

Before the Queenstown Lakes District Council

In the Matter of **the Resource Management Act 1991**

And

In the Matter of **the Queenstown Lakes District Proposed Plan
(Chapter 36)**

**Statement of Evidence of Sheridan Scott
Roberts for Queenstown Airport
Corporation Limited (Submitter 433 and
Further Submitter 1340)**

Dated: 2 September 2016

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INTRODUCTION

Qualifications and Experience

1. My name is Sheridan Scott Roberts.
2. I am a professional Building Services Engineer, and I am employed by, and a director of, Jackson Engineering Advisers Ltd. I hold a Business and Technology Education Council Higher National Diploma in Heating Ventilation and Air Conditioning gained in the United Kingdom. I am a full member of IPENZ, a Chartered Professional Engineer (CPEng), registration number 155746, and I am a full member of the Chartered Institution of Building Services Engineers. I have over 30 years' experience in the building services industry, 27 of which have been in New Zealand. I have been practicing as a professional engineer since 2006.
3. I have formerly been a full member of the Institute of Refrigeration, Heating and Air Conditioning Engineers New Zealand (IRHACE), and have served a governance role for 12 months on the IRHACE Council, being Councillor for Membership. Prior to this I also held office as Chair for the Hawke's Bay branch for several years.

Code of Conduct

4. I confirm that I have read the Environment Court's Code of Conduct for Expert Witnesses and have prepared my evidence in accordance with it. Specifically, I confirm that the issues addressed are within my area of expertise. I have not omitted to consider any material facts known to me that might alter or detract from the opinions I express.

SCOPE OF EVIDENCE

5. My evidence will address the following:
 - (a) Detail the background of my involvement with and QAC's submission on Rule 36.6.3, Table 5 of the Proposed District Plan;
 - (b) Describe the amendments sought to Proposed Rule 36.6.3, Table 5, as per QAC's Submission;
 - (c) Address the Section 42A Report, Dr Chiles' evidence and other submissions;

- (d) Set out my recommendations and conclusions.

References

- 6. In preparing my evidence, I have reviewed the following:
 - (a) Appendix 13 of the QLDC Operative District Plan (as amended by Plan Change 35);
 - (b) QLDC Proposed District Plan, in particular Proposed Chapter 36 (Noise), specifically Rule 36.6.3 Table 5, (Ventilation Requirements for Queenstown and Wanaka Airports);
 - (c) Section 42A Hearing Report dated 17 August 2016, in particular paragraphs 8.62 – 8.64 of this report;
 - (d) Statement of Evidence of Dr Stephen Gordon Chiles, Acoustic Engineer, dated 17 August 2016, in particular paragraphs 14.8 – 14.12;
 - (e) The submission of QAC dated 23 October 2015;
 - (f) The submission of David Jerram (Submitter 80);
 - (g) New Zealand Building Code, in particular clause G4 'Ventilation, Acceptable Solutions and Verification Methods', Third Edition;
 - (h) New Zealand Standard NZS4303:1990 'Ventilation for Acceptable Indoor Air Quality';
 - (i) Australian Standard AS1668.2:2002 and 2012 'The use of ventilation and air conditioning in buildings - ventilation design for indoor air contaminant control';
 - (j) IRHACE / AIRAH Joint Handbook (Second Edition), in particular Section 9, Recommended Design Sound Levels for Areas of Occupancy in Buildings, reproduced from AS2107:1987;
 - (k) The evidence of Christopher Day, dated 2 September 2016 (in draft form).

EXECUTIVE SUMMARY

7. The key findings from my evidence are that:
- (a) QAC, QLDC and Submitter 80 agree that notified Rule 36.6.3 is unsatisfactory and requires amendment;
 - (b) There is general agreement as to how Rule 36.6.3 should be redrafted, subject to matters of detail;
 - (c) I generally support the recommendations of Dr Chiles, including his re-formatting of the Rule, as set out in his evidence and Appendix 1 of the Section 42A Report, but consider some additional refinements are required, to ensure the rule is clear, unambiguous, and practical to implement;
 - (d) The further refinements I consider are required relate to:
 - (i) the minimum and maximum air change requirements;
 - (ii) ensuring the ventilation system heats as well as cools;
 - (iii) ensuring the ventilation system includes an air relief path; and
 - (iv) ensuring the rule clarifies that existing plant may be used to achieve compliance;
 - (v) other minor matters of clarification.

BACKGROUND OF INVOLVEMENT AND QAC'S SUBMISSION ON PDP

8. I was engaged by Queenstown Airport Corporation Limited (**QAC**) during 2014 to review the ventilation requirements contained within Appendix 13, Table 2, of the Operative District Plan (**ODP**) (as amended by PC35). I understand Appendix 13 of the ODP is replicated in Rule 36.6.3, Table 5 of the PDP.
9. I understand the purpose and intent of Appendix 13 in the ODP, and similarly, of Rule 36.6.3, Table 5 of Chapter 36 in the PDP, is to describe the requirement to provide a heating and ventilation system to provide for a comfort amenity that is similar to that which could be experienced if the home owner was free to open their windows and doors.

10. From my review of Appendix 13 it became apparent that there are a number of practical difficulties with implementing, and financial implications with using, a mechanical system in accordance with the Appendix.
11. More particularly, from my review work, and, I understand, from QAC's implementation of mechanical ventilation in accordance with its obligations under the designation, it has become apparent that in a climate such as Queenstown, strict compliance with Appendix 13 may result in the need for large ventilation systems with multiple fans and heating systems.
12. Specifically:
 - (a) The range in airflow rates of 1-15 air changes per hour cannot be achieved by a single fan. A fan capable of delivering 15 air changes per hour cannot readily achieve 1 or even 2 air changes per hour, so multiple fans would likely be required.
 - (b) Since high and low settings for Bedrooms and other Critical Listening Environments are different by a factor of 3, in order to strictly comply with Table 5, separate systems are required for each.
 - (c) Table 5 indicates a requirement of heating the air supplied by 18^oC above the prevailing outdoor air temperature. The specified heating may not warm the incoming air sufficiently in winter. If it is -5^oC outside, as it can be in the Queenstown Basin, the ventilation air could be supplied into the home at 13^oC, which is insufficient without other forms of room heating.
 - (d) The high setting airflow requirement of 15 air changes per hour in living areas may result in large / noisy fans with similarly large ductwork and grilles. These may be costly and difficult to conceal.
 - (e) Supply air only (with no balanced exhaust air) may pressurise the house, and may detrimentally affect the operation of other flued combustion appliances, such as wood burners etc.
 - (f) Such ventilation systems require bespoke design for every home to which they are applied, ideally from persons more qualified than typical contractors, which may result in additional cost.

- (g) The need for 15 air changes per hour is unnecessary in Queenstown's climate. The minimum ventilation requirements for homes as referenced under Clause G4 of the NZ Building Code is 0.35 air changes per hour, all year around. This requirement is aimed at minimising condensation and removing odours. My assumption is that the requirement in Appendix 13 (and Proposed Rule 36.6.3, Table 5) for 15 air changes per hour is intended to provide some thermal comfort by introducing a larger volume of potentially cooler air from outdoors into a room which may at times become overly warm due to the closure of windows and doors. However, even with this elevated air change rate, there may be a limited quantity of "cooling" available, for example during a hot Queenstown summer, when the outdoor air delivered to inside is warm, so it will provide little cooling, if any, no matter what the air change rate.
13. In summary, Appendix 13 of the ODP/Proposed Rule 36.6.3, Table 5 of the PDP appear to have been modelled upon earlier specifications developed for a more temperate climate such as Auckland, rather than specifically designed for the more extreme climate of Queenstown. The specifications stated in the Rule are now outdated, noting at the time the rule was written, it was more normal for homes to include heating and ventilation, but not cooling. With the advent of domestic heat pumps, it is becoming much more usual to see heating and cooling installed into homes.
14. Given my findings, as summarised above, in 2015 QAC requested my advice as to how the mechanical ventilation rule should be amended to address the issues identified. I understand my advice formed the basis of QAC's submission on Rule 36.6.3, Table 5 of the PDP.

RECOMMENDED AMENDMENTS TO NOTIFIED RULE 36.6.3 AS PER QAC'S SUBMISSION

15. Based on the findings of my review, my recommendations were that, to provide adequate ventilation and thermal comfort all year round, the mechanical ventilation system needs to encompass the following:
- (a) The ability to provide low air volume of ventilation particularly during winter;

- (b) The ability to increase the ventilation rate to provide some passive cooling when required, although this should be optional;¹
 - (c) The ability to provide some heating such that cold incoming air does not cool down the spaces it serves, (a potential issue particularly in the winter);
 - (d) The ability to provide some cooling so that warm incoming air does not heat up the spaces it serves;
 - (e) Achieve all of the above safely, bearing in mind there may be combustion appliances contained within the home; and
 - (f) Achieve all of the above within specific noise level criteria.
16. In addition, I consider it is appropriate to clarify in any rule that heating, ventilation or cooling systems need not be duplicated, where they are already present and satisfy above stated requirements.
17. Accordingly, my recommendation was that Rule 36.6.3, Table 5 of the PDP be amended so to:
- (a) Reduce the high setting air changes so that there is no difference between Bedrooms and other Critical Listening Environments, for the purposes of rationalising the type, physical size and quantity of separate ventilation systems required to comply, and that those ventilation systems can readily achieve the difference between high and low setting air flow rates;
 - (b) Provide the ability to use more modern and efficient plant, including heat pump air conditioning units; and
 - (c) Simplify the system design in order that it can be readily designed to comply by local contractors.
18. In accordance with my recommendations, QAC's submission on the PDP (specifically, Annexure D) presents two alternative solutions which are intended to meet the above criteria.

¹ This is because the cooling function will be provided by the heat pump, so elevated ventilation rates will not need to be relied on for such purposes. In fact, introducing a higher air change rate of warm outdoor air will increase the load on the air conditioning system, make it work harder and use more energy.

19. The presentation of two options is aimed at providing flexibility to designers/homeowners, and the ability to choose a number of modern technologies to meet the objectives.
20. The key differences between notified Rule 36.6.3, Table 5 and Annexure D of QAC's submission include:
 - (a) A maximum air change rate of 5 air changes per hour. As explained earlier in my evidence (refer paragraph 12(a)), I consider this is appropriate because any requirement for a greater range of air delivery rate (between low and high setting) will be difficult to achieve efficiently by a single fan, with currently available technology. To further explain, if the required low ventilation rate is less than 1 air change per hour, and the required maximum ventilation rate is greater than 5 air changes per hour, it is likely that a second fan per ventilation system, or a complex air flow control system will be required, with attendant maintenance and operating costs.
 - (b) A low setting air change rate of 0.5 air changes per hour, which is appropriate in that it minimises the amount of additional heating and associated costs to the homeowner.
 - (c) Clarification that if the home is provided with an air conditioning heat pump, there is no need to provide a high setting air flow into the space(s) served. This is because the cooling function will be provided by the heat pump, so elevated ventilation rates will not need to be relied on for such purposes. In fact, introducing a higher air change rate of warm outdoor air will increase the load on the air conditioning system, make it work harder and use more energy.
 - (d) The introduction of a second option for providing ventilation (Option 2 in Annexure D of QAC's submission). Option 2 can be satisfied by the provision of a ducted type heat pump which will deliver the low setting air change rate, whilst simultaneously allowing it to be heated or cooled, or neither. This system provides minimum outdoor air to satisfy the low setting requirements, yet will have increased air circulation rate which more closely approaches the high setting requirements. The ducted heat pump distributes air to

the critical areas via a series of grilles. The occupier has the option of three operating modes:

- (i) Ventilation only – this provides outside air to a space (i.e. Critical Listening Environment), supplied at a low setting rate, with a higher circulation rate;
- (ii) Heating mode – the occupier sets the heat pump into heating mode and this will increase the supply air temperature to provide heating of the supply air, and targets a minimum room temperature of 18°C; and
- (iii) Cooling mode – the occupier sets the heat pump into cooling mode and this will decrease the supply air temperature to provide cooling of the supply air, and targets a minimum room temperature of 25 °C.

RESPONSE TO SECTION 42A REPORT, EVIDENCE AND SUBMISSIONS

- 21. Dr Chiles, on behalf of QLDC, has recommended that Rule 36.6.3, Table 5 of the PDP be amended in response to submissions, albeit it in a manner different to that sought by QAC in Annexure D of its submission.
- 22. In making his recommendations, Dr Chiles relies on the recommendations contained in Beca's 2014 report² prepared for NZTA. I note, this report was not specifically written for the Queenstown environment and climate.
- 23. Accordingly, while I agree that the recommendations contained within the Beca report (as applied in Appendix 1, Rule 36.6.3 of the Section 42A Report) are of general relevance presently, I consider some further amendments are required to the Rule to ensure the characteristics of the local environment are appropriately recognised and addressed.
- 24. I address these, and some other amendments I consider are necessary, below.

² Ventilation Systems Installed for Road-traffic Noise Mitigation – Prepared for NZ Transport Agency by Beca Ltd, 26 June 2014.

**POINTS OF DIFFERENCE/FURTHER RECOMMENDED AMENDMENTS TO
RULE 36.6.3**

25. Rule 36.6.3 in Appendix 1 of the Section 42A Report includes three clauses, ((i), (ii) and (iii)), which I understand are derived from the recommendations set out in Dr Chiles' evidence.
26. I accept that the revised rule appears, on the face of it, generally more straightforward to apply, whilst at the same time providing some flexibility in terms of compliance than both the notified rule, and QAC's modified version in Annexure D of its submission. I am therefore generally supportive of the Section 42A revisions, excepting the following:
- (a) The reference to clause G4 of the NZ Building Code, which I do not consider is appropriate;
 - (b) The requirement for the ventilation system to achieve at least 6 air changes per hour, as opposed to the 5 air changes sought in Annexure D of QAC's submission;
 - (c) The omission of a heating requirement;
 - (d) The omission of a requirement to provide an air relief path; and
 - (e) The omission of other points of clarification as set out in QAC's Annexure D.
27. I address each of these below.

Reference to NZBC

28. In my opinion, the ventilation rates stated in the Rule 36.6.3 should not be linked to the provisions of the New Zealand Building Code, since the intent of these two documents is different. The NZBC clause G4 is in place to control mould and moisture within buildings, whereas Rule 36.6.3 of the PDP is intended to provide ventilation and thermal comfort within buildings in circumstance where windows must remain closed to mitigate external noise. Whether new construction or alteration of an existing dwelling, NZBC G4 has to be met by law in any event.

29. I also note that clause G4 NZBC presents two options for achieving compliance: providing ventilation as stated in the clause, or opening windows.³ Reference to clause G4 NZBC in Rule 36.6.3 therefore has the potential to cause confusion, in circumstances where ventilation is required for the very reason that windows can not be opened.
30. Accordingly, I consider it preferable to expressly state in the Rule the low air change rate that must be achieved, in a similar manner to that stated in clause (ii) of the revised Rule. I recommend that it this be specified within the range of 0.35 to 0.5 air changes per hour. The lower bound (0.35 air changes) allows an existing ventilation system designed to comply with clause G4 of NZBC to be utilised for the purposes of satisfying this rule. The upper bound (0.5 air changes) provides some flexibility for a slightly higher ventilation rate, without creating a draughty environment (which is important in cooler weather).

High Air Change Rate

31. I note that the air flow rate stated in Appendix 1 of the Section 42A Report is 6 air changes per hour, which is similar to the 5 air changes per hour in my recommendation (as per QAC's Annexure D). As noted in paragraph 20(a) above, 5 air changes per hour is recommended to avoid the need for additional equipment, and increased operating costs.
32. As also noted in paragraph 20(a), based on current technology, where ventilation is required to be provided across a wide range of air change rates, such as the 1 – 6 air changes per hour recommended by Dr Chiles/in the section 42A Report, it is likely that a second fan, or a complex air flow control system will be required, with attendant maintenance and operating costs. These costs are disproportionate to any benefit, in my view.
33. As noted in paragraph 20(c) above, if a heat pump cooling system is provided, there is no need to provide the high setting air change rate. This should be stated in the Rule. To further explain, I agree that cooling is required for the provision of thermal comfort during summer conditions. However, in the situation where air conditioning is provided, then the

³ For compliance the window opening area must be greater than 5% of the floor area for each space.

elevated ventilation rate is not required and may actually reduce the cooling effect.

34. These two provisions (high air change rate and cooling) could be presented as either/or options for the designer/homeowner, but should not not go hand in hand.

Omission of Heating Requirement

35. Clause (iii) of the Section 42A revised Rule does not specifically state that in addition to cooling, a heating function is required for any ventilation system. I assume this is an error, as heating is required under the notified Rule, which I consider is appropriate to ensure appropriate thermal comfort amenity is achieved. Refer paragraphs 12(c) and 15(c) for my reasons.

Omission of Air Relief Path Requirement

36. The revised Rule (as set out in Appendix 1 of the Section 42A report) does not address the issue of the proper operation of combustion appliances contained within the home, as previously discussed in my evidence (refer paragraph 12(e) and 15(e)).
37. In order to ensure that combustion appliances can operate safely under the high air change requirement, additional passive relief venting is required to allow air to pass out of the home, rather than pressurise the home or be forced up chimneys or flues. This will also ensure the ventilation system operates with the intended air flow rates.

Recognition of Existing Systems

38. I consider there is no need to duplicate heating, ventilation or cooling systems where they are already present and satisfy the requirements of the Rule. This should be stated in the Rule.

Summary of Differences

39. Provided that all of the above are addressed, Rule 36.6.3 as set out in Appendix 1 of the Section 42A Report is not dissimilar to Option 2 in Annexure D of QAC's submission, and with the further amendments discussed above, would be a preferable alternative, in my opinion. Option 1 in Annexure D of QAC's submission could be deleted since the revised

Rule as discussed above and in paragraph 40 below would encapsulate both Option 1 and Option 2.

40. I understand that Kirsty O'Sullivan will present a revised Rule, which addresses the issues I have just outlined, by incorporating further amendments as necessary. I have reviewed these further amendments in draft form and consider them to be appropriate.

CONCLUSION

41. In the interests of keeping Rule 36.6.3 simple and unambiguous, I consider there is merit in deleting Option 1 from Rule 36.6.3, Table 5 as set out in Annexure D to QAC's submission, and instead adopting the approach recommended by Dr Chiles, as set out in Appendix 1 to the Section 42A Report, subject to incorporating the further amendments detailed in my evidence above.
42. I consider this will address the difficulties encountered with operative mechanical ventilation requirements (Appendix 13 of the ODP), and hence notified Rule 36.6.3, whilst at the same time providing residents with an appropriate level of comfort and amenity.
43. I consider the alternative options (being the notified Rule and the Section 42A revision of it) will likely be more costly to implement, with no real additional benefit, and will be less efficient and effective.

Sheridan Scott Roberts

2 September 2016