AUCKLAND AIRPORT
2021 FINANCIAL YEAR ANNUAL NOISE MANAGEMENT REPORT

30 August 2021

Cover Photo: Robert de Bock

EXECUTIVE SUMMARY

Designation 1100 requires Auckland International Airport Limited (AIAL) to report on its aircraft noise monitoring programme. The programme involves continuous 'on the ground' monitoring of aircraft noise levels at three sites, noise contour calculations for actual and projected aircraft activity, engine testing noise monitoring and noise complaint monitoring. This report has been prepared by Marshall Day Acoustics and provides an overview of the noise monitoring programme for FY21 (Jul 2020 – Jun 2021).

The COVID-19 pandemic had a significant impact on aircraft operations during FY21, and its effects look to be ongoing into FY22 and beyond. Compared with FY20, operations decreased by 32%, with night-time movements (10pm – 7am) down 52% and daytime movements down 30%. This decrease from FY20 is because FY21 was the first full 12 month period affected by the pandemic; movement reductions due to the pandemic only began in the last quarter (April – June 2020) of FY20.

Night-time movements made up 8% of the total movements in FY21 with the remaining movements (92%) occurring in the daytime. The runway usage during FY21 was 64% Runway 23L and 36% Runway 05R. This is within 6% of the historical average runway split of 70%/30% in favour of Runway 23L.

The three permanent noise monitors are located on the outer boundary of the High Aircraft Noise Area (HANA). The measurement results from all noise monitors demonstrate compliance with the 65 dB L_{dn} noise limit at the outer boundary of the HANA. Compared with FY20, the measured noise levels for FY21 have decreased by 3.6 dB at Puhinui School, 4.7 dB at the Velodrome, and by 3.9 dB at Prices Rd.

The Puhinui School and Velodrome noise monitors calibrated satisfactorily throughout FY21. However, there were some noise monitor malfunctions in FY21 The Prices Road and Puhinui monitors were down for around a week and a month respectively due to software and hardware issues (subsequently resolved through an upgrade), and all monitors were down for a further week due to an error in the data provided by Airways.

The calculated noise contours based on actual FY21 aircraft operations also show compliance with the 60 and 65 dB L_{dn} limits at all locations along the Moderate Aircraft Noise Area (MANA) and HANA boundaries respectively.

The projected Annual Aircraft Noise Contours for FY22 (2022 AANC), which represents activity occurring in the coming year, shows a discernible increase (3.6-3.8 dB) in noise compared with the 2021 AANC. This is due to the projected recovery from the pandemic. The Noise Mitigation Programme utilises this information to identify properties eligible for sound insulation offers. This year no new properties are eligible for offers as the 2022 AANC is smaller than previous years.

Noise from engine testing activities has been compliant with the relevant noise limits throughout FY21. The highest recorded L_{dn} at each of the three compliance locations was 43 dB, which is 12 decibels below the permissible noise limit.

There were 83 complaints received in FY21 made by 49 complainants. We note that 30 (36%) of the complaints were from one person. The total number of complaints received has decreased by 68% when compared to FY20. The total number of people complaining has decreased by 29% when compared to FY20.

The complaints for FY21 were predominantly from the Central Suburbs, with the remainder coming mostly from South Auckland and East Auckland. Most people made less than 5 complaints with only one person making more.

There was a loose correlation between the number of complaints and usage of Runway 05 - departures to the east.

The noise reduction initiatives in FY21 have been summarised in Section 9.0. Future initiatives for FY22 were discussed with the ANCCG at its March 2021 meeting, where the primary agreed initiative was the development of a new night track for flights from North America and the Pacific Islands arriving from the east to approach runway 05 without flying over the main urban Isthmus. This is currently being developed by Airways, aiming to be published and available by December 2021.

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1.0 INTRODUCTION

Designation 1100 requires AIAL to report on its statutory aircraft noise monitoring programme. The programme involves continuous 'in-field' monitoring of aircraft noise levels at three sites, noise contour calculations for actual and projected aircraft activity, engine testing noise monitoring and monitoring of public noise complaints.

The Notice of Requirement Lodged in August 2017 to alter conditions in the Designation was approved by Council in late 2019. The updated Conditions have been used for this report along with the updated Aircraft Noise Areas in the Designation.

Designation 1100 is the framework within which the Airport operates. The designation sets out noise performance criteria and noise management obligations for the Airport to comply with. Condition 5(d) of Designation 1100 requires AIAL to undertake the following:

- Monitor noise from aircraft operations near the boundary of the High Aircraft Noise Area (HANA) to demonstrate that the Day/Night level of 65 dB L_{dn} is not exceeded outside the HANA
- Use recognised noise modelling software and noise monitoring data to calculate whether the noise from aircraft operations exceeds 60 dB L_{dn} anywhere outside the Moderate Aircraft Noise Area (MANA)
- Calculate noise levels to ensure compliance with Condition 10 of the Designation relating to the Noise Mitigation Programme

Condition 13(b) of Designation 1100 requires the airport to calculate and report on the noise level from engine testing activities and Condition 9(c) requires the airport to report on the noise complaints it receives.

AIAL is required to prepare an Annual Noise Management Report each year under Condition 9(b) which summarises the measurements and modelling required by Condition 5(d) and identifies past and future initiatives for noise reduction.

This report has been prepared by Marshall Day Acoustics and provides an overview of the noise monitoring programme for the 2021 financial year (Jul 20 – Jun 21) including:

- A review of the noise monitoring system, calibration and results
- Calculation of noise contours for actual aircraft activity (ANC) to determine compliance
- Calculation of the Annual Aircraft Noise Contours (AANC) for projected aircraft activity to determine offers for the sound insulation programme;
- Summary of past and future initiatives to reduce noise in the community

A summary of the air traffic records for the 2021 financial year has also been included in this report along with flight path diagrams, calculation of noise from engine testing activities and a summary of noise complaints received.

A glossary of terminology is given in Appendix A.

2.0 AIR TRAFFIC RECORDS

Table 1 shows a summary of aircraft movement numbers at Auckland Airport during FY21 (Jul-20 to Jun-21) with FY20 data (Jul-19 to Jun-20) included for reference.

Table 1: Aircraft Movements Numbers

	FY20	FY21	Difference	% Change
Total Movements	139,609	94,268	-45,341	-32%
Daytime Movements (7am to 10pm)	122,989	86,301	-36,688	-30%
Night-time Movements (10pm to 7am)	16,620	7,967	-8,653	-52%

To give broader context: FY21 movements represent a 48% decrease from FY19 movements (181,356), which was the last financial year period to not be affected by the COVID-19 pandemic. The data for these records is from the Airport's noise monitoring system which uses air-traffic data provided by Airways Corporation NZ.

We note that aircraft movement numbers from the monitoring system are slightly higher than those reported on the Airport's website. There was a discrepancy of 219 movements for FY21 which is about 0.2% difference. This discrepancy is likely due to aircraft flying into the airport that are not captured by the airports reporting but are picked up by Casper. This could include things such as helicopters and small aircraft. This discrepancy would have a negligible impact on noise levels reported from the monitoring system.

Overall, aircraft activity during FY21 decreased by 32% when compared to the previous year. Night-time movements decreased by 52% and movements in the daytime decreased by 30%. Night-time movements made up 8% of the total movements in FY21 with the remaining 92% of movements occurring in the daytime.

FY21 is the first complete financial year following the start of the pandemic; border closures and lockdowns only came into effect in the last quarter of FY20 (Q4 Apr - Jun) and so flights decreased from then on. The other three quarters in FY20 had 'normal' pre-pandemic flight volumes. This is why there is a 32% reduction in movements from FY20 to FY21. We note this represents a 48% reduction from FY19 – the last full pre-pandemic year – to FY21.

Figure 1 shows the aircraft movements broken down by broad aircraft type. 49% of total flights were jet aircraft and 46% were turboprops.

Figure 1: Aircraft Movements by Aircraft Type

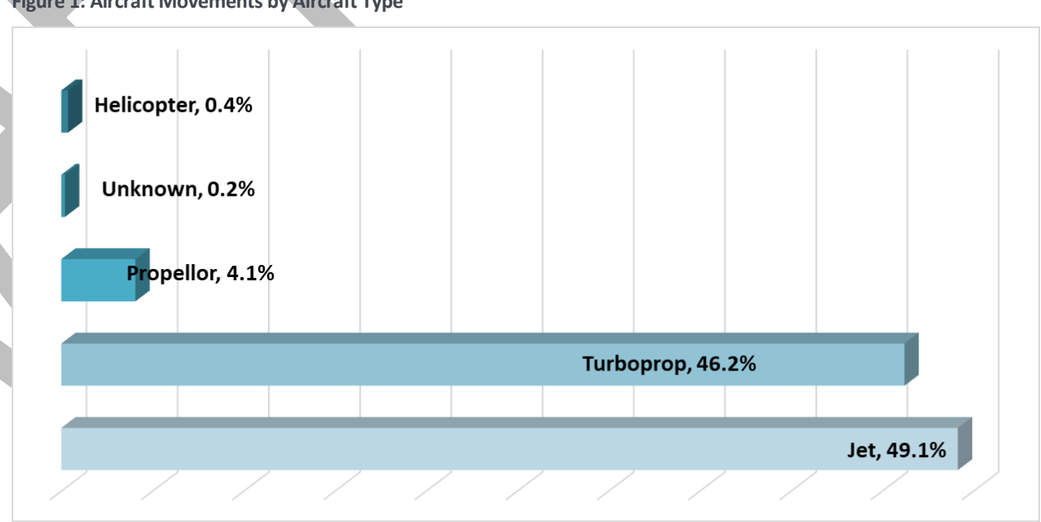


Table 2 below shows the runway usage for FY21. The typical average runway split is 70% Runway 23 (arrivals from the east, departures to the west) and 30% Runway 05 (arrivals from the west, departures to the east). The runway usage for FY21 was slightly different to the typical split with 64% Runway 23 usage and 36% Runway 05 usage. A small number of movements were helicopters and thus were not associated with a runway.

Table 2: Runway Usage

	Typical Runway Split	FY21 Runway Split	Deviation
Runway Mode 23	70%	64%	6%
Runway Mode 05	30%	36%	

3.0 FLIGHT PATHS

The flight paths that aircraft utilise are variable and depend on the aircraft type, aircraft weight, destination/origin, the weather at the time, other air traffic in the area, and other factors. One major factor that influences flight paths is the wind direction. In Auckland, the prevailing wind is from the southwest and under these conditions aircraft use Runway Mode 23 where departing aircraft take off towards the west over the Manukau Harbour and arriving aircraft land on the eastern end of the runway, overflying Papatoetoe.

Figure 2 shows the actual flight paths for the busiest day (7am – 10pm) in FY21 when westerly winds were prevailing (2-Apr-21) and Figure 3 shows the actual flight paths for the busiest night (10pm – 7am) in FY21 when westerly winds were prevailing (2-Apr-21). Each flight path is coloured by altitude. Larger versions of these figures are shown in Appendix B along with figures for the busiest easterly wind day/night (14-May-21).

Figure 2: Individual Flight Paths for the Busiest RW23L Day (7am - 10pm) in the FY21

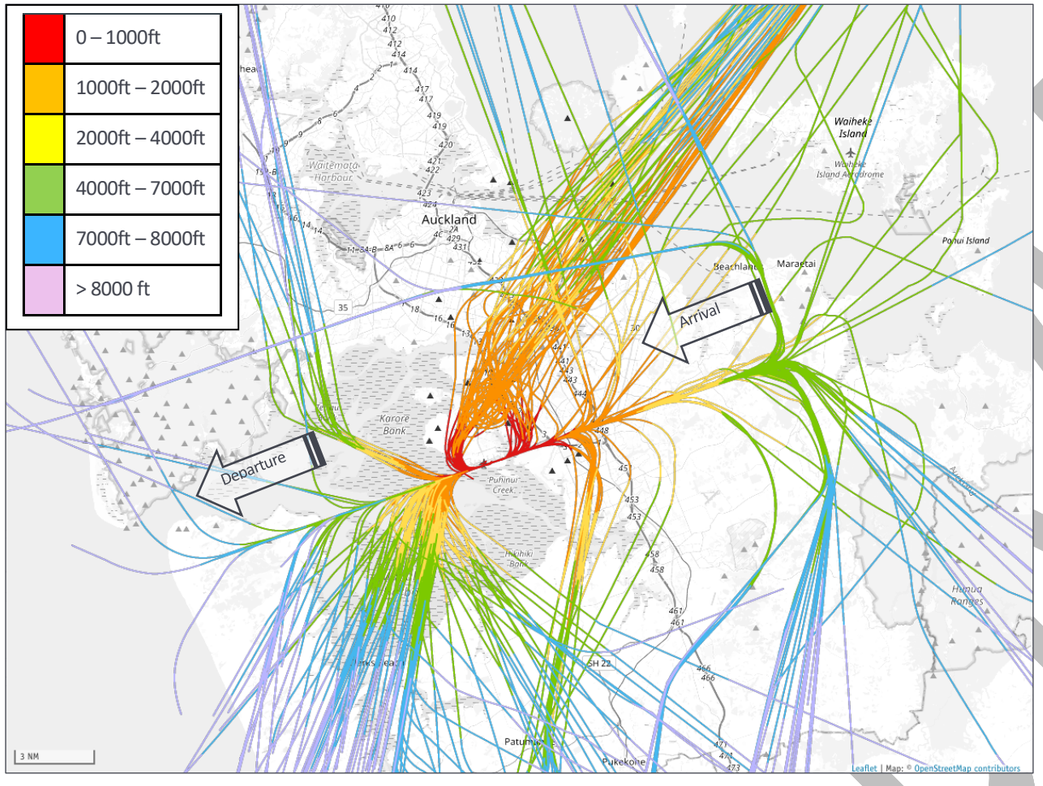
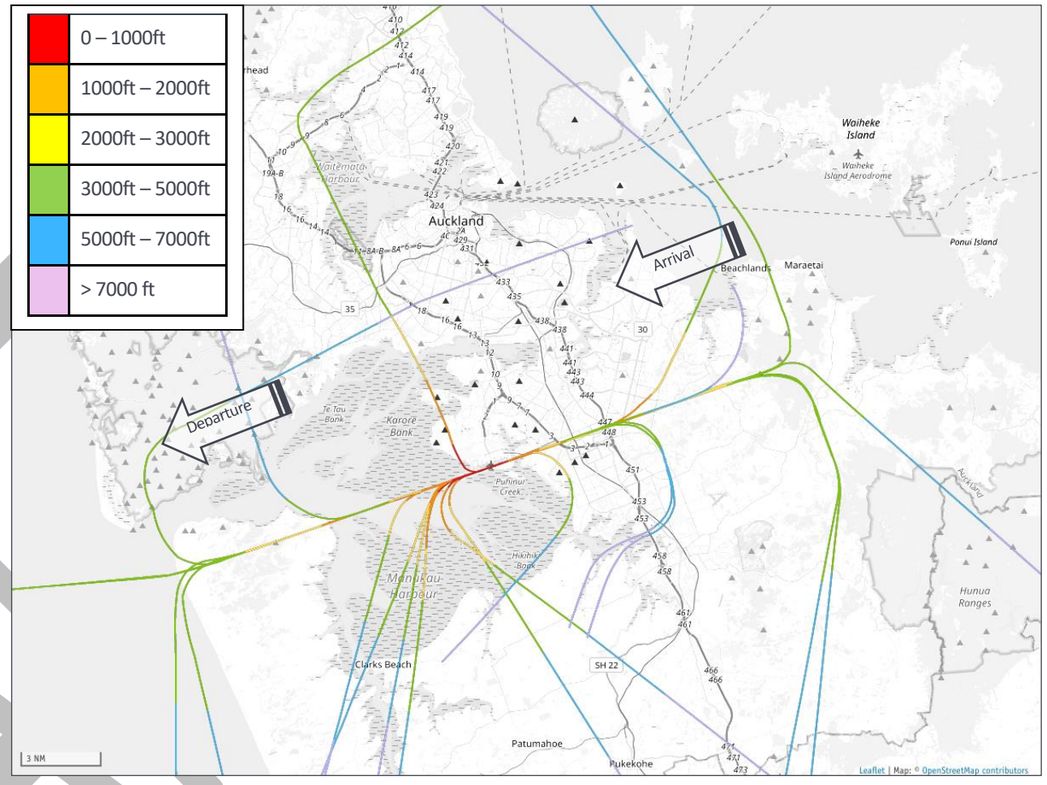


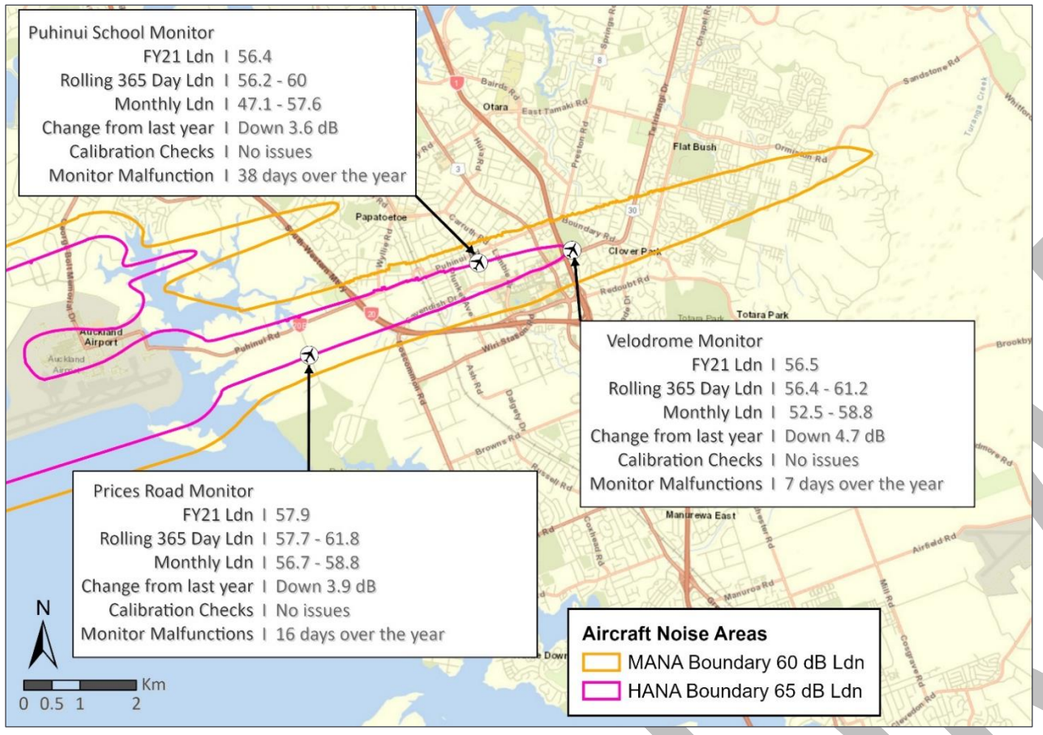
Figure 3: Individual Flight Paths for the Busiest RW23L Night (10pm - 7am) in the FY21



4.0 MONITORED NOISE LEVELS

AIAL has three permanent noise monitors located on the boundary of the HANA at Puhinui School, the Velodrome, and Prices Road. The location of the monitors is shown in Figure 4 along with a summary of the monitoring results for FY21. The noise limit at the boundary of the HANA is 65 dB L_{dn} (365-day average). Appendix C provides information on how the captured noise data is processed and analysed.

Figure 4: Noise Monitor Summary



All noise monitors calibrated satisfactorily throughout FY21, however there were some monitor malfunctions (which have since been resolved through hardware and software upgrades) throughout the year:

- All monitors were down from 16 June – 22 June 2021 due to an error in the radar data from Airways
- The Puhinui Monitor was down for a further 31 days from 25 January – 23 February 2021 due to a combination of hardware and software issues
- The Prices Road Monitor was down for a further nine days due to a software issue

Table 3 compares the measured noise levels for FY20 with FY21. A change in noise level of 3 - 5 decibels would generally be just perceptible to noticeable to those living and working inside the Aircraft Noise Areas. Note that the levels from FY21 were 4 - 5.5 decibels lower than in FY19 (pre-pandemic), which is an appreciable decrease.

Table 3: Measured Noise Levels

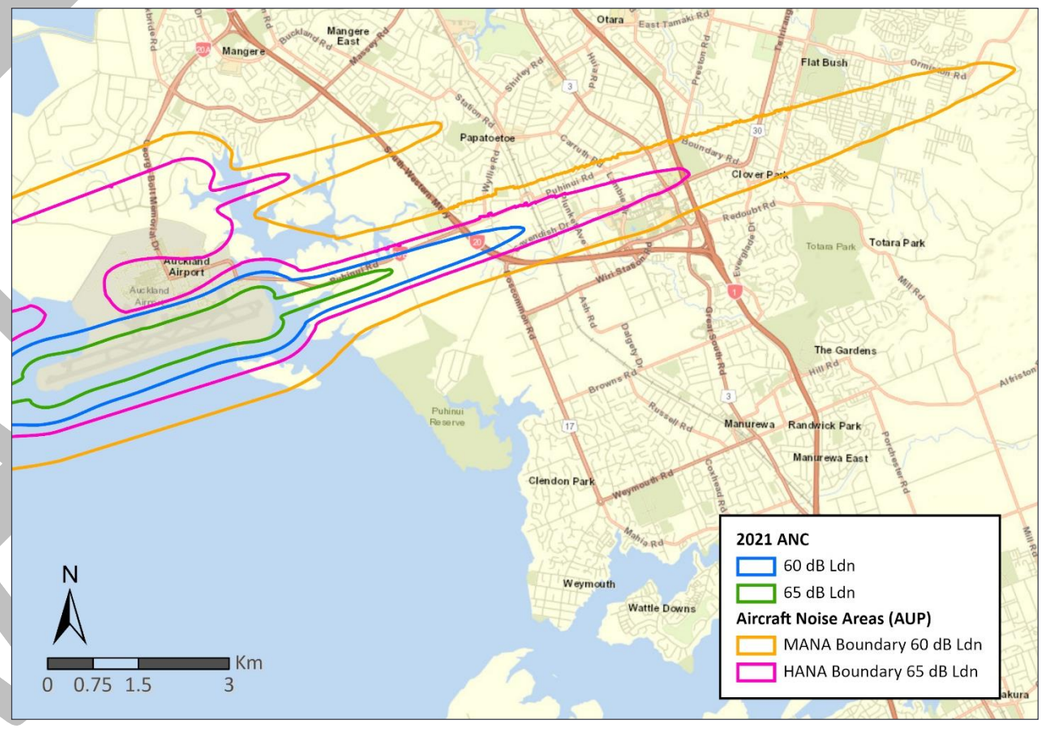
Monitor Location	FY20 (dB L_{dn})	FY21 (dB L_{dn})	Difference (dB)
Puhinui School	60	56.4	-3.6
Velodrome	61.2	56.5	-4.7
Prices Road	61.8	57.9	-3.9

5.0 2021 ACTUAL NOISE CONTOUR (ACTUAL ACTIVITY) - ANC

The ANC noise contours represent the actual aircraft activity occurring in FY21. The purpose of these noise contours is to assess compliance with the MANA and HANA each year. The noise contours have been calculated in the INM version 7.0d using aircraft movement data obtained from the noise monitoring system. Appendix C provides information on how the data is processed for calculation.

Figure 5 shows the calculated 60 and 65 dB L_{dn} contours for FY21. The HANA and MANA boundaries are also shown in Figure 5. Noise from aircraft operations must not exceed 65 and 60 dB L_{dn} at the HANA and MANA Boundaries respectively.

Figure 5: 2021 Actual Noise Contour (ANC)



To give broader context, Appendix D shows the 2021 ANC compared with the 2019 ANC (pre-pandemic).

The calculated noise contours show that noise from aircraft operations in FY21 complied with the limits at the HANA and MANA boundaries. It is important to verify the noise model against the measured levels to ensure an acceptable tolerance. Table 4 lists the calculated noise level at each monitoring site compared with the actual measured noise level for FY21. In this case the model is within 1 dB of the measured levels at the three monitoring locations. This is a reasonable representation for a compliance assessment.

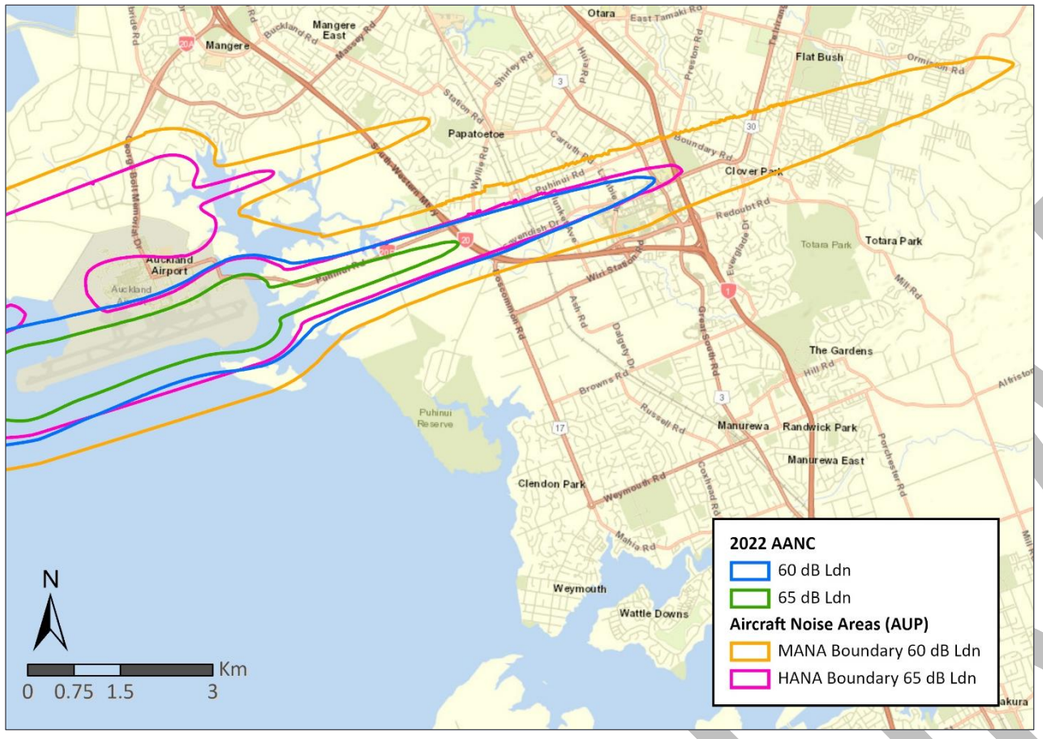
Table 4: Calculated and Measured Noise Levels (Actual Activity FY21)

Monitor Location	Measured Noise Level L_{dn} (dB)	Calculated Noise Level L_{dn} (dB)	Difference (dB)
Puhinui School	56.4	55.8	-0.6
Velodrome	56.5	56	-0.5
Prices Road	57.9	58.4	+0.5

6.0 2022 ANNUAL AIRCRAFT NOISE CONTOUR (PROJECTED ACTIVITY) - AANC

The Annual Aircraft Noise Contours (2022 AANC) will be published in September 2021 and represent noise from aircraft activity predicted to occur in the coming year. The purpose of these noise contours is to identify which properties are eligible to receive an offer for noise mitigation treatment in accordance with Condition 10 of Designation 1100. Figure 6 shows the 2022 AANC contours compared to the HANA and MANA.

Figure 6: 2022 Annual Aircraft Noise Contour (AANC)



The AANC are calculated using the latest version of the FAA Integrated Noise Model (INM version 7.0d). The projected aircraft activity has been based on actual aircraft movements for the 12 months ending 30 June 2021. A predicted growth factor provided by Auckland Airport has been applied to this data to represent movement numbers for the forthcoming year.

Condition 10 of Designation 1100 sets out that qualifying[1] properties in the MANA, become eligible for the mitigation offer if the property falls inside the 60 dB L_{dn} contour of the AANC. Qualifying properties inside the HANA become eligible for the offer if the property falls inside the 65 dB L_{dn} contour of the AANC. There are no qualifying HANA properties inside the 2022 AANC 65 dB L_{dn} contour and no qualifying MANA properties inside the 60 dB L_{dn} contour. Therefore, no mitigation offers are required based on the 2022 AANC. Nonetheless, AIAL intends to voluntarily make offers despite there being no requirement under the designation. Further details are provided in Section 9 of this report.

Appendix E shows the 2021 AANC compared to the 2022 AANC. The 2022 AANC are significantly larger than the 2021 AANC, which is due to the large increase in flights projected for the FY22 as part of the recovery from the COVID-19 pandemic.

Table 5 lists the predicted noise levels at the monitoring sites for the 2021 AANC and 2022 AANC. The noise levels in the 2022 AANC are discernibly higher than the 2021 AANC, due to the recovery from the COVID-19 pandemic.

Table 5: 2020 and 2021 AANC Calculated Noise Levels (Projected Activity)

Monitor Location	2021 AANC (dB L_{dn})	2022 AANC (dB L_{dn})	Difference
Puhinui School	55.5	59.3	+3.8
Velodrome	55.8	59.4	+3.6
Prices Road	57.6	61.3	+3.7

7.0 ENGINE TESTING

Engine testing noise emissions are limited to 55 dB L_{dn} (7 day rolling average) and 75 dB L_{max} (10pm – 7am) received in the "Identified Area" shown in Figure 1 of Designation 1100. Noise emissions from engine testing activities are calculated and assessed for compliance monthly at three key locations in the Identified Area (Res1, Res2, Res3). The calculations are based on records of engine testing activity provided by the airport users and established noise levels relating to each type of test.

Figure 7 shows the lowest, highest and average 7 day rolling L_{dn} noise level at each of the three compliance locations for FY21. The highest L_{dn} calculated out of the three compliance locations was 43 dB, which is 12 decibels below the noise limit.

Figure 7: FY21 Engine Testing Monitoring Summary

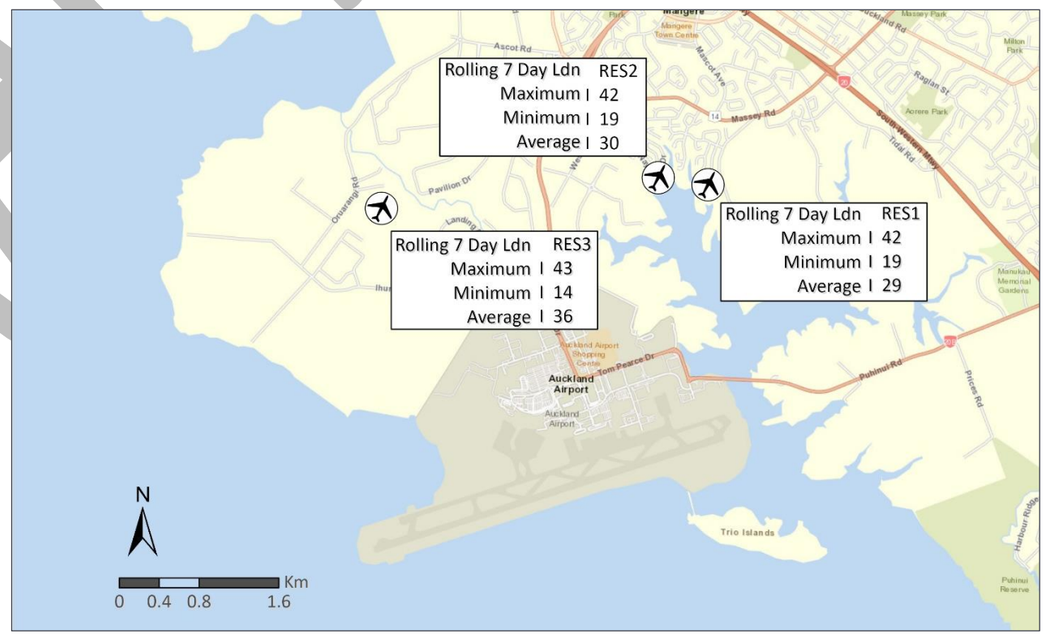


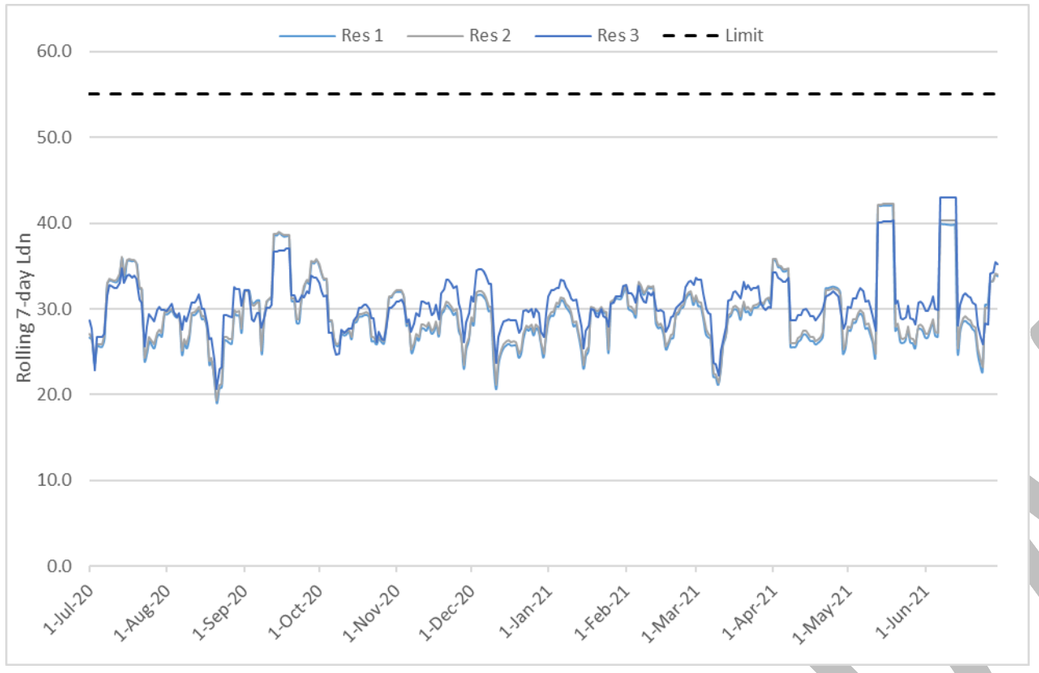
Figure 8 shows a graph of the 7-day rolling L_{dn} noise level at the three compliance locations for each day. Generally, the noise levels were below 40 dB L_{dn}.

The purpose of the L_{Amax} limit is to control the maximum noise level during engine testing at night to protect against sleep disturbance. The L_{Amax} level during a test depends on the aircraft type, power setting and

[1] Meets the Existing Building definition in Designation 1100

propagation conditions but is not affected by the duration of testing. It has been previously ascertained that aircraft undergoing engine testing at Auckland Airport comply with the 75 dB L_{Amax} limit at the three compliance locations for all power settings.

Figure 8: Engine Testing Noise Emissions (Rolling 7 Day Ldn)



8.0 NOISE COMPLAINTS

People may make multiple complaints during the year and each complaint could relate to either a specific aircraft overflight or a more general issue such as increased overflights at night. Therefore, the terminology used in this report when summarising the statistics is as follows:

- The number of 'complainants' (no. of people who complain)
- The number of 'generic' noise complaints (e.g. "there was more aircraft noise last night")
- The number of 'specific' event complaints (e.g. "the flight at 6:25pm last night was particularly noisy")
- The number of 'question' noise enquiries (e.g. "can you tell me more about how noise is managed at the airport")

During FY21 the airport received 83 noise complaints from 49 people, 60 (72%) of these were specific complaints, 15 (18%) were generic complaints, and 8 (10%) were question enquiries.

The complaints for FY21 came predominantly from the Central Suburbs, with the remainder coming mostly from South Auckland and East Auckland

Table 6 shows the noise complaints and number of people complaining over the past 5 years.

Table 6: Summary of Complaints since 2017

	FY17	FY18	FY19	FY20	FY21
No. Complaints	581	467	905	261	83
No. People Complaining	72	155	132	65	49

We note that 30 (36%) of the complaints received in FY21 were from one person. The total number of complaints received in FY21 has decreased by 68% when compared to FY20. The total number of people complaining in FY21 decreased by 29% when compared to FY20.

Figure 9 shows the number of complaints made in each month of FY20 and FY21. The number of complaints received per month ranged between 2 and 18 in FY21. The complaints received each month in FY21 was lower than in FY20 for all months apart from September and April.

Figure 9: Aircraft Noise Complaints in FY20 and FY21

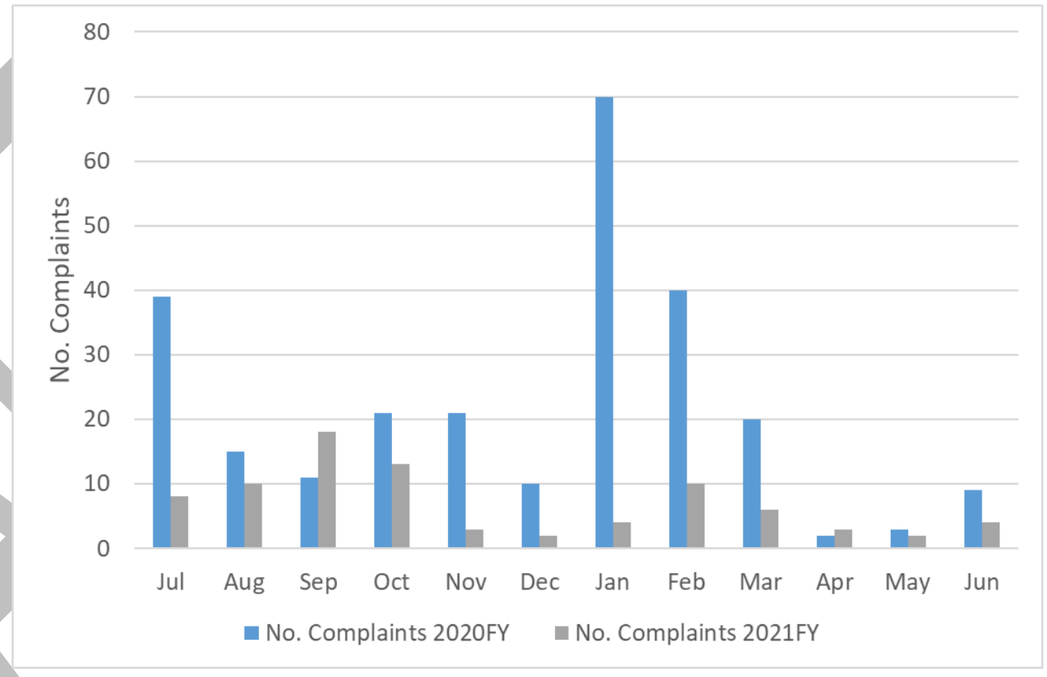


Figure 10 shows the number of people that complained in each month of FY20 and FY21. Each month the number of people making the complaints ranged between 3 and 8 during FY21. Figure 11 shows the specific complaints at night-time (10pm-7am) compared with daytime for each month in FY21.

Figure 10: Number of People Complaining about Aircraft Noise in FY20 and FY21

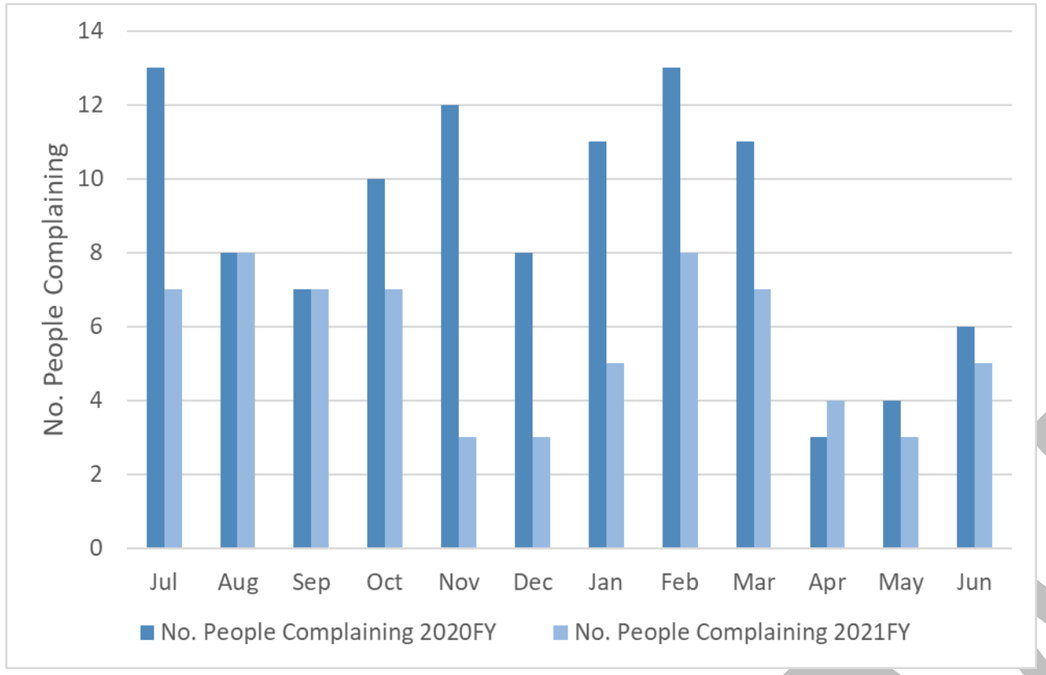
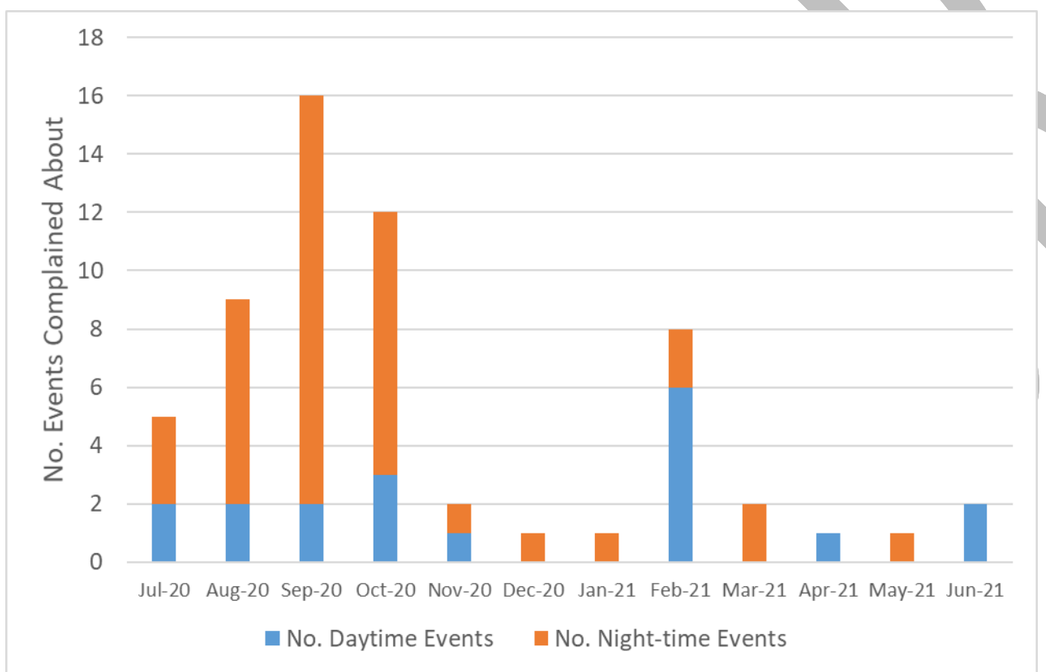


Figure 11: Number of Specific Complaints (by time of day)



Daytime flights made up 32% of the aircraft overflights complained about in FY21 with the remaining 68% relating to aircraft events at night-time. There is little correlation between complaints and frequency of aircraft movements.

Figure 12 shows the percentage usage of Runway 05 compared to the number of specific complaints. There is a loose correlation between runway use and the number of complaints received.

Historically it has been found that the airport receives a higher number of complaints when Runway 05 is used (departures over East Auckland). The increased disturbance caused when Runway 05 is in use is most likely because flights more frequently overfly the Central and Eastern suburbs under these conditions. Departure flight tracks are more dispersed and therefore overfly a larger area of the central and eastern suburbs than arrivals. This is demonstrated by comparing the flight tracks in Appendix B. Departures also have a different noise character and can be louder than arrivals as the aircraft are climbing under power.

Figure 12: Number of Aircraft Noise Complaints vs. Usage of Runway 05

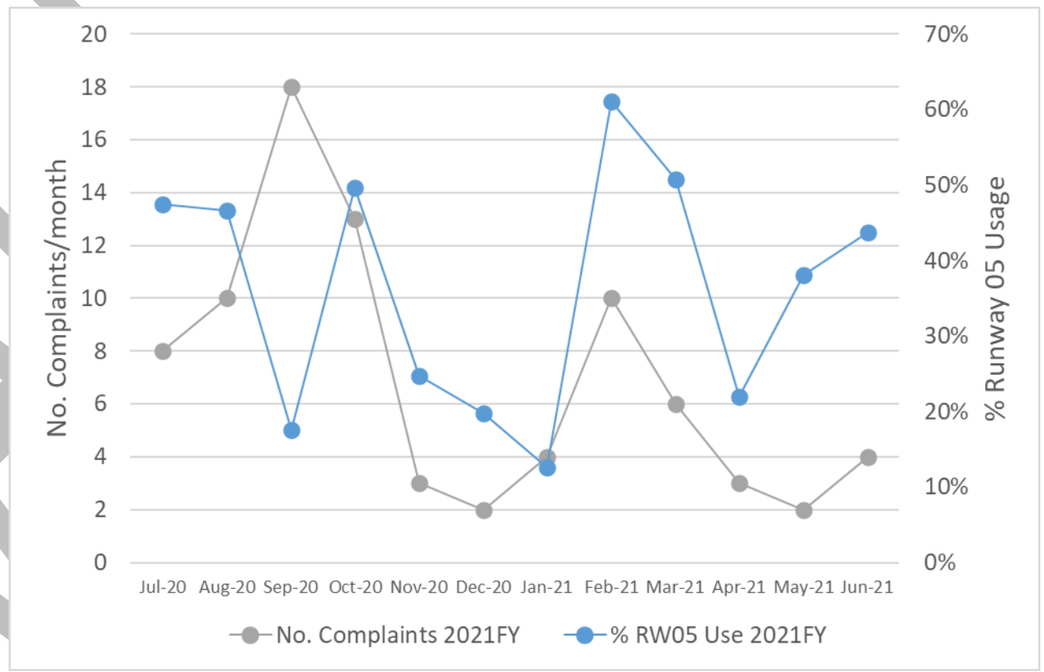


Figure 13 shows the number of complaints received by area. Appendix F gives more detail on the number of complaints received from each suburb. Remuera residents made the largest number of complaints (39%) with the remaining complainants spread over 28 other suburbs. All but two complaints in Remuera were made by one complainant.

Figure 13: Complaints by Area

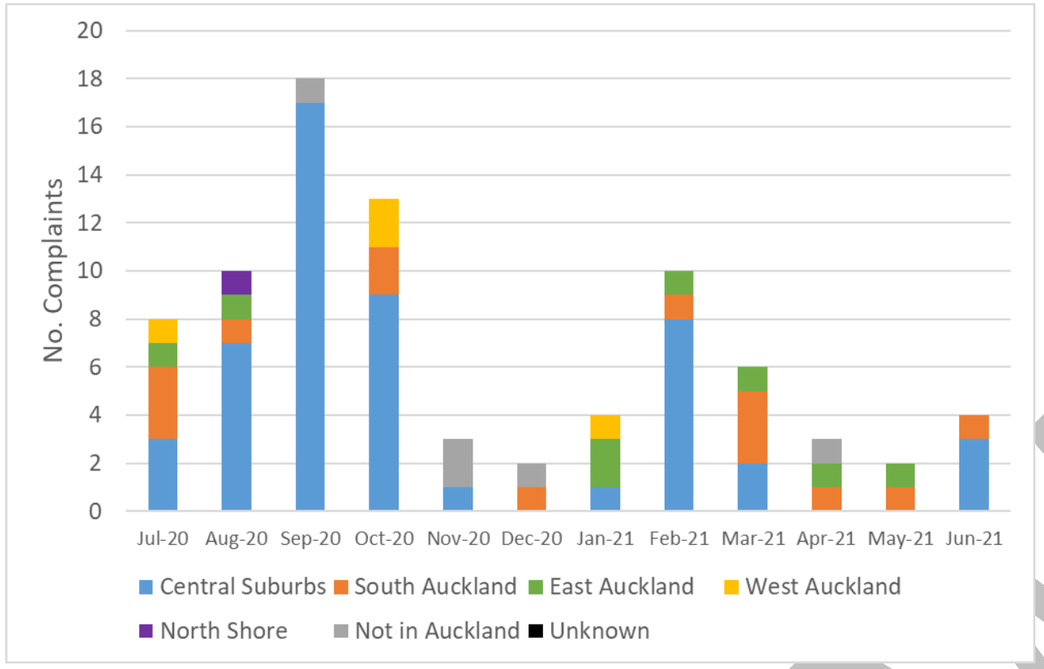
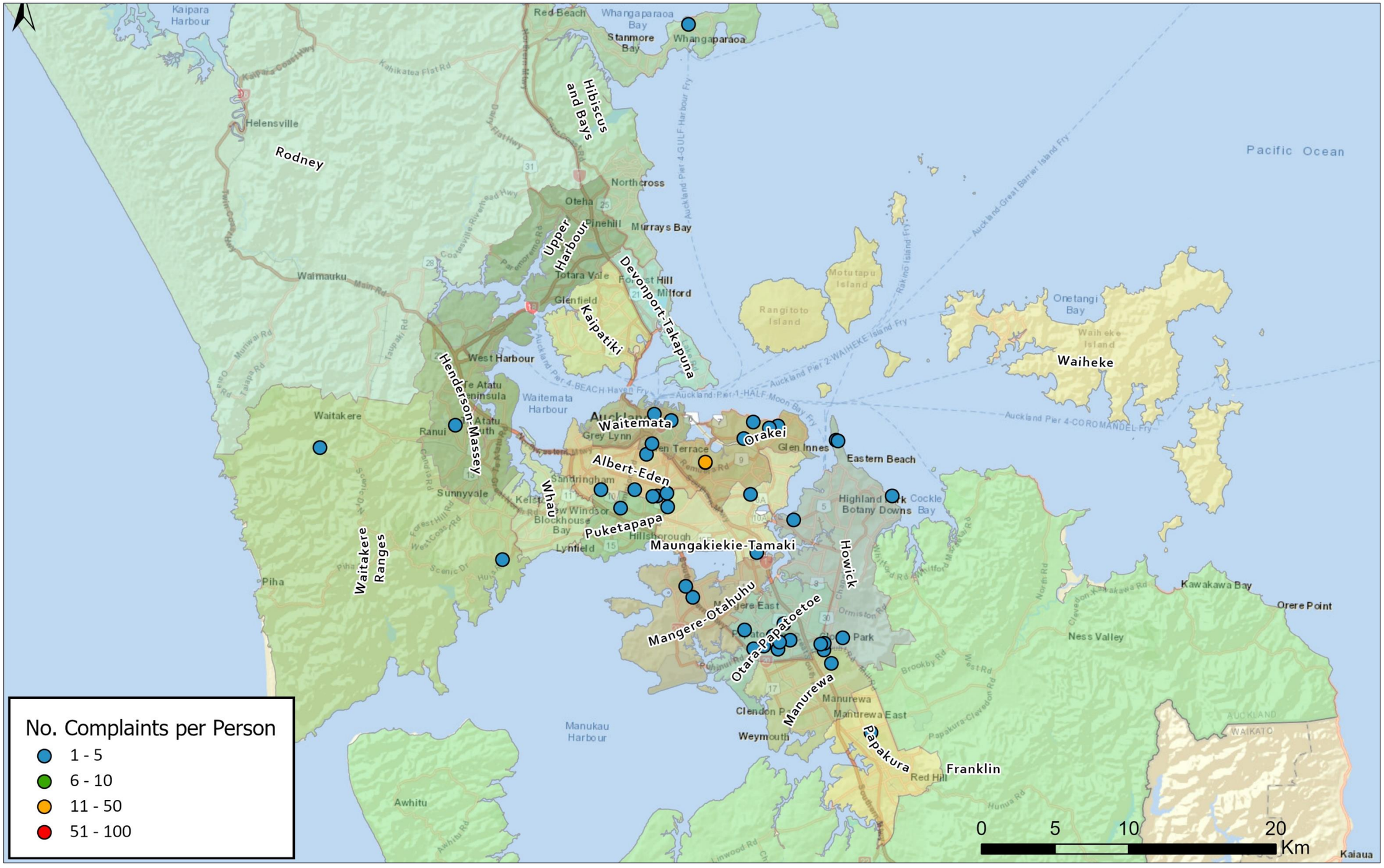


Figure 14 shows the locations of people complaining in FY21 coloured to represent the number of complaints made by that person, the local board outlines are shown behind.

The map shows that the location of complainants is mostly spread over Central and South Auckland, with some in East Auckland, and a small number in West Auckland. Most people made 5 or less complaints (blue dots), with just one person making more than 11 complaints (orange dots) during FY21.

Figure 14: Number of Complaints per Person in FY21



9.0 NOISE REDUCTION INITIATIVES

Condition 9(b) requires AIAL to report on any initiatives to reduce aircraft noise in the community for both the financial year being reported on and the forthcoming financial year. AIAL is required to detail the outcomes of initiatives investigated in the financial year being reported on. This section gives details of these initiatives.

COVID-19 Impact

Notwithstanding the significant reduction in aircraft traffic experienced as a result of COVID-19 when traffic volumes were at the lowest since 1972, and the corresponding financial impact which led Auckland Airport to deliver its first ever annual loss, the Airport has continued to both meet, and exceed, its noise monitoring and community engagement obligations.

There continued to be an additional five noise monitors deployed (above the three noise monitors required by the Designation), the on-line flight tracking tool available to the public (Casper) continued to be provided, the supplementary free 0800 number to make noise complaints in person continued to be offered. The Aircraft Noise Community Consultative Group still met quarterly as required – through a hybrid of attendance on-line and in person representation.

Current Initiatives

Northern STAR Development

In May 2021 the Mt Wellington monitor was removed, with the intention to decommission it for a period of around 15 months. The monitor was under the Green SMART track, predominantly servicing international arrivals from the west. Given the large reduction in international arrivals, the decision was made to retrieve the monitor and save on the operation costs.

These cost savings are being put towards the development of a new Northern STAR serving 05R for flights from North America and the Pacific Islands. It is expected this Northern STAR would meaningfully reduce night-time noise exposure and complaints, and is on track for publication and use in December 2021.

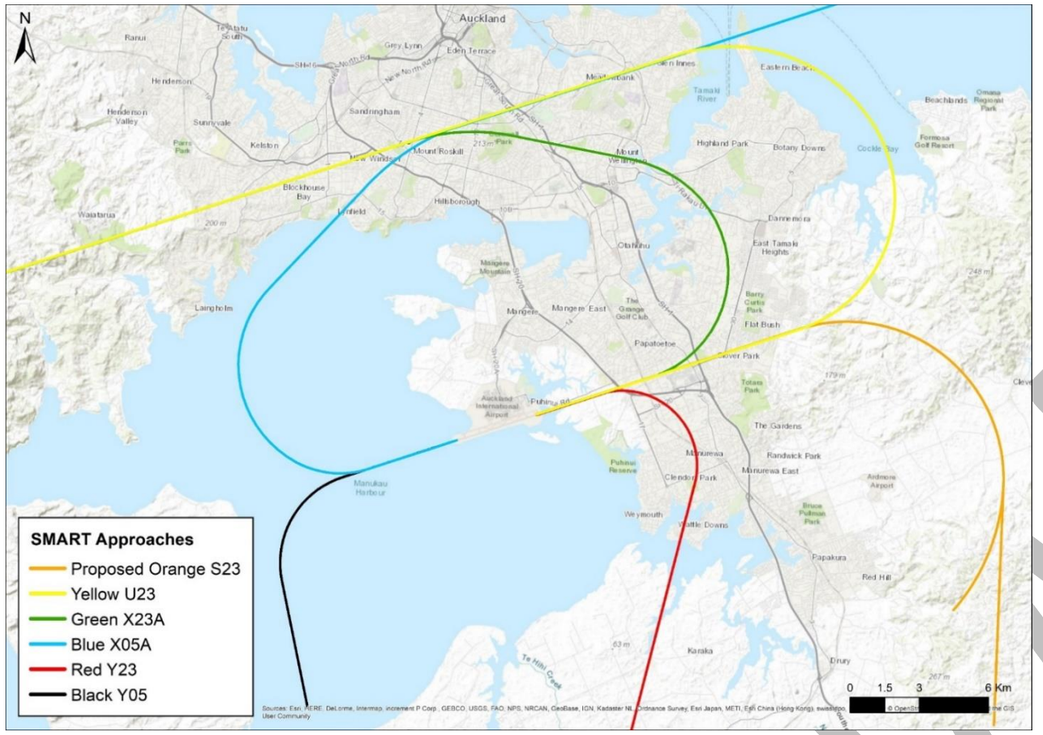
Orange SMART Track

A new SMART track called 'Orange' was implemented in September 2019 on a trial basis, shown in Figure 15. This track was implemented to provide an additional option to the 'Red' SMART track which has been in operation since 2012 and overflies the populated areas of Wattle Downs and Manurewa.

In early 2020 usage of the Orange track ceased after several months of the 12-month trial to recalibrate the arrival profile slightly. The trial recommenced in October 2020 and will continue for a full 12-month period ending in September 2021.

A report of the trial will be produced including information about noise measurements and complaints throughout the trial.

Figure 15: SMART approaches



Noise Mitigation Programme

Condition 10 of Auckland Airport Designation 1100 sets out the requirements for how Auckland Airport should mitigate the effects of aircraft noise within specified noise contours through the implementation of a Noise Mitigation Programme.

COVID-19 has had an unprecedented impact on the aviation industry causing a steep decline in aircraft movements compared to previous years resulting in the 2021 and 2022 AANC being significantly reduced in size. This meant that there were no eligible properties for the 2021 and 2022 annual offer of noise mitigation packages as none were forecast to be exposed to sufficiently high enough noise levels to trigger the requirement of an offer from Auckland Airport. Nevertheless, Auckland Airport decided – despite not being obliged to under its Designation – to make the 2021 and 2022 offers to all properties that qualify[2] for the programme located within the HANA as part of its ongoing commitment to being a good neighbour. This first of these offers was made in March 2021 to 190 properties.

Another opportunity that presented itself during the last year was to readjust the timeframes of the Noise Mitigation Programme, specifically when the annual offer would be made. In practice, current timeframes were misaligned to the financial year, causing difficulties in undertaking accurate reporting and setting budgets. Auckland Airport decided that offers should be made as close to the start of the financial year (being July to June). As a result, Auckland Airport will undertake another offer round in 2021 which is planned for September (aptly called Stage 2 offers) and will continue to make annual offers in September in following years.

Auckland Airport proposed to base the Stage 2 offers on the 2022 AANC. However, since the 2022 AANC do not extend past the HANA, Auckland Airport will reoffer to all qualifying properties within the HANA extent (the same as the March 2021 Stage 1 offers). The choice to continue to offer noise mitigation packages beyond the designation obligations shows the commitment by the Airport to being a good neighbour and an ongoing contributor to the community. The Stage 2 offers will be made to approximately 156 HANA properties (of which 20 are tenanted properties based on the information available).

Auckland Airport has been able to continue the delivery of a high-quality noise mitigation programme despite the risks posed by COVID-19 and delays caused by lockdowns in both Auckland and across New Zealand. A COVID Response Plan was developed in July 2020 which provided clarity on how the programme should be delivered at various COVID-19 alert levels. This Response Plan provided guidance on how to operate in such a way that the allowed the programme to continue in each alert level whilst keeping the community, Auckland Airport staff and its contractors involved in the programme as safe as possible. As a result, Auckland Airport has been able to undertake 22 installations in the last twelve months under the Response Plan and will continue to implement the programme under its guidance.

In addition to the above, improvements to the Noise Mitigation Programme have been made, including:

- Auckland Airport now look to better reach homeowners and tenants when making annual offers by sending offers to both the homeowners address as well as the physical address of the property. This will likely improve tenant awareness of the programme.
- A Community Awareness Campaign has been developed and will be implemented as part of the 2022 offer round, which includes placing community notices in areas within the AANC as well as the development of social media content which can be shared by all interested community groups on various social media platforms.
- All key collateral has been translated in Samoan, Tongan, Hindi, Mandarin, and Te Reo Māori and translated documents will be available to the community as required.

Future Initiatives

The September meeting of the ANCCG is scheduled to receive a presentation from Airways summarising all of the routes developed over the last five years to remove or reduce night-time noise over urban Auckland. This information will be used to inform a discussion paper to be presented to the March 2022 ANCCG on options in relation to reducing or mitigating night-time flights from Sydney, which represents one of the routes frequently complained about in relation to night-time aircraft noise.

Combined with the work already underway, this means that the focus of noise reducing initiatives in FY22 will primarily be:

- Completion and implementation of the new Northern STAR serving 05R for flights from North America and the Pacific Islands, due to be completed December 2021.
- Completion of the Orange SMART Track trial, and analysis of results, with a final report and recommended alternations and/or implementation.
- Identifying and working on opportunities to reduce noise associated with night-time flights from Sydney.

ANCCG members have also requested that work occur during FY22 to create a set of induction materials and a training day for new members of the ANCCG to be used when local board representatives on the ANCCG change after the September 2022 local body elections.

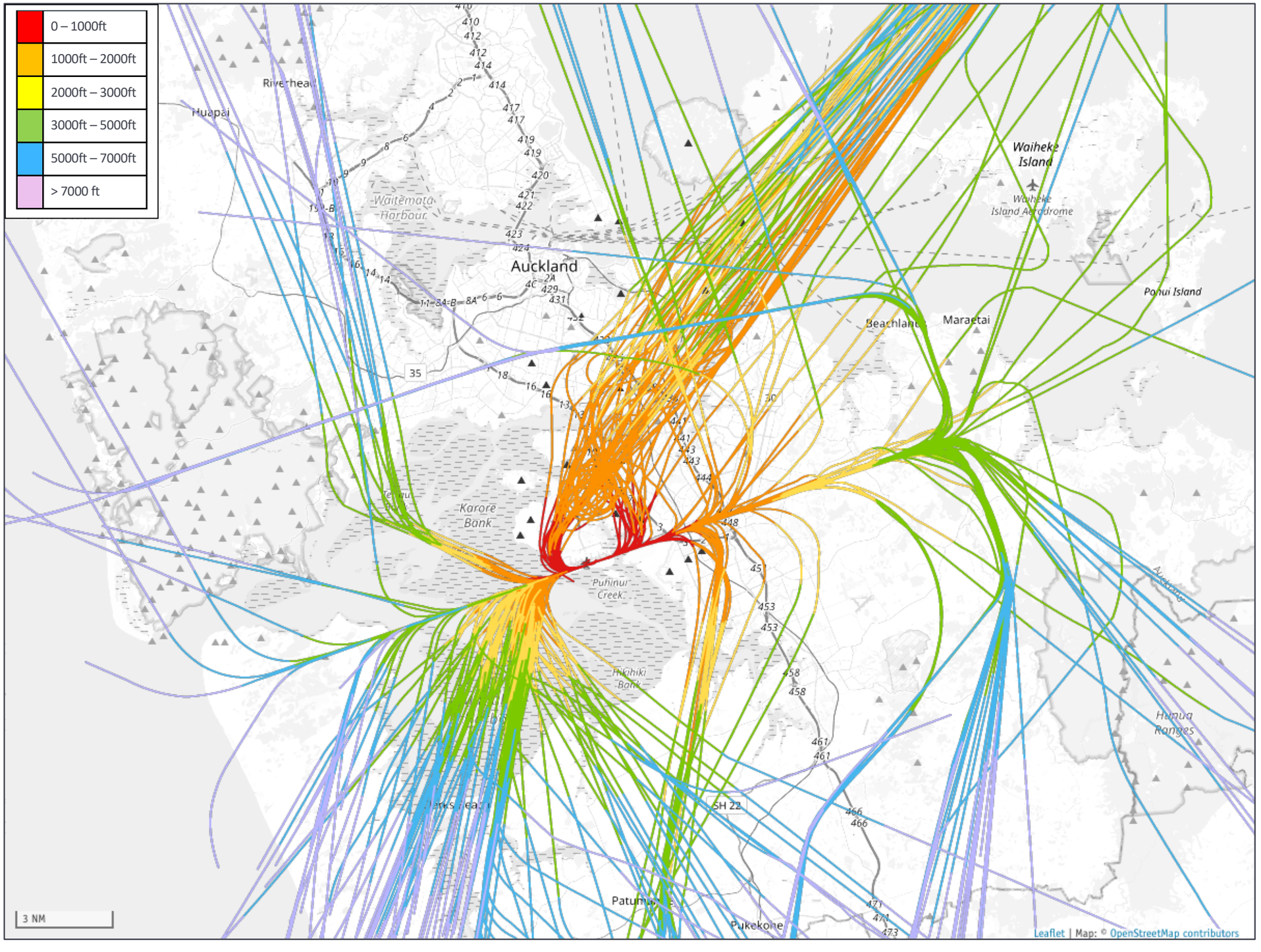
[2] Meet the Existing Building definition in Designation 1100

APPENDIX A GLOSSARY OF TERMINOLOGY

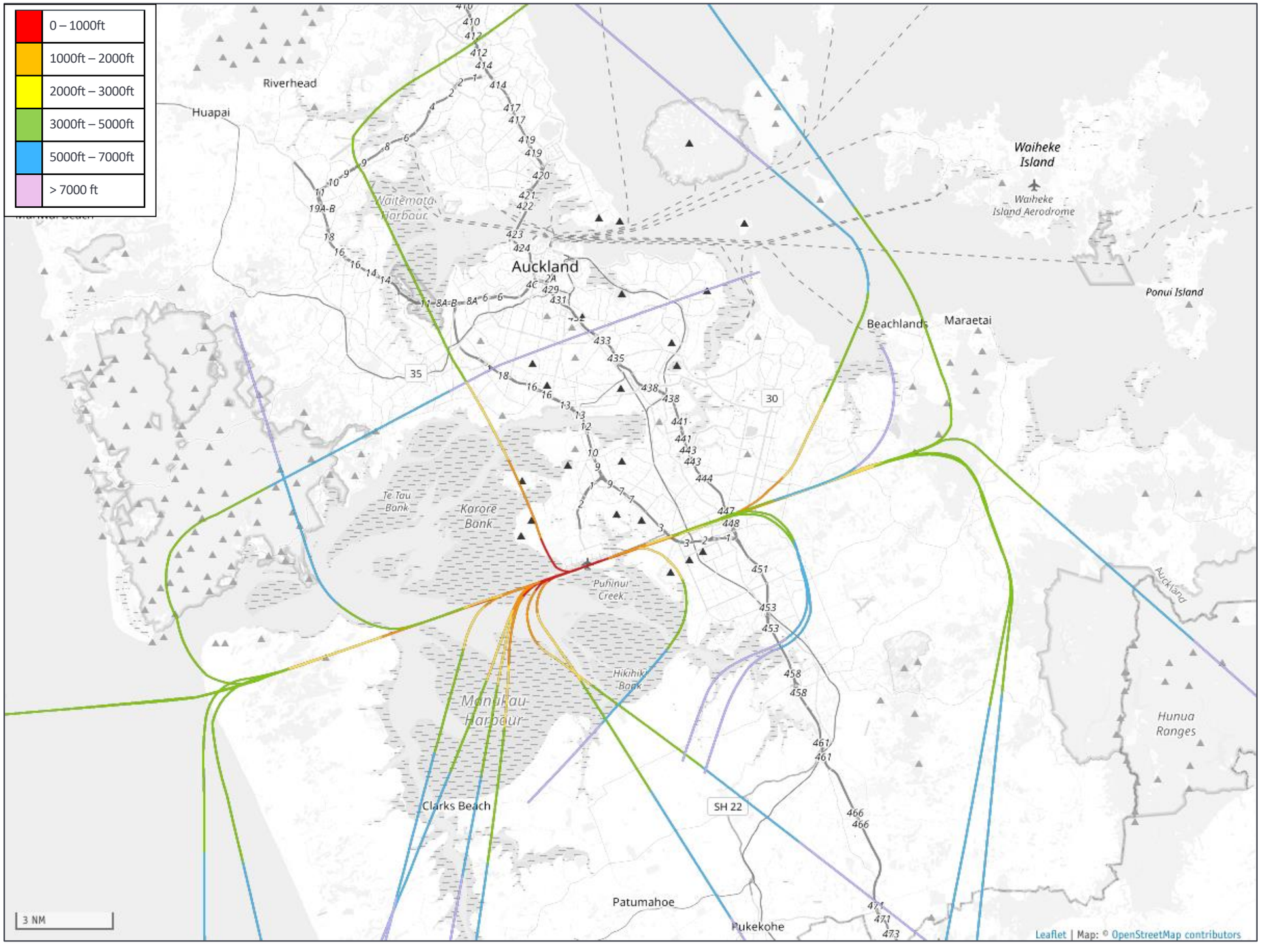
dBA	A measurement of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
L_{eq}	The time averaged sound level (on a logarithmic/energy basis) over the measurement period (normally A-weighted).
L_{dn}	The day-night sound level which is calculated from the 24-hour L_{eq} with a 10 dBA penalty applied to the night-time (2200-0700 hours) L_{eq} (normally A-weighted).
L_{max}	The maximum sound level recorded during the measurement period (normally A-weighted).
Noise	A sound that is unwanted by, or distracting to, the receiver.
Ambient Noise	Ambient Noise is the all-encompassing noise associated with any given environment and is usually a composite of sounds from many sources near and far.
NZS 6805:1992	New Zealand Standard NZS 6805:1992 “Airport Noise Management and Land Use Planning”

APPENDIX B FLIGHT TRACK DIAGRAMS

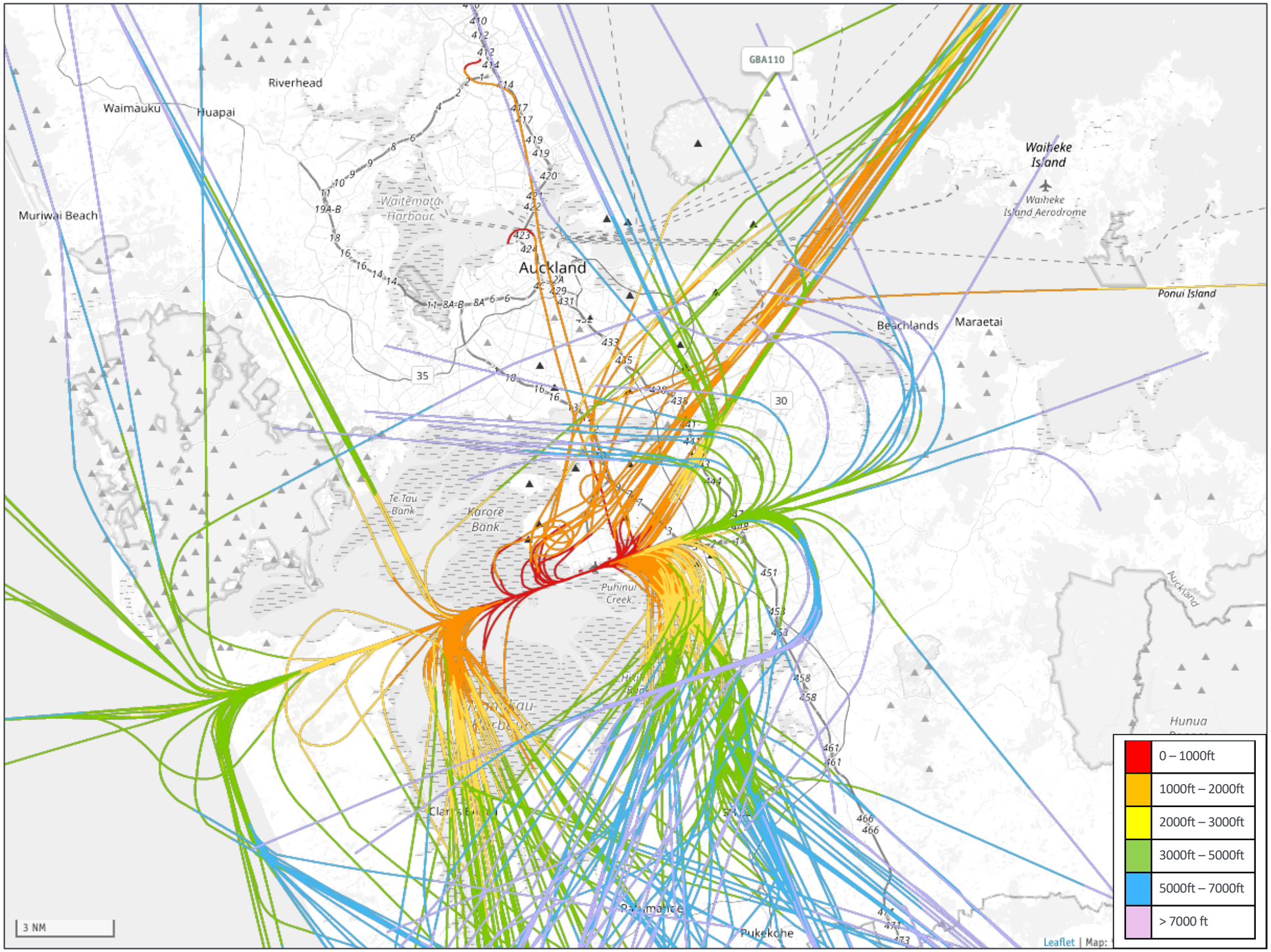
B1 Individual Flight Paths for the Busiest RW23L Day (7am - 10pm) in FY21



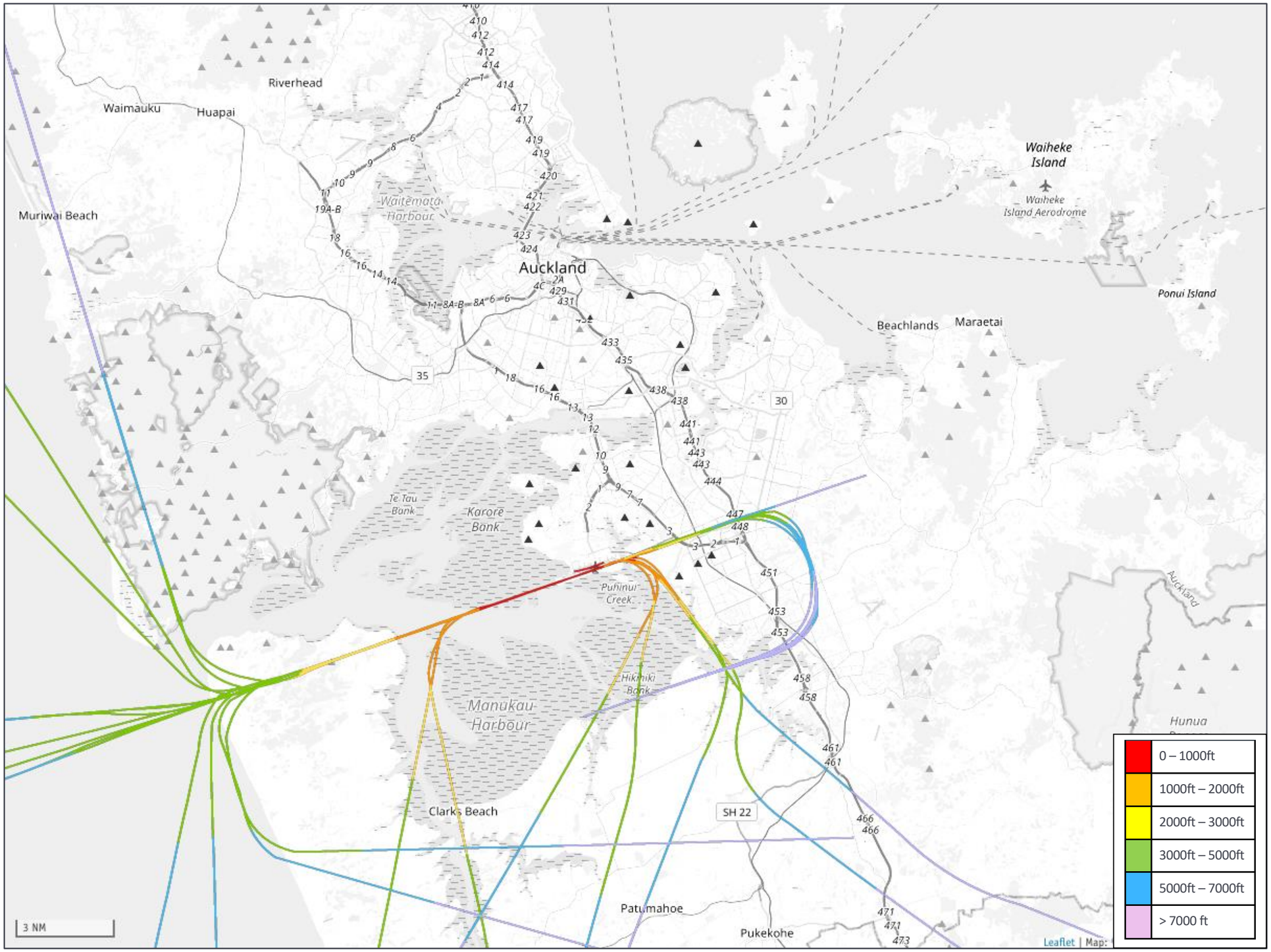
B2 Individual Flight Paths for the Busiest RW23L Night (10pm - 7am) in FY21



B3 Individual Flight Paths for the Busiest RW05R Day (7am - 10pm) in FY21



B4 Individual Flight Paths for the Busiest RW05R Night (10pm - 7am) in FY21

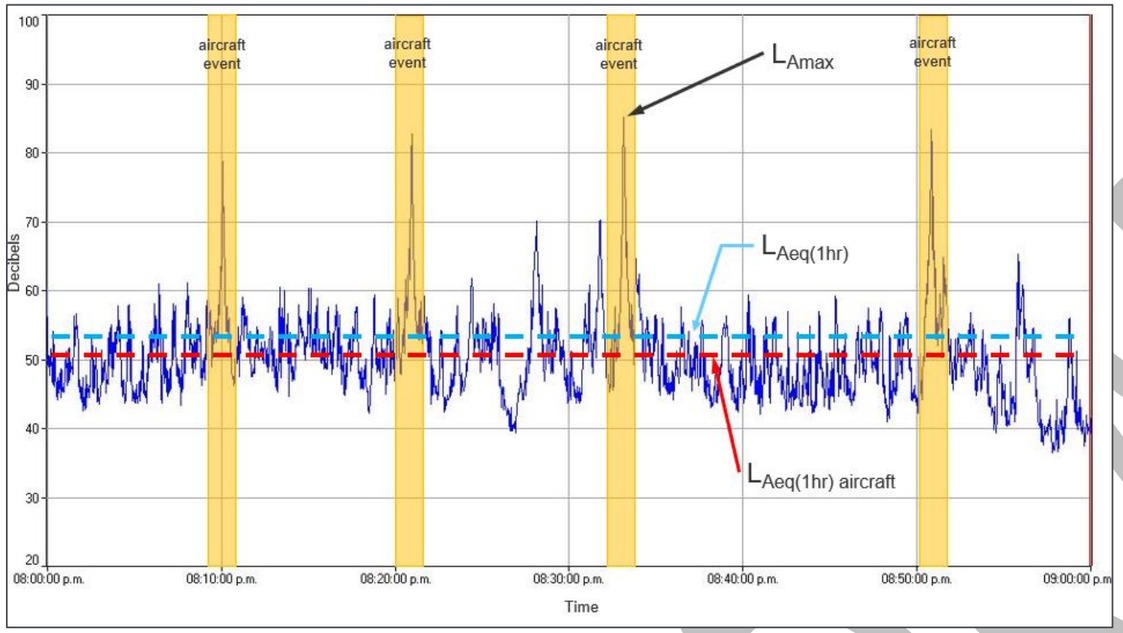


APPENDIX C SCIENCE OF NOISE MONITORING AND NOISE CONTOUR CALCULATIONS

How We Monitor Aircraft Noise

Most environmental noise sources such as roads, quarries, and airports fluctuate throughout the day. Figure C1 shows a sample of an hour long environmental noise measurement with the noise level on the y axis and time on the x axis. The blue trace shows the L_{Aeq} measured every second.

Figure C1: Hypothetical example of hourly average noise level ($L_{Aeq(1hr)}$) from aircraft flyovers



The noise level fluctuates throughout the hour between 40 and 85 decibels and therefore a statistical measure is needed to quantify the noise source. A range of metrics are used to quantify environmental noise. Each of these metrics tells us something about the noise source in question.

L_{Aeq} is the time averaged sound level over the measurement period and is the most common descriptor for environmental noise. Most general environmental noise limits use the L_{Aeq} descriptor.

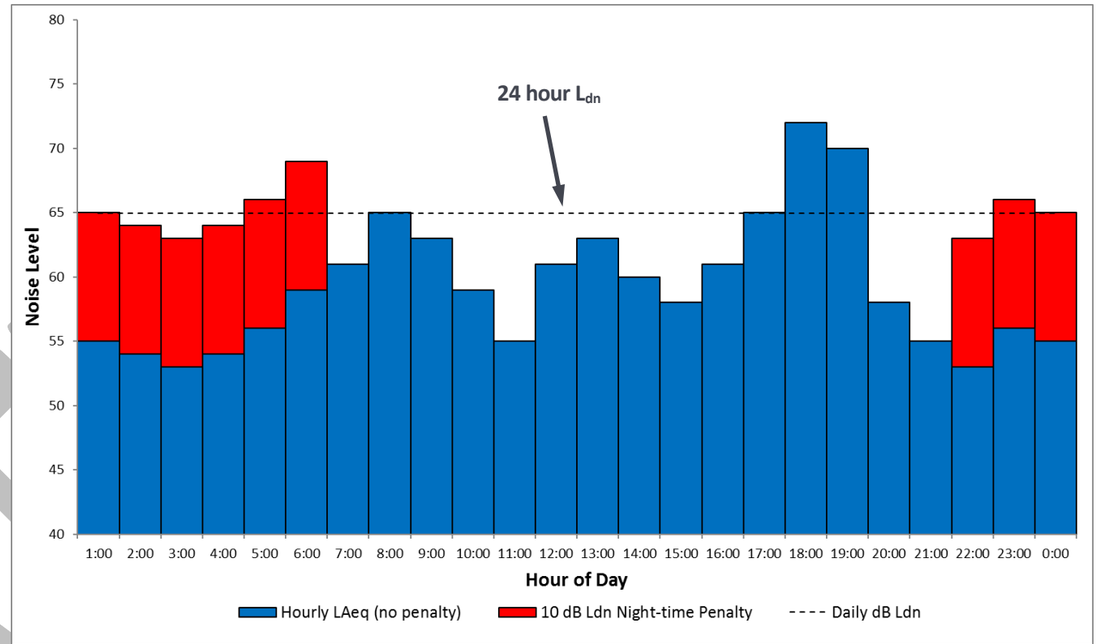
L_{Amax} is the maximum sound level during the measurement period. Most general environmental noise limits include an L_{Amax} noise limit at night. However, transportation noise sources generally are not controlled by L_{Amax} limits.

Aircraft noise is a series of discrete events with periods in between where there is no aircraft noise. The data in the graph includes four aircraft flyovers indicated in yellow. The dashed light blue line is the average sound level (L_{Aeq}) from all sources over the hour. The dashed red line is the average sound level (L_{Aeq}) from aircraft events only over the hour.

Auckland Airport's noise limits are based on a metric called L_{dn} (the day/night weighted average noise exposure). This is the average (L_{Aeq}) noise level from aircraft events over a 24 hour period with a 10 dB weighting during the night (10pm – 7am). Figure C2 shows how the night weighting is applied to calculate L_{dn}.

Like all New Zealand's international and regional airports, Auckland Airport's noise management framework is based on New Zealand Standard *NZS 6805:1992 Airport Noise Management and Land Use Planning*. NZS 6805 recommends noise boundaries based on the L_{dn} metric. International research has found that the L_{dn} metric correlates well with community annoyance to aircraft and other transportation noise. L_{dn} is the metric used for airports in the USA. European airports typically use L_{dn} or L_{den} (which includes an evening time weighting). Australian airports use a day-evening-night weighted average noise metric that is similar to L_{den} and L_{dn}.

Figure C2: Hypothetical example of L_{dn} calculation

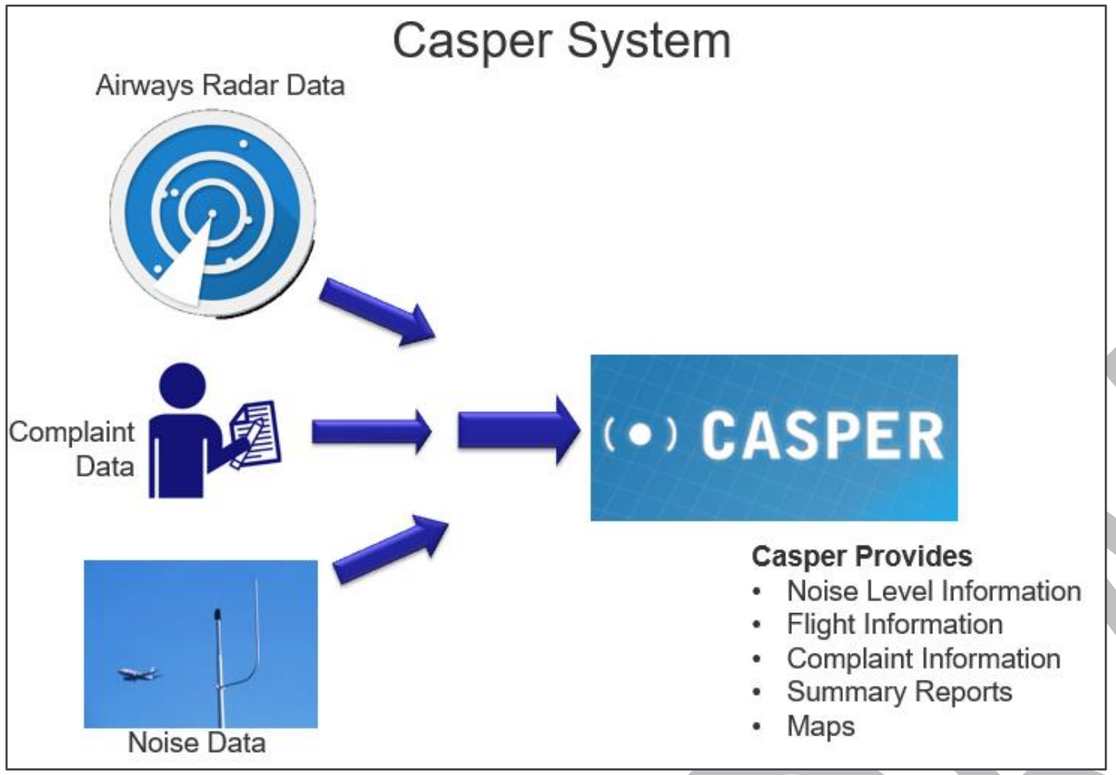


At Auckland Airport, noise levels from aircraft operations are monitored continuously in the community at three locations. These are the three permanent monitoring locations on the HANA boundary required under Designation 1100. The monitoring software identifies possible aircraft events based on defined noise level and duration criteria designed to exclude lower level ambient noise sources. The noise events are then correlated to aircraft flyovers using radar data from Airways to identify whether an aircraft was present at the time a noise event was registered. The correlated aircraft noise events are then used to calculate the L_{dn} noise level for each noise monitor.

The monitoring system is operated by an independent provider Casper. The Casper system combines and correlates data from the noise monitoring terminals, Airways aircraft flight data and noise complaints from the public. Marshall Day Acoustics has access to the Casper software which provides much of the information used to prepare the annual noise report. Figure C2 graphically lays out the Casper inputs and details some outputs.

In addition to the permanent noise monitoring terminals, Auckland Airport commissioned Marshall Day Acoustics to install temporary monitors at various locations in response to SMART track trials and ANCCG recommendations. The data from these temporary monitors also feeds into the Casper system and is correlated with aircraft flyovers. The data from these additional monitoring terminals is included in the quarterly noise reports and is used for SMART track trial assessment reports.

Figure C3: Casper system details



How We Model Aircraft Noise

Several computer based models have been developed internationally to predict the level of aircraft noise on areas surrounding an airport. The model used for Auckland Airport is the Integrated Noise Model (INM). The INM applies calculation algorithms specifically for aircraft noise prediction set out in ECAC Doc 29[3] and SAE AIR 1845[4] and includes a database of noise levels and operating procedures for most commercial, general aviation, military and rotary aircraft.

The INM program calculates L_{dn} noise contours for an average day. For Auckland Airport the average day is determined by averaging 12 months of aircraft movements. This data is extracted from the Casper monitoring software which has details of every aircraft movement including:

- Aircraft type
- Time of Day (daytime 0700-2200 or night time 2200-0700)
- Departure, arrival
- Runway
- Flight track
- Destination (affects aircraft weight)

Marshall Day has built a base model in INM of Auckland Airport runways and typical flight tracks. To calculate the average day of aircraft operations for the noise model, all the aircraft movements over 12 months that share the same parameters above are summed and divided by 365.

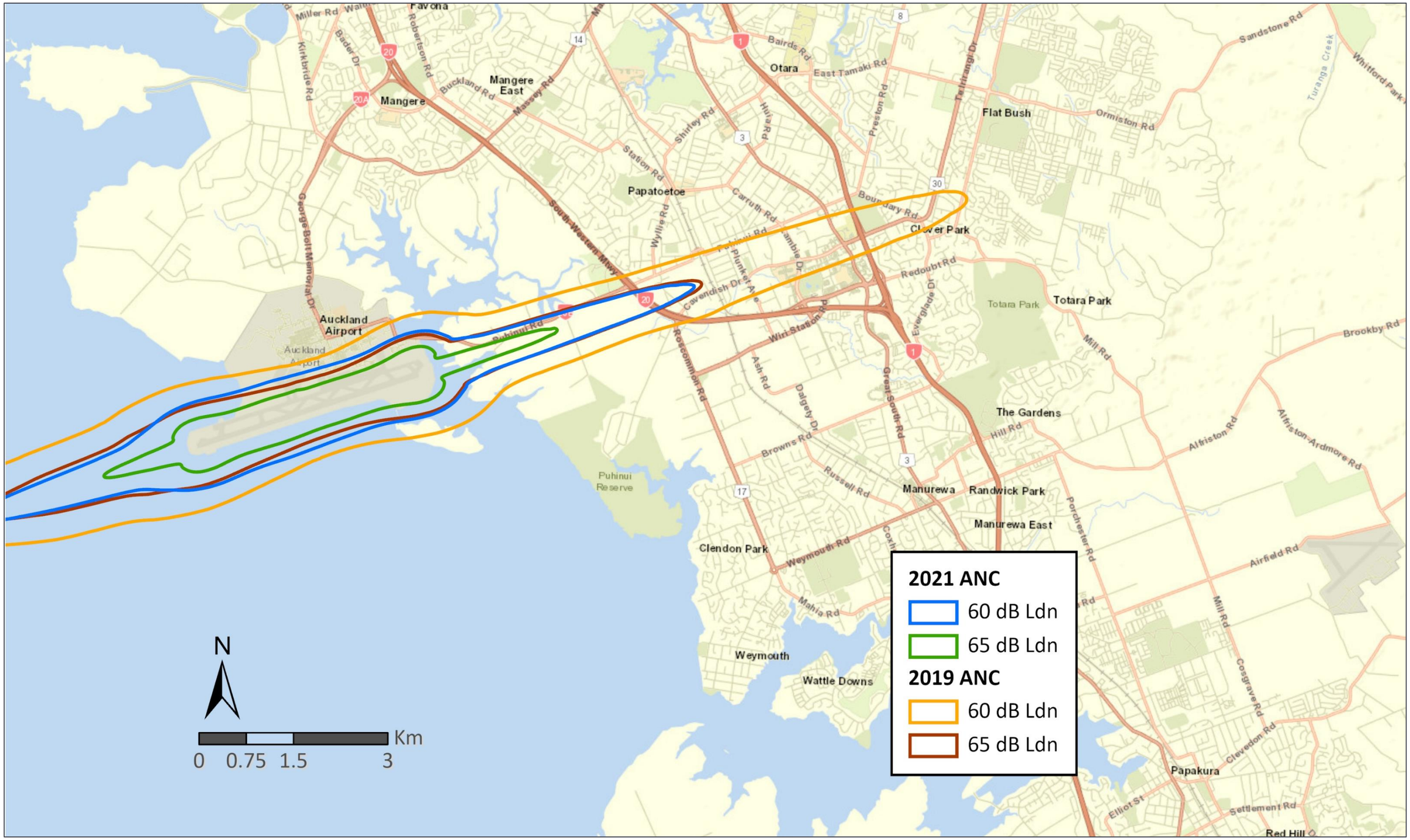
The INM uses its database of noise and operating procedures to calculate the noise level at a large number of grid points by summing the 'noise energy' from each aircraft movement during the average day's operation. The 'noise energy' is calculated using the hourly L_{eq} value, night-weighted by +10 dBA and then averaged over 24 hours to give the daily L_{dn} value at each grid point. The grid points with equal noise level are then joined graphically to give a plot of L_{dn} noise contours.

Over the years Marshall Day has undertaken calibration studies to compare the modelled noise levels with measured levels from the monitoring system for individual aircraft types and operations. Adjustments have been made to the model inputs with respect to take-off procedures and weights to calibrate the model to better represent measured levels.

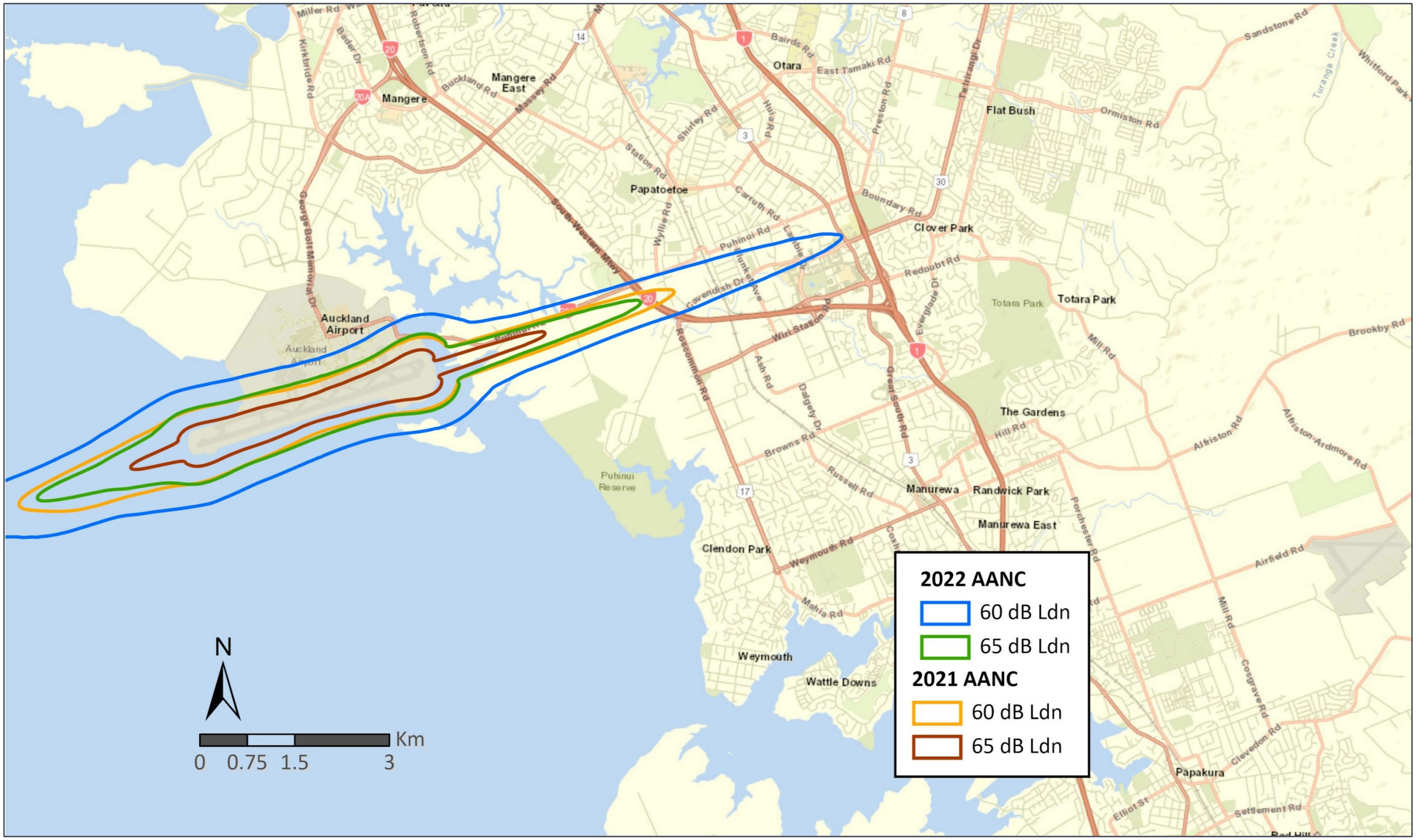
[3] European Civil Aviation Conference Doc 29 Report on Standard Method of Computing Noise Contours Around Civil Airports. https://www.ecac-ceac.org/about-ecac

[4] SAE International - Procedure for the Calculation of Airplane Noise in the Vicinity of Airports. SAE International, formerly named the Society of Automotive Engineers, is a United States-based, globally active professional association and standards developing organization. https://www.sae.org/about

APPENDIX D 2019 & 2021 ANC COMPARISON



APPENDIX E 2021 & 2022 AANC COMPARISON



APPENDIX F NOISE COMPLAINTS BY SUBURB

Suburb	No. Complaints
Auckland Central	1
Bucklands Beach	3
Clover Park	2
Cockle Bay	1
Epsom	8
Flat Bush	1
Goodwood Heights	1
Grafton	1
Gulf Harbour	1
Kaukapakapa	1
Kohimarama	1
Mangere	1
Mangere Bridge	1
Massey	1
Mission Bay	1
Mount Albert	1

Suburb	No. Complaints
Mount Eden	2
Mount Roskill	1
Mount Wellington	2
Pakuranga	1
Papatoetoe	8
Parnell	1
Patumahoe	4
Remuera	32
Saint Heliers	2
Takanini	1
Titirangi	1
Totara Heights	1
Waitakere	1