Before the Hearings Panel
At West Coast Regional Council

Under	Schedule 1 of the Resource Management Act 1991
In the matter of	the Proposed Te Tai o Poutini Plan (pTTPP)

Statement of evidence of Dr Robert Max Langridge on behalf of West Coast Regional Council

Date: 22 October 2024

INTRODUCTION:

1 My full name is Dr Robert Max Langridge. I am employed as an Earthquake Geologist at GNS Science.

2 I have prepared this statement of evidence on behalf of the West Coast Regional Council (the **Council**) in respect of technical related matters arising from the submissions and further submissions on the Proposed Te Tai o Poutini Plan (the **pTTPP**).

3 Specifically, this statement of evidence relates to the matters in the evidence provided by Mr Nicholas Kelvin Harwood.

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 (Geological Sciences – 1998) from the University of Oregon (USA), a Master of Science with Honours (Earth Sciences – 1990) and a Bachelor of Science (Earth Sciences– 1987), both from the University of Waikato.

6 I currently hold the position of Senior Earthquake Geologist at the Institute of Geological and Nuclear Sciences Limited (GNS Science). I have worked at GNS Science since 2000, including 2.5 years as a New Zealand Science and Technology Post-Doctoral fellow (2000-2002).

7 My previous work experience prior to working at GNS Science comprises a Post-Doctoral contract at the United States Geological Survey, Menlo Park, California, working on active faults and disaster response.

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 (**FAZ**s) for District Plans in the Hawkes's Bay region (Napier City, Central Hawkes Bay, Hastings, and Wairoa districts), Horizons region (Palmerston North City, and Horowhenua, Manawatū, Rangitikei, and Tararua districts), Marlborough District, and West Coast region (Westland, Grey and Buller districts), and have peer-reviewed studies across other regions (Canterbury, Otago).

b. Undertaken paleoseismology studies (i.e., pre-historic earthquake studies) on many faults around New Zealand (e.g., Wellington, Alpine, Dunstan, Poukawa, Hope, Mohaka, Patoka, Wairarapa, Carterton faults). These are used to understand the rate of activity, frequency and size of past earthquakes on faults.

c. Along the Alpine Fault I have been involved in site-specific work, reports and hearings related to Franz Josef township and the Lake Poerua subdivision, including as the project lead and lead author of GNS reports and letters referenced in Submission 311 (e.g., Langridge and McSaveney, 2008)[1].

d. I was involved in the development and launch of the New Zealand (GNS) Active Faults Database as an online resource and as a scientific paper in 2016. I have been involved in the upgrade to a High-Resolution ('High-Res') GNS Active Faults Database which was recently re-launched as a WebMap Service (https://data.gns.cri.nz/af/).

e. I was involved in the development of NZ National Seismic Hazard Model in 2012 and the 2022 revision. For these I provided active fault data and expert panel review for many faults around New Zealand, including for the Alpine Fault.

---

[1]Langridge, R.M., McSaveney, M. 2008. Updated review of proposed Lake Poerua subdivision, Grey District. GNS Science Consultancy Report 2008/11, 19 p.

f. I am the lead author on several Alpine Fault-related reports including those regarding the Lake Poerua area and most recently a report to the Council referred to below as Langridge et al. (2022)[2] – see Appendix 1 for citations.

9. I have been a member of the Geoscience Society of New Zealand since 1990 and formerly of the Geological Society of America and American Geophysical Union.

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 Panel. 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 Robert Max Langridge.

12 I have been asked by the Council to provide evidence in relation to submissions on Active Faulting and Earthquake Hazard Overlay mapping in the Langridge et al. (2022) report adopted in part by the pTTPP.

---

[2] Langridge, R.M., Morgenstern, R., Coffey, G.L., Clarke, L.B. 2022. Updated Alpine Fault mapping and fault avoidance zones for priority areas in the West Coast region. Lower Hutt (NZ): GNS Science. 63 p. Consultancy Report 2022/08.

13 My statement of evidence addresses:

a. Points raised in Submission S311 that relate to mapping of the Alpine Fault and associated Fault Avoidance Zone through the property at 2261 Lake Brunner Road, Inchbonnie; and

b. Expert Evidence (dated 23 September, 2024) and associated oral presentation by Mr Nicholas Kelvin Harwood to the Panel on Wednesday 9 October, 2024.

c. Further discussion of how the Langridge et al. (2022) report came to put a dog-leg in the Alpine Fault traces and FAZs in the area of the 2261 Lake Brunner Road.

RESPONSE TO SUBMISSION

16. The Submission S311 asks the following: "*The material component of the Owners submission S311.004 is a request: (a) to use correct information to show the Faultline accurately in Map 65 in particular around my property at 2261 Lake Brunner Road; and (b) if not, then to provide detailed evidence and documentation to support and the rationale as to why this was changed".*

17. For (a) above, I have revisited the Langridge et al. (2022) report including the GIS data and the Submissions pertaining to Mr Marshall's property, and considered the evidence provided by Mr Harwood.

18. The Figure 5.3 map in the Langridge et al. (2022) report has been used to contest the LiDAR based mapping that forms the basis for the fault avoidance zones (FAZs). However, the white dashed fault line in Figure 5.3 shown on an oblique aerial photograph was only intended to be indicative in nature.

19. For (b) above, the location of the fault lines changed because GNS was contracted to map the fault for the Council for the purposes of the pTTPP.

We followed standard mapping practice for use on airborne LiDAR data, which has been available only since 2015 through a research grant to R. Langridge[3]. Fault mapping on LiDAR has been used to develop FAZs according to the MfE Guidelines[4].

20. I consider the key matters comprise: the scope of the Langridge et al. (2022) work; the scale of the mapping; use of LiDAR data; field validation; citation and availability of scientific reports; and reasoning behind the "dog-leg" in the area of 2261 Lake Brunner Road:

Scope of the Langridge et al. (2022) report

21. The scope of Langridge et al. (2022) was for a regional (district-by-district) review of active fault trace location along the Alpine Fault focusing on priority areas where new FAZs were developed. While the scope of the report was not for single property planning decisions (where site specific investigations should be undertaken), the data is appropriate to be used for planning purposes at a district or regional scale.

Scale of the Langridge et al. (2022) mapping

22. . Here I refer to the map scale of fault trace mapping. Within the 18 priority areas the map scale was mostly dependent on the availability of airborne LiDAR and was on average c. 1:7,000 (ranging from 1:4,000-10,000 scale). This is much more detailed than the 1:50,000 to 1:250,000 scale that was typically shown on the New Zealand Active Faults Database (https://data.gns.cri.nz/af/) prior to the recent launch of 'High-Res'

---

[3] Langridge, R.M., Howarth, J.D. 2018. A New Paradigm for Alpine Fault Paleoseismicity: The Northern Section of the Alpine Fault. Lower Hutt (NZ): GNS Science. 49 p. (GNS Science miscellaneous series 121). doi:10.21420/G2WS9H.

[4] 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).

datasets. These detailed mapping scales indicate the Alpine Fault is often not a single line but made up of many complex traces.

Use of LiDAR data

23. LiDAR (**Li**ght **D**etection **a**nd **R**anging) is a state-of-the-art, and revolutionary tool for surveying the land and is particularly useful in vegetated landscapes such as the West Coast where the technique can effectively strip off the tree cover to show the geomorphology of the land underneath (Langridge et al., 2014)[5]. We have been able to improve on many fault locations, e.g. southwest of Lake Poerua and show many new and clear fault relationships, e.g. extending northeast of Lake Poerua.

Field validation

24. This was not within the scope of Langridge et al. (2022), owing to the scale of the project.; however, I have had a long history of field reconnaissance and field work along this part of the Alpine Fault and have been able to field check several sites northeast of the Marshall property since we acquired the LiDAR[6].

Reasoning behind the “dog-leg” in the area of 2261 Lake Brunner Road

25. Much of the mapping methodology is outlined in the evidence above, but the following is provided to elaborate on trace-by-trace decisions.

---

[5]Langridge, R.M., Ries, W.F., Farrier, T., Barth, N.C., Khajavi, N., De Pascale, G.P., 2014. Developing sub 5-m LiDAR DEMs for forested sections of the Alpine and Hope faults, South Island, New Zealand: Implications for structural interpretations: Journal of Structural Geology, v. 64, p. 53-66, doi:10.1016/j.jsg.2013.11.007.

[6]Upton, P., Langridge, R.M., Stahl, T., Van Dissen, R.J., Howarth, J., Berryman, K., Clark, K.J., Kelly, K., Hammond, K. 2017. 8th International PATA Days, Blenheim, New Zealand. Three-day post-conference fieldtrip: Northern South Island, Alpine Fault and Ruptures of the 2016 Kaikōura Earthquake, 17-19th November 2017. Lower Hutt (NZ): GNS Science. 64 p. (GNS Science miscellaneous series 110).

26. At a regional- to district-scale available information and expert experience is relied upon to determine fault locations. In other words, we must look beyond single property scale to understand the nature of the fault over greater distances.

27. In the Lake Poerua Priority Area[7], the Alpine Fault can be clearly mapped from the Taramakau River to Lake Poerua. There is a lot of precedence for the fault being mapped where it is and LiDAR is mainly used to map the traces more accurately. The fault becomes more complex (more traces are visible) closer to the lake because the fault is being exhumed earthquake-by-earthquake as the Taramakau River course stays away to the southeast[8].

28. The fault cannot be mapped across the Taramakau River, and the Langridge et al. (2022) report gives this area the maximum FAZ buffer width in their study of 300 m.

29. Along this course from the Taramakau River to Lake Poerua the fault has a left-stepping character, i.e. the traces step across to the left every few hundred metres and create a fault complexity (stepover). One of these complexities occurs at the southern tip of Lake Poerua, which allowed us to gain the insight that the straight, southeastern edge of Lake Poerua was in fact formed by a fault scarp[9].

30. Alternately, we can confidently map active fault geomorphology from the northeast from the Brown River toward 2261 Lake Brunner Road. LiDAR

---

[7] This is a 10 km long strip along the Alpine fault zone encompassing the LiDAR between the Taramakau and Brown rivers.

[8] Langridge, R.M., Villamor, P., Basili, R., Almond, P., Martinez-Diaz, J.J., Canora, C. 2010. Revised slip rates for the Alpine fault at Inchbonnie: Implications for plate boundary kinematics of South Island, New Zealand. Lithosphere 2: 139-152. doi:10.1130/L88.1

[9] Langridge, R.M. 2008. Resource Consent PL1477-06 Paradise Trust - Lake Poerua. GNS Science Letter Report 2008/73LR.

enables us to recognise striking fault geomorphology hidden under bush between the Brown River and Camp Creek.

31. That geomorphic style is continued as an exhumed 'pip' northeast of, and as a linear range front bench southwest of, Evans Creek. The sites in items 31 and 32 have been field-verified.

32. From Evans Creek to 2261 Lake Brunner Road our mapping is strongly influenced by the shape of the range front and 'ribbing', i.e. curved lines within the schistose bedrock picked out from the LiDAR. In this stretch the linear range front curves in toward Homestead Creek and the ribbings (essentially schistosity) parallel this. These both indicate bedrock structure that I consider is parallel to the Alpine Fault and provide key evidence as to where the fault is.

33. The 'dog-leg' occurs between Lake Poerua and Homestead Creek and is mapped as an uncertain trace. In this area we cannot identify any certain fault traces, due to the thick and recent alluvial fan cover. However, we have had to consider how these two more well-defined parts of the fault (to the northeast and southwest) link up as it is unequivocal that they join up. In essence, the dog-leg was the most logical way to do this at the scale defined for the Langridge et al. (2022) report.

34. Put in different terms, the fault must take a right-step (stepover) across from Lake Poerua to the range front. This is probably more complex than we have been able to convey with a single, uncertain fault trace.

35. While there are alternatives to these interpretations, the RIC Class I Alpine Fault probably goes through the 2261 Lake Brunner Road property. For example, the straight-line geometry proposed for the Alpine Fault would require that the fault is buried beneath the thick alluvial fan deposits in the stretch that includes Homestead and Dry creeks and would have an uncertain poorly constrained location of up to 300 m width.

36. Improved location of the fault could best be achieved by: 1) reconnaissance mapping that targets finding fault shear zones in the locations shown in the Langridge et al. (2022) report, or 2) using at least one subsurface geophysical technique (seismic, GPR) to better define fault location.

CLOSURE

37. Thank you for the opportunity to present this evidence. If it may assist the Panel, I would welcome the opportunity to share the LiDAR mapping in the location of interest on-screen, and which forms the basis of the Langridge et al. (2022) report. Notwithstanding this, I will happily take questions.

Date: 22/10/2024

Dr Robert Max Langridge