

Christchurch Multi-hazards and Liquefaction Studies

Peer Review Panel Final Report May 2026

The Peer Review Panel (PRP) was engaged by Christchurch City Council (CCC) in 2018 to provide rolling peer reviews for the Christchurch Multi-Hazard and Liquefaction Studies (MHLS) project over its lifetime. The Panel comprises experts across natural hazards and climate change, uncertainty decision making approaches and their implementation, hydrology, engineering, liquefaction and groundwater modelling. These skills complemented those in the Council and their consultants. The project has been very long across Stages 1, 2 and 3 and has now concluded. Here we set out the progression of the Project and some recommendations arising from the learnings during the peer review process that have materiality for the Council decision-makers as its hazard management and climate change adaptation functions are executed.

The length of the project (8 years) reflects the large challenges and complexity of the problem being addressed, including the dynamic and uncertain nature of ground conditions across Christchurch, the intensifying and more frequent impacts from pluvial and fluvial flooding combined with the aftermath of the Canterbury earthquakes, and the developing approaches and guidance during the last 8 years, including changes underway to the legislation governing hazard planning and now the prospect of institutional change. We acknowledge these factors have posed issues for both the Council staff, their consultants and for the PRP.

The MHLS project was to have been an examination of *“a broad range of natural hazards and ... the relative consequence of each in exacerbating flooding in the tidally influenced river catchments of the city.”* It was refocused after Stage 2 in February 2023 to: *“The revised scope of Stage 3 of the project provides for limited consideration of alternatives to the OARC Scheme concept for managing flood risk in the lower Ōtākaro Avon Catchment and of any future interventions that may be required to adapt to identified hazards over time.”* A refocusing on a particular policy response to the hazards.

In addition, the CCC has set up the CHAPP programme to advance climate change adaptation. CCC have advised the PRP that it now intends the CHAPP programme to absorb the initial intention to undertake a Dynamic Adaptive Pathways Planning (DAPP) process that considers a wider range of options, with communities. The PRP notes that reviewing the CHAPP is outside the scope of the PRP’s brief and therefore no review of the adequacy of the CHAPP to fulfil this intent has been undertaken.

The process

The PRP has given the Council team and their consultants ongoing reports and verbal briefings, reviewing the technical integrity of the several consultants’ reports. These are held by the Council and include but are not limited to the following PRP reports.

Stage 1-2 MHLS Project (See Table in Appendix)

Stage 3 MHLS Project

4 December 2023. *Peer Review Panel for Land Drainage Recovery Programme Multi-Hazard – Stage 3 Methodology*. Letter to Martin Densham, Christchurch City Council.

26 June 2024. *Review of Scheme Modelling (IZO84400-NW-MEM-0010) and Groundwater Boundary (IZO84400-NW-MEM-0009).*

8 August 2024. *DRAFT Implications of New VLM Data and New Climate Change Projections, Document: IZO84400-NW-MEM-0011.*

27 August 2024. *Christchurch Multi-hazards (LDRP97) – Other Flood Risk Management Options for the Lower Ōtākaro Avon River.*

4 November 2024. *LDRP97 Multi-Hazards Task 2 OARC Modelling Results Memo Updated for Peer Review Comments.* Email Judy Lawrence to Martin Densham.

11 November 2024. *Response to Questions on the VLM Stress Testing Scope.* Email Judy Lawrence to Tom Parsons and Martin Densham.

2 December 2024. *Clarification Note, VLM Peer Review Feedback to Questions.*

14 December 2025. *Christchurch Multi-hazards and Liquefaction studies, Peer Review Panel final Report and Review of Stage 3 Report and cover letter.*

14 May 2026. *Multi Hazards Stage 3 Close out comments from Peer Review Group.* Email to Martin Densham Christchurch City Council.

14 May 2026. *Peer Review Group Final Report to CCC on the MHLS project (this report).*
We note that we have not reviewed all technical reports provided to Council.

The integrity of the technical work

The technical work has generally followed ‘best practice’ (noting that best practice has evolved over the last 8 years) and much of the PRP reviews has been considered and integrated into the Council and consultants’ work which contains a repository of learnings that augur well going forward. However, uncertainties remain which indicate caution in the use of the MHLS.

Risks for Council

Having reached the end of the process, the PRP has identified some critical areas where the Council will need to do further work to help future proof its responses to the complexities of and uncertainties around the multiple hazards in the study area. In particular, we flag the treatment of potential future emergent groundwater, earthquake and liquefaction effects including from rising water levels due to SLR, future performance of the OARC scheme (noting its temporary function) and the associated costs and implementation issues given the uncertainties across these issues.

- a) It is our view that a more realistic accounting of shallow groundwater hazard management costs, including operating costs, is likely to show that the overall scheme costs could potentially exceed the flood damage avoidance value. This is because the hydraulic properties of the shallow sediments that would need to be drained are both highly variable and poorly quantified, with order of magnitude uncertainty ranges which have not been explored. Some of hydraulic properties used in the modelling which underpins the cost estimates are also akin to a best-case scenario in our view. A robust exploration of the potential range of hydraulic properties would provide a much wider range of potential groundwater management costs than the study presents and may show that management is not practically achievable in some areas. *This is a cost risk for CCC.* Furthermore, the ground water management options explored in the study face

feasibility constraints which include the lack of a viable consenting pathway under the current Canterbury Land and Water Regional Plan¹. *This is a cost-risk for CCC.*

- b) The scheme will diminish in effectiveness (performance) over time as the climate impacts exacerbate the hazards. This means that future proofing is dependent on developing other options now (given long lead times for their development with the community) to develop a range of complementary options using the DAPP approach that can better manage the uncertainty highlighted in a) above.
- c) Land use planning controls on development 'protected' by the scheme will be essential to manage the residual risks of increasing exposure. Communicating those residual risks to the community will be necessary, because stopbanks give a false sense of security in a changing climate as hazards become more frequent and intense. When other supporting options are not yet in place there is the risk that pressure to allow further development will result. *This poses an ongoing risk to CCC.*
- d) There are pressures for housing in areas known to be subject to liquefaction. The PRP reports should be made available for those considering developments in such areas, for example, the proposed "edge housing" in known liquefaction areas.

The time duration of this MHLS project and now the consideration of adaptation options through the CHAPP and plan changes, means there will be further elapsed time in the Council being prepared for more frequent and intense rainfall events associated with climate change and climate variability. *This poses an ongoing risk for Council.*

We acknowledge the work of the Council staff and consultants over the last 8 years on this highly complex project. The Peer Review Panel has stayed the course and worked alongside them providing robust expert review on an ongoing basis as requested. We thank CCC for this opportunity to contribute to the MHLS project. We trust our body of review papers enhances the quality of and learning for the Council and wish you well in the ongoing work programme and its monitoring and funding.

Yours sincerely

The Peer Review Panel

Dr Judy Lawrence Panel Convenor

Dr David Painter, Zeb Etheridge, Dr Gavin Palmer, Ian McCahon

14 May 2026

¹ We note that the current RMA reform process is expected to result in redrafting of the Regional Plan over the next few years. This process may provide an important opportunity for CCC to engage with the regional planning authority to explore viable consenting pathway options for groundwater management.

Appendix

Multi Hazard and Liquefaction Peer Review Panel for Christchurch City Council.

Items Reviewed to Date by the Peer Review Panel

Ref	Project Stage	Document	Date Review Comments Received by Council
1	1	Stage 1 report. LDRP 97 Multi Hazard Gap Analysis Report July 2017.	10/12/2018
2	2	Tsunami Study (Feb 18). NIWA	10/12/2018
3		Coastal Sand budget for Southern Pegasus Bay. Stages a & b. April & June 2018. NIWA.	10/12/2018
4		Study of Groundwater Level Changes on Flooding. August 2018. GHD	10/12/2018
5		Memo Christchurch Liquefaction Project – Peer Review Priority Matters #1, from Mike Jacka.	10/12/2018
6		Climate Change Scenarios memo. 13 March 2019. Jacobs.	15/04/2019
7		DAPP Workshop Action Notes Memo. 30 January 2019. Jacobs	N/A
8		Memo Christchurch Liquefaction Project – Peer Review Priority Matters #1, from Mike Jacka, Tonkin and Taylor.	10/12/2018
10		Christchurch Liquefaction Vulnerability study. Draft 1.0. September 2019. Tonkin and Taylor.	19/10/2019
11		Impacts of Earthquakes and Sea Level Rise on Groundwater. January 2018. Aqualinc	10/12/2018
12		Post Earthquake Ground Surfaces (Beca Memo) Appendix 2 December 2017	10/12/2018
13		Update to Canterbury GW Model and 1m SLR Scenario. Memo. Aqualinc. 6 December 2019	TBC
14		Sumner Sea Level Rise Modelling - Groundwater Addendum. Aqualinc. 3 July 2019	19/10/2019
15		Sumner Sea Level Modelling: Response to Panel Review. Memo Aqualinc. 6 December 2019	N/A
16		LDRP 45 Hazard Classification Memo. Groundwater Study. Aqualinc 24 September 2020.	10/12/2018
17		Effects of Earthquakes on Groundwater level Additional Sensitivity Testing Memo. Aqualinc 4 September 2020	19/10/2019
18		Impacts of Earthquakes and Sea Level Rise on Groundwater. August 2020. Aqualinc	31/08/2020
19		Letter from CCC Peer Review Panel for Land Drainage Recovery Programme Multi-Hazard – LDRP 45 Aqualinc Groundwater Report. 18 August 2020	31/08/2020
20		Response to Peer Review Panel. 5 August 2020 Aqualinc	31/08/2020
21		Coincident Inclement Weather Study for Climate Change Planning. May 2018. NIWA.	10/12/2018
22		Findings of the Coincident Weather and Associated Studies. 19 September 2019 Jacobs	19/10/2019
23		Multi Hazard Baseline Modelling Scoping Joint Risks – Pluvial and Tidal Flooding DRAFT Sept 2020	01/10/2020
24		Multi Hazard Baseline Modelling Scoping Joint Risks - Pluvial and Tidal Flooding – Rev 0 Feb 2021	12/04/2021
25		Multi Hazard Baseline Modelling Scoping Joint Risks – Pluvial and Tidal Flooding May 2020	29/05/2020

Ref	Project Stage	Document	Date Review Comments Received by Council
26		CCC Memo Multi Hazard and Liquefaction Peer Review Panel Feedback on: GHD Report LDRP 097 Multi Hazard Baseline Modelling – Scoping Joint Risks – Pluvial and Tidal Flooding. 19 June 2020	25/06/2020 and 20/07/2020
27		Multi Hazard Baseline Modelling Scoping Joint Risks – Pluvial and Tidal Flooding. May 2020. GHD & HKV	1/10/2020
28		Multi Hazard Baseline Modelling – M21 Infiltration with Groundwater Capacity. . September 2020. GHD	25/11/2020
29		Vadose Soil Moisture and Groundwater Sensitivity. 30 Oct 2020. GHD	25/11/2020
30		Multi Hazard Baseline Modelling Scoping Joint Risks – Pluvial and Tidal Flooding. March 2021 Revb. GHD & HKV	12/04/2021
31	3	Stage 3 Scope - LDRP 97 Multi Hazard project charter (developed prior to project starting)	10/12/2018
32		Stage 3 Scope - LDRP 97 Methodology sections of Jacobs Non Price submission Proposal for Multi Hazard Analysis	10/12/2018
33		Stage 3 Scope - LDRP 97 Jacobs Stage 3 Proposed Delivery Plan	10/12/2018
34		LDRP 97 Decision Support Framework Memo	23/01/2019