Decision Paper on Sydney Night Flight Arrivals Track on Runway 23

September 2022

1. INTRODUCTION

During 2018, Airways, AIAL, Air NZ and BARNZ worked to develop alternative routing for night flights arriving from Brisbane/North Australia and Melbourne/South Australia tracks, called Night STARS (standard arrivals routes). Lower domestic traffic volumes at night enabled these routes to be safely developed for night-time use, finishing at 6am. These routes were consulted with the community and implemented 1 September 2018. Together these new Night Stars removed two thirds of night time traffic off the standard Night STAR used by Sydney flights.

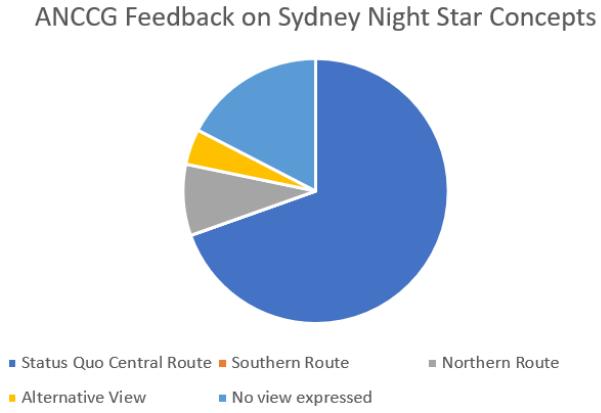
Subsequently, the Orakei Local Board representative on the ANCCG requested work be undertaken on an alternative Sydney night flight path for Runway 23 arrivals to remove these flights from over-flying central Auckland. . In the 2021 Annual Noise Management Report, Auckland Airport committed to preparing a discussion document to examine options for the Sydney Night Flights arriving on Runway 23.

At the March 2022 ANCCG meeting, Auckland Airport presented a Discussion Paper on the Sydney Night Flight Arrivals Track on Runway 23 (available on the ANCCG section of the AIAL corporate website here). For discussion purposes this March paper outlined an as yet, untested and untrialled, concept flight path that could be used to move some or all of Sydney night flights onto the Melbourne/South Australia Night STAR. This alternative route was an extra 8 track miles long per arriving flight, or approximately 10 000 track miles per annum (at 2019 flight volumes).

Feedback from ANCCG members to this concept was mixed, with no clear support for either the concept flight path developed or for change from the existing standard Western arrivals path used by Sydney flights at night. ANCCG members requested that a concept moving Sydney night flights onto a flight path North of the urban areas be developed, as well as further information be provided to the group on:

- the safety risks identified by Airways regarding potential crossing of flight paths
- an assessment of the volumes of people or households affected by the concept flight paths
- the methodology used to calculate the carbon impact of the concept route

A Supplementary Discussion Paper was prepared for the June 2022 ANCCG meeting, which provided that further information, together with a (untested and untrailled) concept flight path for discussion purposes that could be used to move some or all of Sydney night flights onto the Brisbane/North Australia Night STAR crossing Auckland at Stillwater/ Silverdale. Fedback was also invited from the Hibiscus and Bays Local Board (as a Local Board affected by the matter under consideration but not a member of the ANCCG).

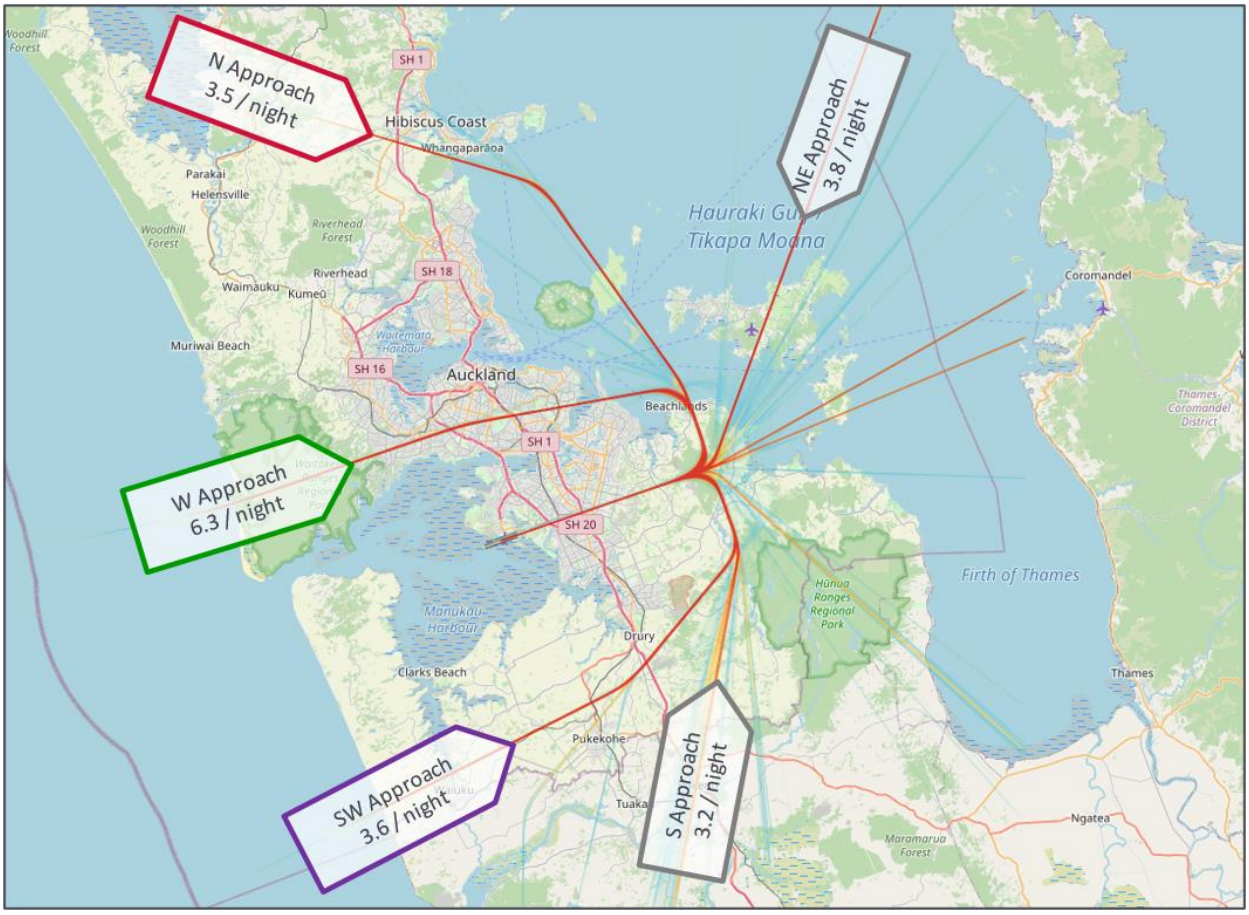


The Supplementary Discussion Paper was discussed at the ANCCG meeting in June with 73% of members (excluding Auckland Airport) favouring retaining the Status Quo, but with work undedrtaken to investigate increasing the height of the LOSGA waypoint. Two members (9%) preferred the Northern Route, one supported a hybrid solution of maintaining the status quo until 1am and then moving arring Sydney flights onto the Southern Route until 5am. Three members (14%) did not express a preference.

2. DISCUSSION OF NIGHT FLIGHTS

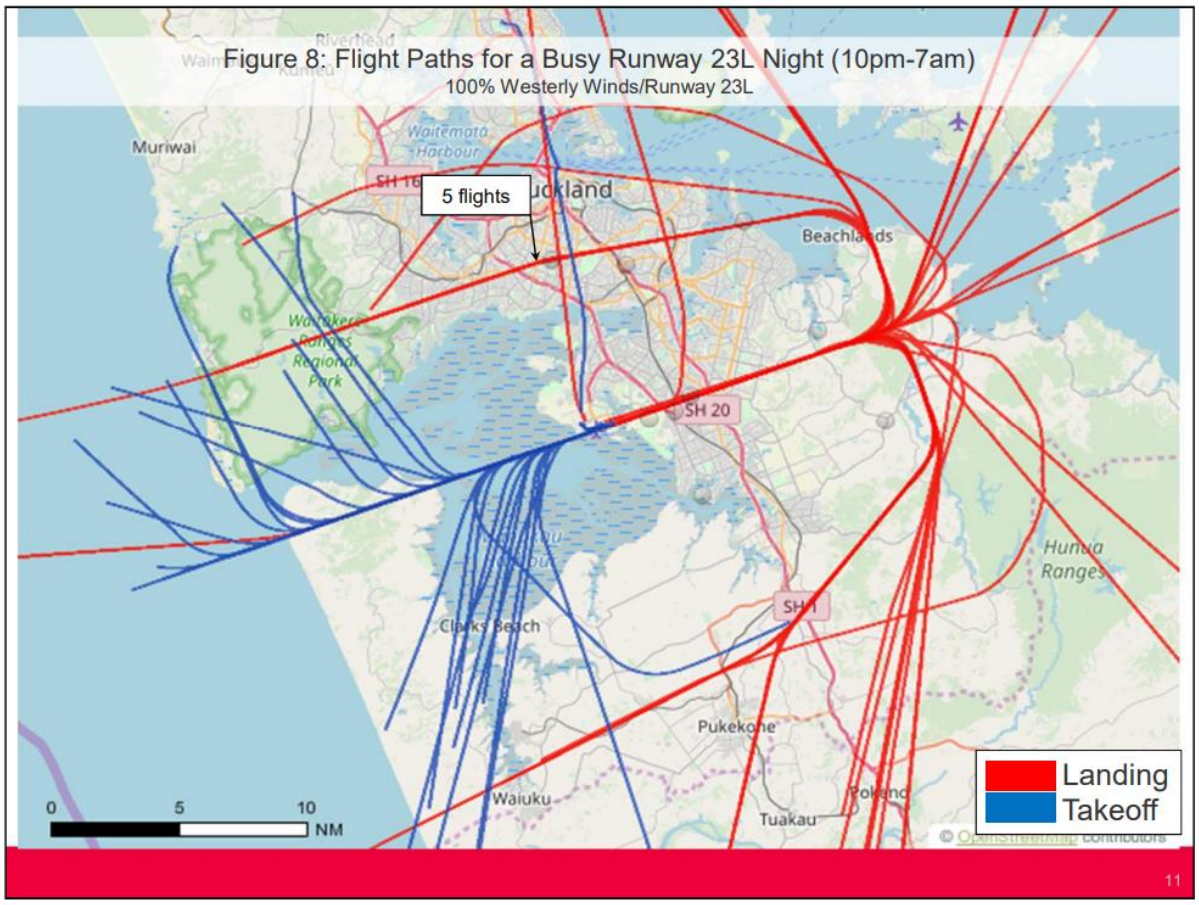
2.1 Night flight distribution

Night flights are experienced by most areas of Auckland. A map showing the distribution of approaches used by all night[1] flights landing on Runway 23 in 2019 is set out below.



By way of further example using a single busy night, the map below shows the distribution of night-time (10pm – 7am) flight paths on Friday 20 December 2019, which was the busiest night in the three month period November 2019 to January 2020 when Runway 23 was primarily in use. There were 82 night flights on this night, and as hightlighted on the map, 5 of them flew the Sydney STAR, crossing central Auckland. There were however flights using the Brisbane Night STAR to the North of the city, and the Melbourne Night STAR to the South. Several flights can also be seen using the night-time preferential runway mode[2] and landing on Runway 05 approaching from the Manukau Harbour. All domestic arriving flights flew over South Auckland, in the vicinity of Pukekohe, Tuakau, Pokeno and Clevedon. Virtually all arriving flights used the main approach flying over Flatbush, Manukau and Mangere before landing at the Airport. Departing flights departed to the West flying over the Manukau Harbour. Most areas of Auckland therefore experienced some degree of noise from night time flights.

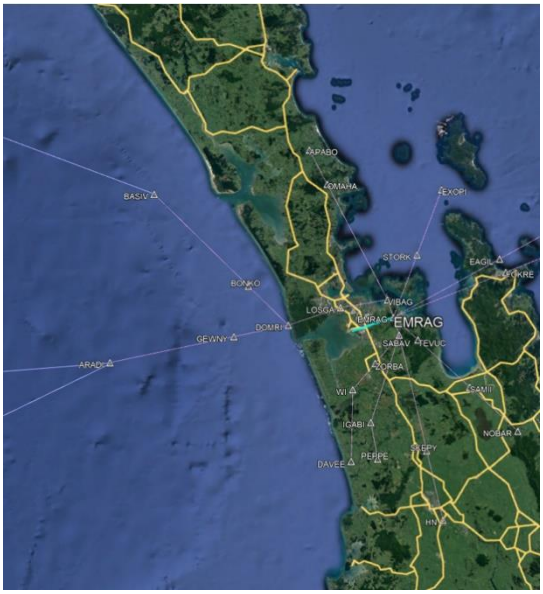
[1] Night for these purposes is defined as 10pm to 7am – based on definition in NZS6805



2.2 HISTORY OF AUSTRALIAN NIGHT STARS

2.2.1 Australian standard arrivals routes for day-time flights

During the day, all Trans-Tasman traffic is brought together to join the standard arrivals route (Sydney Track), with Brisbane/ North Australian[3] flights joining at DOMRI just off the West Coast and Melbourne/South Australia[4] flights joining at the ARADI way-point. By design, the Sydney Track is the most efficient with minimal divergence i.e. it runs in nearly a straight line. Up until 2018 all night flights also flew these same routes.



The map to the right shows the existing standard arrivals route flown for flights arriving from Sydney, Brisbane/North Australia and Melbourne/South Australia during the day.

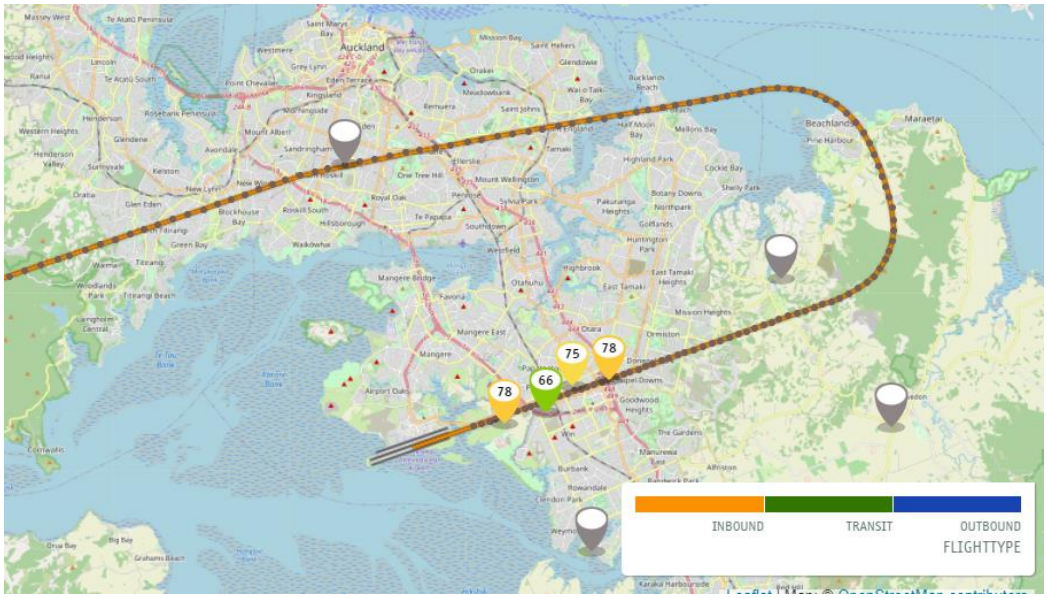
Bringing all Trans-Tasman flights together off the coast of New Zealand, at the DOMRI waypoint in this way, has important safety critical Air Traffic Control management of airspace outcomes, as well as increasing the efficient operation of the airspace. It means the Tasman traffic all joins downwind on the same route and is kept clear of domestic traffic to and from Northland, International traffic to the Pacific Islands, Asia and North America and flights

[3] As well as Brisbane, North Australian flights include flights from Cairns, the Gold Coats, Sunshine Coast and most of Asia (e.g. China, Hong Kong and Taipei)
[4] As well as Melbourne, South Australia flights include flights from Adelaide, Tasmania and Perth.

departing west to Australia. These departures leave the Auckland Terminal airspace through “gates” depending on their destination and are able to be kept clear of the arriving flights.

From the DOMRI waypoint, all flights then fly through LOSGA and VIBAG to intercept the main approach to the runway at EMRAG.

The standard arrivals route these flights fly over the urban Auckland area is shown in map below. It can be seen that flights on the standard arrivals route cross Auckland by flying a path over Titirangi, Blockhouse Bay, Mt Eden, Point England, Eastern Beach and turning South at Beachlands.



2.2.2 Initiatives to date for Trans-Tasman night-flights

During 2018, Airways, AIAL, Air NZ and BARNZ worked to develop alternative routing for night flights arriving from Brisbane/North Australia and Melbourne/South Australia tracks, called Night STARS (standard arrivals routes). Lower domestic traffic volumes at night enabled these routes to be safely developed for night-time use, finishing at 6am. These routes were consulted with the community and implemented 1 September 2018. Together these new Night Stars removed two thirds of night time traffic off the standard arrivals route over the west-central area of Auckland (which is still used by Sydney flights).

The Night STARS are flown from 11pm to 6am, however this is always subject to aircraft safety and operational requirements. For example, bad weather such as winds, storms or lightning may prevent the night routes from being able to be flown, or if flights arriving at the same time as a cluster of domestic flights, then the international flights may need to be routed on the day-time standard arrivals. This sometimes occurs close to 6am as domestic traffic commences for the day.

The Night STARS developed in 2018 are set out in the map below. In summary:

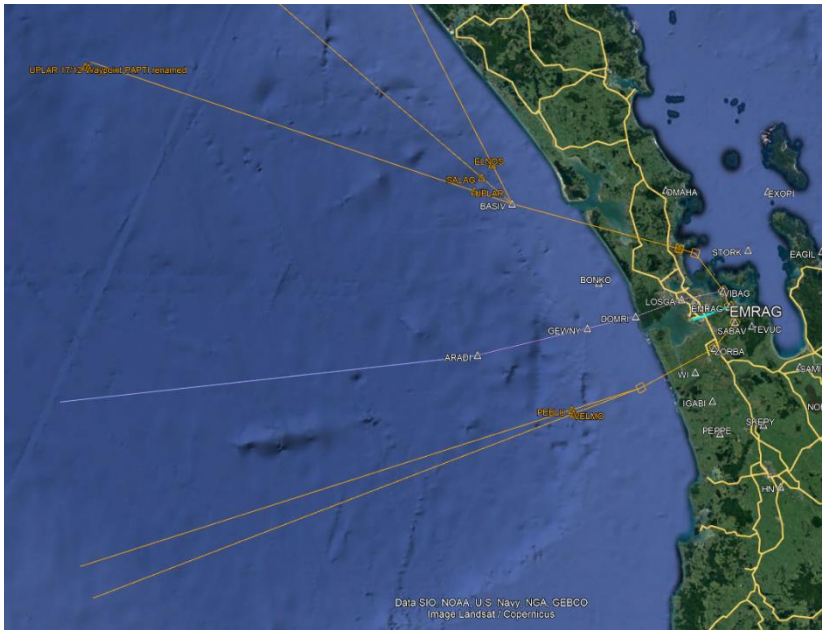
- When the Brisbane/North Australia flights reach the BASIV way-point, instead of moving South-east to BONKO and then to DOMRI to join the main arrivals route which crosses Auckland over LOSGA (ie the central Isthmus) as they would during the day under the standard arrivals route, the flight crosses North of Auckland (flying over Southhead to Whangaparoa) before turning South at VIBAG (a waypoint over the ocean between Waiheke Island and Beachlands) and joining the final approach at EMRAG. In short, the Brisbane/North Australia Night STAR crosses North of Auckland in the vicinity of Whangaparoa, avoiding flying over the central suburbs. This Night STAR is also used for flights from Cairns, the Gold Coats, Sunshine Coast and most of Asia (e.g. China, Hong Kong and Taipei).

- Melbourne/South Australia flights remain on their same direction (instead of flying North East to join the Sydney flights at the ARADI way-point over the Tasman Sea as they would under the standard arrivals route) and cross New Zealand below Auckland (in the vicinity of the Pukekohe,

Aririmu, Drury rural areas) moving through waypoints ZORBA and SABAV before turning North to intercept the final approach at EMRAG. In short, the Melbourne night STAR crosses South of Auckland North East of Pukekohe, also taking night flights off the central suburbs of Auckland.

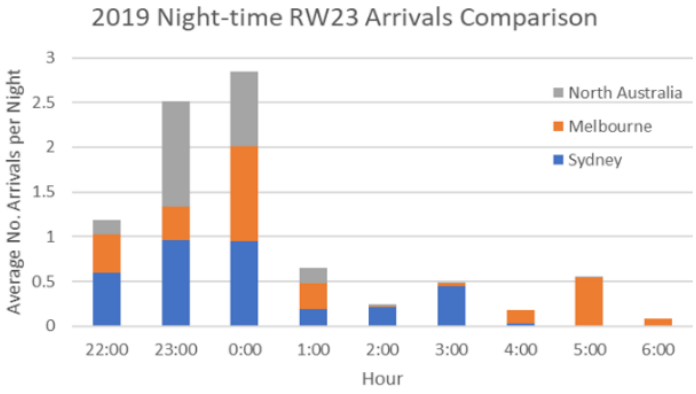
- It is worth noting that flights from Singapore and Malaysia use either the Sydney standard arrivals route or the Brisbane/North Australia Night STAR, depending upon the upper wind levels over Australia and the Tasman, with the use split evenly across these two tracks.

The Sydney flights were left on the direct path over central Auckland represented by the standard arrivals route, as this was the most efficient direct route for these flights.



As noted earlier, the above changes resulted in approximately two thirds of Australian and Asian night traffic being moved off the Sydney standard arrivals route onto the two new Night Stars – being the Brisbane/North Australia Night STAR and the Melbourne/South Australia Night STAR.

This distribution of night flights arriving from Australia to land on runway 23L is currently spread across greater Auckland as shown in the graph to the right showing the route flown by Australian flights arriving on Runway 23 in 2019, with



- flights from Brisbane/North Australia crossing Auckland at the Stillwater/Silverdale area
- flights from Melbourne/South Australia flying a southern route crossing Pukekohe, Aririmu, Drury areas
- flights from Sydney remaining on the standard arrivals day-time route (the Western approach) crossing Auckland from Green Bay via LOSGA at Mt Eden, Point England and Eastern Beach to Beachlands. .

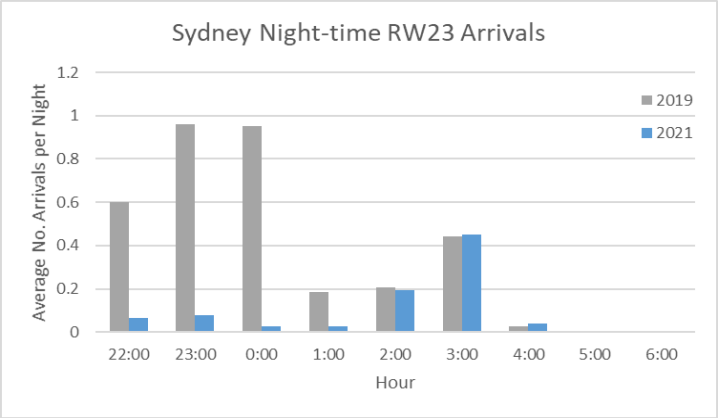
4. SYDNEY NIGHT FLIGHTS

4.1 Volumes of Sydney Night Flights

In 2019 there were 1231 night flights from Sydney arriving on Runway 23L, an average of approximately 4 per night. Due to the effects of COVID-19 on travel, this was much lower in 2021.

Sydney night flights represent 14% to 15% of all night-time arrivals on Runway 23L (15% in 2019 and 14% in 2021). 97% of these Sydney arrivals on Runway 23L fly the standard arrivals route crossing LOSGA (ie Titirangi, Mt Eden, Point England, Eastern Beach and Beachlands).

The spread of these Sydney arriving flights through the night, for both 2019 and 2021, are shown in the table to the right.



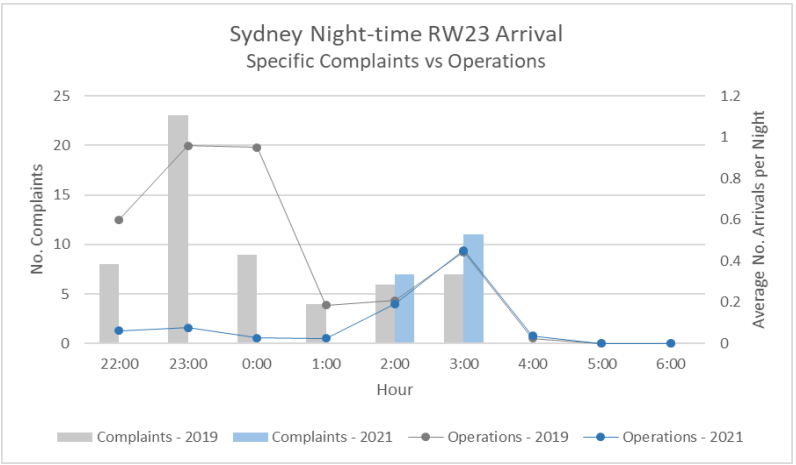
4.2 Complaints received regarding Sydney Night Flights

In 2019 there were a total of 249 night-time noise complaints for all aircraft movements at night. 131 (53%) of these related to the use of Runway 23, and 57 related to Sydney night flights arriving on Runway 23L. The 57 Sydney night flight complaints relating to use of Runway 23L thus represented 44% of the 131 night-time related noise complaints associated with Runway 23 received during 2019 or 23% of all night-time noise complaints. These 57 complaints relating to the Sydney night flights were made by nine individual complainants in the suburbs of Greenlane, Mt Eden, Bucklands Beach, Beachlands, Flatbush and Papatoetoe. These 57 complaints represented approximately 4% of Sydney night flights.

In 2021 there were a total of 38 night-time noise complaints, 23 (61%) of which related to night flights arriving on Runway 23. 18 of these 23 night-time Runway 23L complaints concerned Sydney night flights arriving on Runway 23L. Thus 43% of all night-time related noise complaints received in 2021 related to Sydney night flights landing on Runway 23L. These 18 complaints relating to the Sydney night flights were made by four individual complainants in the suburbs of Remuera, Mission Bay and Beachlands.

The pattern of the noise complaints by time, and also graphed against activity is shown in the graph to the right.

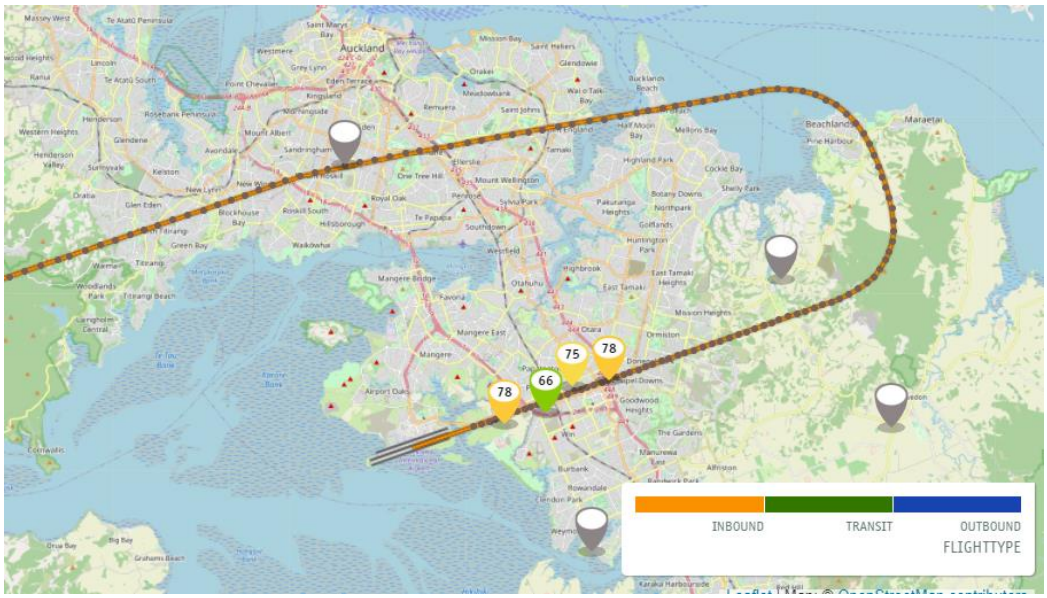
In 2019 most activity occurred from 23:00 to 01:00 and the highest complaints were from 23:00 to 00:00. In 2021 the highest flight volumes were from 2:00 to 4:00, and most complaints were received at this time period.



5 SYDNEY NIGHT STAR CONCEPTS REVIEWED

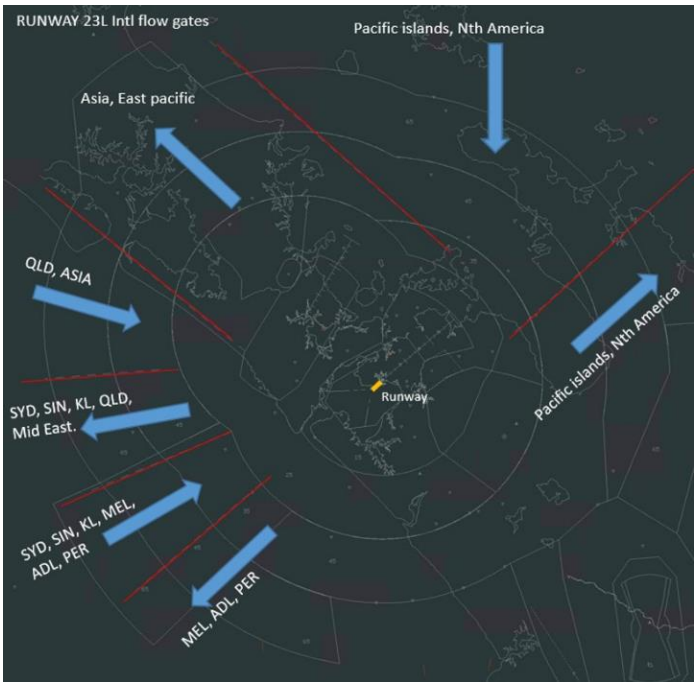
5.1 The Central-West Existing Route

Sydney night flights presently follow the standard arrivals route flown during the day, as shown in map below. This standard arrivals route crosses Auckland by flying a path over Titirangi, Blockhouse Bay, Mt Eden, Point England, Eastern Beach and turning South at Beachlands.



This existing route is considered the most effective and direct by Airways from an airspace management perspective.

Air traffic is managed through various 'gates' being allocated to different regional areas that flights are arriving from or departing towards. Flight paths are designed to reflect these 'gates'. These 'gates' enable safety critical Air Traffic Control management of airspace outcomes, as well as increasing the efficient operation of the airspace. The 'gate' system reduces risk of flight paths crossing and aircraft passing too close to one another, or even colliding. The gates used by Air Traffic Control, for aircraft arriving and departing from Auckland Airport, are shown on an image from the ATC Radar to the right.



Flight paths for air traffic arriving from Sydney (as well as Singapore, Kuala Lumpur, Adelaide and Perth) approach directly towards the airport. The flight paths for flights departing to Sydney (as well as Singapore, Kuala Lumpur, Queensland and the Middle East) use a 'gate' above (ie to the North of) the 'gate' used for arriving Sydney flights. The flight paths for flights departing to South Australia cities use a 'gate' below (ie to the South of) the 'gate' used for arriving Sydney flights.

Moving Sydney night flights to the Southern Night Star used by South Australian flights therefore would have the arriving Sydney flights cross through the 'gate' used by flights departing to South Australia cities.

Moving Sydney night flights to the Northern Night Star used by Brisbane/North Australian flights would have arriving Sydney flights cross through the 'gate' used by flights departing to flights departing to Sydney (as well as Singapore, Kuala Lumpur, Queensland and the Middle East).

By contrast, the existing flight path for Sydney flights has these fly the most direct route to the Airport, without needing to cross the 'gates' used by flights arriving from or departing to other geographic areas.

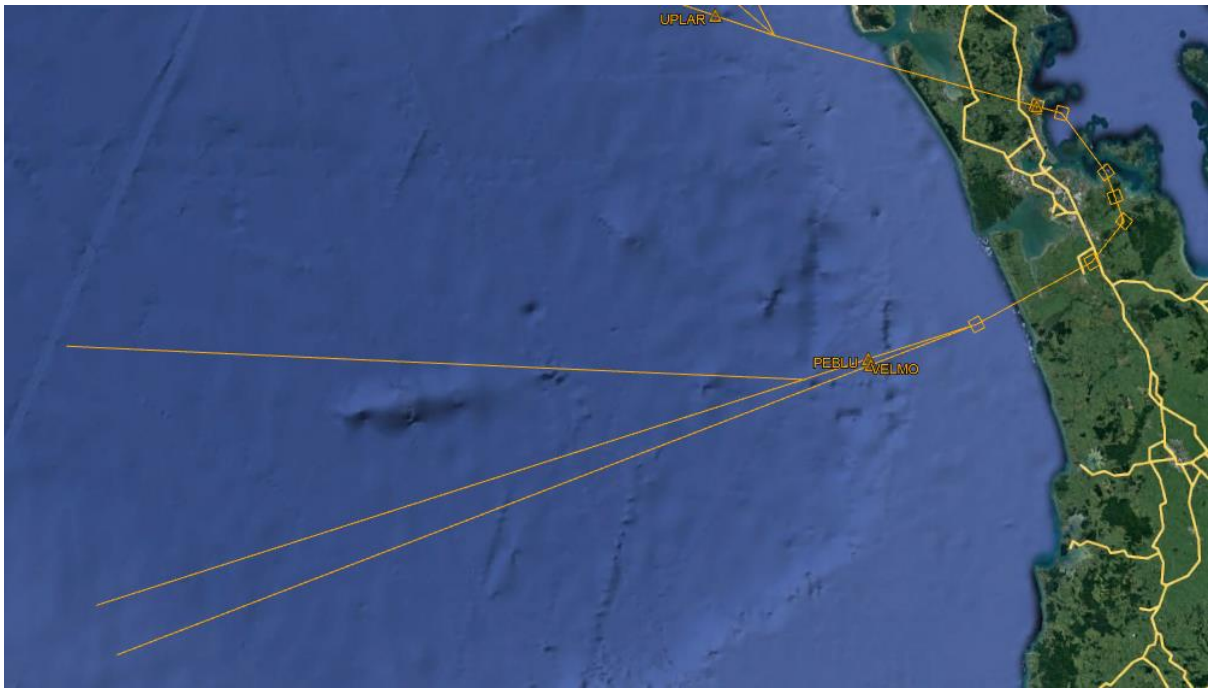
One of the core principles of flight design is safety. Removing flight paths crossing reduces risk of an in air event. Airways has therefore advised that, from a risk reduction or management perspective, it considers that the Night Flights from Sydney remaining on the current standard arrivals is optimal.

The current Sydney standard arrivals route also represents the most efficient flight path for aircraft from Sydney to arrive at Auckland Airport, as it is the most direct, straightest route. This is extremely important to airlines which are continually investing in carbon-reduction technology, including purchasing more efficient aircraft and younger average fleet age, investigating alternative means of fuel and use of battery power, looking to use electric based ground power units rather than fuel based ground power units or auxilary engines, and more efficient approaches and departure using performance-based navigation. Adding track miles runs counter to the strong focus on fuel efficiency and reduced carbon footprint from air travel

5.2 A possible Southern Night STAR

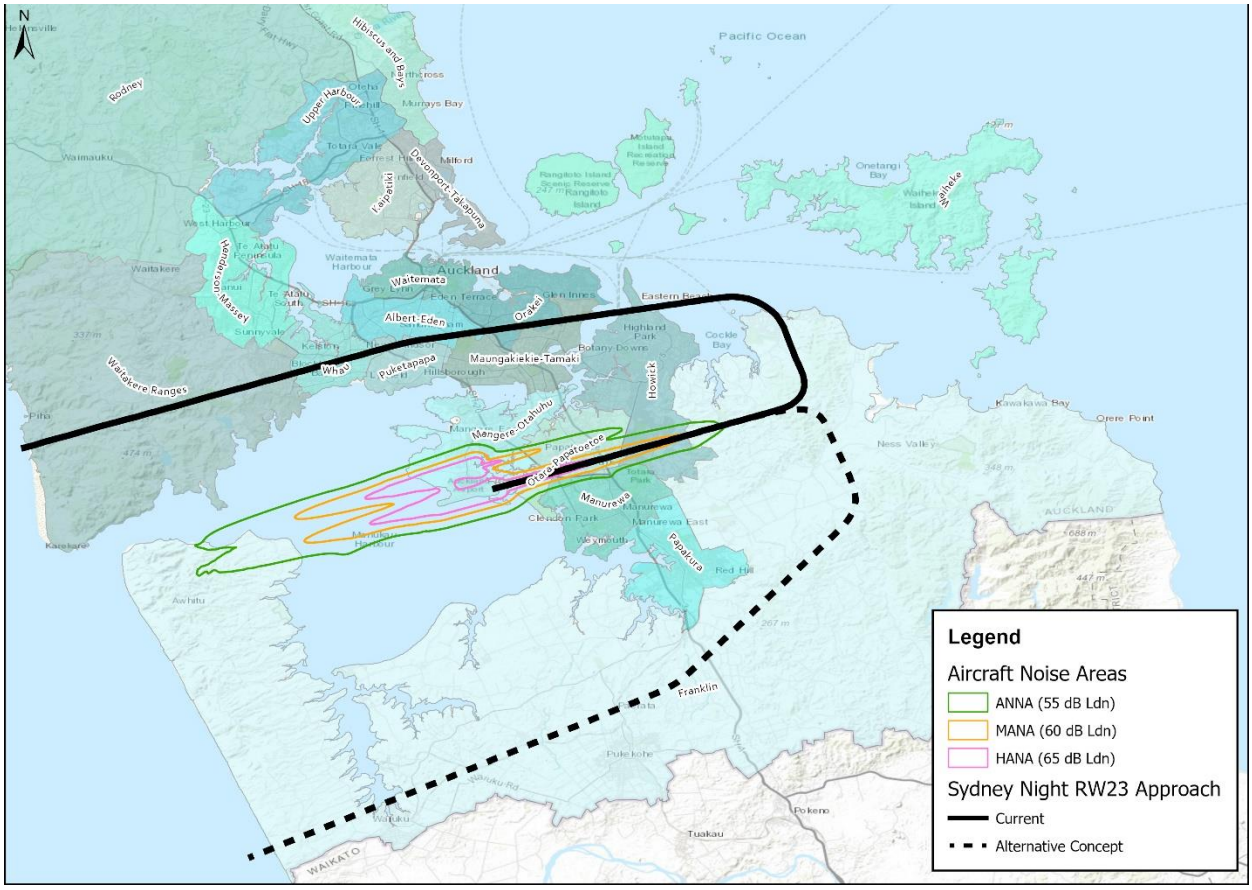
At the request of Auckland Airport, Airways developed an untested alternative concept for discussion purposes of routing Sydney flights onto the same Southern night STAR used by Melbourne/South Australia flights. Note, this untested concept was not subject to a safety test or to flight simulation or technical consultation with airlines, all of which would be necessary as part of any development.

The untested concept suggested route is set out below. In short, Sydney arriving flights in westerly conditions (historically 70%) using Runway 23 would divert Southward as they entered New Zealand domestic airspace approximately 200 nautical miles west of Auckland Airport to join the Melbourne Night STAR approximately 80 nautical miles from Auckland Airport (current waypoint PEBLU). By doing this any crossover of traffic or conflictions occur within one controller's airspace as opposed to near a sector boundary or edge of RADAR viewing. Once aircraft have joined the Melbourne track they would fly the same arrival as Melbourne traffic to waypoints ZORBA[5] then SABAV then join the centre-line of the instrument approach at EMRAG and from there fly directly in a straight line on the standard centre-line approach over Flatbush, Manukau and Mangere to land at Auckland Airport. This route would need to cease being used by 6am, and possibly earlier, depending upon the volumes of domestic traffic.



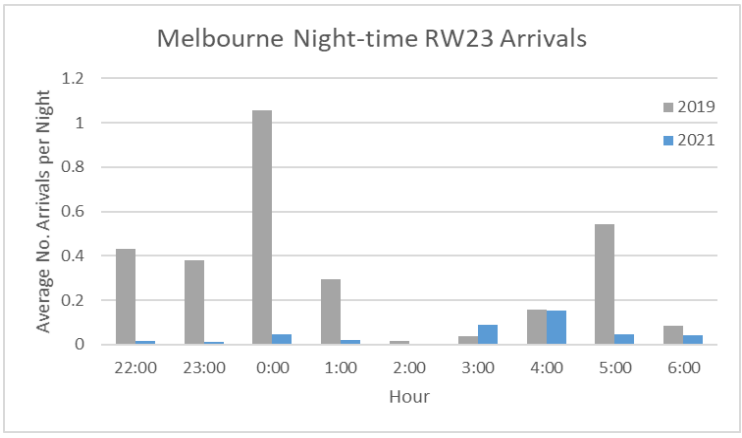
An illustration of the alternative concept route, and illustration of current standard night approach for Sydney flights using runway 23L, plotted against Local Board areas is shown below:

[5] ZORBA is an existing point North East of Pukekohe and is used on the night STAR from Melbourne as well as by all jets during the day flying either the RNAV S (orange) or the ILS approach into Auckland.



This route has been designed to avoid existing urban areas at Pukekohe, Drury and Papakura and to overfly more sparsely populated rural areas or lifestyle blocks such as the Pukekohe district or Ariimu. However, these residents can be sensitive to noise not being exposed to urban noise, and the aircraft noise can be more noticable and irritating. Moreover, with urban development being targetted at South Auckland areas such as Takanini, Drury, Papakura and Pukekohe the size of Southern Auckland urban areas is expanding and is forecast to receive substantial population increases over the next decade. In 2019 there were 14 noise complaints specifically in relation to Melbourne Night flights on Runway 23, which represented 11% of Runway 23 complaints.

This Southern route is already flown by Melbourne, Adelaide and Tasmanian and Perth night flights and parts of it are flown by domestic flights at night-time. It is also used by domestic jets during the day flying either the RNAV S (orange SMART approach) or the ILS approach into Auckland.

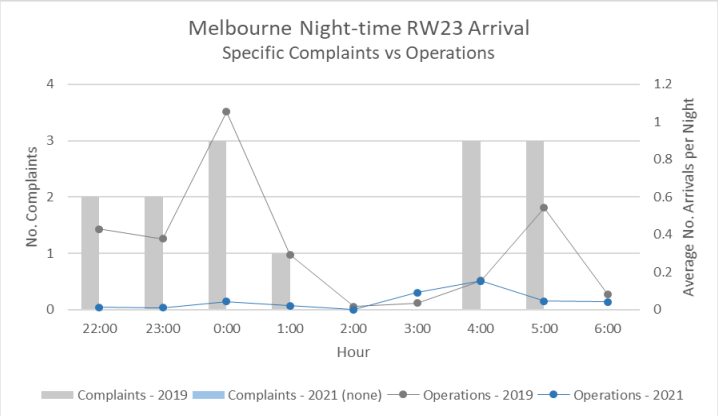


The trade-off of developing the concept Night flight path for Sydney based on the Melbourne/South Australia Night STAR would therefore be to transfer flights from central Auckland onto South Auckland residents, in addition to the flights already experienced by these South Auckland areas from the Melbourne/South Australia Night STAR and domestic night time flights from south of Auckland.

1091 flights used this Melbourne/South Australia Night Star in 2019, which is very similar to the 1231 Sydney flights. Melbourne flights represent approximately 13% of night arrivals on Runway 23.

If Sydney and Melbourne night flights arriving on Runway 23L both used this Southern route (as well as various other South Australian flights), that would represent 28% of Runway 23 night arrivals. In addition, the South Auckland area experiences virtually all night-time domestic flight arrivals using Runway 23L.

Noise complaints are already received with regard to the Melbourne/South Australia Night STAR from South Auckland rural residents. In 2019 14 noise complaints were received regarding Melbourne/South Australia night flights arriving on Runway 23L. This represented 11% of the 131 Runway 23L night arrival noise complaints received during 2019. No noise complaints were received in 2021 for night arrivals from Melbourne on Runway 23L with there being less than one flight per night on average flying this Night STAR. The pattern of the noise complaints by time, and also graphed against activity is shown in the graph to the right. In 2019 the highest complaints were from 23:00 to 01:00, and 04:00 to 06:00.



Carbon impact of Sorthern Route

The Southern Night STAR concept would add 8 nautical miles to the flight or 12.9km. The ICAO calculator indicates this represents 78 kg of additional fuel per representative arriving flight, or 96 tonnes of additional fuel per annum (at the 2019 volume of 1231[6] night time arrivals from Sydney on Runway 23L). In terms of carbon from fuel burn[7], this represents an additional 245kg of CO_2 per arriving flight, or 302 tonnes of additional CO_2 per annum. Refer Appendix A for calculation details.

5.3. A possible Northern Night Star

The possibility of routing Sydney flights onto the same Northern Night STAR used by Brisbane/North Australia flights was also considered as an untested concept developed by Airways at the request of the ANCCG. Two concepts were considered. Note neither of these concepts have been subject to a safety test or to flight simulation or technical consultation with airlines, all of which would be necessary prior to any development.

Discounted Shorter Northern Concept

The first concept considered would add 8 nautical miles to the flight length but has been ruled out and not been put forward. It is assessed by Airways as creating too greater a risk of cross-over between arriving and departing flights, as the point at which arriving and departing flight paths would cross is very close to a RADAR sector boundary where aircraft are transferred from the Oceanic Radar sector to the Auckland Approach Radar sector. For safety reasons, any crossover of traffic or conflictions should be designed to occur within one controller's airspace as opposed to near a sector boundary or edge of RADAR viewing.

To reduce (although not eliminate) this risk it would be necessary to have the arriving Sydney aircraft join the Brisbane/North Australia Night STAR earlier. This would mean that the cross-over with departing flights does not occur at the sector boundary or edge of RADAR viewing, thus providing clearer visibility of potential cross-over risks, and therefore more time for the Air Traffic Controller to manage these. This need for human intervention and management is what is referred to Human Factors risk. Managing these cross-overs during night shifts, when natural circadeum ryhthms are low, and fatigue risks are present, is not ideal, and is why Airways looks to minimise such risks where-ever possible.

Longer Northern Concept

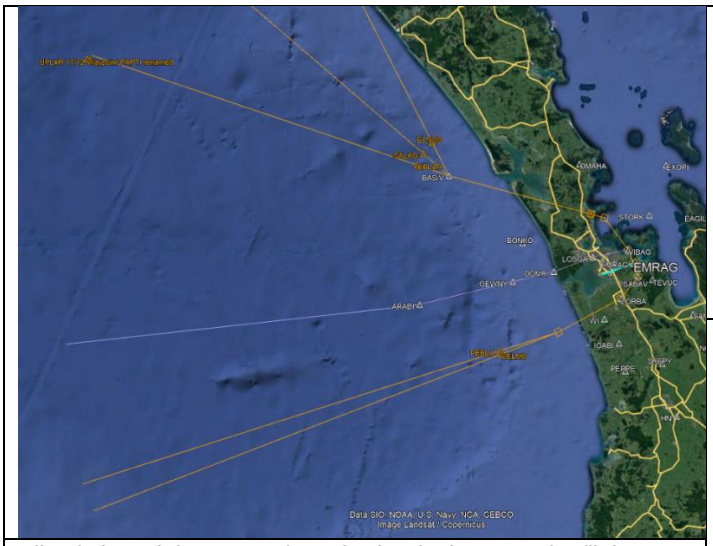
A Northern concept was developed which would have the inbound Sydney night flight join the Brisbane/North Australia Night STAR earlier before the sector boundary or edge of RADAR viewing. This

[6] Note the volume of night-time arrivals from Sydney has been considerably lower in 2020, 2021 and 2022 due to reduction in aircraft volumes as a result of COVID-19, with 2021 night flights being only 26% of 2019 volumes. It is widely estimated that 2019 aircraft traffic levels will not be reached again until approximately 2024.

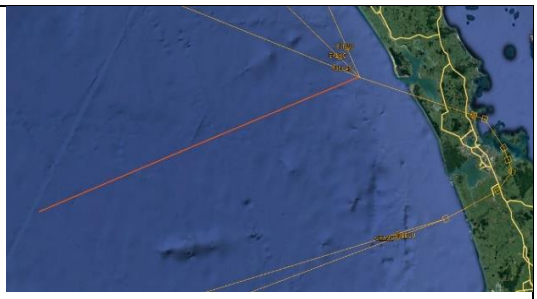
[7] The ICAO calculator emission factor of multiplying fuel weight by 3.16 was applied to calculate the CO_2 emissions.

route would add an additional 15 nautical miles to the flight length on the standard central-western approach.

The concept route is set out below. In short, Sydney arriving flights in westerly conditions (historically 70%) using Runway 23 would divert Northward approximately 200 nautical miles west of Auckland Airport to join the Brisbane Night STAR (shown below) at BASIV approximately 65 nautical miles North West of Auckland Airport. Once aircraft have joined the Brisbane/North Australia track they would fly the same arrival as Brisbane traffic to waypoints BAYES then VIBAG (over Beachlands) before joining the centre-line of the instrument approach at EMRAG and from there flying directly in a straight line on the standard centre-line approach over Flatbush, Manukau and Mangere to land at Auckland Airport. This route would need to cease being used by 6am, and possibly earlier, depending upon the volumes of domestic traffic.

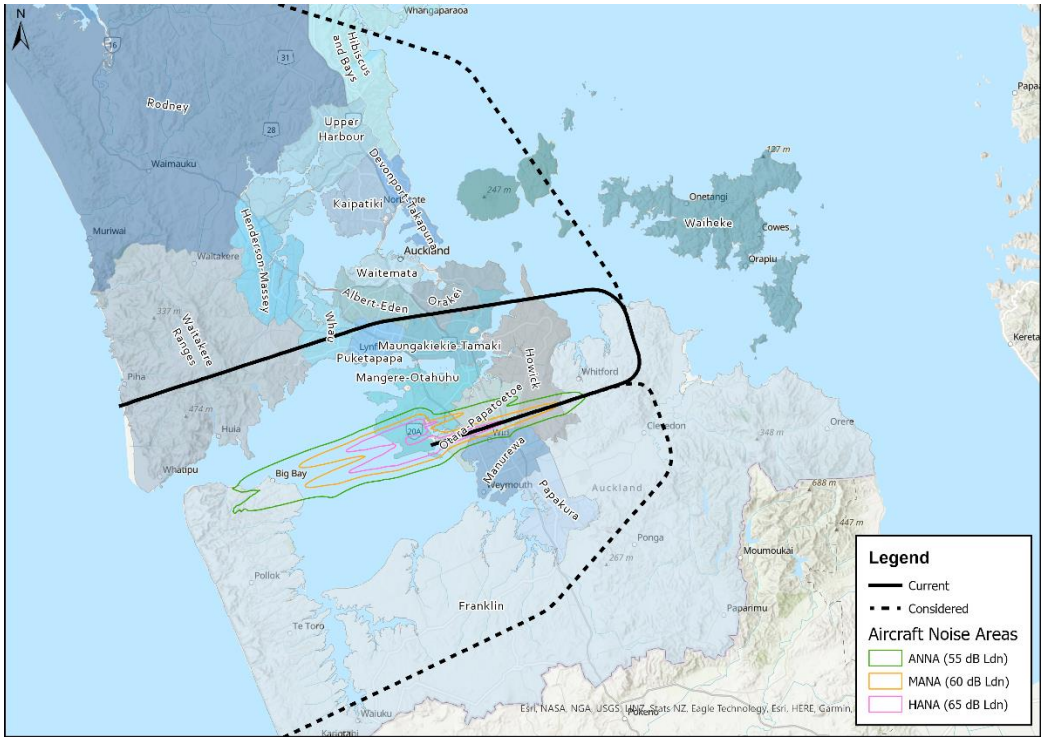


All existing Night STARS/standard arrivals routes for flights from Australia landing on Runway 23L

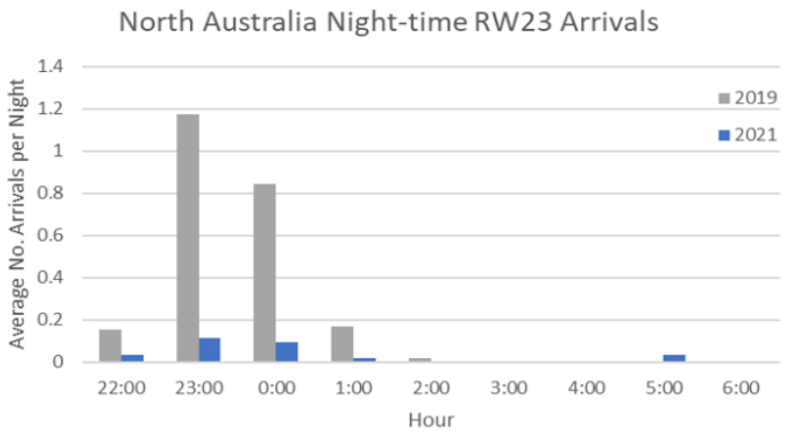


Concept for Sydney flights arriving on Runway 23L to join the Brisbane/North Australia Night STAR at BASIV, crossing North Auckland from the Southern Kaipara Harbour to Silverdale/Stillwater, then flying North to VIBAG at Beachlands, before joining the centre approach line at EMRAG.

An illustration of both the Northern and Southern alternative concept routes, and illustration of current standard night approach for Sydney flights using runway 23L, plotted against Local Board areas is shown below:



Moving Sydney flights to a Northern STAR would transfer overflights from central suburbs to Northern suburbs. Currently, the Northern STAR receives very few flights after midnight (on either current flight volumes or pre-COVID-19 2019 volumes). This does create a risk that these residents, not currently exposed to very much aircraft noise post midnight, become attuned and sensitive to noise from flights passing overhead after midnight.



However, advice from MDA outlined in section 6 below, observes that there would not be any sleep disturbing noise events greater than 60 dB L_{Amax} experienced at the Stillwater area, which aircraft using the Northern STAR fly over. Historically, noise complaints relating to the Brisbane/North Australia Night STAR are comparatively low, with three noise complaints received in 2019 regarding such flights, representing 2% of the 131 complaints relating to night time use of Runway 23L received in 2019. No noise complaints were received in 2021 relating to flights using the Brisbane/North Australia Night STAR.

Carbon impact of Northern Route

The Northern Night STAR concept would add 15 nautical miles to the flight or 24.1km. The ICAO calculator indicates this represents 146 kg of additional fuel per representative arriving flight, or 180 tonnes of additional fuel per annum (at the 2019 volume of 1231[8] night time arrivals from Sydney on Runway 23L). In terms of carbon from fuel burn[9], this represents an additional 460kg of CO_2 per arriving flight, or 568 tonnes of additional CO_2 per annum. Refer Appendix A for calculation details.

6. ASSESSMENT OF VOLUMES OF PEOPLE AFFECTED

Auckland Airport requested Marshall Day Acoustics (MDA) to provide an assessment of the people affected by the existing Sydney night flight path and the two (untested) flight path concepts under consideration. MDA has undertaken this analysis using two complementary approaches, being analysis of the number of persons experiencing a single event sleep disturbance from aircraft noise, and a Person Event Index (PEI).

Single Event Sleep Disturbance Event

MDA has assessed a single event sleep disturbance event as a noise level of an aircraft overflight of 60 dB L_{Amax} or greater. This is a method which looks at the number of people exposed to this noise level, and the number of flights experienced to identify potential noise effects for people outside the 55 dB Ldn area.

MDA have undertaken this calculation for two types of representative aircraft: the A320 and the B777. These two aircraft types represent the range of aircraft noise produced by 86% of aircraft movements landing on Runway 23 from Sydney in 2019. The A320 is one of the quieter aircraft to fly from Sydney at night, representing 12% of movements, whereas the B777 is one of the louder, at 3 – 5 dB louder, and (with all 777 variants) represented approximately 20% of aircraft movements in 2019. The most commonly used aircraft in 2019 was the B737-800, representing 32% of aircraft movements from Sydney in 2019, which produce a noise volume greater than an A320, but significantly less than a 777. Modern B789 (representing 12% of aircraft movements from Sydney in 2019) produce noise levels greater than

[8] Note the volume of night-time arrivals from Sydney has been considerably lower in 2020, 2021 and 2022 due to reduction in aircraft volumes as a result of COVID-19, with 2021 night flights being only 26% of 2019 volumes. It is widely estimated that 2019 aircraft traffic levels will not be reached again until approximately 2024.
[9] The ICAO calculator emission factor of multiplying fuel weight by 3.16 was applied to calculate the CO_2 emissions.

an A320, but less than a 777, and so fit within this noise range. The A320 analysis therefore represents a 'typical best-case' for Sydney night arrivals on RW23, and the B777 represents a 'typical worst-case'.

Using current publicly available GIS information on households, combined with 2018 Statistics NZ data on the number of persons per household, and modelling of flight paths using the FAA Integrated Noise Model, MDA model that the number of people exposed to a single event sleep disturbance of 60 dB L_{Amax} or greater is as follows under the existing Sydney approach, the Northern Night Star and the Southern Night Star for the A320 aircraft and 777 aircraft.

	Existing Western Approach Over Central Suburbs	Proposed Northern Approach Over Stillwater	Proposed South-western Approach Over Clevedon - Drury
Airbus A320	40,776	40,776	40,008
Boeing 777	77,406	64,755	61,230

The volume of total people exposed to a single event sleep disturbance of an aircraft overflight of 60 dB LAmax or greater is very similar for an Airbus A320 on either of the three routes (at approximately 40 000 to 41 000 persons).

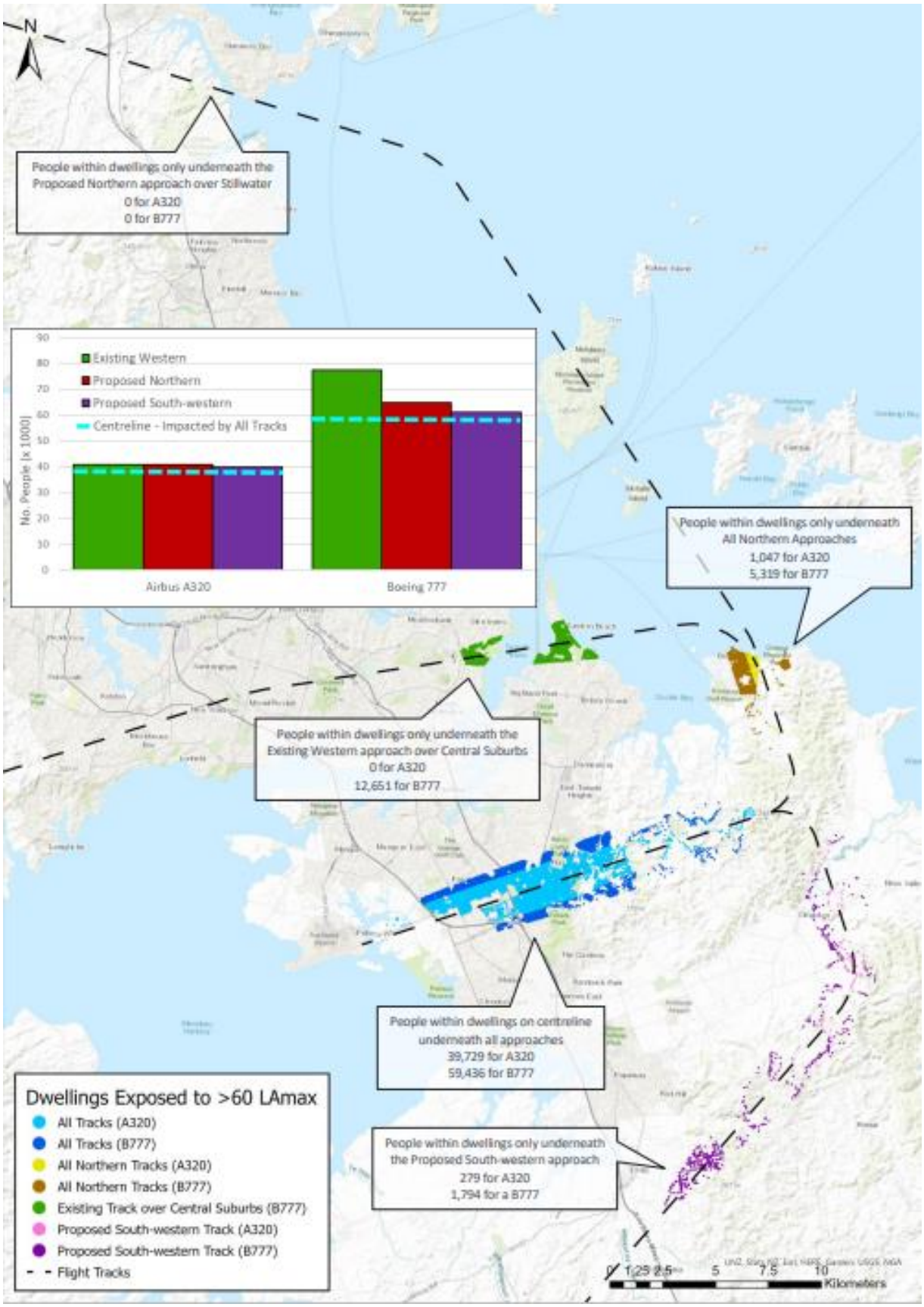
However, when the analysis is undertaken for the louder Boeing 777 aircraft, then more people are exposed to a sleep disturbing event under the current Sydney night flight path. The existing Standard Arrivals Track (ie the Western approach crossing the central suburbs of Auckland) is assessed as having 77 406 people within the 60 dB L_{Amax} contour for a Boeing 777 aircraft (i.e. 77 406 people are within the potential sleep disturbance threshold for each Boeing 777 arrival on this track). This reduces to 61 230 persons if the Southern Night STAR is used or 64 755 if the Northern Night STAR is used. Compared to the existing Standard Arrivals Track, using the Northern STAR would expose 16% fewer people to a sleep disturbance event each time a Boeing 777 flies overhead, and using the Southern Night STAR would expose 21% fewer people. In terms of the number of people who experience 60 dB L_{Amax} or higher from an arrival, MDA conclude this is lowest if the Southern Night STAR is used, and highest if the existing standard arrivals route (the Western approach) continues to be used.

It is worth observing that the vast majority of people under the approaches discussed that are exposed to 60 dB L_{Amax} or greater (meeting the potential sleep disturbance threshold) during an aircraft overflight of live beneath the centre runway approach. For an A320 this is 39 729 people and for a Boeing 777 this is some 59 436 people. Changes to the flight tracks at night to use a Northern or Southern Night STAR would not reduce noise levels for persons living beneath the centre runway approach. The number of persons exposed to a sleep disturbing event from an A 320 passing overhead is relatively low (being between zero and approximately 1000) outside of persons living under the Centre Runway Approach. It is only larger aircraft such as the B777 or A380 that create sleep disturbing events (an aircraft overflight of 60 dB L_{Amax} or greater) for significant volumes of people living outside of the Centre Runway Approach.

Exposure to a sleep disturbing event of an aircraft overflight of 60 dB L_{Amax} or greater

	Persons affected under Centre Runway Approach	+	Persons affected under the Western Approach	Persons affected if Northern Night STAR used	Persons affected if Southern Night STAR used
A 320	39 729	+	1047	1047	279
B 777	59 436	+	(12 651 + 5319) = 17 970	5319	1794

The map below plots where in Auckland the people who would be exposed to a sleep disturbing event from an aircraft overflight of 60 dB L_{Amax} or greater under the three flight path concepts are located. There are no sleep disturbing events under the Waitakere Heritage Area.


N
People within dwellings only underneath the Proposed Northern approach over Stillwater
0 for A320
0 for B777
Existing Western
Proposed Northern
Proposed South-western
Centreline - Impacted by All Tracks
No. People (x 1000)
Airbus A320
Boeing 777
People within dwellings only underneath All Northern Approaches
1,047 for A320
5,319 for B777
People within dwellings only underneath the Existing Western approach over Central Suburbs
0 for A320
12,651 for B777
People within dwellings on centreline underneath all approaches
39,729 for A320
59,436 for B777
People within dwellings only underneath the Proposed South-western approach
279 for A320
1,794 for a B777
Dwellings Exposed to >60 LAmax
All Tracks (A320)
All Tracks (B777)
All Northern Tracks (A320)
All Northern Tracks (B777)
Existing Track over Central Suburbs (B777)
Proposed South-western Track (A320)
Proposed South-western Track (B777)
Flight Tracks
0 1.25 2.5 5 7.5 10
Kilometers

Person Event Index (PEI)

The Person Event Index (PEI) multiplies the number of people experiencing a Sleep Disturbing Event for each aircraft overflight the number of aircraft overflights (ie how many aircraft would pass by at night-time) for both the existing flight paths, and the concepts being examined in these two Discussion Documents. The result is expressed as the number of million persons affected. The results from this analysis are shown for the Boeing 777-300ER. Using a 777 for this calculation represents a worst case assessment as it assumes all Sydney flights use the B777, whereas only 20% are B777 flights (and only 9% are the B777-300ER variant). The A320 and other aircraft that more commonly fly from Sydney are quieter.

Person Event Index for 777 aircraft using Alternative Flight Path Concepts for Sydney Night Flights Arriving on Runway 23

	Central Suburbs	Stillwater	Clevedon - Drury	Centreline	PEI
No. People (B777)	17,970	5,319	1,794	59,436	
Existing Overflights	7.2 overflights	3.6 overflights	4.8 overflights	15.6 (total)*	
Existing PEI (millions)	0.13	0.02	0.01	0.93	**1.08**
Sydney moved to Northern Approach					
Future Overflights	2.9 overflights	7.9 overflights	4.8 overflights	15.6 (total)*	
Future PEI (millions)	0.05	0.04	0.01	0.93	**1.03**
Sydney moved to South-Western Approach					
Future Overflights	2.9 overflights	3.6 overflights	9.1 overflights	15.6 (total)*	
Future PEI (millions)	0.05	0.02	0.02	0.93	**1.01**

* This is the total of all approaches discussed as all flights overfly centreline

Overall the PEI for the Northern and South-western concepts reduces by 5 – 7% compared to the existing Western Central approach, assuming all flights were 777 aircraft (which they are not). The change in PEI is small due to the large majority of affected persons living under the extended runway centreline, so not affected by potential adjustments to the earlier portion of the arrivals flight path.

7. DECISION

The June 2022 Supplementary Discussion Paper, together with the earlier Discussion Paper from March 2022, examinined concepts for Sydney Night flights landing on Runway 23, ranging from:

- No change to the current flight path (although the possibility of raising the height of LOSGA is under examination by Airways and airlines)
- A new Southern flight path joining the Melborne/South Australia Night STAR
- A new Northern flight path joining the Brisbane/North Australia Night STAR
- Staged or blended options such as using the alternative Night STARS after a certain time of day (eg 0100 onwards) or developing the Night STARS but deferring their introduction until flight volumes reach a trigger point (eg 70% of 2019 Sydney Night flight volumes).

It should be noted that the Southern and Northern concepts were prepared for the purposes of facilitating discussion and seeking feedback only. They did not represent any concluded views by Auckland Airport or Airways and had not been the subject of concluded community, industry or aviation feedback, or testing, development and publication in the the Aeronautical Information Publication (AIP).

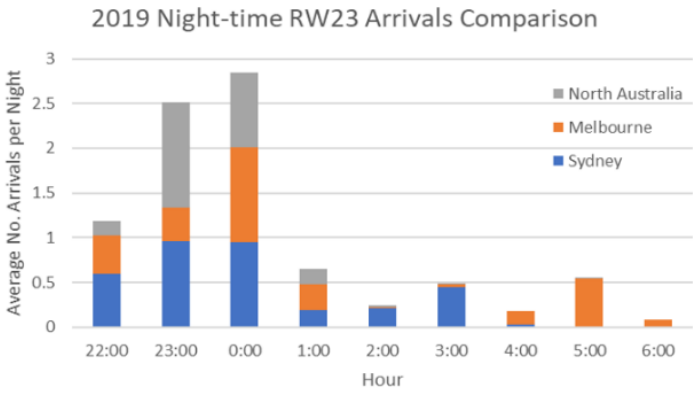
Air space safety favours the continuation of the current arrivals path

Airways advises that it still considers the existing Western central route the most effective and direct from an airspace management perspective. Moving the Sydney night flights onto either the Brisbane/North Australia STAR or the Melbourne/South Australia STAR causes flight paths of arriving and departing aircraft to cross. The fundamental first principle of flight design is always safety. Avoiding flight paths crossing reduces risk of an 'in air' event. Airways has therefore advised that, from a risk reduction or management perspective, it considers that the night flights landing on runway 23 from Sydney remaining on the current standard arrivals route crossing central Auckland is optimal. If a change is to be made, then the Southern Night STAR would be preferable from a risk perspective, as it has fewer flights needing to be managed from a 'cross over perspective' than the Northern Night STAR (which would have the arriving Sydney night flights need to cross the busy 'gate' for flights departing to Sydney, Singapore, Kuala Lumpur, Queensland and the Middle East).

BARNZ also shared this concern regarding the increased risk of flight paths crossing if the Northern route became the standard night-time approach for Sydney night flights landing on Runway 23L.

Auckland Airport concurs, and notes that it is difficult, if close to impossible, to envisage this risk being approved under the Change Management processes which Airways, airlines and Auckland Airport must follow under their Safety Management Systems required under Part 100 of the Civil Aviation Rules.

Changes to flight paths have already shared aircraft noise



Noise from night flights arriving from Australia is currently spread across greater Auckland, with flights from Brisbane/North Australia crossing Auckland at the Stillwater/Silverdale area, flights from Melbourne/South Australia flying a southern route crossing Waiuku/Ariirimu/Drury and flights from Sydney remaining on the standard arrivals day-time route (the Western approach) crossing Auckland from Green Bay via LOSGA at Mt Eden, Point England and Eastern Beach to Beachlands. This distribution of flights can be seen in the graph to the right showing the route flown by Australian flights arriving on Runway 23 in 2019.

Moving Sydney flights to another part of Auckland will transfer noise from one group of residents to another.

Auckland Airport considers that as a result of the removal of Brisbane/North Australia/Asia flights and Melbourne/South Australia flights from the central-western route in 2018, noise from night flights is spread relatively equitably across North Auckland, Central Auckland and South Auckland, and that the remaining Sydney flights that fly over the central Auckland suburbs and represent 15% of arrivals on Runway 23 is an equitable share to remain over central Auckland.

Changes to the Sydney arrivals path will increase track miles and carbon

Moving Sydney flights to another part of Auckland will result in increased carbon emmissions which runs counter to the strong focus on fuel efficiency and reduced carbon footprint from air travel:

- The Southern Night STAR concept would add 8 nautical files per arriving flight representing 78 kg of additional fuel or 96 tonnes per annum[10]. In terms of carbon from fuel burn, this represents an additional 245kg of CO_2 per arriving flight, or 302 tonnes of additional CO_2 per annum.
- The Northern Night STAR concept would add 15 nautical files to the flight representing 146 kg of additional fuel per representative arriving flight, or 180 tonnes per annum (at the 2019 volume of 1231 night time arrivals from Sydney on Runway 23L). In terms of carbon from fuel burn, this

[10] Using the 2019 flight volumes of 1231 night time flights from Sydney arriving on Runway 23. Note current flight volumes are considerably lower with night flight volumes in 2021 only being at 26% of 2019 volumes and not forecast to return to 2019 levels until approximately 2024.

represents an additional 460kg of CO_2 per arriving flight, or 568 tonnes of additional CO_2 per annum.[11]

Airlines are continually looking to reduce carbon useage through means such as investing in carbon-reduction technology, purchasing more efficient aircraft, investigating alternative means of fuel and use of battery power, looking to use electric based ground power units rather than fuel based ground power units or auxilary engines. Airways, airlines and airports in New Zealand have also invested millions developing more efficient approaches and departure using performance-based navigation arrival and departure procedures and utilising satellite-based navigation technology to enable aircraft to fly more optimal flight paths with continuous ascent or descent reducing track miles flown.

BARNZ in its feedback noted that it supported retaining the staus quo, commenting:

> *When working on developing new aircraft tracks, BARNZ supports changes that both avoid increasing noise and avoid increasing carbon miles. The aim is to strike the right balance between noise, carbon impact, safety and cost. BARNZ does not consider either the southern concept or the northern concept routes strikes the right balance. Airlines are not comfortable with flights unnecessarily crossing and increasing risk. Airlines are held accountable by ICAO for the carbon they burn and are always looking for ways to reduce carbon, not increase it. BARNZ does not consider that the volume of complaints received justifies supporting changing the flight path and increasing track miles and carbon burn. There is only a very small overall reduction in noise brought about by a result of these changes versus the increased risk and increased track miles.*

Auckland Airport supports reducing carbon useage where-ever possible through utilising satellite-based navigation technology to enable aircraft to fly more optimal flight paths with continuous ascent or descent reducing track miles flown. However, at the same time, the Airport acknowledges noise impacts on residents also need to be taken into account, and a balance reached. This is why specific Noise Abatement Procedures exist in Civil Aviation Rule 91. If there is a significant reduction to noise impact on residents that can be achieved with a modest increase on carbon useage, then Auckland Airport would be open to supporting such a change in order to minimise noise on residents. However, in the present case, as BARNZ and Airways note, the alternative flight paths create an increased risk from flights crossing, and there have already been changes to flight paths for night flights arriving from Australia in 2018 which significantly reduced the volume of flights using the Central-western route over Auckland City.

The increased carbon miles associated with the two routes considered are therefore a mark against these alternative routes, albeit not a definitive factor.

The Southern Night STAR exposes the lowest volume of people to a sleep disturbing event

Work undertaken by MDA, as outlined in section 6 above, indicates that at present population levels, the number of people exposed to a sleep disturbing event of 60 dB L_{Amax} or higher from an arriving aircraft is lowest if the Southern Night STAR concept is used, and highest if the existing standard arrivals route (the Western approach) continues to be used. However, the Southern suburbs have been earmarked for significant population growth over the next decade, with the Drury area alone (which the Southern route flies over) forecast to increase by 50 000 people.

For larger aircraft such as the 777, which has a greater noise profile than smaller narrow body aircraft like the A320, the volume of people experiencing a sleep disturbing event from an aircraft overflight of 60 dB LAmax or greater is higher for flights under the Western Approach (17 970 additional persons exposed) than the Brisbane/North Australia Night STAR (5319 additional persons exposed) or the Melbourne/South Australia Night STAR (1794 additional persons exposed). Note, for all concepts, 59 436 persons under the Centre Runway Approach are also exposed to a sleep disturbing event from an aircraft overflight of 60 dB L_{Amax} or greater. However, 777 aircraft represent less than 20% of aircraft movements from Sydney.

For smaller aircraft like the A320, the volume of people experiencing a sleep disturbing event is relatively similar under all three approaches, being less than 1000 persons disturbed on any of the three routes to cross Auckland, in addition to the 39 729 persons under the centre runway approach experiencing a sleep disturbing event.

[11] Calculations undertaken using the ICAO Carbon Emissions Calculator available at ICAO Carbon Emissions Calculator.

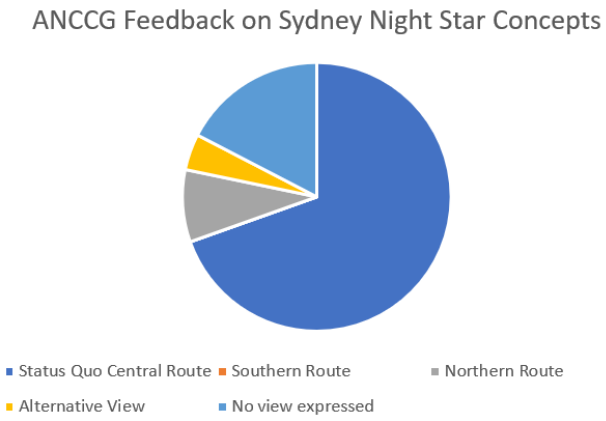
Current Exposure to a sleep disturbing event of an aircraft overflight of 60 dB L_{Amax} or greater

	Persons affected under Centre Runway Approach	+	Persons affected under the Western Approach	Persons affected if Northern Night STAR used	Persons affected if Southern Night STAR used
A 320	39 729	+	1047	1047	279
B 777	59 436	+	(12 651 + 5319) = 17 970	5319	1794
Person Event Index assuming all flights B777			1.08 million	1.03 million	1.01 million

Feedback from ANCCG members supports the Status Quo

Feedback was sought from ANCCG members at both the March and June 2022 ANCCG meetings, as well as on-line using a Microsoft TEAMs survey, with a 73% majority favouring retaining the status quo.

Of the 22 ANCCG members (excluding Auckland Airport's two members) only three members were in favour of a change, with two members (9%) (one Local Board and one community representative) supporting the proposed Northern concept and one independent member supporting a partial use of the Southern route between the hours of 1am and 5am, with flights before 1am, and after 5am, remaining on the central-western route.



73% of members including all industry representatives, the Council governance representative Councillor Alf Fulipiana, the second community representative and ten other Local Board representatives supported the status quo.

Three members did not express a view. The two Auckland Airport ANCCG members have been excluded from this analysis.

Auckland Airport draws a message of support for retaining the status quo from the ANCCG deliberations and feedback.

Auckland Airport Decision

Auckland Airport does not support moving Sydney Night Flights from their current central-west flight path over Auckland City to a Northern Route given:

- The increased carbon used by the route which is 15 nautical miles longer than the central route
- The increased risk to avaition safety caused by arriving flights moving to this Northern route having to cross the airspace 'gates' used by departing flights
- The previous adjustments to flight paths made in 2018 which shared arriving night flights relatively evenly across Northern, Central and Southern Routes; and
- The low level of support from ANCCG members for moving Sydney Night Flights to the Northern route, with just one Local Board supporting this and one community representative.

Auckland Airport has also decided not to move Sydney Night Flights from their current central-west flight path over Auckland City to a Southern Route given:

- The increased carbon used by the route which is 8 nautical miles longer than the central route

- The previous adjustment of arriving flight paths for night flights from Australia in 2018 which shared arriving night flights relatively evenly across Northern, Central and Southern Routes;
- The population increase forecast over the next decade for the South Auckland areas in question, particularly Drury;
- The fact that South Auckland already experiences virtually all domestic night time movements, as well as night time arrivals from South Asutralia; and
- The absence of support from ANCCG members for moving flights from the central route to a southern route over South Auckland.

Auckland Airport has taken into account that the Marshall Day analysis shows that the Southern route would currently affect the lowest number of people in terms of Sleep Disturbance Events. However, the forecast population growth over the next decade in this area of Auckland, means its urban areas will be likely to become similar in population density to the central Auckland area. Moreover, for narrow body aircraft, which comprise the greatest volume of passenger aircraft on the Tasman, the difference in numbers of persons affected across the three routes is extremely minor.

The process undertaken with ANCCG members across the March and June 2022 meetings was extremely valuable, and Auckland Airport would like to thank all ANCCG members for their time considering the material provided, the question asked and discussion held, and the clear feedback provided.

In the course of the work undertaken, Airways has identified that it may be possible to increase aircraft height by 1000 feet at the LOSGA waypoint in the Central-western approach at night, which would reduce aircraft noise over the Central suburbs as aircraft follow the Western Approach (ie crossing Auckland via Green Bay, the LOSGA waypoint at Mt Eden, to Point England and Beachlands). Auckland Airport will work with Airways and BARNZ to explore this possibility with a view to bringing about this change if it is possible and will keep ANCCG members updated.

APPENDIX A CALCULATION OF CARBON IMPACT

Airlines are continually investing in carbon-reduction technology, including purchasing more efficient aircraft, reducing average fleet age, investigating alternative means of fuel and use of battery power, looking to use electric based ground power units rather than fuel based ground power units or auxilary engines. Airways, airlines and airports in New Zealand have also invested millions developing performance-based navigation (PBN) arrival and departure procedures. Utilising satellite-based navigation technology, aircraft fly more optimal flight paths with continuous ascent or descent, reducing track miles flown and the associated kilograms of carbon emissions, along with reducing noise by avoiding populated areas. Adding track miles runs counter to the strong focus on fuel efficiency and reduced carbon footprint from air travel.

The ICAO Carbon Emissions Calculator has been used as an independent objective tool to estimate the additional carbon burned if longer flight tracks were adopted to avoid flying over the central Auckland suburbs. This can be found at ICAO Carbon Emissions Calculator. The ICAO web site notes that the methodology applies the best publicly available industry data to account for various factors such as aircraft types, route specific data, passenger load factors and cargo carried.

One Way/Round Trip	Cabin Class	Number of Passengers
One Way	Economy	1

Leg	From City/Airport	To City/Airport
1	AKL	SYD

Delete All Location(s) | Delete Leg | Add New Leg

Reset | Compute

Metric (KG / KM) | Standard (LBS / MI)

Total

Dep Airport	Arr Airport	Number of passengers	Cabin Class	Trip	Aircraft Fuel Burn/journey (KG)[ab]	Total passengers' CO2/journey (KG)[c]
AKL	SYD	1	Economy	One Way	13061.1	141.4

Flight Stage Detail

Dep Airport	Arr Airport	Distance (KM)	Aircraft	Aircraft Fuel Burn/leg (KG)[a]	Passenger CO_2/pax/leg (KG)
AKL	SYD	2158.0	320, 332, 333, 73H, 77W, 789	13061.1	141.4

a. Fuel Burn information provided are for 1 aircraft per leg

b. Aircraft Fuel Burn/journey = ∑Aircraft Fuel Burn/leg

c. Total passengers' CO2/journey = ∑Passenger CO2/pax/leg×Number of pax

A representative[12] one way flight from Auckland to Sydney is indicated by the ICAO Emissions Calculator to burn:

- 13 061 kg of fuel per leg
- 6 kg of fuel per km
- 141.4 kg of carbon per passenger per leg.

The Southern Night STAR concept would add 8 nautical miles to the flight or 12.9km. The ICAO calculator indicates this represents 78 kg of additional fuel per representative arriving flight, or 96 tonnes of additional fuel per annum (at the 2019 volume of 1231[13] night time arrivals from Sydney on Runway 23L). In terms of carbon from fuel burn[14], this represents an additional 245kg of CO_2 per arriving flight, or 302 tonnes of additional CO_2 per annum.

The Northern Night STAR concept would add 15 nautical miles to the flight or 24.1km. The ICAO calculator indicates this represents 146 kg of additional fuel per representative arriving flight, or 180 tonnes of additional fuel per annum (at the 2019 volume of 1231 night time arrivals from Sydney on Runway 23L). In terms of carbon from fuel burn, this represents an additional 460kg of CO_2 per arriving flight, or 568 tonnes of additional CO_2 per annum.

[12] Note this is a representative flight using the ICAO methodology that averages out aircraft types flown on this sector and average load factors. Different results will be obtained if calculations are undertaken for individual aircraft types and different assumptions regarding load factors.

[13] Note the volume of night-time arrivals from Sydney has been considerably lower in 2020, 2021 and 2022 due to reduction in aircraft volumes as a result of COVID-19, with 2021 night flights being only 26% of 2019 volumes. It is widely estimated that 2019 aircraft traffic levels will not be reached again until approximately 2024.

[14] The ICAO calculator emission factor of multiplying fuel weight by 3.16 was applied to calculate the CO_2 emissions.

APPENDIX B

Below are four of the existing charts from the NZ AIP which are used by pilots showing the STARs as currently published.

The first is the existing STAR from Sydney that comes through LUNBI then flies the ARADI8A arrival. Melbourne traffic comes through PEBLU and can be seen joining at ARADI and Brisbane traffic from UPLAR flies through BASIV to DOMRI.

The second chart shows the TAZEY1N arrival flown off the Melbourne track between 11pm and 6am going through ZORBA and SABAV to intercept final approach.

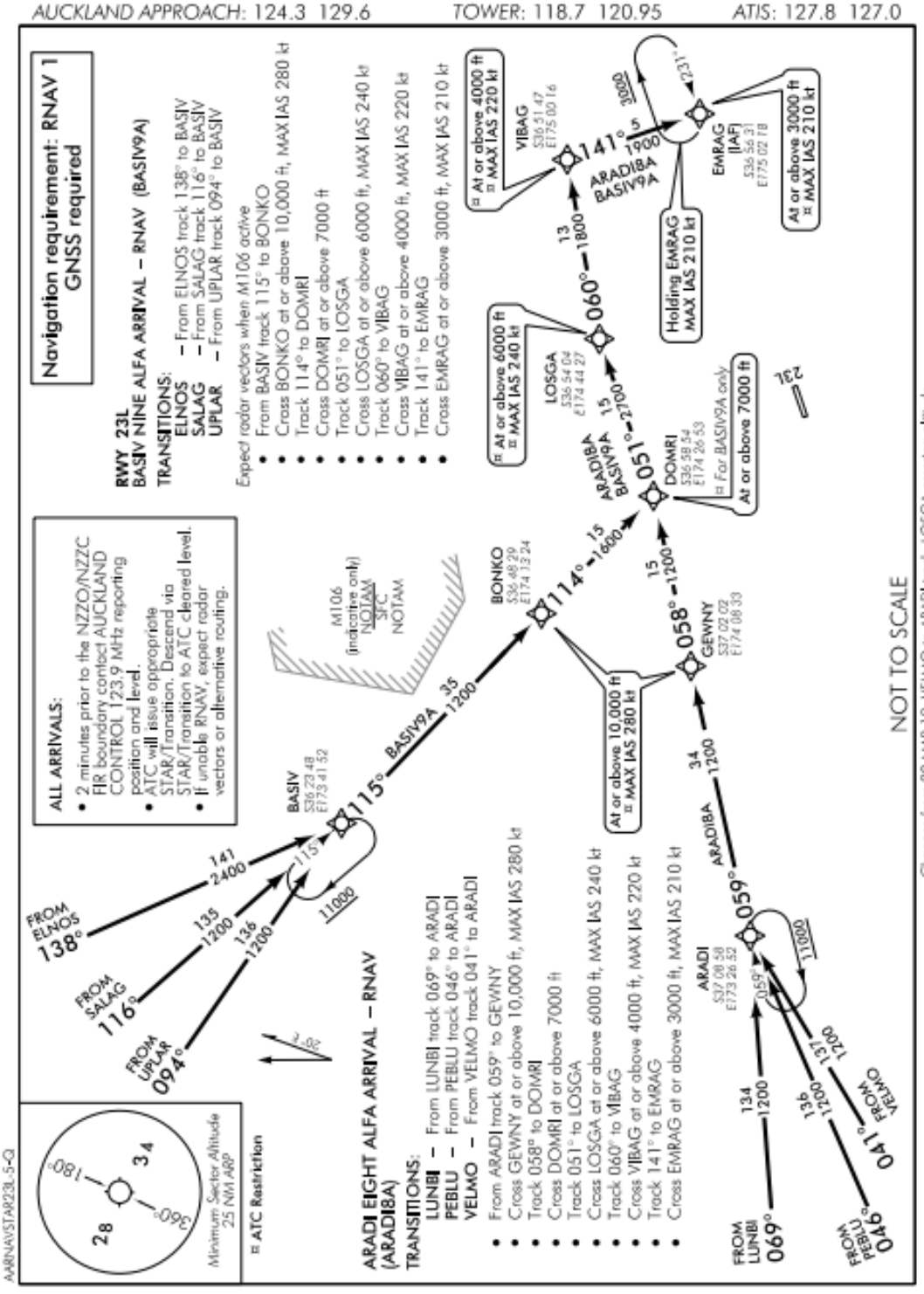
The third chart shows the domestic traffic arrivals from the south of Auckland. Jets from WN, CH, DN and QN all come through DAVEE and fly the DAVEE6A arrival also going through ZORBA and SABAV to intercept final approach.

The final is the existing chart from the NZ AIP showing the Brisbane Night STAR between 11pm and 6am as currently published.

ELEV 23
NZAA
CAT A,B,C,D

AUCKLAND
RNAV STAR RWY 23L (5)

AUCKLAND CONTROL: 123.9 134.0
AUCKLAND APPROACH: 124.3 129.6
TOWER: 118.7 120.95
ATIS: 127.8 127.0



Effective: 7 NOV 19

AUCKLAND
RNAV STAR RWY 23L (5)

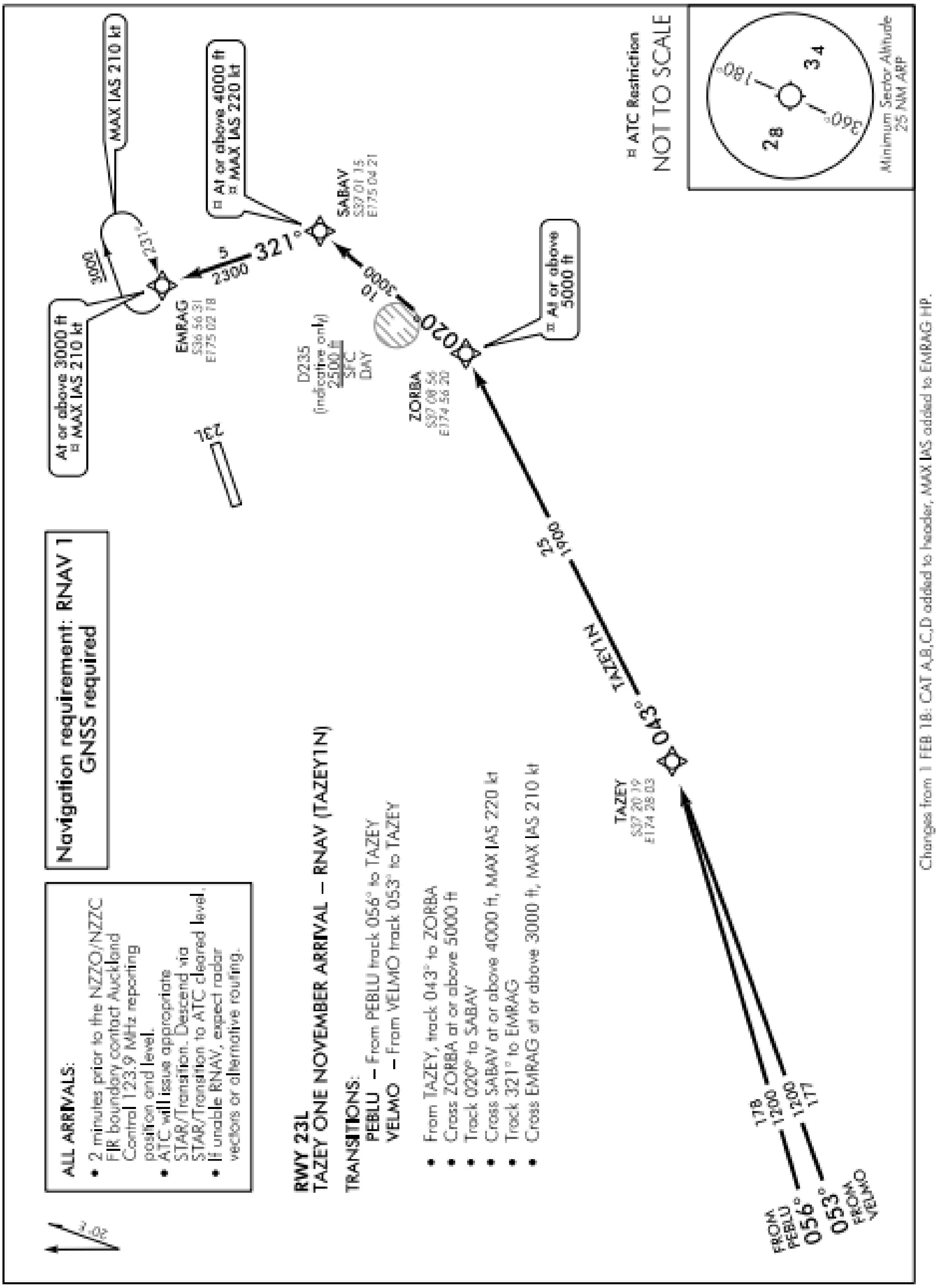
ELEV 23
NZAA
AUCKLAND CONTROL: 123.9 134.0
AUCKLAND APPROACH: 124.3 129.6

CAT A,B,C,D

TOWER: 118.7 120.95

AUCKLAND
RNAV STAR RWY 23L (7)

ATIS: 127.8 127.0



Effective: 28 MAR 19

AUCKLAND
RNAV STAR RWY 23L (7)

ELEV 23
NZAA

CAT A,B,C,D

AUCKLAND
RNAV STAR RWY 23L (9)

AUCKLAND APPROACH: 124.3 129.6 *TOWER*: 118.7 120.95 *ATIS*: 127.8 127.0

RWY 23L

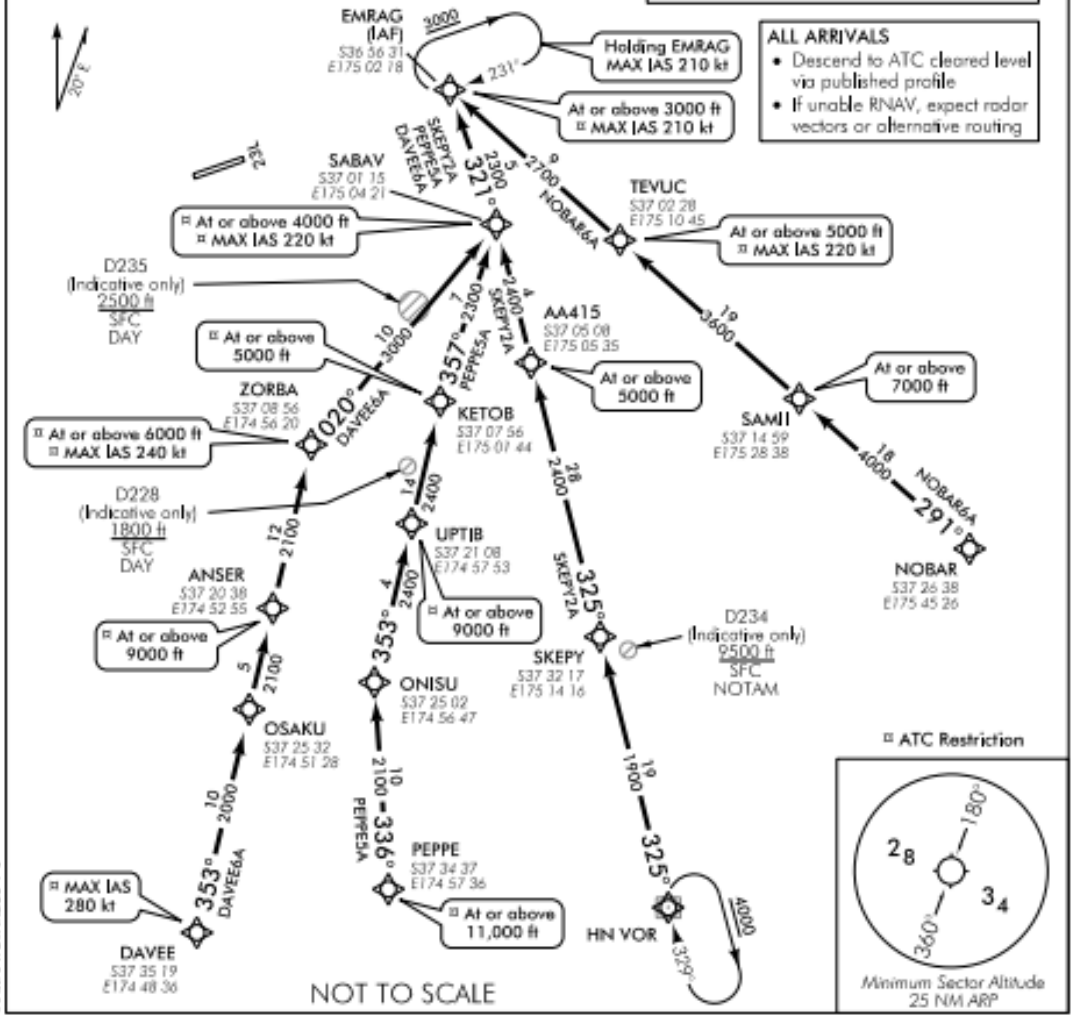
DAVEE SIX ALFA ARRIVAL – RNAV (DAVEE6A)
- Cross DAVEE MAX IAS 280 kt
- Track 353° via OSAKU and ANSER to ZORBA
- Cross ANSER at or above 9000 ft
- Cross ZORBA at or above 6000 ft, MAX IAS 240 kt
- Track 020° to SABAV
- Cross SABAV at or above 4000 ft, MAX IAS 220 kt
- Track 321° to EMRAG
- Cross EMRAG at or above 3000 ft, MAX IAS 210 kt

PEPPE FIVE ALFA ARRIVAL – RNAV (PEPPE5A)
- Cross PEPPE at or above 11,000 ft
- Track 336° to ONISU
- Track 353° via UPTIB to KETOB
- Cross UPTIB at or above 9000 ft
- Cross KETOB at or above 5000 ft
- Track 357° to SABAV
- Cross SABAV at or above 4000 ft, MAX IAS 220 kt
- Track 321° to EMRAG
- Cross EMRAG at or above 3000 ft, MAX IAS 210 kt

SKEPY TWO ALFA ARRIVAL – RNAV (SKEPY2A)
Expect radar vectors when D234 is active
TRANSITION:
HAMILTON – From HN VOR track 325° to SKEPY
- From SKEPY track 325° via AA415 to SABAV
- Cross AA415 at or above 5000 ft
- Cross SABAV at or above 4000 ft, MAX IAS 220 kt
- Track 321° to EMRAG
- Cross EMRAG at or above 3000 ft, MAX IAS 210 kt

NOBAR SIX ALFA ARRIVAL – RNAV (NOBAR6A)
- From NOBAR track 291° via SAMII and TEVUC to EMRAG
- Cross SAMII at or above 7000 ft
- Cross TEVUC at or above 5000 ft, MAX IAS 220 kt
- Cross EMRAG at or above 3000 ft, MAX IAS 210 kt

Navigation requirement: RNAV 1 GNSS required



Changes from 7 NOV 19: SKEPY2A replaces SKEPY1A, SKEPY track bearing.

AARNAVSTAR23L-9-J

Effective: 7 OCT 21

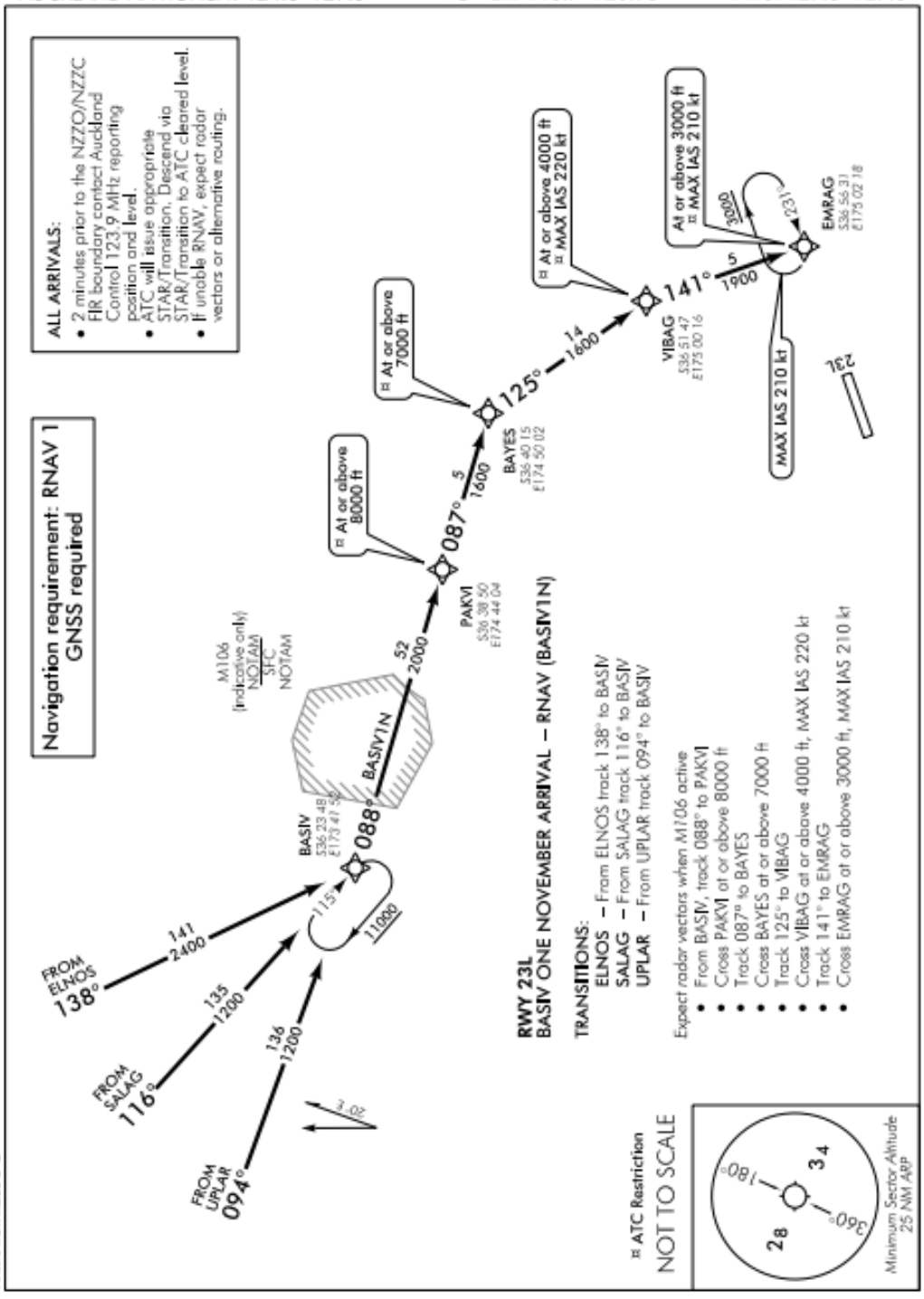
AUCKLAND
RNAV STAR RWY 23L (9)

ELEV 23
NZAA
AUCKLAND CONTROL: 123.9 134.0
AUCKLAND APPROACH: 124.3 129.6

CAT A,B,C,D

AUCKLAND
RNAV STAR RWY 23L (6)

TOWER: 118.7 120.95 *ATIS*: 127.8 127.0



Effective: 28 MAR 19

AUCKLAND
RNAV STAR RWY 23L (6)