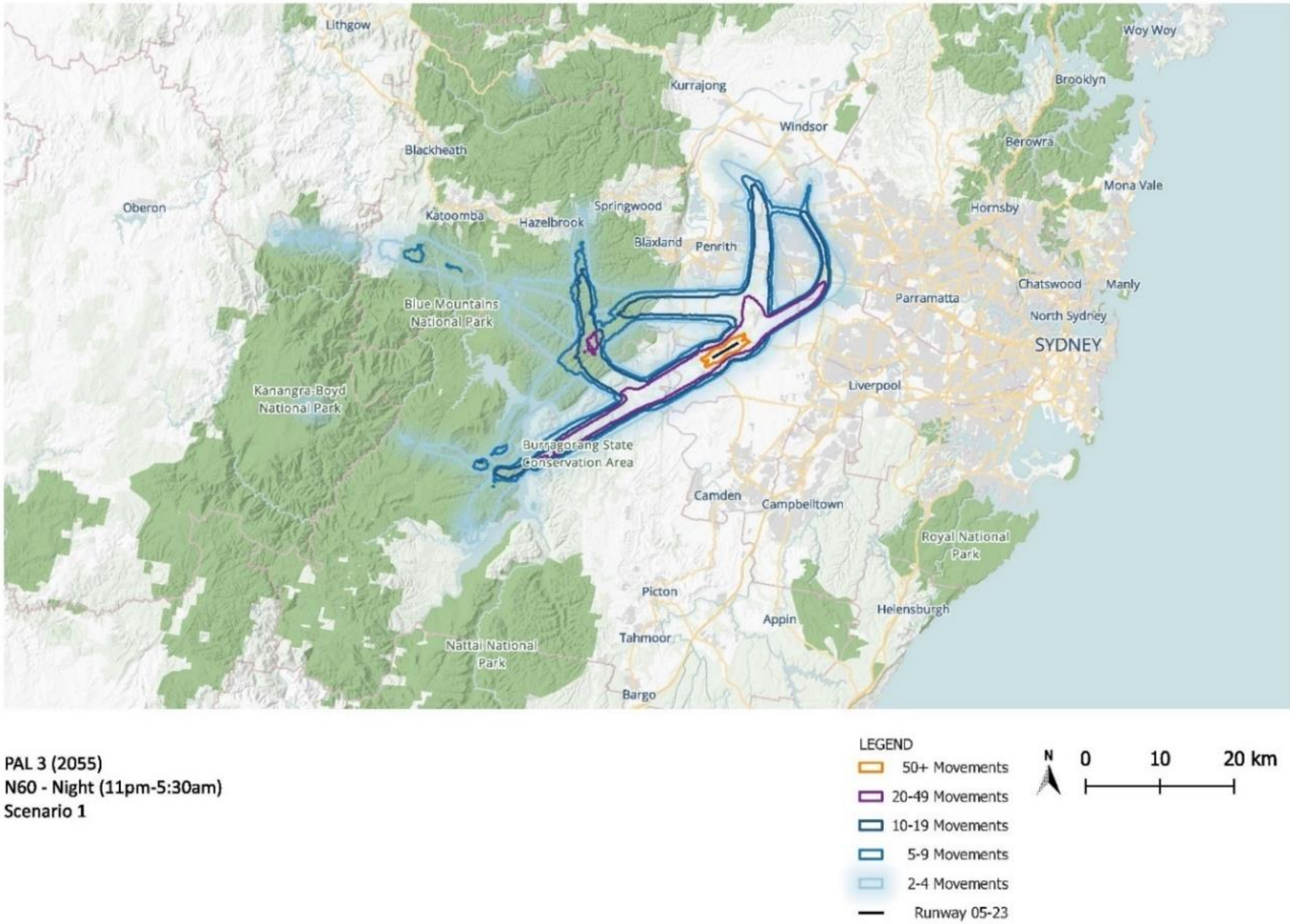


Figure 11.27 N60 noise contours – night – No preference– 2055

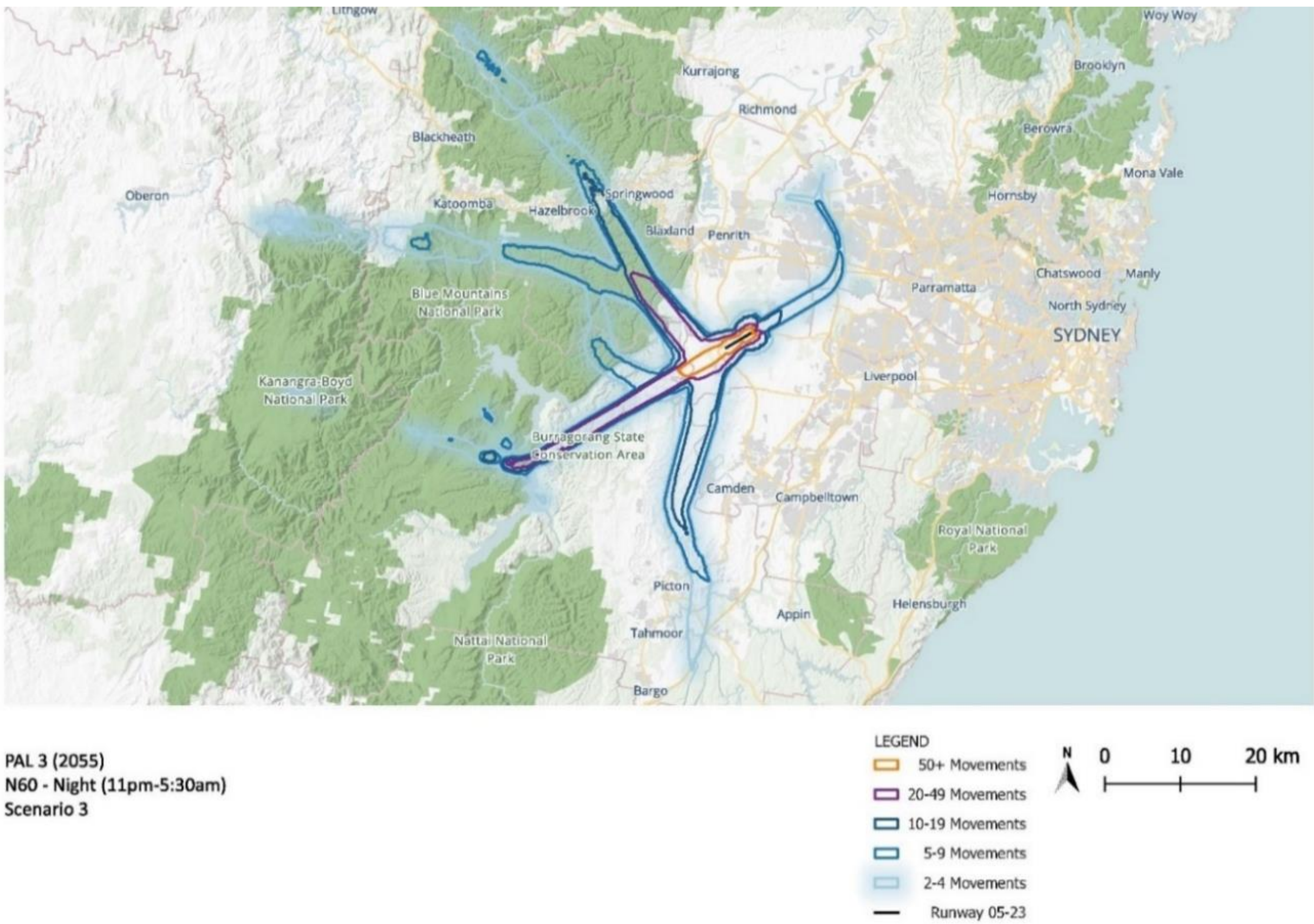


Figure 11.28 N60 noise contours – night – Prefer Runway 05 – 2055

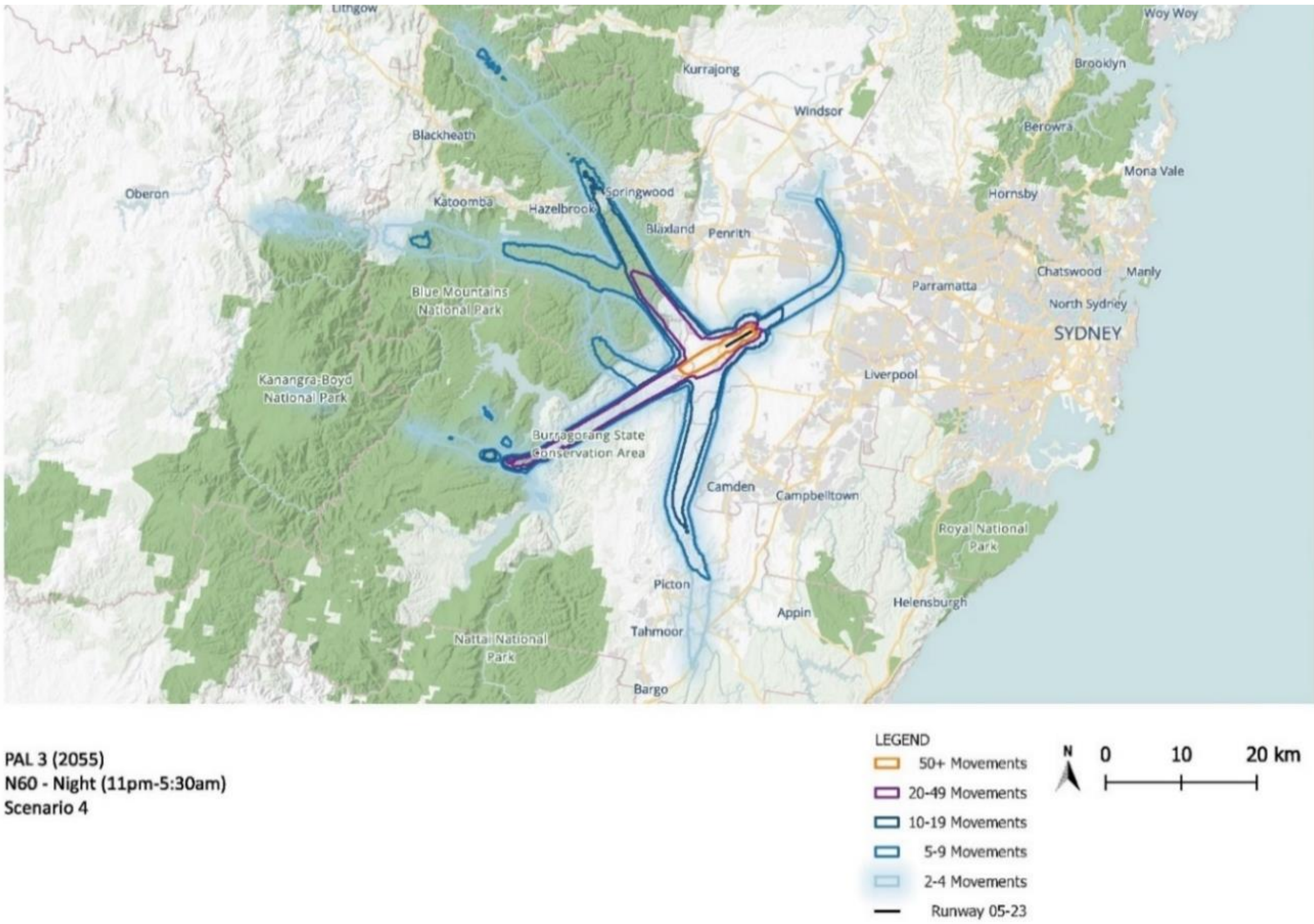


Figure 11.29 N60 noise contours – night – Prefer Runway 23 – 2055

Composite scenarios

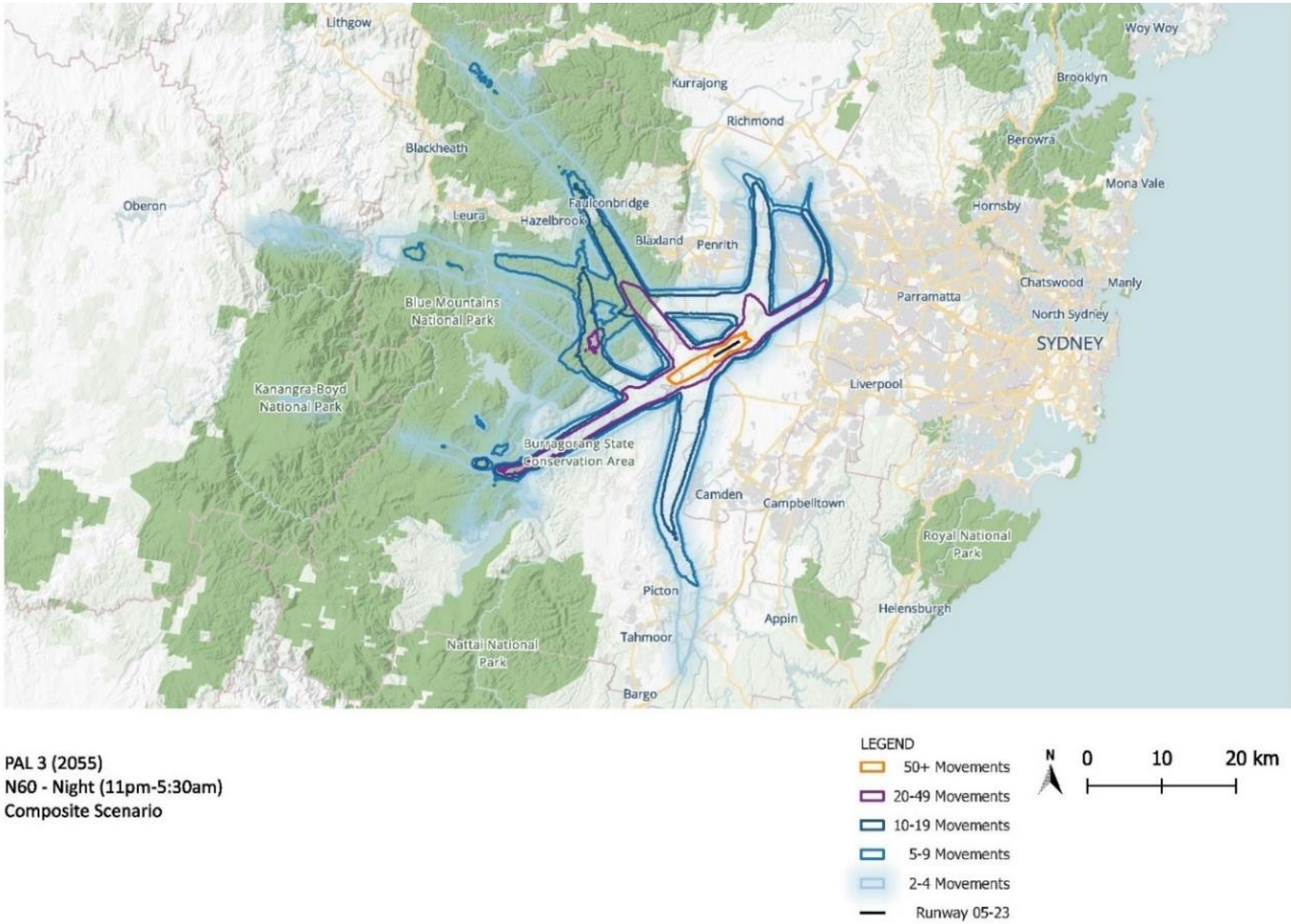


Figure 11.30 N60 noise contours – night – composite scenario – 2055

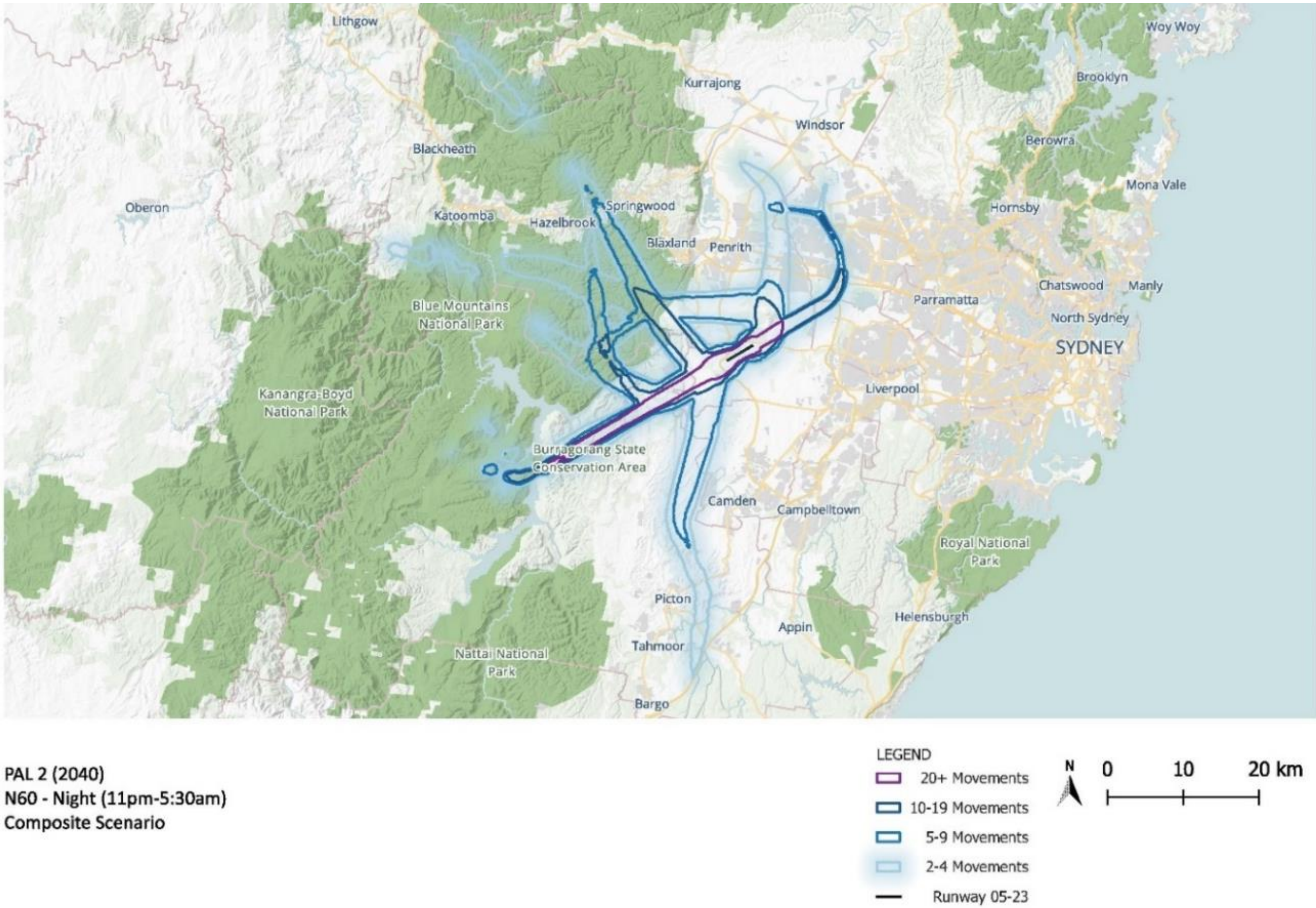


Figure 11.31 N60 noise contours – night – composite scenario– 2040

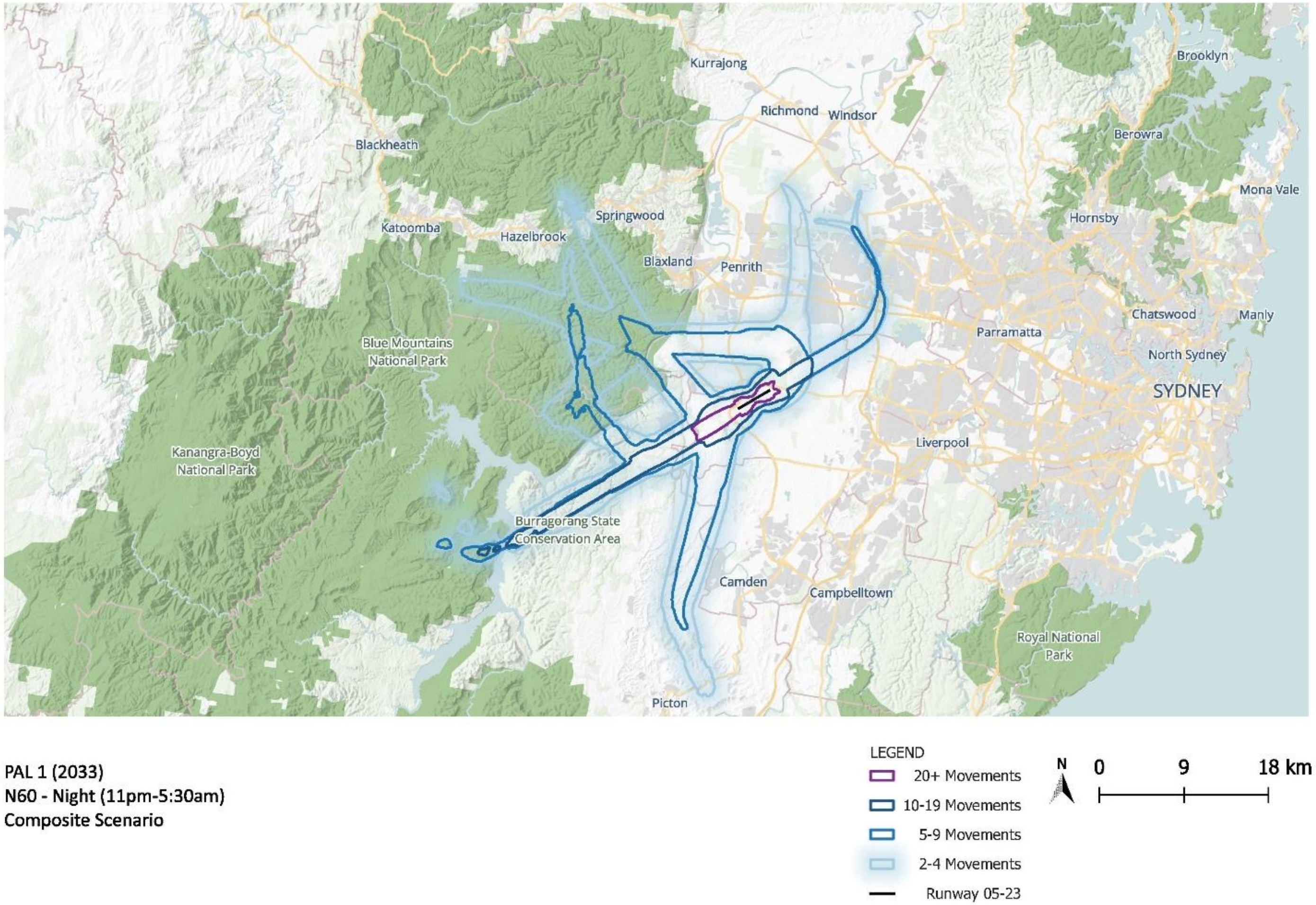


Figure 11.32 N60 noise contours – night – composite scenario– 2033

Population and dwelling counts

The assessment of population and dwellings exposed to an average of more than 2 movements above 60 dB(A) between 11 pm and 5:30 am daily – (Night), indicates the potential for disturbances during sleep hours. Figure 11.33 highlights the growth in population numbers, likely to be exposed to different thresholds of aircraft noise events exceeding 60 dB(A) during night-time (11 pm to 5:30 am) as WSI operational demand increases from 2033 to 2055.

The results show that Prefer Runway 05 and Prefer Runway 23 scenarios (which both incorporate RRO operations) decrease the number of people impacted by various night-time noise event thresholds when compared to a baseline or No Preference (scenario 1) without RRO. While the No preference scenario initially exposes up to 27,500 people to at least 2 noise events above 60 dB(A) per night in year 2033, this grows to over 84,500 people in 2055. The Prefer Runway 05 scenarios and Prefer Runway 23 scenarios minimise numbers of people exposed to approximately 23,000 people in 2055. This number is less than the number that can be expected to be exposed to 2 noise events above 60 dB(A) per night under the No preference scenario in 2033.

Communities such as St Marys, St Clair, Kingswood, Jordan Springs, Werrington and Orchard Hills will benefit from the use of the RRO mode of operation as used in Prefer Runway 05 and Prefer Runway 23. Communities such as the Oaks, Warragamba, Silverdale, Cobbitty, Greendale, Hazelbrook and Linden will see a likely increase in noise exposure when the RRO mode of operation is in use (noting the criteria required to be met for its application).

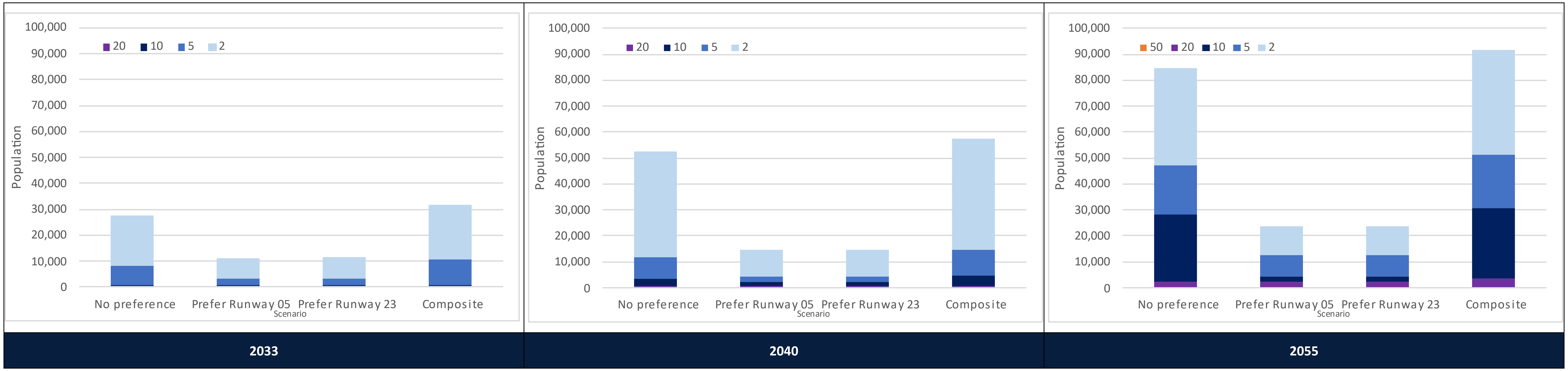


Figure 11.33 Population counts – Night N60 contours for all scenarios

11.7.3 Noise sensitive areas

Appendix D in Technical paper 1 presents the full results for the assessments on noise sensitive areas as described in Section 11.5.8. These assessments were used to inform the determination of noise impact on social amenity in Chapter 18 (Social).

11.7.3.1 Projected average and maximum sound level

The key findings can be depicted by the assessment of the project's impact on residences (by suburb) (refer to Figure 11.34 and Figure 11.35) and schools (refer to Figure 11.36 and Figure 11.37) using projected average sound level (L_{Aeq}) correlated with projected maximum sound level (L_{Amax}) (defined in Section 11.6.2).

The suburbs and schools depicted as outliers from the general grouping on these figures are likely to be more impacted by aircraft noise – that is, by higher average sound levels and higher noise levels from an aircraft noise event.

In terms of suburbs, during the night in 2055 under the Prefer Runway 23 scenario (Figure 11.35), the suburbs of Greendale, Luddenham, Silverdale and Wallacia could be exposed to single events exceeding 70 dB(A) and an average sound level of 50 dB(A) between 11 pm and 5:30 am.

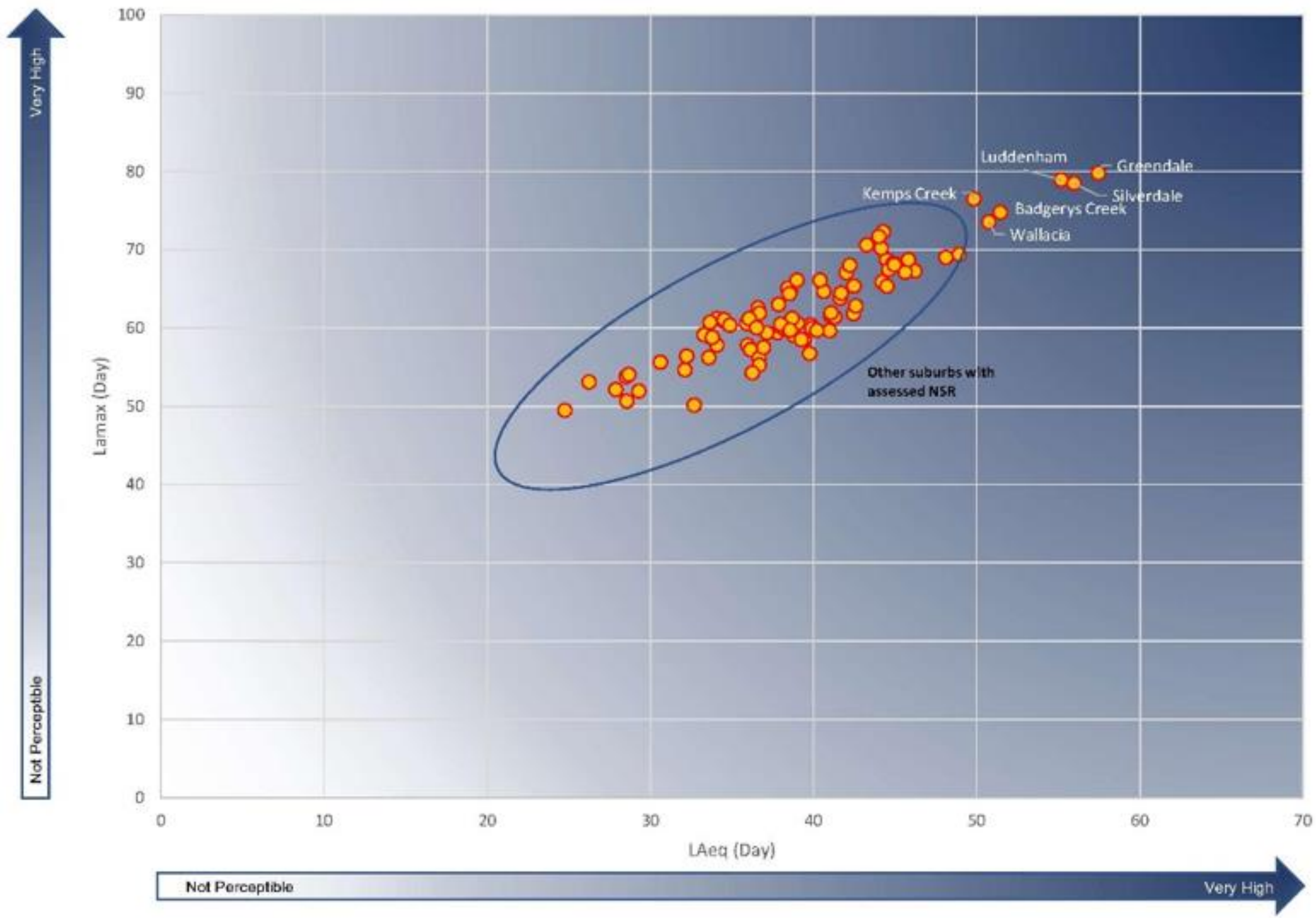


Figure 11.34 Suburbs – maximum sound level vs average sound level – day (5:30 am – 7 pm) – Prefer Runway 23 – 2055

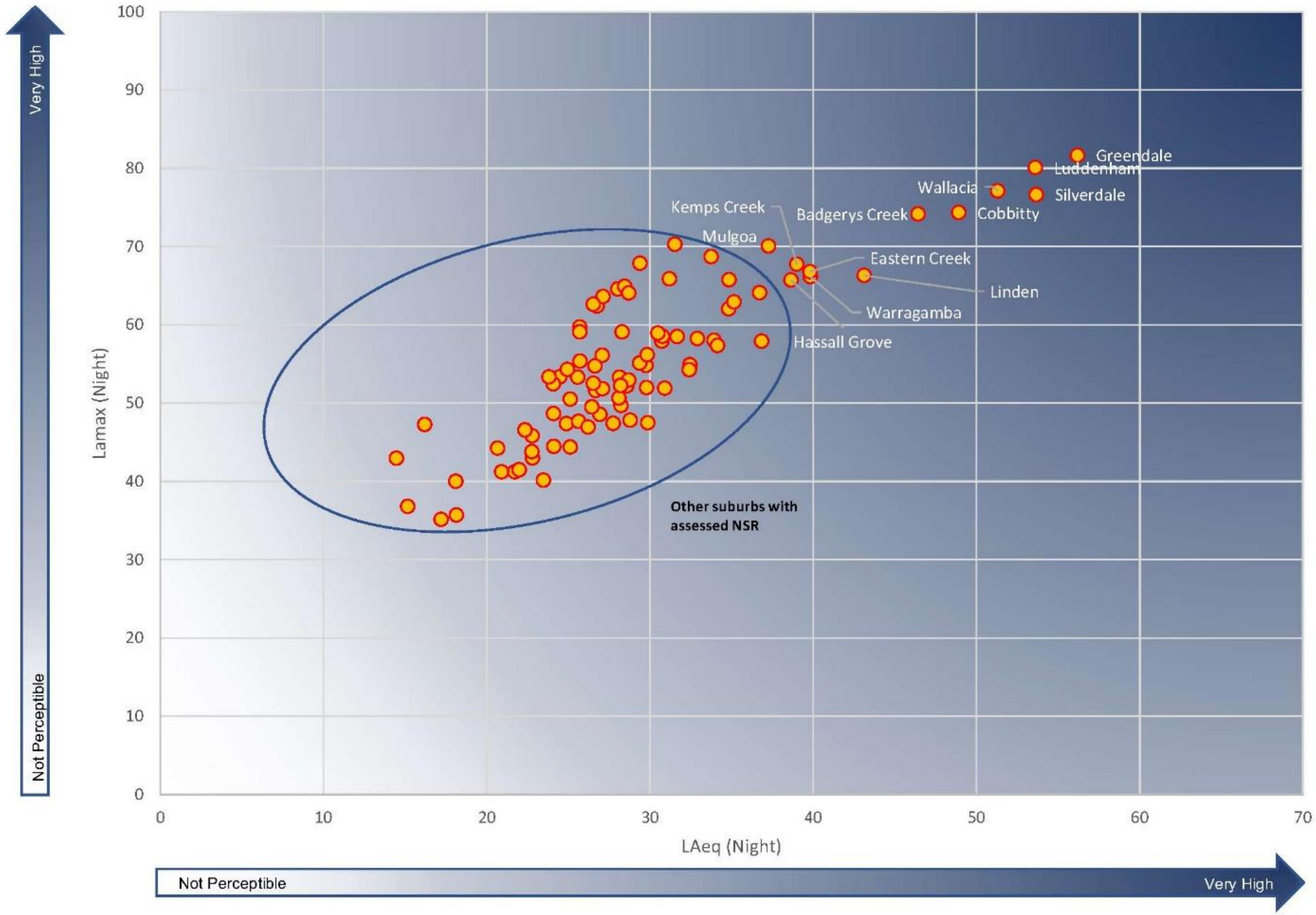


Figure 11.35 Suburbs – maximum sound level vs average sound level – night (11 pm – 5:30 am) – Prefer Runway 23 – 2055

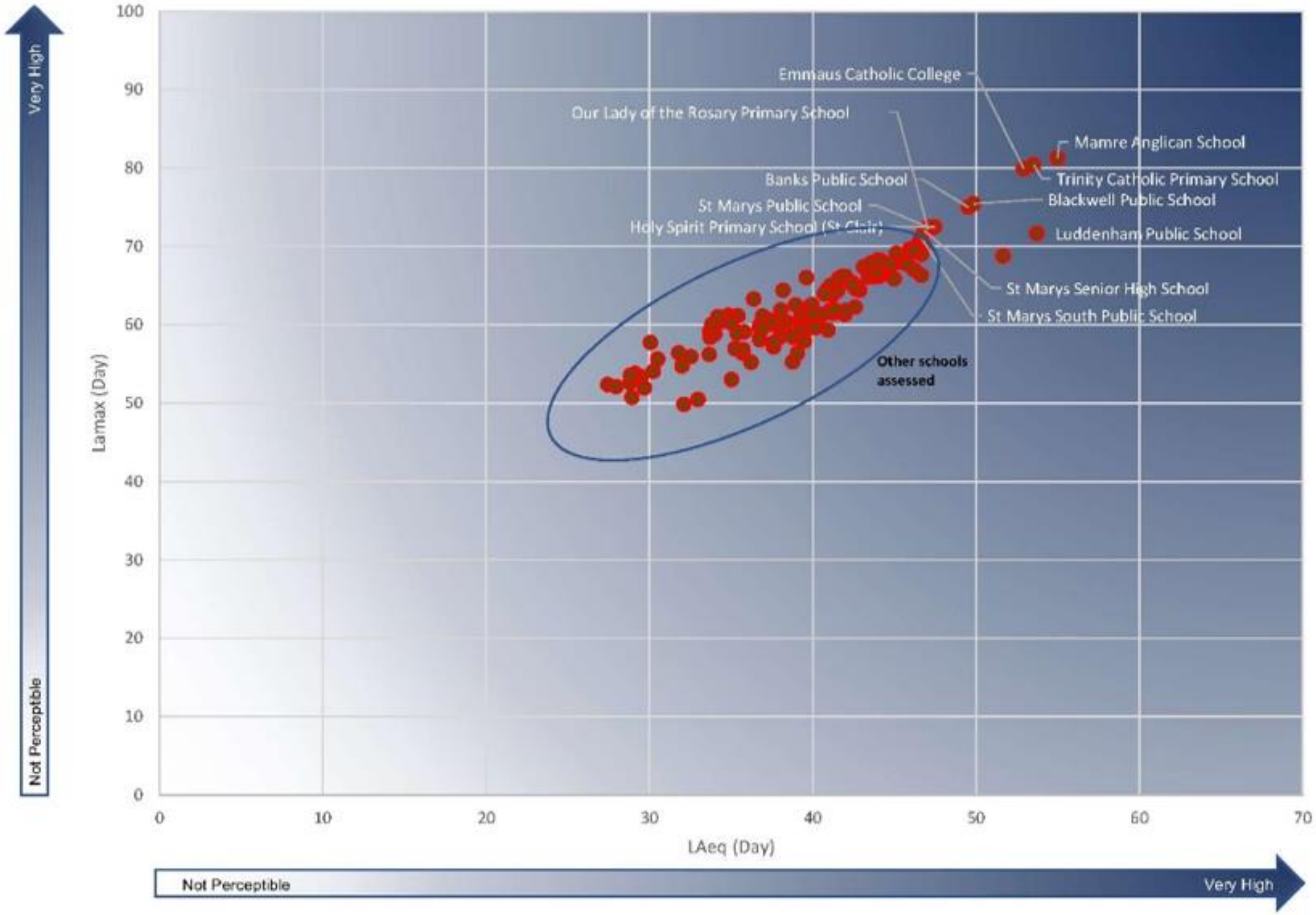


Figure 11.36 Schools – maximum sound level vs average sound level –day (5:30 am – 7 pm) – No preference – 2055

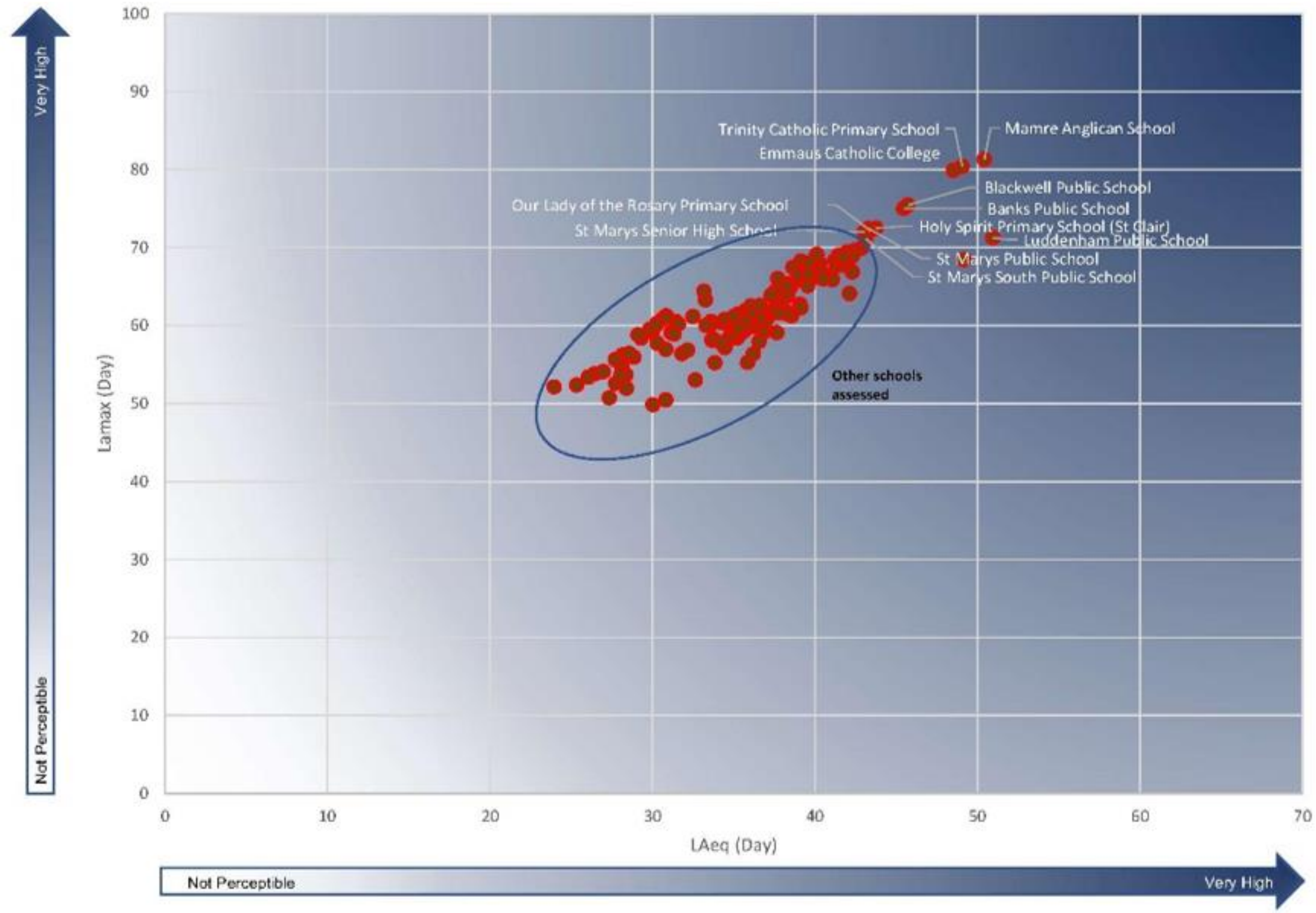


Figure 11.37 Schools – maximum sound level vs average sound level – day –Prefer Runway 23 – 2055

11.7.3.2 Proportion of respite

Figure 11.38 presents an example of a map highlighting the projected proportion of respite at various noise sensitive areas across the Sydney Basin. As supported by Table 11.2 in this context respite is the proportion of days without direct overflights, or flights within a one km width from a flight path corridor, regardless of sound level. This means that some noise sensitive areas may be exposed to a high volume of overflights at low sound levels while others may see no direct overflights but may still be exposed to noticeable sound levels.

Appendix A of Technical paper 1 contains a series of tables presenting the proportion of respite for each noise sensitive area for day, evening and night and the 3 assessment years.

By correlating the proportion of respite with the average daily frequency of aircraft movements, it is possible to identify noise sensitive areas based on the extent of respite that they are likely to experience, by representative year, by time of day and by operating scenario. Figure 11.39 presents a typical scenario, highlighting the noise sensitive areas without respite, and with a high average frequency of movements.

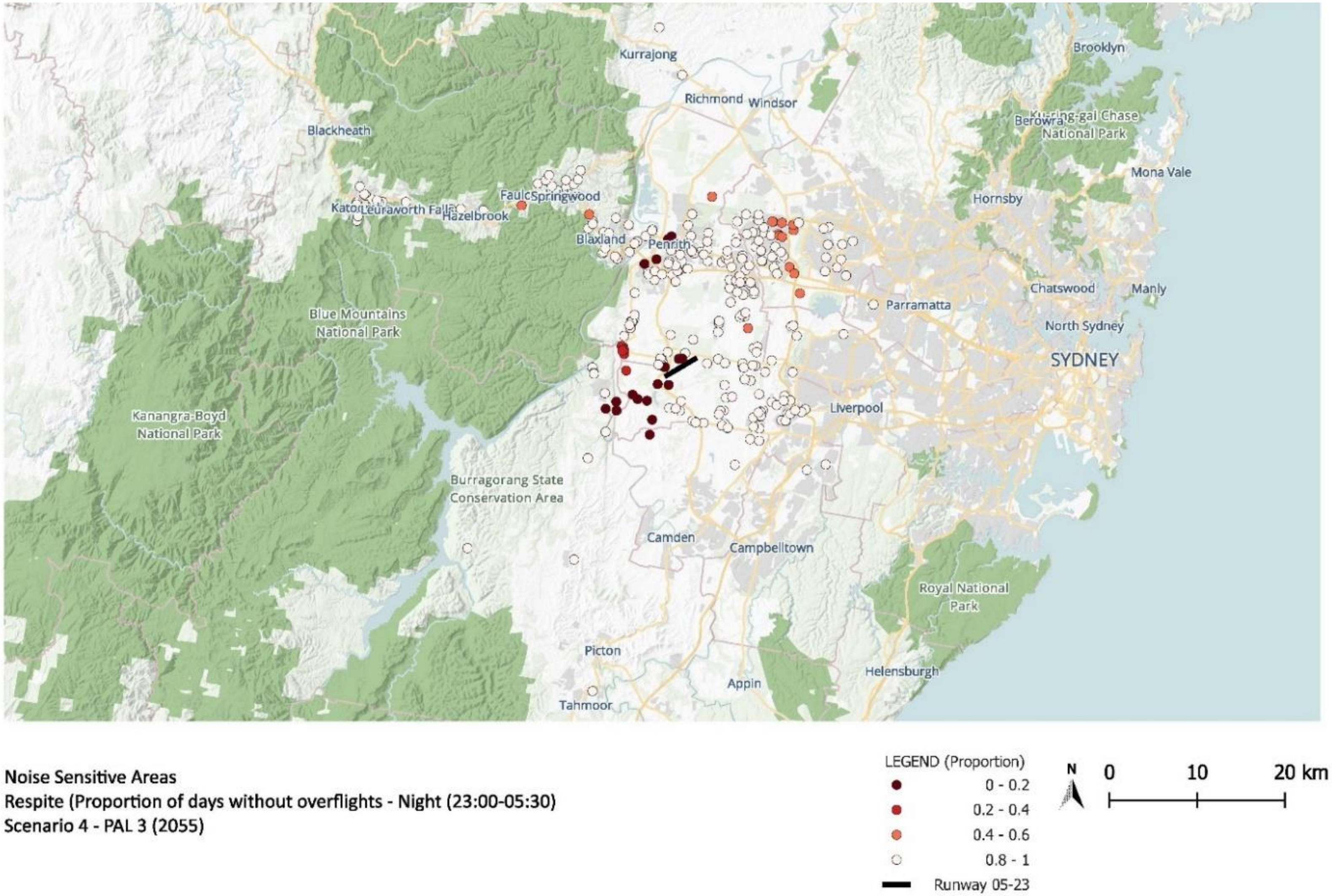


Figure 11.38 Noise sensitive areas – proportion of respite – Night – Prefer Runway 23 (scenario 4) – 2055

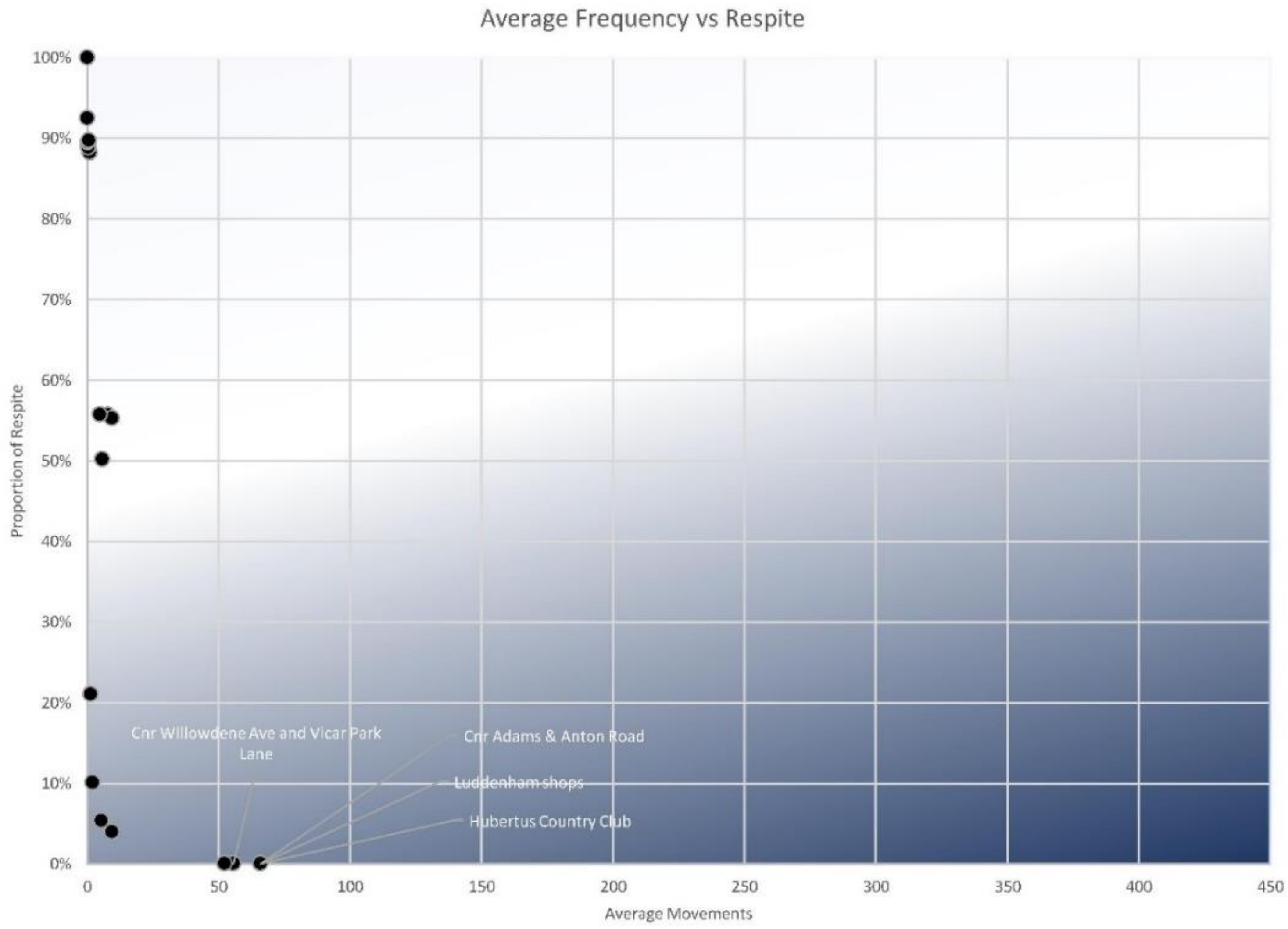


Figure 11.39 Noise sensitive areas – proportion of respite – Night – Prefer Runway 23 – 2055

11.7.3.3 Detailed respite charts

Figure 11.40 and Figure 11.41 present examples of respite charts generated for 15 specific noise sensitive areas, including minimum, average, 90th percentile and maximum movements for day, evening and night, as well as the proportion of days with respite. The sites were selected because they were representative of those most affected under one or more scenarios.

In this example, the percentage of days with respite is shown for locations under the Prefer Runway 23 scenario in 2055 for day, evening and night. Figure 11.40 shows that Blaxland is likely to experience 34 per cent of days with respite during the day, increasing to 100 per cent of days (full respite) during the night (which includes use of RRO in this case) (Figure 11.41).

Scenario 4 - Daytime (5:30 to 18:59)

Location	Minimum Movements	Average Movements	90th Percentile Movements	Maximum Movements	% of Days with Respite
Bents Basin	116	219.8	230.7	244	0%
Kemps Creek (College)	0	45.1	120.6	225	34%
Hassall Grove (School)	1	163.1	206.6	210	0%
Kingswood (School)	46	125.3	136.0	140	0%
St. Marys	0	27.6	73.5	137	34%
Mulgoa Park	0	21.3	56.0	110	34%
Linden	0	73.6	94.0	94	0%
Blaxland	0	17.6	47.4	88	34%
Kemps Creek (School)	0	31.7	41.0	41	0%
Twin Creeks	0	0.0	0.0	0	100%
Luddenham (Shops)	193	418.8	443.1	450	0%
Penrith (High School)	0	17.6	47.4	88	34%
Wallacia (School)	0	6.2	9.0	9	1%
Natai, Brownlow Hill	0	2.6	4.0	4	9%
Bringelly	0	1.2	2.0	2	29%

Scenario 4 - Evening (19:00 to 22:59)

Location	Minimum Movements	Average Movements	90th Percentile Movements	Maximum Movements	% of Days with Respite
Bents Basin	0	34.2	38.7	63	0%
Kemps Creek (College)	0	2.4	9.0	37	75%
Hassall Grove (School)	0	53.7	61.0	62	1%
Kingswood (School)	0	34.5	43.2	46	12%
St. Marys	0	1.5	5.8	21	75%
Mulgoa Park	0	1.8	7.0	29	78%
Linden	0	12.4	15.0	18	1%
Blaxland	0	0.8	2.4	16	76%
Kemps Creek (School)	0	7.5	11.0	12	13%
Twin Creeks	0	0.1	0.0	13	99%
Luddenham (Shops)	0	89.5	98.0	98	0%
Penrith (High School)	0	0.8	2.4	16	76%
Wallacia (School)	0	0.0	0.0	0	100%
Natai, Brownlow Hill	0	0.0	0.0	10	99%
Bringelly	0	0.0	0.0	0	100%

Figure 11.40 Noise sensitive areas – respite charts – Day and Evening – Prefer Runway 23 – 2055

Scenario 4 - Night (23:00 to 5:29)

Location	Minimum Movements	Average Movements	90th Percentile Movements	Maximum Movements	% of Days with Respite
Bents Basin	22	49.0	54.6	68	0%
Kemps Creek (College)	0	0.0	0.0	0	100%
Hassall Grove (School)	0	9.4	28.5	56	55%
Kingswood (School)	0	0.0	0.0	0	100%
St. Marys	0	0.5	0.8	20	90%
Mulgoa Park	0	0.4	1.0	13	89%
Linden	0	3.5	11.4	20	53%
Blaxland	0	0.0	0.0	0	100%
Kemps Creek (School)	0	0.0	0.0	0	100%
Twin Creeks	0	0.9	1.9	31	88%
Luddenham (Shops)	24	65.9	81.6	105	0%
Penrith (High School)	0	0.0	0.0	0	100%
Wallacia (School)	0	1.4	2.0	2	21%
Natai, Brownlow Hill	0	0.3	0.6	9	90%
Bringelly	0	0.0	0.0	0	100%

Figure 11.41 Noise sensitive areas – respite charts – Night – Prefer Runway 23 – 2055

11.7.4 Land use planning impacts

As outlined in Table 11.2 the most important use of ANEC contours is in land use planning around airports, using the principles set out in the AS 2021:2015 (refer to Section 11.5.4.1).

The key findings are depicted by:

- For 2055 – calculated ANEC contours for each of the 3 operating scenarios – shown on Figure 11.42 to Figure 11.44.
- For 2055, 2040 and 2033 – combined ANEC contours for the 3 operating scenarios – shown on Figure 11.45, Figure 11.46 and Figure 11.47 respectively.

Individual figures for ANEC contours for 2055 operating scenarios represent the differences in aircraft noise impacts between these scenarios at these thresholds as the single runway approaches capacity.

As the combined ANEC contours compile noise exposure levels for the 3 operating scenarios, they are a conservative or 'worst-case' representation of noise exposure levels.

Geographical extent

While the No preference (scenario 1) contours are balanced at both ends of the runway, the shape of Prefer Runway 05 (scenario 3) and Prefer Runway 23 (scenario 4) contours reflect operations to be more biased either in the Runway 05 direction or in the Runway 23 direction respectively.

In the early years of operation (2033) (refer to Figure 11.47), the ANEC extends along the standard instrument arrival and departure routes, up to approximately 7 km north-east towards Eastern Creek and 9 km south-west towards Lake Burragorang from the runway ends and a maximum of approximately 2 km wide. In the interim year of operation (2040) (refer to Figure 11.46), the ANEC extends in a similar pattern, but the contours cover a larger area. By the time single runway operations approach capacity (2055) (refer to Figure 11.45), the ANEC covers the largest area of the 3 assessment years, up to approximately 10 km north-east and around 15 km south-west from the runway ends and a maximum of approximately 5 km wide.

2055 scenarios (other than composite)

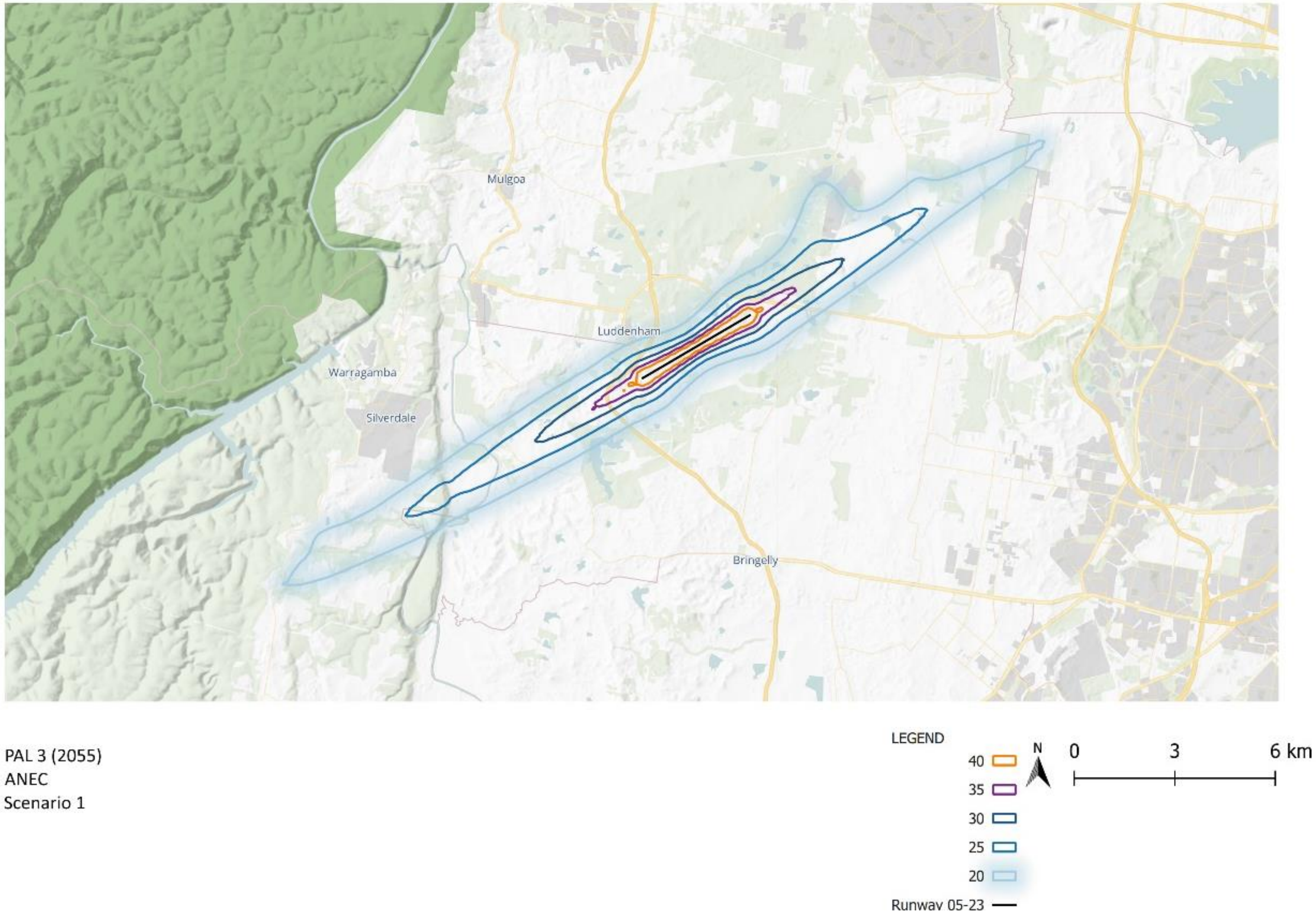


Figure 11.42 ANEC Contours – 2055 – No preference

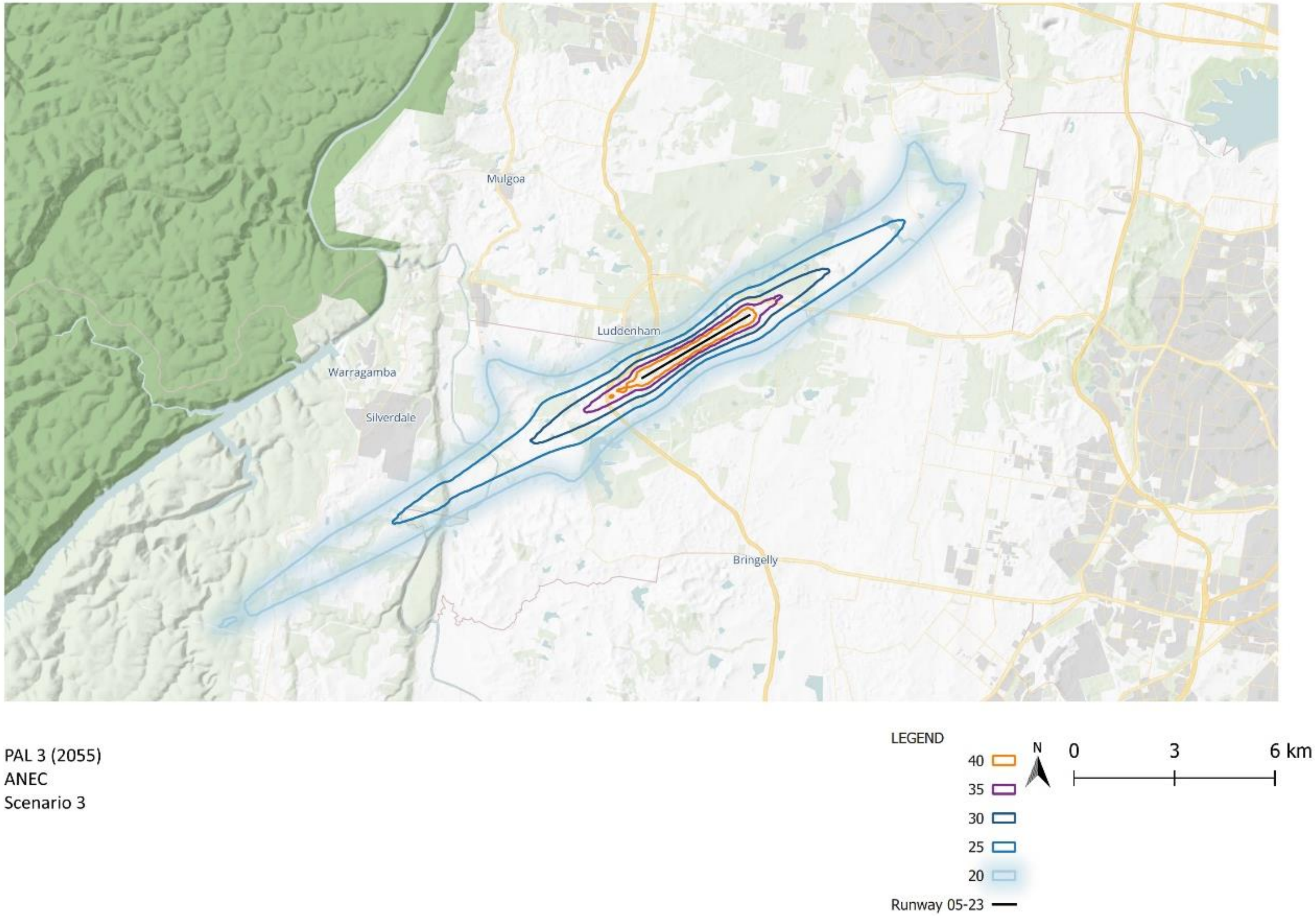


Figure 11.43 ANEC Contours – 2055 – Prefer Runway 05

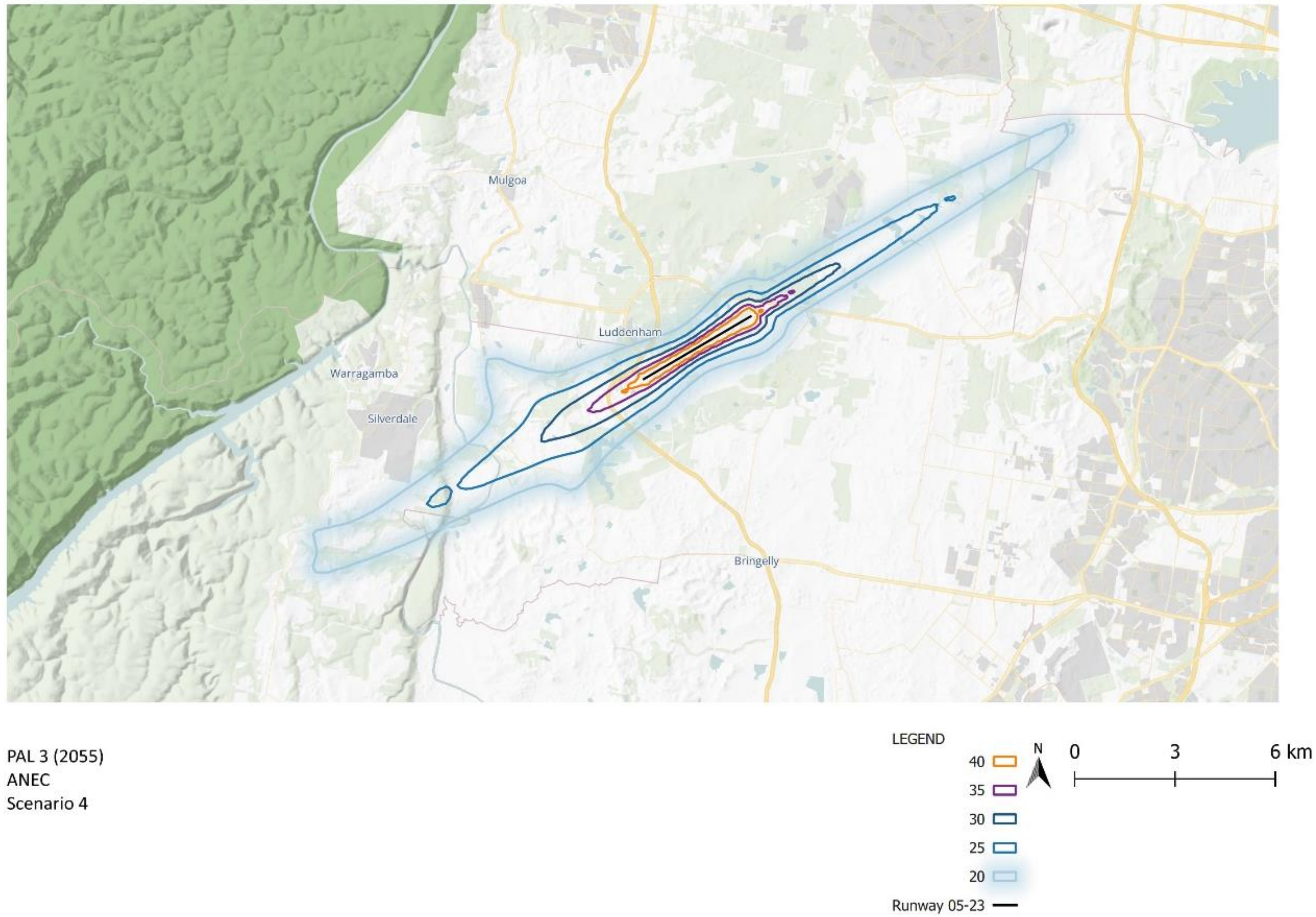


Figure 11.44 ANEC Contours – 2055 – Prefer Runway 23

Composite scenarios

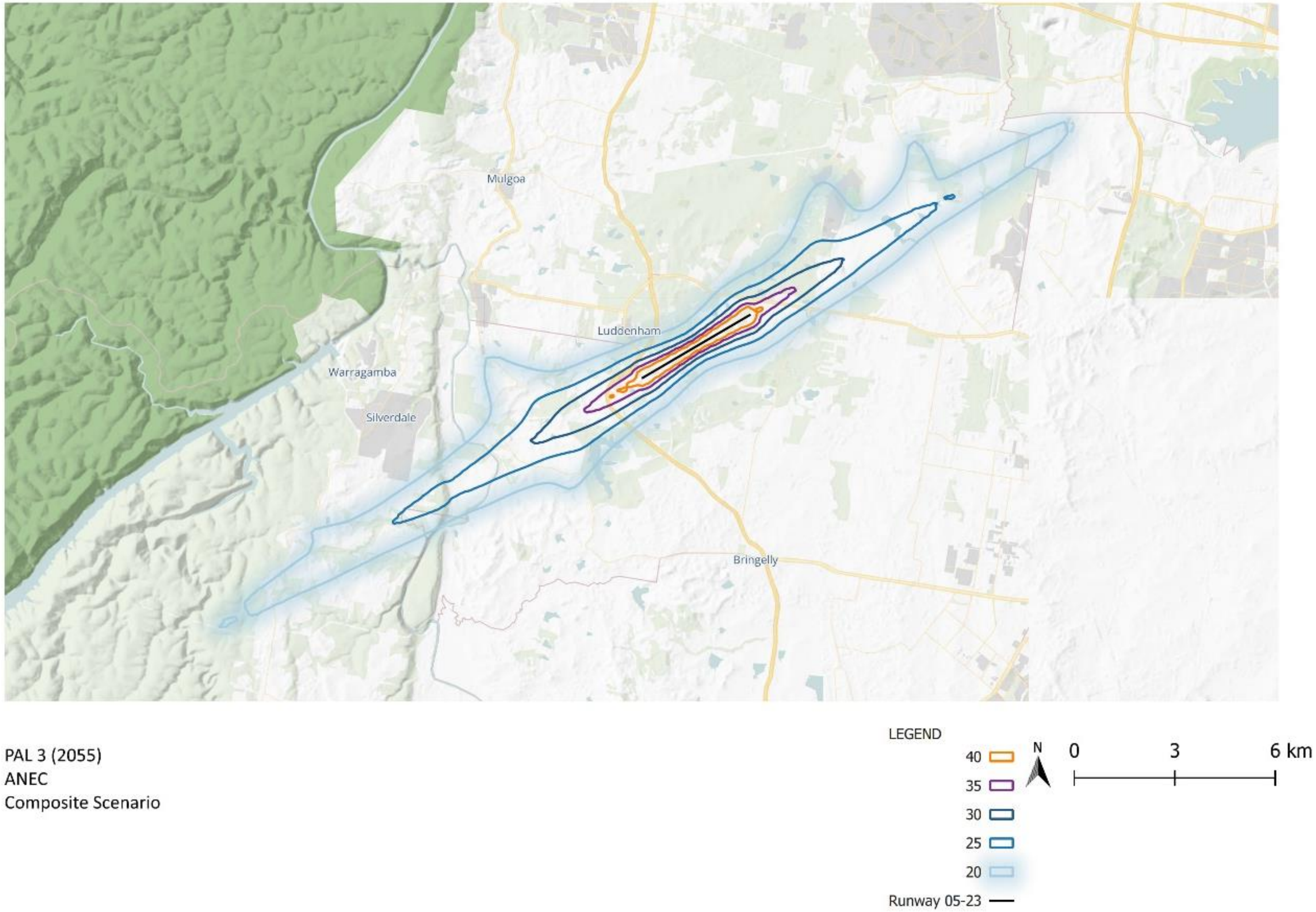


Figure 11.45 ANEC Contours – 2055 – Composite scenario

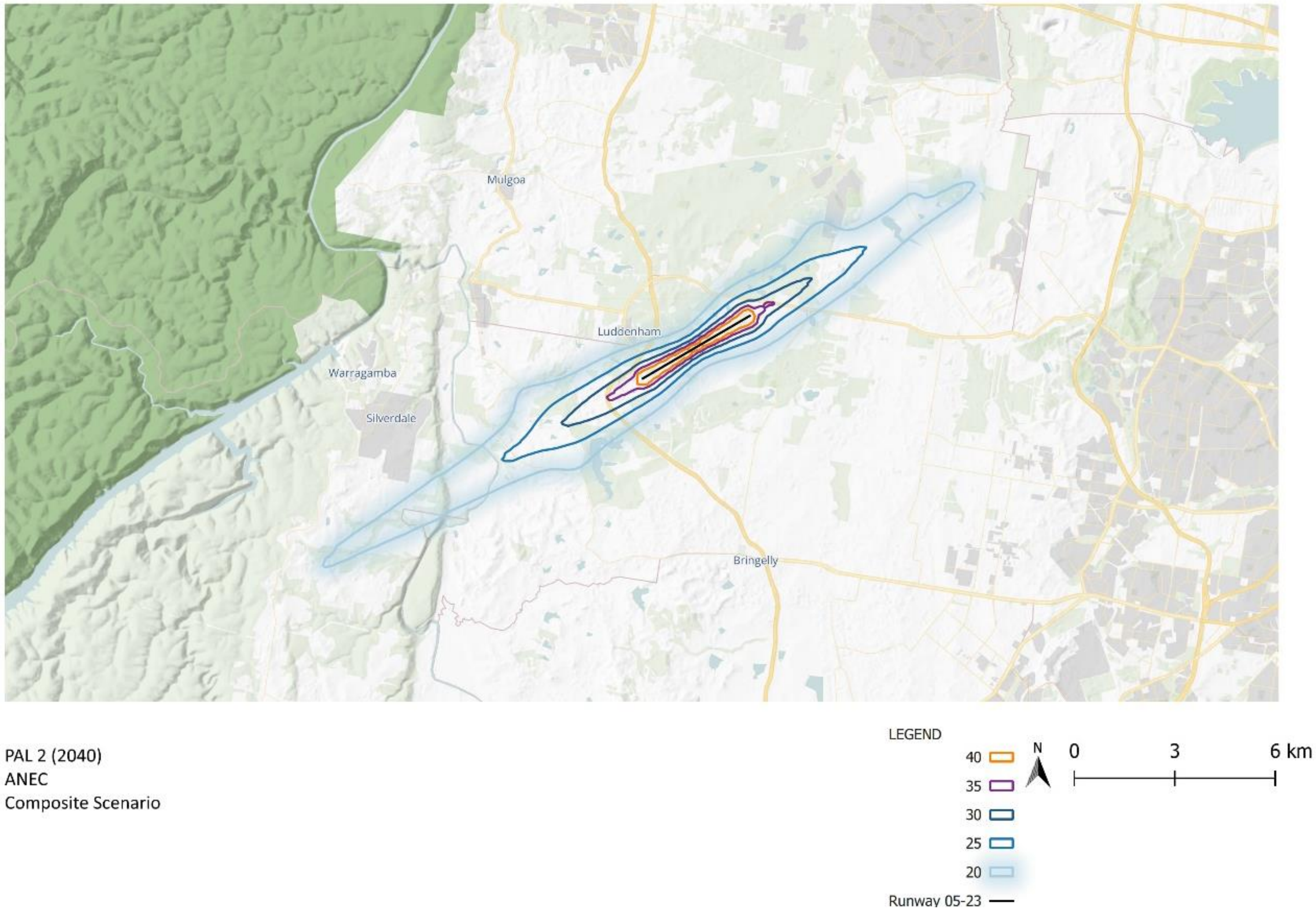


Figure 11.46 ANEC Contours – 2040 – composite scenario

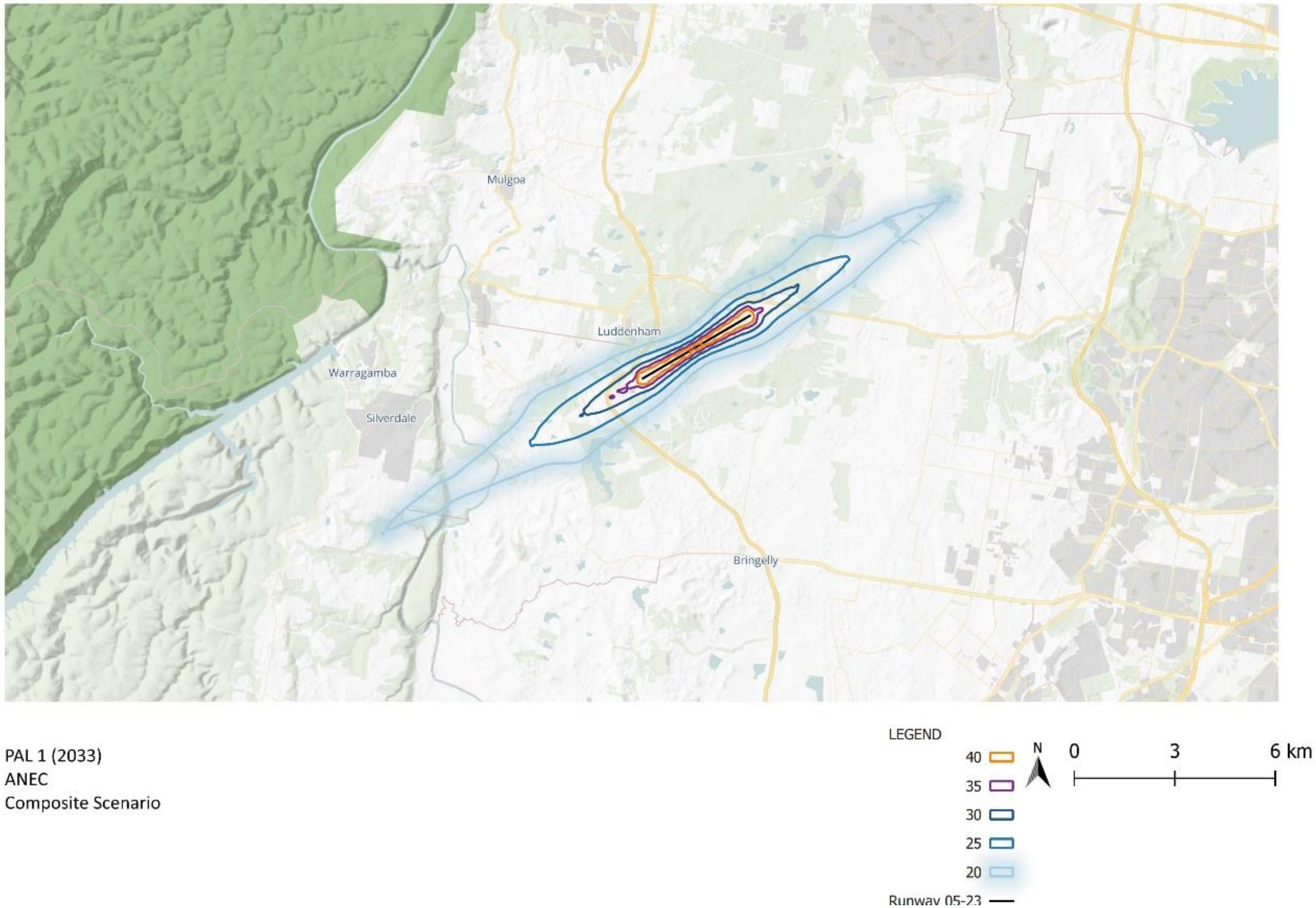


Figure 11.47 ANEC Contours – 2033 – composite scenario

Population and dwelling counts

The estimated population and dwellings count within these contours across the 3 assessment years is shown in Table 11.9.

Table 11.9 Estimated population and dwellings count within ANEC contours

Year	ANEC contours	No Preference		Prefer Runway 05 (with RRO)		Prefer Runway 23 (with RRO)	
		Population	Dwellings	Population	Dwellings	Population	Dwellings
2033	20	270	79	210	65	240	74
	25	57	17	55	16	72	22
	30	13	3	16	4	19	5
	35	4	1	4	1	4	1
	40	2	0	2	0	2	0
2040	20	440	130	330	100	350	110
	25	80	20	80	20	90	30
	30	23	6	23	7	31	9
	35*	4	1	5	1	5	1
	40*	2	0	2	1	2	0
2055	20	990	285	660	205	600	188
	25	170	50	170	50	170	50
	30	42	12	45	13	52	15
	35	9	3	12	4	13	4
	40*	3	1	3	1	2	1

* Estimate based on interpolation of census data. More granular review of specific properties required to identify specific dwellings impacted.

The results show that less than 1,000 people may be living within the 20 ANEC contours by 2055, up from approximately 250 people in 2033, regardless of the operational scenario.

While there are very few residents within the 25 ANEC contours, mostly in Greendale, the 20 ANEC contours could progressively over time include the community of Twin Creeks and rural portions of the suburb of Kemps Creek.

11.7.5 Flight path movement and respite charts

The full set of flight path movement charts and respite charts generated by the assessment is found in Appendix B of Technical paper 1. An example of a flight path movement chart is provided in Figure 11.48, showing the number of aircraft movements on each Runway 05 Day departure flight path.

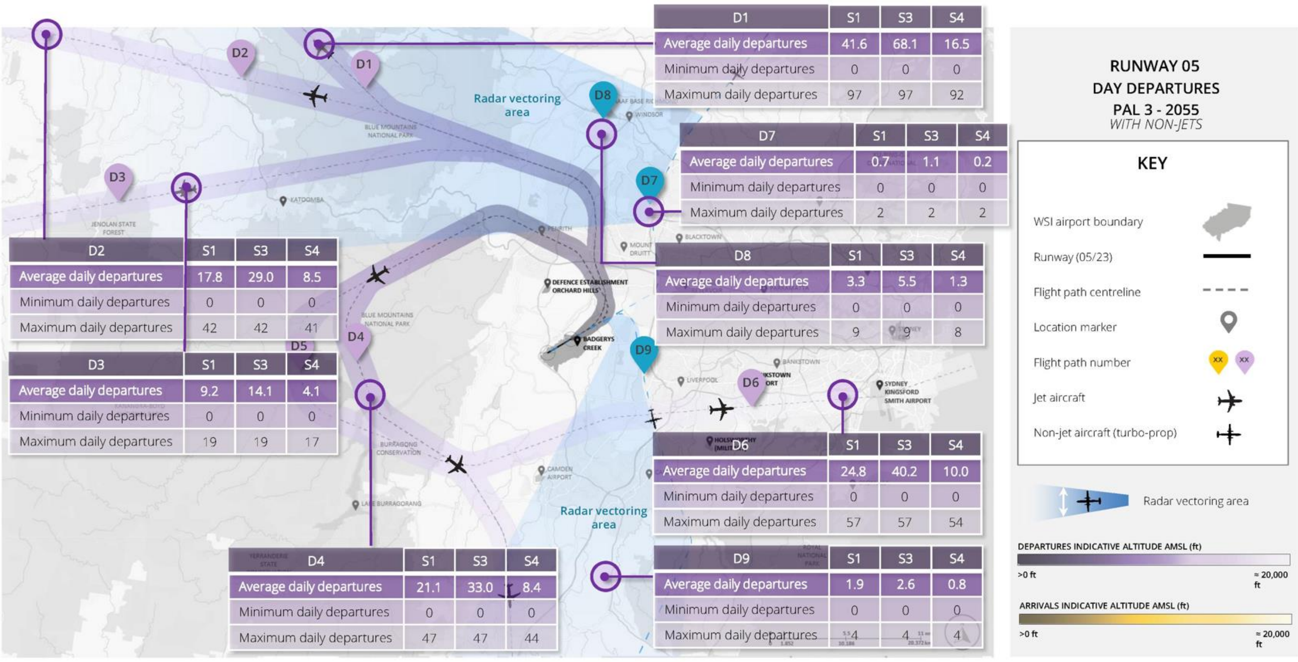


Figure 11.48 Example flight path movement chart for Runway 05 Day departures

Separate respite charts were generated for day, night and RRO flight paths. Respite ranges from 0 per cent (no respite – at least one daily movement every day of the year) to 100 per cent (full respite – no projected movements on all days of the year). An example respite chart is provided as Figure 11.49.

The respite charts focus on the individual flight paths (where the term 'respite' is described as the absence of operations to or from a particular runway end). Section 11.7.3.2 presents an example of the assessment of respite at a range of noise sensitive areas based on whether these areas are directly overflow or within one km of a flight path corridor and Section 11.7.3.3 presents an example of detailed respite charts for specific noise sensitive areas. This provides greater focus for assessment of respite in specific rural, rural residential, and urban communities.

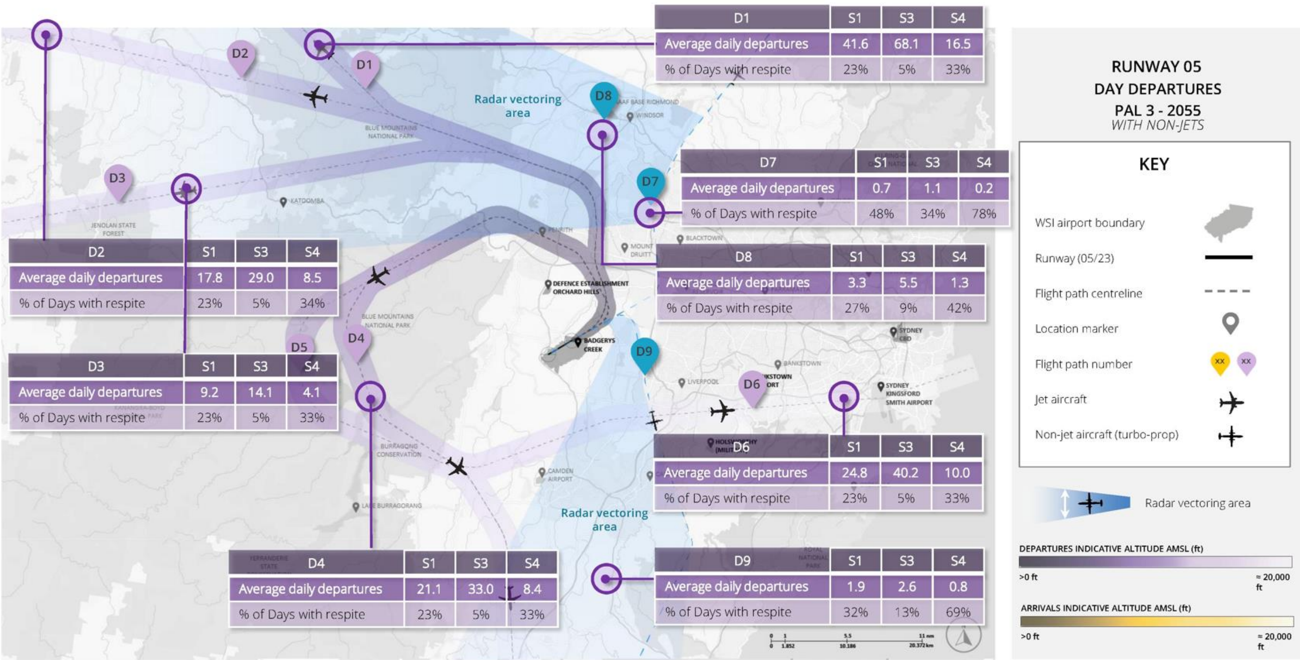


Figure 11.49 Example respite chart for Runway 05 Day departures

11.7.6 Single event or maximum noise levels

Assessment years are not relevant to single event noise contours, as they indicate the maximum (L_{Amax}) noise levels resulting from a single operation of a specific aircraft type on all applicable arrival or departure flight paths. As the aircraft types used in the modelling for the assessment years are generally the same, the single event contours would typically remain unchanged. The full set of figures for single event contours by representative aircraft type (as defined by Table 11.6) are found in Appendix C of Technical paper 1.

11.7.6.1 Loudest and most common aircraft existing

Examples of single event noise contours (L_{Amax} contours) are shown in Figure 11.50 to Figure 11.55. The highest predicted noise levels are typically associated with widebody aircraft such as the Boeing 777-300ER, Boeing 747-8 and Airbus A330 aircraft. However, the more common and likely noise levels are represented by Airbus A320neo and Boeing 737max aircraft.

11.7.6.2 Cumulative maximum noise level – all aircraft types

Figure 11.56 shows the cumulative maximum sound levels for all modelled aircraft types, over 24-hours for 2055, noting there is little difference in single event noise contours for assessment years (refer front of this section).

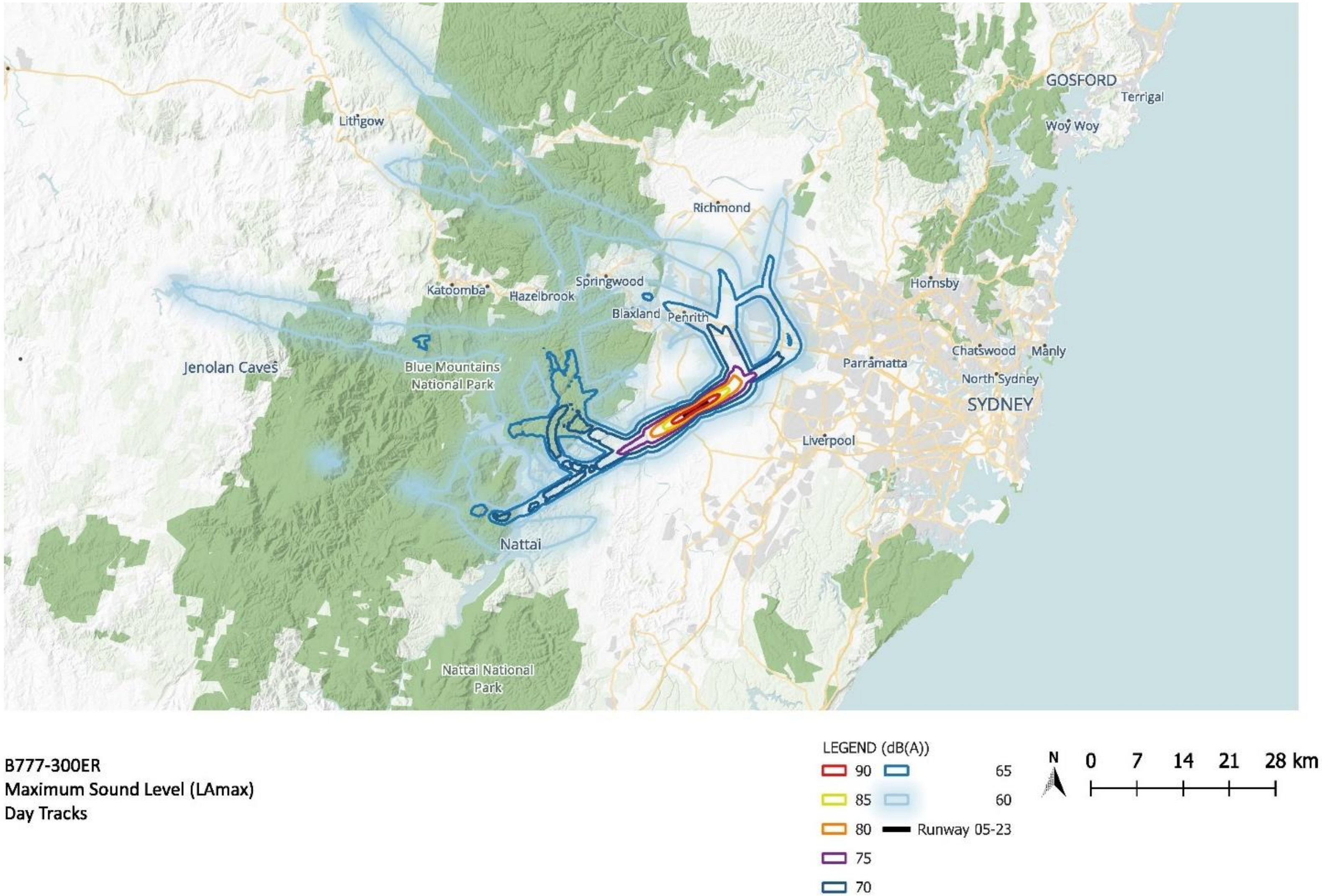


Figure 11.50 L_{Amax} (maximum noise level) – B777-300ER – day

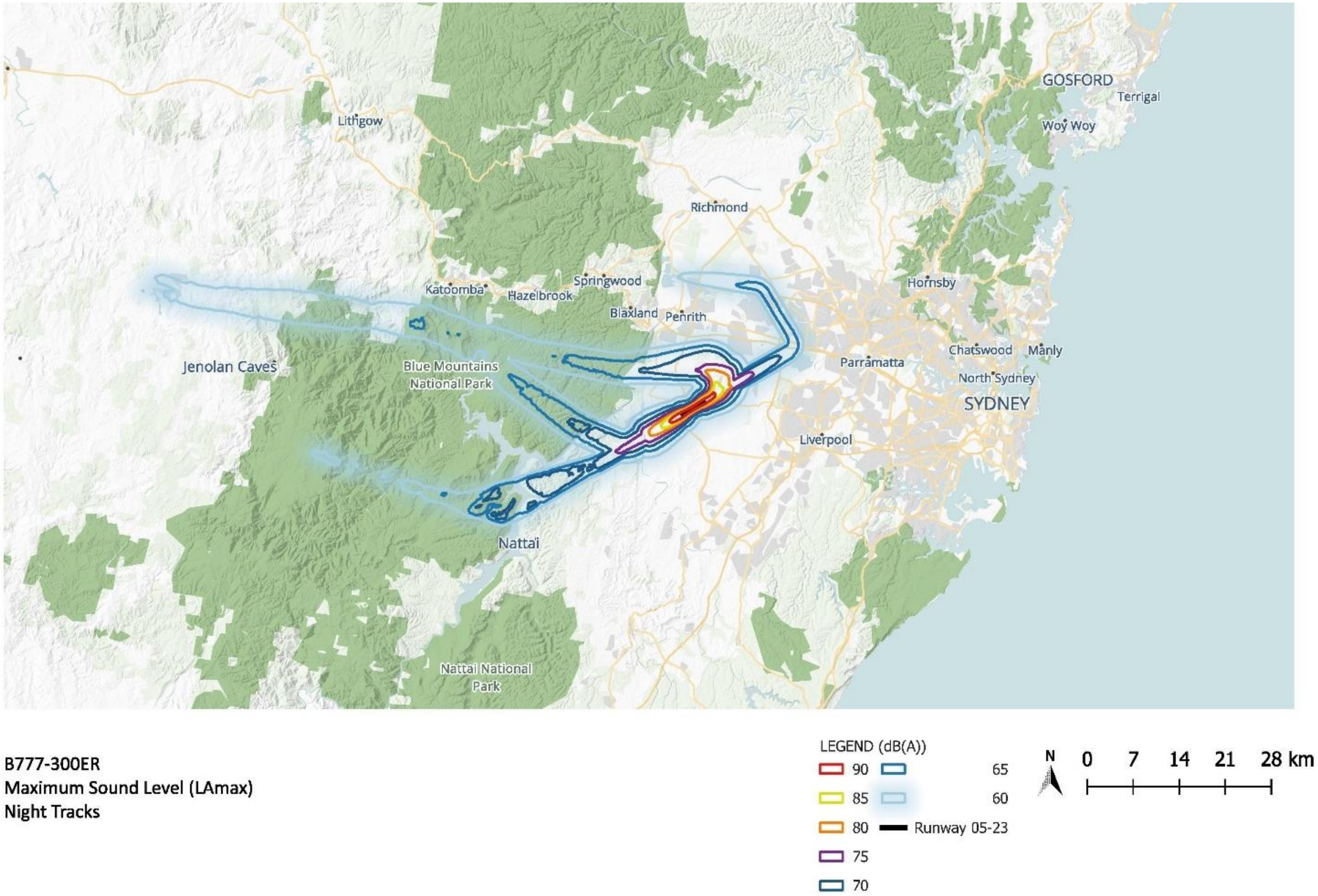


Figure 11.51 L_{Amax} (maximum noise level) – B777-300ER – night

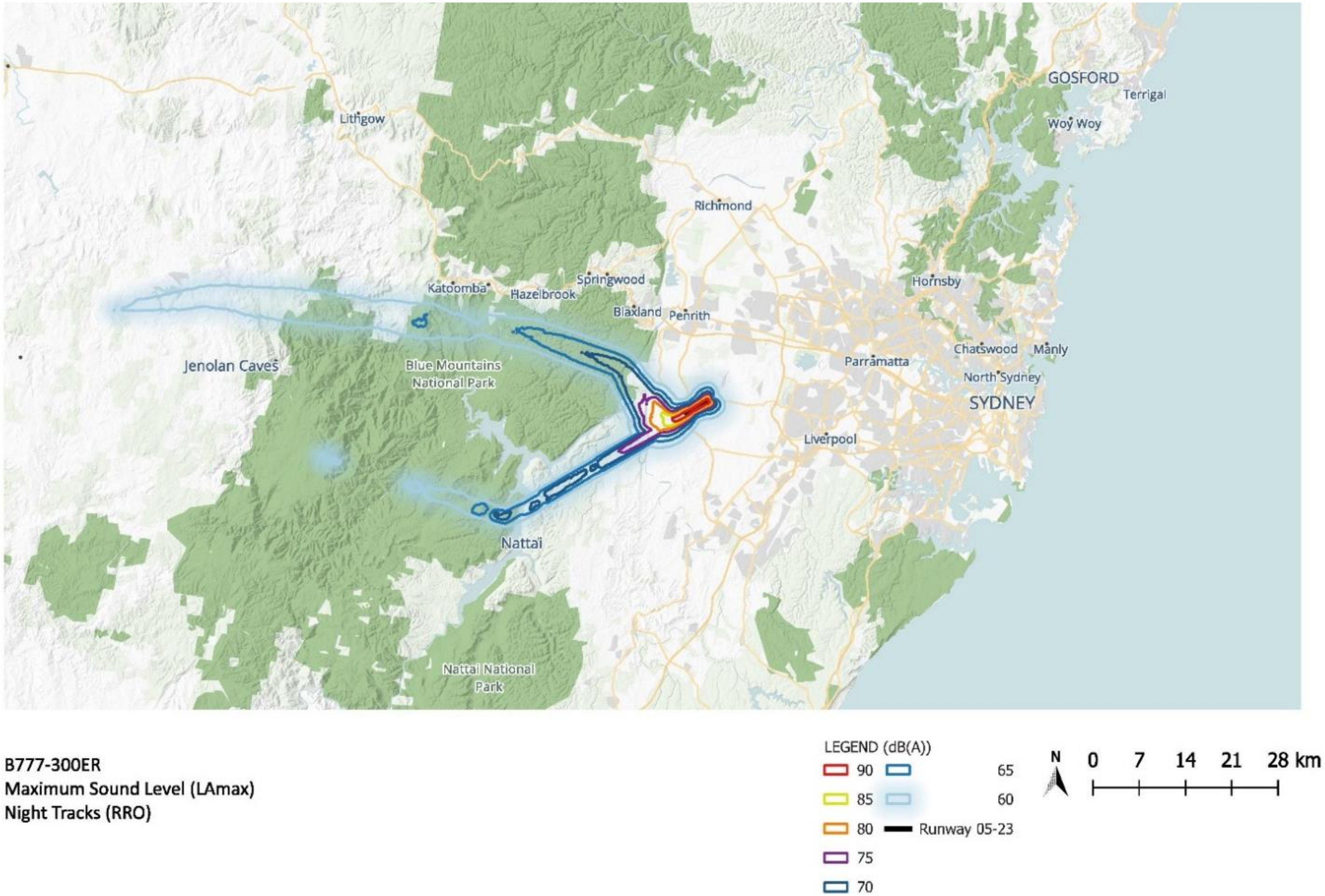


Figure 11.52 L_{Amax} (maximum noise level) – B777-300ER – night (RRO)

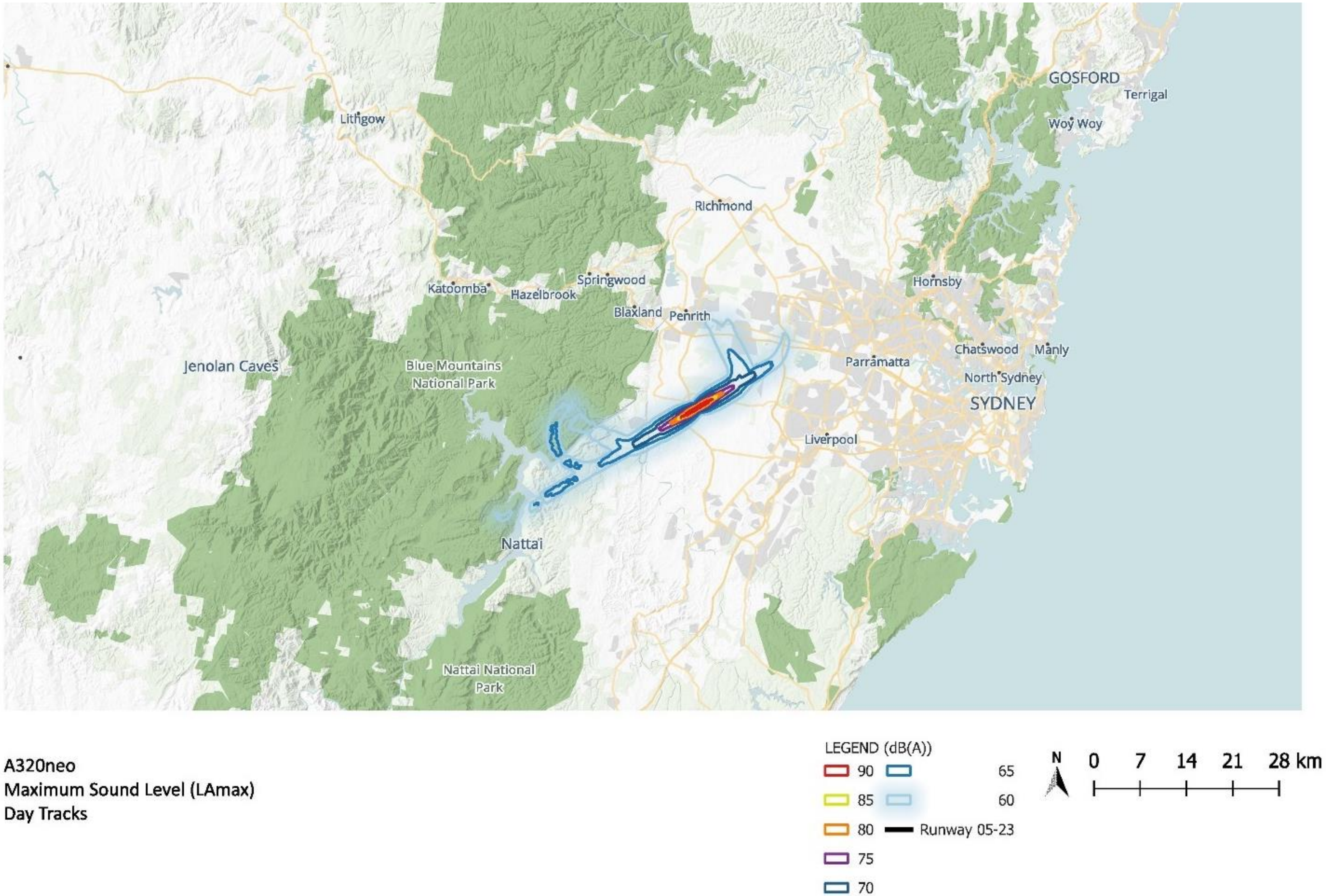


Figure 11.53 L_{Amax} (maximum noise level) – A320neo – day

Figure 11.54 L_{Amax} (maximum noise level) – A320neo – night

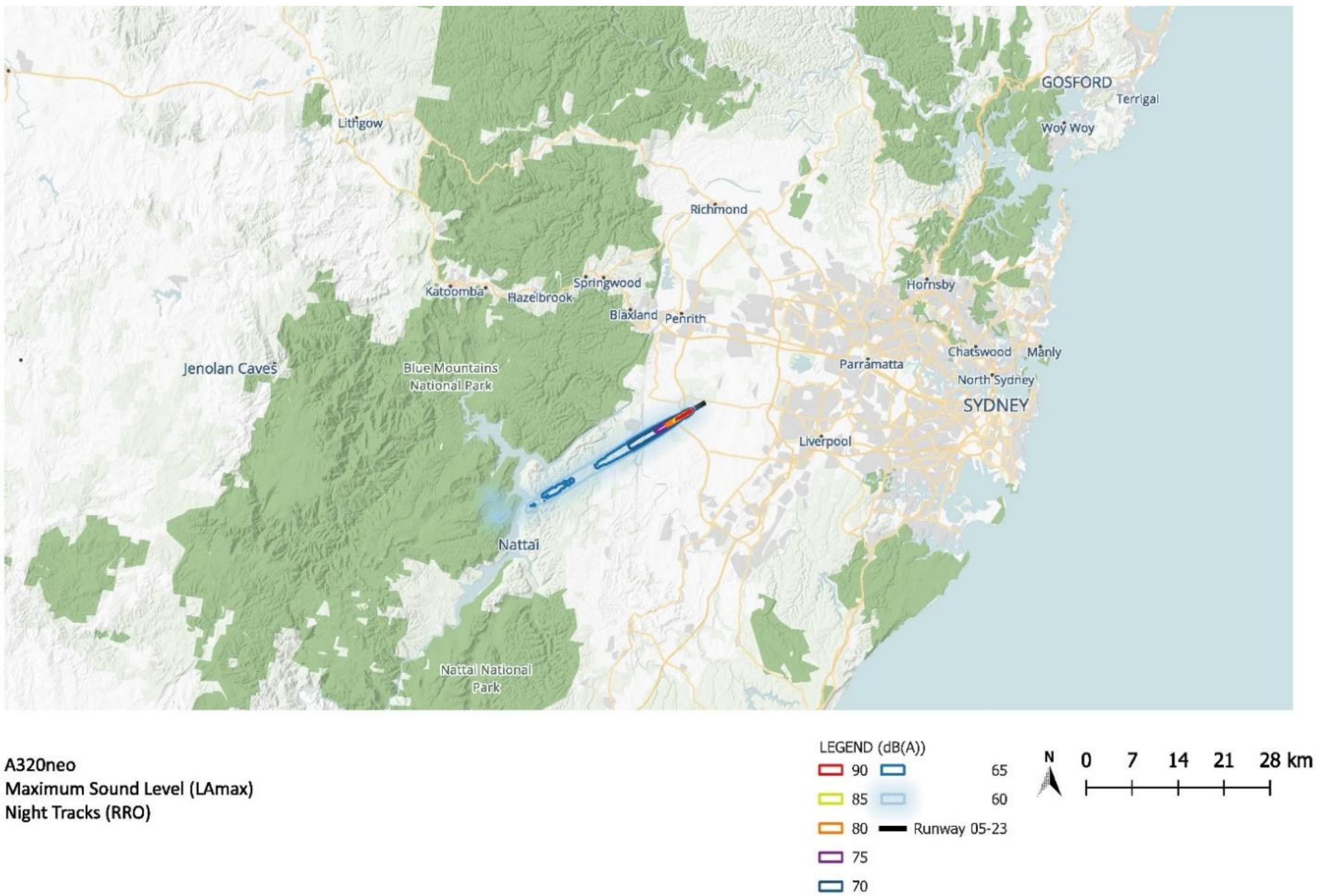


Figure 11.55 L_{Amax} (maximum noise level) – A320neo – night (RRO)

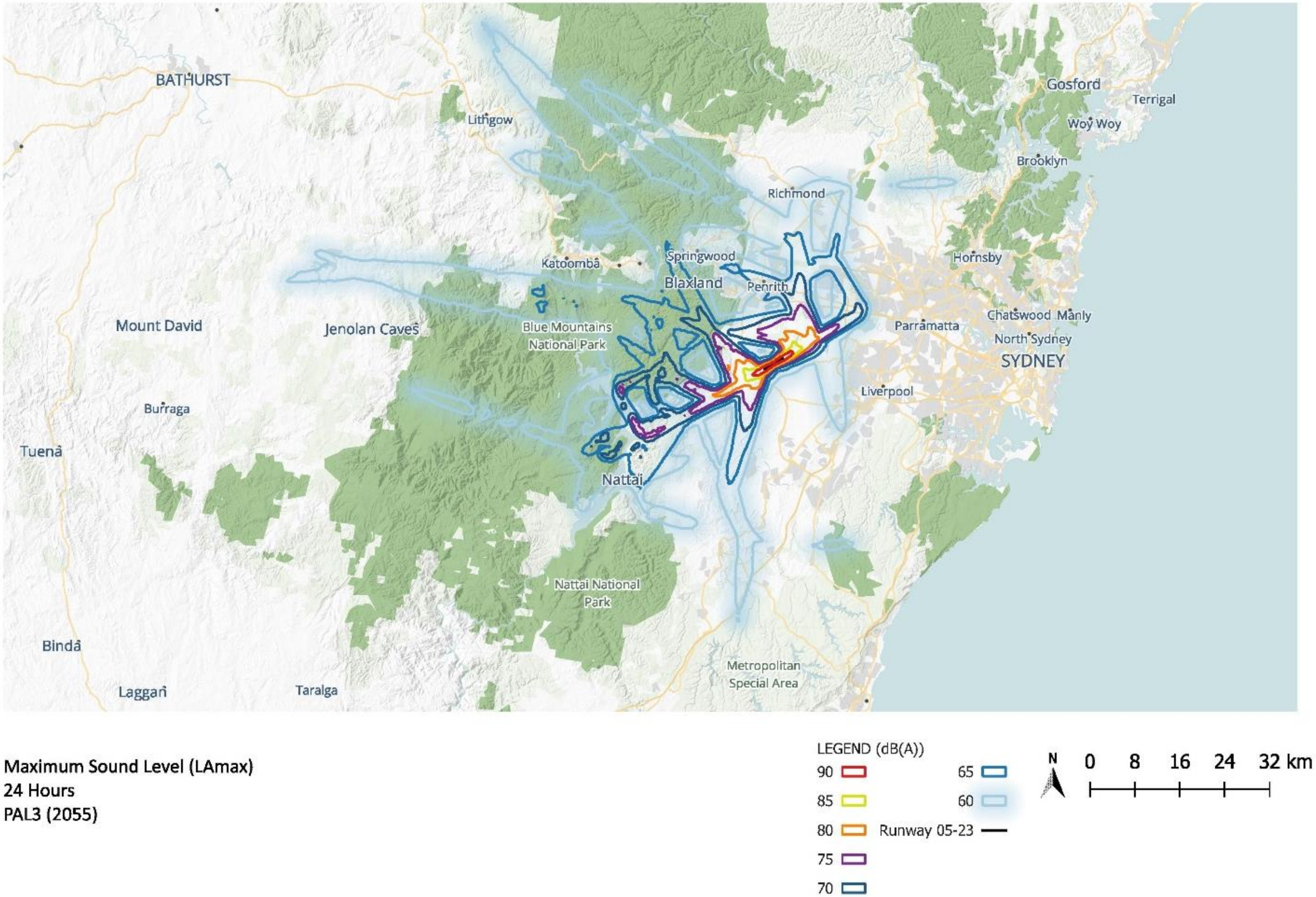


Figure 11.56 L_{Amax} (maximum noise level) – 24-hours – all aircraft types– 2055

11.7.6.3 Single event noise contours population and dwelling counts

This assessment provides an order of magnitude of the population likely to be exposed to at least one event above a 60 dB(A) noise threshold in 5 dB(A) increments. This assessment highlights that the number of people exposed to at least one noise event above 60 dB(A) will remain steady across the scenarios, based on the existing census data (for example, around 360,000 people within 60 dB(A) L_{Amax} contour in 2033 and around 375,000 people within 60 dB(A) L_{Amax} contour in 2055. In practice, the outcome will depend on the evolution of the aircraft fleet and on their operation on all flight paths to and from WSI.

Table 11.10 Population and dwellings counts – projected maximum sound level

Specifications		Population			Dwellings		
Metric	Contour	2033	2040	2055	2033	2040	2055
L_{Amax}	60	360,000	355,000	375,000	126,000	125,000	132,000
	65	152,000	150,000	164,000	56,500	55,900	61,300
	70	32,300	32,300	33,300	11,700	11,700	12,000
	75	9,700	9,500	9,900	3,200	3,100	3,300
	80	1,500	1,200	1,500	400	320	420
	85	180	100	220	50	30	58
	90	34	35	36	10	10	11

11.7.7 Noise induced vibration

At high noise levels, the low frequency components of aircraft noise can result in vibration of loose elements in buildings, notably 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 dB(A). The effect is more common on take-offs than for landings because the noise spectrum for a take-off close to the airport has stronger low frequency components. Figure 11.57 below depicts the 90 dB(A) L_{Amax} footprint for WSI confirming that it is largely contained within the Airport Site.

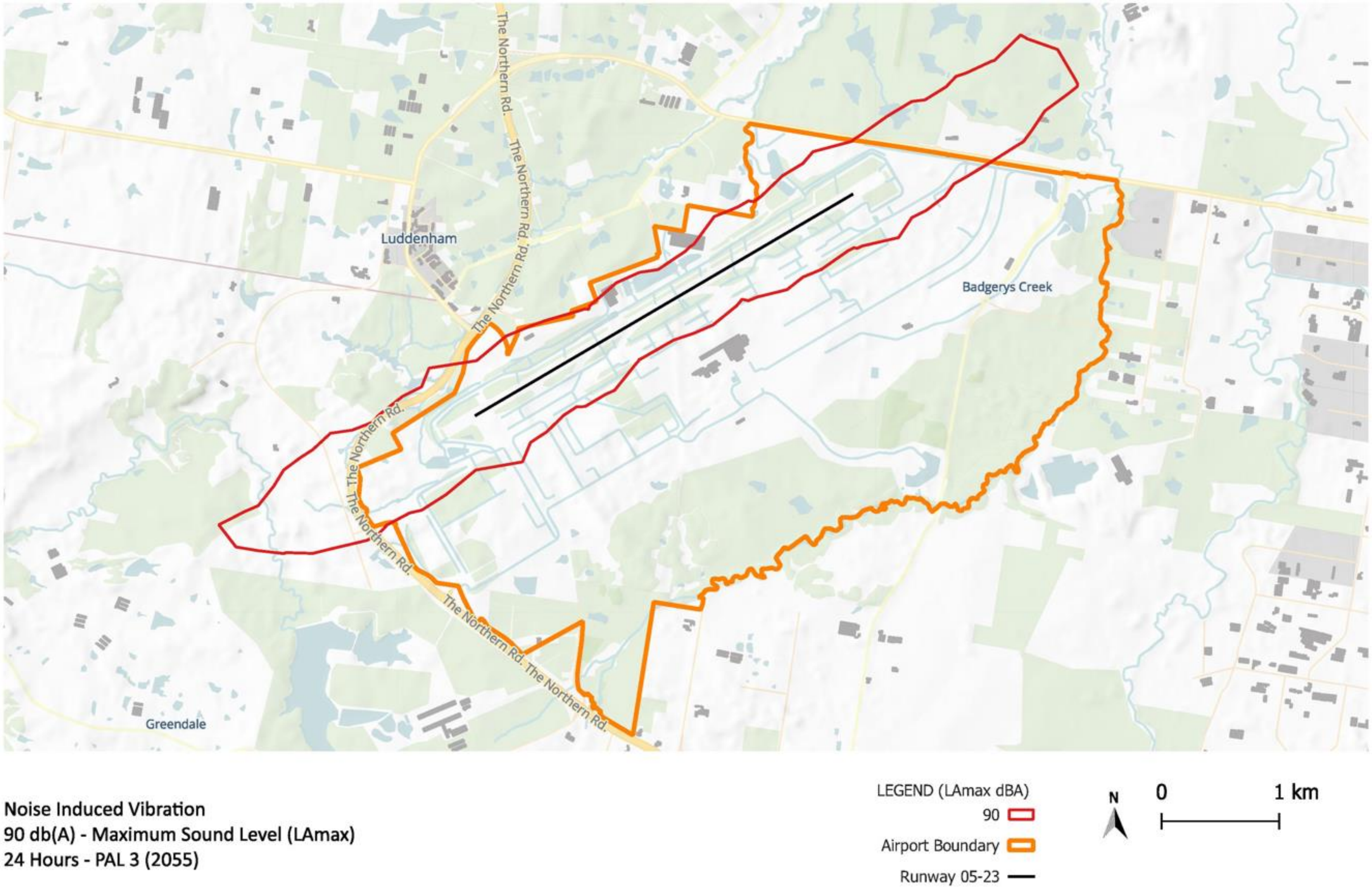


Figure 11.57 Noise induced vibration

11.8 Mitigation and management

Aircraft noise is an inevitable and unavoidable consequence of an operating airport. The collective responsibilities for the management of aircraft noise are described in Section 11.3.2.

As described in Section 11.3.1 there are 4 fundamental options for mitigation of aircraft noise, noting the safe and efficient operation of the airport may limit their availability:

- reduce noise emissions from the aircraft at source
- develop land-use planning or other controls to ensure future noise-sensitive uses are not located in noise affected areas
- plan flight paths, air traffic control and noise abatement procedures and airport operating strategies to achieve lower impacts over noise sensitive areas
- place operational restrictions on aircraft types and time of operation.

As discussed in Section 11.3.1.1, the magnitude of future reductions in aircraft noise emission levels is primarily determined by aircraft designers and manufacturers and future international regulatory initiatives. It is very likely that noise emission from future aircraft will be lower than from current aircraft but due to the absence of specific information this report has adopted a conservative approach by modelling future aircraft types based on existing noise emission levels.

On the second point, the NSW Government and local governments have been actively planning for an airport at Badgerys Creek since the 1980's and have undertaken steps aimed at limiting future noise exposure of the residential population. These have included:

- zoning land near the airport as appropriate for less sensitive uses
- ensuring that local government has planning procedures in place to limit sensitive uses in areas potentially affected by aircraft overflight noise.

This has limited the potential noise impact from an urban greenfield airport to a level that is lower than would otherwise be expected for a development of this type and scale. Planning protections would continue to be part of the operational framework as discussed in Section 11.8.1.1.

The third point is the focus of this EIS, and the basis of mitigation measures recommended in Section 11.8.2.

On the fourth point, WSI will operate over 24-hours, 7 days a week. Restrictions on its operation may affect the efficiency and economic viability of the airport. Restrictions on aircraft types may also be impractical given the proposed level of freight activity.

11.8.1 Operational framework

The WSI operational framework would consist of a range of mechanisms to manage aircraft noise, including planning, policy and consultative measures.

11.8.1.1 Planning protections

A number of planning protections are already in place around the Airport Site following the previous EISs (one in 1985, the next between 1997 and 1999 and most recently in 2016). The indicative ANEC for WSI provided in the Airport Plan and SEPP (Precincts – Western Parkland City) 2021 (NSW) was generated based on the runway direction, dual runway operations and indicative flight paths as presented in the 2016 EIS. An updated ANEC is presented in this chapter for single runway operations. Until the ANEF contour is approved for WSI, the ANEC contour presented as the Noise Exposure Contour Map in the Western Parkland City SEPP, representing the long-term, dual-runway for WSI will continue to inform land use planning.

The Australian Government would continue to work closely with the NSW Government and local governments to implement any long-term planning protections that have been put in place around the proposed airport to minimise incompatible development.

As described in Chapter 5 (Statutory context), the Airport Plan will eventually be replaced by a Master Plan. The Master Plan is required to include a number of measures relevant to noise including an endorsed ANEF chart, flight paths and plans for managing aircraft noise intrusion in areas forecast to be subject to exposure above the significant ANEF level.

11.8.1.2 Draft noise insulation and property acquisition policy

Under Condition 16(7) of the Western Sydney Airport Plan, DITRDCA has developed a draft Noise Insulation and Property Acquisition Policy (NIPA) in relation to aircraft overflight noise for buildings outside the Airport Site and having regard to the 24-hour, 7 days a week operation. The policy has been released for public consultation alongside the Draft EIS. This condition was included as part of the Government's approval for Stage 1 of WSI for single runway operations and 10 million annual passengers.

The draft policy is based on the aircraft noise results from this assessment and provides the local community and other important stakeholders with the chance to be consulted and fully informed of the final expected impacts before the airport commences operations.

The draft NIPA is available at Appendix F.

The development of a new, greenfield, 24-hour domestic and international airport will result in significant additional aircraft overflight noise exposure to surrounding communities than is currently experienced. The draft NIPA is intended to provide assistance to these communities to preserve existing building uses and living amenity for building owners.

The draft NIPA is informed by:

- land use planning and noise exposure documentation including AS 2021:2015, the National Airports Safeguarding Framework, and the Western Parkland City SEPP
- the noise exposure forecasts presented in this draft EIS
- existing building typologies within the Western Sydney area, and associated noise treatments
- previous domestic insulation programs undertaken for Sydney (Kingsford Smith) Airport and Adelaide Airport.

This draft policy is not intended to compensate for economic impacts, for example to building values or other broader impacts resulting from the operations at the airport. These impacts, and any potential mitigations are discussed in the relevant chapters of this draft EIS.

Overview of draft policy eligibility criteria

Based on these factors, the draft policy would offer noise treatment assistance to pre-existing properties that meet the criteria in Table 11.11 below and Figure 11.58.

Table 11.11 Eligibility criteria for noise insulation and property acquisition policy

Eligibility criteria	Metric
Treatments for Residential & Non-Residential buildings within ANEC contour	ANEC 20[1]
Acquisition within ANEC contour	ANEC 40[1] or case by case
Internal noise objective (i.e. bedrooms/living spaces/other)	50 dB(A)
Noise metric to determine level of noise treatment package required	L_{Amax} – all aircraft types

1. Refer to Figure 11.58.

Each of these criteria is explained further below.

Land use planning framework

Western Parkland City SEPP provides airport safeguards that prevent development approval being granted for most noise sensitive developments, including residential buildings, near WSI that are within the long term ANEC 20 or ANEF 20 contour. Where development approval is able to be granted, for example for vacant land where residential development had been approved prior to the commencement of provisions, these buildings must meet the indoor design sound levels in AS 2021:2015. This standard provides guidance on the siting and construction of buildings in the vicinity of airports to minimise aircraft noise intrusion. The standard also informs land use planning to prevent non complementary development in areas that either currently, or under future planned runways, will be severely impacted by aircraft noise. The standard provides that buildings within the ANEC 20 contour should be constructed to achieve an indoor design sound level of 50 dB(A) for sleeping areas and dedicated lounges, with 55 dB(A) for other habitable spaces, requiring significant additional noise insulation treatment than standard residential construction. Noise sensitive receivers should not be constructed in ANEC 25 and above contours.

Guideline A of the NASF Guidelines also indicates that land use planning should not include new designations or zoning changes that would provide for noise sensitive developments within a 20 ANEF where that land was previously rural or for non-urban purposes (in keeping with AS 2021:2015).

All 3 documents rely on the ANEC 20 or ANEF 20 contour as the threshold whereby noise sensitive receivers, such as residential buildings, should either not be constructed, or should only be constructed with additional noise insulation treatment. The draft policy for WSI therefore adopts ANEC 20 contour as the principal eligibility criterion for noise insulation treatment.

Use of ANEC composite contours and natural boundaries

ANEC contours have been adopted for the draft policy to consider noise impacts and potential eligibility for treatment. The ANEC, which is utilised in this policy, as well as ANEF, are explained further in Technical paper 1 and Technical paper 6: Land use and planning.

The draft policy has adopted the 'ANEC composite' contours which reflects all 5 runway modes of operation, including night modes, and represents the largest ANEC footprint. This is a conservative approach to capture the highest number of properties that may be eligible for acquisition or amelioration treatment.

It is important to note that the ANEC 20 contour is a computer generated contour based on a finite number of inputs and assumptions. ANEC contours do not recognise geographical 'natural boundaries' and can, for example, pass through streets even though residents on either side of the contour would have the same or similar noise experience. To avoid arbitrary outcomes, it is likely that the ANEC 20 composite contour (see Figure 11.58) would therefore be extended to natural boundaries, for example to include both sides of a particular street, or an area up to a park or green space. The draft policy does not indicate where these natural boundaries could occur however this is a matter that the DITRDCA is seeking feedback on through the public exhibition process.

Forecast operation year is based on 2040

With the airport opening in 2026 and the anticipated gradual increase in utilisation, and therefore gradual increase in noise overtime, the draft policy has utilised the 2040 forecast operation year instead of 2033 or 2055 (refer to Appendix F). In developing this policy, 2033 was considered too soon after establishment of the airport to reflect the time frame of the program, and 2055 did not take into account the potential second runway that is anticipated to be required around that time, nor any technological advances in aircraft. With these considerations, the draft policy is taking into consideration a higher operational noise impact than what is expected to be experienced when the airport initially opens, or even in 2033. This also reflects moderate airport maturity, when it is forecast to be operating at 15 million annual passengers.

Estimate of number of properties eligible

A desktop approach was used to identify sensitive receptors within the noise contours. A review then identified 91 (residential and non-residential) properties as potentially eligible for insulation treatments. This does not include any properties that may fall within areas outside of the ANEC 20 contour, up to a natural boundary. Note that the eligibility criteria for the draft policy is broader than both previous domestic programs – the lower number of properties potentially eligible for treatment reflects lower residential density in the areas surrounding the Airport site, combined with careful land use planning over many years. For example had the same eligibility criteria for Sydney (Kingsford Smith) Airport been applied to WSI, as few as 5 properties would be eligible for noise treatment assistance. In addition to consistency with the land use planning framework the broader eligibility for WSI reflects the lower existing ambient noise levels around the Airport Site and its character as a new, greenfield, development that will operate on a 24-hour basis.

Treatments for residential and non-residential buildings

Treatments under the policy are to be based on the application of AS 2021:2015*,* as well as research undertaken by the department with experts in this field.

Based on research the ANEC noise contours will be used to identify properties considered eligible for insulation treatments if located within the noise contour ANEC 20 (with potential consideration to natural boundaries). Under the standard, potential treatments, depending on technical assessment, include double glazed windows, wall and ceiling insulation, external door seals and cooling. For more information on aircraft noise treatment refer to Appendix F.

Internal noise target

This draft policy sets an internal noise target of 50 dB(A). This aligns with recommended indoor noise level under AS 2021 for new properties constructed adjacent to an airport. The L_{Amax} represents the absolute maximum sound level modelled on any flight path by any scheduled aircraft movement. It is the highest aircraft single noise event in a 24-hour period. This contour has been used to determine the maximum noise level each dwelling is predicted to experience based on the projected flight schedules. This will determine the level of noise reduction required to achieve the desired internal noise target.

Acquisition of a property

There are no properties identified as located within the ANEC 40. ANEC 40 is the metric used in this draft policy and aligns with the approach taken for the Sydney (Kingsford Smith) Airport. No eligible building is currently within the ANEC 40 composite for 2040, however consideration may be made on a case by case basis for requests for the acquisition of a property outside the ANEC 40, yet still located within the ANEC 20.

The Department proposes to take the following additional criteria into account in making a recommendation on whether a property should be acquired:

1. The proposed acquisition is voluntary and at the request of the owner.
2. The property is very significantly impacted by aircraft overflight noise.
3. Effective remediation treatments are not possible.
4. Agreement on fair value with the owner can be reached.

All final decisions on whether a property should be acquired are a matter for the Australian Government.

Settling the final policy and program timeframe

Decision on the final noise insulation policy, including eligibility, is a matter for the Australian Government, and is currently anticipated in late 2024. The delivery model for a resulting noise insulation program, including timing, will be determined as part of this process.

Based on the policy parameters indicated in this Draft EIS the Department considers it feasible that a program could commence in late 2025, and be delivered over a 5–10 year period.

Figure 11.58

ANEC contours for draft NIPA eligibility

Legend

- WSI Runway
- Western Sydney International (Nancy-Bird Walton) Airport land boundary
- Aboriginal Places raised during consultation (NPW Act)
- Site of Aboriginal significance

2040 ANEC composite contours

- ANEC 20 - residential & non-residential amelioration eligibility contour
- ANEC 25
- ANEC 30
- ANEC 35
- ANEC 40
- ANEC 40 - acquisition eligibility contour

0 1 2 km

Coordinate system: GDA 1994 NSW Lambert

Scale ratio correct when printed at A4

1:100,000 Date: 9/08/2023

Data sources: - DITRDC, DCS, Geoscience Australia
Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community
Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

11.8.1.3 Other mechanisms

WSA Co will establish a WSI CACG to ensure appropriate community engagement on airport planning and operations.

Other mechanisms supporting the WSI operational framework would include:

- The Airservices Australia's Noise Complaints and Information Service (NCIS) – to handle complaints and enquiries about aircraft noise and operations associated with WSI to help identify issues of community concern and provide opportunities for improvement.
- The Aircraft Noise Ombudsman (ANO) (an independent administrative office) – to conduct reviews of Airservices Australia's and Defence's management of aircraft noise-related activities. The ANO would also monitor and report on the effectiveness of the community consultation processes related to aircraft noise for WSI and the presentation and distribution of aircraft noise-related information.

The operational framework would support the implementation of the mitigation measures proposed in Section 11.8.2.

11.8.2 Mitigation measures

Effective noise mitigation often requires several small, incremental improvements that, when combined, could result in a substantial and noticeable reduction in aircraft noise impacts. This must be balanced against a safe and efficient airport operation. The proposed mitigation measures outlined in this section for WSI would be given further consideration at the appropriate stages indicated. Further explanation is provided in Section 11.1 of Technical paper 1.

11.8.2.1 Future phases

As outlined by Chapter 6 (Project development and alternatives), there are 3 remaining phases of the airspace and flight path design process. During the detailed design phase more detailed planning of the airspace design and operating procedures, including the evaluation of the viability and finalisation of noise mitigation measures presented in this chapter, would be undertaken in consultation with industry and stakeholders.

All design decisions made during detailed design for improved noise impact mitigation would be made by Airservices Australia in discussion with DITRDCA and assessed as appropriate prior to being considered by CASA.

During the implementation phase, the final noise abatement procedures and noise management measures would be recorded as part of the overarching noise management plan for WSI. The refinement of noise abatement procedures would then require the actual commencement of operations and measurement and monitoring of the benefits or disbenefits individual initiatives deliver as part of the post-implementation phase.

11.8.2.2 Noise abatement procedures

The concept and different types of noise abatement procedures are introduced in Chapter 3 (Introduction to airspace), along with limitations to their use.

The proposed noise abatement procedures for WSI (see Chapter 7 (The project)) were developed to minimise noise impacts as much as practical without unduly compromising the safe operation of the airport. Advanced mitigations such as Noise Abatement Departure Procedure climb profiles would be considered in the detailed design phase. These are explained in detail in Section 11.2 of Technical paper 1.

11.8.2.3 Monitoring of aircraft noise and flight paths

As a major new international airport, it is expected that a system of permanent noise monitoring terminals (loggers) would be installed at suitable locations around WSI and incorporated into Airservices Australia's NFPMS network and reporting systems. This system operates 24-hours-a-day, 7 days-a-week, collecting data from every aircraft operating to and from each of these airports. Further information is available in Section 10.1.1 of Technical paper 1 and the Airservices Australia website https://www.airservicesaustralia.com/community/environment/aircraft-noise/monitoring-aircraft-noise/noise-monitor-reporting/.

The WebTrak interface allows community and other stakeholders to see where aircraft fly and explore historical trends and patterns.

11.8.2.4 Communication and coordination

It is recommended that information is provided to existing and potential new residents in areas likely to be affected by noise. For existing residents, this information will allow them to understand the anticipated aircraft noise (including the number, frequency, loudness, and timing of events and periods of respite). For potential new residents, comprehensive and accurate information enables their informed consideration of a move into the area. The results of the noise assessment will seek to support this process.

Ongoing consultation with the local community and other important stakeholders would continue in parallel with the future phases of the airspace and flight design process to provide the chance to be consulted and fully informed of the final expected impacts before the airport commences operations (refer to Chapter 9 (Community and stakeholder engagement)).

11.8.2.5 Project specific mitigation measures

Table 11.12 provides a summary of aircraft noise mitigation measures identified for the project. These are supported by the proposed monitoring program in Table 11.13.

Table 11.12 Proposed mitigation measures – aircraft noise

ID No.	Issue	Mitigation measure	Owner	Timing
N1	Noise insulation and property acquisition	DITRDCA will finalise the noise insulation and property acquisition policy which details the eligibility requirements for inclusion in the program. This policy will apply to eligible properties that are significantly impacted by aircraft overflight noise from WSI.	DITRDCA	**Pre-operation** (Detailed design, 2024–2026) and **Operation** (Implementation, 2026 – conclusion of program)
N2	Noise abatement	Airservices Australia will develop and review noise abatement procedures in consultation with stakeholders, including aircraft operators, airlines, WSA and FoWSA/WSI Community Aviation Consultation Group (CACG) following a draft proposal developed by the Expert Steering Group in response to feedback on the draft EIS.	Airservices Australia/ DITRDCA	**Pre-operation** (Initial proposal as part of the final EIS, with any further refinements in detailed design, 2024–2026) and **Operation** (Implementation, 2026–ongoing)

ID No.	Issue	Mitigation measure	Owner	Timing
N3	Communication	WSA Co will establish a CACG to ensure appropriate community engagement on airport planning and operations. This will ensure community and industry have a forum for the groups best positioned to identify, share and test solutions or measures including relevant national or international best practice initiatives.	WSA Co	**Pre-operation** (At the conclusion of detailed design, 2024–2026)
N4	Noise complaints	The Airservices Australia Noise Complaints and Information Service will handle complaints and enquiries about aircraft noise and operations associated with the project to help identify issues of community concern and provide opportunities for improvement.	Airservices Australia	**Operation** (Implementation, 2026–ongoing)
N5	Aircraft noise	The Aircraft Noise Ombudsman (ANO) provides independent reviews of aircraft noise-related activities to ensure appropriate governance and oversight of operations. The ANO is also available to make targeted reviews on specific issues as they are identified or arise.	Airservices Australia	**Operation** (Implementation, 2026–ongoing)
N6	Flight path design	Airservices Australia will undertake a post-implementation review (PIR) of the flight path design and implementation.	Airservices Australia	**Operation** (within 2 years of implementation, 2026–ongoing)

Table 11.13 Proposed monitoring program – aircraft noise

ID No.	Issue	Monitoring measure	Owner	Timing
M1	Aircraft noise	Airservices Australia will install a system of permanent and temporary noise monitoring terminals at suitable locations and incorporated into the Airservices Australia NFPMS network and reporting systems. The interface will allow community and other stakeholders to see where aircraft fly and explore historical trends and patterns. The system will provide accurate noise monitoring data for reporting, validation and noise model calibration. With an established baseline it could give an evidence base for any future flight path modification or noise abatement initiatives. This system will operate 24-hours-a-day, 7-days-a-week, collecting data from every aircraft operating to and from WSI. Noise monitoring will consider the requirements of the WSI Stage 1 Development Noise OEMP.	Airservices Australia	**Operation** (Implementation, 2026–ongoing)

11.8.2.6 Dependencies and interactions with other mitigation measures

Mitigation measures in other chapters that are relevant to the minimisation and management of aircraft noise impacts include:

- Chapter 14 (Land use), specifically the requirement for continued liaison between DITRDCA and WSA Co with State and local government agencies to ensure applicable environmental planning instruments have regard ANEC forecasts produced for the project.
- Chapter 18 (Social), specifically the requirement for WSI CACG to undertake consultation with stakeholders and community, including social organisations, to seek feedback on social issues and to promote social and economic welfare of the community.