

Glenorchy field trip

LaRGE Landslides Conference | 28 April 2026

Introduction

This field trip provides an overview of the natural hazards and resilience in the head of Lake Whakatipu area, including recent natural hazard and risk investigations, and collaborative work completed to develop a natural hazards adaptation strategy.

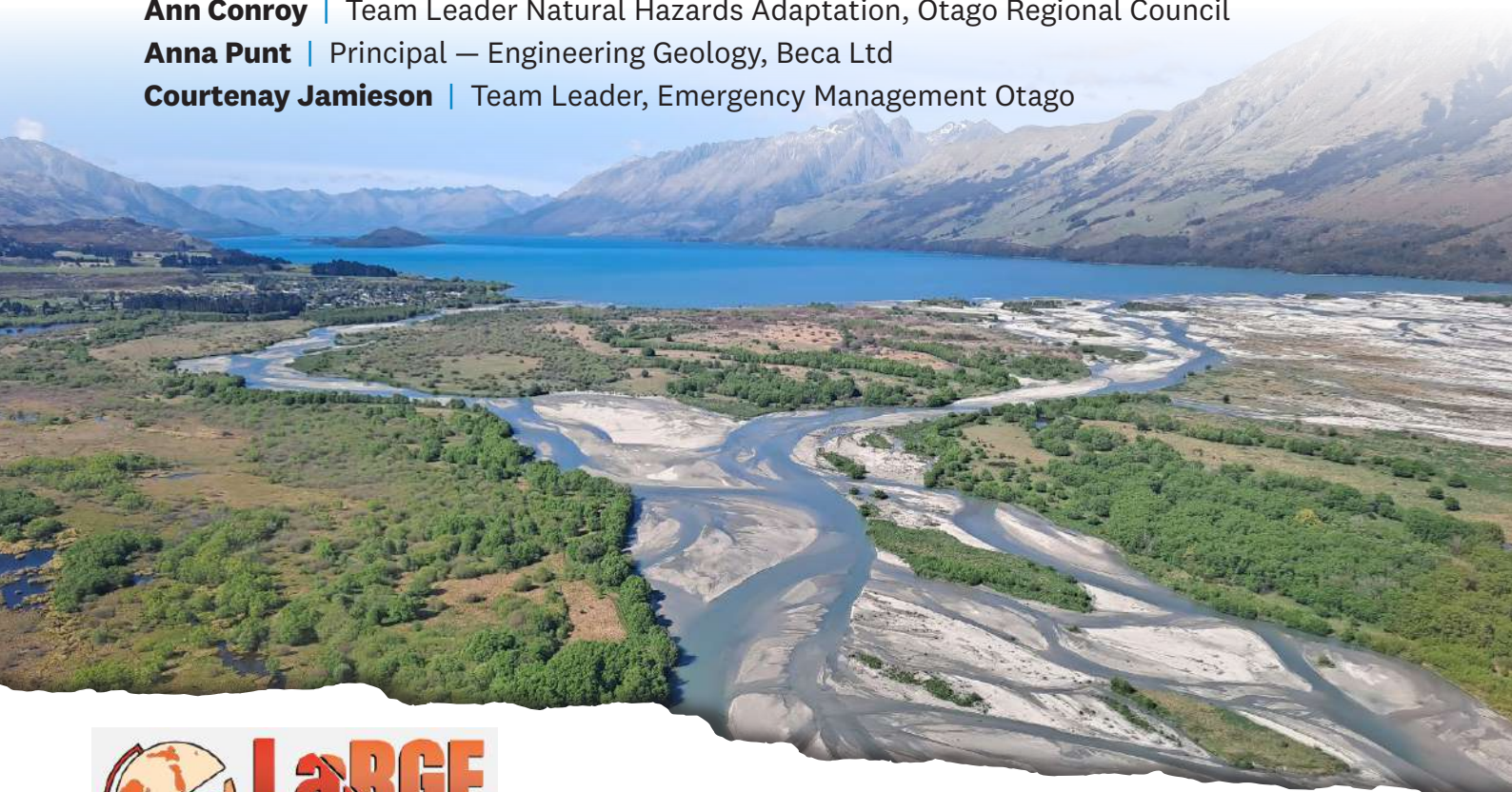
Field trip leaders

Tim van Woerden | Senior Natural Hazards Analyst, Otago Regional Council

Ann Conroy | Team Leader Natural Hazards Adaptation, Otago Regional Council

Anna Punt | Principal — Engineering Geology, Beca Ltd

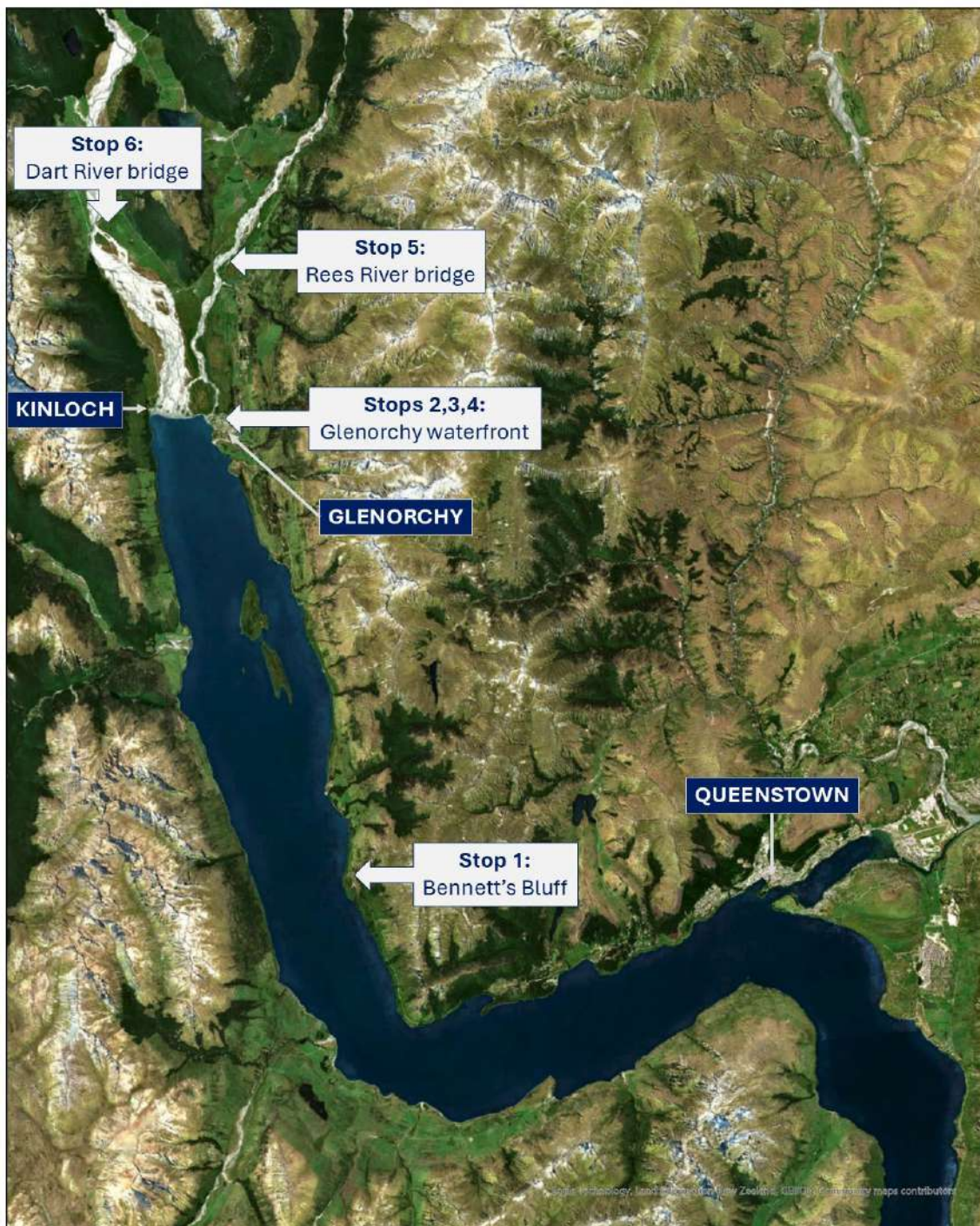
Courtenay Jamieson | Team Leader, Emergency Management Otago



Field trip schedule

Glenorchy field trip schedule	Timing	Notes
Assemble at Millenium Hotel in Queenstown from 8am, leave Queenstown by 8.30am	Leave 8.30am	
Drive to Bennett's Bluff 25-30 minutes driving, arrive by 9am	Arrive 9am	
Stop 1: Geological and geomorphic overview 30 minutes discussion at Bennett's Bluff, leave by 9.30am	9 to 9.30am	
Drive to Glenorchy 20 minutes driving, arrive by 10am	Arrive 10am	Headwaters Eco Lodge — room available as wet-weather back-up 10am to 1.30pm
Stop 2: Glenorchy area hazardscape 40 minutes discussion at Glenorchy waterfront, until 10.40am	10 to 10.40am	
MORNING TEA BREAK (20 minutes), until 11am	10.40 to 11am	
Stop 3: Adaptation, risk communication and engagement 1 hour discussion at Glenorchy waterfront, until midday	11 to 12 noon	
Stop 4: Emergency Management and Community Resilience 30 minutes discussion at Glenorchy waterfront, until 12.30pm	12 noon to 12.30pm	
LUNCH BREAK (1 hour), until 1.30pm	12.30 to 1.30pm	Lunch provided at Headwaters Eco Lodge
Drive to Rees River bridge (10 minutes)	Arrive 1.40pm	
Stop 5: River management challenges 30 minutes discussion at Rees River bridge, leave by 2.20pm	1.40 to 2.20pm	
Drive to Dart River bridge 10 minutes	Arrive 2.30pm	
Stop 6: Dart River and Hillocks rock avalanche 30 minutes discussion at Dart River bridge, leave by 3pm	2.30 to 3pm	
Drive back to Queenstown 1 hour, arrive by 4pm	Arrive 4pm	

Overview map of key locations



Stop 1: Bennett's Bluff lookout, Glenorchy-Queenstown Road

Geological and geomorphic overview

Geology and tectonics

The NW Wakatipu area is underlain by a basement of the Mesozoic Haast Schist Group, with lower grade schists of the Caples Terrain in the west, to the higher-grade, well foliated schists of the Caples and Rakaia Terranes in the north and east (Figure 1; Turnbull, 2000).

The area is tectonically active with the active or potentially active Alpine Fault, West Wakatipu, Moonlight and Nevis-

Cardrona faults all located within about 60 km (Barrell, 2019). The Alpine Fault marks the Australian-Pacific tectonic plate boundary and has a relatively short rupture recurrence interval, estimated to be between 250 and 340 years — last rupturing in 1717. The fault has a conditional rupture probability of 75% in the next 50 years, with an 80% chance of this being an earthquake of magnitude of 8 or above (Howarth et al, 2021).

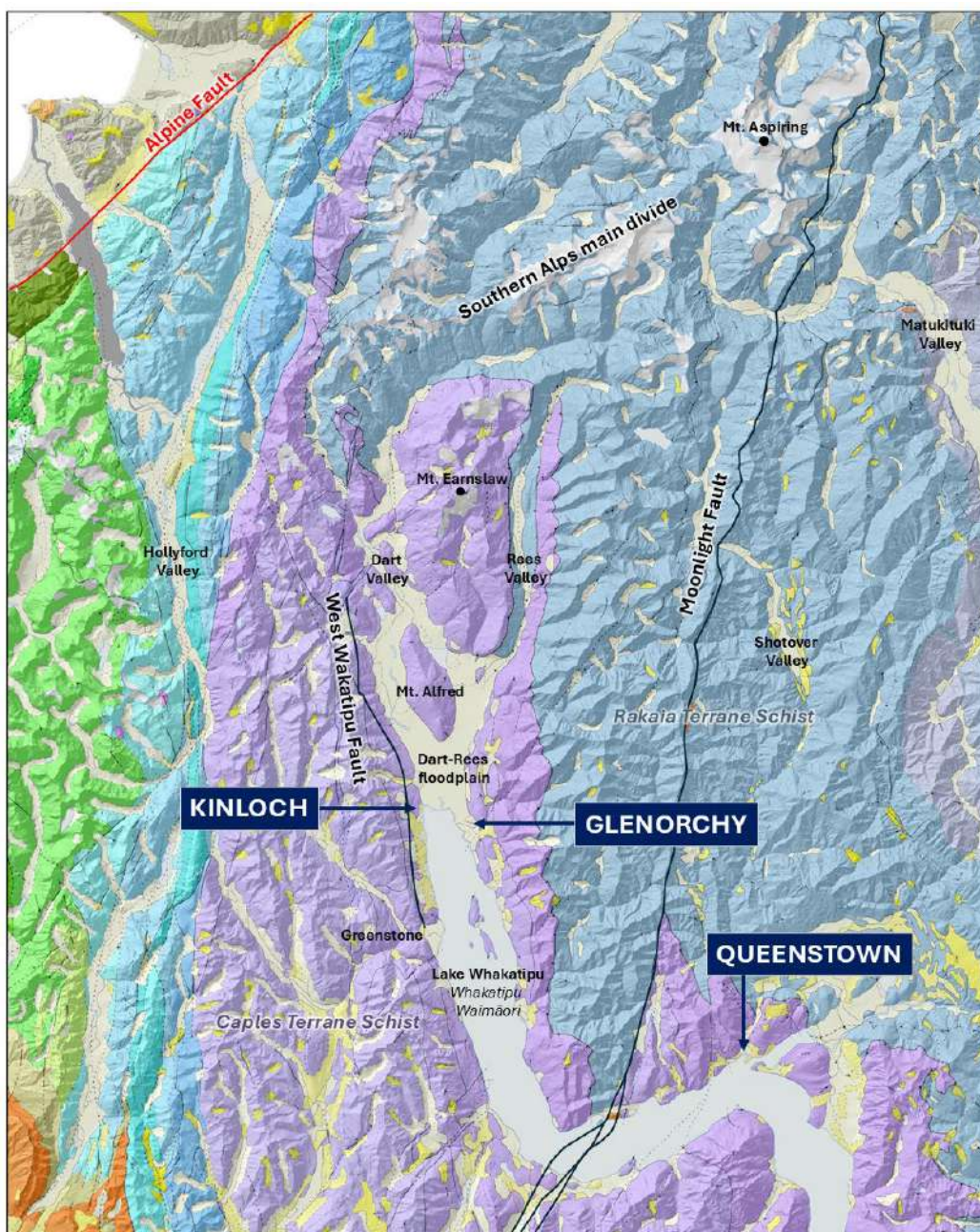


Figure 1: Overview of the geological features of the Wakatipu region.

Lake Wakatipu and the Dart-Rees catchments

Lake Wakatipu (Whakatipu Waimāori) occupies a large glacially-carved basin, lying between the Richardson Mountains to the east and the Humboldt Mountains to the west (Figure 2). The lake has a maximum depth of 380m, with its lake-bed being up to 70 metres below sea level, but the bedrock trough is much deeper — containing a depth of at least 400 metres sediment fill in places (Coursey and Mountjoy, 2022).

The lake formed subsequent to glacial retreat, initially with a water level approximately 50 metres higher than present-day lake levels, and which progressively lowered due to incision and then switching of outlet location from Kingston to Frankton. Remnant paleo-lake shorelines formed at these higher lake levels can be seen on the western lakeshore at the Greenstone River fan and at Glenorchy on Bible Terrace (Sutherland et al, 2019).

The Dart and Rees catchments at the head of the lake have a combined area of over

1050 km², and headwaters rising to over 2000m above sea level. These catchments have a very high sediment availability, driven by very high rates of erosion due to high rates of tectonic uplift (up to 5 mm/year), orographic precipitation which may exceed 5000 mm annually in at higher elevations, and an unstable ‘paraglacial’ landscape characterised by over-steepened slopes, retreating glaciers and abundant active landslides (Brasington, 2025).

The highly erodible schist bedrock in the Rees and Dart catchments is transported down-valley by the river systems, to be eventually deposited into Lake Whakatipu at the Dart-Rees delta. Sediment deposition infilling the glacially carved bedrock valley over time has formed the broad Dart and Rees floodplains which join together downvalley of Mount Alfred, where the floodplain is up to 4 km in width. The delta continues to grow with ongoing sediment deposition, advancing into the lake at a rate of 2-3 metres per year.

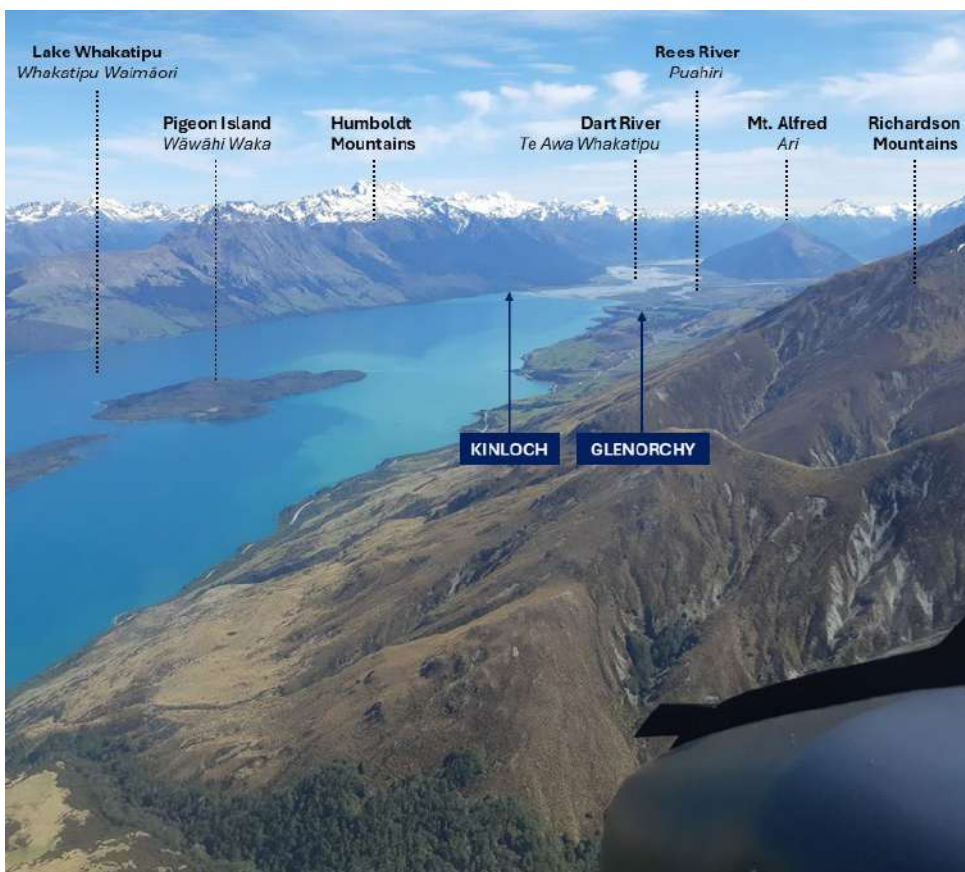


Figure 2: View northwards towards the head of Lake Whakatipu, showing the Dart-Rees floodplain and delta formed in the glacially-carved valley between the Humboldt and Richardson mountain ranges. The settlements of Glenorchy and Kinloch are located adjacent to the eastern and western margins of the Dart-Rees delta, respectively.

Geohazards challenges on the Queenstown–Glenorchy Road

The Glenorchy–Queenstown Road opened in 1962 and was sealed in 1997¹ – prior to completion of the road, the only access Glenorchy and the head of the lake was by boat. The road experiences intermittent disruptions from a range of natural hazard events – for example rockfall, debris flow and flooding – but at times access has also been disrupted due to treefall, snowfall or wildfire.

Figure 3 shows the example of a debris flow which occurred at Shepherds Hut Creek in April 2022.

This event caused a road closure of 36 hours and required clearance of ~3400 m³ of debris (Shaw, 2022). The existing culvert at this location is planned to be replaced with one of larger capacity to improve roading resilience.

The May 2010 rockfall in Figure 3 occurred in a section of the road known as the Narrows, and was estimated at 1500-2000 tonnes.



Figure 3: Left: May 2010 rockfall at the Narrows (photo: ODT). Right: Aerial view of debris flow impacts at the Queenstown-Glenorchy road, annotated to show the approximate extent of debris deposition (photo provided by Maddi Phillips, WSP Ltd).

¹ <https://www.glenorchycommunity.nz/glenorchy/gallery/photo-of-the-month/tom-my-thomson-scenic-drive/>

Stop 2: Glenorchy waterfront

Glenorchy area hazardscape and technical investigations

Glenorchy township is located on a low-elevation alluvial fan landform formed by the Buckler Burn at the lake margin, between the Rees River and Buckler Burn

drainages, and adjacent to the actively growing Rees delta and the Glenorchy Lagoon and wetland (Figure 4).



Figure 4: Overview of Glenorchy township.

Flooding hazards

The township is exposed to potential flooding hazards from sources including high flows in the Rees River (e.g. Figure 6), Buckler Burn and Bible Stream, high-water levels in Lake Whakatipu (e.g. Figure 5), or combinations of these sources. ORC has investigated flooding hazards through 2D hydraulic modelling and flood hazard analysis for the Dart-Rees Rivers (Gardner, 2022) and Buckler Burn (Gardner and Beagley, 2023).

The risk profile for flooding hazards at Glenorchy is expected to increase in future

through the influence of geomorphic and climatic drivers. For the Head of Lake Whakatipu catchments, climate change projections show significant increases in both rainfall and river flow variables (NIWA, 2019). Estimations of the climate change effects on flood flows for the Rees and Dart Rivers, are for the 1% AEP flood flows to increase in magnitude by approximately 20% by 2090 under a RCP8.5 scenario, and 13% under a RCP6.0 scenario (Mohssen, 2021).



Figure 5: Flooding of Glenorchy township residential area, due to highest water levels on record in Lake Whakatipu (November 1999).



Figure 6: Flooding of Glenorchy township residential area, due to high Rees River flows causing overtopping of a section of the Rees-Glenorchy floodbank (February 2020).

Seismic hazards

In addition to flooding, Glenorchy township is also exposed to seismic hazards such as ground shaking and liquefaction. The township is situated ~50 km from the Alpine Fault, and other nearby active faults also include the West Wakatipu Fault, running along the western margin of the lake from Greenstone to Routeburn, and the Moonlight Fault which crosses the lake near Bob's Cove (Figure 1).

As the township is underlain by a thick sequence of deltaic and alluvial sediments it is highly vulnerable to liquefaction and lateral spreading. Liquefaction vulnerability was assessed by Tonkin + Taylor (T+T, 2022), in a study completed to a Level C (detailed area-wide assessment) detail in accordance with the national planning and engineering guidance for potentially liquefaction-prone land (MfE/MBIE, 2017).

The study developed a liquefaction vulnerability categorisation map for the Glenorchy township study area (Figures 7 and 8), intended to show broad trends in liquefaction vulnerability. For strong earthquake shaking, significant and widespread liquefaction land damage may occur across all the lower lying areas of Glenorchy in the north and west.

Findings show the potential for lateral spreading damage is highest near the lake edge and decreases with an increasing distance from the lake. The magnitude of potential lateral spreading damage increases with earthquake shaking at larger return periods, and for stronger shaking may be comparable or worse to that observed in parts of the residential red zone in Christchurch, which was typically in the order of 1m to 3m.

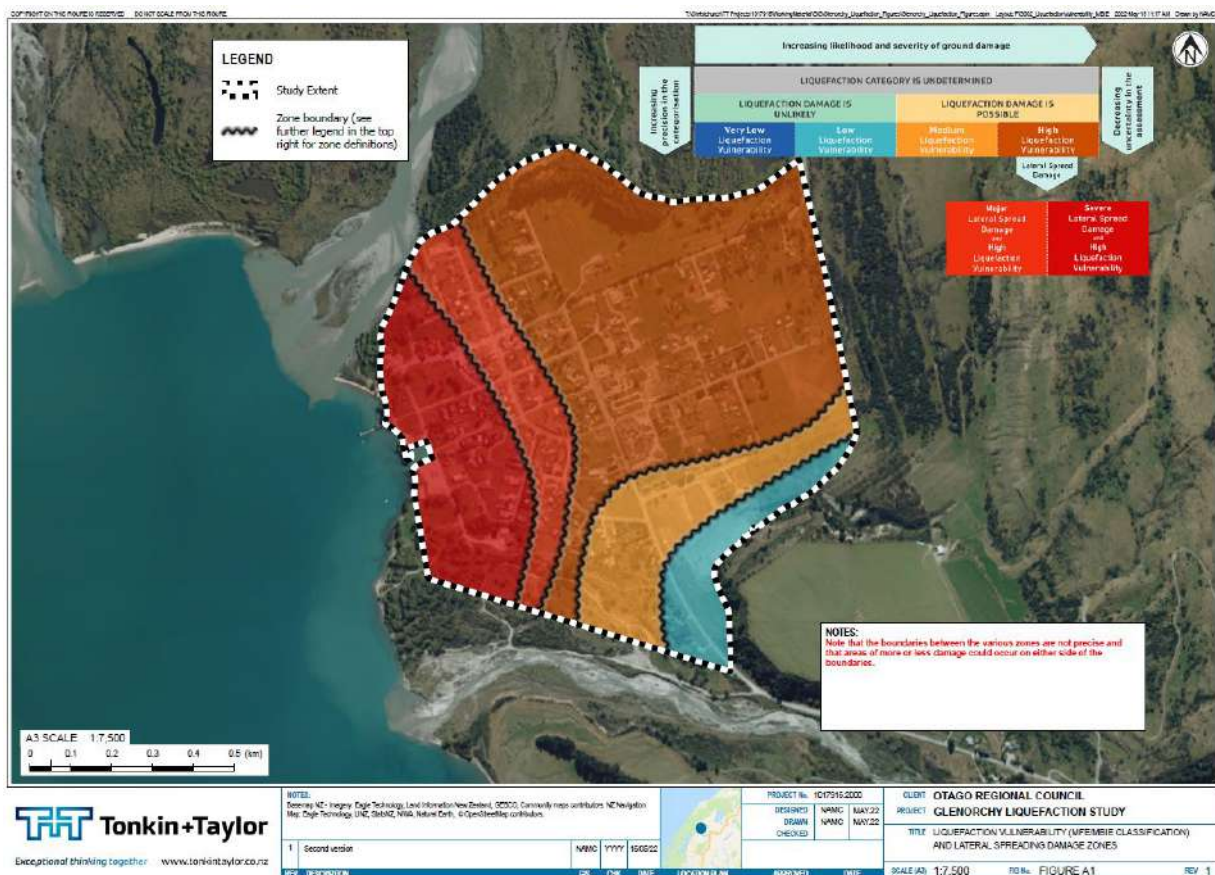


Figure 7: Liquefaction vulnerability categorization for Glenorchy township (T+T, 2022).

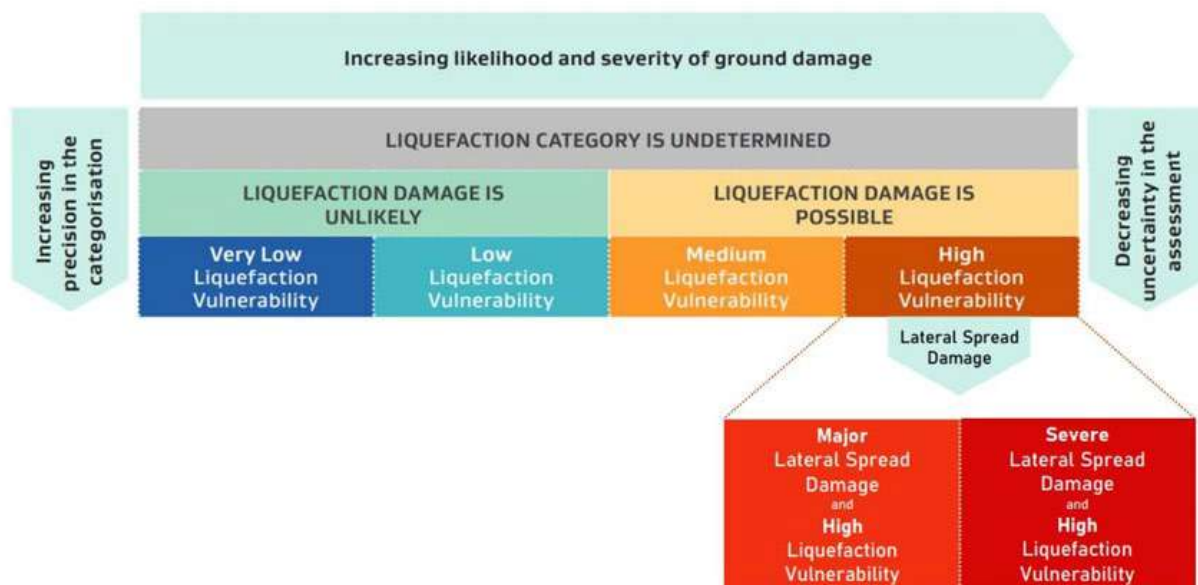


Figure 8: Hazard categorisation used for assessment of liquefaction and lateral spreading hazard at Glenorchy (T+T, 2022).

Natural hazard risk analysis

Hazard assessments for flooding and seismic hazards were followed by a risk analysis to better understand and characterise the natural hazards risks for Glenorchy township. The purpose of the risk analysis was to:

- a. Provide the Head of Lake Whakatipu community with information on the relative levels of natural hazard risk in the township.
- b. Provide a robust evidence base for any future land use decision-making, such as if avoidance approaches may be appropriate for higher-risk areas.
- c. Provide a greater risk understanding for identification and prioritisation of risks to assist adaptation or risk management activities.

The analysis considered the risks to life and property from the following natural hazards:

- River flooding from Rees River, Dart River, and Buckler Burn.
- Lake Whakatipu flooding.
- Seismic shaking.
- Liquefaction and lateral spreading in earthquakes.

For several other hazard types, there was insufficient information available to carry

out detailed risk analysis, but these were discussed at a high level in the report – for example, lake tsunami, debris flow or debris flooding, and cascading hazard scenarios.

Risk analysis was completed by Beca Ltd (Menke et al, 2024) and followed the risk assessment framework of the proposed Otago Regional Policy Statement (ORC, 2021). Risk was initially assessed qualitatively (descriptively), using a risk matrix approach as a screening to determine which risks warranted further assessment, then (if required) followed by a quantitative (numeric) calculation of risk to life (AIFR, Annual Individual Fatality risk) and property (APR, Annual Property Risk).

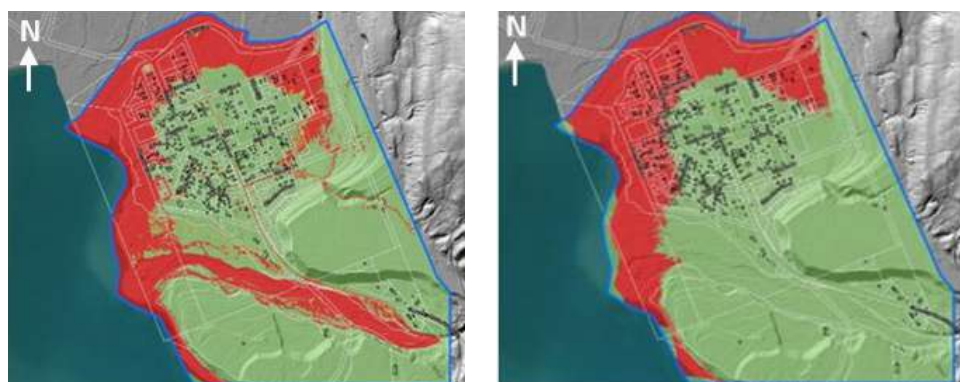
Analysis showed that risk to property (APR) from flooding and liquefaction hazards exceeds the quantitative tolerability thresholds listed in the proposed RPS (Step 4 of APP6), but risks to life were considered acceptable.

For flooding hazards, the areas of higher risk were those in the northern and western (lakefront) parts of the township (Figure 9). For liquefaction hazards, risks to the entire township area were identified as being ‘significant’, with lateral spreading anticipated to result in the most significant damage focused along the lake margins.

Table 1: Summary of risk analysis findings for Glenorchy, showing the qualitative assessment as screening to identify risks carried forward for further quantitative analysis.

Hazard	Qualitative Assessment			Quantitative Assessment	
	Health and Safety Risk	Built Environment Risk		Life Risk (AIFR)	Property Risk (APR)
River flooding - Buckler Burn	☑	☑		Acceptable	Significant
River flooding - Rees/Dart	☑	☑		Acceptable	Significant
River flooding - Joint (multiple sources)	n/a	n/a	☑ risks carried forward for quantitative analysis	Acceptable	Significant
Lake Whakatipu flooding	Acceptable	☑			Significant
Liquefaction and lateral spreading - Glenorchy	Acceptable	☑			Significant
Seismic shaking	Acceptable	Tolerable			

Acceptable and Tolerable risks that do not require further analysis



Quantitative Combined Risk Classification
 APP6 (ORC, 2022)

	Acceptable Risk		Tolerable Risk		Significant Risk
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Figure 9: Quantitative risk assessment outputs for Annual Property Risk (APR) at Glenorchy, for river flooding (left) and lake flooding (right).

Socio-economic impact assessment

Complementing the natural hazard risk assessment was a socio-economic impact assessment completed by Beca Ltd, which was designed to provide a baseline review of social and economic impacts from natural hazards event (Healy et al, 2024). The assessment also examined the potential social and economic consequences of three indicative natural hazard scenarios in relation to the status quo (the current community and the natural hazard management measures currently in place).

The assessment involved a combination of primary (interviews, survey and focus group) and secondary (e.g. desktop review) research, and helped to explore;

- who makes up the community,
- how the community functions,
- what they need to remain living and/or operating in the community, and
- vulnerabilities and resilience (social and economic) to natural hazards.

The assessment provided valuable information about the community and their awareness and preparedness of natural hazards, helping to understand their resiliency and key vulnerabilities (e.g. Figure 10). Inclusion of this study helped to ensure the overall adaptation programme included a stronger consideration of social and community aspects, rather than being solely a ‘technical’ science and engineering project.

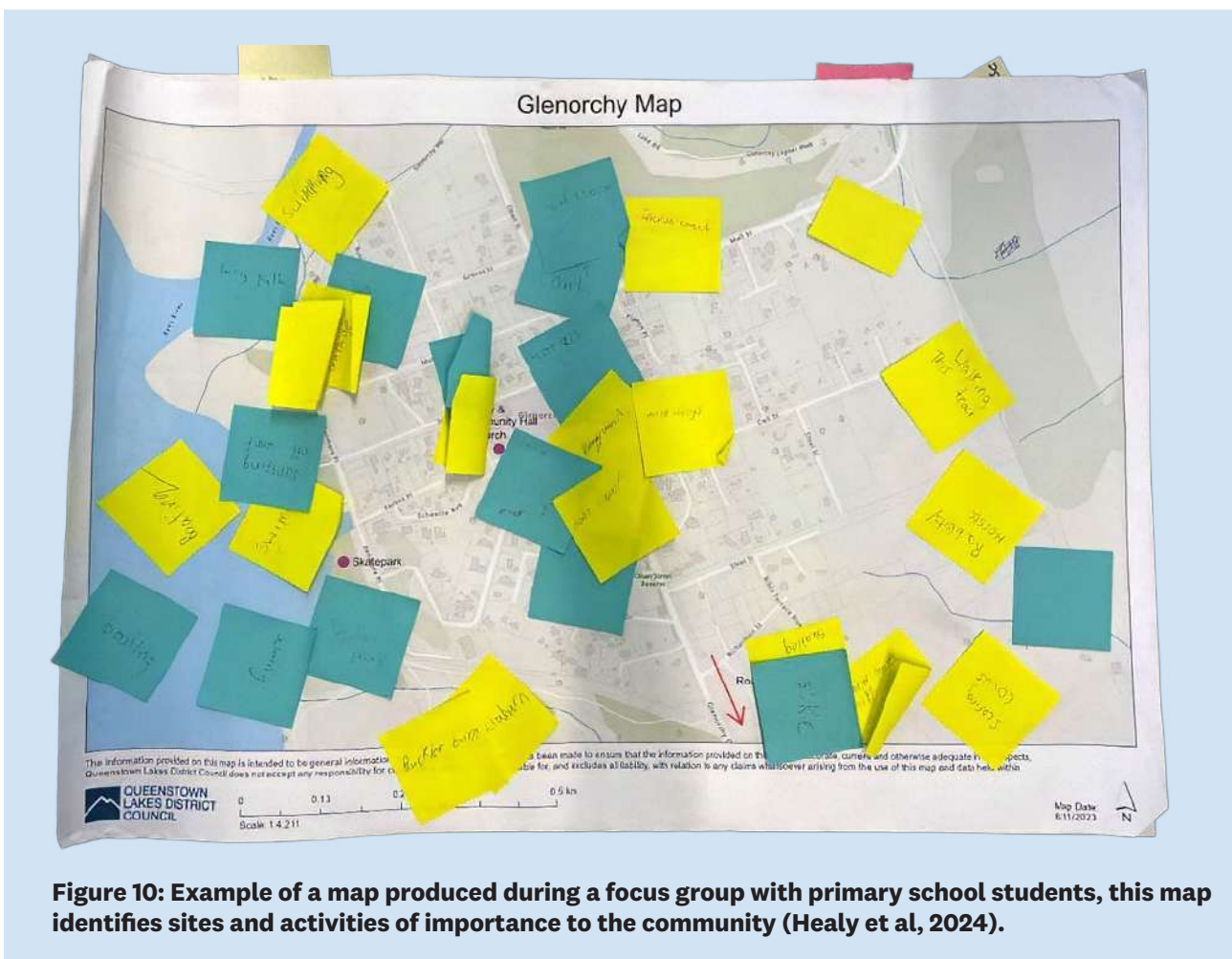


Figure 10: Example of a map produced during a focus group with primary school students, this map identifies sites and activities of importance to the community (Healy et al, 2024).

Stop 3: Glenorchy waterfront

Adaptation, risk communication and engagement

To address the natural hazard risks present in the head of Lake Whakatipu area, ORC led a multi-year (2019-2025) work program to develop a holistic, longer-term natural hazards management plan. This plan was completed in May 2025 as the *Head of Lake Whakatipu Natural Hazards Adaptation Strategy*, completed in partnership between ORC, Queenstown Lakes District Council (QLDC), Civil Defence Emergency Management Otago (CDEM) and the local community, and has been developed in collaboration with mana whenua representatives.

The Strategy is presented as two key outputs (ORC, 2025a, 2025b);

- a. a shorter overview document designed as a simple summary of the strategy content, and
- b. a comprehensive strategy document which includes all detail of the project background and work completed.

The vision for the Strategy was **a resilient and sustainable Head of Lake Whakatipu, where proactive natural hazard and climate adaptation enhance community wellbeing and safety, and contribute to a flourishing environment.**

Strategy content includes;

- **Vision, goals, principles and scope**
- **Setting the scene** – background and context.
- **Drivers for adaptation**
- **Legislative and strategic context**
- **Strategy governance** – including partnerships, and roles and responsibilities for implementation. Adaptation cycle approach to planning – guides the reader through the adaptation process using the five key questions as a framework:

1) *What is happening?* – foundation information about natural hazard processes, characteristics, and potential impacts.

2) *What matters most?* – values, aspirations, fears and concerns we have heard from community, partners and stakeholders; socio-economic vulnerability and resilience; Kinloch and Glenorchy risk analysis findings; and tolerability discussion.

3) *What can we do about it?* – long-list of possible response, including existing and possible future responses; high level evaluation of possible responses and mana whenua assessment.

4) *How can we implement the strategy?* – adaptation pathways with signals and triggers; implementation framework.

5) *How is it working?* – a review framework.

- **Action Plan** – outlines the relevant work of strategy partners in progress, planned and committed.
- **Appendices** – including project deliverables, supporting information about existing responses and future toolbox, and summary of feedback on the draft Strategy.

The Strategy was developed using an approach in line with the Ministry for the Environment's 10-Step adaptation cycle (Figure 11). This cycle incorporates a method known as Dynamic Adaptive Pathways Planning (DAPP) or 'Adaptation Pathways.' The cycle has been promoted by the Ministry for the Environment (e.g. MfE, 2024) as a blueprint for community-influenced decision-making in areas affected by natural hazards, while considering potential future uncertainties (e.g., landscape and climate changes).

The volume of work required to develop a strategy of this type should not be underestimated. Activities in this work programme included; completion of >20 individual technical studies, undertaking 20+ community engagement activities over 5+ years, compiling 45 editions

of a community newsletter, creating and maintaining a programme website, preparation of >10 update reports or workshops to council governance, installation of additional environmental monitoring stations, plus a huge amount of staff time.

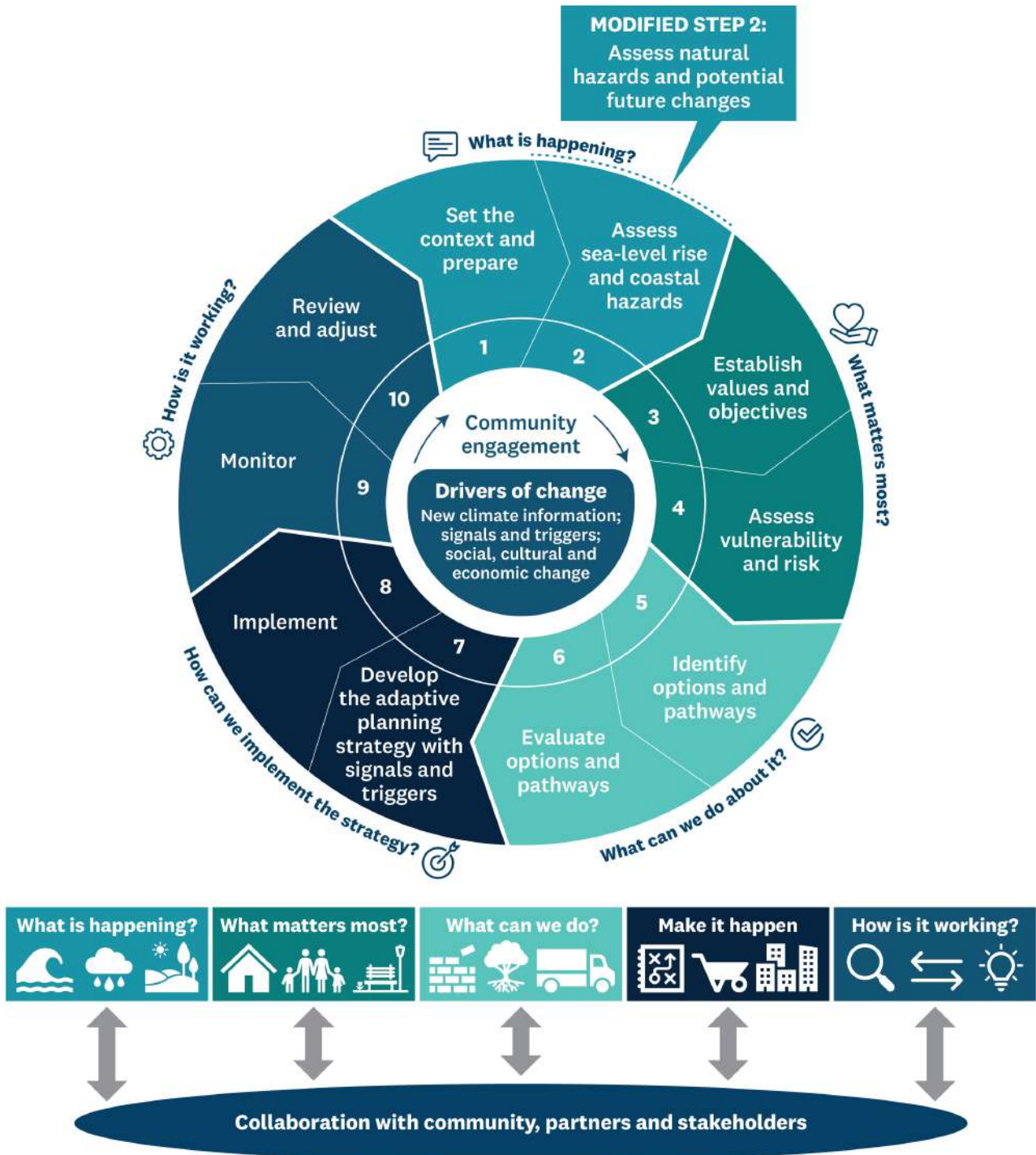


Figure 11: The 10-step decision cycle framework (modified from MfE, 2024) and a simplified sequence of activities making up the approach.

Community engagement

Community engagement is central to the adaptation cycle in all steps. The development of the Strategy and ideas for adaptation pathways has involved extensive engagement with communities, experts, mana whenua and partner agencies.

Collaboration and engagement with the head of the lake community were critical to developing the Strategy. Making sure we included local knowledge about past natural hazards events, understood key natural hazards concerns held by the community, and drew on their thoughts about possible hazard mitigation approaches to be considered.

Engagement and communication activities included drop-in sessions (e.g. Figure 12), presentations (mix of in-person and online), surveys, attendance at community meetings, and an emailed monthly newsletter (e.g. Figure 13).

Key lessons for ORC from the programme and engagement activities;

Programme design and project planning

- Take time to develop relationships, trust and continuity with the community – can't take short cuts or rush the programme.
- Collaborative programme design and engagement planning (e.g. regional and district council, civil defence) ensures a more consistent approach between the organisations involved. We also invited the Glenorchy Community association to provide input to aspects of the programme design and planning for engagement sessions.
- Detailed planning and design for engagement sessions pay off – these need to be well thought out and tailored for the specific community, and cannot just do this ad-hoc.

Engagement and communications

- Allow many opportunities for community feedback and input – helps to ensure the final output considers their views.
- Be up-front and honest – no sugar-coating of difficult findings.
- Attempt to balance bad news – e.g. through showing progression to next steps (“this is new natural hazards information sounds concerning, but we are next investigating potential approaches for managing this hazard, and will report back again when that work is completed”).
- Be clear there are no pre-determined outcomes – the community inputs matter and will assist to guide/inform the final strategy direction and content.
- Share new information progressively as soon as it is available, and through a range of media (e.g. in-person, email, website, video) – no surprises, and make sure they don't hear it from the media first)
- Enable community to talk directly to the experts and discuss their questions/concerns - remove the middleman of council staff.
- Identify short-term quick wins to build trust – what on-the-ground actions can we take now – otherwise there is the perception of no progress (e.g. “it's all talk but no action”, or “just another report”). For example, the installation of additional flow or water level monitoring stations, localised river or vegetation management activities.



Figure 12: Community engagement session in Glenorchy Hall, August 2023.

HEAD OF LAKE WHAKATIPU



COMMUNITY UPDATE 44 | FEBRUARY 2025

Kia ora koutou,

We hope you all enjoyed the holiday period and are looking forward to a new year ahead.

If you haven't yet had a chance to give your feedback on the [Draft Head of Lake Whakatipu Natural Hazards Adaptation Strategy](#), we'd like to remind you that the feedback period is open until **23 February 2025**.

We'd also like to remind you that we are coming back to the Glenorchy Hall to give a presentation of the Draft Strategy and Q&A from **7-9pm on Thursday, 13 February**, which will be available as a formal drop-in session the next day from 10am to 12pm.

Figure 13: Example of a community newsletter, emailed approximately monthly throughout the work programme.

Challenges

A key challenge was that the project resulted in a number of media stories highlighting the natural hazard exposure in Glenorchy (e.g. Figure 14), and as a consequence, the community felt they were ‘in the spotlight’, and worried about implications for property value and insurance etc.

This concern is difficult to manage, as we have no control over the content of media

or insurance decisions, but a key step is making sure any of our natural hazards or risk information is robust and easily understandable.

Although the headlines may have grabbed attention, the content of these media stories was generally non-controversial and a useful avenue to draw attention to, and communicate, the findings of our work programme.



Figure 14: Selected ODT and RNZ headlines relating to natural hazards at Glenorchy, 2022-2024.

Development of adaptation pathways

To inform the step “what can we do about it?” we identified all existing hazard management activities (e.g. BAU actions in Figure 15), and also a range of possible new interventions, referred to as the ‘future toolbox’. These were across the full range of the ‘PARA’ framework (Protect, Accommodate, Retreat, Avoid). All of these existing and potential new approaches were assessed in a high-level evaluation for factors including effectiveness, cost, community preferences, and timeframe to implement.

For selected interventions, more detailed hazard mitigation assessments completed to provide increased information on the feasibility of implementation;

- Damwatch Ltd investigated the feasibility of flooding and floodplain management interventions, including ‘nature-based solutions’ (NbS), for hazards on the Dart and Rees floodplains (Webby, 2022; Menéndez and Shrestha, 2024; Veale and Shrestha, 2024; Veale et al, 2024;).

- For liquefaction and lateral spreading, Tonkin + Taylor Ltd (2023) reviewed a range of engineering mitigation techniques that could be considered for the management of liquefaction and lateral spreading hazard, spanning from very robust options through to a ‘do nothing’ option.

Table 2 is an example of the format used for presenting adaptation pathways, as a combination of existing actions (funded or in-progress), and those of the ‘future toolbox’.

None of the ‘future toolbox’ actions are currently funded within council budgets, and inclusion of these actions in the Strategy doesn’t make any commitment to the councils to their eventual implementation. However, the background work completed to identify and investigate possible future responses sets the scene for these approaches to be considered through council funding processes, such as Long-term Plan development.

Natural hazard resilience at the Head of Lake Whakatipu is reliant on a strong foundation of existing responses.



Figure 15: Existing hazard management actions for natural hazard resilience in the head of Lake Whakatipu.

Table 2: Example of adaptation pathways approaches identified

EXISTING RESPONSES AND IMPROVEMENTS IN OUR ACTION PLAN	POSSIBLE FUTURE RESPONSES IN THE FUTURE TOOLBOX
<p>Existing flood mitigation and protection</p> <ul style="list-style-type: none"> Existing low-level Rees River flood protection by Glenorchy floodbank (maintenance and reactive repair) Existing river management (vegetation and gravel) 	<p>Flood mitigation and protection (possible future responses)</p> <ul style="list-style-type: none"> Small-scale improvements to Glenorchy floodbank to maintain/ reduce flood risk Major works to increase level of service of Glenorchy floodbank Redesign Rees flood protection for changed conditions (e.g. post event) River management and nature-based interventions (e.g. targeted planting) Redesign nature-based interventions for changed conditions Small-scale works to reduce Buckler Burn erosion and/or flood risk
<p>Existing road access</p> <ul style="list-style-type: none"> Maintenance, reactive repair and planned works for the Glenorchy–Queenstown Road Maintenance, reactive repair and planned works for the Kinloch and Glenorchy–Paradise local road system 	
<p>Existing boat access</p> <ul style="list-style-type: none"> Existing boat access at Kinloch and Glenorchy (limited by existing and ongoing sediment accumulation) 	
<p>ACTIONS TO IMPROVE: Addressing impacts of natural hazards and climate change</p> <ol style="list-style-type: none"> Routine maintenance of QLDC transport network, including roading assets, Glenorchy jetty and marina. Glenorchy Area Bridge Resilience (QLDC 24–34 LTP) — non-routine work required to protect the serviceability of the Glenorchy, Paradise and Rees River bridge assets following damage and to minimise threat of road closure due to natural phenomena. Raising Kinloch Road (QLDC 24–34 LTP) — raising Kinloch Road in conjunction with two-yearly gravel extraction under the Rees River bridge. Develop Operational River Management Plans, including the Dart and Rees floodplains (ORC). Develop a gravel management plan for the Buckler Burn (ORC). Annual vegetation management, rock armouring and gravel management (ORC) — ongoing river management activities (such as regular vegetation control in Lagoon Creek / lagoon area). Maintenance of Rees River floodbanks (ORC) — maintain (not renew or increase) the existing banks (*Rees River floodbanks are not owned by ORC). Floodplain and rivers (ORC) — create/trial NBS groynes. 	<p>Road access (possible future responses)</p> <ul style="list-style-type: none"> Small-scale improvement to existing Kinloch and Glenorchy–Paradise local road system (as well as maintenance and reactive repair) Reduced level of service of existing Kinloch and Glenorchy–Paradise local road system (e.g. some parts 4WD only) Major works to increase resilience of Kinloch and Glenorchy–Paradise local road system (e.g. protect, raise, realign) Reactive redesign Kinloch and Glenorchy–Paradise local road system for changed conditions (e.g. post event) <p>Boat access (possible future responses)</p> <ul style="list-style-type: none"> Short-term improvements to existing boat access (e.g. dredging) Upgrade boat access with resilient solution (e.g. relocatable wharfs) Relocate wharfs periodically to maintain future access

Stop 4: Glenorchy waterfront

Emergency Management and Community Resilience

A key component of natural hazard resilience is emergency readiness and planning, which complement longer-term or larger-scale actions such as the potential implementation of hazard mitigations, infrastructure resilience actions or landuse planning tools.

Emergency Management Otago (EM Otago) and the Councils (both ORC and QLDC) have collaborated closely in the development of this natural hazards adaptation strategy, and CDEM staff and information were integrated into all community engagement for the natural hazards strategy project.

Supporting a community-led response is a highly valuable approach to building local

resilience, particularly for more isolated communities like Glenorchy. To develop resilience capacity in the region, EM Otago have established a network of Community Response Groups (CRG's) around the region, with these groups supported through training and funding resilience equipment.

The background to the establishment of the community response groups is outlined in the Emergency Management Otago [Community Resilience Strategy](#) (EMO, 2023). The purpose of the Strategy is to create a structured pathway for EM Otago to enhance community resilience and connectedness both in the readiness and response stages of an emergency scenario.



Figure 16: Conceptual capability framework for different levels of community resilience.

Glenorchy Community Resilience Group

In a large-scale emergency response, help will come to communities, but it may take time. Emergency Management Otago activates its Emergency Operations Centre (EOC) and co-ordinates the response, however reaching everyone doesn't happen right away, so the more prepared and self-sufficient communities are, the better they can support themselves in an emergency. In various after-action reviews to emergency responses, it has been identified that the

community-led responses are the most effective. The more resilient and connected a community is, the lesser the negative impacts of natural disasters.

This is where the Otago Community Resilience Groups (CRGs) come in. Trained community volunteers use local knowledge and plans to keep their neighbourhoods connected, resourced, and ready to support one another. Their efforts ease pressure on emergency services and speed up recovery.

To ensure CRG's have the capability to activate in an emergency, EM Otago provide the following formal training:

- Status reporting and radio communications
- Community Emergency Hub operations
- Health and Safety requirements
- Tabletop exercises — including standing up their community emergency hub.

When CRGs 'stand up' in an emergency, their key responsibilities include:

- Setting up and running a Community Emergency Hub — a safe, central place for the neighbourhood to get information, share resources and support each other. Starlink access may also be available to help check in with your key contacts.
- Coordinating local essentials like food, shelter, and communication.
- Sharing official updates with their community and passing on local information and needs to the Emergency Operations Centre.
- Linking up with other CRGs via established networks like Starlink or emergency radios and sharing intelligence, challenges and solutions.
- Using local knowledge, connections and resources to solve problems faster.

The Glenorchy CRG was established in 2021 and is now one of the more mature CRG's in Otago in terms of capability and experience, having undertaken all the above training. As a result of this there is a strong connection between the Glenorchy community and council, with many collaborative approaches to building resilience in the community.

In Glenorchy two locations have been identified as local community emergency hubs;

Primary: The Headwaters Eco Lodge, 42 Oban St, Glenorchy

Alternative: Glenorchy Hall, 31 Mull St, Glenorchy.

The Glenorchy community emergency hub has activated on several occasions in recent years, with the most recent being the weather events in September 2024 and October 2025.

A strength of the Glenorchy CRG is in its members. They have extensive knowledge of their community and landscape, being locals in the area for decades. Members include the Dart River Operations Manager, Heli Glenorchy Office Manager and DoC field staff. They have extensive local knowledge and can provide local expertise the EOC would otherwise not have.

Although there wasn't flooding within the township area during the above events (however October 2025 was within ~10cm of overtopping the Glenorchy-Rees River flood bank), members of the CRG were on standby, monitoring the situation, and prepared to assist with evacuation if required.

When the Glenorchy CRG activated their emergency hub in the October 2025 severe weather event, they were pro-active in reaching out to EM Otago, as there was already a solid foundation of trust and collaboration. Whilst EM Otago and the Natural Hazards team had data and modelling for the severe weather impacts, it was strengthened further with the on the ground intel from the Glenorchy CRG locals.

Due to the expertise and intelligence provided from the CRG, EM Otago could assess what kind of welfare response was required and when, rather than making assumptions and wasting time and resource. The CRG was able to provide real-time intelligence, rather than EM Otago making educated guesses from an office in the EOC. Having a CRG who has undertaken formal training with EM Otago, knows the response system and how to feed in valuable intelligence, strengthens any emergency response and reduces the negative impacts or a long tail recovery.

In the readiness phase of emergency planning, Glenorchy CRG have worked closely to create an [Emergency Preparedness brochure](#) (Figure 17) and a [Community Resilience Guide](#) tailored specifically to Glenorchy. These are more

great examples of having local knowledge fed into a more structured and formal document to provide a full narrative of community perspective as well as emergency management perspective on practical steps the Glenorchy community can take to be prepared for emergencies.

QLDC has also recognised the importance of having enabled CRG's and ran a funding round to purchase emergency equipment. In collaboration with Central Lakes Trust and EM Otago, CRG's were able to choose from a list of emergency supplies and equipment. These were purchased by QLDC and then delivered to the groups via EM Otago. The Glenorchy CRG received a generator, BBQ equipment and radios, all to be used in their community emergency hub, to strengthen their community-based response, and ease the demand on the EOC.

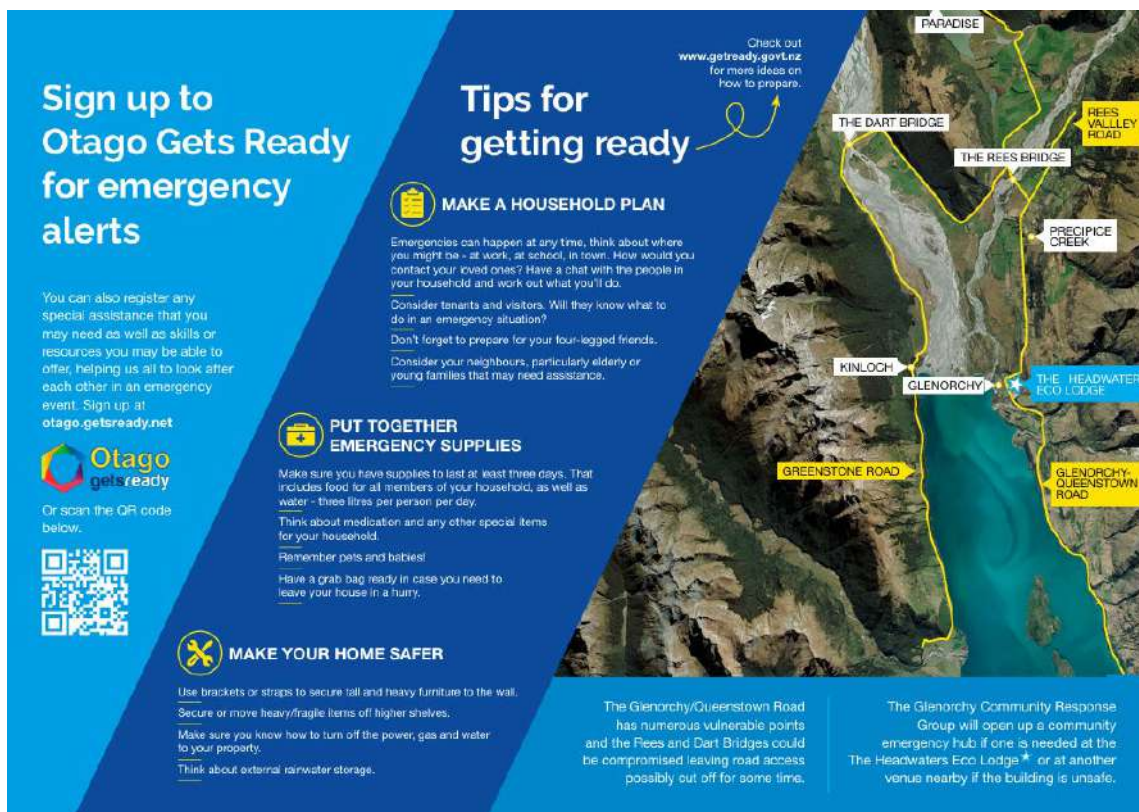


Figure 17: Glenorchy emergency preparedness brochure.

Stop 5: Rees River bridge

River management challenges

The braided Dart and Rees river systems are highly dynamic, due to high rates of sediment supply, regular high flows and persistent channel aggradation (Brasington, 2025). Where infrastructure or other development is located within or adjacent to the floodplain, this creates a challenge to management of those assets in the longer-term

There is a persistent, widespread aggradation trend in the active riverbeds of the Dart and Rees rivers, at rates of >10 cm per decade, and locally as high as >25 cm per decade (Brasington, 2025). Riverbed aggradation impacts on flooding hazards through reducing the flood capacity of the active river channels, in turn reducing available freeboard to riverbanks and floodbank structures, while also increasing rates of lateral migration of the braided riverbed's active channels.

[Rees River](#)

In several locations the Rees River's active channel is super-elevated or 'perched,' higher than the surrounding floodplain (Figure 18, Brasington, 2025). As aggradation of the active riverbeds continues, an avulsion (breakout) of the

river channel into these lower elevation floodplain areas becomes increasingly likely and an inevitable outcome over time.

A major eastwards avulsion of the Rees River towards the Glenorchy Lagoon is likely to increase the depth and extent of flooding at the eastern end of the floodbank. However, effects on potential flooding extent within the township are minor due to the current topography controlling the flood extent.

Ongoing sediment deposition is notably decreasing clearance under the Rees River bridge, which has been significantly reduced compared to historical observations (e.g. ORC, 2013). There is very little freeboard to the underside of the bridge in even a 5-year ARI event (Wong et al., 2023), however at these flows, floodwaters break out over the left and right bank floodplains, relieving pressure at the bridge structure. A structural options assessment for the bridge has recommended management of potential issues through river management approaches rather than structural option such as modification of the bridge (Wong et al., 2023).

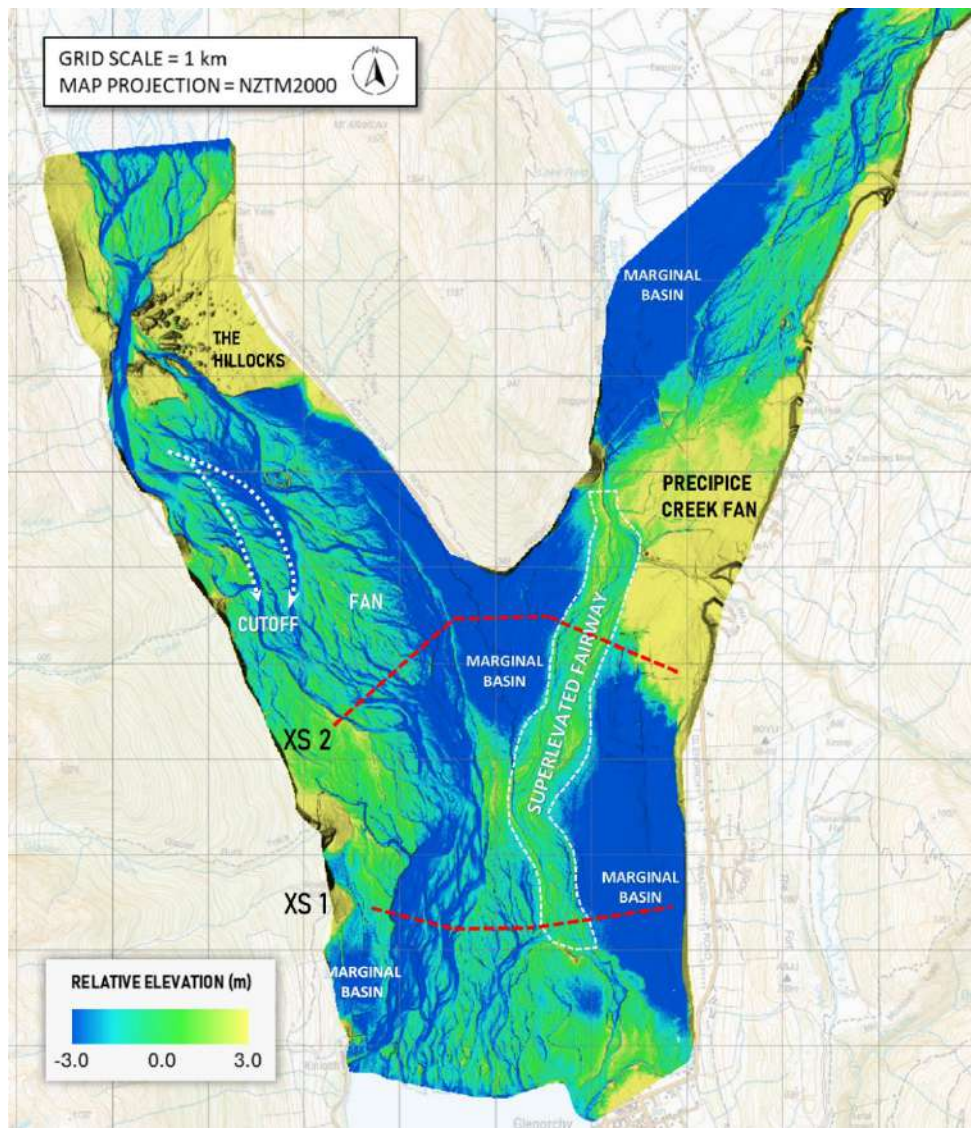


Figure 18: Relative Elevation Model (REM) of the lower 10 km of the Rees-Dart Rivers, highlighting the currently superelevated active channel of the Rees River and the marginal topographic depressions (Brasington, 2025).

Dart River

The road access to Kinloch is located on the Dart River floodplain and is prone to closure due to flooding (e.g. Figure 20), often on multiple occasions per year. Additionally, the road is threatened by ongoing westwards bank erosion (e.g. Figure 19), requiring increasing frequency of mitigation and repair.

The current approach by the road owner (QLDC) is to continue with managing

natural hazards concerns through reactive repair and planned maintenance. Approaches for sustainably managing these erosion hazards in the longer-term have been investigated for ORC by Damwatch Ltd, including the use of vegetated buffers and/or rockfill protections (Webby, 2022; Menéndez and Shrestha, 2024).



Figure 19: Erosion damage to Kinloch Road on the right bank of the Dart River (November 2024), this damage was repaired by realigning a short section of the roadway slightly inland from the river channel.



Figure 20: Flooding of Dart floodplain, showing inundation of Kinloch Road (March 2019).

Stop 6: Dart bridge

Hillocks rock avalanche

The final stop of this field trip is the Dart River bridge, at the distinctive hummocky mounded landscape known locally as ‘The Hillocks’.

These landforms are formed the deposit of a very large rock avalanche sourced from the steep slopes of the Humboldt Mountains, which ran out across the Dart River floodplain and extends to the opposite valley wall at Mt Alfred (Figure

21). Investigations including sedimentology, cosmogenic dating and ground-penetrating radar have shown that the deposit has a volume of ~15–27M m³ and was emplaced at ~8ka, a time by which the Wakatipu Glacier had retreated up valley past this location, and the Dart River had prograded down-valley of this location (McColl and Davies, 2011; McColl et al, 2019).

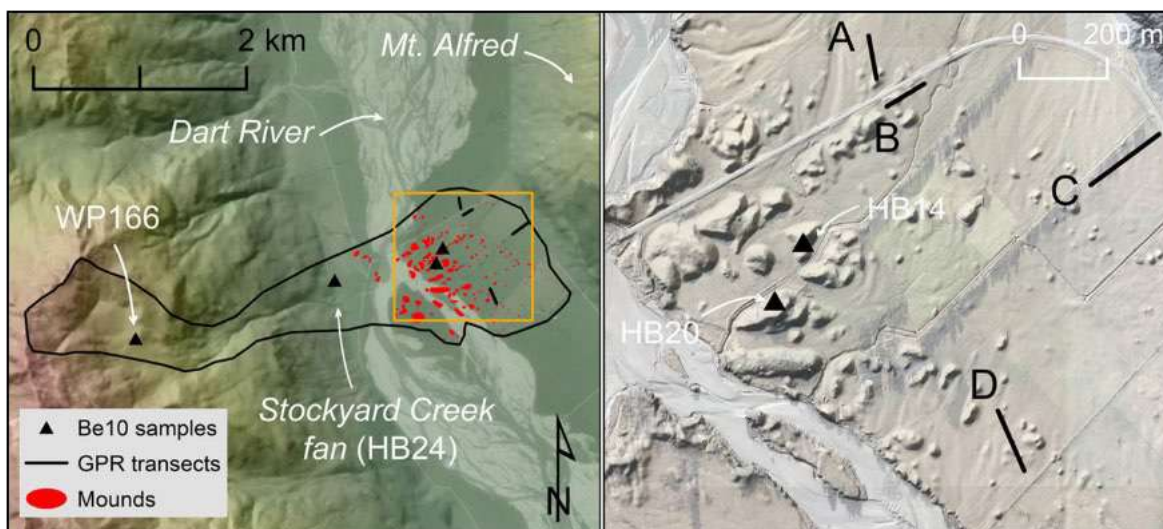


Figure 20: Left-hand map shows outline of the Hillocks rock avalanche (black outline) and mounds (red polygons), right hand is a hillshade image showing the topographic relief of the mounds (McColl et al, 2019).

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