IN THE MATTER of the Resource Management Act 1991

AND

IN THE MATTER of the Environment Canterbury (Temporary Commissioners and Improved Water Management Act) 2010

AND

IN THE MATTER of the hearing of submissions on the Proposed Canterbury Land and Water Regional Plan

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STATEMENT OF EVIDENCE OF BRIAN STEWART CAREY

INTRODUCTION

1. My name is **Brian Stewart Carey**. I am the Geothermal Manager for GNS Science ("GNS") and hold the position of Chair of the Geothermal Heat Pump Association of New Zealand ("GHANZ").

2. I am here today following the GHANZ written submission 271. GHANZ seeks amendments to ensure the Proposed Land and Water Regional Plan (PLWRP) does not unnecessarily restrict the use of geothermal heat-pump technology in Canterbury.

3. I have the following qualifications and experience relevant to the evidence I shall give:

   (a) I hold a Bachelor of Engineering (Honours) and a Master of Engineering Degrees from Canterbury University. I am a Member of the Institution of Professional Engineers New Zealand, and registered as both a Chartered Professional Engineer and an International Professional Engineer.

   (b) I am Vice President of the New Zealand Geothermal Association, Chair of GHANZ and a member of the International Geothermal Association.

   (c) Within GNS I am responsible for managing about 30 scientific and technical staff working on geothermal consultancy and research assignments.

   (d) Between 1981 and 1985, I was employed by the Ministry of Works and Development as a Mechanical Engineer involved in many aspects of geothermal research, development and design.

   (e) Between 1985 and 1987 I was employed by the Electricity Division of the Ministry of Energy as Station Engineer at the Wairakei geothermal power station.

   (f) Between 1987 and 1996 I was employed by the Electricity Corporation of New Zealand Limited ("ECNZ") as Geothermal Resource and Planning Manager for the Ohaaki and Wairakei geothermal fields.

   (g) From February 1996 to May 2007 I was employed by Contact Energy Limited as the Geothermal Resource Manager. I was responsible for the management of the Wairakei and Ohaaki geothermal reservoirs having been involved with these since 1985 and 1987 respectively.

(h) I have been involved in resource management planning associated with regional policy statements, plan formulation and resource consent proceedings in the Waikato region and to a lesser extent in the Bay of Plenty region.

(i) Since June 2007 I have been employed as the Geothermal Manager for GNS where the work of the scientific staff spans from low temperature geothermal resources (~12^{o}C) through to very high temperature resources (~350^{o}C)

4. I confirm that I have read the 'Code of Conduct for Expert Witnesses' contained in the Environment Court Consolidated Practice Note 2006. My evidence has been prepared in compliance with that Code. In particular, unless I state otherwise, this evidence is within my sphere of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

SCOPE OF EVIDENCE

5. The purpose of my evidence is to present an overview of geothermal heat-pump technology and its potential, particularly for Christchurch, and to address a number of aspects of the PLWRP that have the potential to restrict the use of this technology particularly with respect to groundwater-based systems.

6. My evidence will:

(a) Introduce the Geothermal Heat-Pump Association of New Zealand (GHANZ) and provide an overview its structure, role and function; and

(b) Discuss geothermal heat-pump technology and its potential for Christchurch to embrace as part of the re-build; and

(c) Discuss the implications of specific provisions of the PLWRP for geothermal heat-pump technology, namely :

(i) Proposed Policy 4.55 which restricts non-consumptive takes to a single aquifer and does not provide for takes and discharges within different aquifer within the same groundwater allocation zone. This is overly restrictive and will unnecessarily limit the use of groundwater based geothermal heat-pump technology;

(ii) Proposed Rules 5.105 and 5.106 which also restrict takes based on the depth of abstraction rather than the groundwater allocation zone; and

(iii) Proposed Section 9.6.2 which prohibits groundwater abstraction within the Christchurch - West Melton groundwater allocation zone. The PLWRP does not include an estimate of the allocation limit for this zone and does not state whether the allocation limit would apply to non-consumptive takes where the take and abstraction occur at different depths.

GEOTHERMAL HEAT-PUMP ASSOCIATION OF NEW ZEALAND (GHANZ)

7. GHANZ was established at the beginning of 2012 as an interest group of the New Zealand Geothermal Association. Current membership includes geothermal heat-pump suppliers, installers and designers, government agencies, other organisations and a range of interested individuals.

8. GHANZ seeks to raise awareness of geothermal heat-pump technology, encourage quality installations and expand the New Zealand geothermal heat pump market. GHANZ seeks to assist with New Zealand appropriately using this technology for the benefit of the nation.

9. Some of the activities GHANZ has been involved in to date include:

   (a) Holding a series of regional workshops to promote membership (Auckland and Christchurch)

   (b) Contributing to conferences, seminars and trade shows (Invercargill, Wellington, Auckland)

   (c) Liaising with international organisations including the University of Melbourne, the Canadian Geo-Exchange Coalition, IGSPA and others.

   (d) Contributing to the development of an Australia / New Zealand Standard for geothermal heat-pumps.

GEOTHERMAL HEAT PUMP TECHNOLOGY

10. Geothermal heat-pumps (also called ground source heat-pumps) are an established technology that harnesses the low temperature geothermal energy stored in soil, rock, surface water or groundwater and make this energy available for heating and cooling. Applications include space heating and cooling in buildings, heating swimming pools, providing domestic hot water and supporting some industrial heat applications.

11. The energy utilised is renewable, reliable, available all year round, and accessible from almost any building site in New Zealand. The use of geothermal energy results in a range of benefits and positive effects at the local, regional and national level. Utilisation of geothermal energy accords with the Resource Management Act 1991 requirement to have particular regard to the efficiency of the end use of energy (section 7 (ba)) and the benefits to be derived from the use and development of renewable energy resources (section 7 (j). It also aligns with the aspirations in the government's New Zealand Energy Strategy 2011 – 2021 and New Zealand Energy Efficiency and Conservation Strategy 2011-2016.

12. While there are some excellent examples of geothermal heat-pump installations in New Zealand (such as the Christchurch International Airport groundwater system), despite significant potential, the uptake of the technology in this country is lagging behind international trends.

13. The use of groundwater as a geothermal energy source is an ideal solution that can be embraced as part of the rebuilding of Christchurch, due to its low environmental impact and high energy efficiency compared with other technologies. In the Christchurch context, systems will generally involve abstracting groundwater from one well, piping it through a heat exchanger and then discharging the water back into the ground. This is a non-consumptive use of groundwater with the only change between the source water and the discharge water being a small change in temperature, typically around 5°C. The City's location over a high-yielding groundwater resource provides a perfect opportunity for widespread uptake of this sustainable technology.

14. Flexibility is needed to locate the points of take and discharge at different depths. Often the water source and the water discharge points are located at different depths or in different aquifers to prevent heat interference effects which might otherwise adversely impact on the system's efficiency by creating a "short circuit" between the take and discharge points. Flexibility is particularly relevant for large or multi-storey buildings with higher groundwater flow requirements, such as school buildings and central city office blocks. The PLWRP does not adequately recognise this requirement.

15. Examples of groundwater-based geothermal heat-pump systems where water is taken and discharged at different depths include the University of Canterbury and the Christchurch International Airport.

COMMENT ON THE GHANZ SUBMISSION AND THE OFFICER'S REPORT

Policy 4.55 - Non-consumptive groundwater take, GHANZ submission point 271.1

16. GHANZ sought the following amendment to Proposed Policy 4.55 to allow flexibility in the depth and location of the water and heat abstraction and discharge within groundwater allocation zones:

> *"Non-consumptive groundwater takes, including the taking of heat from or adding heat to groundwater, will not be subject to any groundwater allocation zone limits, and will generally be supported, provided the water remains in the ~~aquifer~~* ***groundwater allocation zone****, or is returned to the same ~~aquifer~~* ***groundwater allocation zone*** *within 24 hours and is protected from contamination."*

17. The Section 42A report rejects this submission stating that localised effects may occur, although the Officer recognised that at an allocation zone level there may be little impact.

18. I agree that it is appropriate to consider localised adverse effects such as well interference as part of a resource consent application. This will occur through a restricted discretionary activity status for any moderate to large scale heat exchange abstractions.

19. GHANZ seeks that the PLWRP clearly state that non-consumptive groundwater takes, where the take and discharge are within the same groundwater allocation zone, will not be subject to any groundwater allocation zone limits.

Rules 5.105 and 5.106 - Non-consumptive groundwater take rules, submission point 271.2 and 271.3

20. The GHANZ submission sought amendments to the Permitted Activity Rule 5.105 and Restricted Discretionary Activity Rule 5.106 to ensure that non-consumptive takes and discharges are managed in the context of the groundwater allocation zone, not the single aquifer context.

21. GHANZ sought an amendment to Condition 1 of Rule 5.105 to read

> *"The discharge of the groundwater is to the same ~~aquifer or groundwater source~~* ***groundwater allocation zone*** *as the abstraction, and the discharge is within 50 m of the abstraction point."*

22. GHANZ also sought an amendment to Rule 5.106 to read

> *"The taking and use of groundwater and discharge of the same groundwater to the same ~~aquifer~~* ***groundwater allocation zone*** *is a discretionary activity."*

23. The Section 42A report rejected this submission and recommended that Rule 5.106 be amended to ensure greater consistency with Rule 5.105. This proposed change removes the restriction that the abstracted water must be returned to the same aquifer for non-consumptive takes.

24. The recommended amendments to Rule 5.106 are different than that suggested in the GHANZ submission, however achieves the same intent.

25. On this basis, GHANZ supports the Officer's recommendation and accepts the current wording of Rule 5.105, in light of the changes proposed to Rule 5.106.

Section 9.62 - restriction on Future Allocations in Christchurch - West Melton Zone, submission point 271.4

26. GHANZ's seeks that section 9.6.2 be deleted in its entirety. Section 9.6.2 prohibits further groundwater abstraction within the Christchurch - West Melton groundwater allocation zone except for group or community water supply as set out in Rule 5.88. It does not specifically provide for non-consumptive takes and therefore could inappropriately restrict the uptake of groundwater-based geothermal heat pump systems in Christchurch, even though these do not affect the overall allocation limit.

27. A prohibition on further allocation under Section 9.6.2 is proposed despite the absence of an estimate of the allocation limit for this zone. The Section 32 summary report advises that

> "*… when updating the Christchurch groundwater model the groundwater quantity scientist estimated total actual annual abstraction to reach a maximum of 128 million m^3 per annum, which is equivalent to about 4 m^3/s. It is expected that actual use will be less than total allocation, but the quantum is uncertain. Most water permits in the zone state a maximum rate of take and tend not to have a maximum volume specified. The result of estimating annual volume entitlements from short term maximum rates on resource consents using consent inventory information is that the volume estimate is unsustainable as an allocation limit. Until a sustainable volume limit can be arrived at, the zone has been declared to be fully allocated*."

28. Given this uncertainty over how much water is actually used and what allocation volume would be sustainable, there appears to be little basis for placing such a severe restriction, particularly in the context of non-consumptive use.

29. This restriction is also at odds with the draft Zone Implementation Plan (ZIP) that the Christchurch - West Melton Zone committee has recently released. The draft ZIP emphasises that abstracted water should be used efficiently in a sustainable manner but that it *"continues to be available for community water supplies, industrial, commercial, and environmental uses.".*

30. The key issue for GHANZ is that the PLWRP does not clearly state that this limit will not apply to non-consumptive takes.

31. Should Section 9.6.2 not be deleted in its entirety on the basis that further work is required to determine a sustainable limit, GHANZ seeks that the PLWRP specifically exclude non-consumptive takes from allocation limits, regardless of the depth and location of the take and discharge,. For example, this could be addressed in Schedule 13 which sets out how to calculate groundwater allocation. It is acknowledged that Environment Canterbury has not generally included non-consumptive takes in the allocation calculations to date however it would be prudent and provide greater certainty for the PLWRP to specifically address this.

CONCLUSION

32. Groundwater-based geothermal heat pump systems represent an energy efficient, renewable and sustainable means of providing heating and cooling. These systems offer significant potential for the Christchurch re-build given the accessibility and characteristics of the groundwater resource, the levels of energy efficiency that can be achieved, and the clean and green nature of the technology. Promoting use of this resource is also consistent with the New Zealand Energy Strategy aspirations for direct use of renewable energy and greater energy efficiency.

33. Applications range from domestic hot water, space heating and cooling in residential and commercial systems, district heating / cooling schemes and low temperature industrial processes.

34. In groundwater-based geothermal heat-pump systems, the water source and the water discharge points are often located at different depths or in different aquifers, to prevent heat interference effects which can adversely impact on system efficiency. This requires a flexible management approach to water and heat take.

35. This use of groundwater water is non-consumptive and environmentally benign, with the only change between the source water and the discharge water being a small change in temperature, typically around 5°C.

36. For many areas in Canterbury, and Christchurch in particular, there are several different aquifers within a single groundwater allocation zone. The PLWRP could usefully be amended to ensure that non-consumptive takes are based on the allocation zone rather than the aquifer and that they not be restricted by groundwater allocation zone limits.

37. The amendments sought by GHANZ to the PLWRP will help ensure that the barriers to the uptake of groundwater sourced geothermal heating and cooling technology in Canterbury are reduced, to support the utilisation of an abundant, renewable energy resource that underlies the region.