Before an Independent Hearing Panel
Appointed by Wellington City Council

In the Matter	of the Resource Management Act 1991
And	
In the Matter	of a Notice of Requirement to designate land for Airport Purposes known as the Main Site NOR.
And	
In the Matter	of a Notice of Requirement to designate land for Airport Purposes known as the East Side Area NOR.

Statement of Evidence of **Laurel Smith** for Wellington International Airport Ltd

Dated: 5 May 2021

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INTRODUCTION

Qualifications and Experience

1. My name is Laurel Jean Smith. I am a consultant in the acoustical consulting practice of Marshall Day Acoustics Limited. I hold the degree of Bachelor of Engineering from Auckland University. For the past 18 years I have worked in the field of acoustics, noise measurement and control in New Zealand. My work has included noise control engineering work for various industries in New Zealand.

2. I have undertaken noise prediction and provided consulting advice on over eight airports in New Zealand. My work has involved noise calculations, computer modelling, noise boundary development, assessment of noise effects, recommending airport noise rules, development of sound insulation packages and noise monitoring.

Code of Conduct Statement

3. While this is not an Environment Court hearing, I nonetheless confirm that I have read the Code of Conduct for Expert Witnesses issued as part of the Environment Court Practice Notes. I agree to comply with the Code and am satisfied that the matters which I address in my evidence are within my field of expertise. I am not aware of any material facts that I have omitted which might alter or detract from the opinions I express in my evidence. I understand that I have an overriding duty to assist the hearing in an impartial manner and that I am not an advocate for the party which has engaged me.

Scope of Evidence

4. I was asked by Wellington International Airport Limited (**WIAL**) to undertake an assessment of noise effects for the East Side Area (**ESA**) Notice of Requirement (**NOR**). I prepared the assessment of noise effects report (**ANE report**) lodged with the ESA NOR and provided further information in response to s92 requests on the NOR. I have been asked to present my findings and respond to submitters and the Wellington City Council (**WCC**) in this evidence.

5. I have also been asked to review the Main Site NOR noise conditions and assess whether these would result in any change in noise compared with the current District Plan airport provisions.

6. In preparing this evidence, I have reviewed the following (in so far as they are relevant to my area of expertise):

   (a) The two NOR and associated Assessment of Environmental Effects (**AEE**) documents;

   (b) All further information provided by WIAL in response to requests issued by Council for each NOR;

   (c) The reports and statements of evidence of all the other witnesses giving evidence on behalf of WIAL;

   (d) The Council's section 42A report including the Noise report prepared by Mathew Borich (and an earlier report prepared in December 2020;

   (e) Relevant Submissions.

7. My evidence includes:

   (a) Background to airport noise management

   (b) Notices of Requirement – Main Site and East Side Area

   (b) East Side Area assessment methodology

   (c) Existing noise environment

   (d) Proposed changes in noise emissions

   (e) Effects on surrounding land uses

   (f) Management and mitigation of noise effects

BACKGROUND TO AIRPORT NOISE MANAGEMENT

8. My assessment of noise effects report (26 Feb 2020) included with the ESA NOR, details the New Zealand Standard for airport noise management

NZS 6805:1992[1] and the background to noise management at Wellington Airport.

9. To assist I have **attached** a glossary of terms and acronyms used in my evidence as **Schedule A**.

10. NZS 6805:1992 "Airport Noise Management and Land Use Planning" (the Standard) is the basis for the management of airport noise effects at the majority of airports in New Zealand. The Standard was published in 1992 with a view to providing a consistent approach to noise planning around New Zealand airports. Since publication, the principles of the Standard have been applied to more than 15 New Zealand airports and is still the applicable standard for the emission of airport noise in terms of the more recent National Planning Standards for plan rules.

11. The approach to airport noise management that the Standard provides for is to "implement practical land use planning controls and airport management techniques to protect and conserve the health of people living near airports without unduly restricting the operation of airports." The inference being if the Standard is met then the health of people living near airports will be protected.

12. The Standard uses the "Noise Boundary" concept as a mechanism for local authorities to:

- "establish compatible land use planning" around an airport; and
- "set noise limits for the management of aircraft noise at airports".

13. Typically, the noise boundary concept involves fixing an Outer Control Boundary (**OCB**) and a smaller Air Noise Boundary (**ANB**) around the airport. The OCB is based on a day/night noise exposure level of 55 dB L_{dn} and the ANB is based on 65 dB L_{dn}.

14. L_{dn} is the day/night weighted average noise exposure level which is the sum of the sound energy from all aircraft noise events averaged over 24 hours with a weighting applied to night-time events. For airport noise boundaries the Standard recommends using the average L_{dn} over a three month period[2]. The

[1] New Zealand Standard NZS 6805:1992 Airport noise management and land use planning
[2] NZS 6805 recommends averaging over a three month period or agreed alternative period. L_{dn} can be averaged over any period of 24 hour blocks.

L_{dn} night weighting means that aircraft noise events between 10pm and 7am are weighted by an additional 10 decibels to account for the heightened sensitivity to noise at night. International research has found that the L_{dn} metric correlates well with community annoyance to aircraft and other transportation noise.

15. Typically noise from aircraft operations (arrivals, departures and taxiing) is considered when setting the boundaries; and other airport activities such as maintenance and engine testing are controlled in other ways. I return to discuss the Standard in more detail below.

16. Wellington Airport currently operates in the Airport Area of the Airport and Golf Recreation Precinct identified in the Wellington City District Plan. Rules relating to activities in the Airport Area are set out in Chapter 11A which includes an extensive suite of noise controls described in more detail below.

17. The Main Site NOR seeks to designate the Airport Area for airport purposes and replicate the Chapter 11A rules as designation conditions. It does not seek to amend the Air Noise Boundary.

18. The ESA NOR seeks to designate part of the adjacent Golf Course Recreation Precinct for airport purposes as a separate designation with separate designation conditions. In practice activities in the ESA would be linked to activities in the Main Site, as the ESA would be used to provide additional taxiway and apron space to support the existing operation. So rather than adopting an entirely new framework for ESA noise, I have used the existing Wellington Airport noise provisions framework that have been adapted from NZS 6805:1992 for the local situation.

Summary of Existing Airport Noise Provisions

19. As discussed above, the noise controls for Wellington Airport are based on the NZS 6805:1992 approach, and as for all New Zealand airports, the NZS 6805 recommendations have been adapted to suit the local situation.

20. The main differences that set Wellington Airport's noise management framework apart from airports like Auckland and Christchurch, is that Wellington Airport operates with a partial night-time curfew, and the District Plan sets land use controls inside the ANB only. There is no Outer Control Boundary shown in the District Plan for Wellington Airport.

21. Under Chapter 11A of the District Plan, activities within the Airport Area are subject to a suite of noise control provisions which distinguish between different airport noise sources as follows:

- Aircraft Operations (taxiing, take-off, landing, engine run-up)
- Engine Testing
- Land Based Activities, and
- Ground Power and Auxiliary Power Units

22. Noise from Aircraft Operations (arrivals, departures and taxiing) is controlled by a 65 dB L_{dn} noise limit at the ANB which is defined on Map 35 of the District Plan's planning maps. The day-night weighted noise exposure (L_{dn}) from Aircraft Operations is averaged over 90 days. Rules 11.1.1.1.2 to 11.1.1.1.6 set out a range of exclusions from the ANB noise limit and further operational controls such as night-time restrictions.

23. Noise from the testing of aircraft engines on-wing is controlled by rule 11.1.1.1.7. Engine testing is not a significant contributor to the existing noise environment at Wellington Airport as there is no maintenance facility onsite.

24. All other activities are required to comply with general residential zone noise limits except aircraft auxiliary power units (**APUs**) which are exempt for set periods of time before and after parking at a stand via Rules 11.1.1.1.8 and 11.1.1.1.9.

MAIN SITE NOR

25. From a noise management perspective, the NOR for the Main Site essentially converts the existing District Plan airport noise provisions into designation conditions as they relate to the ANB which is not part of the Main Site NOR.

26. The intent is for the permitted noise emissions from activities in the Main Site to be no greater than what Chapter 11A of the District Plan currently permits at the ANB. Any changes to the existing situation are provided for and addressed in the ESA designation.

27. Accordingly, I have not undertaken an assessment of noise effects for the Main Site designation, but I have compared the proposed designation conditions with the Chapter 11A provisions to ensure the intention is met.

28. The only difference relates to military aircraft. In Chapter 11A, noise from military operations is excluded from the calculation of Aircraft Operations noise and is subject to a separate set of noise controls.

29. In the proposed Main Site designation conditions, military aircraft operations are also excluded from the calculation of Aircraft Operations noise but there are no separate conditions for military aircraft noise.

30. The Chapter 11A noise limits would still apply to military aircraft however the designating authority would not exclusively be responsible for compliance as would be the case if these were included as designation conditions.

31. In summary, the proposed conditions for the Main Site designation would result in no change to the current permitted noise emissions from the Airport.

EAST SIDE AREA (ESA) NOR

32. The ESA designation would allow part of the existing golf course to be developed for a more limited range of airport operations and ancillary activities including taxiways, aprons, aircraft gates, carparking and infrastructure. This would enable noise generating activities in the golf course area where currently few noisy activities take place.

33. I understand from WIAL that the development would be staged with several step changes over time however I have assessed the noise situation under the fully developed ESA based on the year 2050.

Noise Assessment Methodology

34. Details of the noise predictions and results are in my ANE report and further information responses to queries from Wellington City Council (**WCC**).

35. I based my predictions on the ESA layout shown in the 2040 Masterplan and forecast aircraft movements for 2050. I focussed my assessment on the immediate residential neighbours to the ESA. Other receivers are less affected due to screening and distance and I address this further in my response to submissions in this evidence.

36. When fully developed, the main noise sources in the ESA would be aircraft taxiing, APUs and to a lesser extent ground support equipment.

37. I approached my assessment by separating noisy activities into the same categories as used in the existing airport provisions (Chapter 11A of the District Plan) as follows:

- Aircraft Operations (landing, take-off and taxiing)
- Auxiliary Power Units (APUs) and Ground Power Units (GPUs)
- Engine Testing
- Land Based Activities

38. It is common for airport noise controls in New Zealand to include three noise categories: aircraft operations, engine testing and other airport noise. At Wellington Airport, there are also specific controls on APU use which, as far as I am aware, is unique in New Zealand.

39. WIAL has specifically excluded engine testing in the ESA, therefore I have not assessed engine testing noise.

40. The relevant standards for assessing each of the noise categories are:

<u>Aircraft Operations Noise</u>
NZS 6805:1992 Airport Noise Management and Land Use Planning

<u>Land Based Activities Including GPUs</u>
NZS 6802:2008 Acoustics Environmental Noise

<u>APU Noise</u>
NZS 6802:2008 Acoustics Environmental Noise or
NZS 6805:1992 Airport Noise Management and Land Use Planning

41. My assessment involved the following steps:

- Quantify the existing planning environment for airport noise provided for in the District Plan
- Quantify the current noise generated by airport activities (including Aircraft Operations, land based activities and auxiliary power units)

- Predict the noise emissions from the proposed airport activities based on the 2040 Masterplan concept layout and year 2050 operations to quantify the future noise conditions and the change in the noise environment from the expansion into the ESA.

42. In this evidence I summarise the outcomes in my ANE report and provide further details of future noise levels.

ESA Receivers

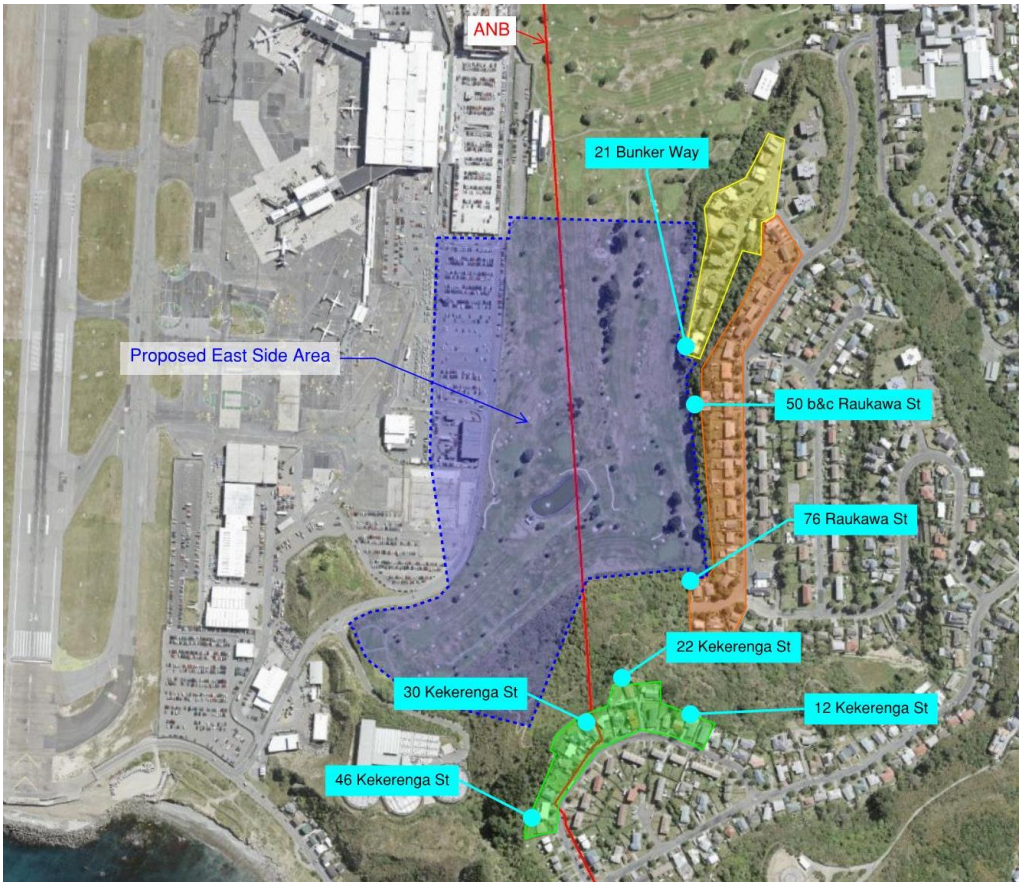
43. The closest noise sensitive receivers affected by the proposed ESA designation are houses in the Outer Residential Area (in Strathmore Park) along Nuku Street, Bunker Way, Raukawa Street and Kekerenga Street which currently directly overlook this part of the golf course. Most of these houses are outside the District Plan ANB however some houses in Kekerenga Street are inside the ANB.

44. My assessment shows that these properties are most affected by noise from activities within the ESA as they generally have direct line of sight to the area. I refer to these properties as "ESA receivers". Houses one or more rows back would be less affected, as noise from activities in the ESA would be screened by the front row of houses[3]. For other residents around the airport and in the ANB there would be no appreciable change in noise effects relating directly to activities undertaken within the newly designated area.

45. In my ANE report I grouped ESA receivers by street for simplicity. For this evidence I have selected 7 representative ESA receiver locations to provide a more detailed picture of the predicted noise levels at surrounding properties. The representative ESA assessment locations are shown in **Figure 1**.

[3] Confirmed by noise modelling

Figure 1 ESA Receivers and Representative Assessment Locations



Existing Noise Environment

46. ESA receivers live adjacent to a golf course but are also close neighbours to the Airport and are currently already affected by airport noise. The District Plan provides for airport noise to reach certain limits and I refer to this as the **existing planning environment** for airport noise.

47. Current airport operations have not reached these permitted limits therefore I have also described the **current noise environment** in terms of actual airport noise levels currently experienced by ESA receivers. The current noise environment in my ANE report and this evidence is based on the pre-Covid19 environment at 2019.

48. Because airport noise is separated into four categories I have considered the existing noise environment for each category but also considered the cumulative noise from all sources.

49. **Table 1** summarises the existing planning and current noise environments at the ESA receivers.

Table 1 Summary of Existing Noise Environment

	Aircraft Operations (dB L_{dn})		Cumulative Noise (dB L_{dn})	
Receiver Point	**Permitted**	**Current**	**Permitted[4]**	**Current[5]**
21 Bunker Way	59	54	61	55
50b & 50c Raukawa St	59	54	61	55
76 Raukawa St	59	54	61	55
12 Kekerenga St	60	55	61	55
22 Kekerenga St	61	56	63	56
30 Kekerenga St	62	57	63	57
46 Kekerenga St	63	58	64	58

50. In summary, current Aircraft Operations noise is 5 dB below the permitted level and current cumulative airport noise is approximately 6 dB below the permitted cumulative level.

Predicted Noise Levels

51. I predicted noise levels from future activities in the fully developed ESA for the year 2050 by separating noise sources into the following categories (as they relate to activities proposed within the ESA):

- Aircraft Operations (taxiing)
- Auxiliary Power Units (APUs)
- Ground Power Units (GPUs)
- Land based activities (ground support equipment, traffic)

Predicted Aircraft Operations Noise

52. The relevant standard for assessing Aircraft Operations noise is NZS 6805:1992. The existing Wellington Airport provisions in the District Plan are based on this standard and are adapted for the local situation. The existing rules require that noise from Aircraft Operations averaged over 90

[4] Based on ANB Aircraft Operations + predictions of APU noise + land based activity limit
[5] Based on predictions of Aircraft Operations and APU noise and supported by measured noise level at the noise monitor in the golf course near Bunker Way.

consecutive days must not exceed 65 dB L_{dn} outside the ANB shown in Map 35 of the District Plan.

53. When fully developed the ESA would contain taxiways, aprons and aircraft stands. Therefore, Aircraft Operations in the form of taxiing aircraft would take place in the ESA.

54. To quantify future Aircraft Operations noise and assess compliance with the ANB, I calculated noise contours for all future Aircraft Operations in the Main Site and the ESA.

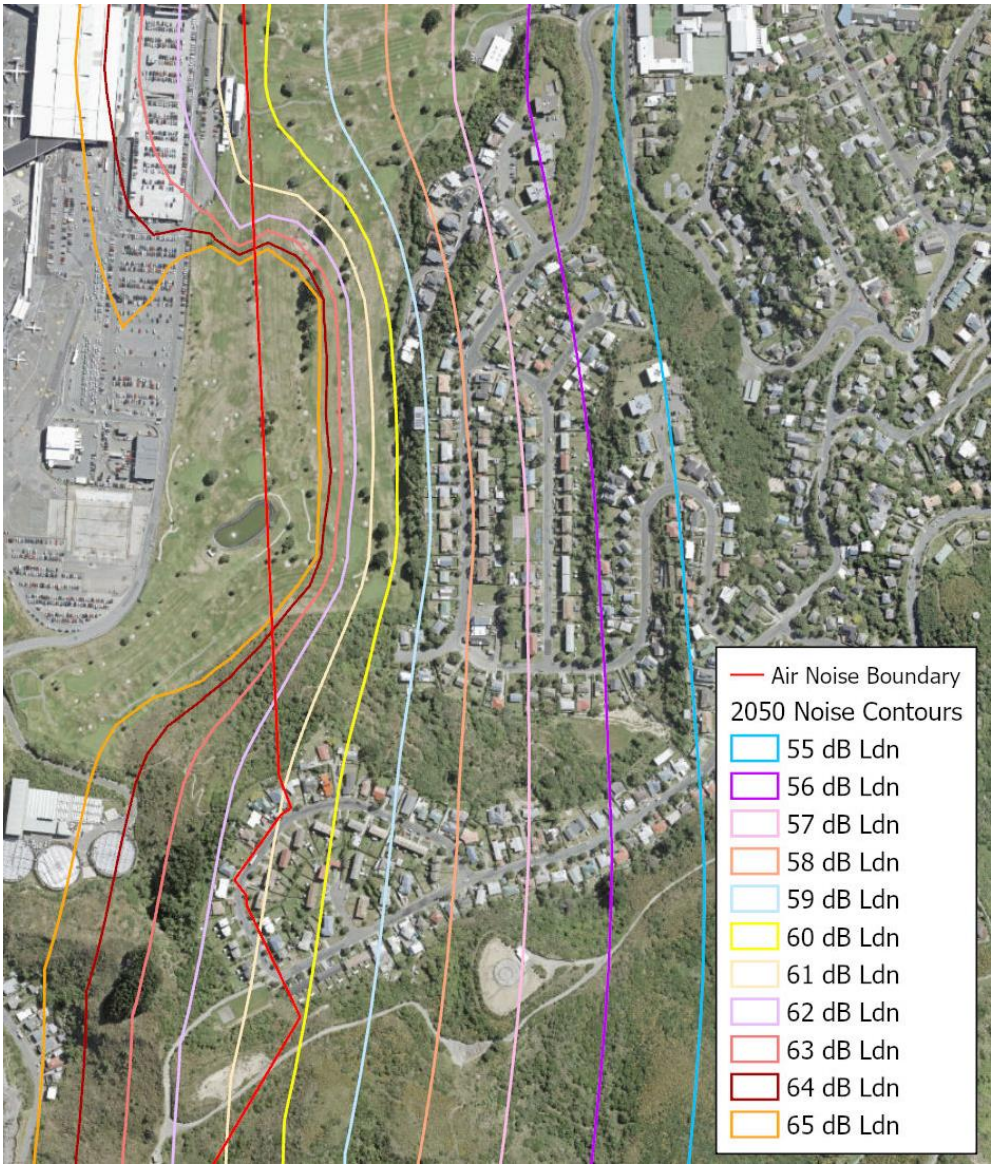
55. The future noise contours are based on the 2040 Masterplan concept layout and passenger and aircraft movement forecasts prepared by InterVISTAS for the year 2050. I understand the life of the Masterplan is to the year 2040 however I have considered noise effects beyond this horizon using the InterVISTAS 2050 forecasts. A thirty year planning horizon is typical for noise contours at New Zealand's major airports and using the 2050 forecast is suitably conservative insofar as noise assessment is concerned as this is effectively "worst case". Details of the noise modelling are contained in my ANE report.

56. The noise model assumptions relating to Aircraft Operations (i.e taxiing) in the ESA are as follows:

- No aircraft taxiing under power between 10pm and 7am
- Between 7am and 10pm an average of 6 Code E (wide body) aircraft and 6 Code C (narrow body) aircraft per day taxiing to and from stands in the ESA. This is an average of 24 aircraft taxiing movements in the ESA per day.

57. My predictions show the year 2050 scenario would have a localised non-compliance of the 65 dB L_{dn} limit at the ANB within the ESA due to aircraft taxiing as shown in **Figure 2**.

Figure 2 Predicted 2050 Aircraft Operations Noise



58. To enable and control taxiing noise in the ESA, it is proposed to define an 'ESA Compliance Line' extending outside the ANB approximately in the location of the 65 dB L_{dn} contour shown in **Figure 2.** Noise from all Aircraft Operations at the Airport, including taxiing in the ESA, would be limited to 65 dB L_{dn} at the ESA Compliance Line (the first orange contour to the right of the ANB boundary). This would not affect the requirement for Aircraft Operations to comply with the ANB in all other areas, but it would allow additional noise within the ESA. I discuss the ESA Compliance Line in more detail below.

59. I have predicted the resulting Aircraft Operations noise levels at the representative ESA receivers and these are listed in **Table 2**. I have

separated noise from the Main Site and ESA to provide further understanding of the contribution that noise from Aircraft Operations (i.e taxiing) in the ESA would make.

Table 2 Predicted 2050 Aircraft Operations Noise at ESA Receivers (dB L_{dn})

Receiver Point	From Main Site	From ESA Only	Total
21 Bunker Way	58	55	60
50b & 50c Raukawa St	58	55	60
76 Raukawa St	59	53	60
12 Kekerenga St	59	46	59
22 Kekerenga St	60	52	61
30 Kekerenga St	61	51	61
46 Kekerenga St	62	44	62

Predicted Aircraft Taxiing Single Event Noise

60. NZS 6805 recommends assessing and controlling Aircraft Operations noise using the average noise exposure metric L_{dn} which takes into account the noise level and number of aircraft events and weights events between 10pm and 7am by a factor of ten (i.e night-time noise is penalised). The Standard also recommends consideration of single event noise levels from aircraft events at night for sleep protection however it does not address single event noise levels during the day. Other general environmental noise standards typically only control single event noise levels at night but not during the day.

61. WIAL proposes that aircraft would not taxi under main engine power in the ESA at night to avoid sleep disturbance effects.

62. For completeness I have considered the change in aircraft single event noise levels during the day due to aircraft using the ESA taxiways. Quantifying the change in aircraft event noise for ESA receivers helps those affected to understand the short duration impacts in practice. The purpose of these predictions is supplementary information only as single event noise limits do not apply during the day.

63. Once the ESA is fully developed, my predictions show that sound exposure level (L_{AE}) of Code C aircraft (narrow body jets) taxiing in the ESA would be

equivalent to current levels experienced by ESA receivers from jet departures. My predictions show that Code E aircraft (wide body jets) taxiing in the ESA would sound twice as loud as current departures which represents a significant increase in aircraft single event noise. The number of these noisier aircraft events would be relatively few compared to the number of departures on the runway. For example, my future predictions assume 12 such events per day under the fully developed 2050 scenario.

Predicted APU and GPU Noise

64. Ground Power Units (**GPUs**) provide electricity to run essential systems on an aircraft while parked at a gate. In my view, GPUs are part of the ground support equipment used on aprons to service aircraft between flights and as such the relevant standard for assessing GPUs is NZS 6802:2008 the general environmental noise standard.

65. Traditional GPUs are diesel powered generators which can be noisy. More modern GPUs simply plug-in to a mains power supply at the gate and emit very little noise. WIAL proposes to provide plug-in GPUs at all ESA gates to avoid noise from diesel generator type GPUs. A requirement for all ESA gates to be fitted with plug-in GPUs is proposed as a designation condition. As such, noise from GPUs in the ESA would be negligible.

66. When an aircraft is not connected to a GPU, it generates its own electricity by running its Auxiliary Power Unit (**APU**) or main engines. An APU is a small turbine engine usually located in the rear of an aircraft's fuselage that burns aviation fuel to generate electricity. When an aircraft parks at a stand, the main engines are generally shut down once the aircraft is stationary and the APU provides power until the ground crew connect a GPU. Generally, this is a matter of minutes to minimise noise and fuel consumption. When an aircraft leaves a gate, the order of events is reversed.

67. The use of APUs is an essential airport activity however it is not essential to run them for long periods of time. WIAL initially advised me that limits of 20 minutes after arriving at a stand and 10 minutes prior to leaving a stand would be practicable. On most occasions, the actual duration would be much less, but some flexibility is necessary for safety reasons.

68. A typographical error in the notified conditions says 20 minutes after parking and 20 minutes prior to leaving. I recommend this is amended however, WIAL

has recently advised me that 15 minutes after parking and prior to leaving is preferable operationally. My assessment is based on 20 minutes after parking and 10 minutes prior to leaving however this is equivalent to 15 minutes at each end therefore changing the condition would not affect the outcomes of my assessment.

69. As far as I am aware, APU noise is not specifically controlled or assessed at other New Zealand airports and there is no precedent for whether NZS 6802 or NZS 6805 applies. The current Wellington Airport District Plan provisions require that APU noise complies with the land based activity noise limits (NZS 6802 approach) except for 60 minutes before parking and 90 minutes before leaving a stand when APU noise is exempt and uncontrolled.

70. In my ANE report, I presented a simplistic assessment of APU noise which predicted the worst case noise levels. For this evidence I have prepared a detailed noise model of APUs based on the fully developed ESA and the year 2050 operating scenario. This detailed assessment distributes APUs over the various ESA gates throughout the day and assumes each APU runs for the full allowable duration.

71. For completeness I have calculated APU noise levels using both NZS 6802 and NZS 6805 methods. **Table 3** lists the calculated levels at the ESA receivers. The modelling includes the following assumptions:

- An average APU noise source based on a range of APU data (83 dB at 20 m)
- 2050 future operating scenario of 12 aircraft distributed across the ESA stands per day (7am – 10pm)
- Maximum permitted durations of APU runtime for each aircraft movement in the ESA (i.e. 12 aircraft with 20 + 10 minutes or 15 + 15 minutes APU runtime each)

Table 3 Predicted 2050 APU in the ESA Noise Levels

			NZS 6802	NZS 6805
Receiver Point	**Worst Case L_p (dB)[6]**	**$L_{Aeq(15\ hour)}$ (dB)**	**Rating Level $L_{Aeq(15\ min)}$ (dB)**	**L_{dn} (dB)**
21 Bunker Way	60	54	55	52
50b & 50c Raukawa St	60	53	55	51
76 Raukawa St	58	51	53	49
12 Kekerenga St	53	46	48	44
22 Kekerenga St	57	49	52	47
30 Kekerenga St	56	49	51	47
46 Kekerenga St	45	38	40	36

72. In the NZS 6805 context, APU noise would be below 55 dB L_{dn} which is considered reasonable for residential receivers. The calculated L_{dn} noise contours are included in **Annexure B**.

73. In the NZS 6802 context, APU noise would be at or below the 55 dB $L_{Aeq(15\ min)}$ limit for land based activities. My NZS 6802 rating level prediction considers either two APU operating simultaneously with a 5 dB duration correction[7] or one APU operating at a time with a 4 dB duration correction[8]. The results are almost identical and I've reported the greater of the two outcomes.

74. In addition, I predict that for ESA receivers, APUs while running in the ESA, would be approximately 4 dB louder than APUs running at the current aircraft stands in the Main Site. A 4 dB increase is just perceptible.

75. I note in the Council's s42A noise report, Mr Borich queries whether APU noise should have a Special Audible Character penalty applied in accordance with NZS 6802. If a noise has tonal or impulsive characteristics it is likely to cause annoyance at lower levels than noise without such characteristics. NZS 6802 sets out methods for assessing whether a noise contains special audible character and if it does, then a 5 dB penalty is applied when calculating the rating level for comparison with a limit. I assume Mr Borich is concerned about

[6] Representative level taken to be 2 APUs operating simultaneously
[7] A total of 12 aircraft running for 30 minutes but always two simultaneously is 180 minutes or 20% of the day time which is a 5 dB duration adjustment
[8] A total of 12 aircraft running for 30 minutes each is 360 minutes or 40% of the day time which is a 4 dB duration adjustment. Note the closest aircraft stand was used for each receiver. In practice levels from more distant stands would be lower.

APUs have a tonal character that may warrant the penalty. At the time of writing, I do not have the necessary 1/3 octave band data for APUs to make a Special Audible Character assessment however I will try to obtain this prior to caucusing with Mr Borich. However I note that no other airport in New Zealand has taken the approach that Mr Borich has suggested.

Predicted Land Based Activity Noise

76. Noise from all other activities in the ESA that are not Aircraft Operations or APUs would be subject to general environmental noise limits. The relevant standard for assessing these noise sources is NZS 6802:2008 Acoustics Environmental Noise. The proposed limits for ESA land based activity noise received in any residential site are:

7am to 10pm	55 dB $L_{Aeq\ (15\ min)}$
At all other times	45 dB $L_{Aeq\ (15\ min)}$
	75 dB L_{AFmax}

77. The proposed limits for the ESA generally align with the existing District Plan limits for airport land based activity noise received in residential zones except the Sunday daytime noise limit is increased from 45 dB L_{Aeq} to 55 dB L_{Aeq} to align with the Monday to Saturday limit.

78. The District Plan limit for airport land based activity noise on Sundays is 45 dB $L_{Aeq(15min)}$ all day and at night. I consider this is an overly restrictive and unrealistic limit during the day in a general urban environment and even more so for an urban environment near an international airport. The noise monitoring data near Bunker Way presented in my ANE report shows the existing noise environment does not support a lower limit on Sundays.

79. The guidelines for setting general environmental noise limits in NZS 6802:2008 recommend a daytime limit of 55 dB $L_{Aeq(15min)}$ is appropriate for residential receivers. The Standard does not identify Sundays as particularly sensitive or requiring lower limits. The approach of Sunday noise limits being consistent with other days has been adopted by almost all other district plans in New Zealand. I note the WCC acoustic expert agrees with the proposed noise limits above.

80. The range of airport activities subject to these limits would include airside activities associated with servicing aircraft on the stands (i.e. baggage and cargo handling, refuelling, water, catering and toilet servicing, GPUs, airbridge and push back) as well as landside activities such as vehicles on the realigned Stewart Duff Drive.

81. My assessment predicts noise from ground support equipment (**GSE**) operating at the new stands would comply with the proposed daytime limit of 55 dB L_{Aeq} at ESA receivers but there is potential to exceed the night-time limit of 45 dB L_{Aeq} if not properly managed. For example, some GSE activity could comply at night particularly if electric GSE are used and this could be managed once specific equipment noise levels are established. I predict that vehicles on Stewart Duff Drive would comply with the daytime and night-time limits although the number of trucks at night may need to be managed in order to comply.

82. In summary, I predict that activities in the ESA other than Aircraft Operations and APUs can be managed to comply with the proposed noise limits which represent typical and appropriate environmental noise limits for residential areas.

Predicted Cumulative Noise

83. For residents living adjacent to an airport, the total noise exposure is the combination of all airport noise sources. It is important to consider what the cumulative effect from all noise sources is on receivers. However, it can be difficult to quantify the cumulative noise as different sources are assessed using different metrics and time frames. I have quantified the cumulative noise from Aircraft Operations (2050), APUs and land based activities by converting all of these sources into the L_{dn} metric. **Table 4** summarises the predicted cumulative noise at the ESA receivers from activities in both the Main Site and the ESA.

Table 4 Predicted 2050 Cumulative Noise at ESA Receivers (dB L_{dn})

Receiver Point	Aircraft Operations	APUs[9]	Land Based Activities[10]	Total Cumulative
21 Bunker Way	60	55	55	62
50b & 50c Raukawa St	60	56	55	62
76 Raukawa St	60	56	55	62
12 Kekerenga St	59	49	55	61
22 Kekerenga St	61	55	55	63
30 Kekerenga St	61	55	55	63
46 Kekerenga St	62	50	55	63

ESA Assessment of Noise Effects

84. I have assessed the noise effects of the various sources in accordance with the following noise standards:

- Aircraft Operations including taxiing — NZS 6805:1992
- Land based activities — NZS 6802:2008
- APUs — NZS 6805:1992 and NZS 6802:2008

85. I also discuss the predicted change in noise for ESA receivers and cumulative noise levels.

Change in Noise Levels

86. As outlined in evidence by John Howarth and Iain Munro, development of the ESA would be staged over time. Noise levels will increase in small steps as each stage is constructed as well as gradual increases in operations between stages.

87. However, I have assessed the fully completed ESA development operational in the year 2050. **Tables 5 and 6** list the change in noise level for ESA

[9] Includes predictions for APUs in the Main Site plus APUs in the ESA
[10] Although theoretically land based activities in the Main Site and the ESA would each be able to generate 55 dB L_{dn} at receivers, this is unlikely in practice therefore the cumulative level includes 55 dB L_{dn} for land based activities

receivers for the 2050 situation compared with the permitted planning noise environment (**PPE**) and current noise environment.

Table 5 Increase in Noise Compared with Permitted Planning Environment

Receiver Point	Aircraft Operations (dB L_{dn})			Cumulative (dB L_{dn})		
	PPE	2050	Increase	PPE	2050	Increase
21 Bunker Way	59	60	1	61	62	1
50b/c Raukawa	59	60	1	61	62	1
76 Raukawa	59	60	1	61	62	1
12 Kekerenga	60	59	-1	61	61	0
22 Kekerenga	61	61	0	63	63	0
30 Kekerenga	62	61	-1	63	63	0
46 Kekerenga	63	62	-1	64	63	-1

88. A one decibel change in noise is indiscernible. Future airport noise levels with the proposed ESA development represent an insignificant change compared with the airport noise levels permitted by the District Plan.

Table 6 Increase in Noise Compared with Current Noise Environment

Receiver Point	Aircraft Operations (dB L_{dn})			Cumulative (dB L_{dn})		
	Current	2050	Increase	Current	2050	Increase
21 Bunker Way	54	60	6	55	62	7
50b/c Raukawa	54	60	6	55	62	7
76 Raukawa	54	60	5	55	62	7
12 Kekerenga	55	59	4	55	61	6
22 Kekerenga	56	61	5	56	63	7
30 Kekerenga	57	61	5	57	63	6
46 Kekerenga	58	62	4	58	63	5

89. Compared with current noise levels, the predictions for year 2050 with the ESA development represent a noticeable to appreciable increase in airport noise. As demonstrated in **Table 5**, this increase is already anticipated in the District Plan (within one decibel) and noting this increase in noise is predicted to occur gradually over some 20 to 30 years.

90. In addition to assessing overall noise exposure with the L_{dn} metric, I considered the effects for ESA receivers during individual noise events of aircraft taxiing under their own power in the ESA.

91. Single event noise is not controlled during daytime hours in the recommendations of either NZS 6802 or NZS 6805. In my ANE report I provided a summary of the predicted change in single event levels due to aircraft taxiing in the ESA for completeness and transparency. However, I was not clear enough that single events are not subject to limits during the daytime.

92. In my assessment I concluded that a small number of single events would sound twice as loud as currently experienced and that the increased levels, while undesirable, would not be unreasonable.

93. The WCC noise Officers' concerns are focussed on APU noise and single event noise from aircraft taxiing. I address the WCC concerns later in evidence in response to the s42A report.

Aircraft Operations Noise – NZS 6805 Assessment

94. As discussed above, NZS 6805 recommends establishing two aircraft noise boundaries, the ANB set at 65 dB L_{dn} and the OCB set at 55 dB L_{dn}. These boundaries are used to define noise limits and identify areas unsuitable for noise sensitive activities (**NSA**). The ANB and OCB define limits of acceptability for NSA and the standard recommends land use controls accordingly.

95. In general, the Standard regards aircraft noise effects at 65 dB L_{dn} or greater are not appropriate for residential activity. Inside the ANB, NZS 6805 recommends prohibiting new NSA and that existing NSA should be provided with acoustic insulation.

96. NZS 6805 considers between 55 and 65 dB L_{dn} the effects are moderate, and NSA should be avoided if practicable. If permitted, new NSA should be insulated however the standard does not recommend insulation is provided to existing NSA.

97. The Standard regards areas outside the OCB are appropriate for NSA and no land use controls or insulation requirements are recommended.

98. At Wellington Airport there is an ANB at 65 dB L_{dn} but no OCB at 55 dB L_{dn}. WIAL administers an established acoustic mitigation programme called Quieter Homes that provides acoustic and ventilation treatment to existing houses inside the ANB as recommended in NZS 6805. This program is described more fully in the evidence of Matt Clarke.

99. For the ESA fully developed 2050 scenario, I predict future noise levels at ESA receivers to be less than 65 dB L_{dn} (between 60 and 65 dB L_{dn}). These are moderately high levels that are generally undesirable for residential activity but not uncommon for residents in the vicinity of New Zealand airports, ports or roads.

100. In the NZS 6805 context, these properties would be considered moderately affected by aircraft noise and land use controls should apply to prevent or mitigate new NSA. However, the standard does not recommend existing NSA are provided with acoustic insulation.

101. In the existing Wellington Airport context, the majority of these properties are outside the ANB and are not subject to land use controls. As such the majority of these properties are not eligible for the Quieter Homes programme that provides acoustic mitigation to houses inside the ANB.

102. One further point of reference is the current best practice at New Zealand airports which is to provide existing NSA exposed to 60 dB L_{dn} or greater with a ventilation system such that windows can be closed to reduce noise ingress.

103. I discuss acoustic mitigation of existing noise sensitive activities in evidence under recommended mitigation measures in response to submissions and the Council's s42A report.

APU Noise Effects

104. Predicted APU noise levels for the fully developed ESA operating in 2050, are listed in **Table 3**. I have calculated noise levels in accordance with both the general environmental noise standard NZS 6802:2008 and the airport noise standard NZS 6805:1992. In the NZS 6805 context, APU noise would be below 55 dB L_{dn} which is considered reasonable in residential receivers. In the NZS 6802 context, APU noise would be at or below the 55 dB $L_{Aeq(15\ min)}$ limit for land based activity noise.

105. Using either assessment approach, I consider that the effects of APU noise would be reasonable. Also, I consider that the proposed duration limits on APUs running in the ESA are a practicable method of controlling APU exposure.

106. The Regional Public Health submission and the WCC s42A noise report by Mr Borich recommend that in addition to the proposed duration limits, a noise control is also placed on APUs. Mr Borich has not suggested details of a control. The Regional Public Health submission recommends APU noise is added to Aircraft Operations noise for compliance with 65 dB L_{dn} at the ESA Compliance Line.

107. While my assessment shows that APU noise at its worst would meet acceptable noise criteria at ESA receivers, I accept that defining a noise control is reasonable.

108. I have considered the Regional Public Health suggestion that APU noise is added to the calculation of Aircraft Operations noise controlled by the ESA Compliance Line. In my view this is a sensible suggestion for the following reasons:

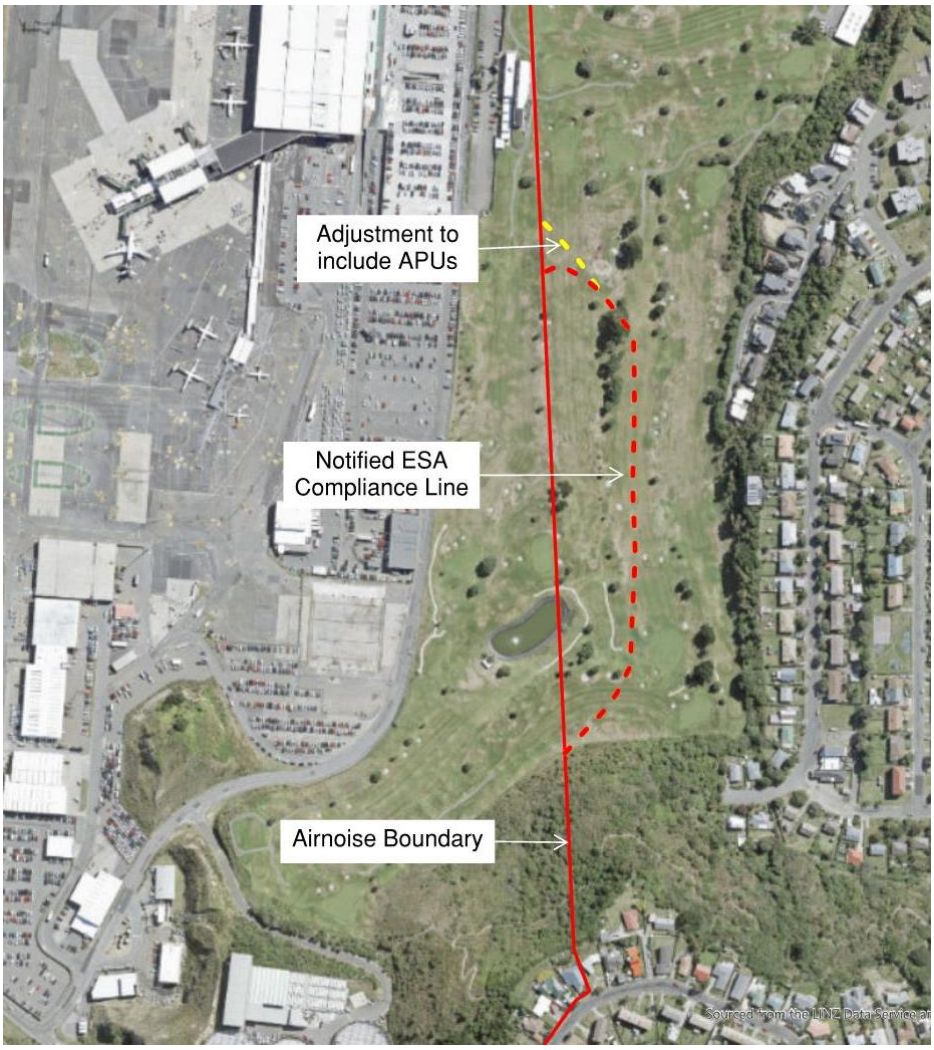
- APU noise is of the same character as aircraft engine noise therefore receivers are likely to identify APUs with aircraft noise,
- APUs would run for short durations either before or after an aircraft movement and are therefore linked to Aircraft Operations.
- Controlling APU noise with the L_{dn} metric provides a noise exposure control as well as a duration control on APUs[11] and would account for the cumulative noise from Aircraft Operations and APUs.

109. However, the notified ESA Compliance Line did not include APU noise. Modelling of Aircraft Operations noise does not usually include APUs as the specialised airport noise software does not provide for it. I have combined my future predictions for Aircraft Operations and APU noise from different software to ascertain the location of the ESA Compliance Line if ESA APU noise were included.

[11] Aircraft ramp noise which includes APUs is controlled by the International Civil Aviation Organisation (ICAO) aircraft certification noise standards (Annex 16 to the Convention on International Civil Aviation)

110. To accommodate ESA APU noise in the manner requested, the publicly notified ESA Compliance Line would need a small adjustment as shown by the yellow dashed line in **Figure 3**.

Figure 3 ESA Compliance Line Adjustment to Include APU noise



111. Adjusting the ESA Compliance Line does not mean allowing more noise than was proposed in the notified NOR, it just means that ESA APU noise is accounted for and controlled by the Compliance Line whereas in the notified proposed conditions it was not. There would be no change in noise levels predicted or permitted at ESA receivers.

Other Activities Noise Effects

112. All activities other than Aircraft Operations and APUs would be required to comply with typical general environmental noise standards for residential areas.

113. The proposed limits generally align with the existing District Plan limits for airport land based activities except the Sunday daytime limit would be increased from 45 dB L_{Aeq} to 55 dB L_{Aeq}.

114. I consider this increase is appropriate given the reasons set out above and the effects on residents would be reasonable.

Recommended Noise Management and Mitigation Measures

115. A suite of noise management and mitigation measures are proposed to manage the noise effects on ESA receivers consisting of:

- An ESA Compliance Line for Aircraft Operations noise;
- Operational restrictions in the ESA;
- Continuous noise monitoring;
- A construction noise management plan prior to construction works taking place.

116. I have reviewed these measures further taking into consideration matters raised by WCC and submitters and I now recommend three additional measures:

- ESA APU noise to also be controlled by the ESA Compliance Line;
- Compliance with the ESA Compliance Line to be demonstrated through annual modelling;
- Ventilation treatment offers to be made to ESA receivers when aircraft noise reaches 60 dB L_{dn}.

117. I discuss each of the proposed measures in turn.

ESA Compliance Line

118. As discussed above, the effect of taxiing activity within the ESA designation necessitates a localised change to the compliance point of the 65 dB L_{dn} boundary at this location. **Figure 3** shows how this differs from the existing ANB in the vicinity of the ESA. This means that compliance with the 65 dB L_{dn} limit would be assessed at the red dashed ESA Compliance Line where it is

shown, or the yellow adjusted ESA Compliance Line if APU noise is included. Elsewhere compliance would be assessed at the existing ANB.

119. Limiting noise to 65 dB L_{dn} at the ESA Compliance Line will control the noise at ESA receivers as set out in **Table 4**.

Operational Measures

120. WIAL proposes the following operational measures to mitigate noise effects from ESA activities:

- No taxiing under main engine power will be permitted on ESA taxiways at night (10pm – 7am);
- No APUs operating in the ESA at night (10pm – 7am). Outside these hours APUs may only run for 15 minutes after parking on a stand and 15 minutes prior to leaving a stand;
- The Airport Noise Management Plan to include operational measures for ground support equipment to comply with the noise limits at night;
- No engine testing in the ESA;
- Plug-in GPUs to be used at ESA gates.

121. I support these measures.

Noise Monitoring and Compliance Reporting

122. In the notified conditions, permanent noise monitoring is required at one location along the eastern boundary of the ESA. My intended purpose of the noise monitor was as a management tool to provide actual data for community assurance and complaints investigation and to provide an indicator for compliance with the noise limits.

123. The notified conditions did not include a method for demonstrating compliance with the ESA Compliance Line. I consider it is appropriate to add such a condition. The submission by Regional Public Health suggests that compliance should be demonstrated through measurement and modelling. I recommend that compliance with ESA Compliance Line is assessed through modelling on an annual basis and that continuous noise monitoring takes place as proposed in the notified conditions.

124. In my view it is more appropriate to measure noise at the interface with residential receivers rather than measuring at the ESA Compliance Line, which would be located well within the ESA designation area.

125. In my opinion, compliance with the ESA Compliance Line should be demonstrated through noise modelling and data from the noise monitor at the residential interface should be used to verify the modelling.

126. Modelling of Aircraft Operations noise does not usually include APUs as the specialised airport noise software does not provide for it. Aircraft Operations noise modelling usually takes account of aircraft take-offs and landings based on departure and arrival records from air traffic control and the associated taxiing is added. Modelling APU noise would require data of the aircraft stand usage in the ESA. To be pragmatic APU noise would be modelled by assuming the maximum duration allowance and an average APU noise source for each aircraft using a stand. This would likely use separate software to calculate APU noise and add this to the Aircraft Operations noise predictions.

127. To my knowledge, this process is unprecedented in New Zealand and is more complex than the normal approach due to the additional data requirements and software limitations. I consider it is reasonable to control APU and Aircraft Operations noise at the ESA Compliance Line and it is possible to assess this through modelling.

Acoustic Mitigation for Noise Sensitive Receivers

128. WCC has recommended that acoustic mitigation should be offered to ESA Receivers. In the WCC Technical Review report (22 Dec 2020), the authors recommended ESA Receivers in Bunker Way and Raukawa St should be offered ventilation treatment to habitable rooms prior to operations commencing in the ESA. In the subsequent report included with the s42A report[12], Mr Matthew Borich recommends the mitigation offers should be extended to more properties and include acoustic treatment to achieve 45 dB L_{dn} in habitable rooms as well as ventilation treatment.

129. In my ANE report and in paragraphs [95-102] of this evidence, I identify that in the context of NZS 6805 and the established Wellington Airport framework, existing houses exposed to levels below 65 dB L_{dn} are not provided with

[12] Appendix C Council Officers Report – Noise (27 April 2021)

acoustic mitigation. However, in the context of best practice in New Zealand, some airports provide fully or partially funded ventilation treatment to existing houses when the aircraft noise exposure at the property reaches 60 dB L_{dn}.

130. In recognition that the ESA development is similar to a new or altered noise situation for ESA Receivers, WIAL proposes to adopt best practice and offer fully funded ventilation treatment to existing houses that will be affected by ESA activities when noise from Aircraft Operations and ESA APUs reaches 60 dB L_{dn}. I understand these offers would be separate to, and not affect the established Quieter Homes programme. The Quieter Homes programmes would continue to apply to houses inside the ANB on Kekerenga Street.

131. The approach taken at other New Zealand airports offering ventilation treatment is to prepare an annual 60 dB L_{dn} contour which is a forecast for the coming year. This contour identifies which properties are eligible for ventilation treatment offers. I recommend the same approach for the ESA designation. In my opinion, it would be appropriate for the ESA forecast 60 dB L_{dn} contour to include all Aircraft Operations and ESA APU noise.

132. The proposed offers would only apply to ESA Receivers that I have described above. Accordingly, I have prepared a schedule of properties that would be eligible for ventilation treatment when noise from Aircraft Operations and ESA APUs reaches 60 dB L_{dn}. This is included as **Annexure C**. I note that two properties in this list (30 and 32 Kekerenga St) are inside the ANB and would also be eligible for a Quieter Homes offer.

133. New conditions are proposed accordingly.

134. I discuss acoustic mitigation further in response to the Council's s42A report.

Construction Noise

135. In my opinion construction noise should be managed to comply with the limits set out in NZS 6803:1999 where practicable. This Standard sets specific limits to manage the effects of construction noise and recognises the specific character of such noise and that such noise is temporary. I recommend that a specific construction noise assessment be undertaken once further information is available about the construction methodology and construction activities are managed according to a fit for purpose management plan.

136. A designation condition to achieve this outcome was included in the notified proposed conditions.

137. The WCC noise expert Mr Borich has recommended some changes to the proposed construction condition and I do not oppose those.

SUBMISSIONS

138. I address the noise concerns raised by submitters by topic below. I also address the submission by Regional Public Health separately.

Increasing Sunday Daytime Noise Limit

139. Submissions opposing increasing the Sunday daytime noise limit express concern that:

(a) This would mean no respite and no opportunity to use outside spaces on any day[13]

(b) No evidence to substantiate that Sunday controls are not practicable due to airport operations

(c) WIAL should not be able to change the existing noise limits[14]

140. Measurements of the existing noise environment show that Sundays are not quieter than Saturdays and the current day time noise level on Sundays is approximately 55 dB L_{Aeq}. Therefore, I consider changing the Sunday daytime noise limit to 55 dB L_{Aeq} is reasonable.

Noise Assessment did not Extend Beyond the ESA Receivers

141. Submissions relating to noise effects at receivers not included the ESA Receivers category express concern that:

(a) No detailed assessment of noise effects on the eastern side of Raukawa Street was undertaken[15]

[13] Sam and Melody Holmes
[14] Jeff Weir, Guardians of the Bay
[15] Strathmore Park Community Centre

(b) No consideration was given to noise effects for residents at the northern end of the golf course[16]

(c) Noise effects on recreational areas such as Lyall Bay beach and Wahine Memorial had not been addressed[17]

142. Noise levels in the Lyall Bay and Wahine Memorial recreational areas would not be affected by the ESA.

143. Noise contours prepared for the ESA assessment show that levels from ESA activities received at the northern boundary of the golf course would be comfortably below acceptable standards (<45 dB L_{dn} from taxiing and APUs in the ESA). Chris Service and Anna Marieke Boleyn's house (446 Broadway) is on the northern boundary of the golf course (south side of Broadway). My assessment shows that aircraft noise at this location would be dominated by aircraft on the runway (approximately 56 – 57 dB L_{dn} in year 2050). Noise from taxiing in the ESA would not increase the overall L_{dn} noise exposure.

144. For properties on the eastern side of Raukawa Street, levels are predicted to be approximately 6 dB lower than on the west side due to distance and screening effects. At the Strathmore Community Centre on Raukawa Street, the predicted levels in 2050 are:

- 49 dB L_{dn} from taxiing and APU in the ESA
- The worst case single event noise from taxiing in the ESA is predicted to be 77 dB L_{Amax} which is similar to levels currently experienced from jet departures.

145. As already provided for in the District Plan, the Community Centre site is predicted to receive 57 dB L_{dn} in 2050 from Aircraft Operations on the runway. The addition of aircraft noise in the ESA is predicted to increase this by one decibel. In summary, the change in noise level at the Community Centre is predicted to be slight.

Single Event Noise

146. Submissions relating to single event noise raise the following matters:

[16] Chris Service, Anna Marieke Boleyn
[17] James Barber

(a) A single event noise control should be introduced[18]

(b) Taxiing in the ESA would be a significant increase in single event noise that would disrupt communication inside the Strathmore Park Community Centre if windows were open.[19]

147. In my opinion the predicted single event noise levels are reasonable during the daytime. Single event noise controls in New Zealand context are generally not applied during the day and in this case a control is not warranted in my view. I address single event noise further in paragraphs [184-197] below.

148. I predict that single event levels from taxiing in the ESA received at the Strathmore Park Community Centre would be similar to those currently experienced from jets taking off and would not be overly intrusive.

Noise Monitoring and Reporting

149. Submissions relating to noise monitoring raise the following matters:

(a) At least two continuous noise monitors should be installed for the ESA rather than one[20]

(b) Monitoring for compliance should be done by continuous in-field measurement and modelling. Noise monitoring should be available real-time to the public.[21]

(c) Currently there are only 3 monitors measuring noise at the ANB and this is not enough. There is a great deal of uncertainty predicting noise levels.[22]

(d) WIAL should be monitoring land based noise as well as Aircraft Operations.[23]

150. It is proposed to measure noise continuously at one location near the most affected dwellings. The monitor would capture all noise sources from the Airport including land based noise sources. Noise modelling would be

[18] Strathmore Park Residents Ass,
[19] Strathmore Park Community Centre
[20] Strathmore Park Residents Ass
[21] Regional Public Health
[22] Jeff Weir
[23] Jeff Weir, Guardians of the Bay

undertaken annually to predict levels at all properties and all locations on the ESA Compliance Line and the modelling would be verified against the measurement results. WIAL proposes to make the monitoring data publicly available monthly and modelling results publicly available annually. I consider this is a comprehensive and appropriate compliance monitoring and reporting framework.

Outdoor Amenity

151. Submissions relating to outdoor amenity express concern that:

(a) Acoustic insulation does not mitigate the effects of noise on outside spaces.[24]

(b) Increased noise from turbo-props and ground vehicles will reduce enjoyment of outdoor spaces.[25]

152. It is generally accepted that noise environments below 55 dB (whether it be daytime L_{Aeq} or L_{dn}) are suitable for residential activity and this includes outdoor living areas. Above 55 dB residential amenity gradually becomes more compromised.

153. NZS 6805 recommends that environments above 65 dB L_{dn} from aircraft noise are not suitable for residential activity. The port noise standard (NZS 6809:1999), also recommends 65 dB L_{dn} is the threshold where new noise sensitive activity should be prohibited. The road noise standard (NZS 6806:2010) requires that for altered roads, mitigation measures such as barriers are used to reduce outdoor noise levels to 64 dB $L_{Aeq(24\ hour0}$ if practicable.

154. In my opinion noise environments above 65 dB L_{dn} are not appropriate for regular residential activity due to the adverse effects on outdoor amenity. Between 55 and 65 dB L_{dn}, outdoor amenity for residential activity would be compromised but not unreasonable in my view.

155. ESA Receivers are already impacted by their proximity to Wellington Airport and the growth in airport noise permitted in the District Plan. Since the date

[24] Sam and Melody Holmes, Tim Jones
[25] Robyn Moriarty

the ANB was included in the District Plan, these properties were anticipated to have a compromised outdoor amenity ranging from 61 to 64 dB L_{dn}.

156. In practice, development of the ESA would mean that some aircraft events would sound twice as loud as they currently do and the sound of APUs would be just perceptibly louder than they are now (4 dB louder). However, the change in the overall outdoor noise exposure compared with that anticipated in the District Plan, would not be significant (< 2 dB L_{dn}). The change compared with the current noise environment (which is approximately 55 - 58 dB L_{dn}) is predicted to be 6 - 7 decibels which is an appreciable increase.

157. In summary, I consider that outdoor amenity for ESA receivers would be compromised but not materially greater than the degree already anticipated for these properties due to their proximity to the Airport, and not to the extent of being unsuitable for residential activity (i.e. < 65 dB L_{dn}).

Health Effects

158. Submissions relating to health effects[26] due to noise, express concern about potentially significant health effects with some submissions referencing the 2018 World Health Organisation (**WHO**) *"Environmental Noise Guidelines for the European Region"* that suggests an increased risk of adverse health effects can occur at levels below 65 dB L_{dn}.

159. The Guidelines document identifies that available research is limited, and there remains knowledge gaps and the need for further research on the health impacts from transportation noise. From my reading of the document, it seems the research is not yet extensive enough to conclusively quantify the potential health effects from aircraft noise at the levels suggested.

160. In the meantime, I consider there should be reliance on NZS 6805 as is evidenced by the recently published National Planning Standards where there is a mandatory direction for Plan rules that manage noise emissions to be in accordance with variously listed NZ standards, including NZS 6805.

161. NZS 6805 provides the ANB level of 65 dBA L_{dn} contour for the protection of community health. My evidence shows that the ESA proposal meets this Standard.

[26] Strathmore Park Residents Ass., Jeff Weir, Regional Public Health, Generation Zero

Noise Mitigation

162. Submissions relating to noise mitigation raise the following matters:

(a) Quieter Homes programme should be extended to include ESA Receivers.[27]

(b) Acoustic insulation is requested by individual submitters.[28]

(c) The proposed mitigation measures are insufficient.[29]

(d) Acoustically treating homes or moving away is not financially achievable for some residents.[30]

(e) Acoustic barriers are requested to mitigate noise for receivers on south side of Broadway[31]

(f) Visual buffer will be ineffective at reducing noise[32]

163. WIAL proposes to adopt best practice and offer fully funded ventilation treatment to noise sensitive activities affected by ESA noise when the level from Aircraft Operations and ESA APUs reaches 60 dB L_{dn}. The Quieter Homes programme is an established program for existing houses in the ANB that relates to the Main Site activities. WIAL proposes that the ESA ventilation offers would be separate to the Quieter Homes program and would specifically target houses affected by ESA activities. I have identified these properties in **Annexure C**. I note that Karen Sale at 44a Kekerenga St is inside the ANB and eligible for the Quieter Homes offer.

164. Acoustic barriers along the northern boundary of the golf course to attenuate ESA noise are not warranted based on the predicted noise levels for houses on Broadway.

165. I understand the visual barrier is not intended to attenuate noise.

Submission by Regional Public Health

[27] Strathmore Park Residents Ass.
[28] Karen Sale, Chris Service, Anna Marieke Boleyn
[29] Sam and Melody Holmes
[30] Robyn Moriarty, Sam and Melody Holmes
[31] Chris Service
[32] Matthew Pohio, Guardians of the Bay, Tim Jones

166. The RPH submission on the ESA NOR is critical of a separate designation for the ESA and claims that it "*undermines the integrity of the controls and introduces ambiguity and uncertainty"*. The author does not provide any examples or specify how a separate designation undermines the integrity of controls and introduces ambiguity.

167. The submission is critical of my ANE report stating:

"*The effect of the change to the control boundary has been downplayed in the Notice of Requirement with extensive reference to small changes in average noise levels. The East Side introduces substantially more noise to the nearest neighbours, even though with extensive averaging this only manifests itself in a visually small movement of the control boundary.*"

168. I do not agree with this criticism. In my ANE report I have gone beyond the requirements of NZS 6805 to predict daytime single event noise from aircraft taxiing in the ESA. With respect to APU noise, I presented the worst case, noise levels without applying a duration limit as provided in NZS 6802. I do not agree the ANE report downplayed the noise effects of the ESA development. Average noise exposure metrics such as L_{dn} and L_{Aeq} are the accepted method for assessing and controlling overall noise effects.

169. The submission opposes the ESA Compliance Line and requests that noise from all Aircraft Operations complies with the ANB. Noise from aircraft taxiing in the ESA could not comply with 65 dB L_{dn} at the ANB. Therefore, it would not be possible to use the ESA for the intended purpose if the ESA Compliance Line was not provided. Given my conclusions on effects and the mitigation measures proposed, I do not consider this is a reasonable request.

170. RPH requests that compliance with the noise limits is monitored based on modelling and measurement. I agree and new conditions are proposed to require annual modelling to demonstrate compliance.

171. RPH requests that Aircraft Operations exempt from the noise limits are listed in a publicly available schedule. I do not oppose this.

172. RPH opposes the exclusion of aircraft for dignitaries, military aircraft and four movements at night from the 65 dB L_{dn} noise limit on Aircraft Operations. WIAL has revised the list of exclusions in the conditions. I address the military operations in paragraphs [29-30]

173. RPH requests that the permanent noise monitoring data is publicly available. I do not oppose this in concept however I do not believe real time data is necessary. WIAL proposes to report the results monthly.

174. RPH suggests that APU noise that is exempt from the land based activity limits should be added to Aircraft Operations noise required to comply with 65 dB L_{dn}. I have agreed with this suggestion in concept and discuss it further in paragraphs [106-111].

175. RPH requests that WIAL provides acoustic treatment for existing houses exposed to aircraft noise below 65 dB L_{dn} like some other New Zealand airports. WIAL proposes to offer ventilation treatment to ESA Receivers in accordance with best practice at New Zealand airports (i.e Auckland, Rotorua, Queenstown). I discuss this further in paragraphs [130-132].

COUNCIL REPORT

176. I have read both the WCC Technical Review report (22 Dec 2020) co-authored by Mr Lindsay Hannah and Mr Borich and the subsequent report authored by Mr Borich and included as Appendix C to the s42A report[33]. The latter contains some recommendations that differ to those in the first report. I will primarily address the points in Mr Borich's most recent report as this focusses on the areas where he disagrees with the proposed NOR.

177. In his assessment Mr Borich states:

"In my opinion the three predominant sources of noise are:

1. *Auxiliary Power Unit (APUs)*
2. *Single event aircraft taxiing (between the runway and the proposed new aprons)*
3. *Construction noise"*

178. In his summary Mr Borich states:

"In my view, noise emanating from all activities can be managed to be reasonable level except for single event sound exposure levels from taxiing of

[33] Council Officers Report – Noise (27 April 2021)

jet aircraft and the operation of APUs during the day. I therefore recommend the need for further mitigation to prevent potentially significant adverse noise effects."

179. Mr Borich recommends some additions to the earthworks and construction conditions to satisfy his concerns about construction noise and I do not oppose those. I will address his concerns about the other two noise sources, (APUs and taxiing noise) before discussing his recommended mitigation.

APU Noise

180. Mr Borich is critical of my assessment of APU noise emissions from the ESA stating, "*the assessment of effects from APUs operating in the ESA is understated in the MDA report*". I do not agree that the assessment is understated. However, I acknowledge the APU predictions in my ANE report were simplistic and I have prepared a detailed assessment as discussed in paragraphs [70-75]:

181. My simplistic predictions would likely have contributed to Mr Borich's concerns about the effects. The results of my detailed NZS 6802 assessment show that APUs in the ESA using the full runtime allowances in the 2050 scenario would comply with the land based activity noise limit of 55 dB $L_{Aeq(15\ min)}$. I note this is dependent on the outcome of a special audible character assessment.

182. Mr Borich recommends that noise from APUs be controlled by noise limits. I have discussed this in paragraphs [106-111].

183. I intend to discuss my revised APU predictions and potential noise control solutions with Mr Borich during upcoming expert caucusing.

Aircraft Taxiing Single Event Noise

184. Mr Borich is concerned about the noise effects from aircraft taxiing in the ESA. He considers that the daytime single event noise effects from aircraft taxiing in the ESA would be significant and warrant immediate acoustic mitigation. However, he has not referenced any limits of acceptability or standards for daytime single event noise.

185. As discussed in paragraphs [60] single event noise is not controlled during the day under NZS 6805 (Airport noise) or NZS 6802 (General environmental noise). To my knowledge, no other New Zealand environmental noise

standard recommends daytime single event controls apart from the construction noise standard which I will discuss below.

186. In his report Mr Borich makes the following statement:

"*An assessment of effects based on human perception when applied to increases to L_{dn} levels alone does not provide a "comprehensive" effect assessment in my view"*

187. He then recommends acoustic and ventilation treatment should be offered to mitigate the effects of daytime single event noise and APU noise. The basis for this recommendation is ambiguous and is not related to any threshold or limit of acceptability. However, I note he recommends an internal design criterion based on the L_{dn} metric.

188. In my opinion, the appropriate standard for assessing taxiing noise is NZS 6805. This Standard recognises that one short duration, high noise event does not result in adverse effects. The L_{dn} metric used for assessing aircraft noise, takes into account the single event level of each event and the number of events over a 24 hour period.

189. An individual event might be disruptive for a short duration but between events, the noise source is not present. Therefore, both the level and the frequency of the events determines the noise exposure and the effects over the longer term. This is the same approach taken for traffic, port and rail noise regardless of whether the noise is new or existing.

190. For taxiing narrow body aircraft in the ESA, I predict single event noise levels of approximately 84 dB L_{AE} and 75 dB L_{Amax} at the closest ESA receivers. These levels are similar to current single event levels experienced by these receivers from jet departures. In addition, these events would even comply with the airport land based activity L_{Amax} limit at night (75 dB L_{Amax}). It is worth noting that L_{Aeq} daytime criteria are typically 10 dB higher than at night which suggests that levels of 85 dB L_{Amax} during the day are reasonable.

191. The single event levels from a wide body aircraft on the ESA taxiway are predicted to be approximately 95 dB L_{AE} and 83 dB L_{Amax} at the closest ESA receivers. These levels are 10 decibels higher than current jet departures (subjectively twice as loud). These louder events are predicted to occur 12 times a day between 7am and 10pm in the 2050 operating scenario. Each

event is predicted to last approximately 60 – 90 seconds with the maximum level occurring for a few seconds.

192. There are no defined limits of acceptability for daytime single event noise in NZS 6805, NZS 6802, the road traffic noise standard (NZS 6806:2010) or the port noise standard (NZS 6809:1999). The construction noise standard (NZS 6803:1999) does define daytime limits ranging from 85 dB L_{Amax} for long duration construction projects to 95 dB L_{Amax} for short duration projects.

193. I take the construction noise limits as guidance on what would be considered unreasonable single event levels and conclude that the levels from taxiing in the ESA would not be unreasonable.

194. Beyond the New Zealand standards, there is an assessment metric used in Australia for aircraft noise called 'Number Above'[34]. This metric is the number of aircraft events above a specified L_{Amax} level during a specified assessment period. For example, the number of aircraft events above 70 dB L_{Amax} over 24 hours.

195. The authors of the concept submit that an aircraft is *'registered as a noise event*' by receivers when it exceeds a noise level of 70 dB L_{Amax} (i.e. all noise events above 70 dB are considered equal). 70 dB L_{Amax} is not defined as a limit of acceptability rather a level above which aircraft noise events are noticeable indoors.

196. ESA receivers are currently exposed to aircraft events above 70 dB L_{Amax} from departures on the runway. Aircraft taxiing in the ESA would also be greater than 70 dB L_{Amax}. Taking the Number Above approach, departures and taxiing events are treated equally as '*registered noise events*' for ESA receivers. Based on the forecast 2050 operating scenario, ESA receivers would experience 110 events above 70 dB L_{Amax} due to departures, and 24 due to ESA taxiing. Meaning that taxiing in the ESA would increase the number of '*registered noise events*' for ESA receivers from 110 departures to 134. I do not consider this is a significant change.

197. The Australian study states that the 'Number Above' concept is not meant to replace the noise exposure analysis, but rather to be used in conjunction with

[34] "Expanding Ways to Describe and Assess Aircraft Noise"; Transport and Regional Services, Australia

that analysis to assist with the communication of noise effects to the public. The study does not suggest any limits of acceptability for the number of events above 70 dB. This is the role of noise exposure metrics such as L_{dn} that take account of multiple individual noise events over an assessment period.

198. In summary it is my opinion that:

- The noise exposure method (using L_{dn}) set out in NZS 6805 is the appropriate method of controlling and assessing the effects aircraft noise including taxiing during the day;
- Single event noise should be considered for information purposes and night-time sleep disturbance effects, but a daytime single event aircraft noise control is not warranted;
- The predicted single event levels from aircraft taxiing in the ESA are not unreasonable;
- ESA Receivers currently already experience multiple aircraft noise events. Aircraft taxiing in the ESA would increase the number of aircraft noise events experienced by ESA receivers by a moderate but not significant amount (110 to 134).

Acoustic Mitigation

199. Mr Borich recommends that to mitigate the noise effects of APUs and aircraft taxiing in the ESA, offers of acoustic mitigation should be made to ESA receivers 6 months prior to operations commencing in the ESA.

200. I do not agree that offers should be made 6 months prior to operations commencing or that the offers should include acoustic treatment to achieve 45 dB L_{dn} indoors.

201. However, I agree that some mitigation of aircraft noise, in line with current best practice at New Zealand airports, would be appropriate. As discussed in paragraphs [130-132], WIAL proposes to offer fully funded ventilation treatment to noise sensitive activities affected by ESA noise when the noise from Aircraft Operations and ESA APUs reaches 60 dB L_{dn} for those ESA receivers not already covered by the Quieter Homes Programme and identified in **Annexure C**. I support this measure.

202. I do not agree with Mr Borich that acoustic and ventilation treatment should be offered 6 months prior to operations commencing in the ESA for the following reasons:

- The ESA development would be staged therefore operations would initially be only a fraction of the levels assessed in my report.

- I have presented the effects for the fully developed ESA operating in the year 2050. In my view it is appropriate to offer mitigation when the effects reach the threshold of 60 dB L_{dn}. This is in line with all other airport programs offering mitigation at 60 dB L_{dn}.

- Mr Borich is concerned about noise from APUs and taxiing. These sources are aircraft noise, and it is appropriate to assess them using NZS 6805 using the L_{dn} metric. The noise exposure from these sources is directly linked to Aircraft Operations. When operations commence in the ESA, noise from APUs and taxiing would be much lower than presented for the year 2050 as there would be fewer aircraft using the ESA stands. I consider the L_{dn} noise exposure is an appropriate metric to use to assess and control the effects of these noise sources. As such it is my opinion that mitigation for ESA receivers would be appropriate when aircraft noise reaches 60 dB L_{dn}.

203. I do not agree with Mr Borich that it is necessary to define an indoor criterion for the mitigation. Best practice at New Zealand Airports is to offer ventilation treatment only between 60 and 65 dB L_{dn}. The reason is that by closing windows, even older houses achieve a noise reduction, on average, of 25 decibels. For outdoor levels of 60 to 65 dB L_{dn} no additional acoustic treatment is necessary to achieve appropriate indoor levels.

204. In summary, I consider that noise sensitive activities affected by aircraft noise from the ESA should be offered ventilation treatment to habitable rooms once the level from Aircraft Operations and ESA APUs reaches 60 dB L_{dn} at the property boundary. This mitigation relates to the ESA affected houses identified in **Annexure C**.

WCC Recommendations on Conditions

205. Mr Borich has recommended some changes to the proposed conditions for the Main Site and the ESA.

206. I do not oppose his recommended changes to the Main Site conditions.

207. For the ESA conditions, WIAL proposes some alterations to the notified conditions that take into account minor drafting changes requested by WCC and submitters so I will not address these minor changes.

208. The main changes Mr Borich recommends relate to the Earthworks and Construction Management conditions and new conditions for acoustic and ventilation mitigation offers.

209. I do not oppose Mr Borich's changes to the Earthworks and Construction Management conditions

210. I consider a condition for ventilation mitigation offers should be added as discussed in paragraphs [130-132] but I do not agree with Mr Borich's condition requiring acoustic and ventilation treatment 6 months prior to operations commencing in the ESA (a discussed in paragraphs [202-203])

CONCLUSION

211. I have predicted the likely future noise levels from proposed activities in the ESA and assessed the noise effects in accordance with the relevant New Zealand standards.

212. The proposed increase in cumulative airport noise exposure for receivers affected by the ESA is up to one decibel greater than the cumulative airport noise currently permitted in the District Plan for airport activities. I consider this is a slight increase in average noise exposure.

213. The proposed increase in cumulative airport noise exposure for receivers affected by the ESA is up to 7 decibels greater than the current cumulative airport noise from airport activities. I consider this is an appreciable increase in average noise exposure.

214. In the context of NZS 6805, the potential aircraft noise related health effects would be appropriately managed.

215. In the context of the relevant New Zealand standards, the residential amenity at the predicted levels would be compromised but not unreasonable for residential activity. Based on the 2050 operating scenario, I consider the

predicted noise levels would result in moderate adverse amenity effects for ESA receivers.

216. In my opinion the proposed suite of mitigation measures, operational restrictions and monitoring requirements reflect best practice and are appropriate to manage the noise effects of activities in the ESA to reasonable levels.

Laurel Smith

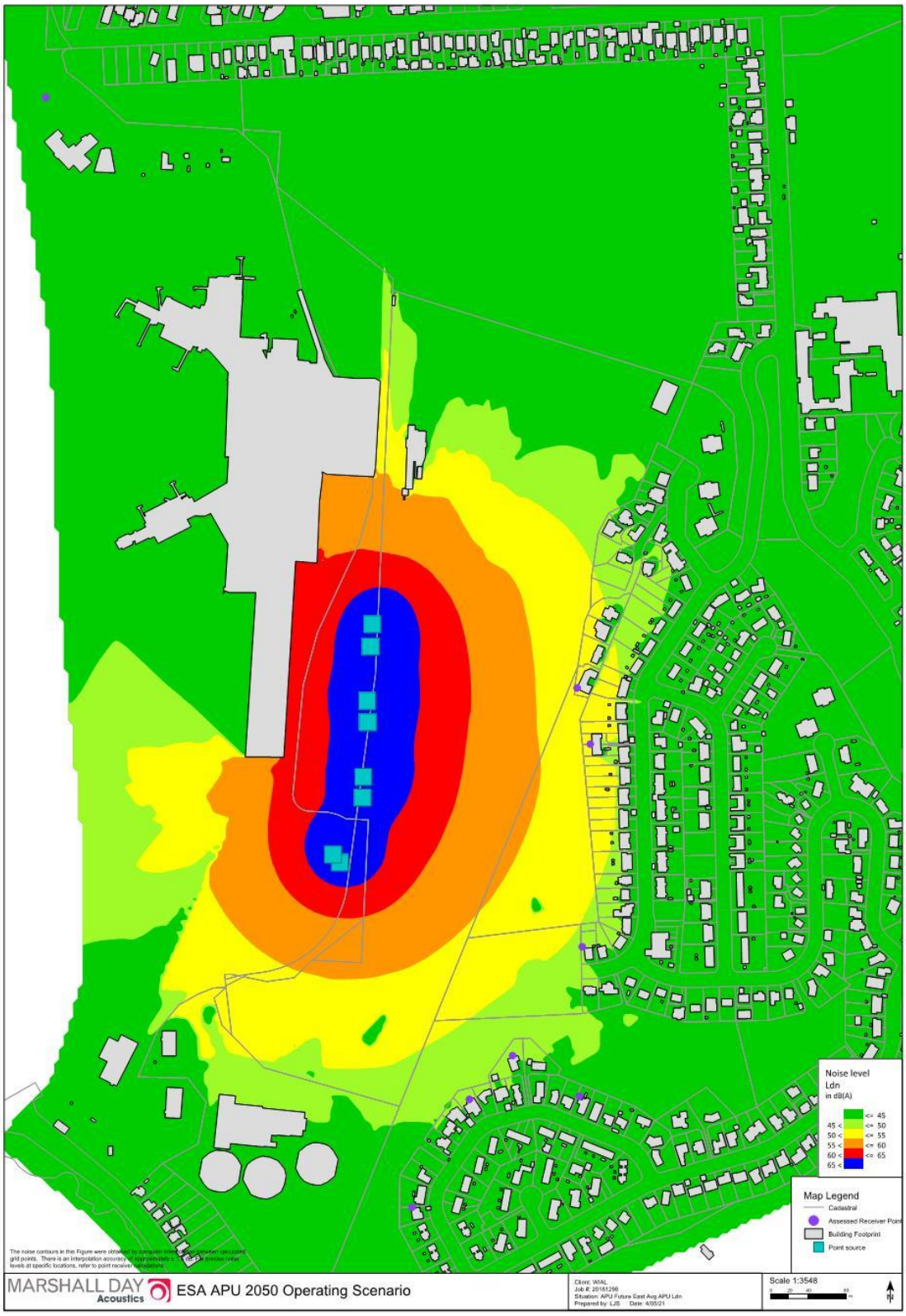
5 May 2021

SCHEDULE A: GLOSSARY OF TERMINOLOGY

ANB	Air Noise Boundary. Noise control boundary used to control aircraft noise and land use with a limit of 65 dB L_{dn}
OCB	Outer Control Boundary Noise control boundary used to control aircraft noise and land use with a limit of 55 dB L_{dn}
SPL or L_p	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
SWL or L_w	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
$L_{Aeq(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
L_{dn}	The A-weighted day night noise level which is calculated from the 24 hour L_{Aeq} with a 10 dB penalty applied to the night-time (2200-0700 hours) L_{Aeq}.
SEL or L_{AE}	Sound Exposure Level The sound level of one second duration which has the same amount of energy as the actual noise event measured. Usually used to measure the sound energy of a particular event, such as a train pass-by or an aircraft flyover.
Rating Level	A derived level used for comparison with a noise limit under NZS 6802:2008
NZS 6801:2008	New Zealand Standard NZS 6801:2008 *"Acoustics – Measurement of environmental sound"*
NZS 6802:2008	New Zealand Standard NZS 6802:2008 *"Acoustics – Environmental Noise"*
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*
NZS 6805:1992	New Zealand Standard NZS 6805:1992 *"Airport Noise Management and Land Use Planning"*

NZS 6806:2010	New Zealand Standard NZS 6806:2010 "*Acoustics –Road Traffic Noise – New and Altered Roads*"
NZS 6809:1999	New Zealand Standard NZS 6809:1999 "*Acoustics –Port Noise Management and Land Use Planning*"
WIAL	Wellington International Airport Limited
ESA	East Side Area
WCC	Wellington City Council
NOR	Notice of Requirement
ANE report	Assessment of Noise Effects report – prepared by Marshall Day Acoustics and included with the ESA NOR (dated 26 February 2020 author Laurel Smith)
APU	Auxiliary Power Unit – Component of a aircraft used to generate power for essential systems when main engines are not operating
GPU	Ground Power Unit – Land based power supply for aircraft essential systems while parked and not running the APU

ANNEXURE B PREDICTED NOISE CONTOURS FOR APU IN THE ESA



ANNEXURE C AFFECTED PROPERTIES FOR VENTILATION OFFERS

Properties Eligible for ESA Ventilation Treatment Offers Triggered by Annual 60 dB Ldn Contour

Number	Street	Predicted ESA Taxiing and APU Noise (Ldn)	Predicted Main Site Aircraft Ops Noise (Ldn)	Combined (Ldn)
15	Bunker Way	56	58	60
17	Bunker Way	56	58	60
19	Bunker Way	57	58	61
21	Bunker Way	57	58	61
10	Bunker Way	55	58	60
14	Bunker Way	55	58	60
16	Bunker Way	55	58	60
44a	Raukawa Street	55	58	60
46	Raukawa Street	56	58	60
46A	Raukawa Street	56	58	60
48	Raukawa Street	57	58	61
48A	Raukawa Street	57	58	61
50	Raukawa Street	57	58	61
50A	Raukawa Street	56	58	60
50B	Raukawa Street	57	58	61
50C	Raukawa Street	57	58	61
52	Raukawa Street	56	58	60
52A	Raukawa Street	57	58	61
54	Raukawa Street	57	58	61
54a	Raukawa Street	57	58	61
56	Raukawa Street	57	58	61
56A	Raukawa Street	57	58	61
1/58	Raukawa Street	57	58	61
2/58	Raukawa Street	57	58	61
58A	Raukawa Street	57	58	61
60	Raukawa Street	56	58	60
62B	Raukawa Street	56	58	60
62A	Raukawa Street	56	58	60
64	Raukawa Street	56	58	60
66	Raukawa Street	55	58	60
68	Raukawa Street	55	58	60
70	Raukawa Street	55	58	60
74	Raukawa Street	55	59	60
76	Raukawa Street	55	59	60
79	Raukawa Street	50	59	60
16	Kekerenga Street	49	60	60
18	Kekerenga Street	48	60	60
20	Kekerenga Street	53	60	61
22	Kekerenga Street	54	60	61
24	Kekerenga Street	51	60	61
26	Kekerenga Street	53	60	61
28	Kekerenga Street	53	61	62
30	Kekerenga Street	54	61	62
32	Kekerenga Street	53	61	62