

**Before the Hearings Panel
At Wellington City Council**

Under Schedule 1 of the Resource Management Act 1991

In the matter of the Proposed Wellington City District Plan

**Statement of evidence of Dr Nicola Jane Litchfield behalf of Wellington City
Council (Fault Rupture)**

Date: 14 June 2023

INTRODUCTION:

- 1 My full name is Dr Nicola Jane Litchfield. I am employed as an Earthquake Geologist/Tectonic Geomorphologist.
- 2 I have prepared this statement of evidence on behalf of the Wellington City Council (the **Council**) in respect of technical related matters arising from the submissions and further submissions on the Proposed Wellington City District Plan (the **PDP**).
- 3 Specifically, this statement of evidence relates to the matters in Chapter Natural Hazards and Risks.
- 4 I am authorised to provide this evidence on behalf of the Council.

QUALIFICATIONS AND EXPERIENCE

- 5 I hold the qualifications of a Doctor of Philosophy (Geology – 2000) from the University of Otago, a Master of Science with First Class Honours (Geology – 1996) from the University of Canterbury, and a Bachelor of Science (Geology – 1993) from the University of Canterbury.
- 6 I currently hold the position of Senior Tectonic Geomorphologist / Earthquake Geologist at the Institute of Geological and Nuclear Sciences Limited (GNS Science). I have worked at GNS Science since 2000, including 4 years as a New Zealand Science and Technology Post-doctoral fellow (2001-2004) and 4.5 years as Head of Department (including the Earthquake Geology team) and 1.2 years as Earthquake Geology team leader.
- 7 My previous work experience prior to working at GNS Science comprises technician positions at University of Canterbury and NIWA, including working with onshore and offshore active fault data.

8 During my time at GNS Science, I have been involved, or am involved, in the following relevant projects:

- a. Fault mapping studies include defining Fault Avoidance Zones (**FAZs**) for District Plans for Upper Hutt City, Porirua, Kaikōura, Taupō, Whanganui, South Wairarapa, Carterton, Masterton and Gisborne Districts, for some individual faults including the Masterton, Greendale, and Wairarapa faults, and the Wellington Fault in Upper Hutt City, and reviewing studies for other regions (Hawke's Bay, Horizons, West Coast, Marlborough, Canterbury, Otago).
- b. Paleoseismology studies (i.e., pre-historic earthquake studies) on many faults around New Zealand (e.g., Wellington, Alpine, Dunstan, Akatore, Titri, Mohaka faults and several in the Taupō Rift). These are used to understand the rate of activity, frequency and size of past earthquakes.
- c. Long-term (that is, spanning thousands of years) vertical land movements of the coastline in tectonically active areas. This includes the Wairarapa and Wellington south coasts.
- d. I was involved in the development of the 2010 NZ National Seismic Hazard Model and the 2022 revision. For the 2022 revision I developed and compiled a database (version 1.0) of paleoseismic site data (covering fault rate of movement, timing of past earthquakes and the sizes of past ground surface ruptures) and contributed to version 1.0 of the NZ Community Fault Model.
- e. I lead the It's Our Fault / Nō Matou Te Hapa research programme, which aims to increase the resilience of the Wellington Region to earthquakes and associated hazards. In November 2022 we held a Science to Practice workshop with Wellington City Council staff (Resource Consent and District Plan Policy teams) to increase understanding of geological hazards and risk in Wellington City.

9. I am a member of the Geoscience Society of New Zealand, Seismological Society of America (associate editor of one of their scientific journals), American Geophysical Union, Australia New Zealand Geomorphology Group, New Zealand Coastal Society, and New Zealand Archaeological Association.

Code of conduct

- 10 I have read the Code of Conduct for Expert Witnesses set out in the Environment Court's Practice Note 2023. I have complied with the Code of Conduct in preparing my evidence and will continue to comply with it while giving oral evidence before the Environment Court. My qualifications as an expert are set out above. Except where I state I rely on the evidence of another person, I confirm that the issues addressed in this statement of evidence are within my area of expertise, and I have not omitted to consider material facts known to me that might alter or detract from my expressed opinions.

SUMMARY

- 11 My name is Dr Nicola Jane Litchfield.
- 12 I have been asked by the Council to provide Fault Rupture evidence in relation to submissions on the Natural Hazards chapter and Fault Overlay mapping in the PDP.
- 13 My statement of evidence addresses:
 - a. My advice I provided to the Council in response to submission 348.3 received on the PDP; and
 - b. My comment on draft revised rules provided by the Council in response to the submissions.

- c. Specific advice on the 20 m building setback related to fault rupture.

INVOLVEMENT WITH THE PROPOSED PLAN

14 I did not prepare any specific reports for the PDP, but I was a peer reviewer of the active fault mapping report by Morgenstern and Van Disen (2021)¹ commissioned by the Council.

SCOPE OF EVIDENCE

15 My statement of evidence addresses the following matters:

- 15.1 Response to submission 348.3 regarding the use of different policies and rules for areas where there are different understanding of fault locations.
- 15.2 Comment on the revised draft rules in response to submissions related to fault rupture.
- 15.3 Specific advice on the 20 m building setback related to fault rupture.

RESPONSE TO SUBMISSION

15. Council officers have sought advice as to whether the below requested changes are appropriate from a technical perspective, particularly in terms of the location of fault rupture.

Submitter Name	Submission Point No.	Submission Point Text
----------------	----------------------	-----------------------

¹ References are listed in Appendix 1.

Kimberley Vermaey	348.3	In areas where there is a good understanding of the fault hazard location, more restrictive policies and rules (such as an avoid policy and non-complying activity status for new buildings, additions, and conversions). Where there is a poorer understanding of the fault location, then less restrictive policies and rules should apply (a policy framework that requires the identification of the position of the fault and a corresponding permitted, controlled, or restricted discretionary activity status).
----------------------	-------	---

16. The recommended use of different rules for areas with different levels of understanding of the fault location is consistent with the risk-based approach outlined in the MfE Active Fault Guidelines (Kerr et al. 2003).
17. Specifically, the MfE Active Fault Guidelines (Kerr et al. 2003) recommend different policies for different areas of fault complexity and it is through fault complexity categories that different levels of understanding of the fault location are addressed.
18. The Morgenstern and Van Dissen (2021) report provided the Council with fault avoidance zones categorised into these fault complexity areas. The footprints of these areas are used in the PDP, but they are not categorised by fault complexity.
19. It would be appropriate to use the fault complexity classification in the District Plan along with more nuanced policy and rules that respond to the different levels of understanding of the fault location.

COMMENT ON REVISED DRAFT RULES

20. Versions of the Natural Hazards Chapter – Rule Framework with revised draft rules for fault rupture was provided by email on 16 May 2023 and 8 June 2023.
21. A number of the revised rules are now specifically linked to the fault complexity areas within the Fault Hazard Overlays and have different rules for different fault complexity areas of the Wellington and Ohāriu faults.
22. Several of the revised rules require new buildings or hazard sensitive activities to be located more than 20 m from the edge of the fault deformation zones. The 20 m setback is discussed further in sections 24-27.
23. I consider the revisions to be a significant improvement and to be fit-for-purpose to mitigate risk from fault rupture.

SPECIFIC ADVICE ON THE 20 M SETBACK RELATED TO FAULT RUPTURE

24. The s42A planner has sought specific advice on the 20 m setback in relation to fault rupture to assist in determining the most appropriate wording for fault rupture hazard policies and rules.
25. The MfE Active Fault Guidelines (Kerr et al. 2003) recommend that a fault avoidance zone be created by establishing a minimum 20 m buffer zone either side of the known fault trace (or the identified likely fault rupture zone). This is shown schematically in Figure 1². The purpose of the buffer zone is to incorporate secondary ruptures and as a precautionary approach to ensure a level of life safety. Geologists also refer to the 20 m

² Figures are contained in Appendix 2.

buffer zone as a setback zone and the likely fault rupture zone as a (fault) deformation zone.

26. The recommended use of the term fault deformation zone, rather than a fault line (which I note is the term used in the PDP fault rupture provisions), is for two purposes:

26.1 When faults rupture the ground surface in a large earthquake the rupture is generally not a single break (crack or trace), but in multiple breaks, as shown by examples from the 2010 Darfield and 2016 Kaikōura earthquakes in Figures 2 and 3. These are collectively referred to as a fault zone and the fault zone width can vary between faults and along faults as shown in Figures 2 and 3.

26.2 When geologists develop fault avoidance zones site-specific information about exactly where the fault is located from past earthquake ruptures is generally not available. Instead, a fault deformation zone is mapped using aerial photographs or detailed topographic maps such as Lidar and includes some level of uncertainty. This is why it's called the likely fault rupture zone in the MfE Active Fault Guidelines (Figure 1).

27. I consider the use of the term 'fault deformation zone', defined as 'means the area of likely fault rupture as determined by a suitably qualified geologist' to be appropriate for use in the District Plan.

Date: 14/06/2023

A handwritten signature in blue ink, appearing to read 'N J Litchfield', is centered on the page. The signature is written in a cursive style with a blue ink color.

Dr Nicola Jane Litchfield

Appendix 1 – References

Morgenstern, R.; Van Dissen, R.J. 2021. Active fault mapping and fault avoidance zones for Wellington City. GNS Science consultancy report 2020/57. 94 p.

Kerr, J.; Nathan, S.; Van Dissen, R.; Webb, P.; Brunsdon, D.; King, A. 2003. Planning for Development of Land on or Close to Active Faults. Institute of Geological & Nuclear Sciences Client Report 2002/124 (prepared for, and published by the Ministry for the Environment, New Zealand).

Appendix 2 – Figures

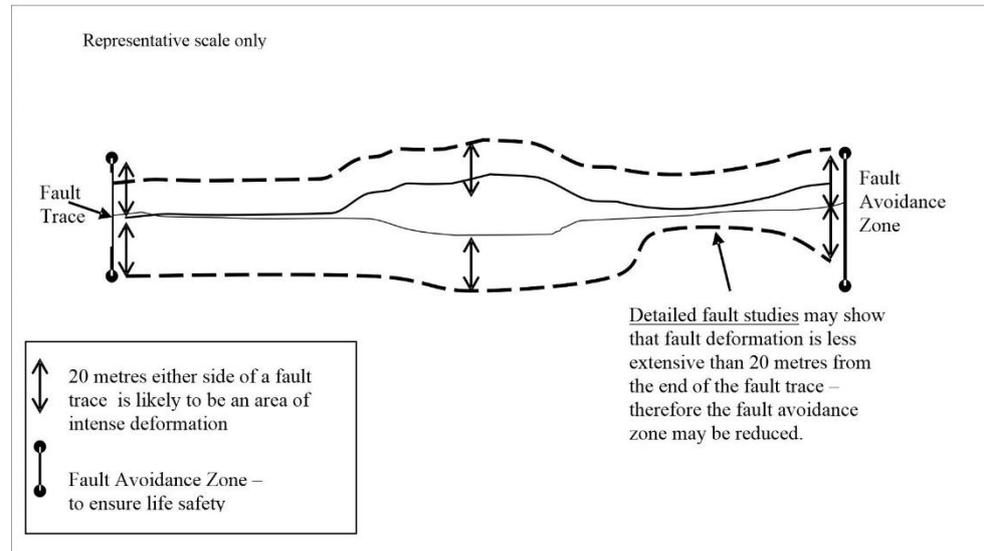


Figure 1. A fault avoidance zone as defined by the MfE Active Fault Guidelines (Kerr et al. 2003).



Figure 2. Greendale Fault rupture from the 2010 Darfield Earthquake. Photograph taken by Richard Jongens.



Figure 3. Kekerengu Fault rupture from the 2016 Kaikōura Earthquake. Photograph taken by Julian Thomson.