Perth Airport

Master Plan 2020

APRIL 2020

Section 7: **Airport Safeguarding**

Safeguarding the safety, viability and growth of aviation operations is vital today and in the future.

7.1 Introduction

The safety of air services arriving and departing Perth Airport daily and the capacity of Perth Airport to expand to meet aviation demand can be compromised by inappropriate land use and activities in the vicinity of the airport.

The Commonwealth Government recognises that the current and future viability of aviation operations at Australian airports can be impacted by inappropriate developments in areas beyond the airport boundary. The National Airports Safeguarding Advisory Group (NASAG), comprising high-level Commonwealth, State and Territory transport and planning officials, prepared and released the National Airports Safeguarding Framework (NASF) in May 2012. The NASF aims to safeguard airports and the communities in their vicinity, and to develop, with State, Territory and Local Governments, a national land-use planning regime. The purpose of the Framework is to enhance the current and future safety, viability and growth of aviation operations at Australian airports, by supporting and enabling:

- the implementation of best practice in relation to land use assessment and decision making in the vicinity of airports,
- assurance of community safety and amenity near airports,
- better understanding and recognition of aviation safety requirements and aircraft noise impacts in land use and related planning decisions,
- the provision of greater certainty and clarity for developers and land owners,
- improvements to regulatory certainty and efficiency, and
- the publication and dissemination of information on best practice in land use and related planning that supports the safe and efficient operation of airports.

The NASF currently comprises nine guidance documents:

- Guideline A: Measures for Managing Impacts of Aircraft Noise,
- Guideline B: Managing the Risk of Building Generated Windshear and Turbulence at Airports,
- Guideline C: Managing the Risk of Wildlife Strikes in the Vicinity of Airports,
- Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation,
- Guideline E: Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports,
- Guideline F: Managing the Risk of Intrusions into the Protected Airspace of Airports,
- Guideline G: Protecting Aviation Facilities — Communications, Navigation and Surveillance (CNS),
- Guideline H: Protecting Strategically Importantly Helicopter Landing Sites (not applicable to Perth Airport), and
- Guideline I: Managing the Risk in Public Safety Areas at the ends of Runways.

Not all the NASF Guidelines listed above are addressed within this Master Plan as they may not be applicable to a large airport. However, Perth Airport encourages the implementation of all the safeguarding measures into the State planning framework.

The term 'safeguarding' refers to measures taken to prevent or minimise inappropriate uses and activities. Safeguarding Perth Airport is a shared responsibility of Perth Airport and all levels of government. Working together is important to maintain and protect current and future aviation operations at Perth Airport.

7.2 Aircraft Noise

Noise from aircraft approaching and departing Perth Airport and from their operations on the airfield is an unavoidable consequence of the provision of critical and safe air services.

From time to time, aircraft from Perth Airport – as well as Jandakot Airport and the Royal Australian Air Force (RAAF) Base Pearce – will fly over most of the Perth metropolitan region.

7.2.1 Aircraft Noise Management

Perth Airport works with Airservices Australia (Airservices), government and the aviation industry to actively manage aircraft noise exposure and its effect on the community while balancing the need for critical and safe air services. This has the benefits of:

- enabling the community to make informed decisions about aircraft noise exposure,
- providing guidance for achieving appropriate land-use outcomes around the airport,
- managing, mitigating and, where possible, working towards reducing the impacts of aircraft noise, and
- protecting Perth Airport's 24-hour seven days a week operation.

Perth Airport has adopted the International Civil Aviation Organization's (ICAO) 'balanced approach' to aircraft noise management for managing noise in the vicinity of the airport. This involves identifying an airport's noise and then analysing the various measures that may be available to reduce noise. The four principal elements of the ICAO balanced approach are:

- **Reduction of noise at source** – aircraft being manufactured today, such as the Airbus A350 and Boeing 787 Dreamliner, are generally quieter than the aircraft types they replace. Australian airlines have amongst the most modern aircraft fleets in the world,
- **Noise-abatement operational procedures** – noise-abatement procedures, such as preferred runways and the design of flight paths that direct aircraft over less populated areas and at higher altitudes when possible, are implemented at Perth Airport and are published by Airservices. Additionally, new operating procedures such as Continuous Descent Approaches and Smart Tracking are being introduced, which may provide some safety, environment and noise benefits,
- **Operating restrictions** – restrictions that limit or ban older and noisier ICAO Standard Chapter 2 aircraft, such as the Boeing 727, have been implemented in Australia. These aircraft no longer operate at Perth Airport, and
- **Land-use planning and management** – this is one of the most critical elements of the balanced approach. Advances in aircraft noise management made by implementing the first three elements of the balanced approach can be lost through inappropriate land use planning and management by State and Local authorities. Incompatible land uses, such as residential development, should be directed away from areas projected to be exposed to aircraft noise, while land uses that are less sensitive to aircraft noise, such as industrial developments, should be encouraged in the areas surrounding the airport. Perth Airport will continue its practice of objecting to new or increased density residential development close to the airport to minimise exposure to aircraft noise.

7.2.2 Roles and Responsibilities

The management of aircraft noise is the responsibility of several organisations.

Perth Airport has limited control over the management of ground-based aircraft noise. Airservices are responsible for managing the airspace around Perth Airport, including designing flight paths as well as managing noise generated from airborne aircraft. CASA is responsible, under the Airspace Act 2007, for the administration and regulation of Australian-administered airspace.

Perth Airport acknowledges that there are communities which are exposed to aircraft noise, however, this exposure is balanced against the broader community and economic benefit that arises from the 24-hour, seven days a week operations. In recognition of aircraft noise impacts, Perth Airport is committed to working with Airservices, airline partners, Commonwealth, State and Local Governments to identify opportunities for improvement. The range of organisations and groups with roles and responsibilities in relation to aircraft noise management is provided in Table 7-1.

Organisation	Roles and Responsibilities
International Civil Aviation Organization (ICAO)	• Establishes strict noise certification standards for new aircraft • Provides guidance on noise management strategy • Australia is a member state of ICAO
Civil Aviation Safety Authority (CASA)	• Independent statutory authority with responsibility for regulation of civil aviation operations in Australia • Provides overriding consideration to air safety • Responsible for airspace regulation through the Office of Airspace Regulation
Department of Infrastructure, Transport, Regional Development and Communications	• Advises the Commonwealth Government on the policy and regulatory framework for Australian airports and the aviation industry • Provides policy advice to the Minister on the management of aircraft noise • Provides regulatory oversight of the Air Navigation (Aircraft Noise) Regulations 1984, including application to aircraft which do not meet Australian aircraft noise standards
Airservices Australia	• Provides Air Traffic Control services • Manages and maintains aircraft navigation, surveillance, and noise monitoring infrastructure • Establishes flight paths, including at Perth Airport • Manages noise complaints and enquiries through the Noise Complaints and Information Service • Provides information on aircraft movements, runway and flight path usage and noise impacts using a range of noise descriptors • Conducts noise monitoring in communities surrounding Perth Airport • Reviews and endorses the Perth Airport associated Australian Noise Exposure Forecast (ANEF) for technical accuracy • Implements Noise Abatement Procedures • Considers environmental impacts (including noise) of air traffic management
Airlines and aircraft operators	• Operate and maintain aircraft that meet the ICAO noise certification requirements • Implement Noise Abatement Procedures principles for flight operations
Aircraft Noise Ombudsman (ANO)	• Oversees the handling of aircraft noise issues by Airservices and the Department of Defence • Conducts independent reviews of noise complainants and complaint handling • Makes recommendations for improvements and changes where necessary and feasible
State and Local Government	• State Government develops land use planning frameworks to prevent developments that are inappropriate having regard to aircraft noise • Local Governments implement State Government land use planning frameworks
Perth Airport	• Manages operations at the airport • Develops and maintains infrastructure to support aircraft operations • Publishes a master plan with ANEF at least every five years • Develops a management plan for managing aircraft noise intrusion in areas forecast to be subject to exposure above significant ANEF levels • Applies an engine ground run management plan • Engages with the Perth Airport Community Forum, Planning Coordination Forum, Perth Airport Aircraft Noise Technical Working Group and broader community
Perth Airport Community Forum (PACF)	• Works collaboratively to consider issues of importance to the community and airport in the context of recognising and enhancing: – the long-term sustainability and growth of Perth Airport, – Perth Airport's role as a responsible corporate citizen within the local and broader community, and – Perth Airport's role as a major economic contributor for Western Australia
Planning Coordination Forum (PCF)	• Supports effective engagement between Perth Airport and Commonwealth, State and Local Government agencies on strategic planning issues, including land use and aircraft noise impacts
Perth Airport Aircraft Noise Technical Working Group (PAANTWG)	• Enables industry to initiate and evaluate operational changes while ensuring that the noise impact of those changes is considered and opportunities to improve noise outcomes are explored

Table 7-1 Organisations responsible for aircraft noise management
Source: Perth Airport

7.2.3 Aircraft Noise Management Strategy

Perth Airport's commitment to managing aircraft noise is guided by the Aircraft Noise Management Framework as shown in Figure 7-1.

This framework takes into account aircraft taking off, departing, approaching, landing and manoeuvring on the airfield, including engine testing, within the airport site. This framework includes six key themes that guides Perth Airport's effective management of the impacts of aircraft noise on surrounding communities, and includes community consultation and engagement, and appropriate infrastructure planning, as principal elements.

7.2.3.1 Theme 1 – Identify Opportunities

Perth Airport works with Airservices, aircraft operators, industry stakeholders and the community to identify opportunities for improvement and achieve better outcomes where possible.

Noise improvement proposals can arise from a variety of sources, such as Airservices internal analysis, the Aircraft Noise Ombudsman, aviation industry and community feedback. Each initiative is assessed first and foremost for its impact on safety. If there are no safety implications, further assessment determines whether it provides an overall benefit to the Perth community. For example, a change may be considered if it exposes a smaller number of people to noise but not if it merely moves the noise from one group to another of a similar size. A proposal may also be unworkable because of airspace constraints, such as the proximity of RAAF Base Pearce's restricted areas preventing a route being moved further north.

Where an initiative is deemed to provide an improvement for the community, a trial of the proposal may be conducted to verify the initial findings. This involves advertising and widespread consultation with all stakeholders, including the community.

The results of the trial, including community feedback, are assessed and a decision made on whether to permanently implement the procedure or discard it. If implemented, a post implementation review is usually conducted to verify the success of the change. Post implementation reviews are published by Airservices on its website, airservicesaustralia.com.

Preferred runways are selected by air traffic control in accordance with the published Noise Abatement Procedures (NAPs). Following a review by Airservices, in May 2015 the preferred runway selection criteria for Perth Airport was amended. At Perth, operational reasons, such as wind direction, runway availability and the military restricted airspace around Perth, often preclude the use of preferred runways. However, for the times when air traffic control has a choice of runway selection, the preferred runway change was found to have provided incremental noise improvements, particularly for areas to the south of Perth Airport that experience aircraft departures.

In September 2015, Airservices introduced a Smart Tracking flight path for suitably equipped aircraft arriving from the north and east and landing onto Runway 03 (southern end of the main runway). In addition to improved safety, fuel burn and emissions outcomes, the Smart Tracking procedure was designed to maximise opportunities for a more gradual descent with less throttle and engine noise. The procedure uses Required Navigation Performance – Authorisation Required (RNP-AR) satellite navigation, coupled with the performance characteristics of an aircraft's autopilot system, to allow the aircraft to fly along a precise flight path with high level of accuracy. RNP-AR is a reasonably new technology and requires the aircraft be fitted with highly sophisticated equipment. New aircraft have this equipment, but for older aircraft it is expensive to install and, in some aircraft, it cannot be installed for technical reasons. It will be many years until all aircraft at Perth are equipped to make these approaches. Currently approximately 30 per cent of aircraft operating at Perth are capable of flying RNP-AR approaches.

Figure 7-1 Perth Airport Aircraft Noise Management Framework
Source: Perth Airport

7.2.3.2 Theme 2 – Land Use Planning

Perth Airport works with Airservices, CASA and Commonwealth, State and Local Governments to coordinate land-use planning and management. This facilitates change to land-use planning and a policy that directs inappropriate land uses away from the airport, while encouraging compatible land uses in the intervening areas to protect operational flexibility and 24/7 operations.

Perth Airport supports a 'push-pull' strategy. This means incompatible land uses – such as residential development – are directed away from areas that are, or will be, exposed to significant aircraft noise, while land uses that are less sensitive to aircraft noise, such as industrial developments – are encouraged in areas surrounding the airport estate.

Local Government guidance regarding development in the vicinity of Perth Airport is provided by the State Planning Policy 5.1 Land Use Planning in the Vicinity of Perth Airport (described in Section 2). It adopts Perth Airport's ANEF to determine the acceptability of various development types within each of the ANEF contours. The intention is to restrict, or require building treatment, for noise-sensitive developments in areas forecast to be exposed to aircraft noise. Perth Airport developed its first ANEF as part of the Master Plan 1985, nearly 35 years ago. Since that initial noise forecast, which included the future new runway, the overall footprint of the ANEF contours has remained relatively the same. However, since 1983, there has been considerable residential development and infill within the ANEF contours.

Perth Airport supports the Western Australia Planning Commission (WAPC) and Local Governments in their statutory role of managing residential land uses within aircraft noise exposed areas. Perth Airport continues to advocate for the Western Australian Government to follow the Queensland Government in adopting the NASF guidelines, including the N-above contours, through its State planning framework.

7.2.3.3 Theme 3 – Engage and Communicate

Perth Airport is committed to ensuring the community is fully informed and that their concerns and priorities are considered in guiding aircraft noise management outcomes. A key focus of this engagement is to communicate aircraft noise information in an uncomplicated and easy to understand manner.

Perth Airport therefore provides a range of material to inform and engage the community about noise implications and flight paths. This includes the ANEF contours, N-above contours (described in Section 7.3.6), published material on aircraft noise, and an online Aircraft Noise Informational Portal.

Launched in 2014, the web-based interactive Aircraft Noise Information Portal was developed by Perth Airport to provide information on flight paths, the ANEF and N-above contours and how they apply to a property a person resides in or may be looking to purchase. The portal, shown in Figure 7-2, provides information on current and future operations at Perth Airport and is available at perthairport.com.au/aircraftnoise.

Since 2015, the Perth Airport ANEF and N-Above (N65) contours have been made available through Landgate Property Interest Reports.

Section 10 details Perth Airport's ongoing consultation and education mechanisms. They include a Planning Coordination Forum to foster planning discussions with Commonwealth, State and Local Government, the Perth Airport Community Forum which gives members of the public the opportunity to meet with representatives from Perth Airport as well as guests, such as Airservices and the Aircraft Noise Ombudsman.

In mid-2017, Perth Airport invited community members to participate in a number of focus groups to understand how information on flight paths and aircraft noise is perceived. This has assisted Perth Airport to provide clear, concise and meaningful information which assists the community in making informed decisions.

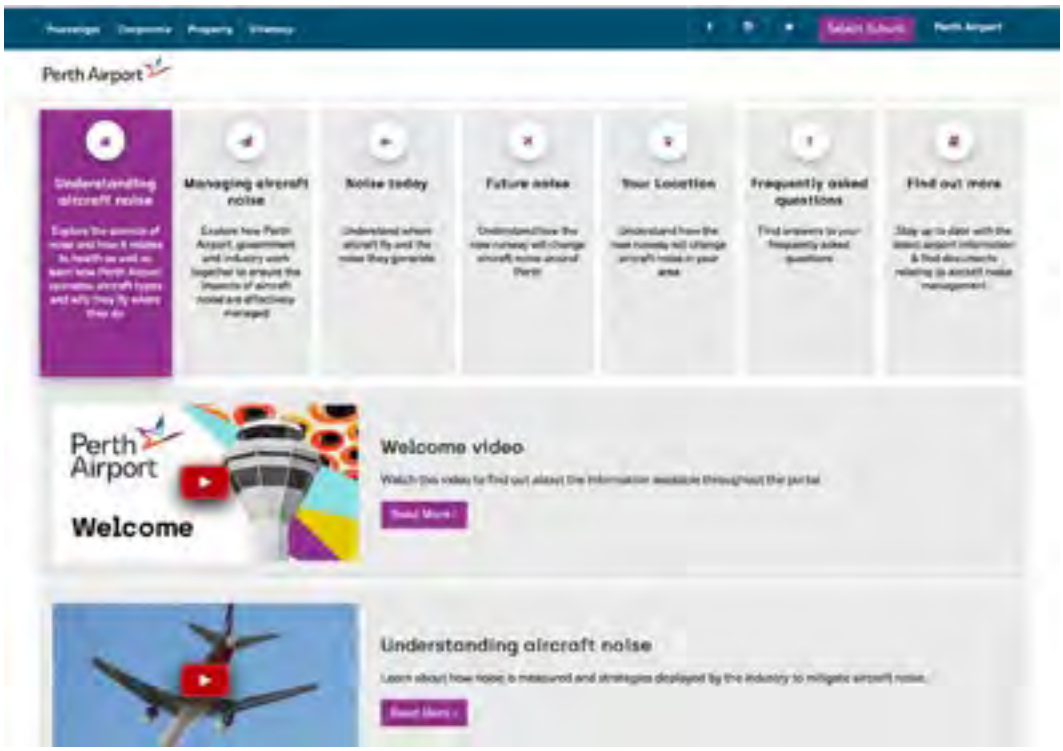


Figure 7-2 Perth Airport Aircraft Noise Information Portal
Source: Perth Airport

7.2.3.4 Theme 4 — Improve Understanding

Perth Airport continually seeks to improve understanding of aircraft noise and its impacts to ensure effective noise management.

In 2018, Perth Airport commissioned a review of relevant literature relating to the health impacts of aircraft noise, including research, reviews and guidelines. The assessment considered 168 articles published between 1993 and 2017, including large research projects undertaken in areas close to some of the major international airports, such as Heathrow and Munich airports. While nearly every study suggested that further research into potential health impacts was needed, the review has encouraged Perth Airport to focus on noise management strategies which can assist in reducing the health consequences of aircraft noise exposure. These include appropriate land planning around airports, careful route planning, noise abatement procedures, provision of clear and comprehensible information about the likely exposure to aircraft noise, as well as information to assist those affected by the noise to undertake amelioration measures that can reduce noise penetration into homes.

Perth Airport continues to invest in understanding aircraft noise, impacts and ways to engage and communicate. Perth Airport also participates in a number of national forums and working groups focussed on aircraft noise.

7.2.3.5 Theme 5 — Infrastructure Planning

Perth Airport applies best practice aircraft-noise management practices where relevant in the development of new airport infrastructure, including through design and community consultation. The design of airport infrastructure, including runways, taxiways and engine run up facilities can impact on the aircraft noise exposure around an airport. The design of the new runway and associated infrastructure has considered best practice aircraft noise management practices.

Designing flight paths for new infrastructure is a complicated process. Airservices design flight paths through extensive consultation — often over many years — with airports, aircraft operators, government, CASA, and the local community.

The final flight paths for the future parallel runway system will be designed by Airservices during the detailed design phase before the new runway opens. This phase also includes the development of both air traffic management procedures and noise abatement procedures. Opportunities to minimise noise impacts on communities will be considered in developing the final flight paths.

The *Airservices Act 1995* states that Airservices must make safety of air navigation its most important consideration. Subject to this, Airservices must perform its functions so that, as far as practicable, the environment is protected from the effects associated with the operation and use of aircraft. Consideration is given to approach and departure paths that minimise noise over residential areas, fuel consumption and emissions.

Flight paths for Perth Airport are constrained by military airspace to the north, west and south, and Jandakot Airport airspace to the south. These constraints increase with the introduction of a new runway as new procedures are developed and existing procedures modified to facilitate parallel runway operations. A draft Airspace Management Plan, based on a preliminary airspace design, has been completed by Perth Airport in consultation with Airservices and the Department of Defence, and was presented in the Preliminary Draft Major Development Plan for the New Runway Project that was released for public comment in mid-2018. In determining the proposed flight corridors for parallel runway operations, current and emerging technologies were considered to explore whether there can be improved outcomes for implementation in the detailed design stage.

7.2.3.6 Theme 6 — Best Practice Benchmarking

Perth Airport seeks to understand what best practice is and learn lessons from other airports and industries on how to manage the impacts of aircraft noise and community engagement.

By participating in forums such as the Perth Aircraft Noise Technical Working Group and the National Industry Noise Forum, Perth Airport can discuss and consider aircraft noise-management initiatives both in Australia and at airports around the world.

In 2016, an Australian initiative was led by Perth Airport and resulted in the publication of a booklet called 'Reducing Aircraft Noise in Existing Homes'. The booklet provides information about practical modifications that can reduce noise levels and is available from perthairport.com.au/aircraftnoise.

7.3 Aircraft Noise Metrics

A range of metrics are available to describe the level of aircraft noise in an area, each being useful for a different purpose. Those relevant for an assessment of aircraft noise associated with airport infrastructure, are described in the sections below.

7.3.1 Australian Noise Exposure Forecast System

The ANEF system comprises the following three noise exposure indicators that, although they use the same noise metric for calculation, are based on different inputs and vary in purpose:

- Australian Noise Exposure Forecast (ANEF) – ANEF noise contours show the anticipated noise contours for the most likely or preferred development and forecasts for an airport. Only one ANEF can be promulgated for any particular airport at one time and is the basis for Australian Standard 2021:2015 Acoustics – Aircraft noise intrusion – Building siting and construction,
- Australian Noise Exposure Concept (ANEC) – ANEC noise contours are a planning tool used to test changes to noise exposure resulting from proposed changes to airport operations. Several ANECs may be produced based on a range of scenarios, and
- Australian Noise Exposure Index (ANEI) – ANEI noise contours are based on historical aircraft movement data and show actual noise exposure for a previous period, generally a year. The ANEI is mostly developed to compare with ANEF and ANECs to highlight differences in anticipated noise exposure.

While all previous ANEF contours for Perth Airport were produced using the Integrated Noise Model (INM) software, the ANEF system contours shown in this Master Plan 2020 were produced using the Airport Environmental Design Tool (AEDT) software, developed by the US Federal Aviation Administration.

AEDT is the most modern software package used for aircraft noise modelling. The AEDT is more comprehensive than the INM and can model a greater range of current and new aircraft types, such as the Boeing 737 MAX and Airbus A320neo. AEDT also predicts noise levels to a much greater level of accuracy than was previously output using INM, this is evidenced by the fact that the Perth Airport AEDT predictions more closely aligned with noise levels recorded by Airservices Noise and Flight Path Monitoring System (NFPMS).

Similar to the INM, input data for the AEDT noise model includes the following variables:

- selection of aircraft types (aircraft fleet mix),
- numbers of aircraft operations (including departures and arrivals),
- runway dimensions and allocation to respective operations,
- flight track descriptions and flight track dispersal to consider the spread on the track by aircraft operations,
- aircraft destinations or origins (stage lengths) to take into consideration track allocation,
- day/night split of operations,
- terrain data, and
- normalised wind velocity and temperature information.

7.3.2 Australian Noise Exposure Forecast

The *Airports Act 1996* (Airports Act) requires a master plan to provide an ANEF for the areas surrounding the airport. In addition, the master plan must specify the airport's plans, developed through a consultative process with airline partners and Local Government authorities in the vicinity of the airport, for managing aircraft noise intrusion in areas forecast to be subject to exposure above significant ANEF levels. Significant ANEF levels are defined as the 30 ANEF contour and above.

The ANEF is a forecast of future aircraft noise exposure and shows the concentration of noise around a particular airport, based on the:

- expected aircraft movement numbers,
- types of aircraft,
- daily distribution by time period of arrivals and departures,
- configuration of the runways, and
- arrival and departure tracks flown, along with ascent and decent profiles.

An ANEF must be formally endorsed for technical accuracy by Airservices.

7.3.2.1 Use of ANEF for Land Use Planning

For land-use planning in Australia, the accepted metric for aircraft noise exposure is the ANEF. The ANEF is central component of the Australian Standard 2021:2015 Acoustics – Aircraft noise intrusion – Building siting and construction (AS2021). AS2021, in conjunction with the ANEF contours, provides guidance to development control authorities (such as State and Local Government) on the acceptability of certain types of land use or development in areas near airports, based on the ANEF level in the area. Further to its role as a guidance document for determining land use and development, AS2021 also provides detail regarding construction methods and materials to minimise noise intrusion to development within ANEF contours.

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, AS2021 recommends that new buildings should incorporate acoustic treatment to achieve specified internal noise levels. The building type acceptability for ANEF zones is shown in Table 7-2.

	Forecast Noise Exposure Level (ANEF)		
Building Type	**Acceptable**	**Conditionally Acceptable**	**Unacceptable**
House, home unit, flat, caravan park	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hotel, motel, hostel	Less than 25 ANEF	25 to 30 ANEF	Greater than 30 ANEF
School, university	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Hospital, nursing home	Less than 20 ANEF	20 to 25 ANEF	Greater than 25 ANEF
Public building	Less than 20 ANEF	20 to 25 ANEF	Greater than 30 ANEF
Commercial building	Less than 25 ANEF	25 to 30 ANEF	Greater than 35 ANEF
Light industrial	Less than 30 ANEF	30 to 40 ANEF	Greater than 40 ANEF
Other industrial	Acceptable in all ANEF zones		

Table 7-2 Building site acceptability table based on Australian Noise Exposure Forecast contours
Source: Australian Standard 2021:2015

Standards Australia also published a handbook, SA HB 149:2016, Acoustics—Guidance on producing information on aircraft noise, on how to meaningfully present information on the impact and nature of aircraft noise to the public, and to assist in land use planning and building assessments.

7.3.3 Aircraft Noise Contours

Forecasts outlined in Section 2.11 indicate that at the end of the 20-year planning period, Perth Airport would not be operating at or near its capacity in terms of aircraft movements.

The 'Manner of Endorsement for Australian Noise Exposure Forecasts' released by the Department of Infrastructure, Transport, Regional Development and Communications outlines the projected timeframes that an ANEF can cover. The document describes the following ANEFs:

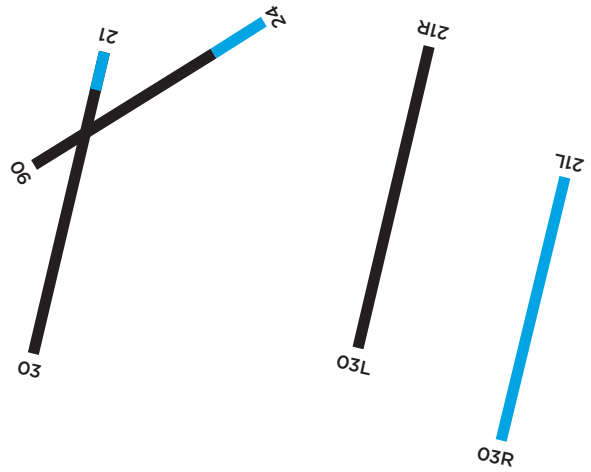
- a standard ANEF – forecast noise exposure levels up to a maximum of 20 years,
- a long-range ANEF which specifies a year – forecast noise exposure levels up to or beyond 20 years, or
- an ultimate practical capacity ANEF – forecast noise exposure level likely if an airport was operating at its ultimate practical capacity.

If land use planning near Perth Airport was based on a 20-year ANEF (a smaller contour) rather than the ultimate ANEF, this could result in inappropriate development in areas surrounding the airport.

Therefore, from 2004 to 2014, an ultimate ANEF based on 350,000 annual aircraft movements was developed in consultation with State and Local Governments. This level of annual aircraft movements was consistent with anticipated levels of activity once the airport was starting to reach capacity during the peak periods. Further technical analysis of Perth Airports ultimate capacity concluded the airfield was capable of reaching 362,000 annual aircraft movements. As a result, the 2020 Ultimate ANEF was developed using this updated ultimate capacity.

Perth Airport adopted a 'composite' ANEF for the Master Plan 2014 which reflected a combination of three ANECs that are based on the existing and potential future runway operating modes. A composite ANEF has also been adopted for this Master Plan 2020 and comprises two ANEC scenarios.

The Master Plan 2014 ANEC 1 (current runways) and ANEC 2 (current runways with extensions) have been combined into one noise contour for this master plan, forming a new ANEC 1. The reduction in ANEC's from three in 2014 to two in 2020 was made after considering the worst case contours for the existing runway system. This also means ANEC 2 now considers the parallel runway system and there is no longer an ANEC 3. The two ANEC scenarios are detailed as follows and shown in Figure 7-3 below:



ANEC 1:

Runway 03/21: 3,800m

Runway 06/24: 3,000m

ANEC 2:

Runway 03L/21R: 3,800m

Runway 03R/21L: 3,000m

Figure 7-3 ANEC scenarios
Source: Perth Airport

Existing Airfield with Extended Runways Maximum Capacity ANEC (ANEC 1)

The first ANEC (ANEC 1) reflects the existing runway system, considers future extensions of the main (03/21) and cross runway's (06/24) and looks at when this operating mode would reach capacity. This ANEC provides a capacity of approximately 190,000 aircraft movements per annum which is the maximum movements on this system.

Parallel Runway Maximum Capacity ANEC (ANEC 2)

The second ANEC (ANEC 2) is based on the long-term airfield layout including the construction of the proposed new runway (03R/21L) parallel to the existing main runway (03L/21R), which is subject to approval. This scenario can accommodate approximately 362,000 annual aircraft movements and is consistent with the anticipated level of activity once the airport is again starting to reach capacity during the peak periods.

The 'composite' ANEF is created by taking the worst case (outer contour lines) of the two ANECs.

The Perth Airport 2020 Ultimate ANEF, endorsed by Airservices for technical accuracy, is shown in Figure 7-4.

Associated aircraft movement tables for ANEC 1 and ANEC 2 are shown in Table 7-3 and Table 7-4.

This ANEF represents where most aircraft will fly, however all areas of Perth will have aircraft from Perth Airport, Jandakot or RAAF Base Pearce flying overhead from time to time.

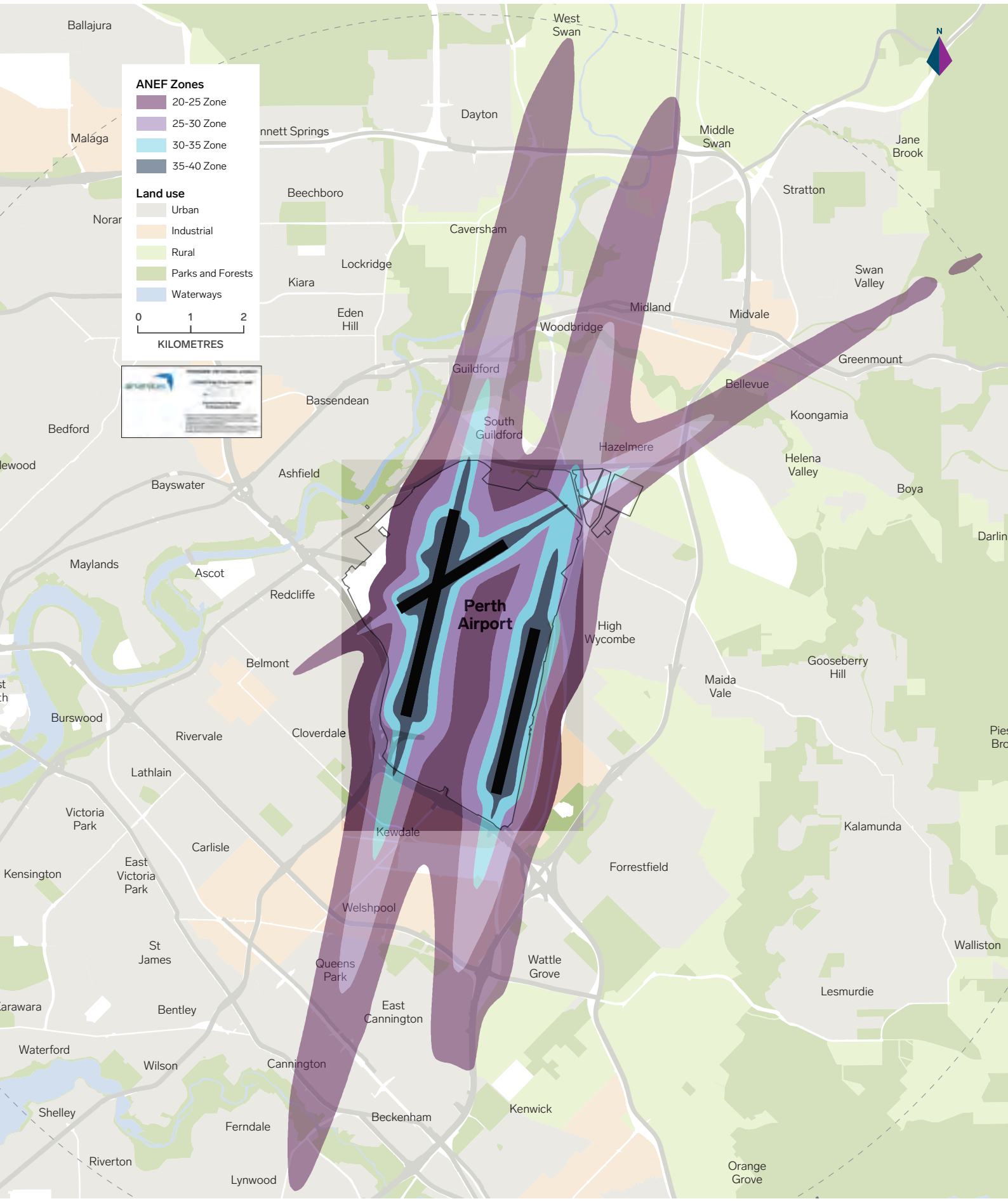


Figure 7-4 2020 Ultimate ANEF
Source: Perth Airport

		Arrivals			Departures			
Runway	Aircraft Type	Day	Night	Total	Day	Night	Total	Grand Total
03	1900D	0.37	0	0.37	0.23	0.09	0.32	0.68
03	717200	1.06	0.21	1.27	0.63	0.33	0.96	2.23
03	737800	3.17	0.5	3.67	0.92	1.32	2.24	5.91
03	7378MAX	4.24	2.13	6.37	2.68	1.13	3.81	10.18
03	7878R	3.19	1.75	4.94	1.85	0.73	2.58	7.52
03	A221	9.68	1.79	11.47	4.46	3.39	7.85	19.32
03	A223	1.04	0.22	1.26	0.64	0.33	0.97	2.23
03	A319NEO	1.09	0.22	1.31	0.63	0.35	0.99	2.3
03	A320NEO	6.01	1.19	7.2	3.07	1.7	4.77	11.97
03	A321NEO	2.88	3.72	6.6	2.21	1.75	3.96	10.56
03	A338	2.5	0.83	3.33	1.33	0.62	1.95	5.28
03	A351	0	0.41	0.41	0.15	0.09	0.24	0.65
03	A359	4.72	2.1	6.81	2.45	1.34	3.78	10.6
03	A380-861	0.38	1.16	1.55	0.12	0.88	1	2.55
03	B7379MAX	3.09	5.17	8.26	2.5	2.62	5.13	13.39
03	B779	0	0.52	0.52	0	0.28	0.28	0.8
03	B781	0	0.42	0.42	0.14	0.09	0.23	0.66
03	B797	10.79	6.25	17.04	6.64	3.39	10.02	27.07
03	BD-700-1A11	0.63	0.25	0.88	0	0.24	0.24	1.11
03	BEC58P	0.57	0.28	0.85	0.49	0.19	0.68	1.53
03	CNA441	0.13	0.11	0.24	0.17	0	0.17	0.42
03	DHC6	0.37	0	0.37	0.22	0.09	0.31	0.69
03	DHC830	3.55	0.13	3.68	1.74	0.69	2.44	6.12
03	F10062	4.95	0.79	5.74	2.11	1.84	3.95	9.69
03	F10065	5.03	0.76	5.79	2.2	1.78	3.98	9.77
03	HS748A	0.71	0	0.71	0.42	0.11	0.53	1.24
03	SF340	0.7	0	0.7	0.42	0.12	0.54	1.24
03 Total		**70.84**	**30.91**	**101.76**	**38.43**	**25.5**	**63.93**	**165.69**
06	1900D	0.03	0	0.03	0.22	0.09	0.31	0.34
06	717200	0.08	0.02	0.09	0.55	0.37	0.92	1.01
06	737800	0.22	0.03	0.26	0.74	1.43	2.18	2.43
06	7378MAX	0.34	0.23	0.57	2.32	1.13	3.44	4.01
06	7878R	0.25	0.17	0.42	1.68	0.79	2.47	2.89
06	A221	0.67	0.13	0.8	3.73	3.74	7.47	8.27
06	A223	0.08	0.02	0.09	0.54	0.37	0.9	1
06	A319NEO	0.08	0.02	0.1	0.55	0.39	0.94	1.04
06	A320NEO	0.43	0.11	0.54	2.65	1.82	4.48	5.02
06	A321NEO	0.22	0.43	0.64	1.98	1.84	3.83	4.47
06	A338	0.19	0.1	0.29	1.15	0.66	1.81	2.09
06	A351	0	0.04	0.04	0.15	0.1	0.25	0.29
06	A359	0.35	0.23	0.57	2.14	1.39	3.52	4.1
06	A380-861	0.02	0.19	0.21	0.09	0.9	0.99	1.2
06	B7379MAX	0.22	0.6	0.82	2.21	2.86	5.07	5.89
06	B779	0	0.05	0.05	0	0.3	0.3	0.35
06	B781	0	0.04	0.04	0.15	0.1	0.25	0.29
06	B797	0.82	0.58	1.41	6.03	3.49	9.51	10.92
06	BD-700-1A11	0.05	0.04	0.09	0	0.17	0.17	0.26
06	BEC58P	0.04	0.02	0.06	0.48	0.22	0.69	0.76
06	CNA441	0.01	0.01	0.02	0.15	0	0.15	0.17
06	DHC6	0.03	0	0.03	0.23	0.09	0.32	0.35
06	DHC830	0.24	0.01	0.25	1.53	0.75	2.28	2.54
06	F10062	0.35	0.05	0.4	1.81	2	3.81	4.22
06	F10065	0.35	0.05	0.4	1.86	1.93	3.79	4.19
06	HS748A	0.05	0	0.05	0.41	0.12	0.53	0.58
06	SF340	0.05	0	0.05	0.38	0.12	0.51	0.56
06 Total		**5.17**	**3.16**	**8.33**	**33.73**	**27.17**	**60.89**	**69.22**

		Arrivals			Departures			
Runway	Aircraft Type	Day	Night	Total	Day	Night	Total	Grand Total
21	1900D	0.36	0	0.36	0.32	0.08	0.4	0.76
21	717200	0.94	0.36	1.3	1.44	0.31	1.75	3.05
21	737800	1.72	0.92	2.63	2.77	1.28	4.04	6.68
21	7378MAX	3.57	2.11	5.69	6.73	2.97	9.69	15.38
21	7878R	2.11	0.88	2.98	3.88	1.59	5.48	8.46
21	A221	6.97	3.14	10.12	11.19	3.26	14.45	24.57
21	A223	0.94	0.36	1.3	1.43	0.33	1.76	3.05
21	A319NEO	0.98	0.37	1.35	1.48	0.33	1.81	3.16
21	A320NEO	4.45	1.67	6.12	7.33	2.42	9.75	15.87
21	A321NEO	2.59	3.12	5.71	5.38	3.98	9.37	15.08
21	A338	1.74	0.74	2.48	2.91	1.29	4.2	6.67
21	A351	0	0.22	0.22	0.12	0.23	0.35	0.57
21	A359	3.31	1.54	4.85	5.6	2.83	8.43	13.27
21	A380-861	0.71	0.7	1.42	0.62	1.57	2.2	3.61
21	B7379MAX	3.15	4.07	7.22	6.04	5.4	11.44	18.66
21	B779	0	0.16	0.16	0	0.26	0.26	0.42
21	B781	0	0.22	0.22	0.13	0.22	0.35	0.57
21	B797	7.54	5.23	12.77	13.83	7.41	21.24	34
21	BD-700-1A11	0.31	0.16	0.47	0	1.27	1.27	1.74
21	BEC58P	0.6	0.21	0.81	0.77	0.18	0.95	1.76
21	CNA441	0.22	0.08	0.29	0.44	0	0.44	0.74
21	DHC6	0.36	0	0.36	0.32	0.08	0.4	0.75
21	DHC830	3.02	0.21	3.23	3.84	0.99	4.83	8.05
21	F10062	3.67	1.39	5.06	5.36	1.78	7.14	12.2
21	F10065	3.65	1.39	5.04	5.44	1.69	7.13	12.17
21	HS748A	0.64	0	0.64	0.7	0.11	0.82	1.46
21	SF340	0.64	0	0.64	0.73	0.1	0.83	1.47
21 Total		54.2	29.24	83.43	88.8	41.96	130.77	214.2
24	1900D	0.29	0	0.29	0.02	0	0.02	0.31
24	717200	0.78	0.28	1.05	0.08	0.01	0.09	1.14
24	737800	1.37	0.71	2.08	0.14	0.04	0.18	2.26
24	7378MAX	2.91	1.58	4.5	0.26	0.05	0.31	4.8
24	7878R	1.71	0.65	2.35	0.14	0.02	0.16	2.52
24	A221	5.66	2.45	8.1	0.61	0.1	0.71	8.81
24	A223	0.79	0.27	1.06	0.08	0.01	0.09	1.15
24	A319NEO	0.79	0.29	1.08	0.08	0.01	0.09	1.17
24	A320NEO	3.52	1.29	4.81	0.35	0.06	0.41	5.21
24	A321NEO	2.06	2.42	4.47	0.19	0.07	0.26	4.73
24	A338	1.44	0.59	2.03	0.15	0.02	0.18	2.21
24	A351	0	0.17	0.17	0	0	0.01	0.18
24	A359	2.65	1.14	3.79	0.25	0.05	0.3	4.09
24	A380-861	0.57	0.48	1.05	0.01	0.03	0.04	1.1
24	B7379MAX	2.58	3.11	5.68	0.24	0.1	0.34	6.03
24	B779	0	0.12	0.12	0	0.01	0.01	0.12
24	B781	0	0.17	0.17	0.01	0	0.01	0.18
24	B797	6.24	4.04	10.29	0.59	0.13	0.72	11.01
24	BD-700-1A11	0.25	0.11	0.36	0	0.02	0.02	0.38
24	BEC58P	0.48	0.15	0.63	0.03	0.01	0.04	0.67
24	CNA441	0.17	0.06	0.23	0.02	0	0.02	0.25
24	DHC6	0.29	0	0.29	0.01	0	0.02	0.31
24	DHC830	2.43	0.17	2.61	0.2	0.02	0.23	2.83
24	F10062	2.95	1.09	4.04	0.29	0.05	0.34	4.38
24	F10065	2.93	1.08	4.02	0.29	0.05	0.34	4.36
24	HS748A	0.52	0	0.52	0.04	0	0.04	0.56
24	SF340	0.53	0	0.53	0.04	0	0.04	0.57
24 Total		43.9	22.42	66.32	4.12	0.88	5	71.31

		Arrivals			Departures			
Helipad	Aircraft Type	Day	Night	Total	Day	Night	Total	Grand Total
PER	EC130	1.29	0.08	1.37	1.29	0.08	1.37	2.74
PER		1.29	0.08	1.37	1.29	0.08	1.37	2.74

Table 7-3 ANEC 1 aircraft movement data
Source: Perth Airport

		Arrivals			Departures			
Runway	Aircraft Type	Day	Night	Total	Day	Night	Total	Grand Total
03L	1900D	0.39	0.07	0.47	0	0	0	0.47
03L	737800	1.58	0.32	1.89	1.24	1.72	2.97	4.86
03L	7378MAX	4.06	0.4	4.46	1.29	1.6	2.89	7.36
03L	7878R	4.97	3.26	8.23	4.71	4.43	9.14	17.37
03L	A221	2.96	0	2.96	2.58	2.68	5.26	8.22
03L	A223	6.31	0.94	7.25	4.8	4.65	9.45	16.69
03L	A319NEO	6.33	0.94	7.27	4.76	4.65	9.41	16.68
03L	A320NEO	5.34	0.75	6.09	2.53	3.4	5.93	12.02
03L	A321NEO	5.04	4.2	9.24	3.8	1.33	5.13	14.37
03L	A338	2.5	1.14	3.64	0.37	0.57	0.93	4.57
03L	A351	5.43	3.63	9.07	4.3	4.82	9.12	18.18
03L	A359	5.57	3.35	8.92	3.5	3.14	6.64	15.56
03L	B7379MAX	8.25	7.88	16.12	2.87	1.32	4.19	20.32
03L	B779	2.13	2.22	4.35	2.14	2.51	4.66	9
03L	B781	3.86	1.63	5.49	3.36	2	5.37	10.86
03L	B797	9.9	4.38	14.27	5.3	2.28	7.57	21.84
03L	BD-700-1A11	0.74	0.29	1.03	0	0.42	0.42	1.45
03L	BEC58P	1.08	0.11	1.19	0.51	0	0.51	1.7
03L	CNA441	0.3	0.02	0.32	0.16	0	0.16	0.48
03L	DHC6	0.38	0.07	0.46	0	0	0	0.46
03L	DHC830	4.75	0.35	5.1	1.39	0.12	1.52	6.61
03L	HS748A	0.23	0.05	0.28	0	0	0	0.28
03L	SF340	0.23	0.05	0.28	0	0	0	0.28
03L Total		**82.32**	**36.05**	**118.37**	**49.6**	**41.66**	**91.27**	**209.63**
03R	1900D	0	0	0	0.26	0.52	0.78	0.78
03R	737800	1.01	0.24	1.25	0.63	0.43	1.06	2.31
03R	7378MAX	3.32	0.66	3.98	4.7	2.52	7.22	11.19
03R	7878R	1.62	0.02	1.64	1.39	0.14	1.52	3.16
03R	A221	5.2	0.99	6.19	3.28	3.37	6.65	12.84
03R	A223	6.58	1.59	8.17	5.96	4.84	10.8	18.97
03R	A319NEO	6.55	1.6	8.15	6.02	4.83	10.85	19
03R	A320NEO	4.35	0.93	5.27	5.46	2.87	8.33	13.61
03R	A321NEO	3.55	1.89	5.44	7.23	6.22	13.44	18.89
03R	A338	2.52	0.49	3.01	3.2	3.27	6.48	9.48
03R	A359	2.69	0.51	3.2	3.34	3.47	6.81	10.01
03R	B7379MAX	9.23	4.88	14.1	18.6	15.9	34.5	48.61
03R	B797	17.32	6.13	23.44	25.06	9.24	34.3	57.74
03R	BEC58P	0	0	0	0.51	0.45	0.95	0.95
03R	CNA441	0	0	0	0.11	0.21	0.31	0.31
03R	DHC6	0	0	0	0.27	0.51	0.79	0.79
03R	DHC830	0	0	0	3.29	2.15	5.44	5.44
03R	HS748A	0	0	0	0.24	0.46	0.7	0.7
03R	SF340	0	0	0	0.24	0.46	0.69	0.69
03R Total		**63.93**	**19.92**	**83.85**	**89.79**	**61.84**	**151.63**	**235.49**

		Arrivals			Departures			
Runway	Aircraft Type	Day	Night	Total	Day	Night	Total	Grand Total
21L	1900D	0.45	0	0.45	0.25	0.27	0.52	0.96
21L	737800	1.26	0.75	2.01	0.86	0.2	1.06	3.07
21L	7378MAX	8.33	2.09	10.42	6.38	2.19	8.57	18.98
21L	7878R	2.22	0.1	2.32	2.54	0.1	2.63	4.95
21L	A221	8.48	2.72	11.2	4.31	1.7	6.01	17.21
21L	A223	10.32	4.55	14.87	7.74	2.45	10.19	25.06
21L	A319NEO	10.28	4.52	14.81	7.76	2.43	10.19	25
21L	A320NEO	9.5	3.22	12.72	7.14	2.36	9.5	22.22
21L	A321NEO	8.7	7.55	16.25	8.64	4.62	13.26	29.51
21L	A338	5.14	2.46	7.6	4.48	2.45	6.93	14.53
21L	A359	5.52	2.63	8.16	4.7	2.61	7.31	15.46
21L	B7379MAX	22.33	19.3	41.63	22.43	11.88	34.3	75.93
21L	B797	26.96	17.73	44.68	30.87	9.66	40.53	85.21
21L	BD-700-1A11	0.6	0	0.6	0	0	0	0.6
21L	BEC58P	0.54	0	0.54	0.6	0.23	0.83	1.37
21L	CNA441	0.25	0	0.25	0.23	0.11	0.34	0.59
21L	DHC6	0.45	0	0.45	0.25	0.26	0.51	0.96
21L	DHC830	3.11	0.37	3.48	4.06	1.53	5.59	9.07
21L	HS748A	0.25	0	0.25	0.11	0.23	0.34	0.59
21L	SF340	0.25	0	0.25	0.11	0.23	0.34	0.59
21L Total		**124.94**	**68**	**192.93**	**113.45**	**45.5**	**158.95**	**351.88**
21R	1900D	0.2	0.18	0.38	0	0	0	0.38
21R	737800	1.65	0.83	2.49	1.65	0.9	2.55	5.04
21R	7378MAX	1.61	0.8	2.41	1.71	0.81	2.53	4.94
21R	7878R	6.32	5.15	11.47	6.51	3.85	10.37	21.83
21R	A221	2.43	0	2.43	3.49	1.37	4.86	7.3
21R	A223	5.67	2.73	8.39	5.88	2.36	8.24	16.64
21R	A319NEO	5.71	2.74	8.45	5.86	2.37	8.23	16.68
21R	A320NEO	3.34	1.48	4.82	3.31	1.76	5.07	9.9
21R	A321NEO	3.29	2.97	6.26	3.79	1.82	5.61	11.87
21R	A338	0.29	0.64	0.93	0.52	0.32	0.84	1.77
21R	A351	6.12	4.36	10.48	5.9	4.53	10.43	20.91
21R	A359	4.77	3.43	8.2	4.88	2.8	7.68	15.88
21R	B7379MAX	2.26	2.97	5.23	2.97	1.8	4.77	10
21R	B779	4.09	2.23	6.31	4.08	1.93	6.01	12.32
21R	B781	3.26	1.91	5.17	3.31	1.98	5.3	10.47
21R	B797	5.37	3.94	9.31	7.14	2.17	9.31	18.62
21R	BD-700-1A11	0	0.3	0.3	0	1.36	1.36	1.66
21R	BEC58P	0.83	0.36	1.18	0.62	0	0.62	1.8
21R	CNA441	0.32	0.08	0.4	0.16	0	0.16	0.56
21R	DHC6	0.2	0.19	0.38	0	0	0	0.38
21R	DHC830	3.88	0.49	4.37	0.39	0	0.39	4.77
21R	HS748A	0.39	0.12	0.51	0	0	0	0.51
21R	SF340	0.39	0.12	0.51	0	0	0	0.51
21R Total		**62.38**	**38.01**	**100.39**	**62.2**	**32.12**	**94.32**	**194.71**

		Arrivals			Departures			
Helipad	Aircraft Type	Day	Night	Total	Day	Night	Total	Grand Total
PER	EC130	2.59	0.15	2.74	2.59	0.15	2.74	5.48
PER Total		2.59	0.15	2.74	2.59	0.15	2.74	5.48

Table 7-4 ANEC 2 aircraft movement data
Source: Perth Airport

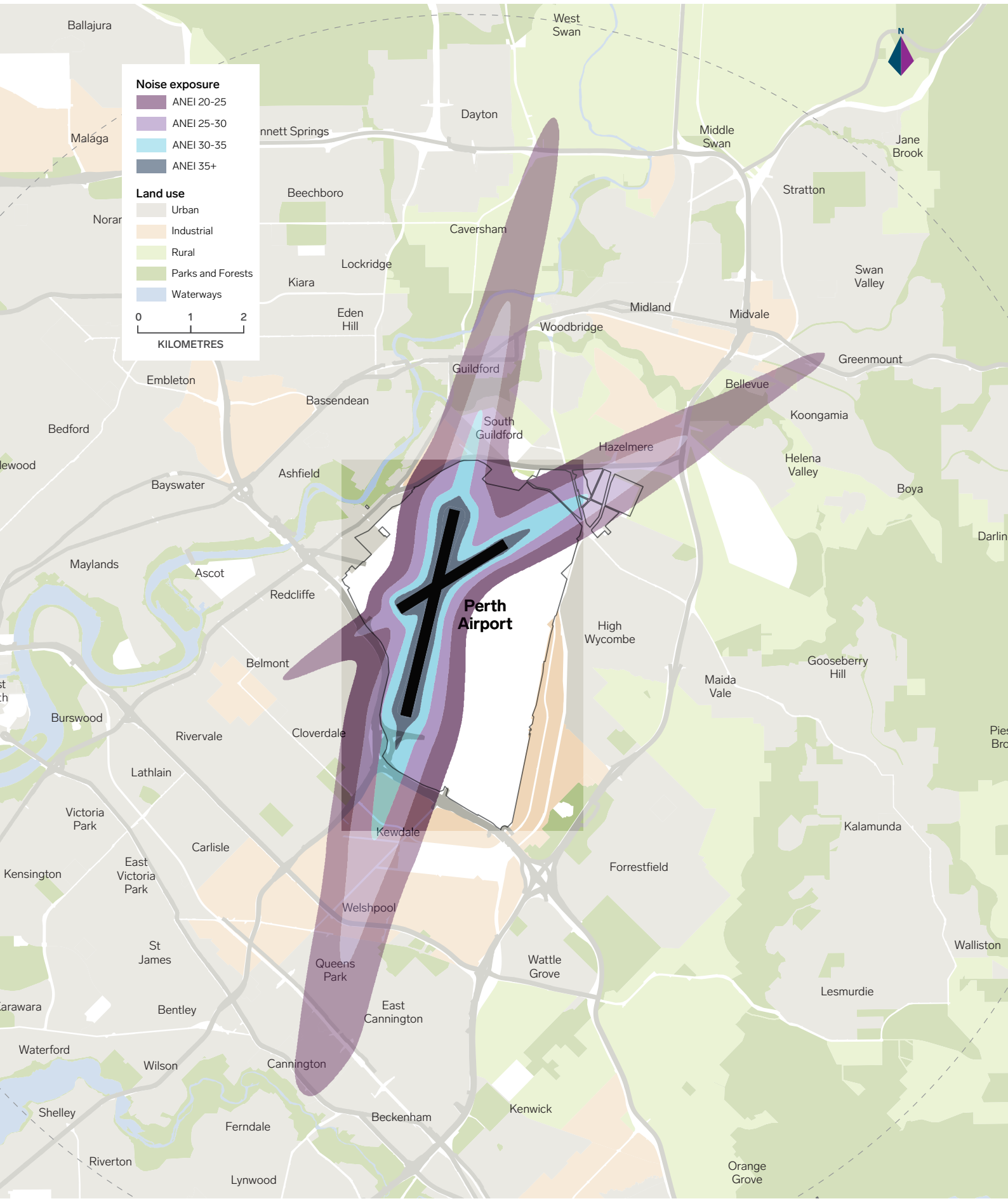


Figure 7-5 2016 ANEI
Source: Perth Airport

7.3.3.1 ANEI

The ANEI is provided in Figure 7-5. The ANEI shows the average daily aircraft noise exposure based on aircraft movements for the year 2016.

7.3.4 Flight Paths

Flights paths can be considered 'highways in the sky'. They define three-dimensional routes that aircraft use to arrive at or depart from an airport.

Flight paths are often shown as a single line on a map, however, unlike a train on a railway line or a car on a highway, it is not always possible for aircraft to follow precisely along the line depicted. In practice, a flight path can vary up to several kilometres or more. This occurs for a range of reasons, including:

- weather conditions,
- requirement to keep a safe distance between aircraft in the sky, and
- aircraft performance.

For visual presentation of flight paths, the path shown is based on a nominal spread around a central corridor. A flight path diagram illustrates flight paths in two ways:

- as a chart that visually shows:
  - if the flight path is used for arriving or departing aircraft, shown by different colours,
  - the approximate height of the aircraft, shown as a colour gradient, and
  - the potential width of the flight path.
- in a data table below the chart that shows:
  - the average number of times that an aircraft is likely to use the flight path per day, and
  - the average number of day and night aircraft that is likely to use the flight path.

The flight path diagrams are shown in Figure 7-7 to Figure 7-10 for each ANEC scenario and in either south flow or north flow.

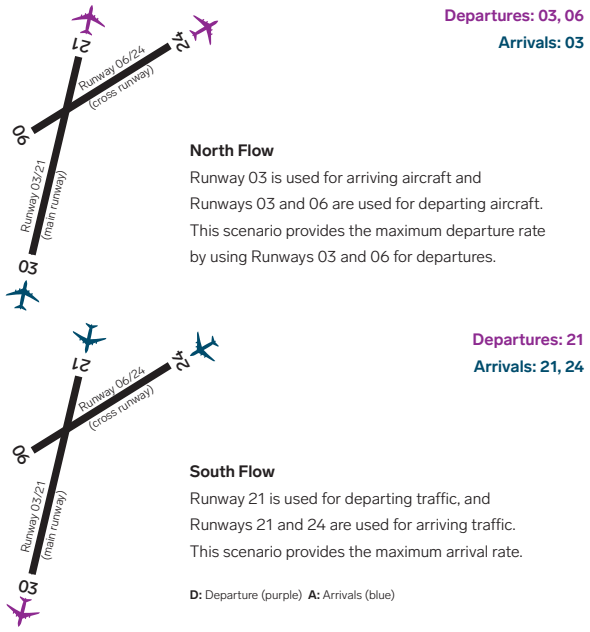


Figure 7-6 Perth Airport Operating Flows
Source: Perth Airport

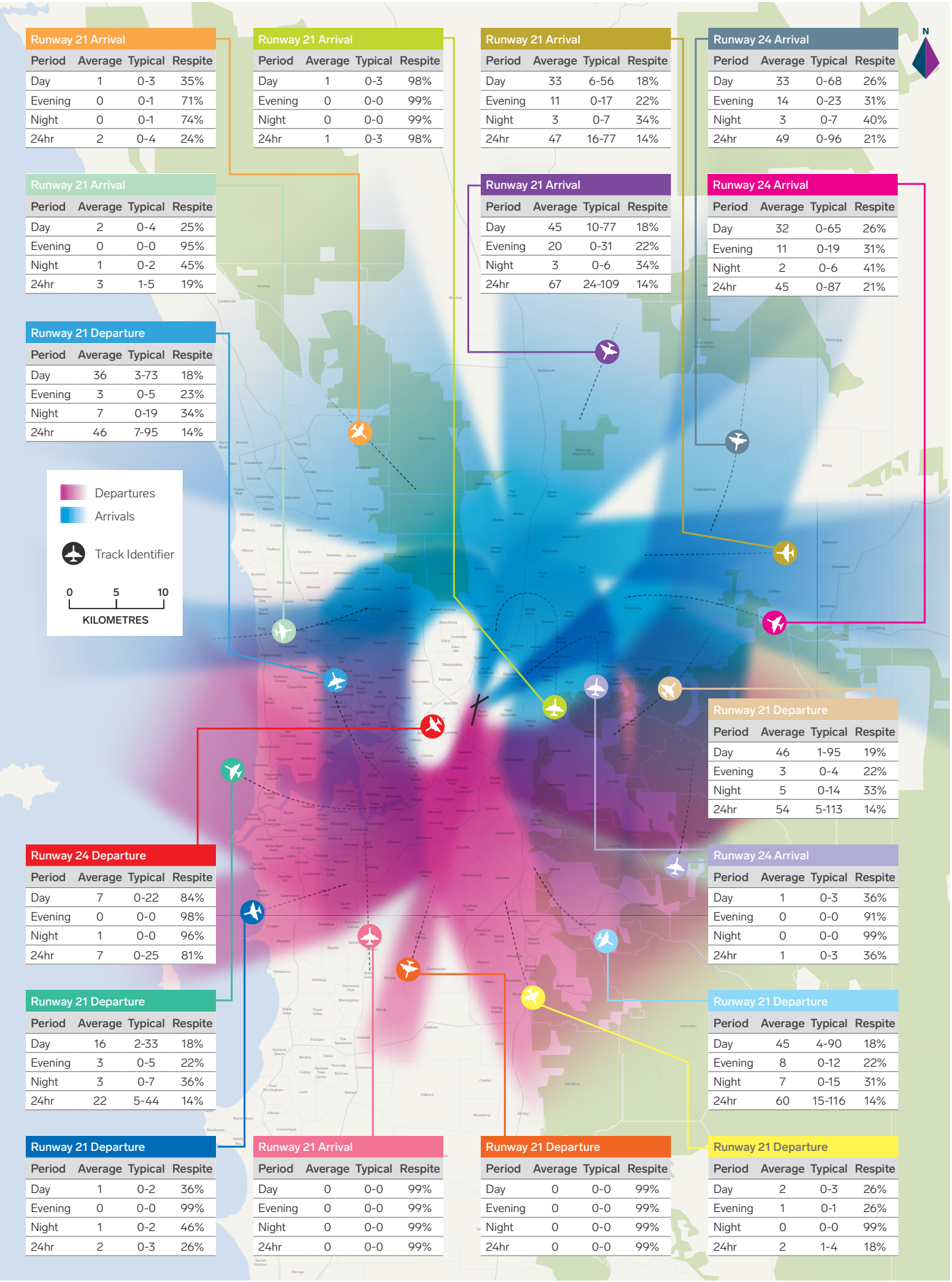


Figure 7-7 ANEC 1 south flow arrivals and departures flight path diagram
Source: Perth Airport

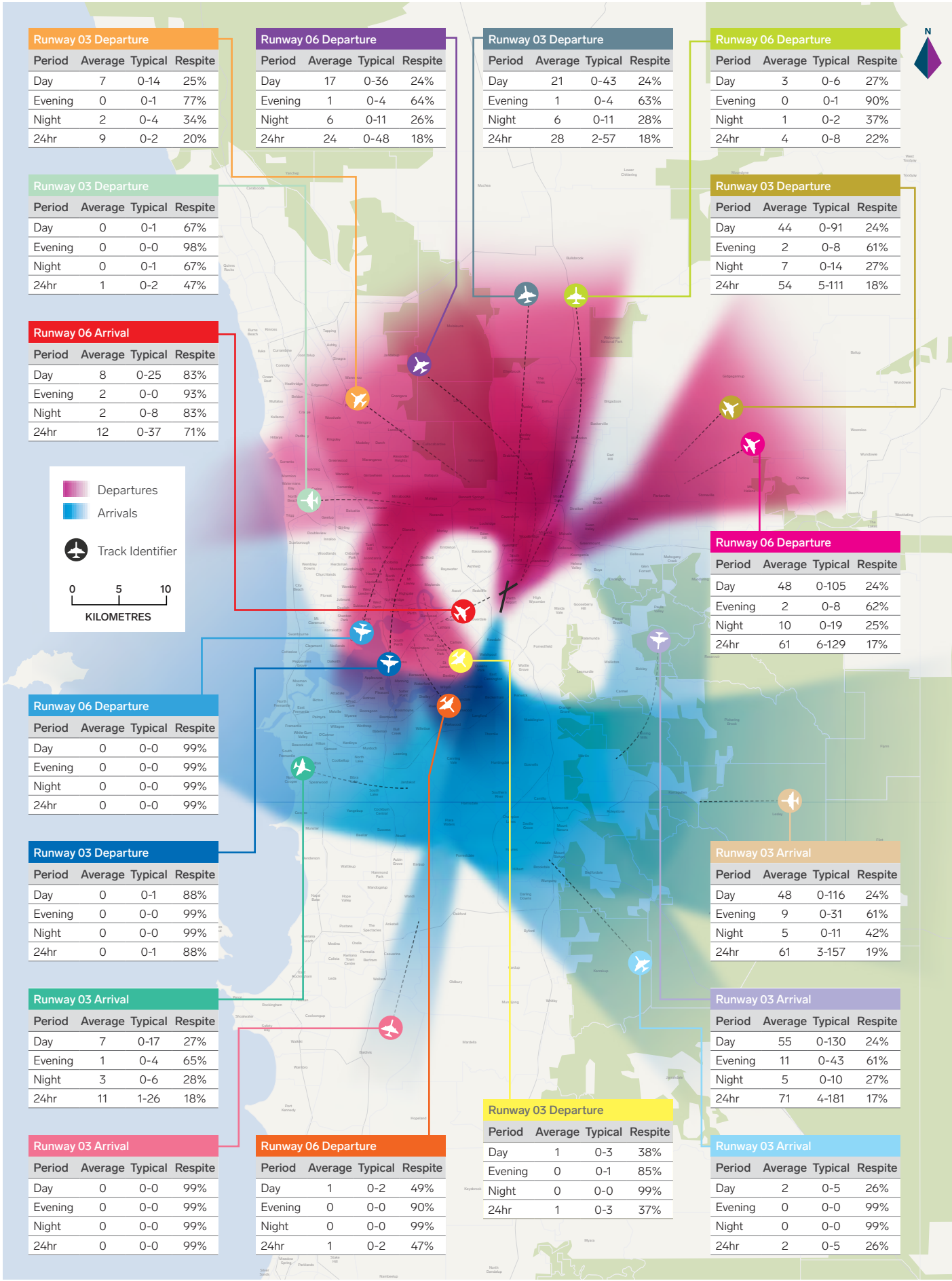


Figure 7-8 ANEC 1 north flow arrivals and departures flight path diagram
Source: Perth Airport

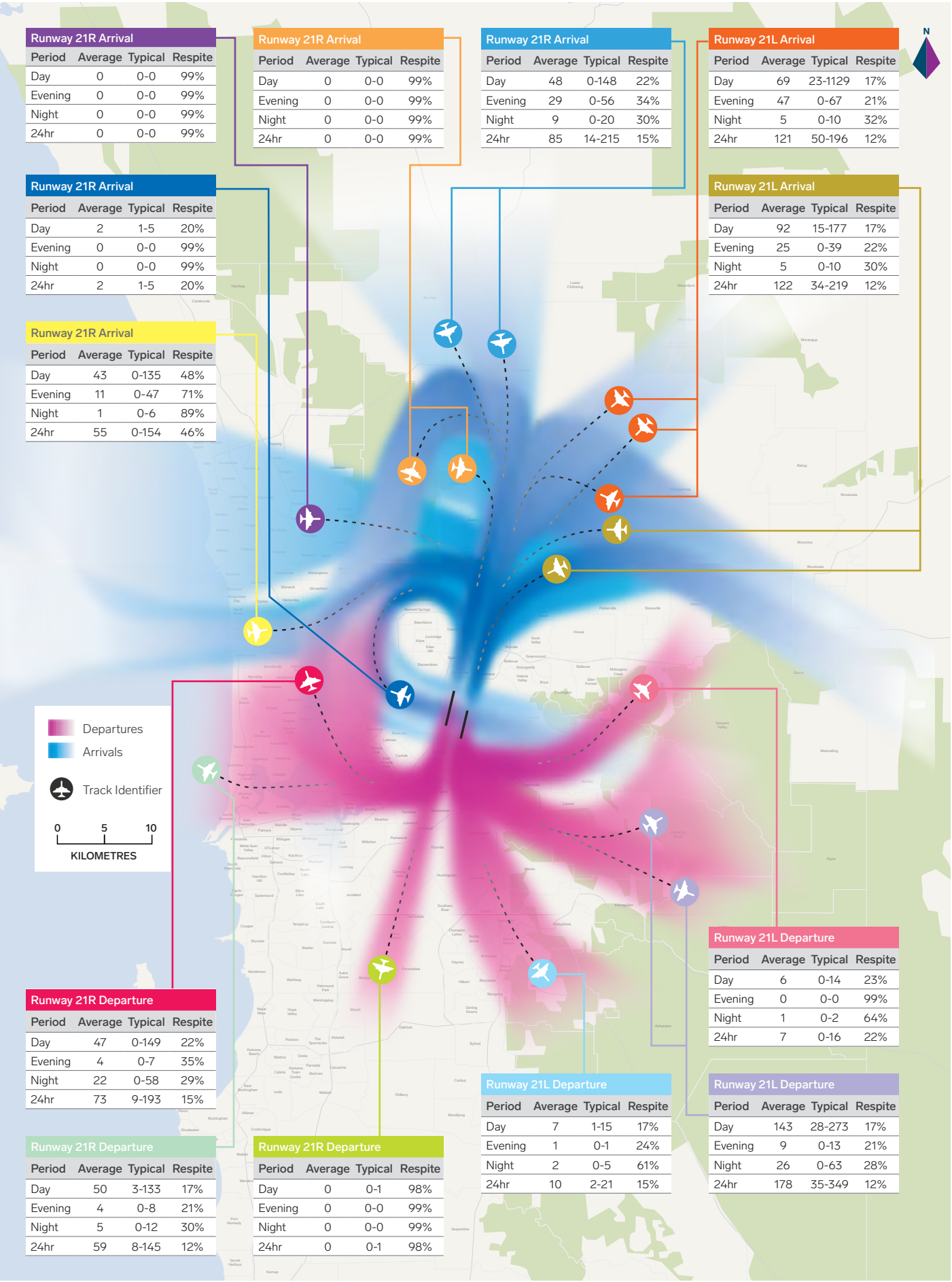


Figure 7-9 ANEC 2 south flow arrivals and departures flight path diagram
Source: Perth Airport
This diagram is based on Perth Airports projected movements at ultimate capacity. Based on the forecasts used in this Master Plan, it is expected Perth Airport will reach capacity around 2080.

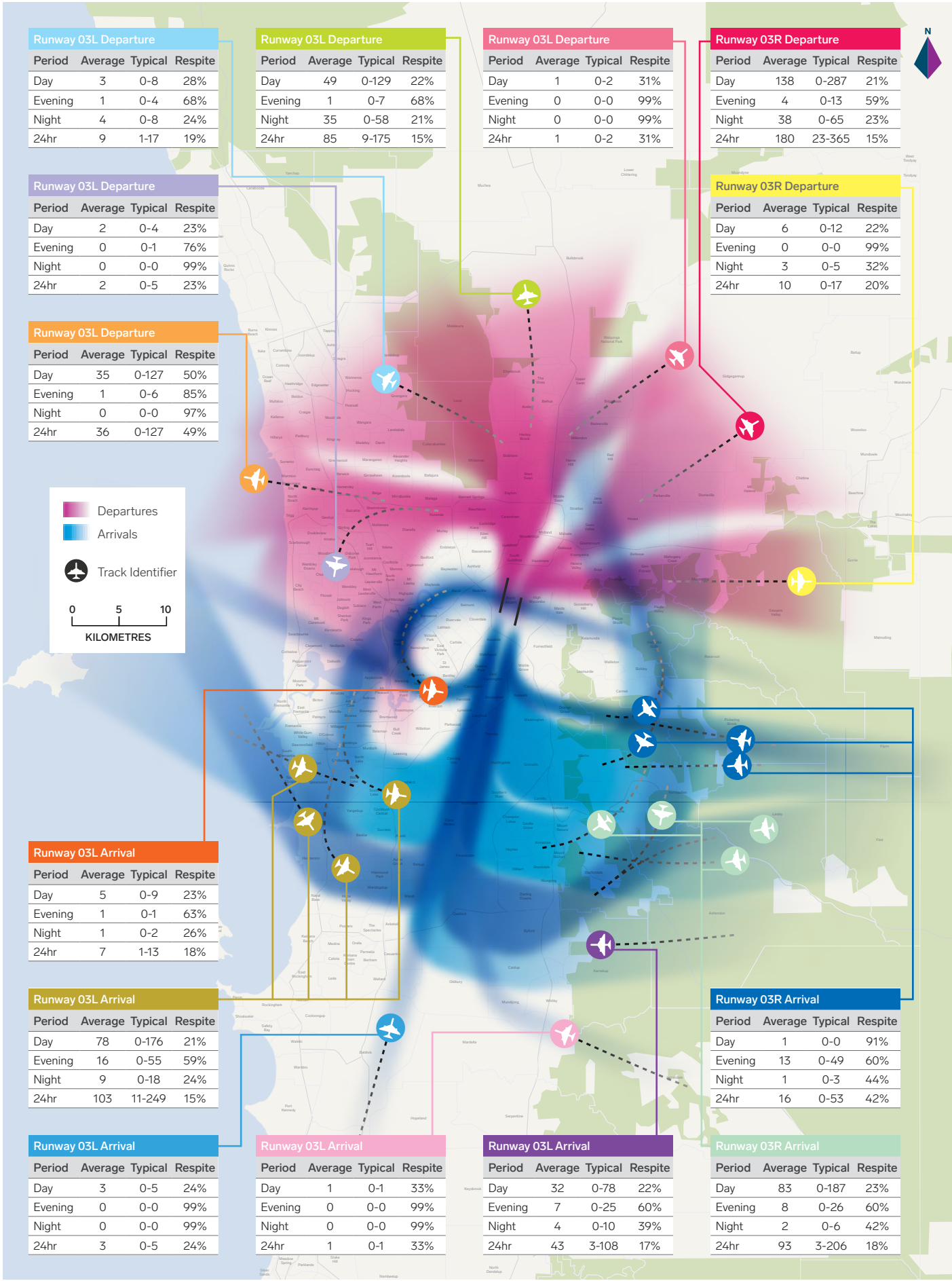


Figure 7-10 ANEC 2 north flow arrivals and departures flight path diagram
Source: Perth Airport
This diagram is based on Perth Airports projected movements at ultimate capacity. Based on the forecasts used in this Master Plan, it is expected Perth Airport will reach capacity around 2080.

7.3.5 Houses within the 30 ANEF Contour

The Airports Act requires a master plan to provide plans, developed in consultation with airlines and Local Government bodies within the vicinity of the airport, for managing aircraft noise intrusion in areas forecast to be above the significant ANEF (30 ANEF) levels.

There are 38 houses in the South Guildford and Guildford area that sit within the 30 ANEF contour.

Overall the net difference between the ANEF charts published in 2014 and 2020 is a decrease of approximately 69 residential properties with exposure above the significant ANEF levels (30 ANEF contour).

These changes are mostly attributed to:
- detailed preliminary design of the flight corridors for parallel runway operations,
- changes to forecast aircraft mix to incorporate quieter new-generation aircraft, and
- the use of AEDT software, a newer aircraft noise modelling tool which is more comprehensive and can model a greater range of current and new aircraft types.

As discussed in Section 7.2, Perth Airport works closely with Airservices, airline partners, Commonwealth, State and Local Governments to manage aircraft noise, with a focus on houses located within the 30 ANEF contour. Specific measures include land use planning controls, noise abatement procedures with preferred runways, and initiatives from the Perth Airport Aircraft Noise Technical Working Group (PAANTWG).

7.3.6 Supplementary Noise Metrics

The ANEF is a land use planning tool and does not necessarily fully convey the impact of aircraft noise and aircraft noise exposure to the community in a suitable manner. The frequency of over-flight and the sound level of a single aircraft are typically the two factors that determine how a person will perceive noise. These are not clearly translated by the ANEF system.

To improve how aircraft noise is communicated to the public, the then Commonwealth Department of Infrastructure and Transport developed 'Number Above' (or 'N' noise) contours. These contours illustrate the average number of events (single aircraft movements) per day that exceed a certain sound level.

The volume (loudness) of a sound depends on its sound-pressure level, which is expressed in decibels (dB). For measurement purposes, A-weighted decibels (dBA) are generally used because they take into account varying sensitivity of the human ear to different frequencies of sound.

Guidelines, including the NASF, suggest that an outdoor sound level of 70 dBA corresponds to an indoor noise level of approximately 60 dBA with the windows open. This is considered the sound level at which conversation and other indoor activities can generally be disturbed.

Perth Airport recognises that residents of the region enjoy an outdoor lifestyle, supported by a mild climate and an abundance of warm weather and sunshine during the summer months, which is often reflected in building construction. As a result, Perth Airport has historically adopted an outdoor sound level of 65 dBA for noise modelling, which correlates to an indoor noise level of approximately 55 dBA and is the sound level at which conversation may be disturbed. The N65 contours represent the average number of events per day over 65 dBA for an area. This is a conservative approach compared to other Australian airports to account for the anticipated prevalence of outdoor living.

For assessment of night-time noise impacts, it is customary to consider N60 values. The N60 describes the number of events exceeding 60 dBA external to a building, which would typically result in a maximum noise level of 50 dBA within a building having windows open to a normal extent. If this were the case in a room where a person is sleeping, a 50 dBA maximum noise level is considered to be close to the point at which noise may cause awakening.

N-above contours are presented for five or more events per period. This threshold is adopted because it represents a level above which aircraft noise would be considered a regular feature of the noise environment (i.e. five events per day). N-above values of five or more are considered appropriate for describing aircraft noise in areas that currently experience aircraft noise, as well as areas which would be newly affected. Furthermore, they provide sufficient resolution to describe the change in aircraft noise for both existing and newly exposed areas.

The Perth Airport N65 and N60 contour plans, based on 2016 aircraft movements and the ultimate capacity forecast, are provided in Figure 7-11 to Figure 7-14.

The 'Number Above' noise contours represent an average day and not a typical day. On a typical day, residents may actually experience more events or less events than the N-above contours suggest. This is because the traffic at Perth Airport varies significantly from weekdays to weekends and depending on the runway being used at any particular time.

As outlined in Section 7.2.3, Perth Airport has developed a web-based portal to allow community members and representatives to more easily understand current and anticipated aircraft noise exposure. The web-based portal is available on Perth Airport's website at perthairport.com.au/aircraftnoise.

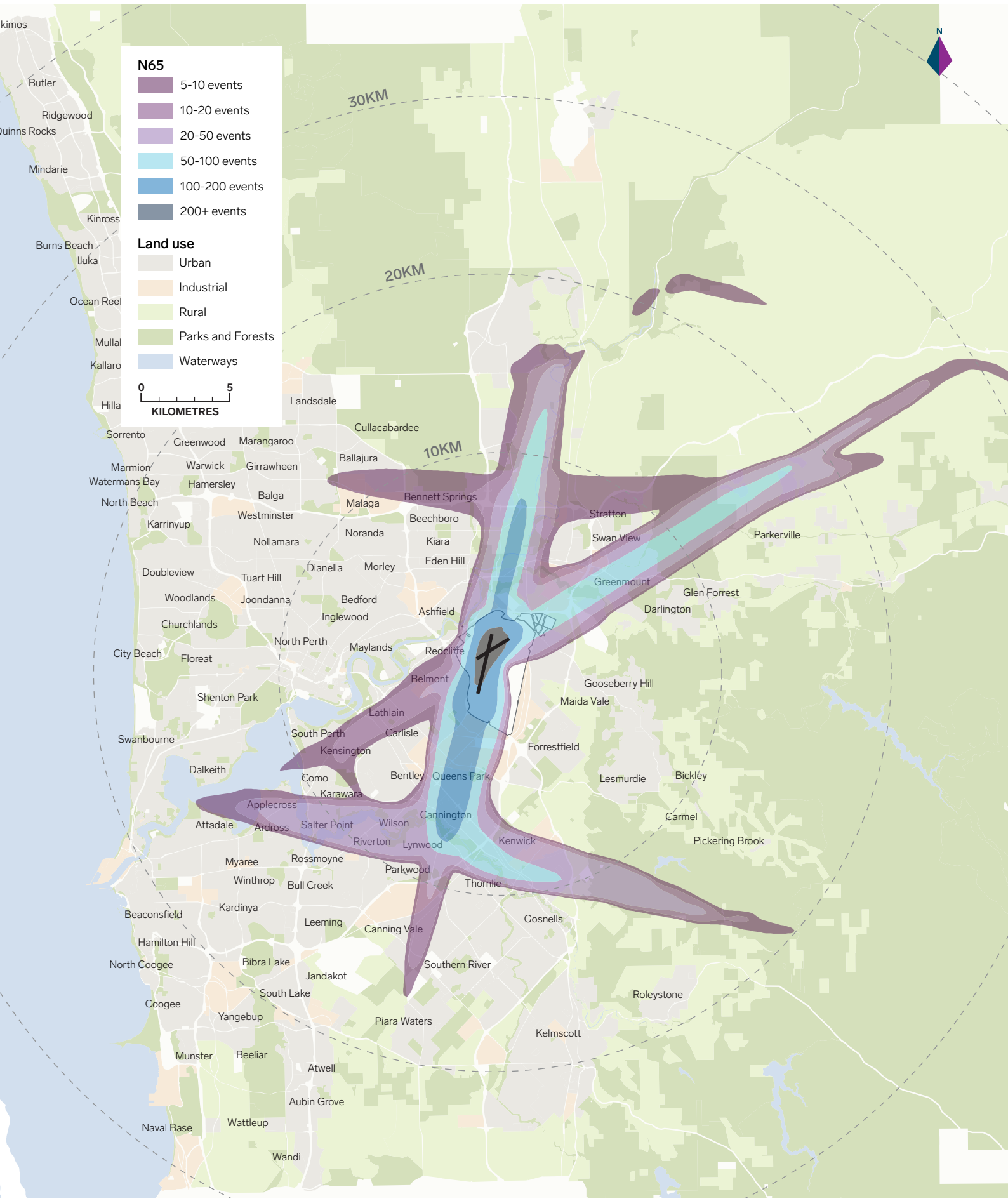


Figure 7-11 2016 N65 contour
Source: Perth Airport

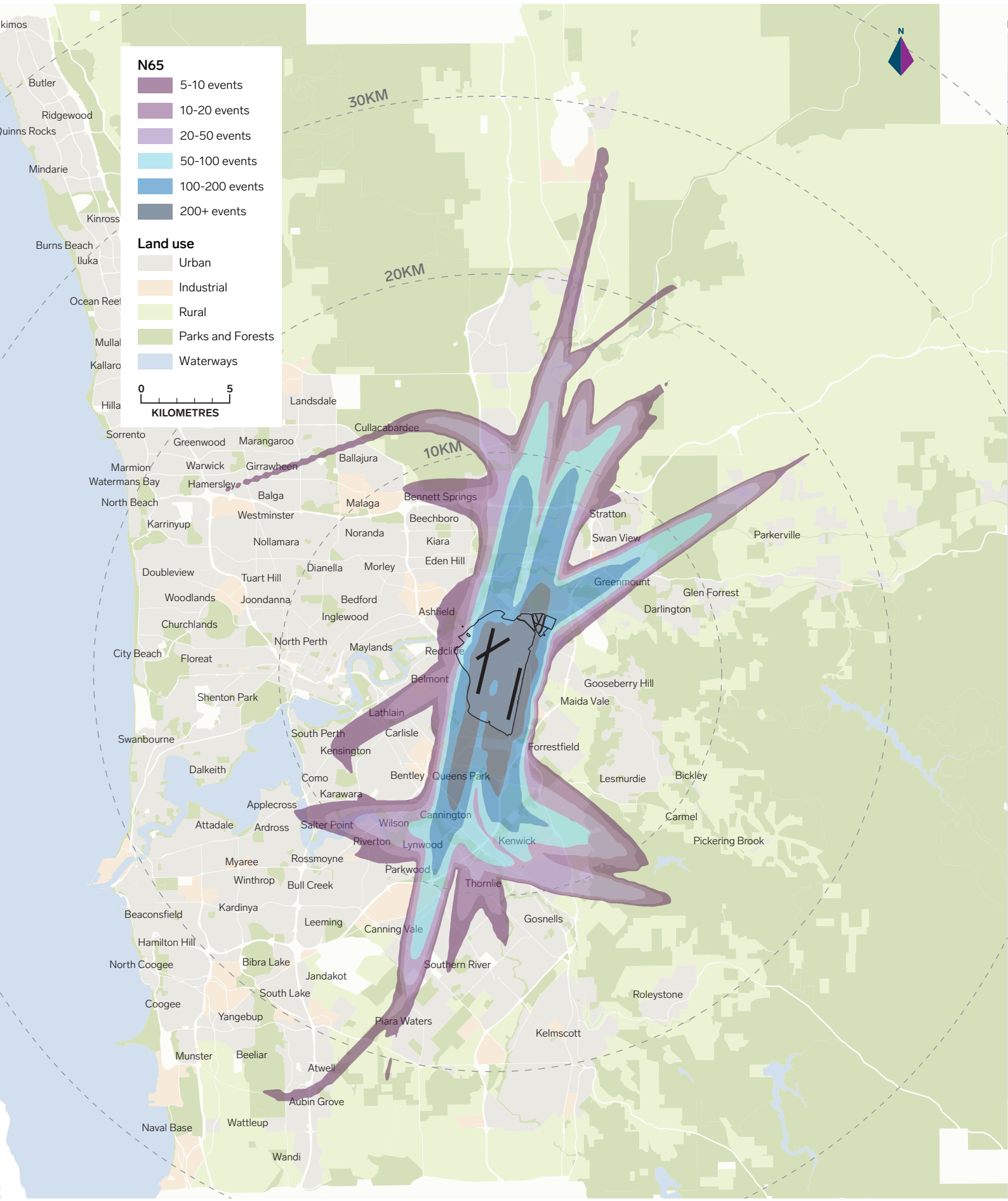


Figure 7-12 Ultimate N65 contour
Source: Perth Airport
This diagram is based on Perth Airports projected movements at ultimate capacity. Based on the forecasts used in this Master Plan, it is expected Perth Airport will reach capacity around 2080.

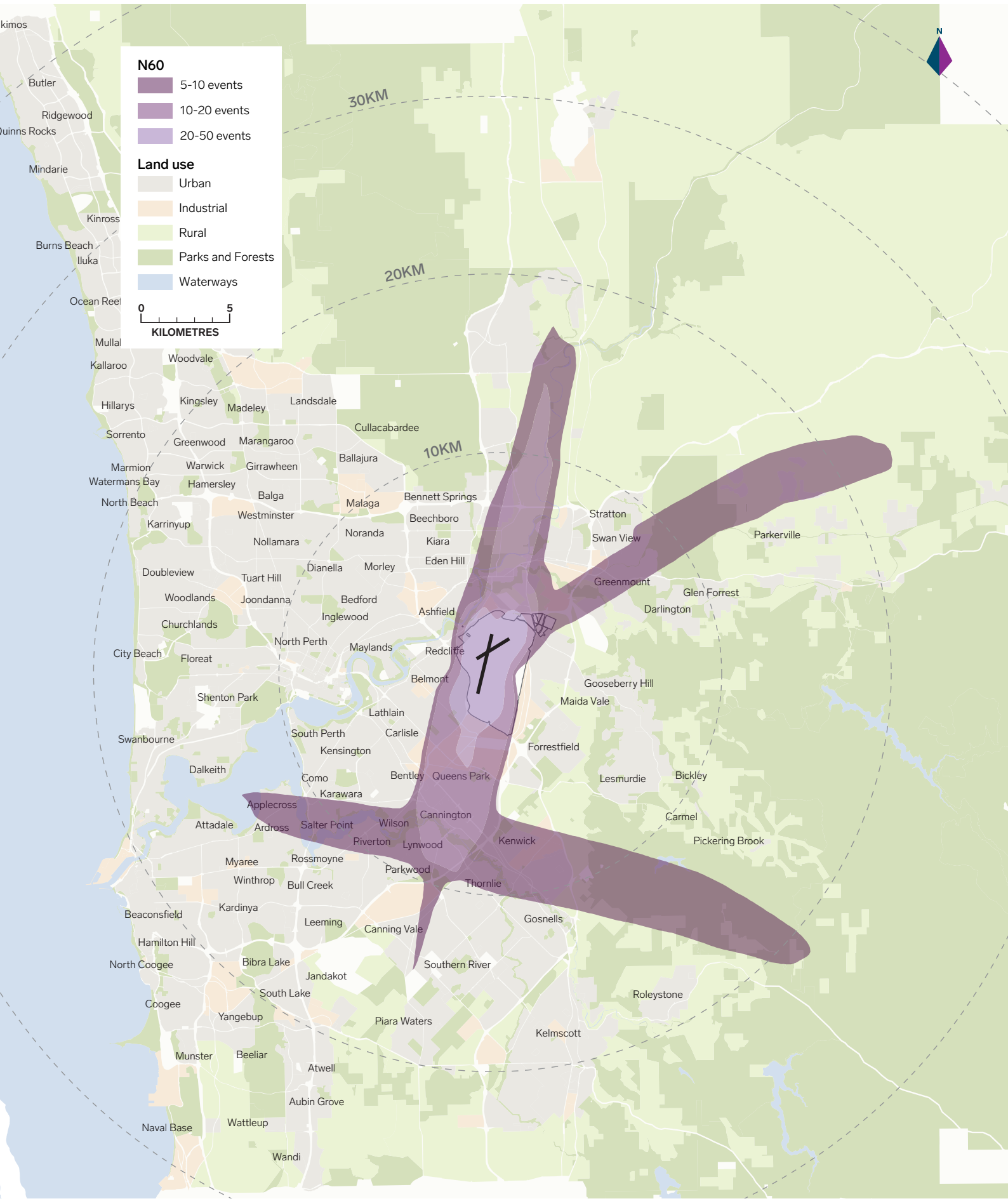


Figure 7-13 2016 N60 contour
Source: Perth Airport

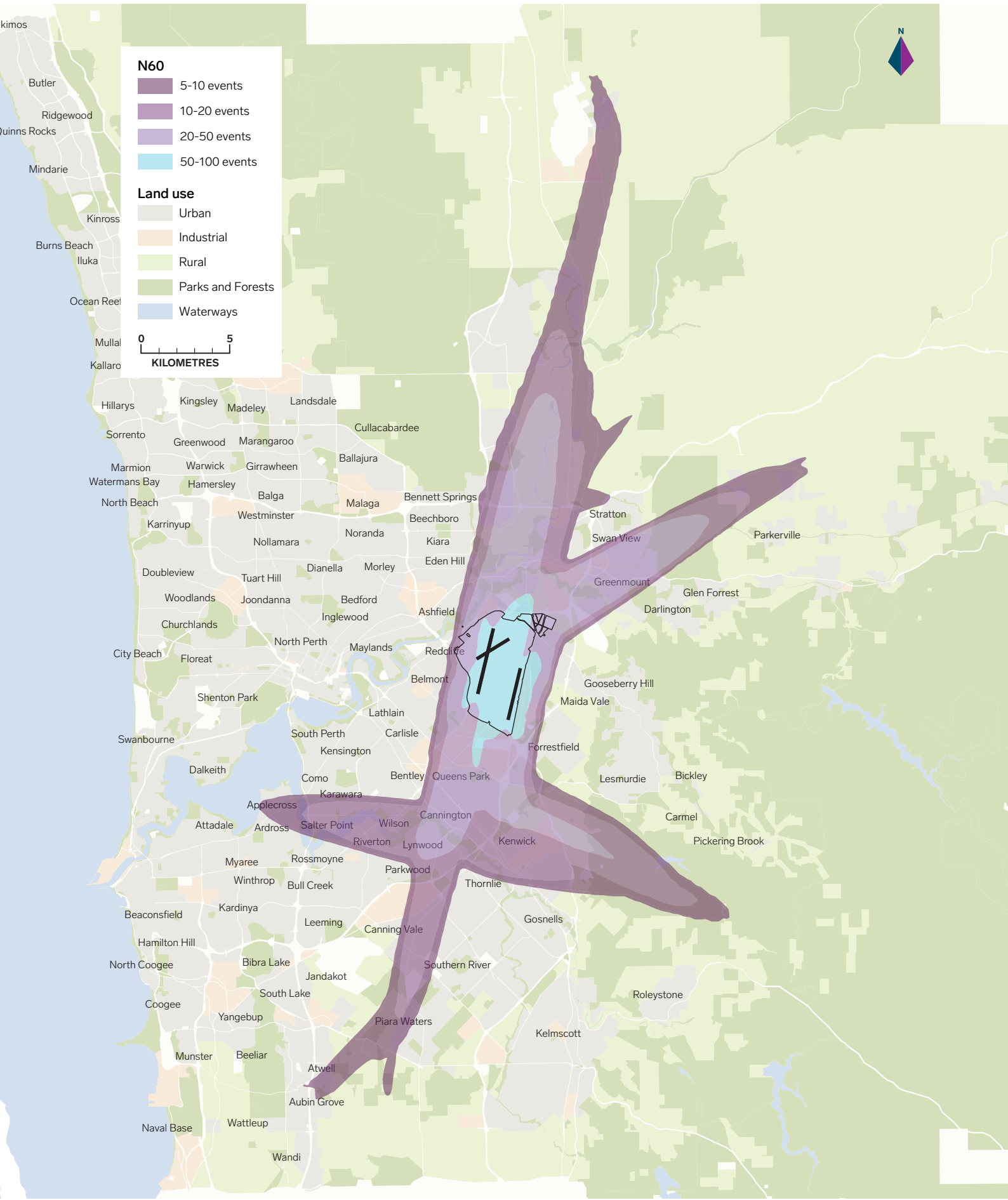


Figure 7-14 Ultimate N60 contour
Source: Perth Airport
This diagram is based on Perth Airports projected movements at ultimate capacity. Based on the forecasts used in this Master Plan, it is expected Perth Airport will reach capacity around 2080.

7.3.7 Ground Based Noise

Perth Airport has limited control of noise generated by aircraft on the ground.

An essential safety measure following maintenance of aircraft is to perform engine testing, known as 'ground running'. Perth Airport does not have major airline maintenance facilities and consequently has less ground running than other major airports. There is, however, a continuing requirement for aircraft operators to carry out engine ground running at Perth Airport.

Perth Airport acknowledges that engine ground running can contribute to the overall noise created at an airport and, as a result, has developed an Engine Ground Running Management Plan. The Management Plan places restrictions on the time, location, and maximum power settings for engine ground runs. Aircraft operators must seek approval from Perth Airport if a proposed engine run cannot be conducted in accordance with the endorsed parameters for time, power and location of ground running.

Although engine ground running is considered the critical factor in the generation of ground-based aircraft noise, there are other ground-based aircraft noise sources on the airfield, such as the use of Auxiliary Power Units which power aircraft while they are on the ground. One measure adopted by Perth Airport to reduce ground noise sources has been the installation of fixed electrical ground power units at aircraft parking positions to minimise the use of auxiliary power units and mobile ground power units.

Perth Airport regularly reviews its Engine Ground Running Management Plan to assess opportunities for improved noise management.

Other sources of ground-based noise are detailed in Section 9.

7.4 Airspace Protection

Protection of airspace required for Perth Airport's current and future needs is essential to provide a safe, predictable environment for the arrivals and departures of aircraft using Perth Airport in all weather conditions.

The Airports (Protection of Airspace) Regulations 1996 (APA Regulations) prescribe airspace around the airports for protection from activities that could pose a hazard to air navigation. These are referred to as controlled activities and include, but are not limited to:

- construction or erection of any building or other structure that may intrude into prescribed airspace, including construction cranes,
- an activity that results in artificial or reflected light that exceeds acceptable light intensities or is capable of blinding or confusing pilots,
- an activity that results in air turbulence, and
- an activity that results in the emission of smoke, dust, or other particulate matter.

Prescribed airspace comprises the airspace above the lower of two sets of defined invisible surfaces above the ground known as the Obstacle Limitation Surfaces (OLS) and Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) surfaces.

OLS defines the airspace that should ideally be kept free of obstacles. These surfaces only relate to visual operations or the visual stages of an instrument flight. The purpose of the OLS is not to restrict or prohibit all obstacles but to ensure that existing or potential obstacles are examined for their impact on aircraft operations and that their presence is properly considered.

PANS-OPS surfaces define the airspace related to aircraft operations that are reliant on instrument navigation. PANS-OPS surfaces are not to be permanently infringed in any circumstance.

The APA Regulations require that details of proposed controlled activities are provided to Perth Airport to be assessed against the OLS and PANS-OPS. Perth Airport follows the Processing Applications under the APA Regulations Guidelines for Operations of Federal Airports, published by the then Commonwealth Department of Infrastructure and Transport.

Perth Airport assesses proposed short-term controlled activities against the OLS and PANS-OPS to ensure day to day operations are not impacted by an infringement. Perth Airport also uses the OLS and PANS-OPS to safeguard the planned new runway and its associated airspace against any proposed long-term or permanent development which could cause an infringement.

For proposals within the airport estate, controlled activities are identified and addressed through Perth Airport's development approval and consent processes. For proposals outside of the airport estate, Local Governments should refer applications for developments or structures that may constitute a controlled activity to Perth Airport for assessment.

Any controlled activity that is found to infringe the prescribed airspace is referred to Airservices and CASA for review before being submitted to the Department of Infrastructure, Transport, Regional Development and Communications for approval.

Conditions may be imposed on an approval which will be monitored by Perth Airport, with any breach reported and rectification required. Developments and structures of a short-term basis (up to three months), typically cranes, may be approved by Perth Airport following consultation with Airservices and CASA.

Buildings and structures comprise the majority of potential controlled activity, as well as erection and operation of construction cranes, that need assessment.

Perth Airport has prepared Structure Height Control Contour plans that indicate the height at which a building or structure triggers the need for a referral to Perth Airport for assessment. There are areas identified immediately adjacent to the airport, and particularly in the final approach and take-off areas, where the airport requires all development and structures to be referred for assessment.

Perth Airport has developed an online system for the assessment and management of crane applications and permanent structures. The Protected Airspace Assessment Tool (PAAT) (https://paat.perthairport.com.au) will automatically issue a permit if no airspace infringement is detected. Perth Airport receives notification of any assessments that would result in an airspace infringement, and relevant applications are then issued to Airservices, CASA and Department of Infrastructure, Transport, Regional Development and Communications for approval where required.

In 2001, Perth Airport declared the prescribed airspace including the new runway at 2,700 metres long. Following approval of the Master Plan 2014 Minor Variation, which extended the runway length from 2,700 to 3,000 metres as a result of changed design standards for runway approach lighting, Perth Airport has commenced the process of updating the prescribed airspace and declaration in accordance with Part 2 of the Regulations. Perth Airport will ensure notice is issued as per the APA Regulations and new prescribed airspace charts are published, and displayed on the Perth Airport website.

The current long-term OLS for Perth Airport is shown in Figure 7-15. The current long-term critical PANS-OPS surface for Perth Airport is shown in Figure 7-16. Both of these plans consider the future runway infrastructure as outlined in Section 4, which is subject to approval.

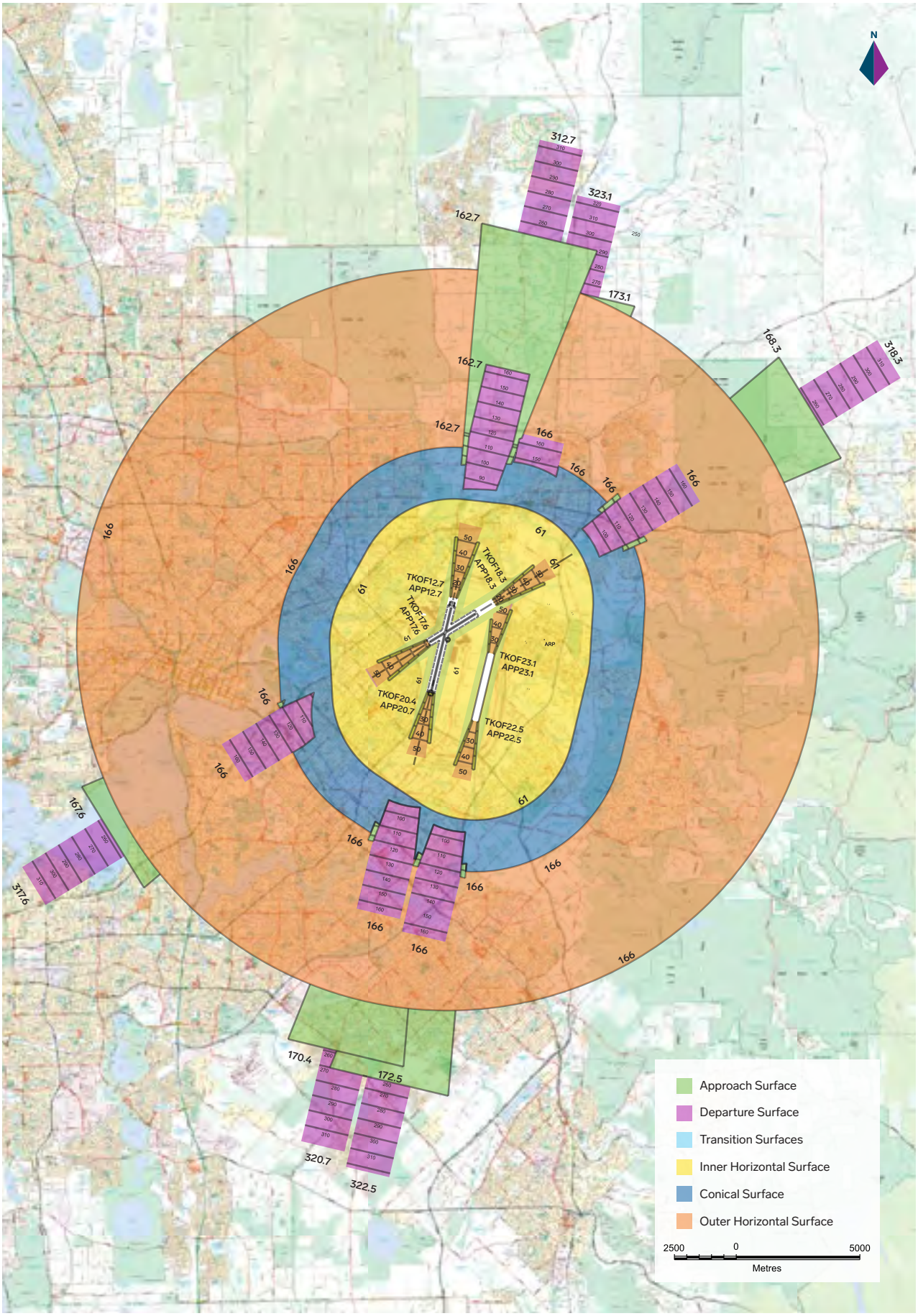


Figure 7-15 Perth Airport Obstacle Limitation Surface (OLS)
Source: Perth Airport

Figure 7-16 Perth Airport Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS)
Source: Perth Airport

7.5 Managing the Risk of Wildlife Strikes in the Vicinity of Perth Airport

Wildlife around aerodromes can present serious hazards to aircraft operations. The most obvious of these is the presence of birds, but other animals can also present a hazard.

Under the Civil Aviation Safety Regulations 1988 Part 139, Perth Airport is required to control the risk of wildlife striking operating aircraft. Perth Airport has a comprehensive Wildlife Hazard Management Plan that incorporates monitoring, assessment, reporting, and control methods for bird and animal hazards. CASA regulates and conducts surveillance and ensures that the risk of wildlife striking aircraft at Perth Airport is being adequately managed.

Perth Airport also manages vegetation and open waterways across the estate to minimise the attraction of species that may pose a risk to aircraft safety. As part of Perth Airport's commitment to managing the risk of wildlife strikes, a project to net open drains throughout the airfield commenced in 2017. This $1.7 million project resulted in over three kilometres of previously uncovered open drains becoming netted.

Aviation safety regulations do not address the risk of bird strikes that occur outside the airport boundary in the same way as they address on-airport risks. However, there is still a risk of bird strike off-airport. The NASF has guidelines for managing the risk of wildlife strikes in the vicinity of airports to inform State and Local Governments. Perth Airport works with these planning authorities to monitor conflicting land uses or changing waste disposal strategies, such as landfills, that may cause wildlife and birds to pass or roost in the vicinity of the airport.

7.6 Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation

Wind turbine farms can be hazardous to aviation as they are tall structures with the potential to come into conflict with low-flying aircraft. There is also the possibility for wind turbines to cause turbulence which is noticeable up to 16 rotor diameters downwind of the turbine. The NASF Guideline D – Managing the Risk to Aviation Safety of Wind Turbine Installations states that proposed wind turbines that are greater than 150 metres above the ground and within 30 kilometres of an aerodrome should be referred to CASA and Airservices (or the Department of Defence for a military aerodrome).

The probability of a wind farm or turbine of this scale being proposed within 30 kilometres of Perth Airport is very low and the vast majority of aircraft operations at Perth Airport would not be considered low flying. However, Perth Airport will comply with NASF Guideline D and notify CASA if it becomes aware of any proposal for wind farms within 30 kilometres of the airport which could potentially interfere with current or proposed flight corridors.

7.7 Managing the Risk of Distractions to Pilots from Lighting

Glare from ground lights or large reflective surfaces near the runway have the potential to obscure vision or cause confusion and distraction for pilots and air traffic controllers.

Guidance to designers and installation contractors is provided for ground lighting within six kilometres of the estate under Civil Aviation Safety Regulations 1988 Part 139 and Manual of Standards Part 139, which specify maximum ground lighting intensities (measured at three degrees above the horizontal) within four light zones which surround a runway. These zones reflect the degree of interference ground lights can cause as a pilot approaches to land, with the closest zone the most onerous.

The lighting zones for Perth Airport is shown in Figure 7-17.

CASA has the power, through Regulation 94 of the Civil Aviation Regulations 1988, to require interfering lights to be extinguished or modified. Lights within six kilometres of the estate are most likely to be subjected to the provisions of Regulation 94.

The fact that a certain type of light fitting already exists in an area is not necessarily an indication that more lights of the same type can be added to the same area.

Even though a proposed installation is designed to comply with the zone intensities, designers are advised to consult with CASA as there may be overriding factors which require more restrictive controls to avoid conflict.

The regulations pertaining to lighting intensity also address sources of glare that may distract pilots. This has become increasingly significant as the popularity of solar panels continues to grow. Perth Airport will continue to work with CASA in the assessment of relevant solar panel applications.

Further guidance for managing the risk of distractions to pilots from lighting near airports is provided in the NASF Guideline E – Managing the Risk of Distractions to Pilots from Lighting in the Vicinity of Airports.

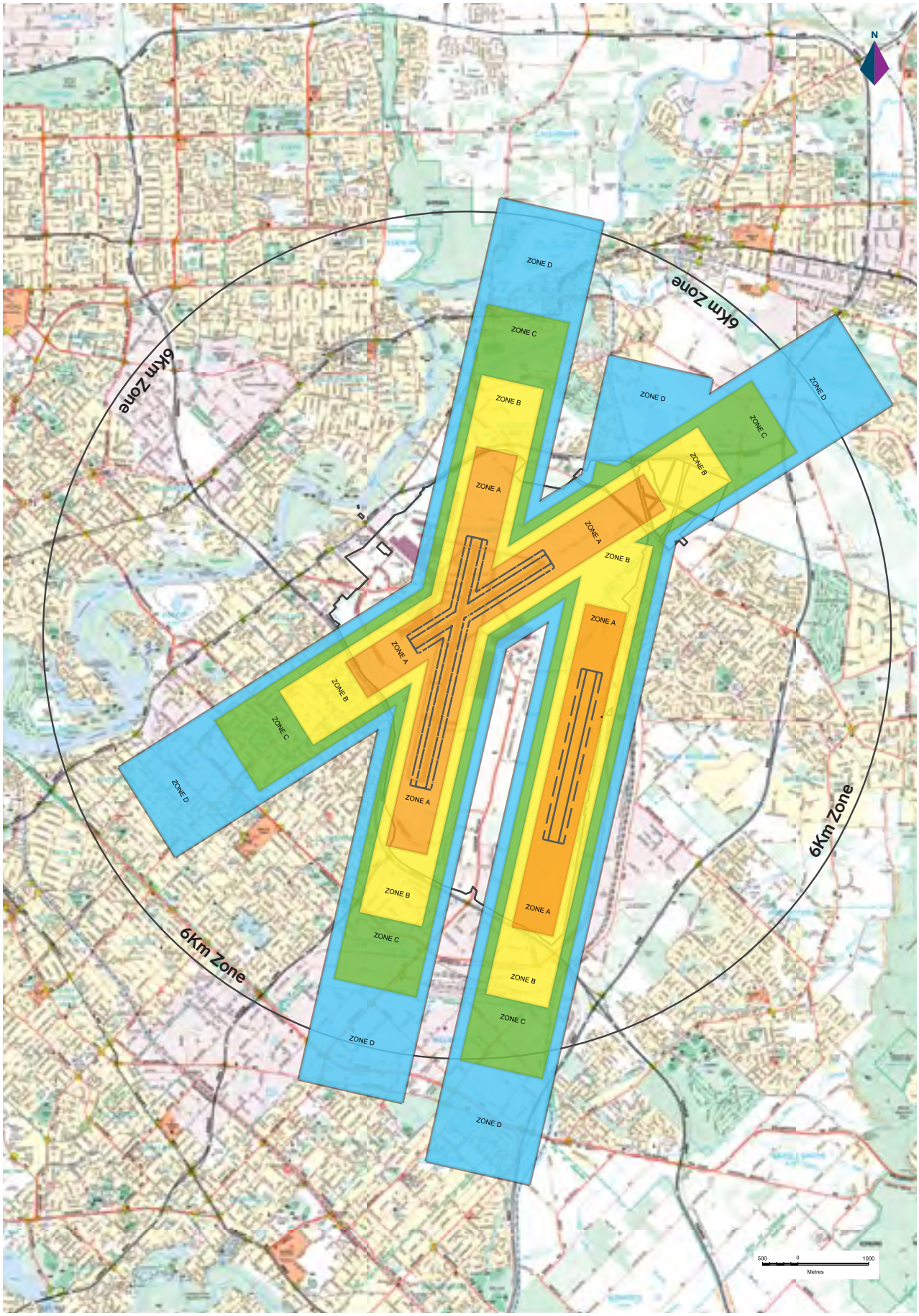


Figure 7-17 Perth Airport Lighting Control Zones
Source: Perth Airport

Figure 7-18 Windshear Trigger Assessment Areas
Source: Perth Airport

7.8 Managing the Risk of Building Generated Windshear and Turbulence

The risk of windshear (a change of wind speed and/or direction over a relative short distance) created from a large building or terrain located in the vicinity of a runway is a critical consideration for safe airport operations.

Windshear poses the greatest risk on approach, landing and take-off when an aircraft's speed is low and the pilot's ability to respond is more limited.

Building-generated windshear becomes critical to safety when a significant obstacle, such as a building, is upwind of the approach path to an operational runway. In such circumstances, wind flow may be diverted around and over the building, causing the wind speed and direction to vary along the approach path.

Perth Airport's development approval process considers NASF Guideline B. Guideline B does not attempt to regulate the assessment process or mitigation of risks, but rather provide a framework for preliminary assessment of individual risks so that they can be either discounted or made the subject of more detailed analysis.

Guideline B outlines a staged process for the assessment of buildings and obstacles near airports with regards to building generated windshear and turbulence. Firstly, Guideline B defines an area based on distances from the extended runway centreline and runway ends within which buildings and other obstacles are considered to pose a safety risk in terms of windshear and turbulence. This area is referred to as the 'assessment trigger area'. The second stage of assessment is to test whether single buildings or obstacles within the assessment trigger area infringe the 1:35 surface. The 1:35 surface is a defined invisible surface that originates at the runway centreline and rises 1m for every 35m perpendicular to the runway centreline (i.e. at 350m perpendicular from the runway centreline this surface has risen 10m). Any buildings or structures that penetrate this surface should be further assessed and aerodynamic modelling may be required. This rule is noted as being very conservative and any building that does not penetrate the 1:35 surface is considered not to create unsafe wind effects.

The windshear assessment trigger areas as described in the Guideline are shown in Figure 7-18. The assessment trigger areas shown consider the existing runway layout as well as the new runway and the potential future extensions of the main and cross runways. When determining the siting of buildings within the trigger assessment areas, the prevailing wind conditions are considered to gain an understanding of how often they will be upwind of the approach path to the runway. The height of the buildings is also considered.

7.9 Protecting Aviation Facilities – Communications, Navigation and Surveillance

There are a number of communication, navigation and surveillance systems (CNS) on or near Perth Airport that are critical to the safe and efficient operation of aircraft. Airservices typically installs and maintains these systems at Perth Airport. Such systems currently in operation at Perth Airport include:

- Instrument Landing System (ILS) (localiser/glideslope),
- VHF Omnidirectional Range (VOR) / Distance Measuring Equipment (DME),
- microwave link path, and
- Terminal Area Radar (TAR).

Objects such as aircraft, buildings, vehicles and other facilities emitting electromagnetic energy can interfere with these systems.

Development and construction proposals on the airport estate, or referred to Perth Airport by surrounding Local Governments, are assessed in consultation with Airservices to ensure the performance of such facilities remains acceptable and that current and future anticipated systems are suitably protected in accordance with the Civil Aviation Safety Regulations 1988.

This involves the protection of land for equipment installations (including protection for required services such as a fibre optic communication systems) and any potential airspace required for its operation.

Perth Airport works with Airservices to assess, and when appropriate, introduce new technologies that may improve safety, performance, economics and efficiency of Perth's air traffic and airspace.

7.10 Public Safety Areas

Public Safety Areas (PSA) are areas of land at the ends of the runways, identified by quantifiable risk contours, within which development is restricted in order to control the number of people on the ground at risk of death or injury in the event of an aircraft accident on take-off or landing. PSA risk contours are developed based on runway use statistics correlated against international crash data and provide an objective basis for precautionary planning decisions in those areas of highest risk.

Perth Airport has adopted the United Kingdom (UK) approach to public safety as detailed in NASF 'Guideline I — Managing the Risk in Public Safety Areas at The Ends of Runways'.

Under the UK model, the PSA is generally broken into two areas representing 1-in-10,000 and 1-in- 100,000 probabilities of being killed or injured per year from an aircraft accident. Although the boundary of a PSA generally corresponds with the 1-in-100,000 contours, the predicted level of risk within this area may be higher. The model considers the maximum tolerable level of individual third-party risk of being killed as a result of an aircraft accident as 1-in-10,000 per year. Any occupied residential properties, or commercial and industrial properties occupied as normal all-day workplaces, within the 1-in-10,000 are not recommended.

In the remaining PSA between the 1-in-10,000 and 1-in-100,000 individual risk contours, developments which involve a low density of people working or congregating is considered acceptable. For example, this may include car parking, open storage or certain types of warehouse development. According to the NASF Guideline I, new residential buildings should not be permitted within this area of the PSA, however existing developments may remain. The compatibility for new developments is shown in Table 7-5.

Perth Airport has developed PSA contours that reflect the ultimate development and demand of the airport at approximately 362,000 movements per year of which the 1-in-10,000 and 1-in-100,000 areas are shown in Figure 7-19.

PSA	Compatible uses	Incompatible uses/activities
INNER AREA — 1 in 10,000	• Long stay and employee car parking (where the minimum stay is expected to be in excess of six hours) • Built development for the purpose of housing plant or machinery and would require no people on site on a regular basis, such as electricity switching stations or installations associated with the supply or treatment of water • Golf courses, but not club houses (provided appropriate mitigation measures are in place to reduce wildlife attraction risk - see NASF Guideline C)	• Accommodation activities: This includes dwelling houses, multiple dwellings, resort complexes, tourist park, hostels, retirement villages or other residential care buildings • Community activities: educational establishment, community centres, hospitals, theatres, child- care and playgrounds, detention facilities, place of worship • Recreation activities: This includes parks, outdoor recreation and sport, major sport and entertainment facilities • Entertainment and centre activities: Shopping centres, service stations, showrooms, markets, hotels, theatres, tourist attraction, garden centres • Industrial and commercial uses involving large numbers of workers or customers: Intensive uses such as high impact, medium and low impact industry, warehousing, services industry • Manufacture or bulk storage of flammable, explosive or noxious materials • Public passenger transport infrastructure: This includes bus, train and light rail stations
OUTER AREA — 1 in 100,000	• Long stay and employee car parking (where the minimum stay is expected to be in excess of six hours) • Shorter stay car parking (with a safety case — depends on intensity of use) • Built development for the purpose of housing plant or machinery and would require no people on site on a regular basis, such as electricity switching stations or installations associated with the supply or treatment of water • Golf courses, but not club houses (provided appropriate mitigation measures are in place to reduce wildlife attraction risk) • Open storage and types of warehouses with a very small number of people on site. The planning authority could consider imposing conditions to prevent future intensification of the use of the site and limit the number of people to be present on the site • Developments which require few or no people on site on a regular basis such as buildings housing plant or machinery • Low intensity public open space	• Accommodation activities: This includes dwelling houses, multiple dwellings, resort complexes, tourist park, hostels, retirement villages or other residential care buildings • Community activities: educational establishment, community centres, hospitals, theatres, child- care and playgrounds, detention facilities, place of worship • Recreation activities: This includes parks, outdoor recreation and sport, major sport and entertainment facilities • Entertainment and centre activities: Shopping centres, service stations, showrooms, markets, hotels, theatres, tourist attraction, garden centres • Industrial and commercial uses involving large numbers of workers or customers: Intensive uses such as high impact, medium and low impact industry, warehousing, services industry • Manufacture or bulk storage of flammable, explosive or noxious materials • Public passenger transport infrastructure: This includes bus, train and light rail stations

Table 7-5 Public Safety Area compatibility for new and proposed developments
Source: National Airports Safeguarding Framework Guideline I

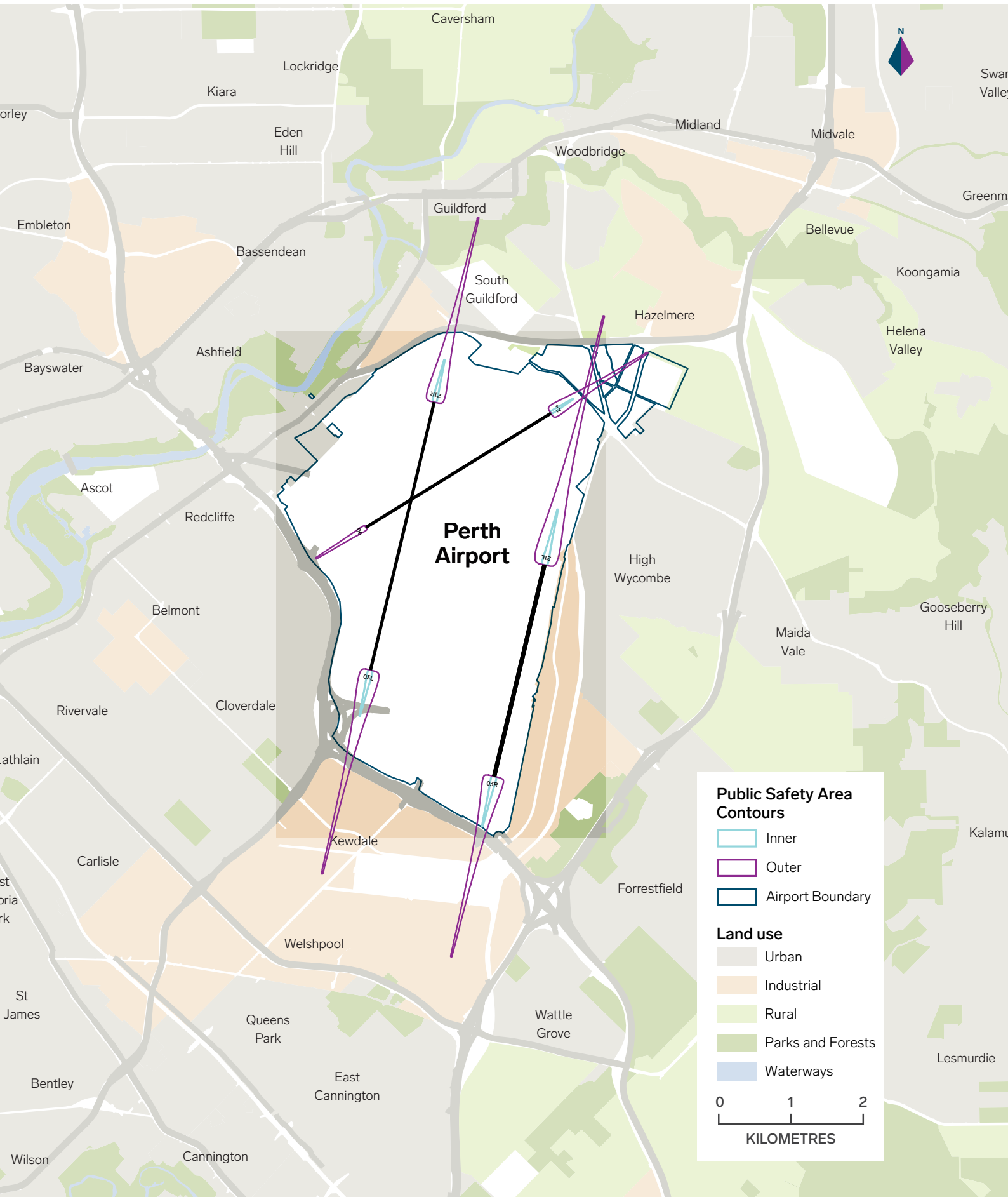


Figure 7-19 Public Safety Areas at Ultimate Capacity
Source: Rehbein

7.11 Managing the Risk of Exhaust Plumes

Exhaust plumes of significant vertical velocity (plume rise) can emanate from ground activities, such as vents and stacks, and can interfere with aircraft operations in various stages of flight.

Civil Aviation Safety Regulations 1988 Part 139 provides that CASA may determine that an exhaust plume, having a velocity in excess of 4.3 metres per second, is or will be a hazard to aircraft operations because of the velocity or location of the efflux.

Information regarding the velocity, temperature, composition of the effluence and any particulate matter must be provided in any application for development on the estate where an exhaust plume is present. After review by Perth Airport, the exhaust plume information is provided to CASA for assessment if required.

Perth Airport works with local planning authorities to ensure they are informed of the risk from exhaust plumes and encourages information about off-airport developments that include exhaust plume(s) to be submitted to Perth Airport for assessment.

7.12 Improving Airport Safeguarding

Perth Airport believes that NASF considers a broad range of important safety matters and supports the framework. As a critical element of public infrastructure to Western Australia, Perth Airport must be appropriately safeguarded against inappropriate land development and continues to advocate for the implementation of the safeguarding measures into the State planning framework.

In 2018, the Western Australian Planning Commission commenced a review of planning policy in relation to land use in the vicinity of airports. The review included an assessment of how the NASF Guidelines could be integrated into the State's planning system. Perth Airport participated in stakeholder workshops and will continue to work with the State Government on policy and guideline changes to provide appropriate safeguarding for the safe and effective operation of the airport.