BEFORE INDEPENDENT HEARING COMMISSIONERS
AT CHRISTCHURCH

I MUA NGĀ KAIKŌMIHANA WHAKAWĀ MOTUHAKE
KI ŌTAUTAHI

IN THE MATTER	**of the Resource Management Act 1991**
AND	
IN THE MATTER	**of the hearing of submissions and further submissions on Plan Change 14 to the Operative Christchurch District Plan**

STATEMENT OF EVIDENCE OF JONATHAN DAVID SELKIRK ON BEHALF OF KĀINGA ORA – HOMES AND COMMUNITIES

(VENTILATION)

18 SEPTEMBER 2023

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1. EXECUTIVE SUMMARY

1.1. My name is Jonathan David Selkirk, and I am a Senior Engineer at Jacksons Engineering Advisors Limited. I have been engaged by Kāinga Ora-Homes and Communities (**Kāinga Ora**) to provide evidence in support of its primary submission (submitter #834) and further submissions (further submitter #2050) on the Christchurch City Council (**the Council**) Proposed Plan Change 14 (**PC14**) to the Operative Christchurch District Plan (**ODP**).

1.2. My evidence recommends changes that are aimed at achieving acceptable levels of indoor air quality to ensure the creation of lifelong healthy homes, as well as ensuring minimum levels of comfort are achieved for dwellings located within noise affected areas, where it is accepted that external doors and windows will be required to remain closed to ensure the integrity of specialist acoustic treatment, and in order to ensure acceptable internal noise levels are maintained within all habitable rooms.

1.3. Having reviewed the PC14 and the ventilation requirements as expressed in rule 6.1.7.2.1(d), I note that specific design parameters have been provided that rely solely on New Zealand Building Code rates of ventilation. This solution is not considered effective in cooling and does not adequately address the potential for overheating. I have therefore proposed alterations to the rules in my evidence to address those shortcomings.

1.4. In carrying out my assessment, I have referred to applicable New Zealand and Australian Standards, the NZ Building Code G4/AS1, and CIBSE guidance as reference documents for my recommended solutions. These standards include NZS4303:1990 - Ventilation for acceptable indoor air quality, AS 1668.2-2002 - The use of ventilation and air conditioning in buildings - Part 2: Mechanical ventilation in buildings, MoE DQLS Indoor Air Quality and Thermal Comfort (v2.0) and CIBSE Guide A Environmental Design.

1.5. In my opinion, it is important to clearly articulate minimum standards, and ensure sufficient flexibility to allow a range of methods by designers to meet those minimum standards. The adoption of minimum ventilation rates based on and referenced to established codes, such as the NZ Building Code and Industry organisations such as CIBSE (Chartered Institute of Building Services Engineers) together with minimum / maximum internal temperature ranges (18°C – 25°C), will result in a combined requirement for heating, cooling and ventilation systems to ensure compliance. Ambient Design has also been stipulated to ensure design consistency across the various climate zones throughout New Zealand. Compliance is required to be demonstrated for each separate habitable space and consideration of intermittent ventilation systems is required under separate codes for bathrooms, laundries and kitchens. As such, capital costs, maintenance costs and running (energy consumption) costs must all be considered by the system designer. Choice of fuels should also be considered within a sustainability framework, including exclusion of fossil fuels, in-line with current government carbon reduction strategies.

1.6. Minimum heating, cooling and ventilation requirements I recommend for noise affected habitable spaces:

a) Mechanical ventilation compliant with section 1.5, Mechanical Ventilation of NZBC G4/AS1 is to be provided for all habitable rooms.

b) Ventilation, heating and cooling, is to be provided for each separate habitable space, including each bedroom, assuming bedroom doors will be closed.

c) Where only the minimum ventilation rates are provided, they are to be at fixed airflow. Ventilation system(s) are only to be adjustable between the minimum ventilation rate and elevated ventilation rates where prescribed in the rules or provided by the owner/developer.

d) All controls and ancillary items to effect the correct operation of the above systems is to be provided.

e) A suitable heating system that is controllable by the occupant and capable of maintaining a minimum internal design temperature of 18°C, while operating within the specified noise criteria as defined in the proposed Rule 6.1.7.2.1(d). Equipment breakout noise must also fit within this criteria.

f) A suitable cooling system that is controllable by the occupant and capable of maintaining a maximum internal design temperature of 25°C, while operating within the specified noise criteria as defined in the proposed Rule 6.1.7.2.1(d). Equipment breakout noise must also fit within this criteria.

g) The design is to be based on the NIWA 2.5% design weather dataset (i.e. 24 hour data as published by NIWA) for ensuring that heating and cooling solutions work appropriately "24/7" for the geographic location in which the dwelling is located.

h) Where buildings are fitted with non-compliant or fixed windows, the minimum ventilation requirement should be increased to 1 air change per hour.

i) Alternatively, a specific engineered system can be proposed by a suitably qualified and experienced HVAC expert, provided the above outcomes can be met or exceeded.

1.7. As this is a specialist area of engineering, I would expect that Council would benefit from considering the consenting approval process. Options for ensuring compliance may include:

a) The use of Producer Statements accompanied by appropriate levels of insurance.

b) Requiring a suitably qualified and experienced HVAC designer complete the design and construction monitoring.

c) Requesting a Peer Review by a suitably qualified designer.

2. INTRODUCTION

2.1. My full name is Jonathan David Selkirk. I am a specialist Building Services Engineer of Jacksons Engineering Advisers Limited, for the past 10 years. I am actively involved in the design, construction, and assessment of building services, working across New Zealand.

2.2. I am a graduate of the University of Canterbury holding bachelor's degrees in science (Physics & Electronics) and engineering with honours (Mechanical). I am a current Chartered Professional Engineer with Engineering New Zealand with 10 years practise in the field of Building Services, specialising in heating, cooling and ventilation services.

2.3. I have provided design advice, construction monitoring, and technical reviews across the residential, healthcare, education, commercial and hospitality sector for Te Whatu Ora, Ministry of Education, and Christchurch City Council.

2.4. This evidence statement responds to the ventilation standards within the PC14 sub-chapter 6.1 Noise.

2.5. I have considered the PC5E Section 32 report and the PC5E S42A report in regard to ventilation.

Code of Conduct

2.6. Although this is a Council hearing, I confirm that I have read the Expert Witness Code of Conduct set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing this evidence and agree to comply with it while giving evidence.

2.7. Except where I state that I am relying on the evidence of another person, this written evidence is within my area of expertise. I have not omitted to consider material facts known to me that might alter or detract from the opinions expressed in this evidence.

Scope of evidence

2.8. My evidence will address the following matters:

a) The amendments I propose for the ventilation provisions (including proposals for heating and cooling) set out in PC14 sub-chapter 6.1 Noise.

b) The reasons for the amendments and why they are generally aligned with creating healthy and comfortable internal environments within the affected dwellings where the use of openable windows is restricted.

c) The reasons why I generally do not support mechanical ventilation for internal space temperature control, including where high levels of mechanical ventilation (i.e., 3+ air changes per hour) are provided.

3. HEATING COOLING AND VENTILATION OF BUILDINGS

Housing within noise affected areas

3.1. Addressing the effects of high noise emissions on residential housing requires a combination of design, engineering, and policy measures to mitigate potentially detrimental effects on residents' health, well-being, and overall quality of life.

External Measures

3.2. Measures undertaken to the external environment of the affected housing may include:

a) Land use planning and zoning, including noise mapping to identify high-noise areas such as vehicle and rail corridors, airports and industrial areas.

b) Noise regulations and enforcement.

c) The use of urban green space and buffer zones.

d) The use of acoustic barriers such as earth bunds or engineered fencing.

Direct Measures

3.3. Measures applied directly to affected housing may include:

a) Building design considerations such as location and orientation and soundproofing by the use of noise-reducing materials in walls, floors, and ceilings.

b) The use of specialised glazing to provide better noise insulation from external sources.

c) Ensuring gaps and cracks in the structure are properly sealed, ensuring integrity of the noise envelope.

Effects of Sealing a Building

3.4. With the building envelope closed (doors and windows closed), even with high rates of mechanical ventilation, the internal temperatures will rise well past the prevailing ambient temperatures on clear sunny days.

3.5. While beneficial to external noise reduction, the added acoustic insulation will also increase the thermal insulation properties of the building, effectively trapping more heat within the building, especially during periods of high solar gain. For this reason, the provision of air conditioning (mechanical cooling), will be essential to limit internal temperatures to less than 25°C.

3.6. Without the ability to open windows to provide ventilation to all habitable spaces, mechanical ventilation will be required.

3.7. Ventilation rates are typically kept to a minimum during winter periods to avoid wasting energy by over-ventilating with cold outside air, which would also require higher capacity heating plant. Similarly, once air conditioning (mechanical cooling) is introduced, summer ventilation rates are also required to be kept to a minimum to avoid wasting energy by over-ventilating with very warm outside air, also requiring larger capacity plant. My recommendation is therefore that continuous minimum ventilation rates are maintained year-round. This is described further under **Ventilation**.

Thermal Comfort

3.8. Internal space temperature limits are not set out in the New Zealand Building Code for many building usage types. Minimum internal space temperatures are required by the New Zealand Building Code G5 for retirement homes and early childhood centres only. Upper limits are not set. These requirements do not apply to the majority of buildings constructed for commercial or residential use. I consider a suitable reference guide to be the Chartered Institute of Building Services Engineers (CIBSE) – Guide A Environmental Design Table 1.5. This provides guidance on internal temperature limits with a proposed minimum winter indoor temperature of 18°C and a maximum summer indoor temperature of 25°C.

3.9. The heating and cooling capacity required to achieve the internal temperatures defined in para **3.8** above are dependent upon the ambient conditions (along with solar gain and internal heat gain in the case of cooling capacity). For this reason, I recommend that the internal temperatures defined in para **3.8** above are to be achieved at the ambient conditions as published by NIWA – specifically the 2.5% 24-hour design weather data for the applicable location. This is further relevant to selection of modern heat pumps, as their heating and cooling capacity depends upon the ambient air temperature which they use as a heat source (or sink) to absorb (or reject) heat from (to).

Occupant Control

3.10. Residential houses and most apartment buildings are normally equipped with openable windows and/or external doors.

3.11. In standard buildings, ventilation rates are achieved by a human response to prevailing climate and building operating conditions by opening or closing doors and windows. A wide range of ventilation effectiveness is achievable through an occupants' ability to open or close external doors or windows to an extent they consider appropriate in response to climatic conditions. This infers that higher or lower ventilation rates can be achieved due to events such as temporary increases in occupancy numbers, periods of high internal moisture, washing and drying clothes etc. A human response also caters for periodic or extraordinary events such as recovery from a water leak within the house or re-habitation of a dwelling after an extended absence.

3.12. However, to ensure the effectiveness of the direct building related measures (refer para **3.3** above) required to allow normal activities such as holding a conversation or listening to television or music to continue without interruption, it is essential that all external doors and windows remain closed during periods of high external noise, regardless of the prevailing ambient conditions.

3.13. If a dwelling is required to operate with all of its external doors and windows closed, this natural ability for residents to manage their own internal environment is lost, and hence must be replaced or replicated by engineered solutions.

Engineered Solutions

3.14. The required engineered solutions fall into two categories: ventilation requirements (in terms of indoor air quality) and thermal comfort (an aspect of indoor environment quality).

3.15. I will look at these two aspects independently, with the aim of identifying any modifications required to the planning rules to ensure minimum standards are established to supplement existing Codes and Standards, so that fundamental indoor air quality and thermal comfort requirements will be met for residential housing, specifically designed and constructed within high noise environments.

3.16. As a point of clarification, Indoor Air Quality (IAQ) specifically refers to the management of the quality of the air within a building, including the presence of pollutants and contaminants. On the other hand, Indoor Environmental Quality (IEQ) is a broader concept that encompasses the overall quality of the indoor environment, including factors such as air quality, thermal comfort, lighting, acoustics, and ergonomics, all of which can impact the health, well-being, and satisfaction of building occupants.

Ventilation

3.17. The purpose of providing ventilation to residential houses is to maintain an acceptable level of indoor air quality and to promote a healthy and comfortable living environment. Ventilation involves the exchange of indoor air with fresh outdoor air to remove pollutants, excess moisture which can lead to mould growth or interstitial condensation, odours, and other contaminants from within the indoor space. Adequate ventilation contributes towards a reduced risk of respiratory illnesses, allergies, and asthma by preventing the build-up of airborne pollutants and allergens.

3.18. The minimum general ventilation requirements for buildings are set out in the New Zealand Building Code, under section G4. The acceptable solution (G4/AS1) requires occupiable spaces to have either an openable window area equivalent to 5% of the floor area (per space), or mechanical ventilation complying with NZS 4303:1990 and AS1668.2:2002. NZBC G4 also requires mechanical exhaust ventilation to cooktops, showers and baths within residential dwellings.

3.19. Consideration is needed to ensure ventilation solutions acknowledge all aspects of NZBC compliance to ensure integrated, practical, and cost-effective solutions are available, taking into account interactions between all ventilation and air conditioning systems within a dwelling – whether they be operating intermittently or permanently.

3.20. Some aspects of ventilation are already covered under existing legislation as per section 1.1.2 of NZ Building Code G4 and referenced standards NZS4303 and AS1668.2:2002. These include:

a) Ventilation for bathrooms and laundries to extract moisture laden air at source.

b) Ventilation for internal toilets to extract foul air.

c) Ventilation for kitchen cooktops to extract cooking smells and contaminants at source.

d) A requirement under NZBC G4 section 1.5.3 that building interiors ventilated by mechanical systems shall maintain positive pressure.

3.21. Having reviewed the S42A Sub-Chapter 14.16 Rules Appendices provided by Christchurch City Council referring to the ventilation requirements as expressed in *"Minimum construction requirements for all Central City zones"*, I note that specific design parameters have not been provided and rely solely on the New Zealand Building Code. These solutions do not address the potential for overheating of the dwelling, or times when additional ventilation could be beneficial.

3.22. Having reviewed the PC5E Appendix 1 dated 20 March 2023, I note that inconsistent ventilation requirements are required depending on the noise source. This may result in inequitable outcomes for differently zoned dwellings and lead to confusion when managing the consenting process.

3.23. Within PC5E Appendix 1 dated 20 March 2023 section 6.1.7.2.1, I note that the proposed rules do not provide specific design parameters and rely solely on the New Zealand Building Code for ventilation, in combination with requiring an air conditioning unit. The only qualifying statement regarding air conditioning is in relation to noise levels generated internally by the air conditioning unit. No qualifying statements are provided to determine an acceptable level of air conditioning to be provided to ensure compliance with the intent of this section.

3.24. Within PC5E Appendix 1 dated 20 March 2023 section 6.1.7.2.3, I note that the proposed rules do not provide specific design parameters or reference the New Zealand Building Code in regard to ventilation. The last rule in this section requires an adjustable air flow rate up to 6 air changes per hour be provided, which is I assume to manage ventilation and overheating simultaneously.

3.25. I propose a common set of rules be applied to residential dwellings to manage ventilation, heating and cooling where openable windows are not appropriate due to external noise. The reasons for this are set out below.

3.26. Where opening windows are not provided or are inadequate to meet the requirements of NZBC G4, supplementary levels of mechanical ventilation (up to 1ACH as per CIBSE Guide A Environmental Design Table 1.5) are proposed on a pro-rata basis relative to the extent of opening windows provided (in relation to the building code requirements). i.e.;

a) Where no opening windows are provided, mechanical ventilation shall be the greater of; 1 air change per hour, or, mechanical ventilation shall be provided in compliance with NZBC G4.

b) Where opening windows are provided that comply with NZBC G4 but are not appropriate to be open due to external noise sources, mechanical ventilation shall be provided in compliance with NZBC G4.

3.27. Overheating of internal spaces due to climatic conditions and/or internal heat generation has historically been managed by the home occupants via opening windows. Where windows are inadequate (less than 5% of floor area), cannot be physically opened, or external noise levels dictate that windows cannot be opened without compromising living standards, it is accepted that some additional form of climate control (cooling) is required to achieve acceptable indoor air temperatures.

3.28. I note that even where increased amounts of outdoor air ventilation are provided (i.e. 3+ air changes per hour), internal space temperatures will not necessarily be considered comfortable during periods of high temperature weather. Even where large quantities of outdoor air ventilation are provided, it is likely that internal space temperatures will rise above external temperatures due to factors such as solar gain (sunlight entering through glazed elements of the building and heating up internal features) and internal heat loads typically generated by electrical appliances and people within the building.

3.29. I recommend that the proposed internal space temperature limits in the proposed rules are achieved based upon an agreed weather condition. I propose designers are required to use a 2.5% design weather dataset (i.e. 24 hour data as published by NIWA) for ensuring heating and cooling solutions work appropriately for the geographic location. This requires the designer to select a heating or cooling device which could maintain the internal space temperature between 18-25°C year-round, based upon a regionalised historical outside air temperature which would not be exceeded more than 2.5% of the duration of a typical year.

Cooling

3.30. Temperature Control falls within the Indoor Environmental Quality sphere. Proper ventilation can also assist with regulating indoor temperatures by allowing the exchange of indoor air with the outside air, particularly during moderate seasons.

3.31. Overheating of internal spaces due to climatic conditions and/or internal heat generation has historically been managed by the home occupants via opening windows. Where windows are inadequate (less than 5% of floor area), cannot be physically opened, or external noise levels dictate that windows cannot be opened without compromising living standards, some additional form of climate control is required to achieve acceptable indoor air temperatures.

3.32. Even with significantly elevated ventilation rates (6-8 air changes per hour), it is inevitable that dwellings will overheat (above 25°C indoor temperature) during warm clear days, when the windows will be closed, in order to achieve the required reduction in external to internal noise levels. I believe that air conditioning, providing mechanical cooling, will be required to maintain acceptable indoor air temperatures.

3.33. I propose that the rules include provision to install air conditioning system(s) to ensure year-round comfort conditions can be maintained in all affected habitable rooms within the prescribed ambient conditions. The air conditioning will operate simultaneously with the prescribed minimum rates of outside air ventilation. Note that high rates of ventilation are incompatible with the operation of air conditioning equipment.

4. CONCLUSION

4.1. If windows must be closed to achieve the design noise levels, I recommend that the building is required to simultaneously achieve acceptable levels of indoor air quality (to ensure the creation of lifelong healthy homes), ensure minimum levels of comfort (Internal temperatures of 18°C – 25°C), and ensure the heating, cooling and ventilation systems maintain acceptable internal noise levels.

4.2. My recommendations for achieving these outcomes for heating, cooling and ventilation are set out in the executive summary.

Dated 18 September 2023

Jonathan Selkirk

APPENDIX – ADDITIONAL INFORMATION

Indoor Air Quality vs Indoor Environmental Quality

- Indoor Air Quality (IAQ) and Indoor Environmental Quality (IEQ) are related but distinct concepts that refer to different aspects of the indoor environment. While both are concerned with the well-being of occupants within buildings, they focus on different parameters and factors. Here's the difference between the two:

Indoor Air Quality (IAQ):

- Indoor Air Quality specifically refers to the 'quality of the air' within a building or enclosed space. It focuses on the presence and concentration of various pollutants and contaminants in the indoor air that can affect the health and comfort of occupants. Common indoor air pollutants include:

  - Particulate matter (e.g., dust, pollen)
  - Volatile organic compounds (VOCs) from building materials and household products
  - Carbon dioxide (CO_2) from human respiration
  - Mold
  - Bacteria / viruses
  - Allergens

Improper ventilation, the use of certain products or materials, and the presence of pollutants from external sources (e.g., traffic, industrial emissions) or internal sources (bacteria / viruses) can all contribute to poor indoor air quality.

IAQ management involves strategies such as proper ventilation, air filtration, air cleaning, source control of contaminants and the use of low-emission building materials.

Indoor Environment Quality (IEQ):

- Indoor Environmental Quality is a broader concept that encompasses various factors contributing to the overall ‘quality of the indoor environment’, beyond just air quality. IEQ takes into account not only indoor air quality but also factors such as thermal comfort, lighting, acoustics, and ergonomic considerations within the space. IEQ recognizes that multiple elements of the indoor environment interact and influence the well-being, productivity, and comfort of building occupants. In addition to addressing IAQ issues, IEQ initiatives may focus on:

    - Ensuring proper temperature levels are maintained
    - Ensuring proper humidity levels are maintained
    - Providing adequate and well-designed lighting and natural daylighting
    - Minimising noise pollution
    - Creating ergonomic and comfortable spaces for occupants