BEFORE INDEPENDENT HEARING COMMISSIONERS
AT PORIRUA

I MUA NGĀ KAIKŌMIHANA WHAKAWĀ MOTUHAKE
KI PORIRUA

IN THE MATTER	**of the Resource Management Act 1991**
AND	
IN THE MATTER	**of the hearing of submissions on the Proposed District Plan and Variation 1**

HEARING STREAM: **Hearing Stream 7 – Variation 1; Plan Change 19; Residential; and Commercial Zones**

STATEMENT OF PRIMARY EVIDENCE OF MARTIN GLEDHILL ON BEHALF OF KĀINGA ORA – HOMES AND COMMUNITIES

(ELECTROMAGNETIC FIELD SAFETY)

24 FEBRUARY 2023

Instructing solicitor:
C E Kirman
Special Counsel
Kāinga Ora - Homes and Communities
PO Box 14594
Central Auckland 1051
E: claire.kirman@kaingaora.govt.nz

Counsel Instructed
N M H Whittington
Hawkestone Chambers
PO Box 12091
Thorndon
Wellington 6140
E. nick.whittington@hawkestone.co.

1. EXECUTIVE SUMMARY

1.1 The Radio New Zealand (RNZ) Titahi Bay transmitter can potentially create hazardous levels of electromagnetic fields (EMFs) in publicly accessible areas that could cause health effects, both through direct exposure to the fields, and also through contact with metal objects exposed to them.

1.2 Exposure standards, such as NZS 2772.1:1999 *Radiofrequency Fields Part 1: Maximum exposure levels – 3 kHz to 300 GHz* set limits to protect against these hazardous fields and their health effects.

1.3 The submissions from RNZ, including the technical material provided, are insufficient to support the distance and height controls they propose for the area around the transmitter. They do not appear to be based on an analysis of likely EMF levels and how they relate to the limits in exposure standards.

1.4 The proposal to require detailed EMR assessments for new developments at heights greater than 10 m in the 528-1027 m zone, and for the use of a crane or elevated work platform taller than 10 m in the 212-1027 m zone, could add significant costs to any development.

1.5 While interference with domestic electronic equipment may be a genuine problem in the area, it is not clear that the proposed controls are necessary to overcome such problems, or whether other approaches such as including information on the LIM may better.

1.6 In my opinion, any height or other controls based on distance from the transmitter should be supported by a more rigorous analysis of likely EMF field levels in order to ensure that any controls do, in fact, protect against potential health effects but are not overly restrictive. This analysis should be supplemented by design and construction guidelines for the areas potentially affected to prevent hazardous exposures.

2. INTRODUCTION

2.1 My name is Martin David Gledhill. I have an MA degree in Natural Sciences (Physics) and an MSc in Medical Physics. I am a member of the Australasian Radiation Protection Society and of the Bioelectromagnetics Society (recently renamed BioEM). I serve on the Standards New Zealand/Standards Australia committee on "Human exposure to electromagnetic fields" which develops exposure assessment standards and also on the Institute of Electrical and Electronic Engineers (IEEE) International Committee on Electromagnetic Safety (ICES), which develops EMF assessment and safety standards internationally.

2.2 I am a Director of Monitoring and Advisory Services NZ Ltd (MAASNZ), which through its EMF Services division provides measurement and advisory services related to possible health effects of electromagnetic fields (EMFs). These services are provided to central and local government (including the Ministries of Health and the Environment), the public and industry. Before forming MAASNZ in 2011 I was head of the non-ionising radiation section at the National Radiation Laboratory of the New Zealand Ministry of Health, where my role was similar to what it is now. Both with the Ministry of Health and with my own company my work has included the assessment of electromagnetic fields around AM radio transmitters of the type at the Radio New Zealand (RNZ) Titahi Bay site.

2.3 I have been asked by Kainga Ora to review the material prepared by RNZ supporting its submission as to how development of land around the Titahi Bay site should be constrained in order to avoid any hazards posed by EMFs from the RNZ transmitter.

Code of Conduct

2.4 Although this is a Council hearing, I have read the Environment Court's Code of Conduct 2023 and agree to comply with it. My qualifications as an expert are set out above. I confirm that the issues addressed in this statement of evidence are within my area of expertise unless stated

otherwise. I have not omitted to consider material facts known to me that might alter or detract from the opinions that I express.

Scope of Evidence

2.5 My evidence will address the following matters:

(a) The nature of the hazards that could be created by the EMFs from the RNZ transmitter at the Titahi Bay site;

(b) EMF exposure standards and how they set limits to protect against potential hazards;

(c) Gaps in the information provided by RNZ to support the development constraints that they propose;

(d) The nature of the information that would need to be provided in order to meet the RNZ "site-specific and construction-materials specific EMR assessment" "temporary structure assessment" requirements proposed by RNZ, and the likely cost of undertaking this; and

(e) Reverse sensitivity caused by interference with household technology.

2.6 In preparing my evidence I have reviewed:

(a) The RNZ submission and associated attachments;

(b) The Council's s42A report analysing the RNZ submission, and the related recommendations; and

(c) Aerial and Street View photographs of the site and its surroundings.

2.7 I have discussed this material with Mr Ric Tell of Richard Tell Associates Inc in the USA. Mr Tell has several decades of experience in electromagnetic field safety and has authored numerous peer-reviewed scientific papers in this area. He is a highly regarded expert with more than fifty years' experience in the field of non-ionising radiation safety. I asked Mr Tell to prepare some calculations of EMF

levels in the vicinity of the Titahi Bay transmitter as he has access to a software programme (NEC v. 4.2) which calculates the strength of EMFs. I have relied on these calculations as set out in section 3 of my evidence.

3. SUBMISSIONS

Nature of potential hazards

3.1 The nature of potential hazards posed by EMFs at frequencies around 1 MHz, such as those produced by the RNZ Titahi Bay transmitter, are usually divided into two types: direct effects and indirect effects.

3.2 Direct effects are caused by direct interaction between the EMFs and the body. At frequencies around 1 MHz, two types of direct effect may occur: absorption of power from the electromagnetic fields that may, if the EMFs are sufficiently strong, cause the body temperature to increase, and the induction of electric fields and currents inside the body that may interfere with nerve activity. (These effects are referred to in the RNZ submission as thermal and athermal effects).

3.3 Indirect effects are mediated by an electrically conducting object in the environment. For example, a large metal object that has no electrical connection to ground (such as a car with electrically insulating tyres) in an electromagnetic field accumulates electric charge. If someone who is electrically earthed touches that object the electric charge will flow to ground through the point of contact. This could cause an electric shock or a burn at the point of contact. The severity of the shock or burn depends on the magnitude of the electromagnetic field and the size of the object. In the same way, if an ungrounded person touches a grounded metal object, there may also be a shock or burn at the point of contact.

3.4 The RNZ submission describes the possibility of both direct and indirect effects occurring at distances of up to 1057 m from the mast.

Exposure standards

3.5 Standards have been developed that limit exposures to levels that would not cause any health effects. In New Zealand, there is a standard NZS 2772.1:1999 *Radiofrequency Fields Part 1: Maximum exposure levels – 3 kHz to 300 GHz*, which follows recommendations from the International Commission on Non-Ionising Radiation Protection, a scientific body that is recognised by the World Health Organisation for its independence and expertise in this area. IEEE-ICES also develops exposure standards, and standards providing methods to assess exposures in relation to limits.

3.6 These exposure standards provide two types of limits. *Basic restrictions* set fundamental limits on quantities that are directly related to the interaction between the electromagnetic field and the body. At frequencies around 1 MHz, NZS 2772.1 sets basic restrictions on absorption of power and on currents induced in the body. Compliance with the standard means that the basic restrictions should not be exceeded.

3.7 As assessment of exposures against the basic restrictions is often difficult (for example, there is no equipment that can be used in the field to measure absorption of power) the standards also provide a second set of limits, referred to as *reference levels*. These are given in terms of quantities that are more readily measured or calculated, such as the strengths of the electric and magnetic fields that make up the electromagnetic field. The reference levels are derived from the basic restrictions and are set so that compliance with the reference levels ensures compliance with the basic restrictions. If the reference levels are exceeded, this does not necessarily mean that the basic restrictions have also been exceeded. However, a more detailed analysis (for example, by using computer modelling) would be necessary to verify compliance with the basic restrictions.

3.8 The reference levels are typically based on worst-case assumptions about the circumstances of the potential exposure, and in some situations may be very conservative. Nevertheless, in practice

reference levels are generally used as the yardstick for determining compliance of broadcast transmitters.

3.9 At frequencies around 1 MHz, NZS 2772.1 provides reference levels for:

(a) Incident electric fields;

(b) Incident magnetic fields;

(c) Contact currents.

The first two of these protect against direct effects, and the third against indirect effects.

Gaps in information provided by RNZ

3.10 I have read the RNZ submission of 12 September 2022, in particular Appendix A of that submission and Attachment 3 to Appendix A. Attachment 3 provides the technical basis for the rule changes proposed by RNZ.

3.11 In my opinion the information provided in Attachment 3 is insufficient to demonstrate the necessity for the proposed rules, or to determine whether the proposed rules do, in fact, adequately protect health and safety. I understand that the PCC did not seek any independent review of the information provided by RNZ, and the author of the s42A report relied upon the RNZ information in his assessment (that largely accepted the RNZ proposals).

3.12 As an example, it is not clear from the information why the very precise distances of 528 m and 1057 m have been selected to delineate what I will refer to as the “inner” and “outer” zones around the transmitter. The only clue given in Attachment 3 is that these distances correspond to one and two wavelengths from the transmitter. While the longest wavelength station broadcast from the Titahi Bay site is indeed about 528 m (the shortest wavelength broadcast from the site is about 290 m) other factors, such as the power of the transmitters, would have a far greater influence on the level of EMF exposure, and potential contact currents, as a function of distance from the site. Transmitter power

does not appear, however, to have had any influence on the determination of the distances.

3.13 It is also not clear why a difference of one metre in building height, between 10 m and 11 m, should be so critical in determining whether exposures are likely to comply with the limits or not, all the way from 200 m from the site (distance of the closest house) to 1057 m from the site. One of the key factors in determining compliance is the strengths of the electric and magnetic fields. Figure 1 shows the electric and magnetic field strengths 1 m above ground level as calculated by Mr Tell (based on the mast height of 137 m and the licensed transmitter powers taken from the Radio Spectrum Management licensing database). These suggest that the electric field strength decreases by a factor of about 4.5 between 200 m and 1000 m, and the magnetic field strength by a factor of about 6.7.

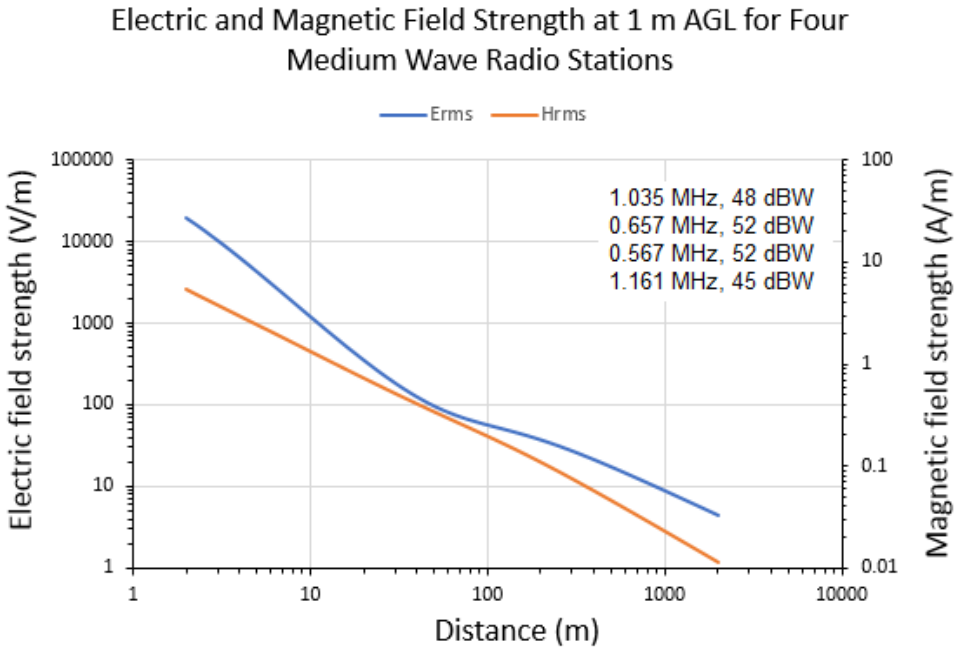

Figure 1. Calculated electric and magnetic field strengths as a function of distance from the RNZ Titahi Bay transmitter, based on a mast height of 137 m and the licensed transmitter powers and frequencies.

3.14 Figure 2 shows Mr Tell's calculations of the variation in field strengths for the 567 kHz transmitter as a function of height, at a distance of 100 m from the mast. These show that there is little difference in the strengths of the fields between 10 m and 11 m above the ground. The

same would be expected at greater distances and at the other frequencies.

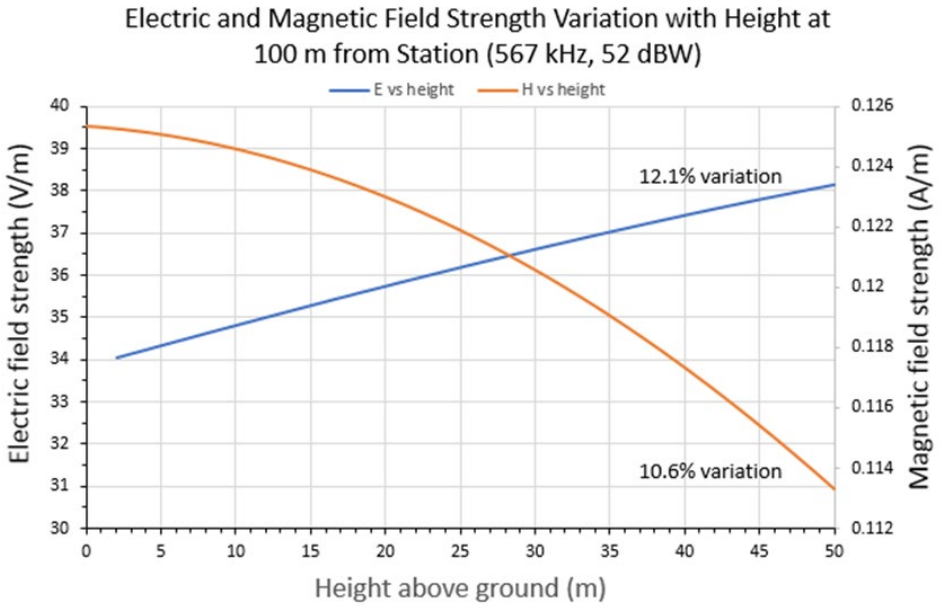

Figure 2. Electric and magnetic field strengths for the 567 kHz RNZ Titahi Bay transmitter with a power of 52 dBW.

3.15 In view of these results, I am unable to understand why it is proposed that the height rules change by only one metre between the inner and outer zones, or assess whether those height limits ensure that exposures do not exceed the limits or are unduly restrictive. This is not explained by RNZ's Attachment 3.

3.16 I acknowledge that Mr Tell's calculations are relatively basic, and do not, for example, take into account localised enhancement of the fields that may occur close to tall metal structures. This enhancement is caused by such structures reradiating some of the energy incident upon them. Nevertheless, the amount of reradiation will vary in proportion to the strength of the incident field, and so the variations in total field strength will be similar to those derived from Figure 1, and show a similar decrease with distance from the RNZ mast.

3.17 There are well developed computer programs, such as that used by Mr Tell, used to calculate electromagnetic fields. I have seen the results of calculations performed by RNZ using such a program at another of their transmitter sites, in order to determine the field

enhancement near a cellsite tower close to that site. In my opinion, the height and other rules proposed by RNZ should be based on the more robust analysis provided by such calculations, rather than the very limited information provided in Attachment 3. I would expect the details and methodology of the assessment to be explained before basing a restrictive planning framework on that assessment. To be clear, I am not saying that the planning framework is in fact too restrictive, just that the proposed framework is not explained by the material and analysis RNZ has provided.

3.18 Potential hazards posed by the contact currents arising from indirect effects (described in paragraph 3.3 of my evidence) are less amenable to computation. However, there is some published research literature on the subject that enables the magnitude of contact currents to be estimated and hence to decide the circumstances under which they might exceed limits.

3.19 In summary, in my opinion the technical material provided by RNZ is insufficient to justify the proposed height and distance rules for the inner and outer zones. Rather, the distance to the boundary between the zones, and for the extent of the outer zone, and the height rules proposed, appear somewhat arbitrary.

Information needed for EMR assessments in the inner and outer zones

3.20 RNZ propose that “all temporary structures and use of cranes with a vertical height greater than 10 m to be subject to a site and equipment-specific EMR assessment and specific work practices to mitigate EMR risks.” They also propose that in the outer zone, “the design of any structure above 10 m (two storeys) in height must include a site-specific and construction materials-specific EMR assessment to ensure the structure does not affect transmission propagation nor expose construction workers or occupants to EMR above NZ standards”.

3.21 Preparation of these assessments will require very specialist knowledge and experience that is not widely available in New Zealand. It would normally involve use of the computer programs such as the one

used by Mr Tell, with the specific site information included as input data. Assessing the effects of buildings on propagation of the transmissions from the RNZ site would involve additional computer modelling. Construction workers may require specialised training, and measurement equipment to verify exposure levels on site.

3.22 It is difficult to estimate the cost of these requirements but I would hazard a guess that they could be in the region of $5-10,000 on each occasion. These assessments would need to be reviewed by qualified individuals, which would add further costs.

3.23 If a detailed analysis does support the need for particular care with construction design and methods to ensure EMF safety at particular heights and/or distances, an alternative to requiring an EMR assessment for each individual development would be to provide guidance on what building designs, and construction methods, would ensure EMF safety. Development of such guidance would require additional work, but could then be applied to many developments rather than each development having to undertake the same work.

3.24 I would not like to presuppose what those designs and methods would involve, but simple examples might include:

(a) Metal roofs to be electrically grounded in some specified number of locations;

(b) No metal downpipes;

(c) No corrugated iron or other metal cladding;

(d) Cranes and elevated work platforms to be grounded;

(e) If cranes taller than a specified height are to be used, construction staff must wear dry leather gloves to avoid shocks and burns when touching the hook or attaching loads to the hook.

Reverse sensitivity

3.25 RNZ raise concerns about possible reverse sensitivity due, amongst other things, to interference to domestic electronic devices. Attachment 3 notes that "while the EMR levels [from RNZ transmitters] may be within regulations, poorly designed home technology devices may not operate correctly leading to frustration".

3.26 I do not claim substantial expertise in radiofrequency interference. However, through my involvement in EMF safety matters with other transmitters, I have gained some familiarity with the types of problems that may occur.

3.27 Radio engineers who normally deal with these problems generally attribute the problems to poorly designed devices that do not meet recognised standards for immunity to interference. Often the problems are solved by using devices that do meet such standards.

3.28 While the RNZ submission comments that RNZ has direct experience of interference complaints around "some" of its sites, they do not discuss whether there have been complaints around this site, or at what distance they occur, or provide firm evidence (for example, based on field strength calculations) to support the height and distance constraints they propose.

3.29 I agree with RNZ that avoiding nuisance effects is highly desirable. However, the submission from RNZ does not provide any evidence that the proposed distance and height controls will resolve the problems. Indeed, it may be that other measures, such as including a note on the LIM of potentially affected properties that good quality appliances that meet immunity standards may be necessary to avoid interference problems.

4. SUMMARY

4.1 There are well established exposure limits that protect against adverse effects caused by EMFs.

4.2 There are also computer programs that allow EMF levels to be calculated in the region around the transmitter. These programmes include the ability to take account of structures in the area that might cause local enhancement of the fields. While it is more difficult to assess the likelihood of indirect effects (shocks and burns) caused by contact currents, there is material available that allows this to be estimated.

4.3 In my opinion, the RNZ submissions are insufficient to justify the proposed distance and height controls. The controls do not appear to be based on a rigorous analysis of likely exposures. It is not possible to say whether the proposed controls are too restrictive or too lax, or some combination of both.

4.4 The requirement for site specific EMR assessments in the outer zone, and on the use of cranes and EWPs in both zones, could impose significant costs on developers and the PCC.

4.5 While I agree that avoiding interference with domestic electronic equipment is highly desirable, the RNZ submissions do not provide evidence of the magnitude of any problem, and there may be alternative approaches to achieve the same end.

4.6 In my opinion, any distance and height controls in the area around the RNZ Titahi Bay transmitter should be based on a more complete theoretical analysis of EMF levels supplemented, if necessary, by measurement data. In the absence of this technical evidence being produced and verified, I do not consider that the management framework currently recommended in the Council's s42A report is appropriate.

Martin Gledhill
24 February 2023