Safety and Resilience Committee
7 November 2024

Meeting will be held in the Council Chamber at Level 2, Philip Laing House
144 Rattray Street, Dunedin
Live streamed on the ORC Official YouTube channel

Members:
Cr Gary Kelliher (Co-Chair)
Cr Alan Somerville (Co-Chair)
Cr Alexa Forbes
Cr Michael Laws
Cr Kevin Malcolm
Cr Lloyd McCall
Cr Tim Mepham
Cr Andrew Noone
Cr Gretchen Robertson
Cr Elliot Weir
Cr Kate Wilson

Senior Officer: Richard Saunders Chief Executive

Meeting Support: Kylie Darragh Governance Support Officer

07 November 2024 01:00 PM

Agenda Topic — Page

Agenda 1

1. WELCOME

2. APOLOGIES

No apologies were submitted prior to publication of the agenda.

3. PUBLIC FORUM

No requests to address the Committee under Public Forum were received.

4. CONFIRMATION OF AGENDA

Note: Any additions must be approved by resolution with an explanation as to why they cannot be delayed until a future meeting.

5. DECLARATION OF INTERESTS

Members are reminded of the need to stand aside from decision-making when a conflict arises between their role as an elected representative and any private or other external interest they might have. Councillor interests are published on the ORC website.

6. CONFIRMATION OF MINUTES 3

Confirming the Minutes of the Safety & Resilience Committee 7 August 2024 as a true and accurate record.

7. OPEN ACTIONS FROM THE RESOLUTIONS OF THE COMMITTEE

There are currently no open actions for this Committee.

8. PRESENTATIONS

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To update the Committee on the progress related to the development of a natural hazards adaptation strategy for the Head of Lake Whakatipu area.

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To update committee on the programme for investigations into reducing the flood risk in North East Valley (Lindsay Creek).

9.3.1 Appendix 1 NEV Flood Hazard 138

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To present the approach developed for the prioritisation of future natural hazards activities within the Otago region.

10. CLOSURE

Otago Regional Council

Safety and Resilience Committee
MINUTES

Minutes of an ordinary meeting of the Safety and Resilience Committee held in the Council Chamber, Level 2 Philip Laing House, 144 Rattray Street, Dunedin on Wednesday 7 August 2024, commencing at 1:30PM.

PRESENT

Cr Alan Somerville	*(Chair)*
Cr Alexa Forbes	
Cr Gary Kelliher	*(online)*
Cr Michael Laws	
Cr Kevin Malcolm	
Cr Lloyd McCall	
Cr Tim Mepham	
Cr Andrew Noone	
Cr Gretchen Robertson	
Cr Bryan Scott	
Cr Elliot Weir	
Cr Kate Wilson	

1. WELCOME

Chair Somerville welcomed Councillors, members of the public and staff to the meeting at 1:30pm with a karakia. Staff present included Richard Saunders (Chief Executive), Nick Donnelly, online (GM Corporate Services), Anita Dawe (GM Planning and Transport), Joanna Gilroy (GM Environmental Delivery), Tom Dyer (GM Science and Resilience) Kylie Darragh (Governance Support), Ann Conroy (Team Leader Natural Hazards Adaptation), Tim van Woerden, (Senior Natural Hazards Analyst), Jamie MacKenzie (Natural Hazards Adaptation Specialist), Jean-Luc Payan (Manager Natural Hazards).

The Chair noted to the Committee that the Natural Hazards Risk Assessments paper will now be coming to the Committee in November.

2. APOLOGIES

There were no apologies for this meeting.

3. PUBLIC FORUM

There were no requests to speak at Public Forum.

4. CONFIRMATION OF AGENDA

It was moved by Chair Somerville, seconded by Cr Weir:
That *the agenda be confirmed as published.*
MOTION CARRIED

5. DECLARATIONS OF INTERESTS

Members were reminded of the need to stand aside from decision-making when a conflict arises between their role as an elected representative and any private or other external interest they might have.

6. PRESENTATIONS

There were no Presentations for this meeting.

7. CONFIRMATION OF MINUTES

Resolution: Cr Wilson Moved, Cr Forbes Seconded
That *the minutes of the Safety and Resilience Committee meeting held on 8 May 2024 be confirmed as a true and accurate record.*
MOTION CARRIED

8. OPEN ACTIONS FROM RESOLUTIONS OF THE COMMITTEE

There are currently no open actions for this Committee.

At 1:39 pm Cr Laws sat back from the table
Cr Laws returned to the meeting at 2:03pm.
Cr Scott left the meeting at 2:04pm.
Cr Scott returned to the meeting at 2:05pm.

9. MATTERS FOR CONSIDERATION

9.1. Head of Lake Whakatipu Natural Hazards Adaptation

(YouTube 10:58) This report updated the Committee on progress towards development of a natural hazards adaptation strategy for the Head of Lake Whakatipu area. Ann Conroy (Team Leader Natural Hazards Adaptation) Tim van Woerden (Senior Natural Hazards Analyst), Jamie MacKenzie (Natural Hazards Adaptation Specialist), and Jean-Luc Payan (Manager Natural Hazards) were available to respond to questions.

Resolution SRC24-110: Cr McCall Moved, Cr Weir Seconded

That the Safety and Resilience Committee:

1. ***Notes** this report.*
2. ***Notes** the Head of Lake Whakatipu natural hazards adaptation work programme and community engagement.*

MOTION CARRIED

9.2. Clutha Delta Natural Hazards Adaptation

(YouTube 41:31) This paper was brought to the Committee to provide an update on progress with the Clutha Delta natural hazards adaptation programme including engagement planning and natural hazards assessments. Ann Conroy (Team Leader Natural Hazards Adaptation), Tim van Woerden (Senior Natural Hazards Analyst), Jamie MacKenzie, (Natural Hazards Adaptation Specialist), Jean-Luc Payan (Manager Natural Hazards) were available to respond to questions.

Resolution SRC24-111: Cr Malcolm Moved, Cr Forbes Seconded

That the Safety and Resilience Committee:

1. ***Notes** this report.*

MOTION CARRIED

9.3. CDEM Partnership Report 2023 - 2024

(YouTube 1:07:23) To report on ORC's delivery of its responsibilities under the Otago Civil Defence and Emergency Management Agreement, for the second half of 2023/24. Tom Dyer (GM Science and Resilience) was available to respond to questions.

Cr Laws left the meeting at 3:00pm.

Resolution SRC24-112: Cr Wilson Moved, Cr Weir Seconded

That the Safety and Resilience Committee:

1. ***Notes** this report.*

MOTION CARRIED

Cr Laws returned to the meeting at 3:01pm.

12. CLOSURE

There was no further business and Chair Somerville declared the meeting closed at 3:01pm with a karakia.

_____ _____

Chairperson Date

9.1. Roxburgh Natural Hazards Management

Prepared for:	Safety and Resilience Comm
Report No.	HAZ2404
Activity:	Governance Report
Author:	Julion Wright, Natural Hazards Analyst Tim van Woerden, Acting Manager Natural Hazards
Endorsed by:	Tom Dyer, General Manager Science and Resilience
Date:	7 November 2024

PURPOSE

[1] To update the Council on the progress with the Roxburgh debris flows hazard management programme.

EXECUTIVE SUMMARY

[2] The Roxburgh area from Coal Creek Flat to north of Ettrick is exposed to alluvial fan hazards, including debris flows, where steep creeks exit the Old Man Range towards the Clutha River.

[3] Debris flows are a rapidly moving slurry of water, sediment, and debris that may occur on alluvial fans with a high impact force. The geological and geomorphic characteristics of the catchments in the Roxburgh area allow for the high sediment yields required for debris flow generation. In conjunction, debris flows are initiated by high-intensity rainfall events driven by thunderstorms, so typically provide little warning time.

[4] A number of debris flow events have been recorded in Roxburgh since at least 1938. Most of these recorded events have resulted in direct impact of debris to either infrastructure or property.

[5] The debris flow events of November 2017 highlighted the significance of the hazard to the Roxburgh community and prompted the contemporary hazard management response. This included channel maintenance, debris flow investigations, and monitoring of the catchments.

[6] Preliminary risk assessments conducted by Golder Associates for the Otago Regional Council (ORC) in 2019 indicated that the risk to life is 'significant' at Pumpstation, Reservoir, and Golfcourse Creeks. These reports also recommended that ORC implement an interim channel monitoring and maintenance plan and conduct a more detailed and spatially comprehensive hazard and risk assessment.

[7] The ORC Natural Hazards team has also identified additional catchments other than those active during 2017 and included these in the work programme scope. This included a prioritisation based on a catchment's geomorphic characteristics, history of debris flows, and the exposure of infrastructure and property to potential flows.

[8] This update paper also describes the Roxburgh debris flows work programme which has two parallel works to be conducted this financial year, these action the key recommendations of the Golder reports:

- An interim channel maintenance and monitoring plan to manage the hazard whilst we conduct further investigations and,
- The detailed hazard and risk assessment for debris flows in the Roxburgh area, which is the key technical study that will inform future management options including potential Central Otago District Council (CODC) spatial planning.

RECOMMENDATION

That the Committee:

*1) **Notes** this report.*

BACKGROUND

Physical environment and natural hazard overview

[9] The Roxburgh area is highly susceptible to alluvial fan hazards, including debris flows. The focus for this update paper is the area from Coal Creek Flat to just north of Ettrick, including the township of Roxburgh, the orchards of Coal Creek Flat, Dunbarton, and State Highway 8 (SH8) infrastructure west of the Clutha River (Figure 1).

[10] Alluvial fan hazards in the Roxburgh area have previously been mapped by Otago Regional Council (ORC) at a regional scale[1], with follow-up assessments then completed by GNS Science[2] and the ORC Natural Hazards team.[3] This mapping and initial assessments highlighted the exposure of the Roxburgh area to alluvial fan hazards (Figure 1).

[11] Alluvial fans[4] are depositional landforms that occur where creeks exit steep hills or mountains to a valley floor (Figures 2 and 3). Alluvial fans are dynamic landforms, where flows commonly break out of existing channels (avulsion) and travel along alternative pathways across the fan surface.[5]

[12] Flows on alluvial fans can contain a variety of sediment concentrations. These flows range from floods (low sediment concentration) to debris flows (high sediment concentration), with intermediate processes (hyper-concentrated flows and debris floods)[6] that contain a substantial amount of sediment, but less than debris flows.[7]

[13] Debris flows are rapid onset, high-velocity flows that form a slurry of water, debris (e.g., trees, man-made debris), and sediment (including coarse-grained). Debris flows have a

[1] Grindley J, Cox S and Turnbull I, 2009. Otago Alluvial Fans Project. Report by Opus International Consultants Ltd and GNS Science for Otago Regional Council.

[2] Barrell, D., Cox, S., Greene, S., and Townsend, D. 2009. Otago Alluvial Fans Project: Supplementary maps and information on fans in selected areas of Otago. (GNS Science consultancy report; 2009/052).

[3] Woods, R. 2011. Otago Alluvial Fans: High Hazard Fan Investigation. Report prepared by the ORC Natural Hazards team as part of the Alluvial Fans project. 69-75pp.

[4] Also referred to as debris fans depending on their dominant process regime

[5] Barrell, D., Cox, S., Greene, S., and Townsend, D. 2009. Otago Alluvial Fans Project: Supplementary maps and information on fans in selected areas of Otago. (GNS Science consultancy report; 2009/052).

[6] For this update paper, we refer to "debris flows" as a generic term for flows containing a sediment concentration greater than typical flood flows (i.e. also including debris floods and hyper-concentrated flows).

[7] De Haas, T., Lau, C., and Ventra, D. 2024. Debris-Flow Watersheds and Fans: Morphology, Sedimentology and Dynamics. In *Advances in Debris-Flow Science and Practice.* Jakob, M., McDougall, S., and Santi, P. (Eds). Springer Nature Switzerland AG. 9-73pp.

high sediment concentration and are very dense relative to clear water, they also contain coarse sediments (i.e., boulders) (e.g., Figure 4).

[14] Debris flows can pose a significant threat to individuals, property, and infrastructure because of their high impact force, and the fact they may occur with little warning due to triggering by high-intensity rainfall cells (e.g. thunderstorms/cloudbursts) which are difficult to forecast with certainty and are spatially variable.

[15] The Roxburgh area has a history of documented debris flow events since at least 1938, many of which caused significant impacts and disruption, these are summarised in Table 1.

[16] The geomorphic and geological characteristics of the Old Man Range and the Roxburgh area, west of the Clutha River, are the primary drivers for the debris flow susceptibility in the Roxburgh area. Key factors include the high sediment yields of the Creeks that drain the eastern flanks of the Old Man Range, and the relatively small, steep nature of the catchments themselves (Figures 3 and 5).

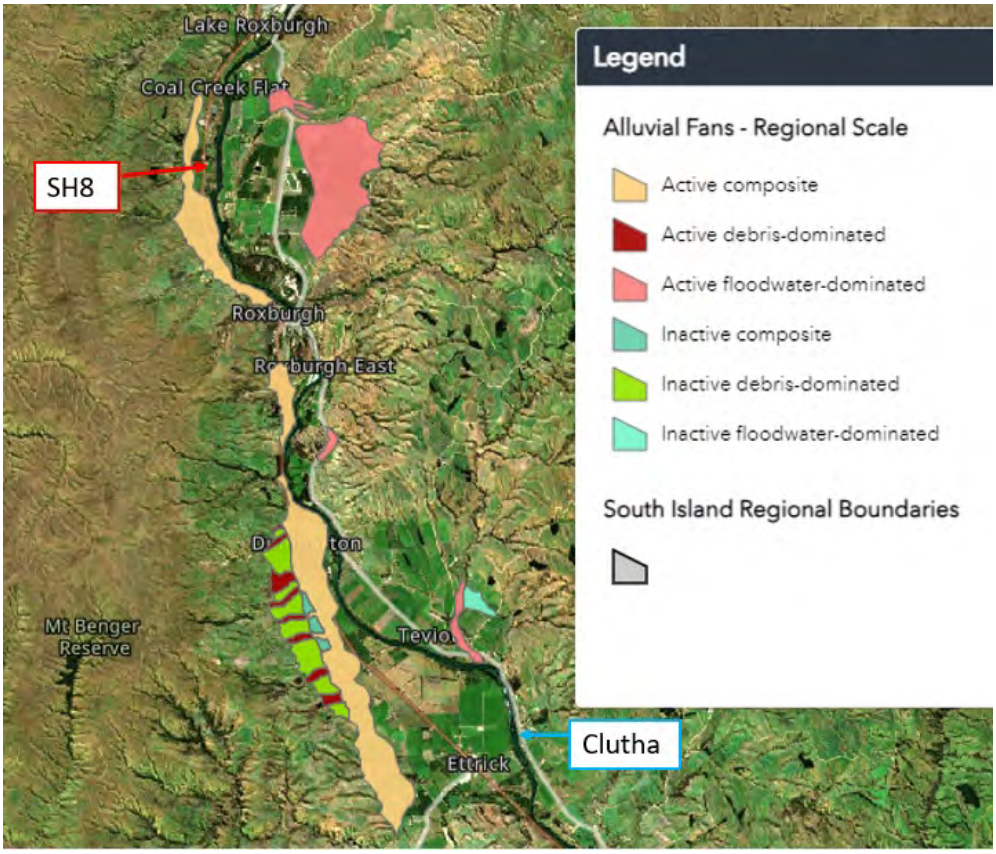

Figure 1: Regional-scale (Otago Alluvial Fans Project) mapping of alluvial fan hazards in the Roxburgh area, this shows the extensive alluvial fan development at the base of the Old Man Range catchments.

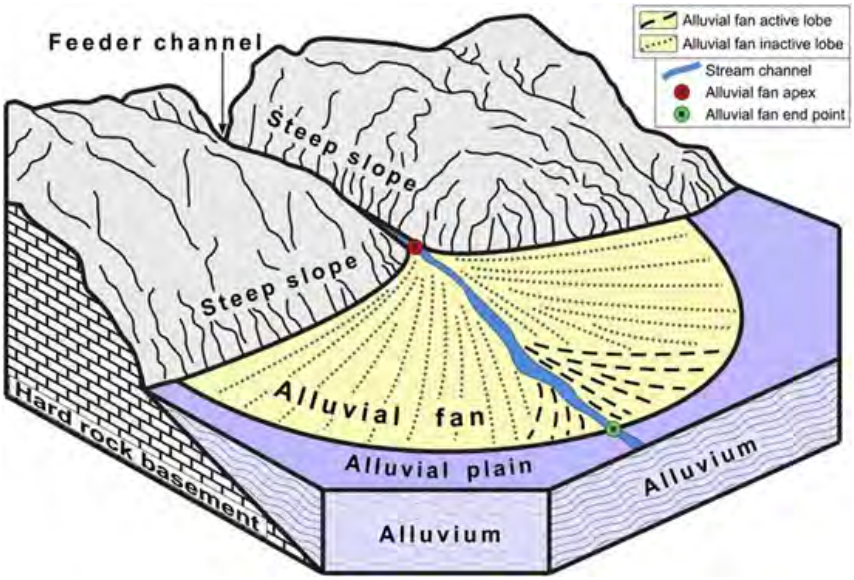

Figure 2: Simplified model of a generic alluvial fan, showing typical fan characteristics.

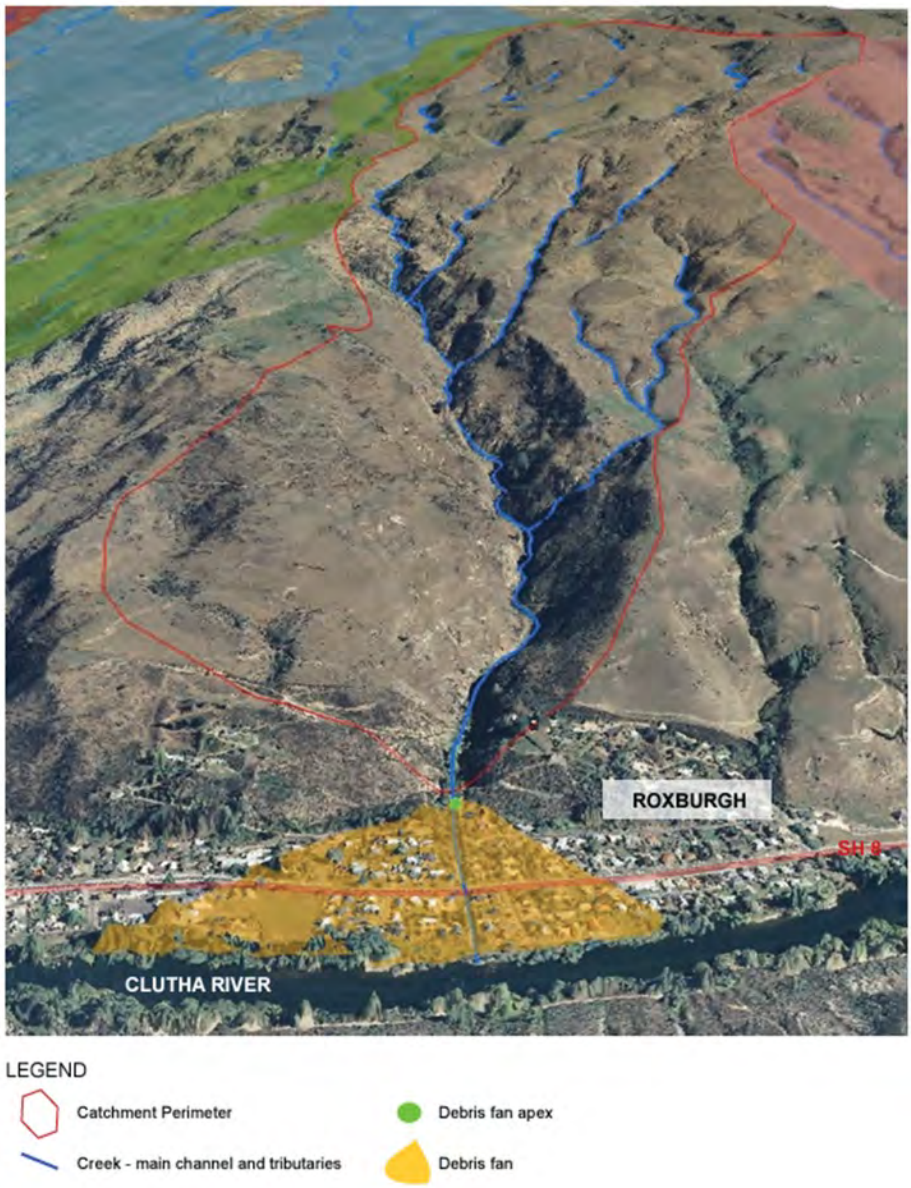

Figure 3: The Reservoir Creek catchment and alluvial (debris) fan[8].

[8] Golder. 2019a. Management and reduction of debris flow risk in Roxburgh, Otago – geomorphological assessment report. Report prepared for Otago Regional Council.

Figure 4: Examples of debris flow deposits from Roxburgh events: top, debris flow at Blackjacks Creek in 2015, and bottom, boulders removed from a debris flow deposit at Blackjacks Creek after the November 2017 events.

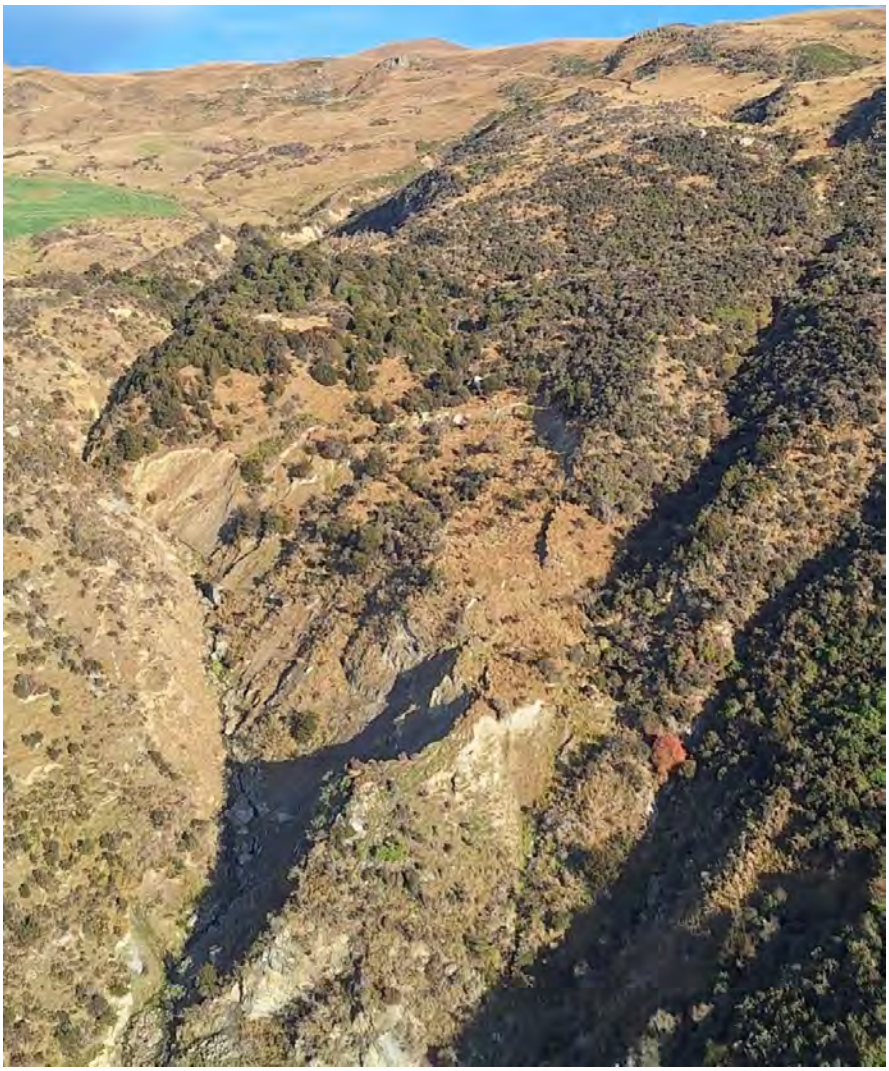

Figure 5: Example of a large active landslide in Golfcourse Creek, currently being undercut and eroded by the channel, which likely supplies sediment to a debris flow during an event. This is a typical situation in these catchments.

Past debris flow events in the Roxburgh area

[17] Known debris flow events in the Roxburgh area are described in Table 1. In addition to those listed, likely, numerous lower-magnitude events have also occurred. Where the triggering event for the debris flows has been described, it has been high-intensity rainfall associated with a convection cell.

[18] Following the 1978 event (Figure 6), in the early 1980's, the Otago Catchment Board (OCB) excavated the channel and constructed a concrete-lined channel in the downstream section of Reservoir Creek (from where it exits the valley). The channel structure is designed to rapidly convey floodwaters and debris across the alluvial fan and into the Clutha River. The concrete channel is 200 metres long, 3 metres wide at the base, 9 metres wide at the top, and 2 metres deep (Figure 7).

Table 1: Significant debris flow events on record in the Roxburgh area.

Date	Catchments	Key Impacts
1938	Slaughterhouse Creek and several others adjacent	9 m high debris flow. 2.4 km section of SH8 inundated and orchards severely damaged
1978	Reservoir Creek, Blackjacks Creek, Pumpstation Creek, and Slaughterhouse Creek at least	Direct debris flow impact to dwellings, extensive property damage at Reservoir Creek (Figure 6). Impact to SH8 likely. Prompted the construction of the concrete chute.
1993	Slaughterhouse Creek and Pumpstation Creek at least	Substantial damage to property, orchards, SH8 network (30-ton boulder deposited in middle of road), and power supply cut at Pumpstation Creek
2015	Blackjacks Creek	SH8 inundated with debris (Figure 3).
November 2017	Pumpstation, Reservoir, Golfcourse, Blackjacks, and Stevensons Creek (no direct impact)	Damage to water and power supply, extensive inundation of SH8, property damage by debris and flooding associated with the debris flows (Figures 8-10).

Figure 6: Direct impact of a debris flow at Reservoir Creek, 1978, showing extensive debris deposition, and direct impact to dwellings adjacent to the stream channel.

Figure 7: The Reservoir Creek concrete chute, constructed in the early 1980s.

Figure 8: Impacts of the November 2017 debris flow event at Reservoir Creek, showing the extensive deposition of sediment debris at the confluence with the Clutha River.

Figure 9: Impacts of the November 2017 events at Reservoir Creek, looking upstream of the SH8 bridge.

Figure 10: Impacts of the November 2017 debris flow event at Blackjacks Creek, showing the extensive deposition of sediment debris over State Highway 8.

Debris flow management since the November 2017 events

[19] The magnitude and associated damages of the November 2017 debris flow/flood events prompted a response from the ORC, Central Otago District Council (CODC), and Waka Kotahi NZ Transport Agency (NZTA). Several mechanisms have been employed to address the hazard to date.

[20] ORC commissioned several preliminary hazard assessments. The first was conducted soon after the November 2017 events by GNS Science and described the triggers, dynamics, and impacts of the debris flows[9].

[9] GNS. 2018. Hazard and risk assessment of the Roxburgh debris flows of 26th November 2017. Lower Hutt (NZ): GNS Science. (GNS Science consultancy report; 2018/65).

[21] Two further investigations were conducted by Golder Ltd for ORC in 2019 that provided preliminary geomorphic mapping, culvert capacity calculations, and risk-to-life estimate[10] and a review of possible hazard mitigation concepts for further study[11]. Note that studies by GNS Science and Golder Ltd focused only on the five catchments where debris flows occurred in 2017.

[22] The findings of Golder (2019a) indicated that several SH8 culverts were not up to design standards for clear water. NZTA have since upgraded these culverts with greater capacity (Pumpstation, Golfcourse, and Blackjacks Creeks) but these upgrades may not be sufficient to convey large debris flows. In addition, the Golder (2019a) preliminary risk assessment found the risk to life to be 'significant' at Pumpstation, Reservoir, and Golfcourse Creeks.

[23] In response to debris flow sedimentation into the Clutha River, ORC undertook a preliminary investigation to understand the significance of this sedimentation on flooding and bank erosion hazards.[12] This concluded there would have been a slight increase in flooding hazard, but that these effects would trend back to their pre-November 2017 levels as sediment deposits were eroded over time.

[24] Updates on the ORC investigations and management responses were presented to the ORC Technical committee in January 2018,[13] October 2018 and September 2019.[14]

[25] A series of mitigation works have been conducted to remove the excess sediment deposited by, and since, the 2017 events, as well as some channel armouring. These included emergency works immediately following the events in addition to further works since the events.

[26] Since the 2017 debris flow events, ORC monitoring in the Roxburgh area has included;

- Installation of a rain gauge in the upper reaches of Reservoir Creek, with data available from October 2018. This can indicate high-intensity rainfall in the catchment.
- LiDAR topography and ortho-imagery were captured in 2019 and 2022 for the catchment which experienced debris flows in 2017. Additional LiDAR is being captured in October 2024 to extend coverage further north and south from those initial surveys. These LiDAR surveys provide the necessary data for geomorphic assessment, change detection, and debris flow modelling.

Current work programme

[27] The Golder reports recommended key next steps in the project were to;

[10] Golder. 2019a. Management and reduction of debris flow risk in Roxburgh, Otago – geomorphological assessment report. Report prepared for Otago Regional Council.
[11] Golder. 2019b. Management and reduction of debris flow risk in Roxburgh, Otago – Engineering options report (conceptual design). Report prepared for Otago Regional Council.
[12] Webby G, 2017. Roxburgh – preliminary assessment of flood and erosion hazards in Clutha River. Damwatch Engineering ltd.
[13] Payan J and Mackey M, 2018. November 2017 Roxburgh debris flow. Report to the ORC Technical Committee, 25 January 2018.
[14] Mangoes F and Mackey B, 2019. General Manager's Report to Technical Committee, 11 September 2019.

- Conduct a detailed spatial hazard/risk assessment to inform longer-term options, and to,
- Put in place an interim plan to manage the hazard in the short-term.

[28] The November 2017 events highlighted the significance of the debris flow hazard in the Roxburgh area. However, as demonstrated in this update, the five are not the only catchments where debris flows can occur (Figures 1 and 12).

[29] Staff have identified 22 additional catchments (Figure 10) from the Barrell et al. (2009) mapping and conducted a 'high-level' hazard and exposure analysis to prioritise work for the additional catchments.

[30] To action the key Golder reports recommendations, the current ORC Natural Hazards programme for the Roxburgh debris flows comprises two parallel projects:

- Development of an interim channel monitoring and maintenance plan, and
- Completion of a detailed hazard and risk assessment.

[31] To provide detailed topographic information to inform both these projects, an updated LiDAR survey is being captured to provide topographic data for the full area, as well as a recent survey of channel morphology to inform potential channel maintenance.

[32] ORC Natural Hazard Team have also conducted a helicopter survey of the catchments to assess vegetation recovery rates and their geomorphic state. In addition, staff presented an update on the Roxburgh debris flows work programme at a community meeting in Roxburgh in early July.

Interim channel monitoring and maintenance plan

[33] The purpose of this plan would be to maintain the capacity of the channels to convey high flows during a debris flow event to limit the avulsion of the creeks and any subsequent debris inundation of infrastructure or property. This project is designed to inform ORC Engineering river management and act as an interim plan whilst detailed and spatial hazard/risk assessments are completed. Upon completing these assessments and subsequent planning for further options, a longer-term action plan will supersede the interim monitoring/maintenance project. In addition, the results of further investigations may highlight the need for interim monitoring and maintenance in other creeks in the Roxburgh area.

[34] The ORC Natural Hazards Team has designed a high-level monitoring and maintenance plan, which will be finalised following analysis using the 2024 LiDAR survey.

Detailed hazard and risk assessment

[35] A detailed natural hazard and risk assessment will be carried out primarily to inform potential Central Otago District Council (CODC) spatial planning measures, as well as possible physical mitigation or adaptation options. This risk assessment will include developing an understanding of potential debris flow runouts, and a comprehensive, spatial understanding of the natural hazard risk characteristics. In addition, climate change may impact the magnitude and frequency of debris flows in the future, and this will be considered. CODC has assisted in scope design and will be a part of the evaluation panel for the procurement of this study.

[36] This investigation will comprise of two main stages: 1) hydrogeomorphic modelling (i.e., a detailed hazard assessment) which will map potential debris flow event scenarios in detail and 2) a risk assessment which will include both qualitative and quantitative assessments depending on the results of the modelling stage. The level of detail in the analysis will align with national guidance on landslide and debris flow risk assessment[15][16].

[37] The investigation will focus on debris flow hazard and risk from 13 of the 22catchments in the Roxburgh area (Figure 10). These catchments have been identified and prioritised based on factors including their known history of debris flow occurrences, geomorphic indices[17] which indicate susceptibility to debris flow generation, and the exposure of buildings and infrastructure[18].

[38] Procurement of this study is underway. The investigation is anticipated to be completed before the end of the 24/25 financial year.

[39] The study findings will be of value to a range of stakeholders (e.g., ORC, CDEM, CODC, NZTA, and community members).

[15] GNS. 2024. Landslide planning guidance: reducing landslide risk through land-use planning. Lower Hutt (NZ): GNS Science miscellaneous series; 144.
[16] NZGS. 2023. Slope Stability Geotechnical Guidance Series: Unit 1 – General Guidance. New Zealand Geotechnical Society, Draft for Comment.
[17] e.g. Melton ratio, a measure of a catchment's ability to generate debris flows.
[18] Wright, J. 2024b. Roxburgh debris flow catchments prioritisation using morphometrics and hazard exposure analysis. June 2024. Internal Otago Regional Council report.

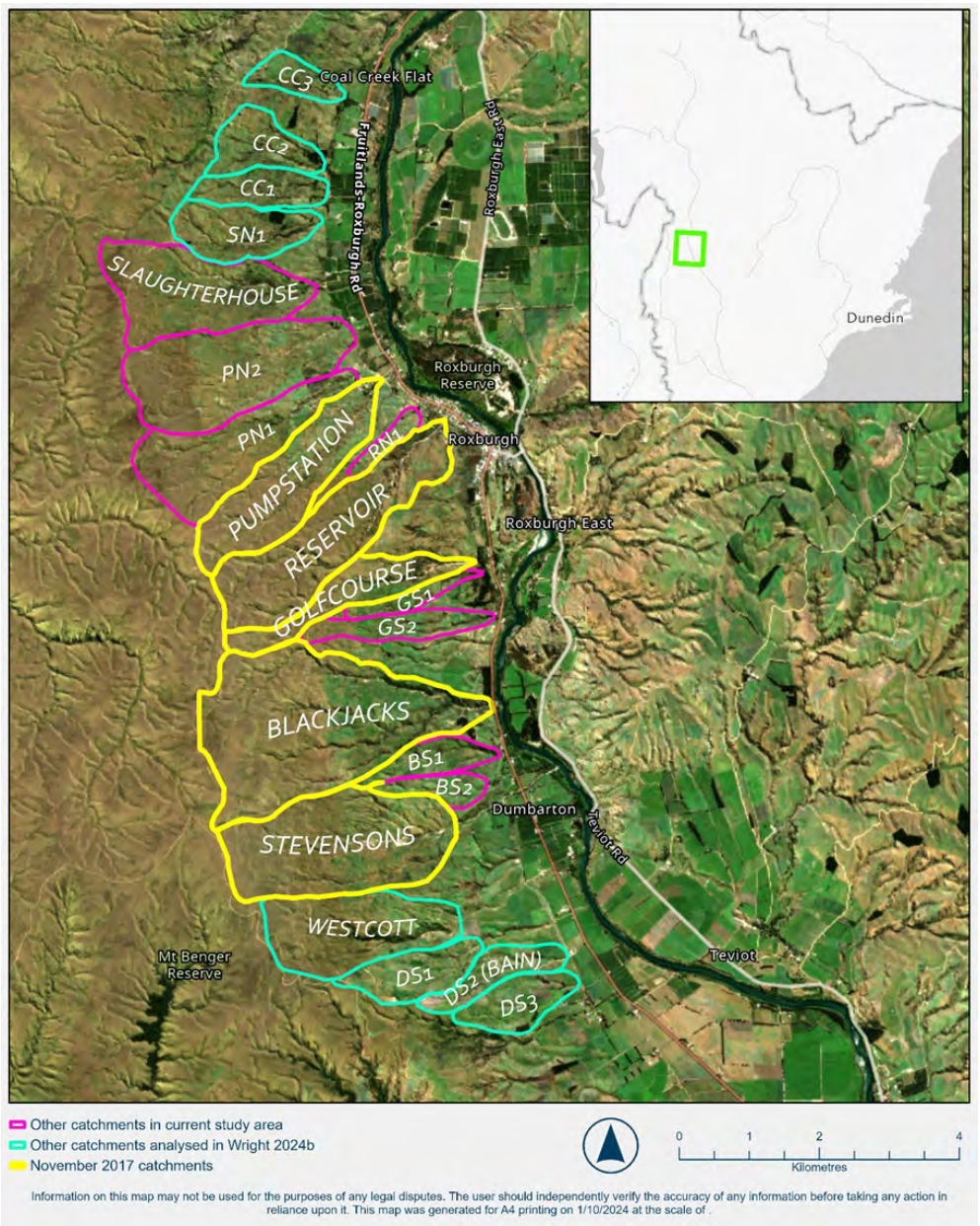

Figure 11: Map of the catchments susceptible to debris flows in the Roxburgh area. Yellow indicates the catchments active during the 2017 events, pink indicates the additional catchments incorporated during this stage of the programme, and blue indicates the other catchments assessed during prioritisation.

DISCUSSION

[40] The Roxburgh debris flow hazard has high potential consequences for the Roxburgh area. This is due to the immediate exposure of property and infrastructure to rapid and dense debris flows that occur with little warning.

[41] Debris flows in the Roxburgh area also occur relatively frequently, as evidenced by the record of past events and the geomorphic characteristics of the fans and catchments. Additionally, climate change may increase the magnitude and/or frequency of debris flow events in the Roxburgh area.

[42] The ORC's natural hazards investigations into the Roxburgh debris flows since the November 2017 events have highlighted the potential significance of the hazard and risk. However, a more comprehensive, detailed, and spatial understanding of the debris flow hazard and risk in the Roxburgh area is required to inform further management of this natural hazard.

[43] The detailed hazard and risk assessment will provide the technical basis to further develop debris mitigation and adaptation for Roxburgh, including any potential CODC landuse planning responses. The work to investigate potential options will be conducted in the 25/26 financial year. The interim monitoring and maintenance plan will allow ORC to manage the debris flow hazard in the meantime.

[44] The results of the detailed hazard and risk assessment will be made available to all interested stakeholders, including CODC, NZTA and the Roxburgh community.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[45] This natural hazards investigation programme will contribute towards the vision statement included in ORC's Strategic Directions: communities that are resilient in the face of natural hazards, climate change and other risks.

[46] The work programme 'Roxburgh Natural Hazards Management Investigations' is specified in the ORC Long-term Plan (LTP) 2024-2034 as key natural hazards work for years 1 to 3 of the LTP.

Financial Considerations

[47] The budget in the 2023/24 Annual Plan provides for the forward work programme described in this paper. The combined budget for the 2023/24 and 2024/25 financial years for the Roxburgh debris flow hazards programme is $150,000 (professional services and staff time).

Significance and Engagement Considerations

[48] ORC Natural Hazards staff presented in July 2024 at a public meeting in Roxburgh, this was to give a summary of debris flow hazards in the area, and to indicate the planned activities which are outlined in this paper.

[49] ORC will develop an engagement Plan for the Roxburgh debris flow hazards programme. The objectives for the first phases of this plan would include;

a. identifying and connecting with partners, affected communities and stakeholders.
b. building community understanding of debris flow hazards and findings of the new hazard and risk investigations.

Legislative and Risk Considerations

[50] The work described in this paper helps ORC fulfil its responsibilities under sections 30 and 35 of the RMA and the Soil Conservation and Rivers Control Act 1941

Climate Change Considerations

[51] Climate change is a factor potentially influencing debris flow hazard and risk, and will be considered in natural hazard and risk assessments.

Communications Considerations

[52] ORC will make all findings from debris flow hazard and risk investigation findings available to the Roxburgh area community and other stakeholders.

NEXT STEPS

[53] There are two key next steps:

- Implementation of the interim monitoring and management plan.
- Commencement of the detailed hazard and risk assessment.

ATTACHMENTS

Nil

9.2. Head of Lake Whakatipu Natural Hazards Adaptation Programme

Prepared for:	Safety and Resilience Committee
Report No.	HAZ2403
Activity:	Governance Report
Author:	Toan Nguyen, Senior Natural Hazards Adaptation Specialist Ann Conroy, Team Leader Natural Hazards Adaptation Tim van Woerden, Acting Manager Natural Hazards
Endorsed by:	Tom Dyer, General Manager Science and Resilience
Date:	7 November 2024

PURPOSE

[1] To update the Committee on the progress related to the development of a natural hazards adaptation strategy for the Head of Lake Whakatipu area.

EXECUTIVE SUMMARY

[2] Otago Regional Council (ORC) is applying the Dynamic Adaptive Pathways Planning (DAPP) approach, also referred to as 'Adaptation Pathways', as the framework for developing the Head of Lake Whakatipu Natural Hazards Adaptation Strategy, which is progressing well.

[3] This paper provides an update on the programme's activities since the previous committee paper in August 2024[1], including an overview of expenditures since the programme's inception (FY19-20) and a summary of key deliverables achieved so far.

[4] In August and September 2024, programme activities focussed on sharing the key findings from two recently completed natural hazard investigations: (1) the Glenorchy and Kinloch natural hazards risk analysis, and (2) assessments of floodplain management interventions for the Dart and Rees Floodplains. These activities were a workshop with ORC councillors, briefings with QLDC councillors and with QLDC staff, and two community engagement sessions.

[5] Two community engagement sessions were held in September at Glenorchy. The first was an evening in-person presentation of the key findings of the two natural hazard investigations by the technical experts and Q&A forum. The presentation was also livestreamed online and recorded[2]. The drop-in session the next day offered a one-on-one opportunity for community members to talk to staff from councils, EMO and technical experts. There were also adaptation pathways activities. Staff from ORC, QLDC and EMO attended both sessions.

[6] In the coming months, the programme will focus on developing a draft strategy document and improving the draft through input and engagement from ORC staff, programme partners, stakeholders and the community.

[1] Conroy A, van Woerden T, MacKenzie J and Payan J, 2024. Head of the Lake Whakatipu Natural Hazards Adaptation. Report OPS2341 to the Otago Regional Council Safety and Resilience Committee, 7 August 2024.

[2] https://www.youtube.com/watch?v=hUfBlxzkUCI

RECOMMENDATION

That the Committee:

a) ***Notes*** *this report.*

b) ***Notes*** *the Head of Lake Whakatipu natural hazards adaptation work programme progress and expenditure update.*

c) ***Recommends*** *that Council endorses the use of the information presented in the recent reports 1) Glenorchy and Kinloch natural hazards risk analysis, and 2) assessments of floodplain management interventions for the Dart and Rees Floodplains to inform natural hazards management and adaptation planning for the Head of Lake Whakatipu area.*

BACKGROUND

[7] Otago Regional Council (ORC), in collaboration with programme partners, is leading a programme of work to develop a natural hazards adaptation strategy for the Head of Lake Whakatipu area.

[8] The area at the Head of Lake Whakatipu (Whakatipu-Wai-Māori) is exposed to multiple natural hazard risks, including those due to seismic events, flooding and slope-related processes (e.g. landsliding and debris flow). This risk setting is compounded by a changing climate and large-scale landscape change (e.g. river channel migration and sedimentation) as well as socio-economic changes.

[9] Otago Regional Council (ORC) is applying the Dynamic Adaptive Pathways Planning (DAPP) approach, also referred to as 'Adaptation Pathways', as the framework for developing the Head of Lake Whakatipu Natural Hazards Adaptation Programme. ORC is also utilising this approach in natural hazards adaptation planning for the South Dunedin Future[3] and Clutha Delta natural hazards adaptation programmes[4].

[10] The approach and work activities for the adaptation programme completed are detailed in a series of papers presented between 2021 and 2024[5]. The most recent paper, presented in August 2024, provided an update on progress regarding the two natural hazard investigations and outlined preparations for planned community engagement sessions.

[11] Quarterly update papers will continue to be presented to the Safety and Resilience Committee until the adaptation Strategy for the Head of Lake Whakatipu is delivered.

[12] This paper is focussed updates on current or planned activities in this work programme including the completion of two natural hazard investigations and associated activities to share the new findings; community engagement activities as well as the drafting of the adaptation Strategy.

[13] Figure 1 shows an overview of key activities in the Head of Lake adaptation work programme, with the programme currently focussing on the fourth phase "*Make it*

[3] https://www.dunedin.govt.nz/council/council-projects/south-dunedin-future

[4] van Woerden T, Conroy A and Payan J, 2023. Clutha Delta Natural Hazards Adaptation. Report OPS2341 to the Otago Regional Council Safety and Resilience Committee, 9 November 2023.

[5] Reports to Council (27 May 2021), the ORC Data and Information Committee (9 June 2022) and the ORC Safety and Resilience Committee (10 May 2023, 10 August 2023, 9 November 2023, 8 February 2024, 8 May 2024 and 7 August 2024).

happen?" and building towards delivery of a first iteration of the strategy document. Figure 1 updates the similar figure presented in the previous committee papers.

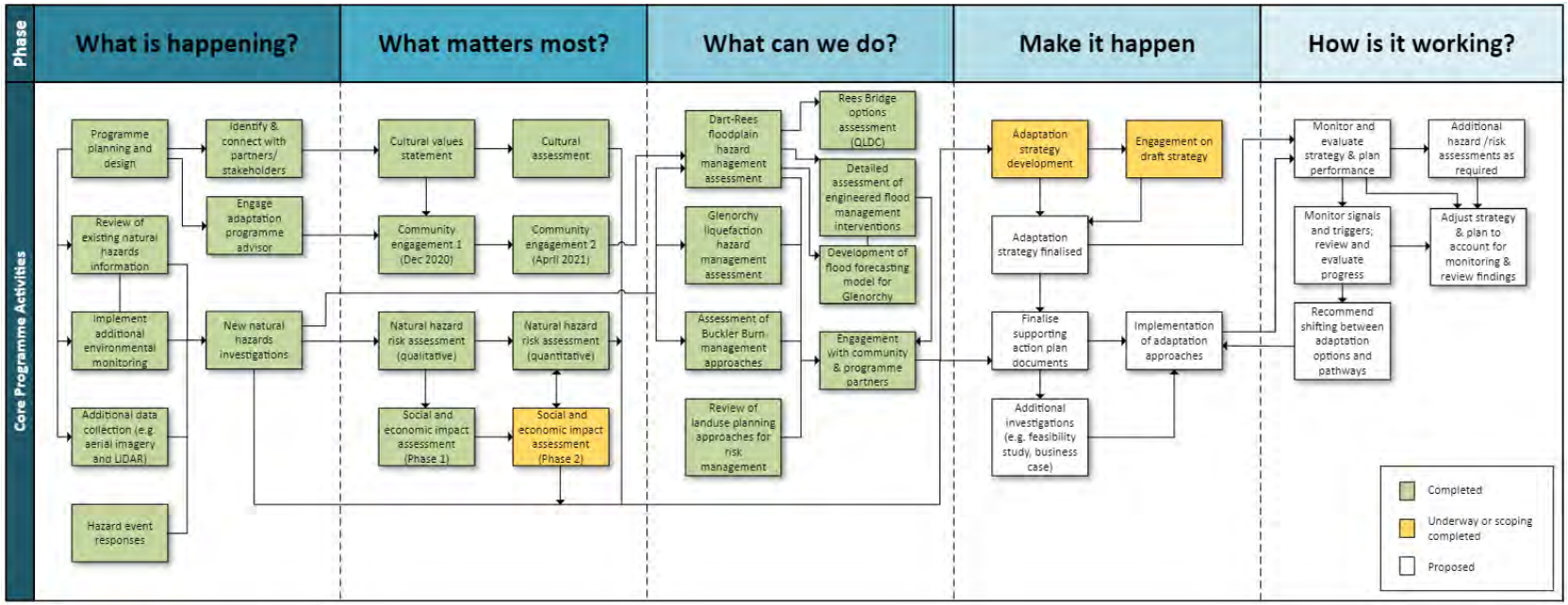

Figure 1: Head of Lake Whakatipu programme overview of key activities. This diagram updates from the previous (August 2024) and earlier committee paper

NATURAL HAZARDS RISKS ASSESSMENT

[14] A natural hazard risk assessment for Glenorchy and Kinloch townships led by Beca Group Limited (Beca) was completed in August 2024. This investigation involved review and analysis of natural hazards characterisation work completed by ORC and others and conducted qualitative and quantitative risk analyses based on this information.

[15] A comprehensive report[6] on this assessment has been completed and publicly released which details the key findings and processes involved.

FLOOD AND EROSION MITIGATION AND NATURE-BASED SOLUTIONS FEASABILITY ASSESSMENTS

[16] Damwatch Engineering Ltd (Damwatch) has recently completed a technical feasibility investigation to explore potential floodplain hazard management approaches for the Dart-Rees floodplains. Three reports[7] [8] [9] detailing the investigation findings were released in August 2024.

[17] The investigation provides a detailed analysis of various natural hazards management options and helps develop an understanding of existing flood hazard and geomorphological setting of the Rees-Dart River Floodplains. The outcomes of this study are important for the development of the Head of the Lake adaptation strategy.

SHARING THE FINDINGS

[18] ORC organised a series of activities to share new findings from the two technical investigations with Councillors, QLDC staff and the Head of the Lake communities. The table below summarises the purpose, outcomes and process of these activities.

Table 1: Completed activities to share key findings from new technical investigations and provide updates

Activity	Content	Date	Methods and channels
Two technical review meetings with QLDC staff from various teams	• Key findings presented the ORC staff • Open discussion	27 Aug 2 Sept	Online
Workshop with ORC Councillors	• Programme intro and next steps (ORC staff) • Key finding presented by technical experts from Beca and	29 Aug	In-person Workshop recording is

[6] Menke, et al. (2024). Glenorchy and Kinloch Natural Hazards Risk Analysis Report. (https://www.orc.govt.nz/media/hnlim52b/glenorchy-and-natural-hazards-risk-analysis-report_final-report-26aug2024-compres.pdf)

[7] Arán DM and Shrestha J (2024). Assessment of Floodplain Intervention Options – Dart River. (https://www.orc.govt.nz/media/tpel14hu/damwatch-ltd-dart-river-assessment-of-floodplain-intervention-options-final-report.pdf)

[8] Veale, et al. (2024). Assessment of Floodplain Interventions Options – Upper Rees River. (https://www.orc.govt.nz/media/15edpfyj/damwatch-ltd-upper-rees-river-assessment-of-floodplain-intervention-options-final-report.pdf)

[9] Veale B and Shrestha J (2024). Assessment of Floodplain Intervention Options– Lower Rees River & Glenorchy. (https://www.orc.govt.nz/media/wk1bvoy2/dwe-e2350-rpt-lower-rees-river-assessment-of-floodplain-intervention-options-issue-03_final-report.pdf)

Activity	Content	Date	Methods and channels
	Damwatch and Q&A • Adaptation pathways discussion		available on the ORC YouTube channel[10]. The presentation can be found in Appendix 4.
Briefing to QLDC Councillors	• Programme update and key findings presented by the ORC staff • Q&A	10 Sept	In-person
Community presentation and drop-in	• Presentation and Q&A a) Programme intro and next steps (by ORC staff) b) Key finding presented by technical experts from Beca and Damwatch and Q&A • Drop-in session next day for one-on-one discussions with technical experts and ORC, QLDC, EMO staff; and pathways activities	10 Sept presentation 11 Sept Drop-in	In-person & livestream Recording is available on programme website

ADAPTATION STRATEGY DEVELOPMENT

[19] The key upcoming programme activities with Council and community are as follows:

- Draft of the Strategy document will be released for community feedback and comment in late 2024. In conjunction, we are developing an 'accessible' report for community feedback and considering approaches for capturing community feedback on the draft Strategy.
- Finalised strategy document presented to Council (early 2025) – timing is subject to the feedback on the draft documents.

[20] Aukaha has conducted a screening assessment of the potential cultural significance of a long-list of possible adaptation responses at the Head of Lake Whakatipu to incorporate a Te Ao Māori worldview into decision-making processes.

[21] Development of the adaptation strategy is currently focused on developing a draft strategy and seeking input and feedback from ORC staff and partners, before the public feedback period at the end of the year.

[22] The Strategy will include an Action Plan that describes adaptation responses that are underway, in progress and committed.

COMMUNITY ENGAGEMENT

[10] https://www.youtube.com/watch?v=80loARHLfUw

[23] Proposed and completed engagement activities from early 2024 to early 2025 are outlined in Table 2. In addition to these activities, regular programme updates are provided to the community through the monthly newsletter (see Appendix 1) and programme webpage[11]

Table 2: Overview of proposed engagement activities for the delivery of the programme

Engagement activity (and level of participation[12])	Purpose	Early 2024	Sep-Oct 2024	Late 2024 - early 2025
Collaborate with Enviroschools to facilitate learning activities at Glenorchy Primary School ➢ *Involve*	Build youth understanding of hazardscape and adaptation approaches	✓		
Head of the Lake youth art competition ➢ *Involve/Collaborate*	Involve youth in Strategy design	✓		
Share Socio-Economic Impact Assessment (SEIA) Phase 1 findings ➢ *Inform*	Update community of the findings of technical studies in an accessible way	✓		
Share natural hazards risk assessment and feasibility assessment findings ➢ *Inform*	Update the community on the findings of technical studies, in an accessible way		✓	
Discuss and develop preferred adaptation responses and pathways ➢ *Involve/Collaborate*	Build understanding and generate ideas on signals, triggers, trade-offs, preferred pathways and how to monitor changes		✓	
Gain feedback on draft strategy document ➢ *Consult*	Receive feedback on the Strategy document and strategic framework for adaptation so that the Strategy works for this community			

[24] The two community engagement sessions were well-attended. About 30-35 community members came to the evening presentation, mostly older adults, with a few younger people. Around 20 people attended the drop-in session throughout the day. They are local community members, also mainly older adults. About half of the drop-in attendees had already attended the evening presentation the previous day.

[25] An engagement report summarizing the community's feedback shows that the sessions were valuable. Community members got a chance to learn about natural hazards risks and explore possible floodplain solutions, share ideas for adaptation pathways. They asked questions, raised concerns, and felt their voices were heard. Community members also expressed support for the programme's holistic approach and for nature-based solutions, and showed interest in staying involved.

[11] https://www.orc.govt.nz/get-involved/projects-in-your-area/head-of-lake-whakatipu/

[12] IAP2 Spectrum of Public Participation (as committed to in He Mahi Rau Rika) describes levels of participation, that define the public's role in any public participation process Inform → Consult →Involve → Collaborate → Empower

[26] Overall, the engagement sessions provided effective updates on the investigations' key findings and fostered social learning, strengthening trust and building stronger relationships between ORC, QLDC, EMO and the Head of the Lake communities.

[27] Figure 2 below shows active community engagement during the drop-in session.

Figure 2: Participants at the Drop-in session on 11 September 2024 at Glenorchy Hall

Planning for Upcoming Engagement Activities

[28] Planning is underway for community engagement sessions in late 2024 and early 2025 to share the draft adaptation strategy with the public and communities at the Head of the Lake, and seek their feedback and input.

[29] A multi-pronged approach to engagement[13] aims to provide opportunities for different parts of the community to better understand what the draft strategy means for them, and to provide feedback on how best to respond and adapt for the future. The feedback plan will consider suitable methods for feedback on the detailed long-form draft report and an accessible short-form summary.

[30] Engagement planning is a collaborative process, working with QLDC and the community. Engagement planning is considering other community engagement programmes across Queenstown Lakes District or that local communities may be interested over the same time period. This aims to avoid engagement fatigue and better support alignment across ORC community engagement programmes.

DISCUSSION

[31] The ORC-led natural hazards adaptation programme for the Head of Lake Whakatipu is advancing significantly. An early draft report of the adaptation strategy has been completed and shared with ORC staff and programme partners including QLDC staff and

[13] A multi-pronged approach to engagement means using different ways to reach and involve people. This could include public meetings, newsletter, surveys and drop-in sessions. The aim is to hear from a wide range of people by giving them different options to share their thoughts.

Aukaha for their feedback, and a draft Strategy document will be completed to be shared in a public feedback period by the end of the year.

[32] Two major technical investigations have been completed, accompanied by activities to share the findings and community engagement sessions. These are expected to be the last substantial natural hazards risk or hazard management investigations required to inform the development of this natural hazards Strategy

CONSIDERATIONS

Strategic Framework and Policy Considerations

[33] The information presented and the adaptation approach discussed in this paper reflects Council's Strategic Directions, *"Otago builds resilience in a way that contributes to the wellbeing of our communities and environment through planned and well-managed responses to shocks and stresses, including natural hazards"*[14].

[34] The proposed Otago Regional Policy Statement June 2021[15], notified in late March 2024[16], states that ORC and territorial authorities are both responsible for specifying objectives, policies, and methods in regional and district plans for managing land subject to natural hazard risk. ORC specifically is responsible for "*identifying areas in the region subject to natural hazards and describing their characteristics as required by Policy HAZ–NH–P1, mapping the extent of those areas in the relevant regional plan(s) and including those maps on a natural hazard register or database*."[17]

Financial Considerations

[35] As of 30 September 2024, the programme of work to develop a natural hazards adaptation strategy for the Head of the Lake Whakatipu has a to-date expenditure of $1,511,000 since its inception (FY19/20).

[36] This expenditure has delivered a range of the programme outputs and activities, including technical studies led by consultants, community engagement, collaboration with partners and key stakeholders as well as administration and staffing. Total staffing cost as of 30 September is $529,000 (about 35% of to-date expenditure).

[37] Appendix 1 provides an overview of the deliverables the programme has achieved from its inception through to October 2024. This appendix illustrates the considerable volume of activities completed for the work programme, with a total of 23 individual technical assessments completed, and numerous community engagement activities completed.

[14] ORC Draft Strategic Directions: https://www.orc.govt.nz/your-council/our-team/strategic-directions/

[15] Section HAZ-NH-M1

[16] Note that the RPS is still subject to appeal.

[17] ORC Natural Hazards Portal: http://hazards.orc.govt.nz

[38] The budget in the 2024-34 Long Term Plan provides funding towards delivery, implementation and monitoring of actions in the Head of Lake Whakatipu natural hazards adaptation strategy. The proposed budget for the 2024/25 financial year is approximately $175,000.

[39] The Ministry for the Environment (MfE) funding programme, *Nature Based Solutions for Resilience Planning* financially supported the 'nature-based solutions' aspects of the flood protection feasibility assessments completed by Damwatch Ltd. The MfE funding contribution was $100,000.

Significance and Engagement Considerations

[40] Engagement planning considers and is designed to be consistent with organisational commitments made through He Mahi Rau Rika: ORC Significance, Engagement and Māori Participation Policy.

[41] Otago communities including those at the Head of Lake Whakatipu and South Dunedin have raised concerns with ORC about how risk information could affect property insurance.

[42] In response, ORC reached out to the Insurance Council of New Zealand (ICNZ) for clarification. The ICNZ issued a letter to help property owners understand the impact on the availability of insurance and their premium levels in the future if natural hazard risk information is put on their LIMs or property titles.

[43] The ICNZ's letter notes that as risk increases, it affects the cost and availability of insurance. Property owners must disclose if their property is identified as being at risk from natural hazards, and insurance is assessed on a case-by-case basis. Residents are already being risk underwritten at a property level, so any information placed on a LIM may have little or no effect on their insurance and insurability. However, if the new information reveals greater risk, insurers may respond accordingly. The full letter is attached for further details (Appendix 3).

Legislative and Risk Considerations

[44] The work described in this paper helps ORC fulfil its responsibilities under sections 30 and 35 of the RMA.

[45] There is not currently a formalised programme governance agreement between ORC and QLDC for this adaptation programme, although there is a strong collaborative relationship at staff level. It will be critical to the successful delivery and implementation of the strategy that both councils endorse the strategy. Joint ELT discussions occurred in late May. It was agreed that having a joint Natural Hazards Steering Group would be useful and staff are working on standing it up.

[46] Both the QLDC 2024-2034 Long-Term Plan (LTP)[18] and QLDC 30-year Infrastructure Strategy[19] have been approved. The 'Community Associations Work Programme' of the LTP includes support for ORC's Head of Lake Whakatipu natural hazards project. The QLDC Infrastructure Strategy also highlights the area in its key initiatives; for example,

[18] https://www.qldc.govt.nz/your-council/council-documents/long-term-plan-ltp/
[19] https://www.qldc.govt.nz/media/o5bprma2/qldc_infrastructure-strategy_2024-2034_final.pdf

Glenorchy/Kinloch area resilience of the transportation network; and Glenorchy adaptation in the response to natural hazard risks and the effects of climate change.

[47] Central government has repealed the Natural and Built Environment Act and the Spatial Planning Act.

[48] The Finance and Expenditure Committee has completed its cross-party inquiry into climate adaptation and its final report [20] has been released. The report includes recommendations on adaptation objectives such as minimising expected long-term costs, improving information flows about climate risks and responses; of principles such as fairness and equity, local flexibility and co-benefits; of roles and responsibilities of stakeholders as well as adaptation costs and data. ORC is considering the implications of this report.

[49] The National Direction for Natural Hazards[21] is being developed under the Resource Management Act. This is to ensure the risks are handled consistently across the country. It is expected to provide direction to councils on how to identify natural hazards, assess the risk they pose now and in the future, and respond through their planning and consenting processes.

[50] There is no clear, specific, mandated requirement to reduce risk through planning and implementation of adaptation or relocation. Gaps identified in the current adaptation planning and planned relocation frameworks include the lack of national direction, insufficient powers, tools and mechanisms, and the lack of articulated roles and responsibilities[22].

Climate Change Considerations

[51] The effects of climate change have been considered in flood hazard assessments for Dart and Rees Rivers, and Buckler Burn, and in the assessment of risks and potential hazard management responses for those hazards.

[52] Councillors recently endorsed ORC's draft Strategic Climate Action Plan[23] for public consultation. ORC ran an online survey between September and October to gather feedback from the public. This consultation process has been completed and the results have now been analysed to support the finalisation of the Action Plan. ORC's vision is for a "low-emissions Otago that is climate-resilient in its ecosystems, communities, and businesses has two components: climate mitigation and climate adaptation."

Communications Considerations

[53] ORC will continue to make all investigation findings available to the Head of Lake Whakatipu community and provide regular programme updates via the email newsletter (see Appendix 2)[24].

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[20] Inquiry into climate adaptation (selectcommittees.parliament.nz)

[21] https://environment.govt.nz/acts-and-regulations/national-direction/natural-hazards/#:~:text=The%20Government%20has%20since%20decided,National%20Direction%20for%20Natural%20Hazards.

[22] Expert Working Group on Managed Retreat. 2023. Report of the Expert Working Group on Managed Retreat: A Proposed System for Te Hekenga Rauora/Planned Relocation. Wellington: Expert Working Group on Managed Retreat.

[23] https://www.orc.govt.nz/your-council/plans-and-strategies/strategic-climate-action-plan/

[24] https://www.orc.govt.nz/get-involved/projects-in-your-area/head-of-lake-whakatipu/holw-community-get-in-touch-be-involved/

[54] A communications plan has been developed as part of this work programme. The programme team is working closely with the Communications team to ensure communications and engagement planning is integrated, complementary and build off each other.

NEXT STEPS

[55] The key next step activities for the work programme which are in progress or scheduled are identified in Figure 1.

[56] A high-level timeline for key programme and engagement activities, and development of an adaptation strategy, is given in Table 3.

Table 3: High-level timeline for key programme and engagement activities, and development of an adaptation strategy, for the Head of Lake Whakatipu programme.

	Programme Activity	Community Engagement
Sept-Nov 2024	Strategy development and design	
December 2024	Deliver draft strategy and action plan Request approval from Council to distribute draft for public feedback (December 4 Council meeting) Go-live on public feedback period	 Distribution of draft strategy for feedback
Early 2025	Continue feedback period for draft strategy Deliver finalised strategy document to Council	Focus of community engagement: • Draft strategy • Final strategy

ATTACHMENTS

1. Head of Lake Whakatipu - programme deliverables at October 2024 [**9.2.1** - 3 pages]
2. Head of Lake Whakatipu - Update 41 _ October 2024 [**9.2.2** - 7 pages]
3. Letter of Insurance Council of New Zealand- September 2024 [**9.2.3** - 2 pages]
4. Presentation Workshop with ORC Councillors 29 August 24 FINAL slides compiled [**9.2.4** - 73 pages]

Appendix 1: Deliverables completed for the Head of Lake Whakatipu natural hazards adaptation work programme as of October 2024

Nu.	Programme deliverables	Details
I	**Technical studies**	
	3 flooding hazards assessments	• Gardner M, 2022. Dart/Rees Rivers flood hazard modelling. Prepared by Land River Sea Consulting Ltd. • Gardner M and Beagley R, 2023. Buckler Burn flood hazard modelling. Prepared by Land River Sea Consulting Ltd • Beagley R, 2024. Glenorchy flood modelling – flood hazard scenarios. Prepared by Land River Sea Consulting Ltd
	1 liquefaction hazard assessment	• Tonkin + Taylor Ltd (T+T), 2022. Glenorchy Liquefaction Vulnerability Assessment.
	8 supporting studies (e.g. hydrology, geotechnical, geomorphic)	• Fuller I and McColl S, 2021. Key notes and observations from preliminary assessment of debris flood and flow hazard potential at Glenorchy, Otago, Prepared by Massey University. • Jaquin P, 2020. Glenorchy Floodbank Rees River. Prepared by WSP. • Jaquin P, 2020. Glenorchy Rees Floodbank - Floodbank Assessment. Prepared by WSP • Mohssen M, 2021. Analysis of Flood Hazards for Glenorchy. • Mohssen M, 2024. Glenorchy Catchments Hydrology and Design Flows. Prepared by HydroScience • Morris T and Ashfield D, 2021. Rees-Glenorchy floodbank structure failure modes assessment. Prepared by Tonkin + Taylor Ltd • Shaw M, 2022. Shepherds Hut Creek debris flow hazard report. Prepared by WSP • Tonkin + Taylor Ltd, 2021. Head of Lake Wakatipu Natural Hazards Assessment.
	1 social and economic impact assessment (two phases)	• Healy J, Stringer K and Goodall, 2024. Socio-economic Impact Assessment - Head of Lake Whakatipu Adaptation Strategy - Phase 1. Prepared by Beca Ltd • Healy J, Stringer K and Goodall, 2024. Socio-economic Impact Assessment - Head of Lake Whakatipu Adaptation Strategy - Phase 2. Prepared by Beca Ltd
	1 natural hazards risk assessment	• Menke R, Hoetjes, and Punt A, 2024. Glenorchy and Kinloch Natural Hazards Risk Analysis Report. Prepared by Beca Ltd
	5 natural hazards mitigation studies	• Menéndez Arán D and Shrestha J, 2024. Assessment of Floodplain Intervention Options – Dart River. Prepared by Damwatch Engineering Ltd. • Veale B and Shrestha J, 2024. Assessment of Floodplain Intervention Options – Lower Rees River & Glenorchy. Prepared by Damwatch Engineering Ltd • Veale B, Shrestha J and Webby G, 2024. Assessment of Floodplain Intervention Options – Upper Rees River. Prepared by Damwatch Engineering Ltd

Nu.	Programme deliverables	Details
		• Tonkin + Taylor Ltd (T+T), 2023. Engineering Approaches for Managing Liquefaction-Related Risk. Prepared by Tonkin + Taylor Ltd • Webby G, 2022. Dart-Rees Floodplain Adaptation - Report on 23-24 February 2022 Workshop.
	1 cultural values statement	• Takau Y, 2024. Cultural Values Statement, prepared by Aukaha.
II	**Papers for Council meetings**	
	9 ORC Committee papers or workshops	• May 2021 • June 2022 • May 2023 • August 2023 • November 2023 • February 2024 • May 2024 • August 2024 (1 workshop, 1 committee paper)
	2 workshops for QLDC Councillors	• May 2021 (jointly with ORC) • September 2024
III	**Community engagement**	
	15 community engagements	• 2019-2020 – Updates at Glenorchy Community Association meetings • December 2020 – Community drop-in session • April 2021 – Public presentation • April 2021 – Community drop-in session • June 2022 – Online presentation • July 2022 – Community drop-in session • August 2023 – Community workshops • July 2023 – April 2024 – Community involvement in SEIA (from scope to review stages) • September 2023 – Online survey • November 2023 – Stall at Glenorchy Village Fair • April-May 2024 – Two adaptation classroom sessions at Glenorchy School • April-May 2024 – Head of the Lake Youth Art Competition • May 2024 – Online presentation • September 2024 - Public presentation (in-person and livestreamed) • September 2024 – Community drop-in session

Nu.	Programme deliverables	Details
	41 editions of a community newsletter	• Commencing in August 2020 and ongoing
IV	**Website**	• Webpage on ORC website from December 2020, regularly updated
V	**Other technical and supporting work**	
	3 environmental monitoring stations installed	• Glenorchy lagoon (water level) • Rees river at invincible (flow) • Lake Wakatipu at Glenorchy marina (water level)
	1 flood forecast model developed and tested	• Mohssen M, 2023a. Flood Forecasting for Glenorchy Township. Prepared by HydroScience for Otago Regional Council. • Mohssen M, 2023b. Analysis of Glenorchy Lagoon Levels for Event September 2023 and its FFM Model's Performance. Prepared by HydroScience
	2 research projects supported	• MacKenzie J, 2023. Telling Stories: Community engagement in a complex and dynamic natural hazards adaptation context at the Head of Lake Whakatipu. Masters Thesis, University of Otago. • Coursey S, PhD research project, in progress. Massey University, NIWA, University of Otago.

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HEAD OF LAKE WHAKATIPU

COMMUNITY UPDATE 41 | OCTOBER 2024

Kia ora koutou,

Thank you to everyone who joined us for the presentation and drop-in sessions in September. We hope you found these sessions useful.

Here's what we covered:

- At the presentation evening, we showed you the findings of the Glenorchy and Kinloch Natural Hazards Risk Analysis, which investigated risks from selected natural hazards by assessing a range of natural hazard scenarios. We also shared the findings of the Assessment of Floodplain Intervention Options study, which investigated possible interventions to manage risks from flooding and erosion in the lower Rees River area by the Glenorchy township, the Dart River floodplain, and in the upper Rees River area by the Rees River bridge.

- The next day, we held an interactive drop-in session, which included an adaptation game, an adaptation pathways activity, and opportunities to chat with the experts from Otago Regional Council, Queenstown Lakes District Council, Emergency Management Otago, NIWA, Beca Ltd and Damwatch Engineering Ltd. We'd like to thank the attending councillors and these organisations for helping us make these sessions a success.

It was a great opportunity to get input from the community and understand which adaptation actions you would like to see happen in the long term. One thing that

stood out was the interest from community members in taking an integrated approach to managing the environment, including ways to manage hazard risks that may also have ecological and environmental benefits.

Image: Manager Natural Hazards Jean-Luc Payan at the community drop-in session

Feedback from the September sessions

What we heard from you:

- There is a lot of interest in and support for ‘nature-based solutions’ to mitigate flood risks and improve environmental and biodiversity outcomes.
- There is support for a holistic approach to adapting to natural hazard challenges in the Head of Lake Whakatipu area.

- At the presentation evening, there was some interest in an assessment completed for QLDC to provide guidance for management of the Rees River bridge – you can find the report at the bottom of the page here.

- There was also some interest in what this natural hazard risk information means for the insurance industry. We reached out to the New Zealand Insurance Council, and you can read their response by selecting the button below.

Read the Insurance Council letter

Image: Playing NIWA's Township Flood Challenge game

Viewing the recording of the presentation

If you missed the presentation, or would like to watch it again, please select the button below.

Watch the presentation

Image: The Rees River bridge

What's coming up next?

We are pulling all the feedback and report results together into a draft Natural Hazards Adaptation Strategy for the Head of Lake Whakatipu.

The draft strategy is due to be finalised in **December**, when we will ask for your feedback again.

We plan to come back to Glenorchy before the feedback period ends in **February**. These dates will be confirmed very soon.

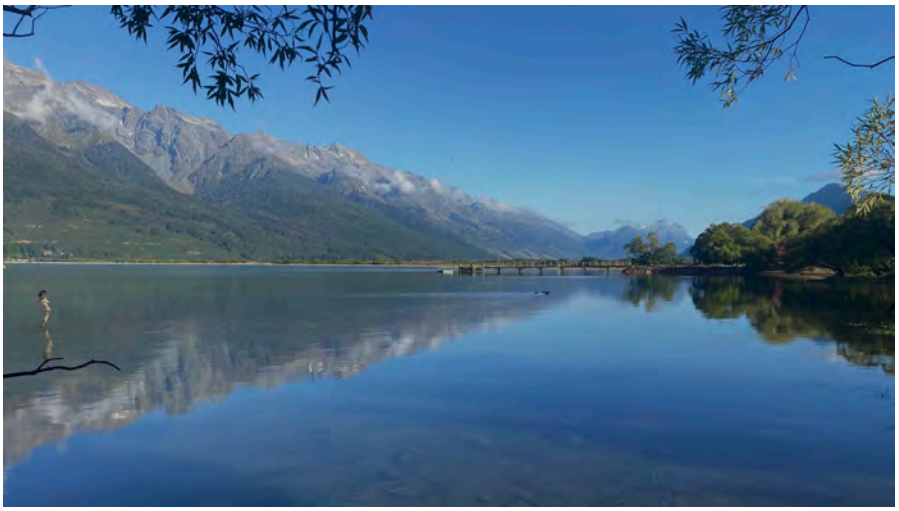

Image: View towards Glenorchy

As always, we value your feedback

This adaptation programme was initiated because complex, increasing natural hazards in the Head of Lake Whakatipu require a comprehensive management response that takes a long-term view and encompasses all types of natural hazards.

This is your community, and we want to work with you to develop understanding and resilience.

If you have questions or need information:

- Visit our website to learn more about the whole programme.
- Read the reports
- Watch the presentations
- Get answers.

You can also speak to a member of the ORC Natural Hazards team on 0800 474 082 or email us for more information at headofthelake@orc.govt.nz.

We will provide responses to any emailed questions and facilitate answers from our consultants if needed.

Head of Lake Whakatipu newsletter sign-up

If you are currently not receiving our monthly newsletters, you can sign up here and view archives of past editions.

Contacts
If you have any questions or would like to get in touch with us, please email us at headofthelake@orc.govt.nz.

Sign up here

Otago Regional Council

12 September 2024

Information for Property Owners

The Insurance Council has been advised that the Otago Regional Council is undertaking a natural hazard risk assessments and will identify some locations in the region as high or significant natural hazard risk.

It is well understood that as risk increases, this impacts the cost and availability of insurance. Property owners will be keen to understand the impact on the availability of insurance and their premium levels in the future if natural hazard risk information is put on their LIMs or property titles.

Insurers believe that increased transparency and awareness of risk is a good thing for homeowners and communities. This can lead to community and local and central government action to plan for and mitigate the impact of damage caused by the identified risks. This can then lead to more resilient, safer and stronger communities which will have greater access to affordable insurance.

Property owners are required to disclose to their insurer if their property has been identified as being at risk from any natural hazard by their local Council, through information being placed on the properties LIM or by way of a Section 74 notice on the property title. Failure to disclose may risk claims to your insurer being declined following an event such as a flood or landslip.

Insurers are in the business of knowing how much risk properties carry, including from natural hazards such as flooding and landslips, whether a Council designates them in a district plan or not. Insurers have ongoing awareness of natural hazards and evaluate this risk throughout the country.

All insurance cover is assessed on a case-by-case basis, where insurers consider the likelihood and impact of all risks to a property, including natural hazards. Insurers gather all relevant information when they make their assessments.

Insurers may take different approaches to risk management in certain locations. Some will underwrite at a property level, and some will underwrite at a community or area level.

It may be that residents are already being risk underwritten at a property level, so any information placed on a LIM may have little or no effect on their insurance and insurability. If the new information highlights greater risk, this may trigger a response from their insurer. However, insurers already use a range of information, including their own models and data. Responses can range from increased premiums to better cover that risk, increasing excesses or in extreme cases, declining to continue cover. On the other hand, if the information highlights lesser risk, premiums may benefit, or product offerings may improve.

Further, those risk items placed on the LIM may only have a small impact on insurance because natural hazards risk is just one area of risk out of many that is being taken into

account. Some examples of perils are flood, fire, earthquake, storm, accidental damage, impact damage.

The Otago Regional Council review of natural hazard risks establishes risk profiles. In most cases this does not have an immediate effect for property owners on the availability of insurance.

Sarah Knox
Consumer Affairs Manager
Insurance Council of New Zealand

Head of Lake Whakatipu Natural Hazards Adaptation Update

1-3.30pm, 29 August 2024

Jean-Luc Payan, Manager Natural Hazards
Ann Conroy, Team Leader Natural Hazards Adaptation
Tim van Woerden, Senior Natural Hazards Analyst
Jamie MacKenzie, Natural Hazards Adaptation Specialist

Otago Regional Council

Introduction

Purpose of workshop:

1. To share key findings of two natural hazard investigations
   - Glenorchy and Kinloch Risk Analysis (Beca Ltd)
   - Assessments of Floodplain Management Interventions for the Dart and Rees Floodplains (Damwatch Engineering Ltd)

2. To discuss adaptation pathways planning and development of an adaptation strategy for the Head of Lake Whakatipu area

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Agenda

1. Brief introduction
2. Presentation followed by Q&A – Glenorchy and Kinloch Risk Analysis (Beca Ltd)
3. Presentation followed by Q&A – Assessments of Floodplain Management Interventions for the Dart and Rees Floodplains (Damwatch Engineering Ltd)
4. Adaptation pathways and strategy development discussion

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Why do we need to adapt at the Head of Lake Whakatipu?

- The area faces complex multi-hazard challenges (e.g. flooding, liquefaction due to earthquake, debris flow, landslides and multi-hazard events)
- The landscape and climate are also changing (e.g. rivers and sediment are moving and changing, flood frequency is projected to increase)
- There are no simple solutions

➢ **Together we need to manage hazard risks and adapt to changes, now and in the future**

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Head of Lake Whakatipu Flooding Hazards

Rees River flooding, 2020
(photo: Luke Hunter)

Lake flooding, 1999

Buckler Burn flooding, 1999
(photo: Kelly family)

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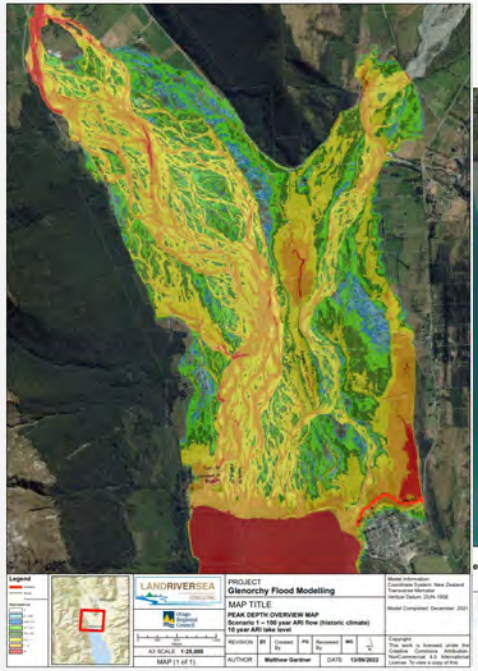
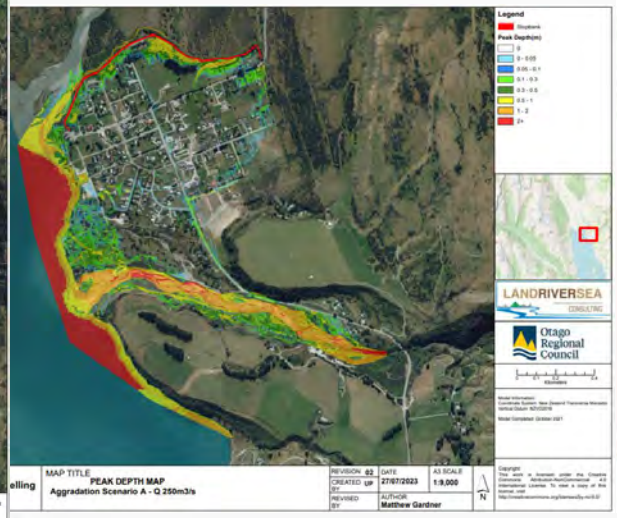
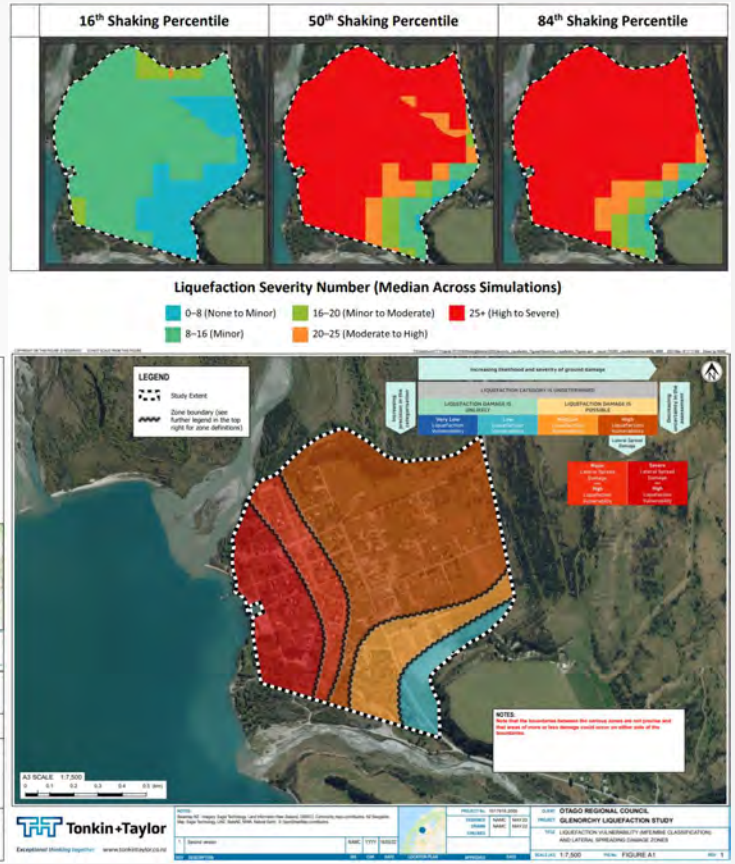
Safety and Resilience Committee - 7 November 2024

Natural hazards analysis and modelling

Flooding and liquefaction hazards







Safety and Resilience Committee - 7 November 2024

What is the Head of Lake Whakatipu natural hazards adaptation programme?

Programme Objective: Develop a framework to actively manage risks associated with natural hazards for the resilience of the area located at the Head of Lake Whakatipu, including Glenorchy and Kinloch

- A holistic approach to manage complex natural hazard challenges and uncertainties

- Lots of building blocks to support decision-making – technical studies, community engagement, risk analysis, social impact assessment, options analysis and more…

  ➢ **Doing it in collaboration with QLDC, mana whenua and the community**

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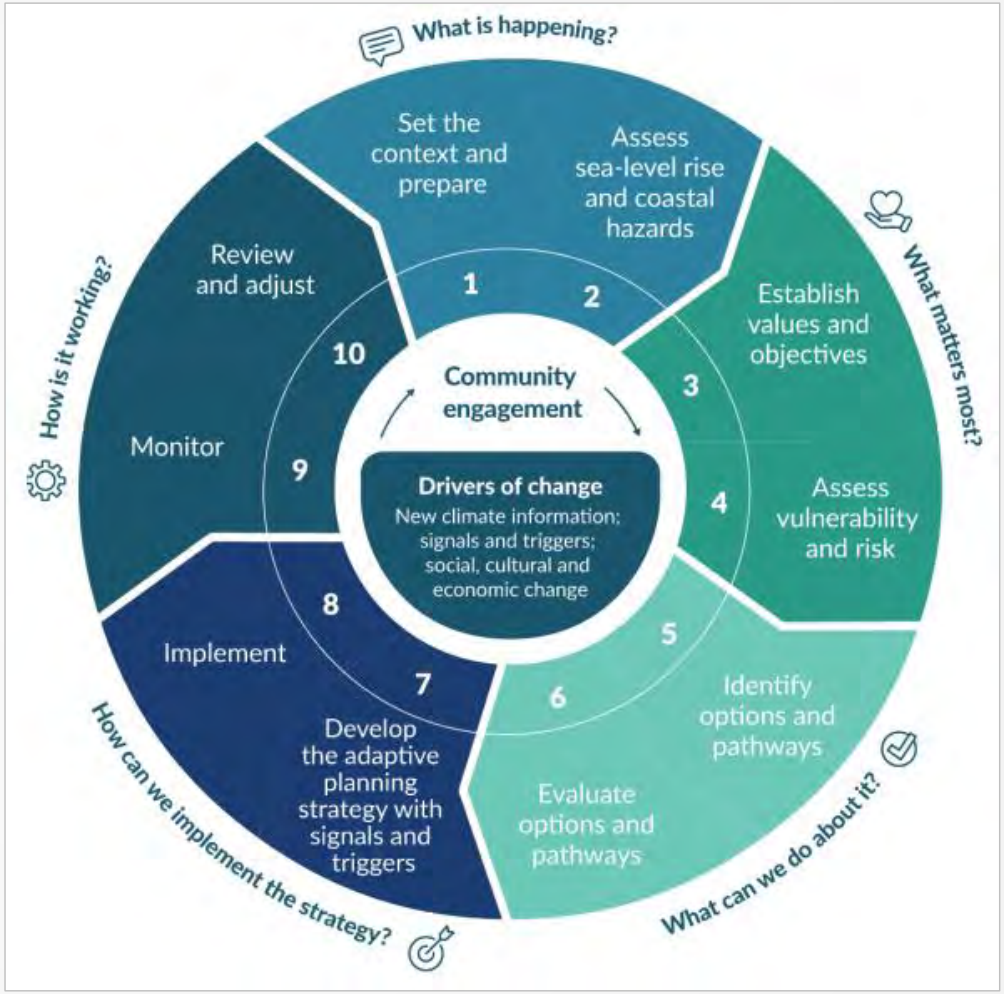
What is our approach?

- **Dynamic Adaptive Pathways Planning (DAPP)** – best practice in Aotearoa New Zealand
- 10-step decision cycle guided by five key questions
- Taking a DAPP approach for other work programmes
  - South Dunedin Future
  - Clutha/Mata-Au Delta



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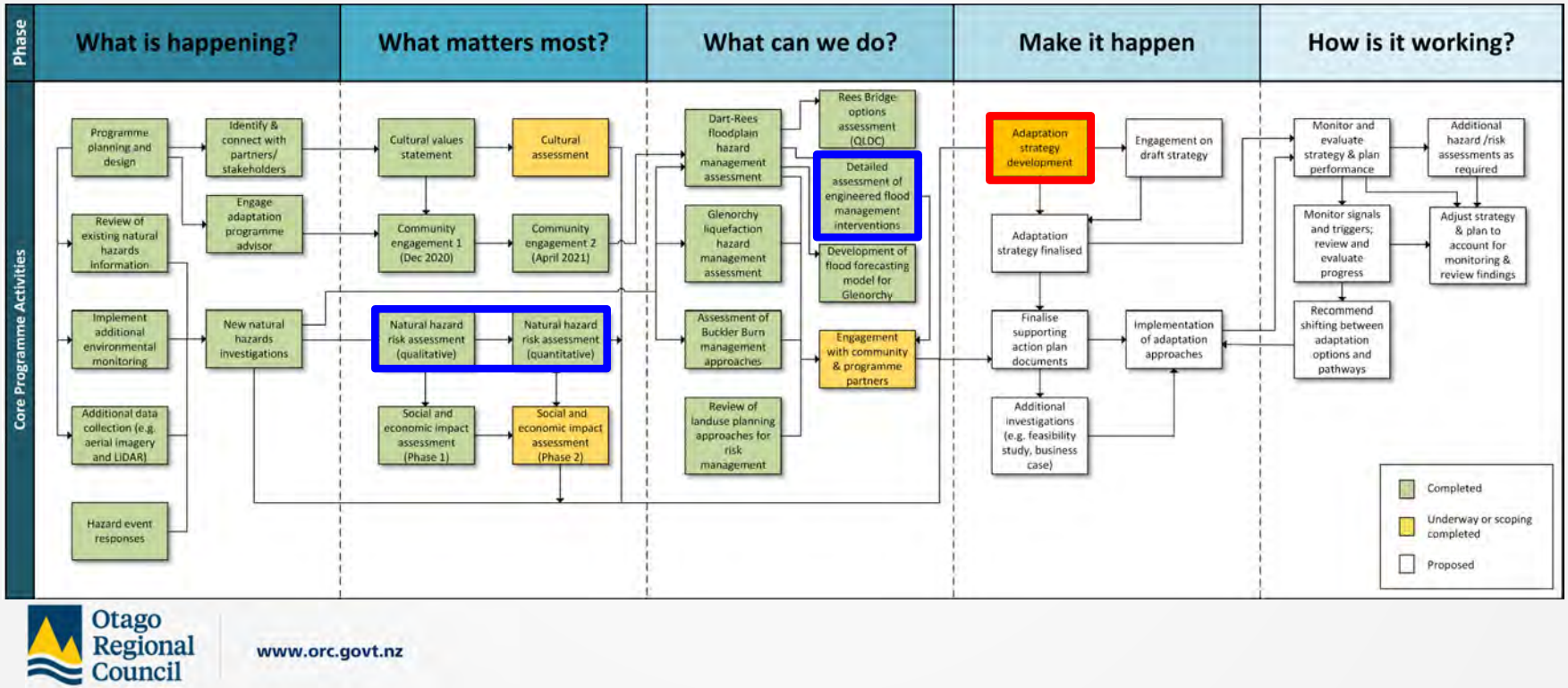
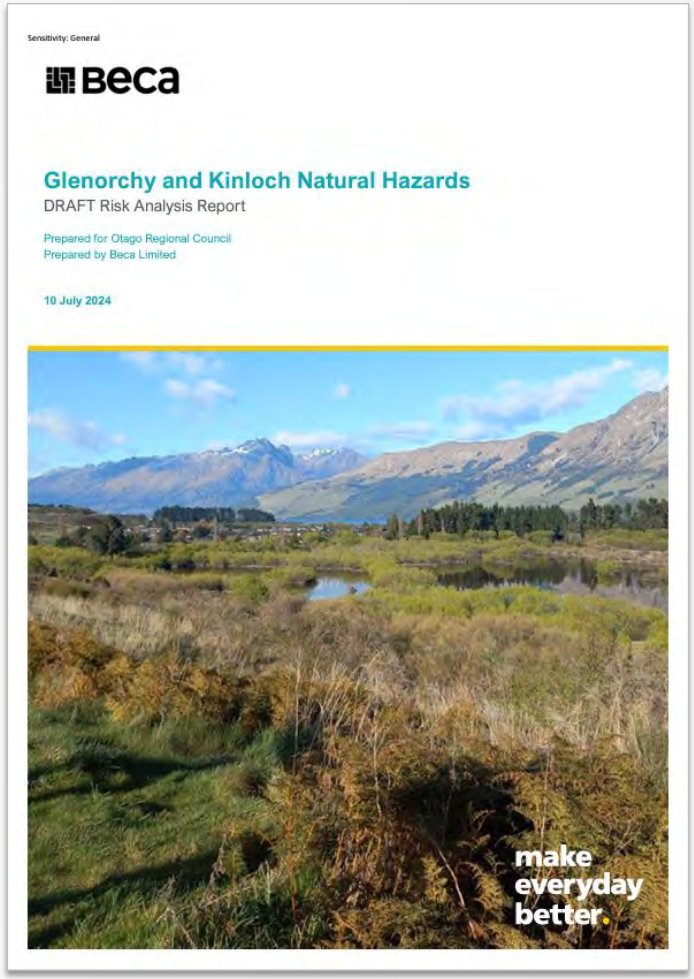
Head of Lake Whakatipu Adaptation Strategy Development



Beca Ltd Presentation

Glenorchy and Kinloch Natural Hazards Risk Assessment

- Anna Punt
- Elliot Tuck
- Marcus Gibson



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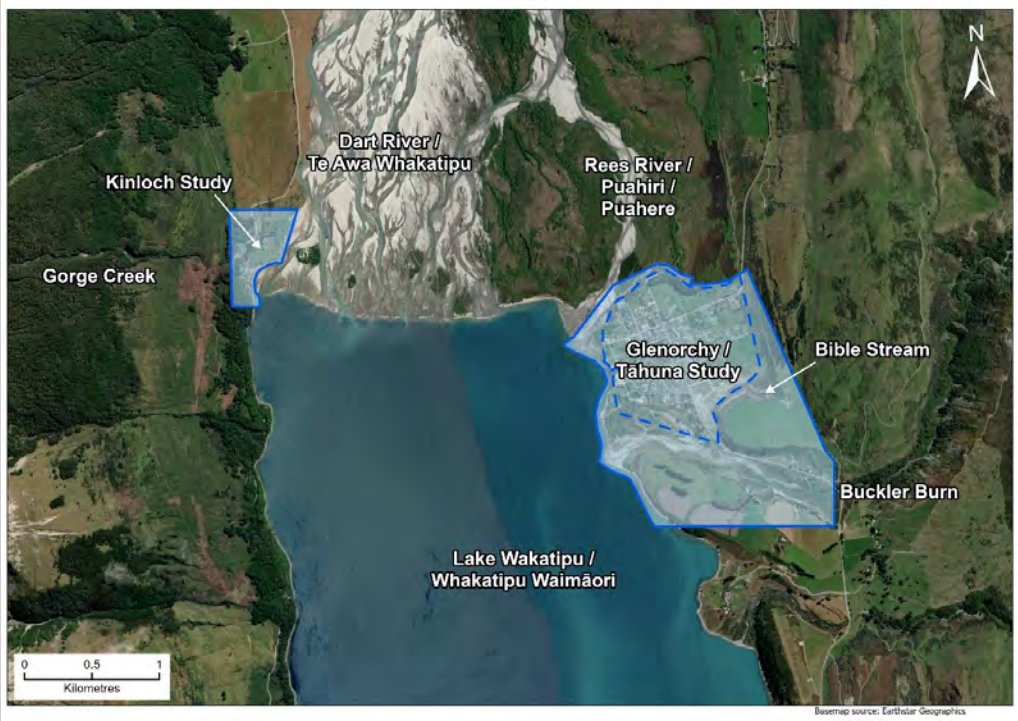
Glenorchy and Kinloch Natural Hazards Risk Assessment ORC Councillor Workshop 29 August 2024

Safety and Resilience Committee - 7 November 2024

Content

- Scope of study
- Risk analysis process
  - Qualitative risk
  - Quantitative risk
- Hazards
- Risk levels
- Risk tolerability



Beca

Study scope and process

Input – hazard definition work conducted by others:
- Liquefaction analysis
- Flood modelling

- Judgement and observations
- Assign risk level – Acceptable, Tolerable, Significant
- Significant hazards taken through to quantitative analysis

- Output numerical risk value
- Risk level re-categorised (Acceptable, Tolerable, Significant)

- Community engagement

Limitations of study

- Not property or people specific
- Based on existing climate & environment
- Based on existing land use & built environment
- Currently no New Zealand agreed methodology on risk analysis
  - Otago Regional Policy Statement guidance adopted
  - RPS based on Australian Geomechanics Society (AGS) method
  - AGS used in Otago and throughout New Zealand

Qualitative risk analysis process

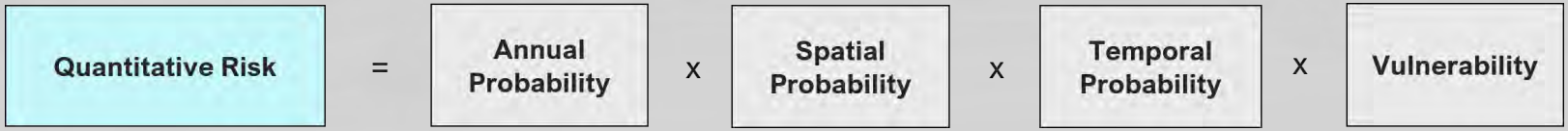
$$Risk = Hazard\ (likelihood)\ x\ Consequence$$

- Uses judgement, established relationships and observations
- Risk assessed for:
  - Health and safety (injuries and death)
  - Built environment - buildings and lifelines

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain					
Likely					
Possible					
Unlikely					
Rare					
Green, Acceptable *Risk*: Yellow, Tolerable *Risk*: Red, Significant *Risk*					

Quantitative risk analysis process

- Life Risk (Annual Individual Fatality Risk)
  - Annual probability that individual most at risk is killed as a result of the hazards occurring
- Property (Annual Property Risk)
  - Annual probability of total property loss as a result of the hazards occurring



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Quantitative risk levels

- Assessed against RPS areas with *existing development* (per annum)*:*

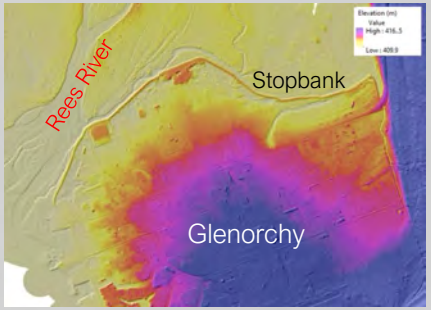
Risk Category	Risk Value
Acceptable	Less than $1x10^{-5}$
Tolerable	$1x10^{-4}$ to $1x10^{-5}$
Significant	Greater than $1x10^{-4}$

- Life (AIFR) and property (APR) risk tolerability levels the same
- Tolerability is an order of magnitude lower for *new developments*

Natural hazards assessed

Hazard	Qualitative Assessment		Quantitative Assessment	
	Health and Safety Risk	Built Environment Risk	Life Risk	Property Risk
River flooding – Buckler Burn	Assessed	Assessed	Assessed	Assessed
River flooding – Rees / Dart	Assessed	Assessed	Assessed	Assessed
River flooding – Joint (multiple sources)	-	-	Assessed	Assessed
Lake Wakatipu flooding	Assessed	Assessed	-	Assessed
Seismic shaking	Assessed	Assessed	-	-
Liquefaction and lateral spreading - Glenorchy	Assessed	Assessed	-	Assessed

Flooding



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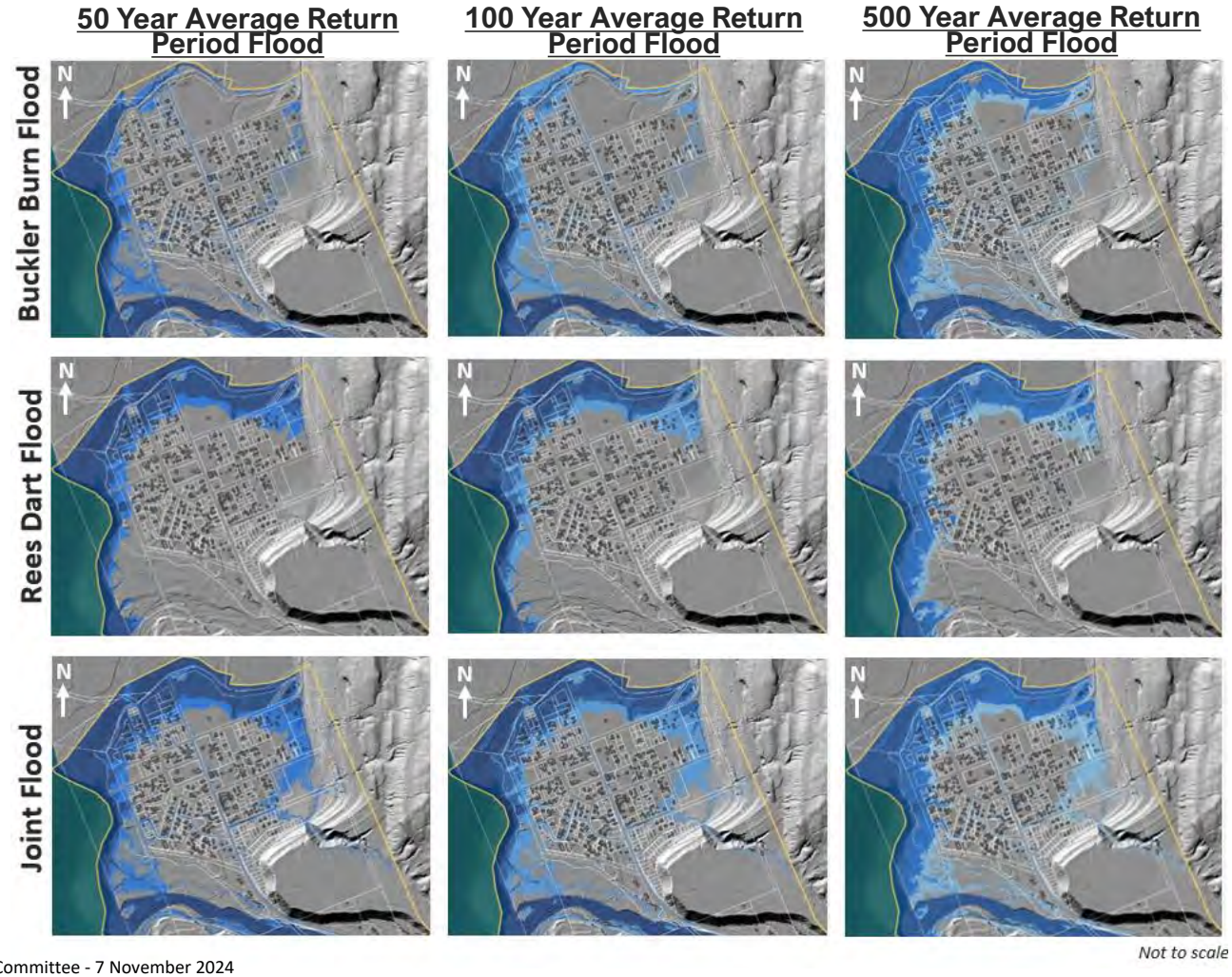
Life risk (AIFR) river flooding

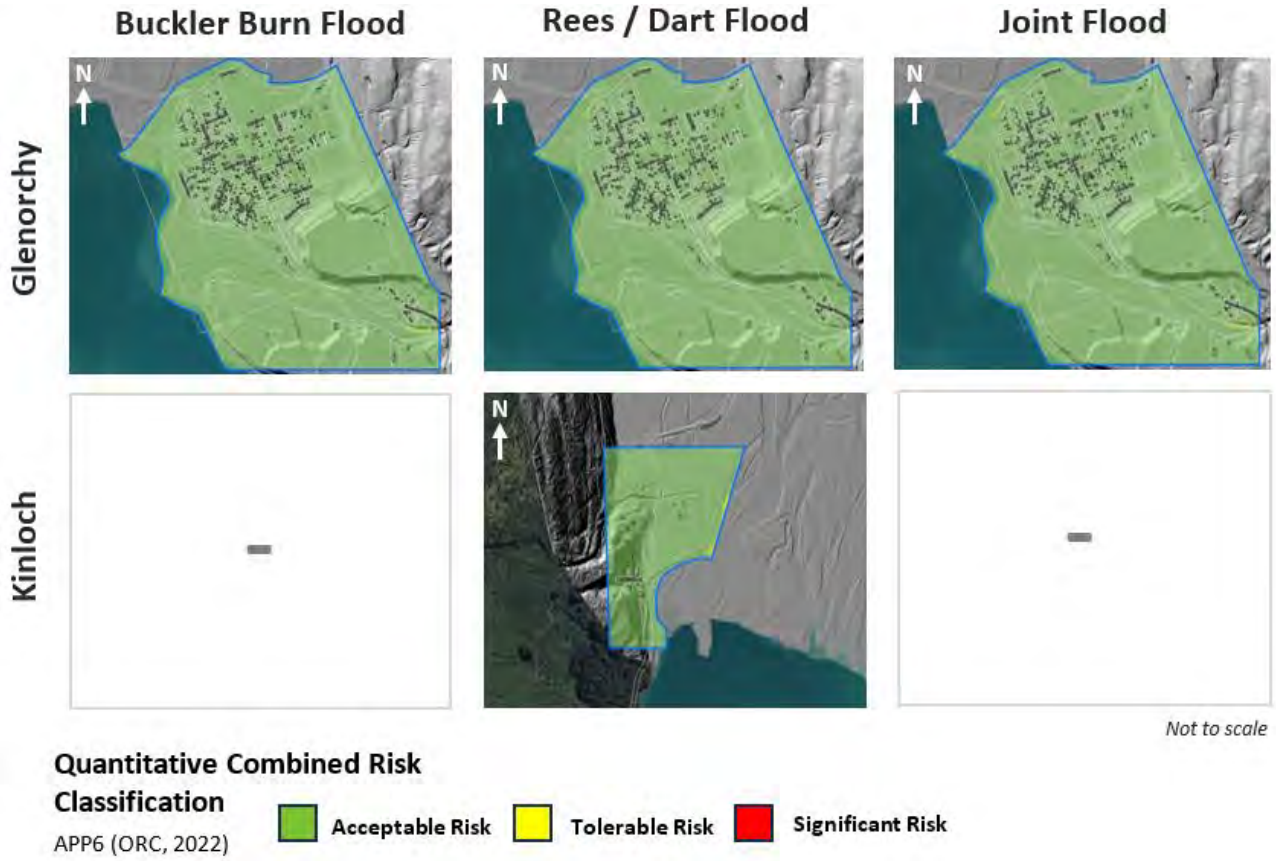


Risk level threshold at $1x10^{-5}$ for acceptable

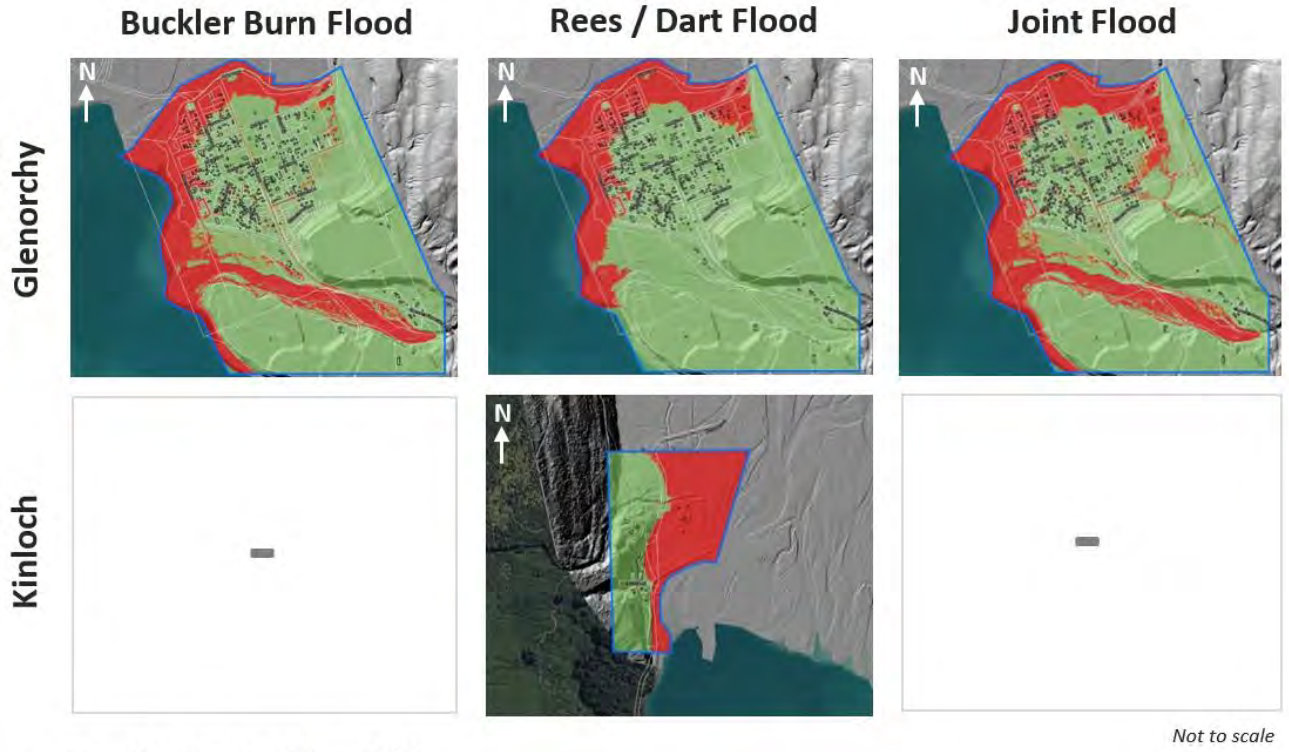
Risk Value (Upper Value)
0
$9x10^{-9}$
$4x10^{-8}$
$9x10^{-8}$
$2x10^{-7}$
$4x10^{-7}$
$5x10^{-7}$
$9x10^{-7}$
$2x10^{-6}$
$3x10^{-6}$
$4x10^{-6}$
$5x10^{-6}$
$9x10^{-6}$

Beca

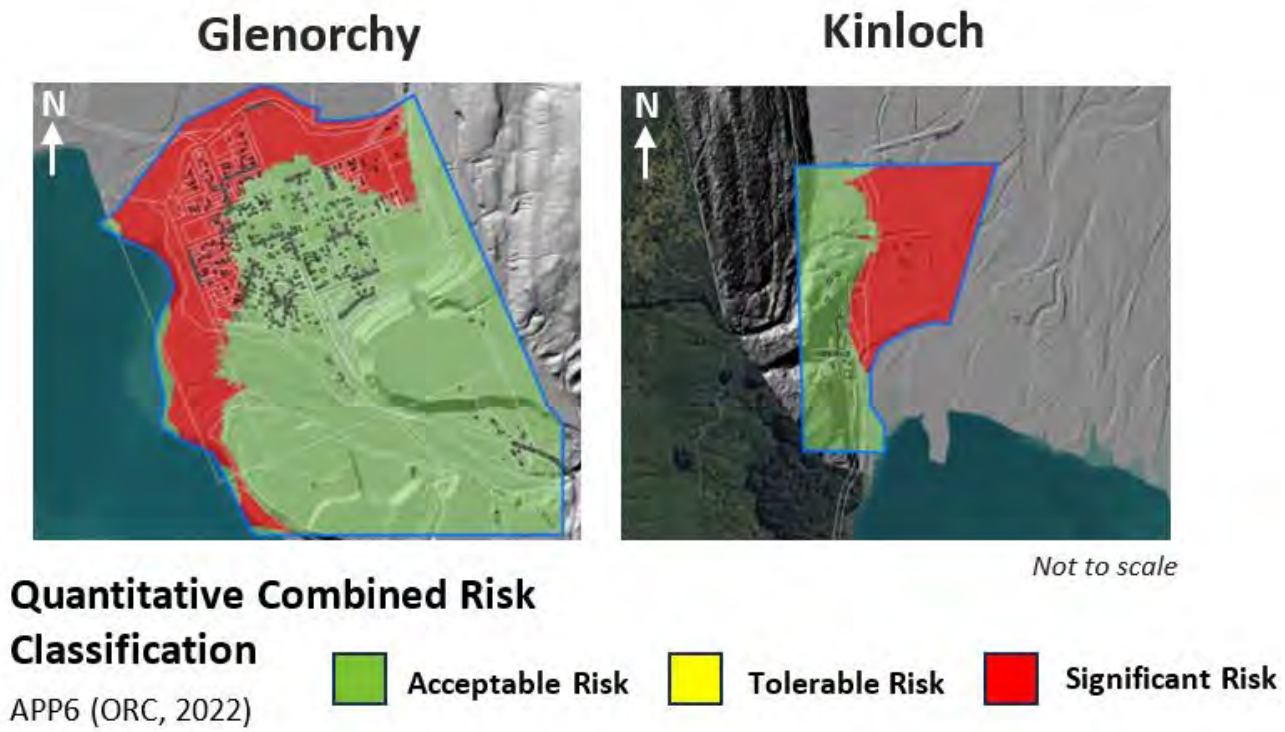
Quantitative Life Risk (AIFR) – River Flooding



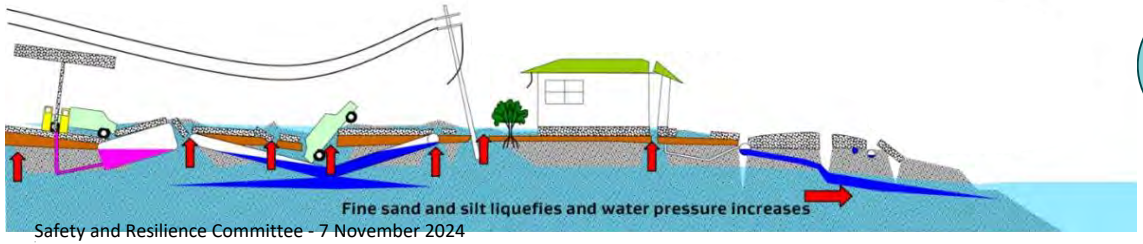
Quantitative Property Risk (APR) – River Flooding

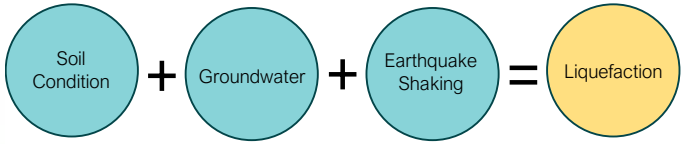


Quantitative Property Risk (APR) – Lake Flooding



Earthquake Damage





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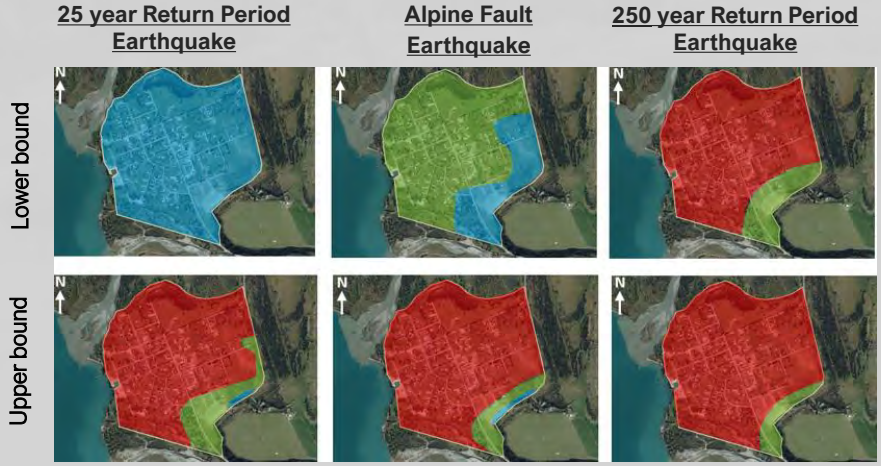
Liquefaction Damage

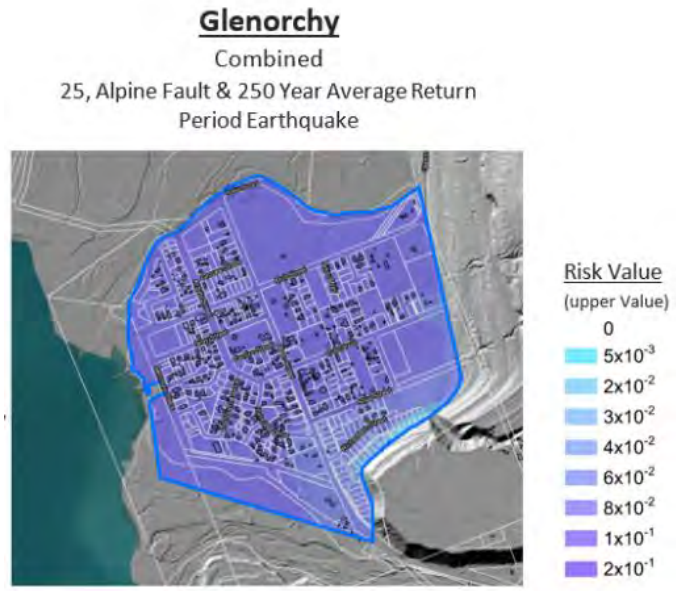
- Liquefaction and lateral spreading assessment for Glenorchy
- Land damage has been categorised to assist with estimating levels of damage to built environment

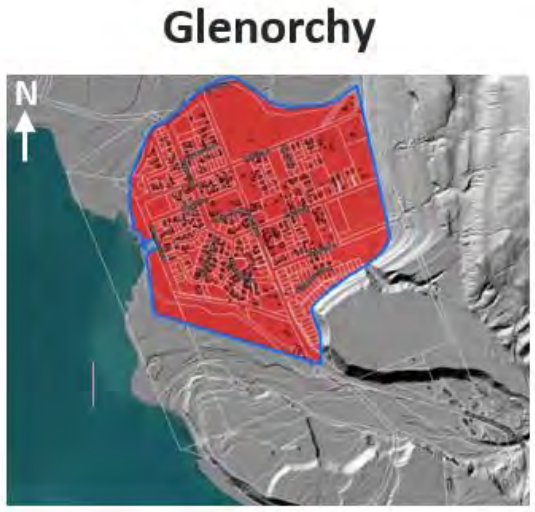
T+T, 2022



Beca, 2024

Quantitative Property Risk (APR) – Liquefaction





Quantitative Combined Risk Classification

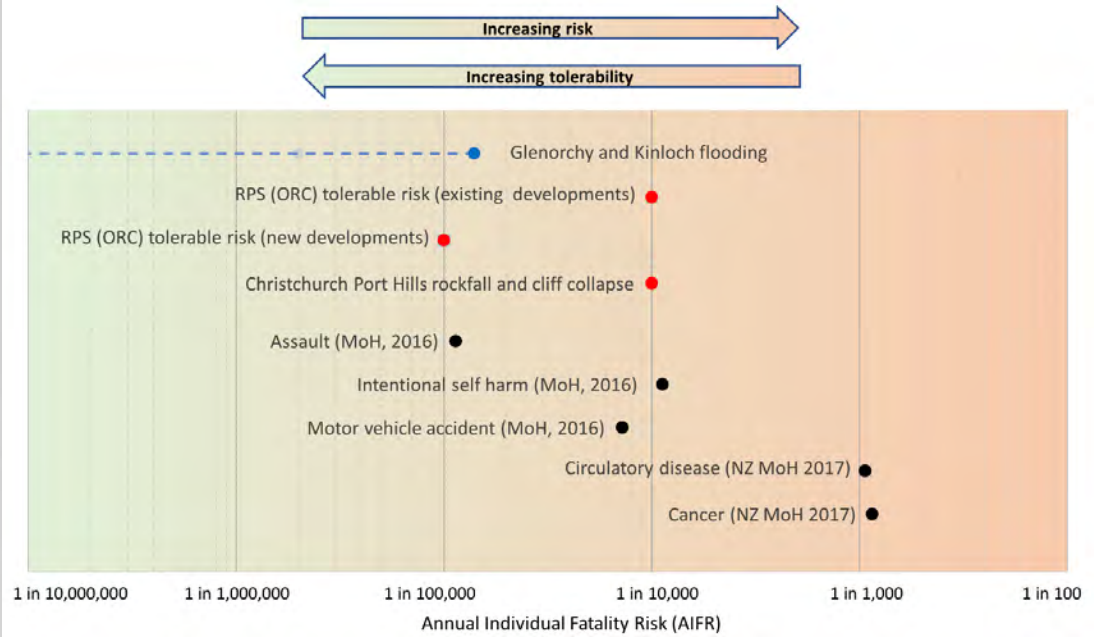
Acceptable Risk | Tolerable Risk | Significant Risk

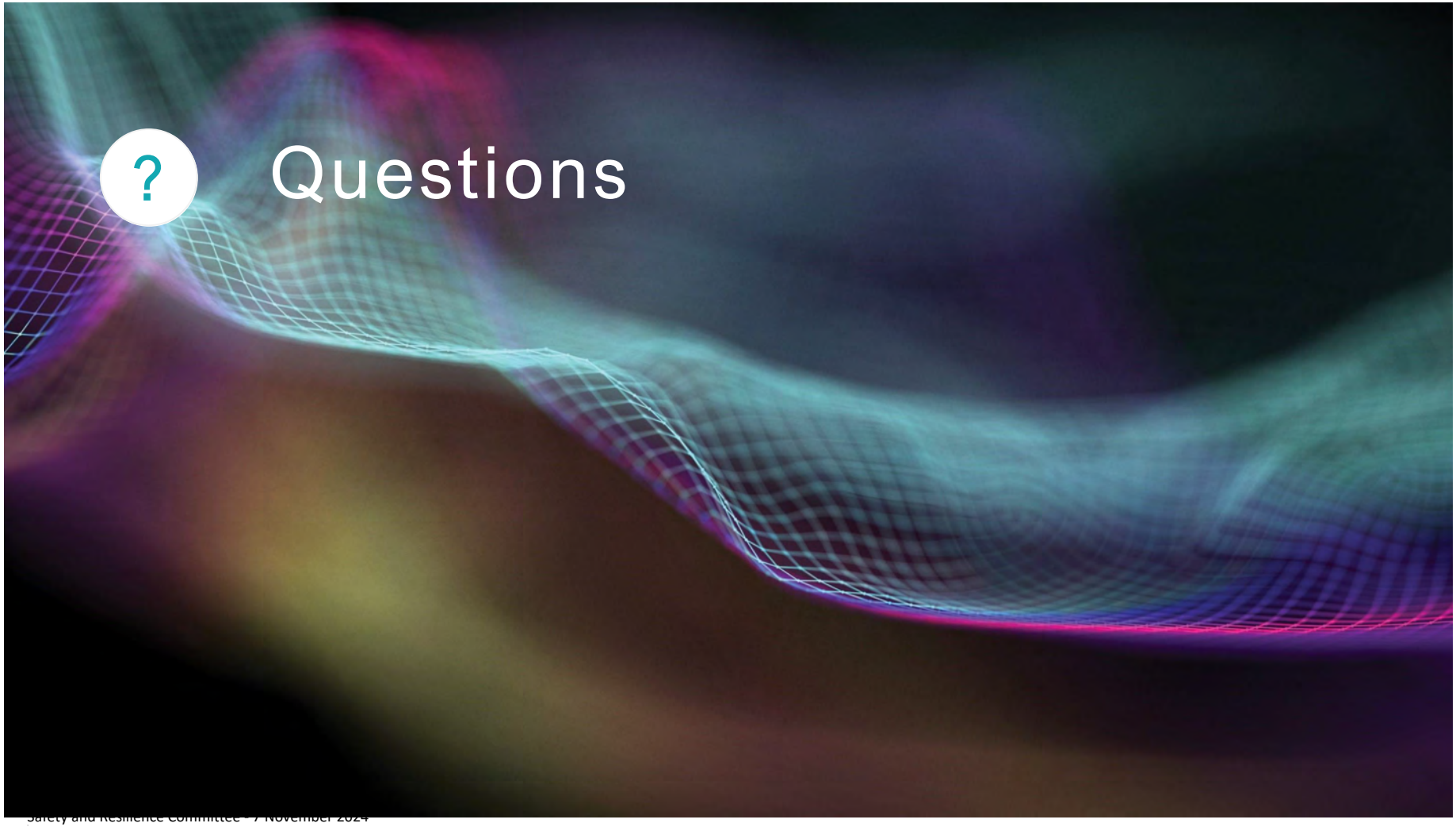
Natural hazards risk summary

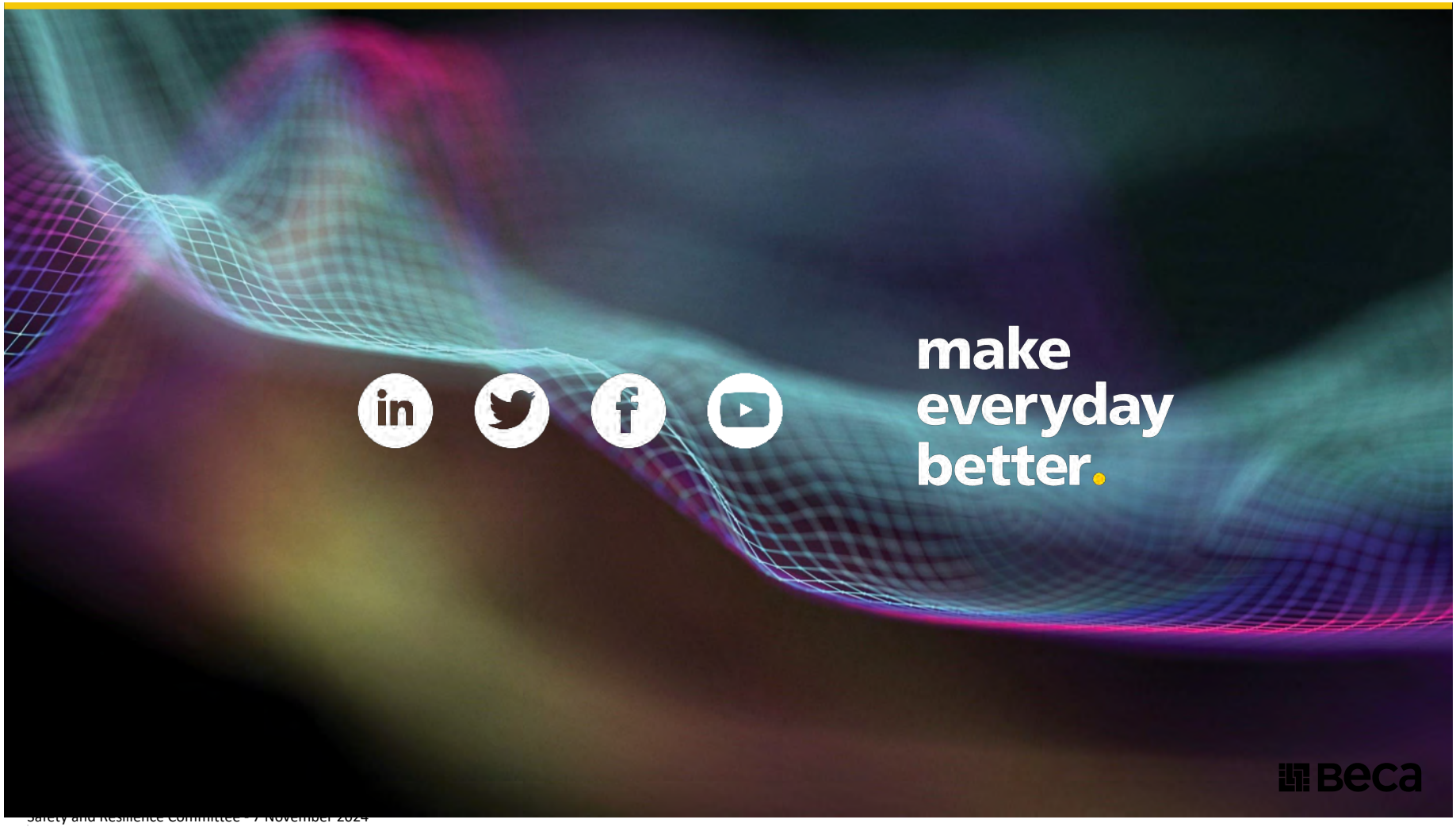
Hazard	Qualitative Assessment		Quantitative Assessment	
	Health and Safety Risk	Built Environment Risk	Life Risk (AIFR)	Property Risk (APR)
River flooding – Buckler Burn	Tolerable	Significant	Acceptable	Significant
River flooding – Rees / Dart	Significant	Significant	Acceptable	Significant
River flooding – Joint (multiple sources)	-	-	Acceptable	Significant
Lake Wakatipu flooding	Acceptable	Significant	-	Significant
Seismic shaking	Acceptable	Tolerable	-	-
Liquefaction and lateral spreading - Glenorchy	Acceptable	Significant	-	Significant

Risk Tolerability

- RPS: “local authorities are required to undertake a consultation process with communities, stakeholders and partners regarding risk level thresholds”




Questions


make
everyday
better.
Beca

Damwatch Engineering Ltd Presentation

Assessments of Floodplain Management Interventions for the Dart and Rees Floodplains

- Dr Grant Webby
- Bill Veale

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DAMWATCH
ENGINEERING BEYOND THE SURFACE
Head of Lake Whakatipu Natural Hazard Adaptation Strategy Workshop
29th August 2024
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Safety and Resilience Committee - 7 November 2024

Rees and Dart Rivers - Assessment of Floodplain Intervention Options

Introduction

DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Introduction

Purpose of this presentation:

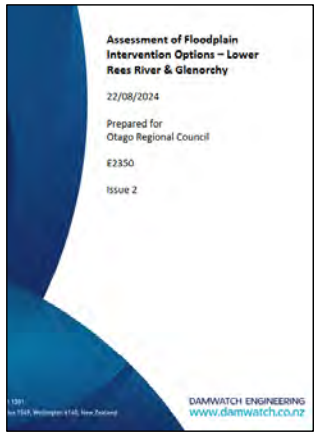
- Scope and objectives of assessments
- Overview of approach methodology
- Key findings and outcomes
- Opportunity for questions at the end of the presentation

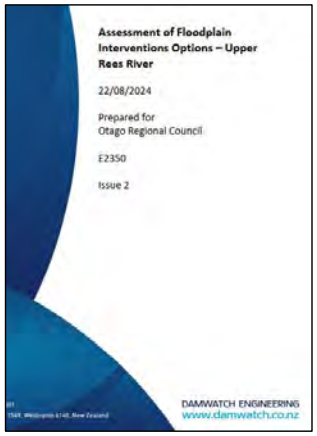
Flood inundation of Kinloch Road from the Dart River, 2019 flood event
(Photo supplied by ORC)

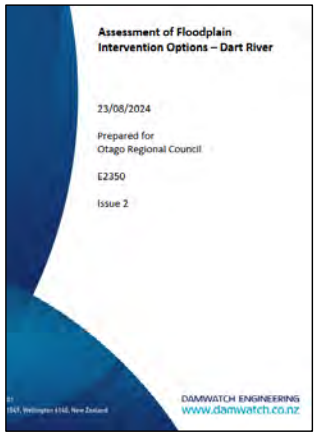
DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Introduction

- Further details available in the three assessment reports:
  1. Lower Rees River & Glenorchy
  2. Dart River
  3. Upper Rees River



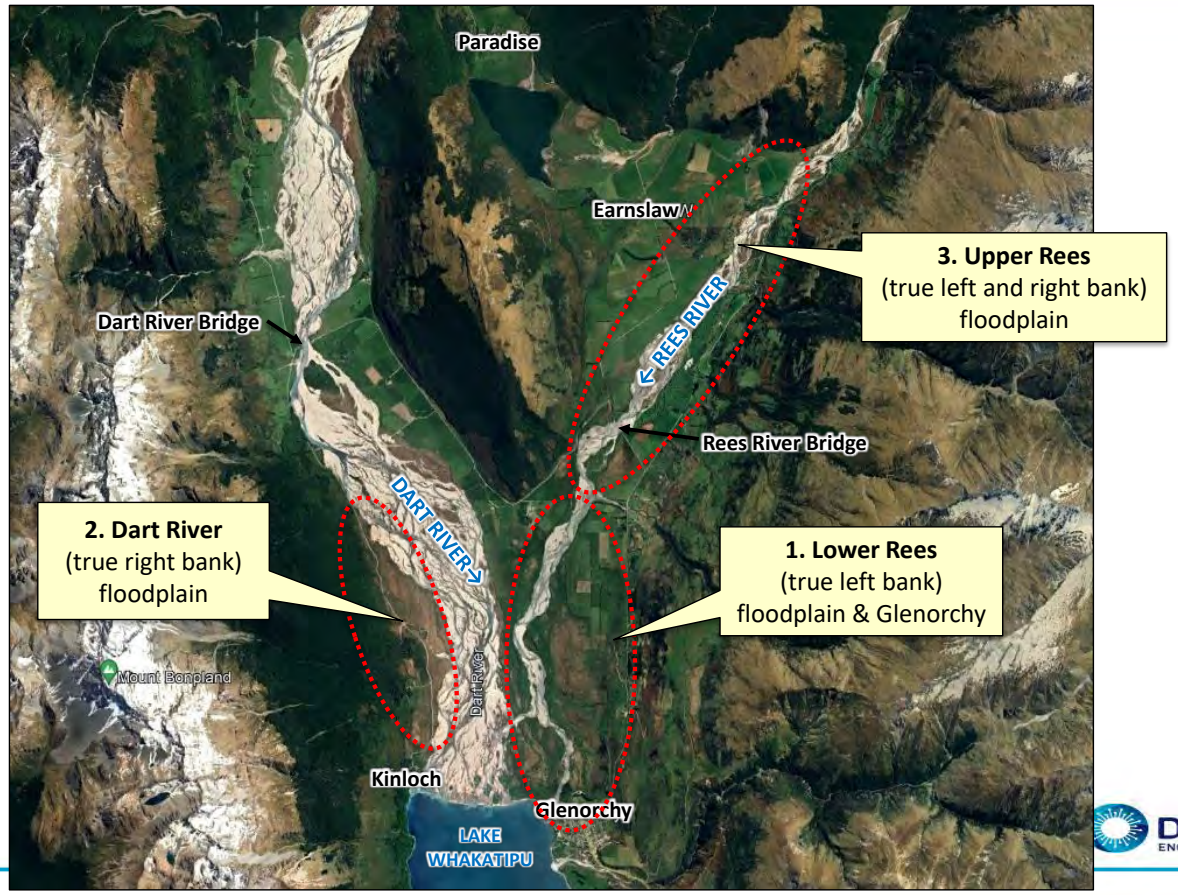




- These reports will be made publicly available soon

DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Introduction



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Rees and Dart Rivers - Assessment of Floodplain Intervention Options

Scope & Objectives

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Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Scope and Objectives

- The **scope and objectives** of the current assessments were to:
  - Provide an evidence base to rule out various floodplain management options
  - Assess the viability of potential options that mitigate existing flood hazards
  - Test viable options for their alignment with a Nature-based Solutions (NbS) approach to floodplain management
  - Viable options were taken forward to a concept level design stage (i.e. drawings and costings)

February 2020 flooding at Glenorchy (ORC, photo credit to Luke Hunter)

DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Scope and Objectives

- Outside of scope:
  - Backwater flooding hazard to Glenorchy from high water levels in Lake Wakatipu
  - Options to raise and/or lengthen the existing Rees River Bridge
  - Options to raise or re-route the existing Kinloch Road
  - Any options previously discounted in 2022 floodplain adaption workshop

February 2020 flooding at Glenorchy (ORC, photo credit to Luke Hunter)

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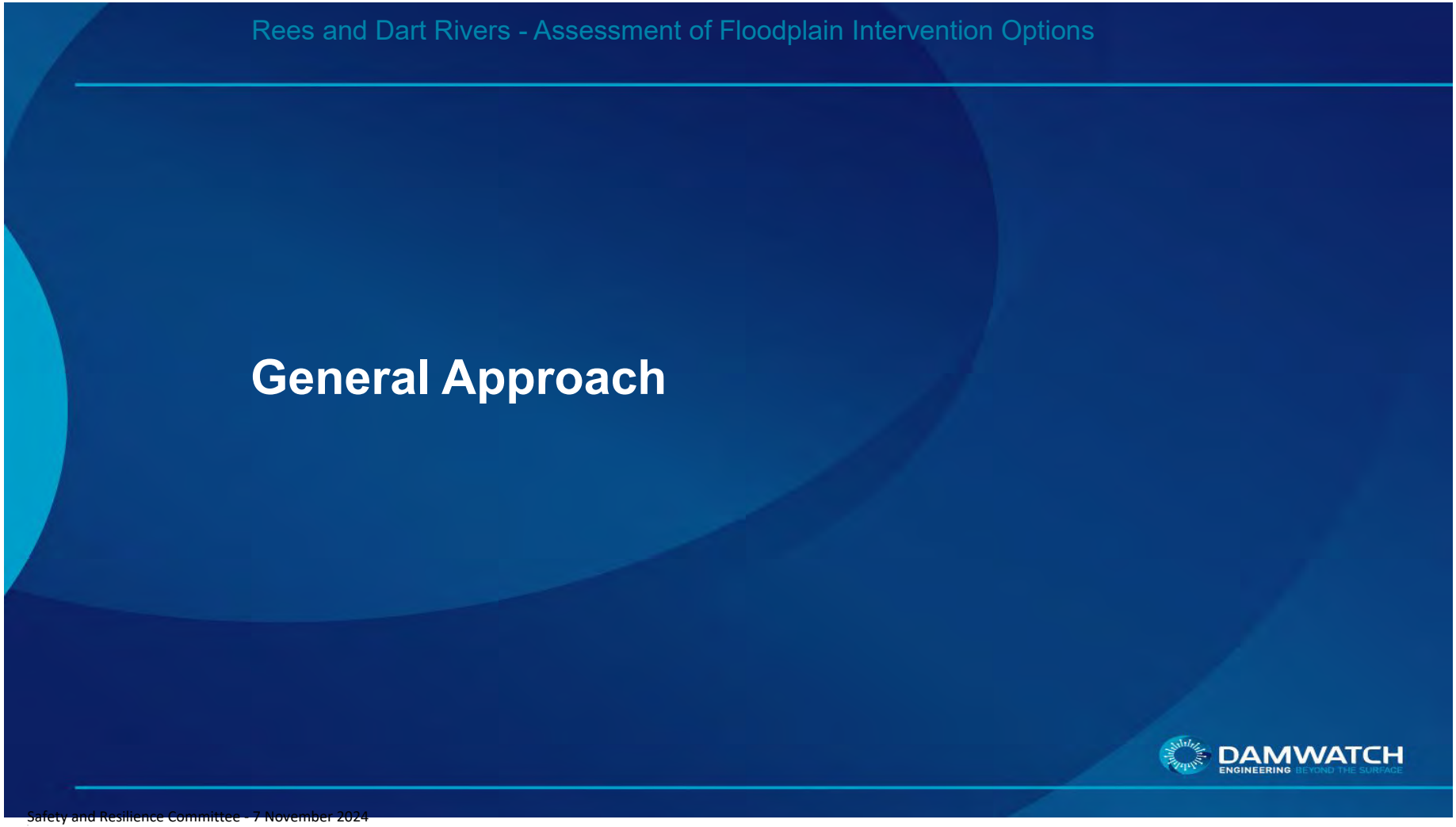
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
General Approach
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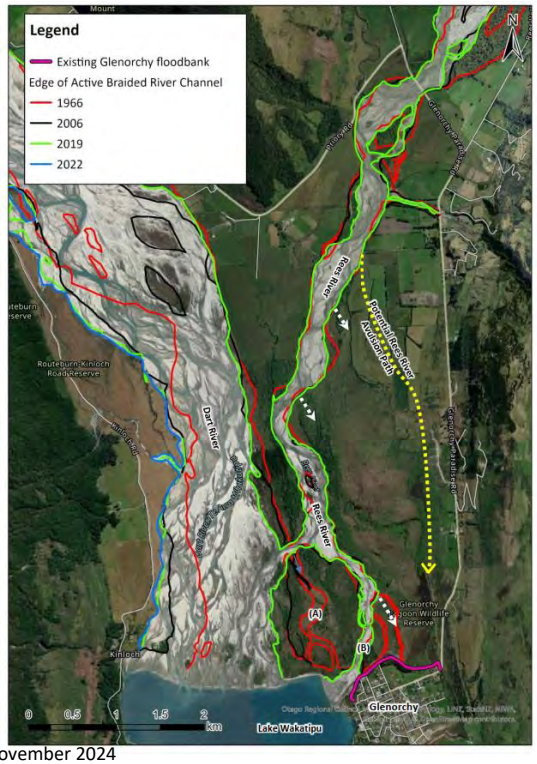
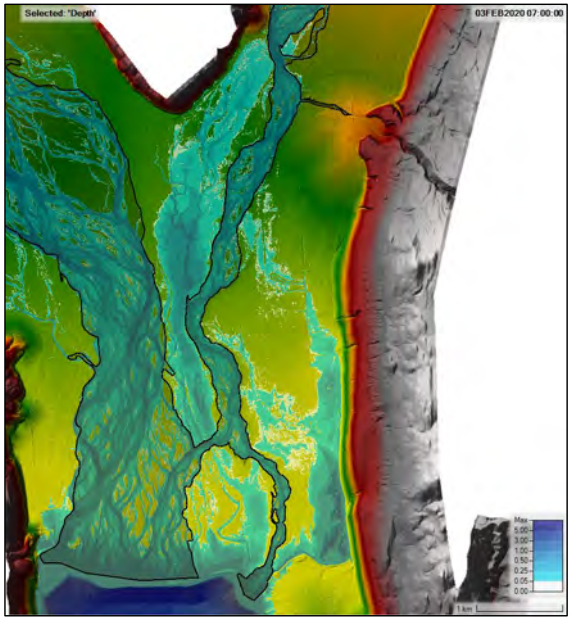
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
General Approach

- **Develop an understanding** of existing flood hazard and geomorphological setting of the Rees-Dart River system



- **Development of potential floodplain intervention options** with the aid of two-dimensional computational hydraulic models (HEC-RAS)



Example predicted flood depth outputs from HEC-RAS model

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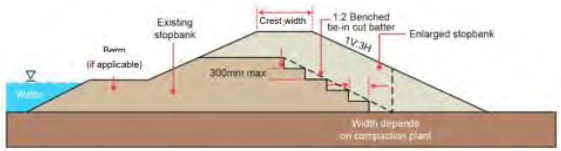
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
General Approach

- Comparison of options in terms of meeting floodplain management objectives and alignment with **Nature-based Solutions** (NbS)

	Room for Flood Conveyance	Room for Water Retention	Room for Bank Erosion	Impact Reduction
Floodplain widening	✓		✓	
Retention areas		✓		
Wetland restoration	✓	✓	✓	
Embankment removal	✓		✓	
Meander restoration			✓	
Zonation/ Building codes				✓
Elevating houses				✓
Reviving old channels	✓		✓	
Removing obstacles	✓		✓	
Early-warning system				✓

- For viable options, development of **concept level design**:
  - Drawings and indicative construction costs
  - Preliminary review of consenting, design and construction considerations
  - Long-term resilience testing (e.g. to climate change impacts, river bed level aggradation)
  - Identification of potential issues and further work for any future detailed design phase



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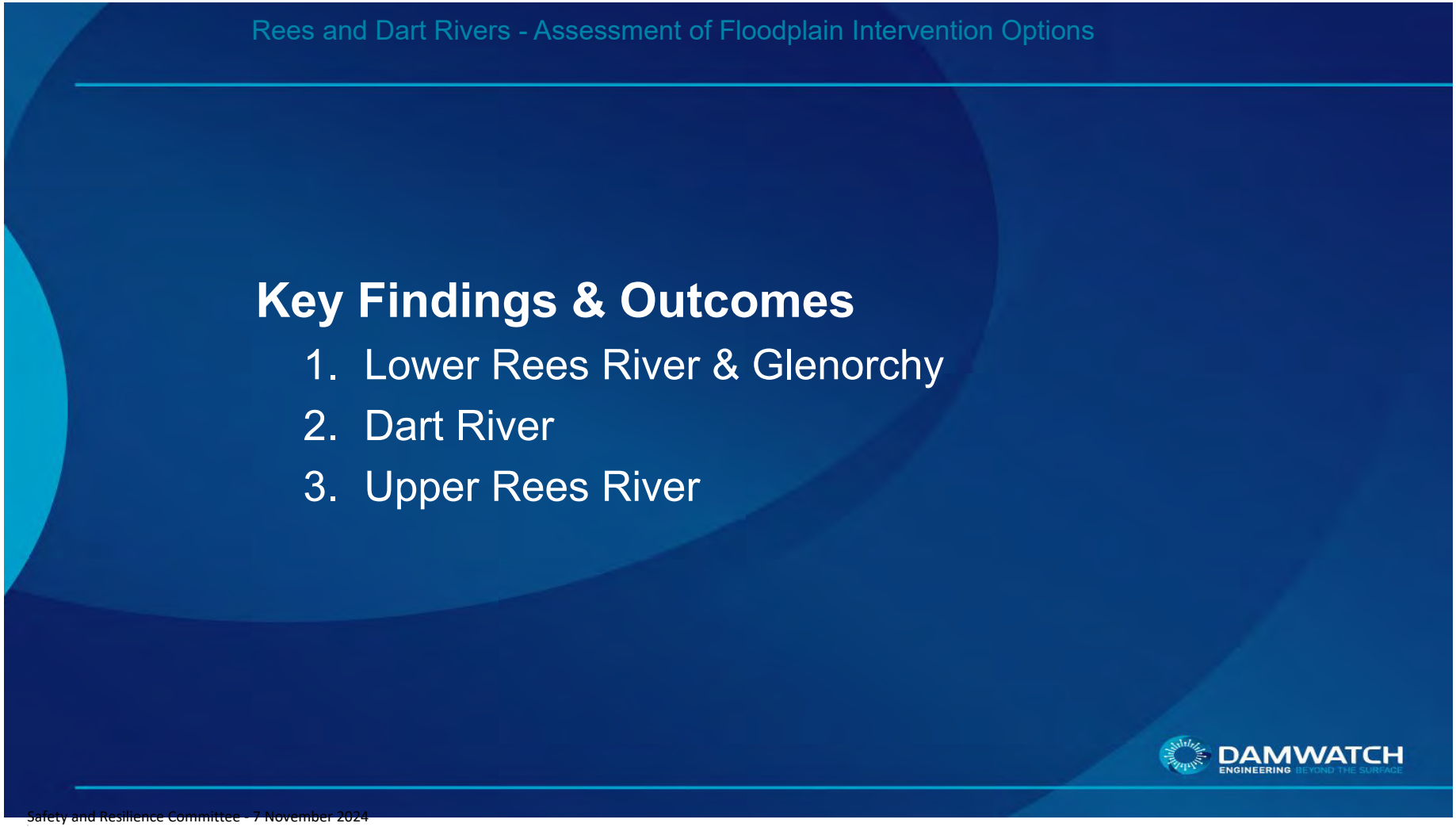
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes
1. Lower Rees River & Glenorchy
2. Dart River
3. Upper Rees River
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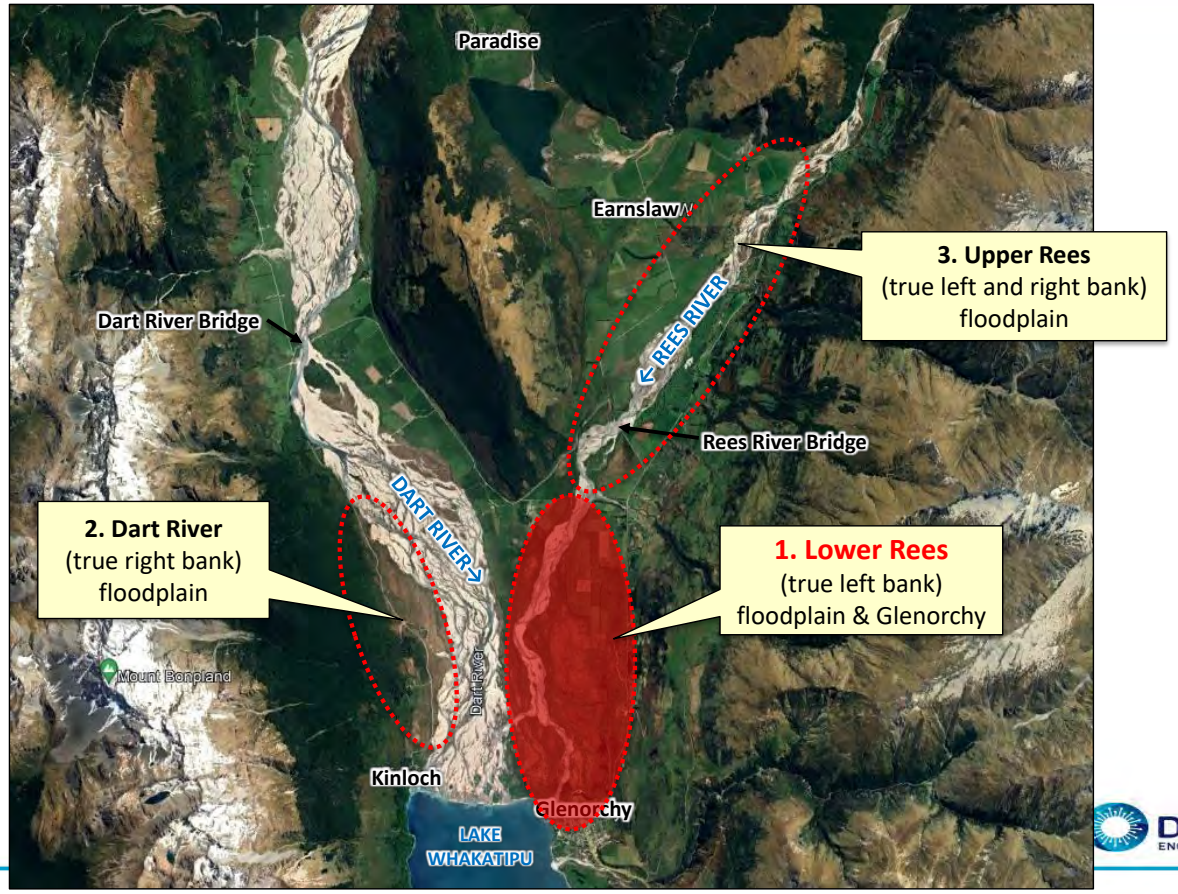
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes



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Rees and Dart Rivers - Assessment of Floodplain Intervention Options

Key Findings & Outcomes

1. LOWER REES & GLENORCHY

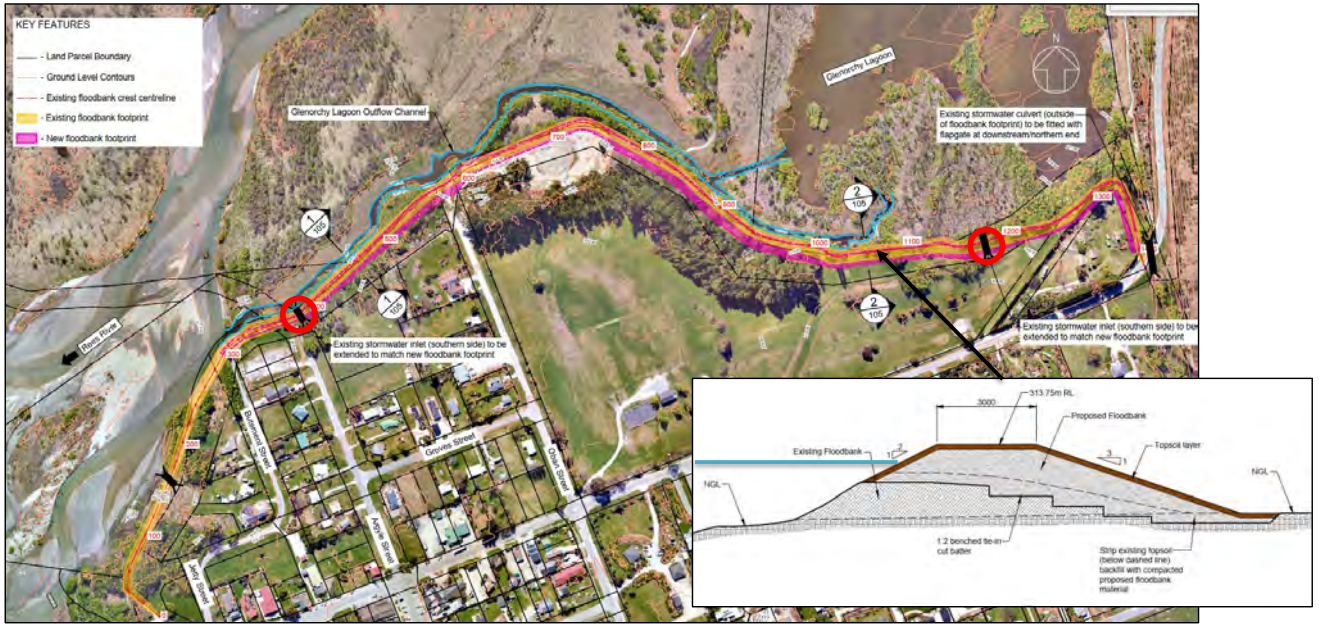
- Potential floodplain intervention options considered:

DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes

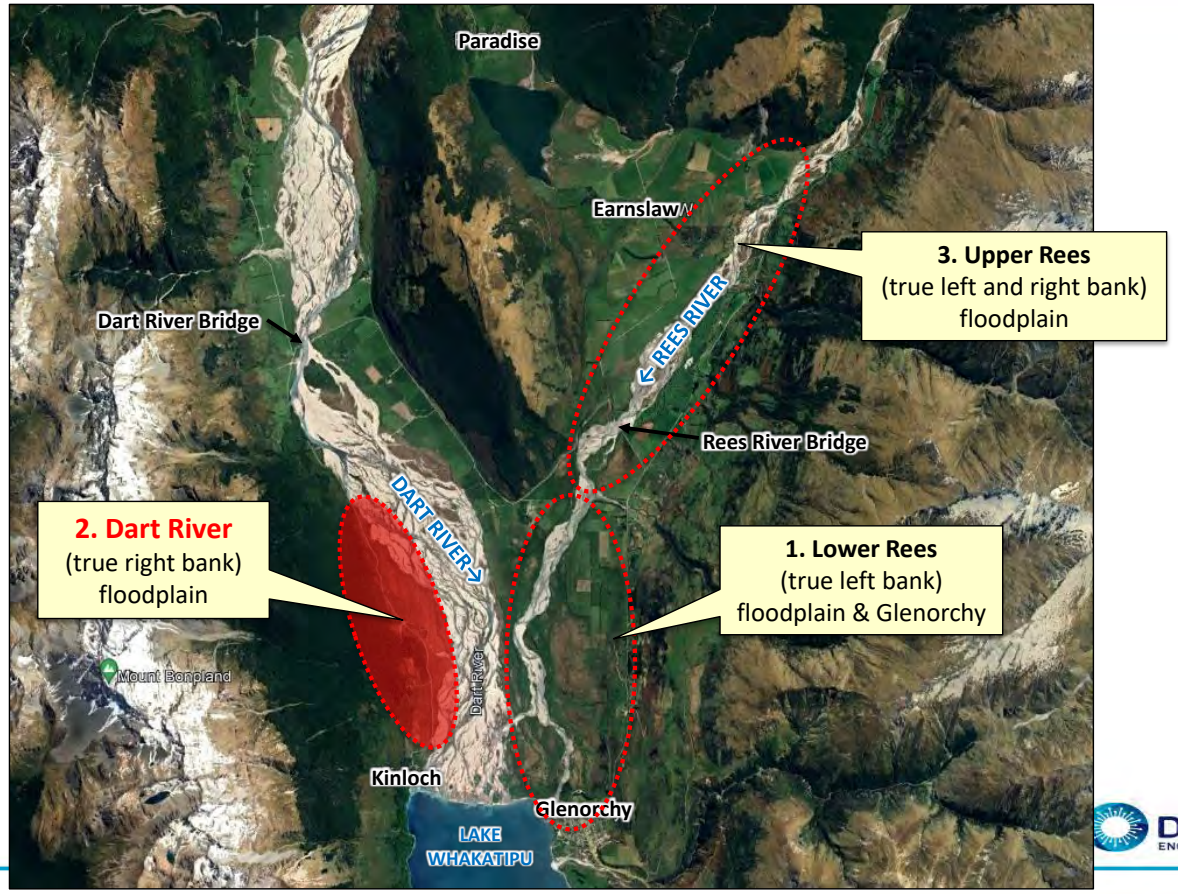
1. LOWER REES & GLENORCHY

- Only Option A (raise existing Glenorchy floodbank) found to be potentially viable:



DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes



DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes

2. DART RIVER (true right bank only)

- Floodplain intervention options focused on:
  - Mitigating river-bank migration
  - Preventing damage to Kinloch Road
  - Reducing rate of farmland loss between the road and the riverbank to provide protection for the road
- The scale of the flood hazard is very challenging to defend against with conventional engineering solutions (e.g. floodbanks)
- The focus was therefore on mitigation of existing flood hazards and providing room for the river rather than rather than construction of new floodbanks

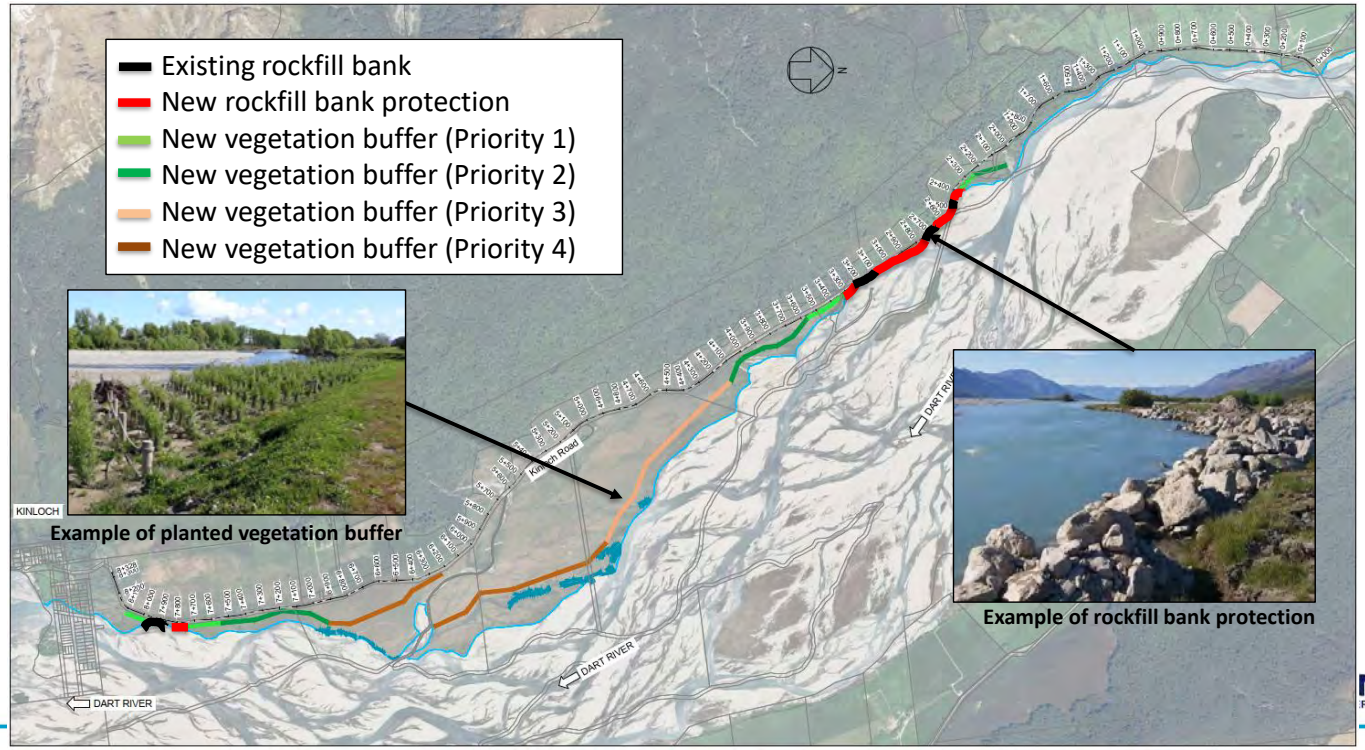
HEC-RAS model outputs for 1 in 20 AEP flood (current climate)

DAMWATCH ENGINEERING BEYOND THE SURFACE

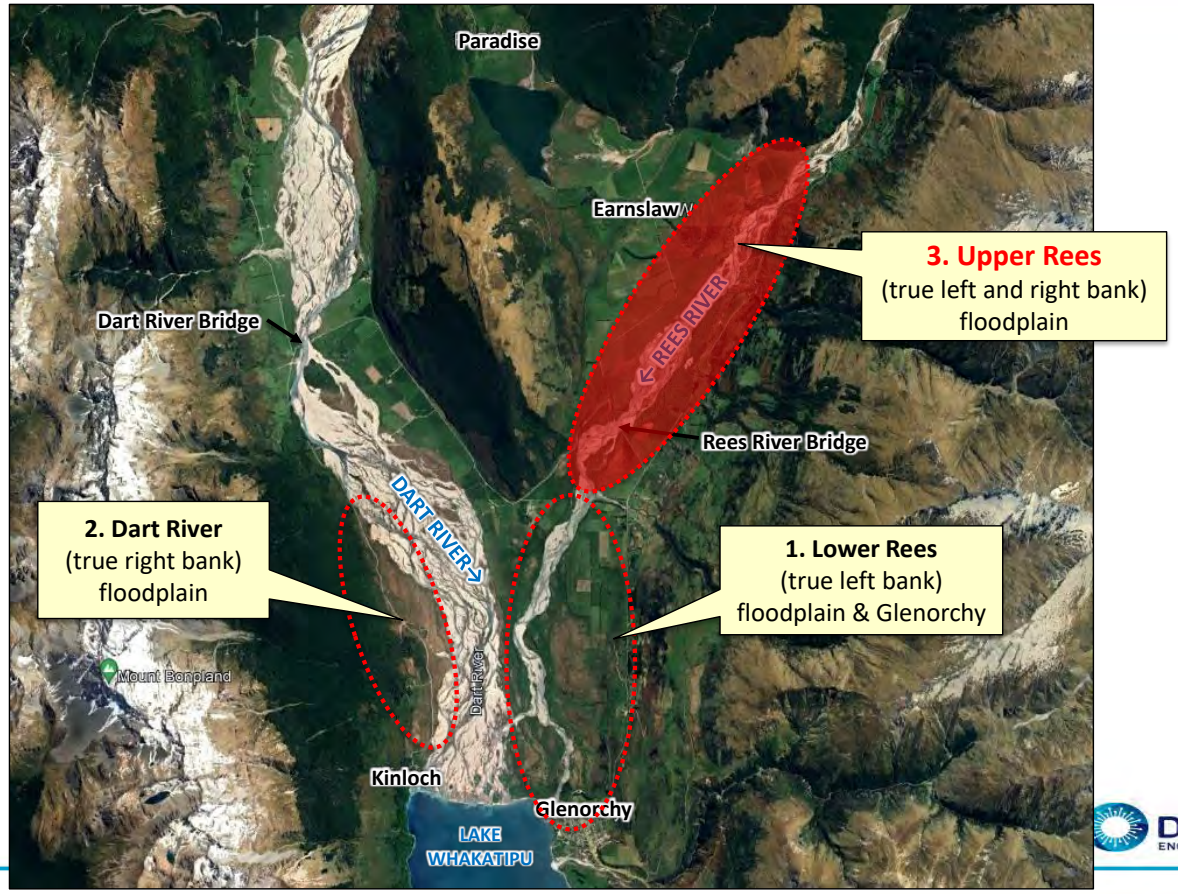
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes

2. DART RIVER

- The intervention options selected were a combination of rockfill and vegetated buffer protections (prioritised to allow staged implementation)



Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes

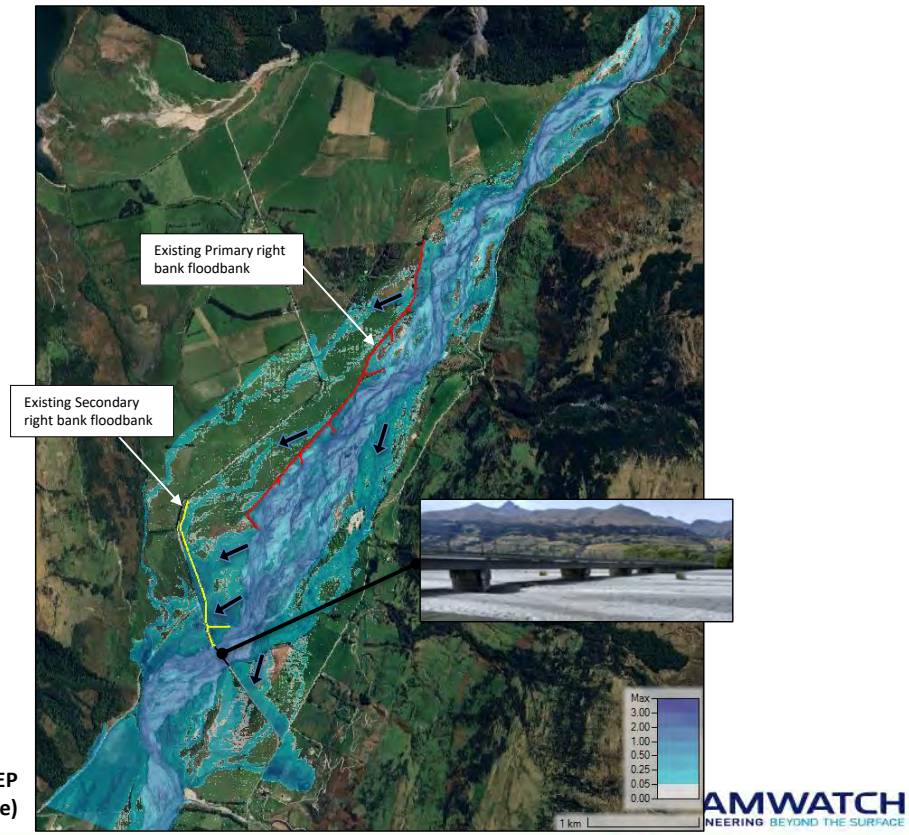


DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes

3. UPPER REES

- The scale of the Upper Rees River flood hazards are very challenging to defend against with conventional engineering solutions (e.g. floodbanks)
- Under flood conditions, there is insufficient conveyance capacity through the bridge waterway
- The river naturally wants to break-out on the true left and right bank floodplains (but primarily on the right bank floodplain).
- There existing floodbank system on the right bank is outflanked and overtopped in large flood events



HEC-RAS model outputs for 1 in 100 AEP flood (current climate)

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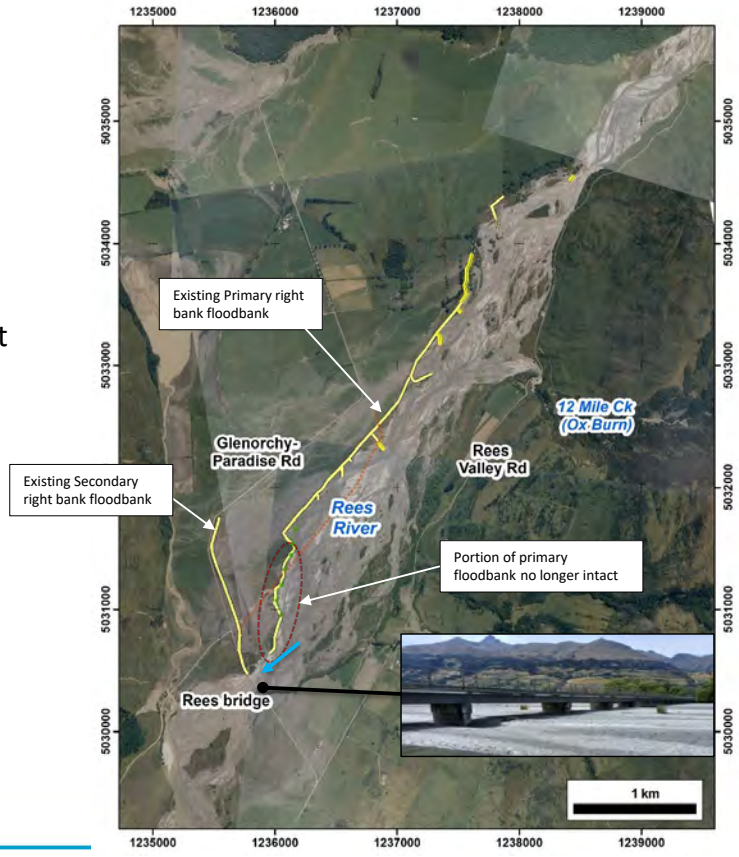
Rees and Dart Rivers - Assessment of Floodplain Intervention Options

Key Findings & Outcomes

3. UPPER REES

- The Rees River Bridge was constructed in c.1950
- A floodbank system on the right bank (privately owned) was constructed in c.1980.
- The floodbank system diverts right bank floodplain flows and increases the flood discharge passing through the Rees River Bridge waterway.
- In conjunction with channel bed aggradation, this has lowered the level of service of the bridge



AMWATCH
INEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options

Key Findings & Outcomes

3. UPPER REES

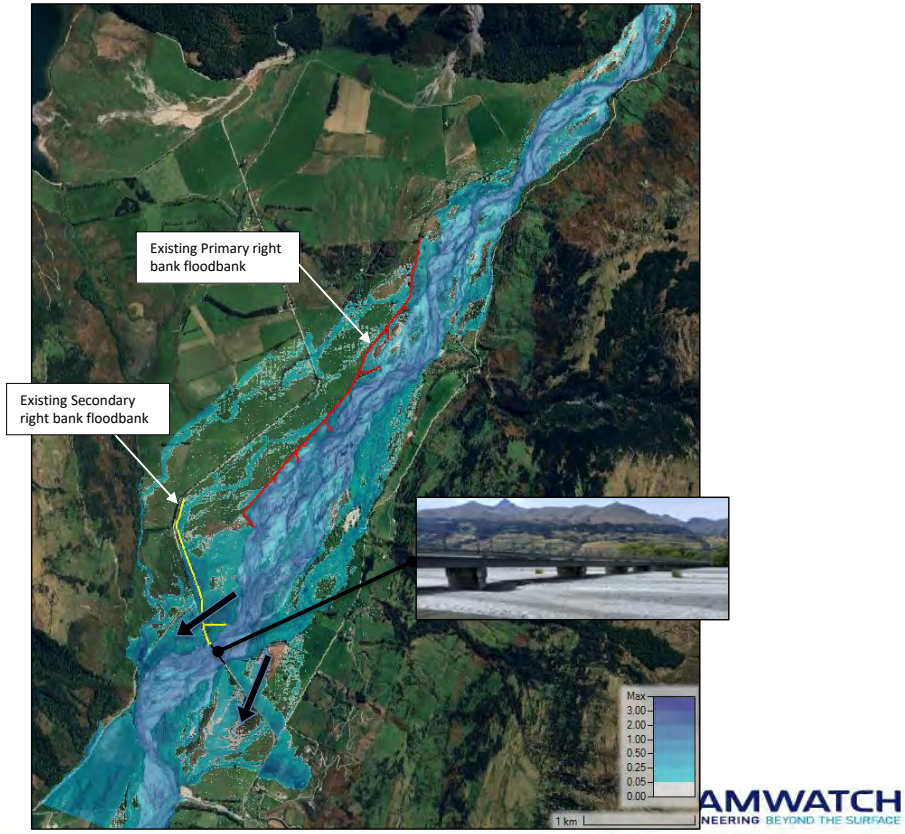
- The floodplain intervention options considered in the current assessment were therefore focused on meeting the following objectives:

I. Providing a managed floodway on the left and/or right bank approaches to the bridge.

- Guide floodplain flows in defined areas past the bridge
- Reduce flood discharge through the Rees River Bridge waterway.

II. Alignment with NbS strategies that provide "room for the river"

- Floodplain widening and embankment removal or retreat, rather than construction of new floodbanks

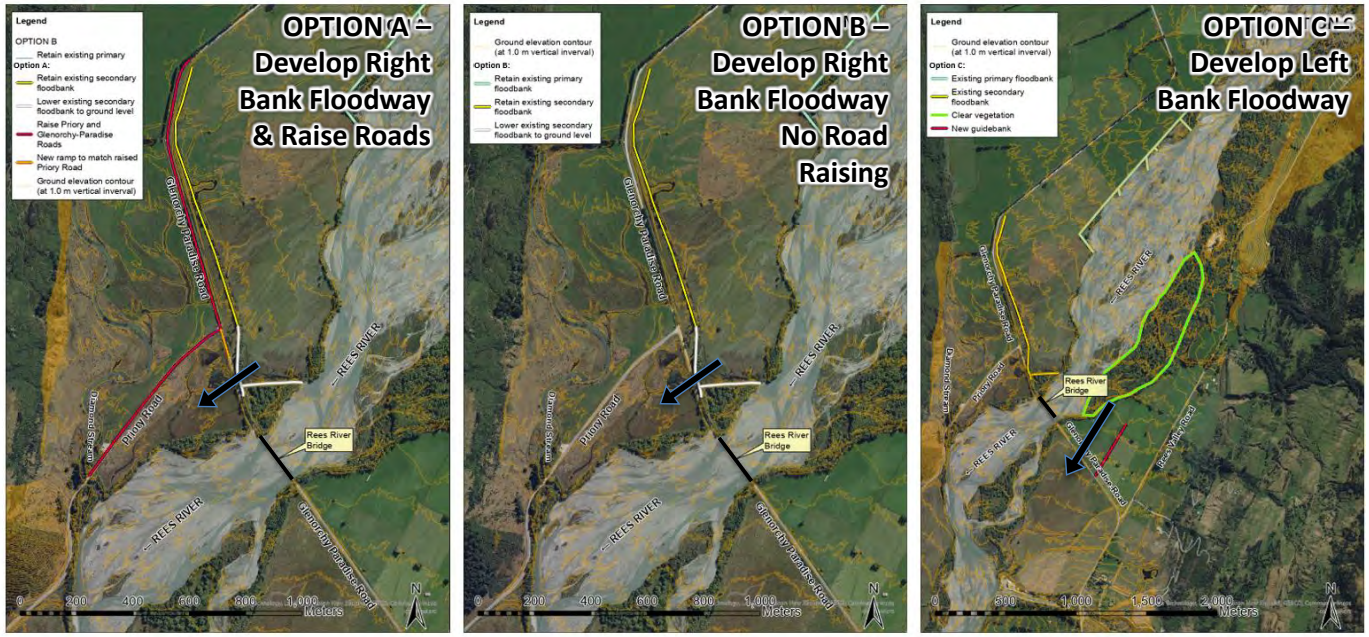


AMWATCH
NEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Key Findings & Outcomes

3. UPPER REES

- Potential floodplain intervention options considered:



NB: Options A, B and C for the Upper Rees are intended to relieve the pressure on the Rees River Bridge under flood conditions by allowing excess floodwaters to bypass the bridge waterway. They are not designed to remove the existing flood hazard to farmland and roads.

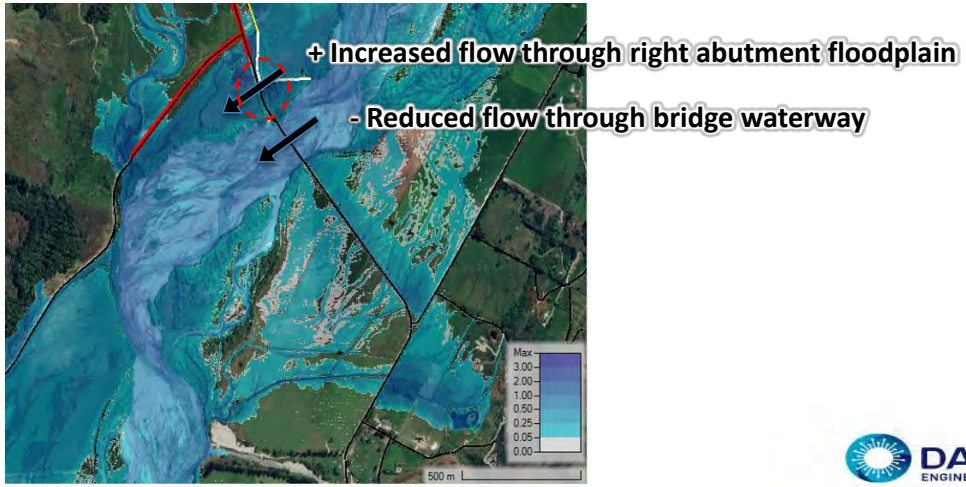
Rees and Dart Rivers - Assessment of Floodplain Intervention Options

Key Findings & Outcomes

3. UPPER REES – Residual Risks

- For the section road approaching the Rees River Bridge on the true right bank Options A and B increase:
  - The frequency of flooding to this road section
  - The potential for erosion damage to the road

- Provisions for scour protection, post-flood repair/maintenance or integration with future bridge raising would need to be considered if these options are pursued



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Rees and Dart Rivers - Assessment of Floodplain Intervention Options

Summary & Next Steps

DAMWATCH ENGINEERING BEYOND THE SURFACE

Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Summary & Next Steps

Summary

- Potential floodplain intervention options, aimed at mitigation of existing flood hazards and alignment with NbS, were investigated for:
  1. Lower Rees River (left bank) & Glenorchy
  2. Dart River (right bank)
  3. Upper Rees River
- An evidence base was provided to rule out non-viable options
- Potentially viable options were taken forward to a concept design stage (i.e. preparation of concept level drawings, costs, consenting requirements, etc)

Next Steps

- *Community engagement*: what does the community think and want?
- *Funding arrangements and constraints*: how might the options be funded?
- *Land ownership*: how to implement works on privately owned land?
- *Consenting*: resource consent application and conditions
- *Detailed engineering design and implementation*

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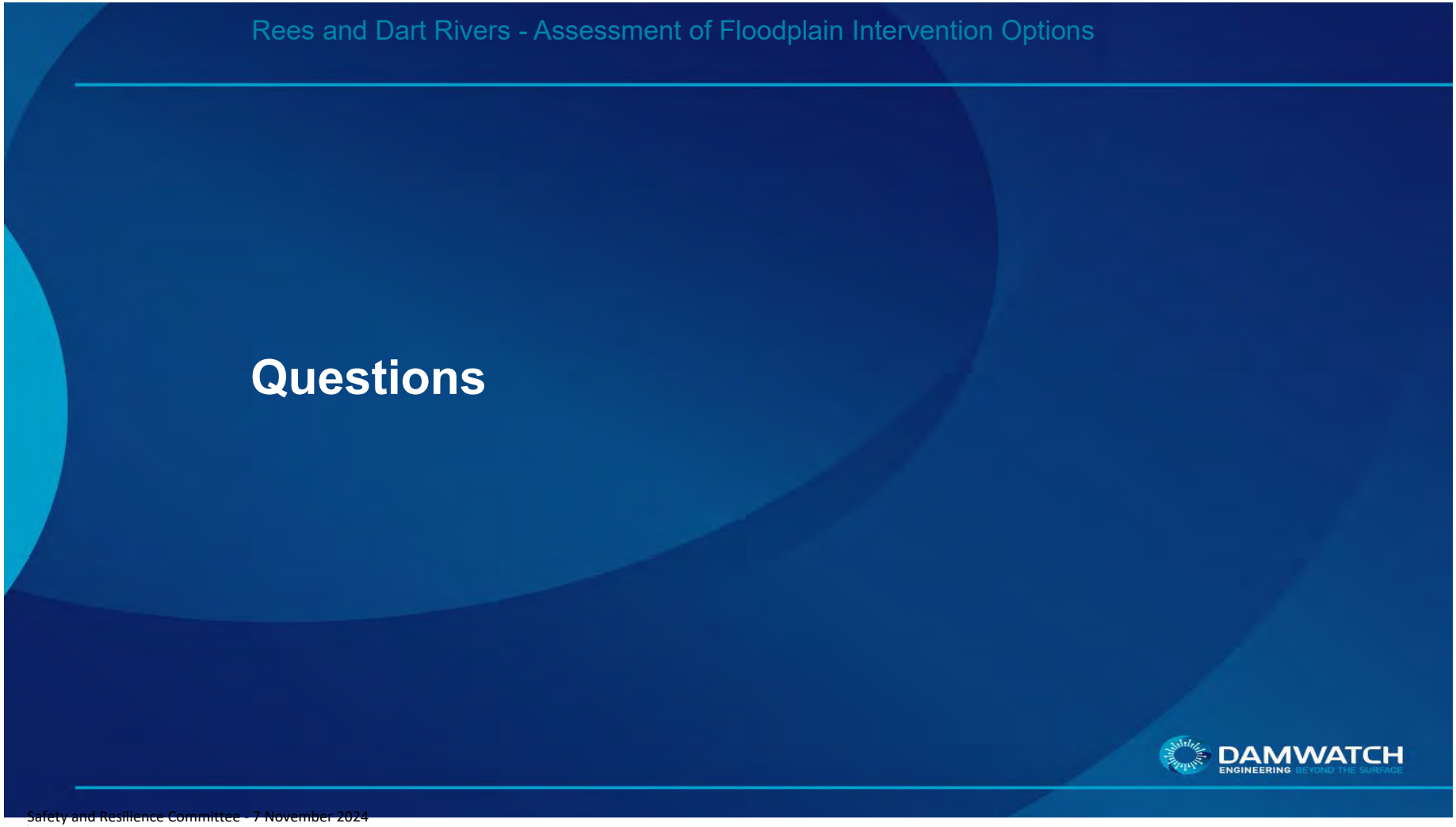
Rees and Dart Rivers - Assessment of Floodplain Intervention Options
Questions
DAMWATCH
ENGINEERING BEYOND THE SURFACE
Safety and Resilience Committee - 7 November 2024


Break
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Adaptation Pathways and Strategy Development

- What can we do about it?
  - Responses, areas of responsibility, implementation
- When and how do we make decisions?
  - Pathways example
- Looking forward – how does this information come together in the Strategy, what's next

Joined by Paula Blackett (NIWA)

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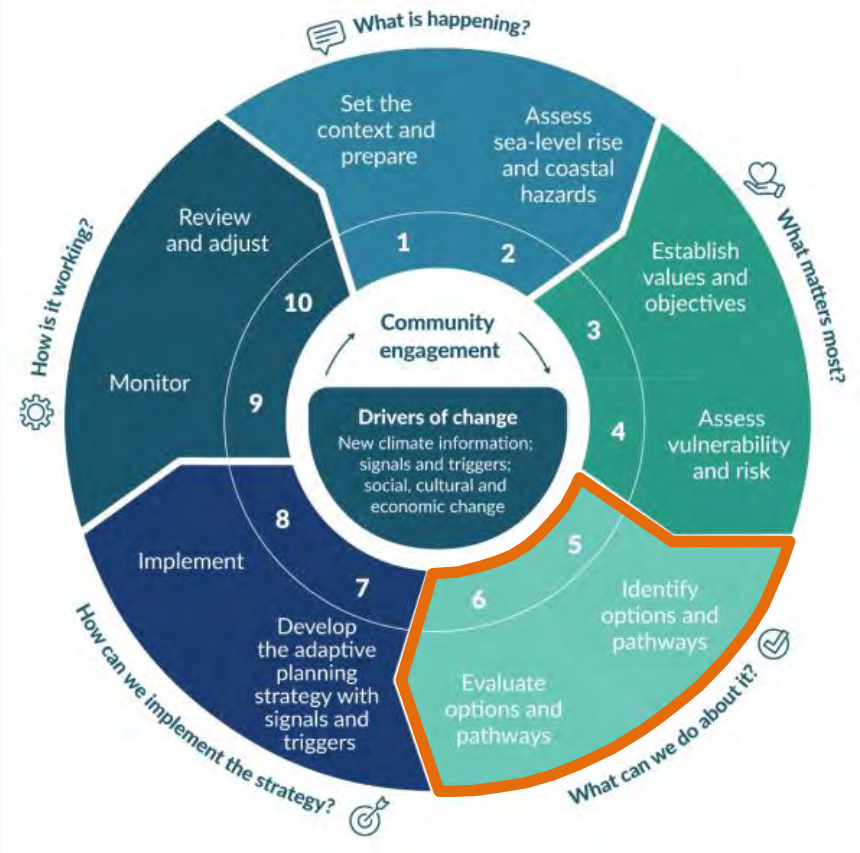
What can we do about it?

- Identify a long-list of possible ways to manage natural hazards and adapt to environmental changes
- Ongoing conversation with community, iwi, QLDC
- Evaluate acceptability of options – feasibility assessment, socio-economic impact screening, cultural impact screening, community engagement



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Types of responses to manage hazards:

☑ indicates existing responses already in place

Protect

☑ Existing low level flood protection for Glenorchy township

☑ Existing road network maintenance and repair

Improvements to Glenorchy flood protection

Road network resilience improvements (e.g. erosion protection, raising, re-aligning)

Community wide ground and building improvement works for liquefaction hazard

Accommodate

☑ Behavioural and societal changes

☑ Readiness, response and recovery

☑ Monitoring, flood forecasting and early warning

☑ River management (gravel and vegetation)

☑ Boat and wharf access to Glenorchy and Kinloch

☑ Individual and business insurance cover

Property level interventions to increase resilience (e.g. floor raising, flood proofing, strengthening)

Nature-based floodplain interventions

Accept a reduced level of future service (e.g. 4WD road, lower flood protection)

Retreat

Proactive relocation plan

Voluntary proactive relocation from higher hazard areas

Reactive retreat (post-event)

Avoid

☑ Existing development rules (minimim floor height)

Revised development rules

No new development, redevelopment or change of land-use that may exacerbate risk

Types of responses to manage hazards:

☑ indicates existing responses already in place

Protect

☑ Existing low level flood protection for Glenorchy township

☑ Existing road network maintenance and repair

Improvements to Glenorchy flood protection

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Reactive retreat (post-event)

Avoid

☑ Existing development rules (minimim floor height)

Revised development rules

No new development, redevelopment or change of land-use that may exacerbate risk

Whose area of responsibility?

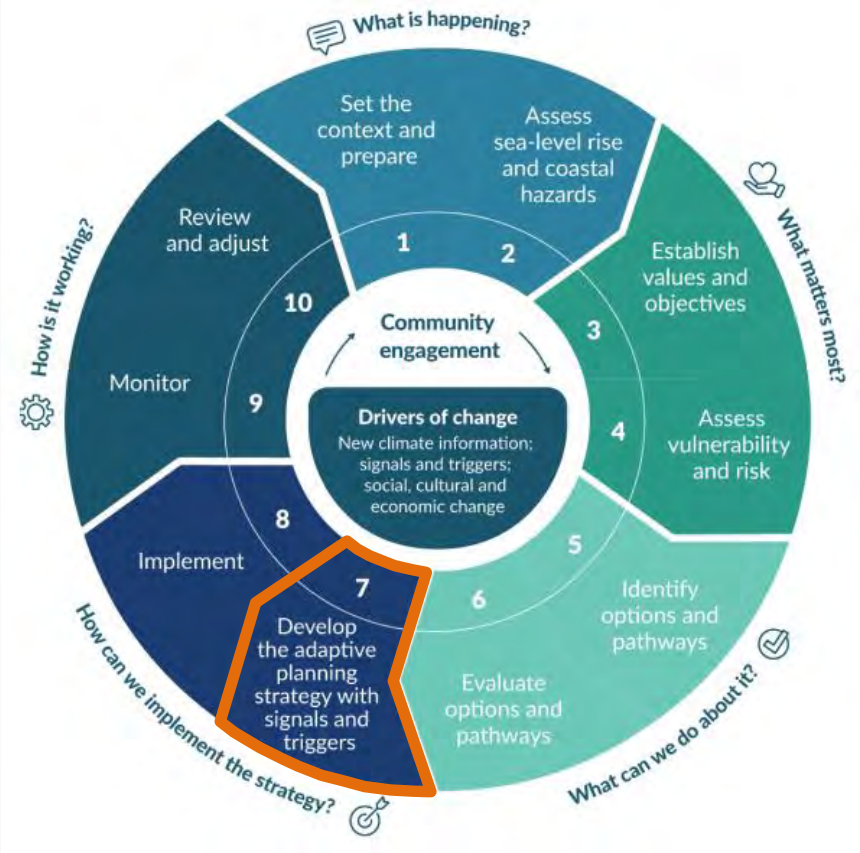
Otago Regional Council (ORC)
Queenstown Lakes District Council (QLDC)
Joint responsibility – ORC and QLDC
Individual property owner
Multiple actors (QLDC, ORC, EMO, community, individual)
Not defined at this stage

QUESTION AND DISCUSSION

- Types of responses – Protect, Accomodate, Retreat, Avoid
- Future action could be undertaken through:
  - Business-as-usual activities
  - Individual, household or community level actions
  - Established ways of managing hazards
  - One-off arrangements
  - Reactive response after an event
- Different roles and responsibilities for undertaking adaptation action

How can we implement the strategy?

- Develop adaptation pathways
  - Signals, triggers, thresholds
  - Decision-making process
  - Trade-offs
- Today we will develop an example adaptation pathway to understand what this could look like in practice



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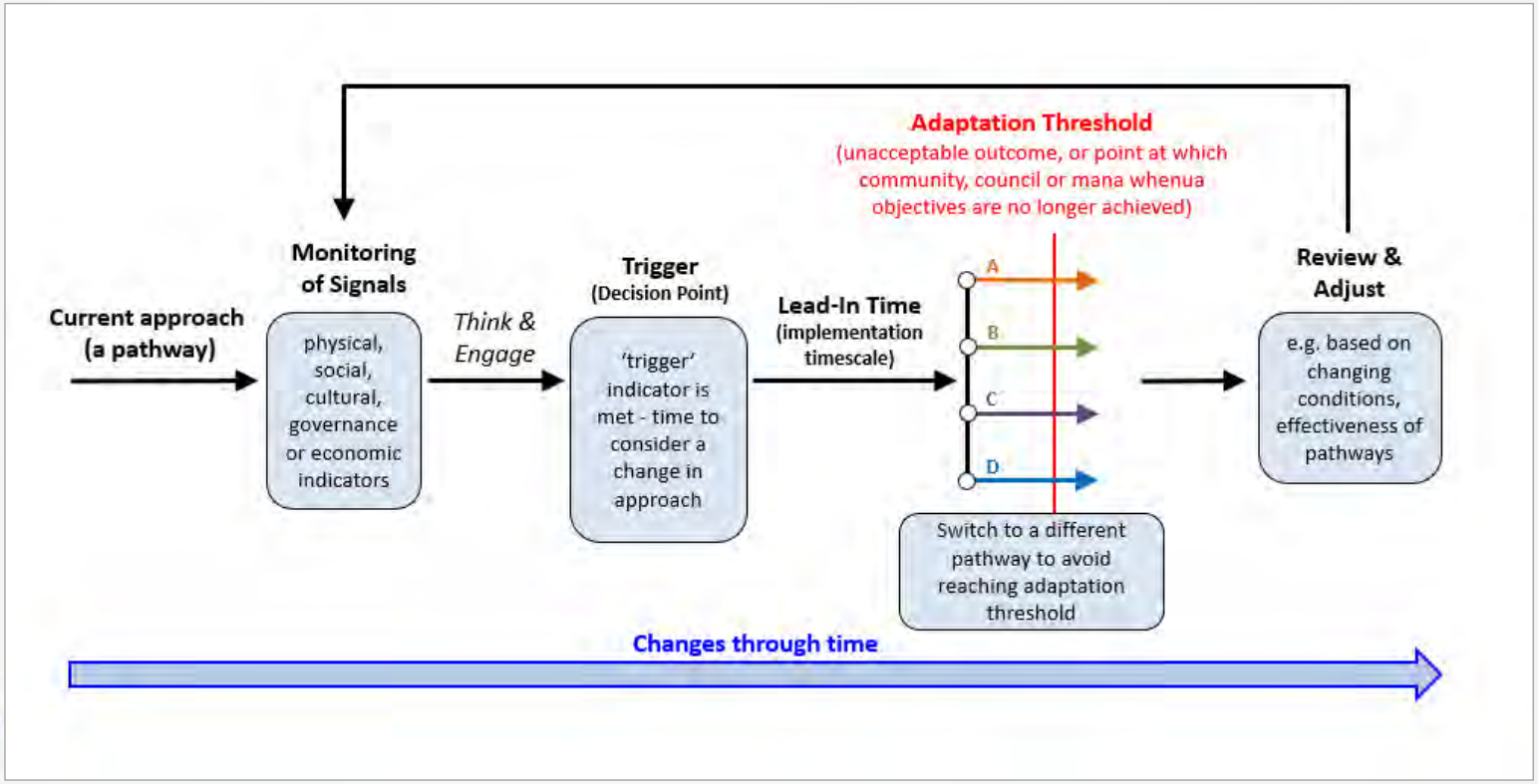
Adaptation pathways concept



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Pathways Development Example
Flood risks in Glenorchy township

Current approach
(a pathway)

- Glenorchy floodbank
- Behavioural – hazard and risk awareness
- Monitoring, flood forecasting and early warning
- Readiness and response

Monitoring of Signals

physical, social, cultural, governance or economic indicators

Trigger
(Decision Point)

'trigger' indicator is met - time to consider a change in approach

Lead-In Time
(implementation timescale)

	Examples of signals and triggers
Physical	Significant flood damage, repeated damage, overtopping of floodbank, change in flood risk (e.g. due to river movement or sediment accumulation)
Social	Level of community concern or tolerability, mental health impacts or stress, repeated cleanups and volunteer burnout
Cultural	To be determined by mana whenua
Governance	Planning cycles, legislation change, funding opportunity, fracturing of relationship between community and councils
Economic	Partial insurance retreat, hard to secure bank mortages, maintenance and repair costs exceed a threshold
Environmental	Not defined for this example

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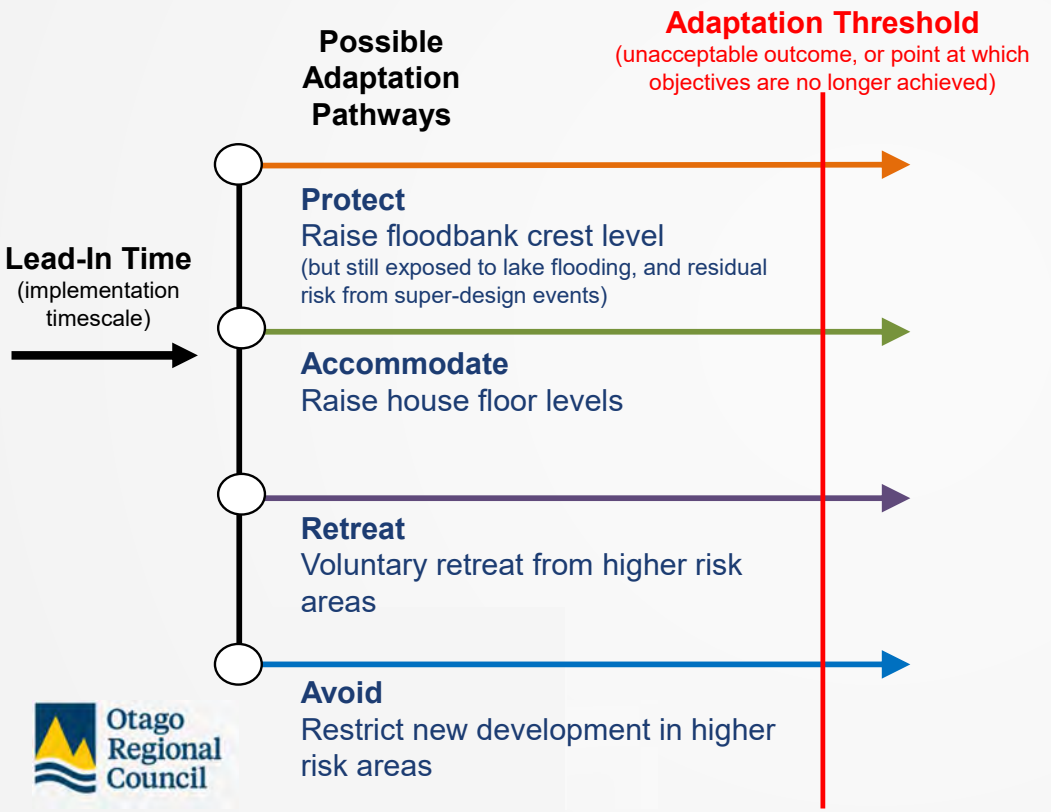
Pathways Development Example
Flood risks in Glenorchy township



Need to consider:

- Financial cost vs. benefit
- Community acceptability
- Environmental and natural amenity factors
- Cultural considerations
- Long-term sustainability
- Natural hazard risk
- Maladaptation
- Possible combinations of pathways options
- Recognition of residual risk

Safety and Resilience Committee - 7 November 2024

QUESTION AND DISCUSSION

- Triggers are decision-points
  - Physical, social, cultural, governance, economic or environmental
- Adaptation pathways includes monitoring for signals and triggers
- Trigger might arise suddenly
- Multiple factors and trade-offs to consider in decision-making

What is the Adaptation Strategy?

Foundational Knowledge

Summary of information so-far to guide decision-making

Vision and Strategic Framework

Objectives and key drivers

Action Plans

Systems-based implementation
Monitoring and review progress

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What's next?

- Now have a robust understanding of hazards and risks
- Ongoing discussions with Queenstown Lakes District Council and Emergency Management Otago staff about the implications of new findings, collaboration, roles and responsibilities for implementation
- Ongoing community engagement
- Developing draft Strategy – aim to present to Council by end of the year
  - Foundational Knowledge
  - Strategic Framework
  - Action Plans

➢ **Adaptation is ongoing and having a Strategy gives us a common direction**

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Coming up

QLDC Council Workshop

- 11-12pm, Tuesday 10 September, QLDC Council Chambers, 10 Gorge Road

Community Engagement

- Community presentation of new findings – 7pm, Tuesday 10 September at Glenorchy Hall and via livestream
- Drop-in session about adaptation pathways – 2-7pm, Wednesday 11 September at Glenorchy Hall

Next ORC Council Update

- Safety and Resilience Committee Meeting – 7 November 2024

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9.3. North East Valley Flood Risk Mitigation

Prepared for:	Safety and Resilience Committee
Report No.	OPS2412
Activity:	Governance Report
Author:	Jean-Luc Payan, Manager Natural Hazards Tim van Woerden, Senior Natural Hazards Analyst (Acting Manager Natural Hazards)
Endorsed by:	Tom Dyer, General Manager Science and Resilience
Date:	7 November 2024

PURPOSE

[1] To update committee on the programme for investigations into reducing the flood risk in North East Valley (Lindsay Creek).

EXECUTIVE SUMMARY

[2] The flood hazard risk for large parts of the Lindsay Creek floodplain is significant and is higher than what is generally considered tolerable in New Zealand and in Otago for an urban area.

[3] A comprehensive flood protection scheme and a scaled back version have been presented to Council previously, in 2011 and 2013 respectively.

[4] Council previously decided not to pursue both versions of the scheme. The decisions were informed by the economic climate at the time, feedback from community consultation, and the potential impact of costs on residents vs. the benefits provided by the proposed work.

[5] Limited flood hazard and erosion mitigation is provided in the Lindsay Creek floodplain but the flood hazard risk remains largely unmitigated. The residual risk is significant.

[6] Given the level of risk for North East Valley, and considering ORC strategic directions, it is prudent to take a fresh look at the flood hazard associated with the Lindsay Creek floodplain and to investigate options to reduce the flood risk in the floodplain and for North East Valley.

[7] To enable a reconsideration of the flood hazard, an initial multi-year programme of investigations into reducing the flood risk in North East Valley has been included in the Long-Term Plan 2024-2034 and in the Infrastructure Strategy 2024-2054. This paper outlines the approach that will be taken to implementing those investigations and the associated community engagement.

RECOMMENDATION

That the Committee:

1) ***Notes*** *this report.*
2) ***Notes*** *the significance of the flood hazard risk in North East Valley.*
3) ***Endorse*** *the need to revisit a programme for investigations into reducing the flood risk in North East Valley.*

4) ***Notes*** *the proposed programme for investigations into reducing the flood risk in North East Valley part of the Long-Term Plan 2024-2034 and the Infrastructure Strategy 2024-2054.*

BACKGROUND

[8] Lindsay Creek rises on the flanks of Mount Cargill and runs southwest, draining North East Valley and joining the Water of Leith at the Botanic Garden. The catchment is compact with an area of about 12km^2, and the main channel is relatively short being about 7km long (Figure 1).

[9] The valley-floor floodplain is intensely developed and populated, with urban land use occurring immediately next to the channel (Figure 2). Several hundred residential properties and few thousand people have some degree of exposure to flood hazard, along with three schools, a Police Station, Ross Home and the Otago Community Hospice, roads (including North Road, which is the main access to North East Valley) and a number of commercial properties.

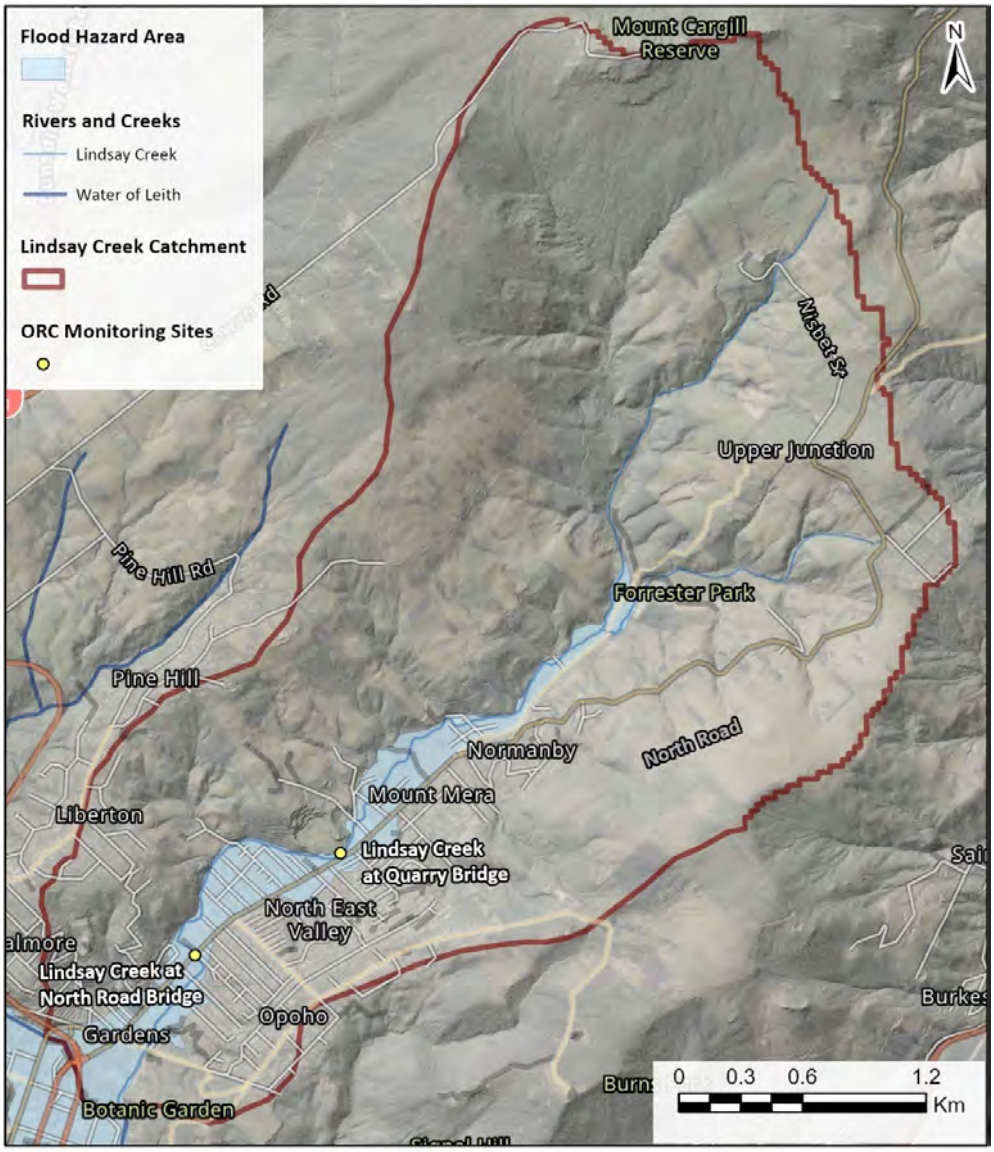


Figure 1. The Lindsay Creek catchment and North East Valley.

[10] In the upper catchment, the streambed is steep, and the stream has the characteristics of a mountain torrent. Under high flows, it can erode its banks and carry large volumes of debris and detritus. In the lower catchment, the slope of the streambed decreases through the urbanised area of North East Valley.

[11] All along the catchment, short tributaries (also with short, steep catchments) contribute to the flow in Lindsay Creek. The western slopes are mainly bush covered, with farmland and some urban development on the lower slopes, while the sunnier, eastern slopes are more densely populated.

[12] During large flood events, the steep upper reaches of Lindsay Creek can produce large volumes of debris. Accumulations around bridges or other instream structures is likely, resulting in full or partial blockage of the creek channel. Floodwater would then back up behind the debris and this could lead to floodwater spilling onto the floodplain.

[13] Lindsay Creek has a relatively narrow channel including in the lower sections (sometimes a few meters wide only, particularly susceptible to blockage (full or partial).

Figure 2. Typical sections of the Lindsay Creek channel in North East Valley (all looking upstream). Note the narrowness of the channel, the steepness of the right bank and the proximity of the houses and residential activities at many locations along the stream channel. The concrete channel lining and floodwall are ORC assets, some infrastructure is also owned, controlled and maintained by Dunedin City Council and adjacent private landowners.

[14] High flow velocities in Lindsay Creek can cause bank erosion affecting properties and structures close to the channel or resulting in premature overtopping and inundation of the floodplain.

[15] Dormant and creeping landsliding above some sections of the channel could be activated in a heavy rainfall event and partially or fully block the channel, causing substantial out-of-channel overflow. For example, a number of landslide features on the steep true-right (northern) bank of Lindsay Creek between Palmers Quarry and Allen

Street were identified[1], and the toe (or base) of these landslides encroach into the main channel. If a landslide were to fully block the stream channel, which is already relatively narrow, the full river flow would break out and travel overland through roads and residential areas.

[16] Most of the stormwater network in North East Valley discharges into Lindsay Creek. During heavy rainfall events, high water levels in Lindsay Creek will prevent the free discharge of the stormwater network. Stormwater overflows contribute to surface flooding and can compound the effects of river flooding.

[17] The characteristics of the catchment (steep and compact) result in the flood peak reaching the urbanised part of North East Valley quickly (less than 2 hours from the onset of heavy rain). This leaves a very limited ability for residents and Emergency Services to plan a response during a heavy rainfall event. Precautionary evacuation is also a matter usually considered in response to a heavy rainfall event.

[18] Assessments of channel capacity have showed that some sections of Lindsay Creek are very restricted resulting in various overtopping locations (Appendix 1): for example the section between Watts Road and Felix Street (adjacent to Palmers Quarry) has a capacity of approximately 30m^3/s. It is estimated that this flow has approximately a 79% probability of occurring in a 10-year period and a 95% probability of occurring in a 20-year period.

[19] Once this flow is exceeded, floodwater will overtop the left bank into North Road and, depending on the volume of water spilled, inundate large parts of the residential area between Felix Street and Allen Street. The flood hazard characteristics (depth and velocity) are likely to create unsafe conditions for people and result in building damages. North Road could also be unsafe for all types of vehicles, restricting the ability for people and emergency services to safely access parts of North East Valley.

[20] Records and observations indicate that flooding from Lindsay Creek has been a regular occurrence. A number of floods in Lindsay Creek have caused damage to properties through bank erosion and from floodwater overtopping the river banks. Severe flooding and consequent damage were reported for example in 1868, 1877, 1912 (Figure 3), 1923, 1929, 1968, 1971 and 1991 (Table 1).

[21] The flow record from ORC's Lindsay Creek monitoring station at North Road bridge is shown in Figure 4. This illustrates the frequent occurrence of high flows in the catchment, with three high flow events of up to about 30 m^3/s (February 1991, April 2006, June 2015) in the 45-year period this monitoring station has been in operation.

[1]Lindsay Creek Value Engineering Study Geotechnical Appraisal, Coffey Geotechnics, 2010. Report prepared for Otago Regional Council.

Figure 3. View from Blacks Road across the North East Valley floodplain and North Road, during a flood event in 1912. Note the water flowing on North Road.

Figure 4. View downstream on Lindsay Creek at Palmers Quarry Bridge during a January 2002 flood event (12 January 2002). Note the very limited freeboard remaining until floodwaters would overtop the left bank onto North Road. The peak flow in this 2002 event was ~19 m^3/s, well below peak flows of 30-32 m^3/s recorded in 1991, 2006 and 2015. Photograph is not necessarily taken at the peak of the high flows for the event.

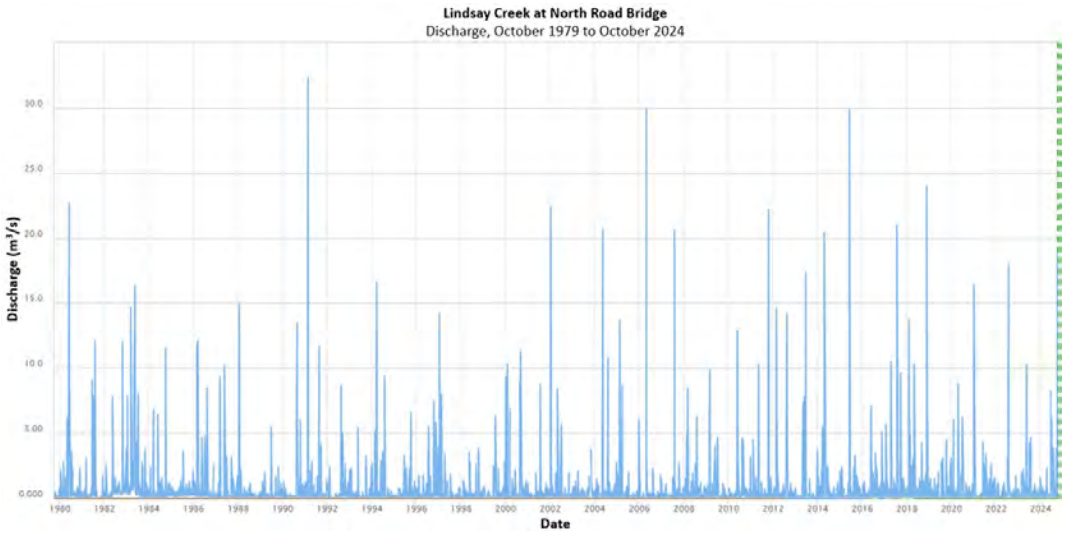


Figure 5. Lindsay Creek discharge for the 45-year period since October 1979. The three highest flows in this period are; February 1991 (32 m^3/s), April 2006 (30 m^3/s), and June 2015 (30 m^3/s).

Table 1. Recorded major floods in Lindsay Creek and damage description (from Lindsay Creek Flood Hazard Report, ORC, 2001)

Date of Flood	Comments
February 1868	Considerable damage was done to properties in North East Valley.
February 1877	In North East Valley the low-lying sections were inundated and numerous residences suffered considerably.
July 1882	At Lindsays Bridge, the water rose 3 or 4 inches above the roadway and the last tram at night was unable to get through.
November 1883	Inundation occurred at North East Valley and it occurred with suddenness that gave little or no time for preparation.
April 1923	Flooding was extensive and caused serious damage in Dunedin.
May 1923	The Botanic Gardens area was inundated to a considerable depth.
March 1929	This was one of the largest floods in recorded history. Caused general flooding of the valley floor and inundation of the Botanic Gardens.
March 1936	Lindsay Creek overflowed its banks, causing flooding in North East Valley. Some residents were forced to leave their homes.
November 1938	Serious flooding in Dunedin City.
April 1944	A rapid rise of Lindsay Creek caused the creek to scour badly and undermine the foundations of a house, leaving it overhanging the creek bed.
May 1945	Lindsay Creek and the Water of Leith rose to high flood within a few hours, causing some houses in North East Valley and many suburban gardens to become flooded. Tram services to Normanby were suspended.
September 1946	Several parts of Dunedin were flooded and many people were forced to leave their homes.
March 1968	Severe flooding occurred in Lindsay Creek, with overtopping at Chingford Park and at the Quarry. Ten houses in the Felix Street to Allen Street area were flooded.
June 1971	Lindsay Creek overtopped its banks at Crown Street, the quarry and upstream of Watts Road. Large sections of bank were eroded and walling collapsed in Chingford Park. A house in Norwood Street was isolated by a tributary inflow. Flooding of property occurred on North Road in the vicinity of Northumberland and Craigleith Streets. Flows in some places were higher than in 1968.
February 1991	Bank erosion occurred at the end of Tannadice Street. The creek broke out and flooded properties in the area. Aggradation of the riverbed at Bonnington Street occurred.

[22] Flooding hazard risks are projected to be exacerbated by potential impacts of climatic changes[2].

[23] The ORC proposed Regional Policy Statement (2021[3]) provides a methodology for natural hazard risk assessment (APP6) based on flood hazard characteristics and consequences.

[24] An initial assessment of the flood hazard risk using this methodology (details in Appendix 2) indicates that the flood hazard risk for parts of the Lindsay Creek floodplain is significant and is higher than what is generally considered acceptable in New Zealand and in Otago for an urban area.

Current management of the flood hazard risk

Green-fields areas

[25] In 2014, ORC worked closely with the Dunedin City Council to provide flood hazard information related to Lindsay Creek to inform the development of the Second-Generation District Plan (2GP)[4]. This information was incorporated into the 2GP as a flood hazard overlay. The overlay informs future land use decisions.

[26] The flood hazard overlay developed for the 2GP is also displayed publicly in the ORC Natural Hazards Database (Figure 6).[5] This mapping identifies the geomorphic floodplain area which may be affected if water overtops the main channel, and subsequently flows in a downslope direction across the floodplain.

[27] More recently, the flood hazard information associated with Lindsay Creek has been included in the draft Dunedin Future Development Strategy 2024-2054[6] (FDS). The FDS identify natural hazards as development constraints that remove or severely limit opportunity for growth.

[2] Otago Climate Change Risk Assessment, prepared by Tonkin + Taylor Ltd for ORC, 2021 https://www.orc.govt.nz/media/9653/tt-otago-climate-change-risk-assessment-2021.pdf

[3] https://www.orc.govt.nz/media/12992/porps-edited-version-identifying-non-freshwater-parts.pdf

[4] *Dunedin City Urban Streams Flood Hazard*, ORC, 2014. https://maps.orc.govt.nz/hazards/NHDBDocuments/Dunedin%20City%20Urban%20Streams%20Flood%20Hazard%20(2014).pdf

[5] hazards.orc.govt.nz

[6] https://www.dunedin.govt.nz/__data/assets/pdf_file/0004/1026589/Draft-Dunedin-Future-Development-Strategy-2024-2054.pdf

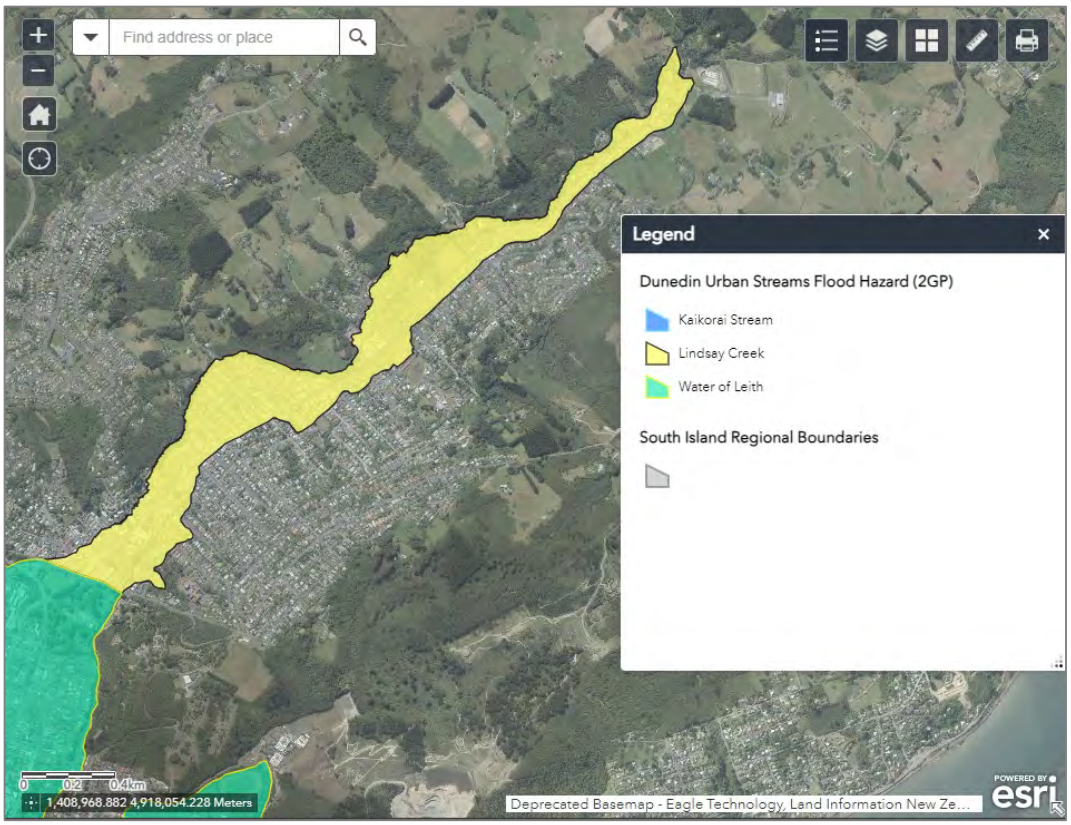


Figure 6. Lindsay Creek flood hazard mapping developed for the Dunedin City Council's 2GP, this is shown as a screenshot from the ORC Natural Hazards Database, which can be viewed at hazards.orc.govt.nz.

Existing development areas

[28] Physical flood and erosion mitigation work in Lindsay Creek has generally been constructed in response to issues arising from specific flood events. As a result, there is currently no continuous and comprehensive flood and erosion mitigation work for the Lindsay Creek floodplain.

[29] In addition to ORC-owned structures, some infrastructure such as bank protection works are owned, controlled and maintained by Dunedin City Council and adjacent private landowners.

[30] Appendix 3 provides an overview of the past flood and erosion mitigation work constructed since 1929.

[31] Between approximately 2005 and 2011, ORC has extensively investigated and developed a concept design for a more comprehensive flood and erosion mitigation scheme for Lindsay Creek between Potters Road and the confluence with the Water of Leith[7]. This work was part of the development of the Leith Lindsay Flood Protection Scheme.

[32] Physical flood mitigation work in Lindsay Creek is challenging due to the density of the existing developments in the floodplain. Dealing retrospectively with the flood hazard for Lindsay Creek is more difficult than if it were a green-fields area. Intense subdivision

[7] Water of Leith and Lindsay Creek - Design Philosophy for Achieving Minimum Design Flood Standard, Opus 2005

has occurred, constraining the river, restricting the space available for public works and increasing the vulnerability of houses and their occupants to the impacts of flooding. Road bridges have been constructed in a way that impede and/ or redirect flood flows in Lindsay Creek and which limit the ability to alter the channel.

[33] Due to the above, the developed scheme had a complex combination of bank raising, bunding, wall construction, channel widening, bed regrading and bridge replacement or modification. It also required land acquisition along the Lindsay Creek channel to enable some of the work.

[34] The land presently owned by ORC is shown in Figure 7. ORC does not presently own or have legal access to all of the land which would be required for implementation of a flood protection scheme.

[35] In 2011, Council decided, when adopting the 2011-12 Annual Plan and amendments to the 2009-19 Long Term Plan, to complete the Water of Leith component of the Leith Lindsay Flood Protection scheme, and defer the Lindsay Creek portion pending further investigations into options for the Lindsay Creek. The magnitude of the estimated construction cost of the proposed work was a key factor to this decision.

[36] Between 2011 and 2013, ORC developed and presented to Council an updated, scaled back flood mitigation proposal[8]. The updated proposal provided a lesser degree of protection but was simpler and less expensive and potentially more affordable.

[37] It relied on temporary storing floodwater in the area upstream of Forester Park and in Chingford Park, completed by small scale localised channel work (such as bed regrading and bunding) between Palmers Quarry bridge and Pentland Street.

[38] In 2013, however, Council resolved not to pursue the revised, smaller scale package of works. The decision was informed by the economic climate at the time, feedback from community consultation, and the potential impact of costs on residents vs. the benefits provided by the proposed work.

[8] *Lindsay Creek Flood Hazard Mitigation*, Report 2012/1032, ORC Engineering and Hazards Committee and *Lindsay Creek Flood Mitigation – Works Programme, Costs and Benefits*, Report 2013/0604, ORC Engineering and Hazards Committee.

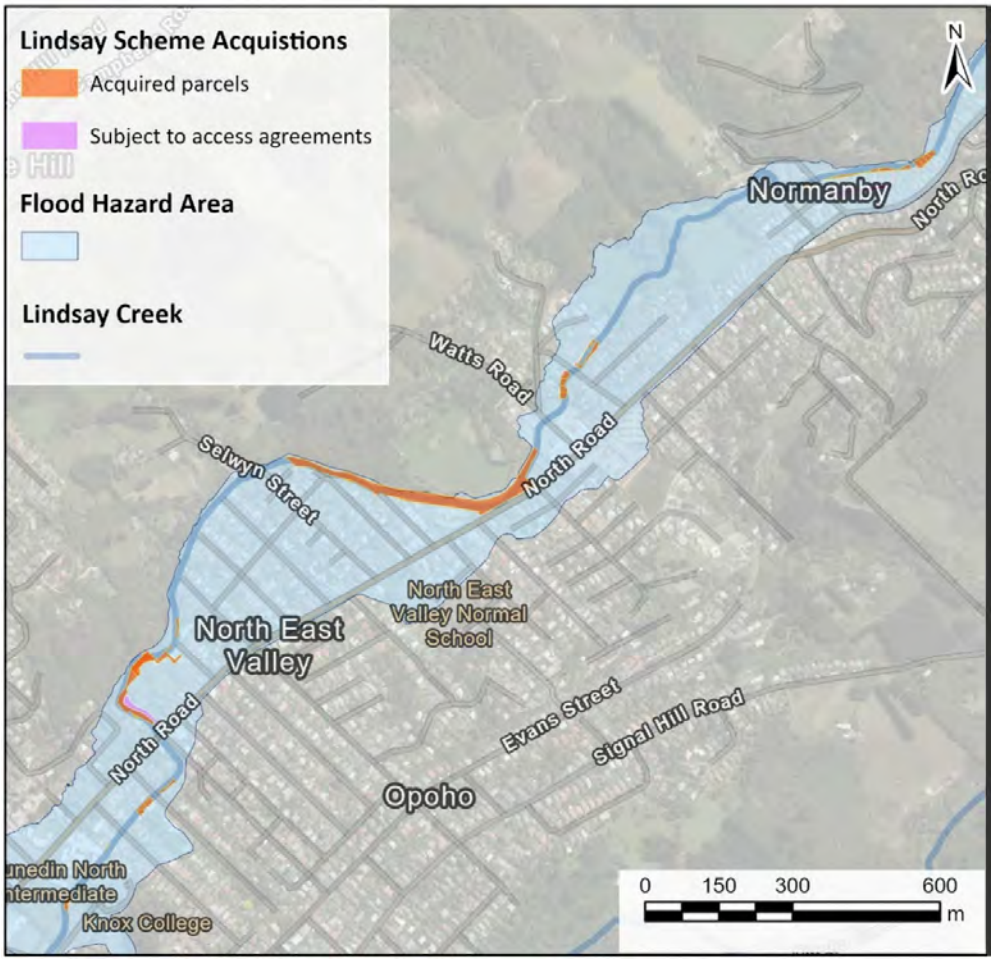


Figure 7. Lindsay Creek floodplain, showing land parcels which have been acquired by ORC, or which are subject to access agreements.

River management and bank protection infrastructure

[39] The Lindsay Creek channel is part of the Dunedin river management area and is actively managed (at a basic level) by ORC to ensure flows and sediments are transported as efficiently as possible (e.g. routine monitoring, vegetation control, removing obstructions, bank erosion repairs where applicable).

[40] ORC also maintains some rockwork and concrete walls designed to minimise erosion and help retain the creek within its existing channel (e.g. Figure 2)[9].

[41] In 2005 ORC has constructed a debris trap below Bethunes Gully (Figure 8). This structure help reducing the volume of debris in the channel and the likelihood of blockage.

[9] ORC does not own or maintain all the bank protection work in Lindsay Creek. Some infrastructure is owned, controlled and maintained by Dunedin City Council and adjacent private landowners.

Figure 8. Lindsay Creek debris trap (looking upstream), 3 June 2015. The peak flow in this event was ~30 cumecs (measured at North Road Bridge), however the photo is not necessarily showing the period of peak flows.

Flood warning and response

[42] The Lindsay Creek catchment is part of ORC flood monitoring areas.

[43] To inform the flood warning and flood response, ORC operates a water level/flow site located at the North Road bridge and a water level site at Quarry Bridge (Figure 1), rainfall stations in Pine Hill and Sullivans Dam. The Musselburgh rainfall station (operated by NIWA) is also used.

[44] The water level site located near the Palmers Quarry bridge is used to monitor Lindsay Creek water level in relation to the level of the left bank and to identify potential overtopping into North Road (this section has very limited channel capacity with potential major consequences if significant overtopping occurs, refer to paragraphs 18 and 19).

[45] The catchment is also well covered by the MetService rain radar[10] [11] which provides detailed spatial rainfall information that is also used to inform the flood warning and ORC flood response (Figure 9).

[46] A flood forecasting model specifically developed for the Lindsay Creek catchment assists the flood warning and ORC flood response. It uses rainfall data (forecast and observed) to estimate the flood peak and timing for Lindsay Creek at North Road. The model

[10] Otago Rain Radar – Rainfall Analysis and Nowcasting Service, ORC Safety and Resilience Committee, November 2023. https://www.orc.govt.nz/media/15475/2023-11-09-sr-committee.pdf

[11] The rainfall radar service is generally reliable, but can not be guaranteed as there are occasional outages.

provides an indication for the approximate magnitude of potential peak flows, but cannot give a highly reliable forecast for the timing or peak discharge.

[47] The information from the ORC monitoring network, the MetService rain radar and from the flood forecasting model is analysed and provided to the public when relevant and to various stakeholders such as ORC Engineering Team and Emergency Management services.

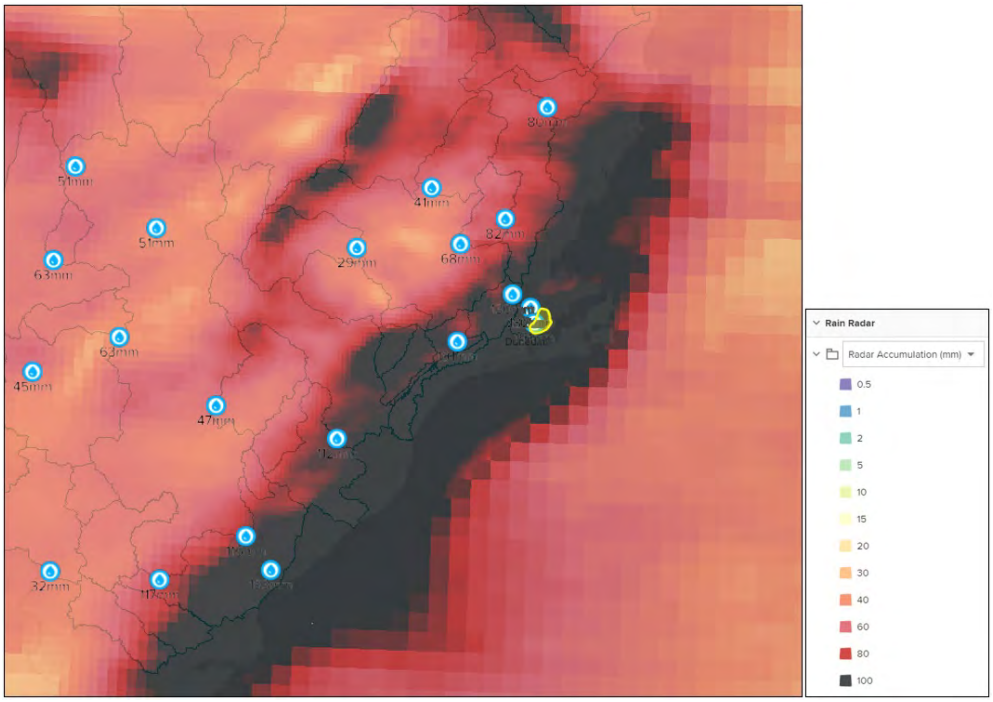


Figure 9. Rainfall accumulations for the early October 2024 weather event, derived from rainfall radar. Areas shaded dark grey received precipitation of 100mm or greater for the event. Lindsay Creek catchment is highlighted yellow.

DISCUSSION

[48] As described in the previous section, limited flood hazard and erosion mitigation is provided in the Lindsay Creek floodplain but the flood hazard risk remains largely unmitigated, significant and higher than what is generally considered acceptable for an urban area. The residual risk is high.

[49] Communities' resilience in the face of natural hazards and climate change are focus areas of both the current ORC Strategic Directions[12] and the draft Strategic Directions 2024-2034[13]. One of the goals of the draft Strategic Directions 2024-2034 is "*Plans are in place to ensure that the region's most vulnerable communities (geographic and demographic) and ecosystems are resilient in the face of natural hazards*".

[50] Given the level of risk for North East Valley, and considering ORC strategic directions, it is prudent to take a fresh look at the flood hazard associated with the Lindsay Creek

[12] https://www.orc.govt.nz/our-council-our-region/our-council/strategic-directions
[13] https://www.orc.govt.nz/media/16481/draft-strategic-directions-2024-2034-otago-regional-council.pdf

floodplain and to investigate options to reduce the flood risk in the floodplain and for North East Valley. A higher and more uniform standard of flood protection will need to be considered to provide a standard of flood protection that is more comparable with other urban areas across New Zealand.

[51] There have been changes in the social, environmental and economic setting that have occurred in the past 12 years, following Council's decision to not reduce the flood hazard for North East Valley. These include:

- Heightened awareness of flood risk amongst the general community, especially following the Auckland and Hawkes Bay events;
- Improved understanding of future climate change and the need for pro-active adaptation;
- Changes in community tolerance of flood risk;
- The need to consider maximum credible events and not limit consideration to a design event;
- The possibilities that nature-based solutions present;
- The potential to achieve wider objectives such as active transport, public amenity and ecological restoration;
- The potential for central government co-investment for investment-ready flood resilience projects;[14]

[52] To enable a reconsideration of the flood hazard, a multi-year programme of investigations into reducing the flood risk in North East Valley has been included in the draft Long-Term Plan 2024-2034 and in the Infrastructure Strategy 2024-2054.

[53] The proposed programme is part of the "Resilience and Climate Change" activity in the draft Long-Term Plan 2024-2034 and is integrated to the ORC Natural Hazards, Flood Protection, Drainage and River Management and Emergency Management activities.

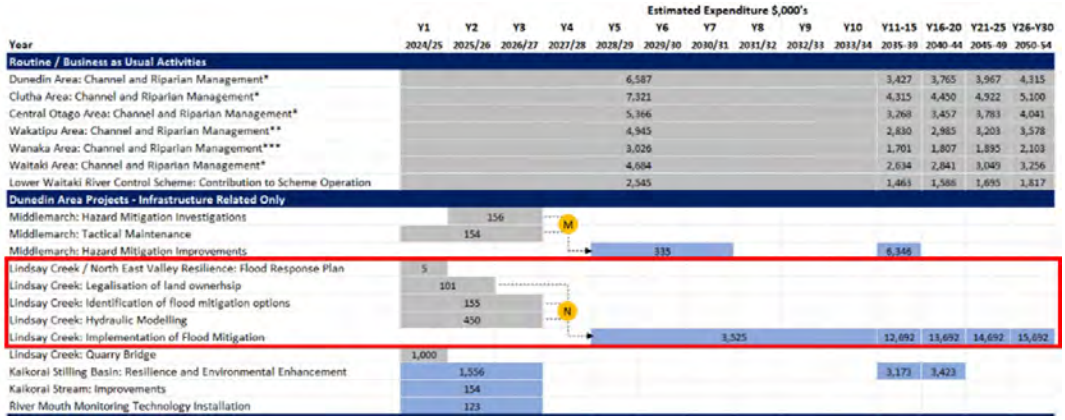
[54] It is proposed that the programme will be staged and will adopt a principled approach based on the framework described in the New Zealand Standard 9401:2008 Managing Flood Risk and on the approach described in the Infrastructure Strategy 2024-2054 (refer section 4, Figure 1 of the Infrastructure Strategy) including the Protect, Avoid, Retreat, Accommodate (PARA) Framework (Ministry for the Environment[15]).

[14] ORC's suite of climate resilience co-investment projects do not presently include work on Lindsay Creek.

[15] https://environment.govt.nz/publications/aotearoa-new-zealands-first-national-adaptation-plan/adaptation-options-including-managed-retreat/

Figure 10. Key areas of infrastructure management and their relationship.

[55] The high-level programme and timeframe are described in the Infrastructure Strategy 2024-2054 (11).



	Estimated Expenditure $,000's														
	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11-15	Y16-20	Y21-25	Y26-Y30
Year	2024/25	2025/26	2026/27	2027/28	2028/29	2029/30	2030/31	2031/32	2032/33	2033/34	2035-39	2040-44	2045-49	2050-54
Routine / Business as Usual Activities														
Dunedin Area: Channel and Riparian Management*					6,587						3,427	3,765	3,967	4,315
Clutha Area: Channel and Riparian Management*					7,321						4,315	4,450	4,922	5,100
Central Otago Area: Channel and Riparian Management*					5,366						3,268	3,457	3,783	4,041
Wakatipu Area: Channel and Riparian Management**					4,945						2,830	2,985	3,203	3,578
Wanaka Area: Channel and Riparian Management***					3,026						1,701	1,807	1,895	2,103
Waitaki Area: Channel and Riparian Management*					4,684						2,634	2,841	3,049	3,256
Lower Waitaki River Control Scheme: Contribution to Scheme Operation					2,545						1,463	1,586	1,695	1,817
Dunedin Area Projects - Infrastructure Related Only														
Middlemarch: Hazard Mitigation Investigations		156		M										
Middlemarch: Tactical Maintenance		154												
Middlemarch: Hazard Mitigation Improvements					335						6,346			
Lindsay Creek / North East Valley Resilience: Flood Response Plan	5													
Lindsay Creek: Legalisation of land ownership		101												
Lindsay Creek: Identification of flood mitigation options		155												
Lindsay Creek: Hydraulic Modelling		450		N										
Lindsay Creek: Implementation of Flood Mitigation						3,525					12,692	13,692	14,692	15,692
Lindsay Creek: Quarry Bridge	1,000													
Kaikorai Stilling Basin: Resilience and Environmental Enhancement		1,556									3,173	3,423		
Kaikorai Stream: Improvements		154												
River Mouth Monitoring Technology Installation		123												

Figure 11. Proposed investment programme for the Dunedin Area (Infrastructure related only). Work related to the programme for investigations into reducing the flood risk in North East Valley is highlighted by the red rectangle

[56] The investigations phases are planned between financial year 2024/25 (year 1) until 2026/27 (year 3). During those phases, it is planned to complete a detailed assessment of the Lindsay Creek flood hazard that will inform the flood mitigation investigations but also the emergency flood responses. The investigation will consider all the sources of flooding (river, stormwater and surface runoff), account for the effects of climate change on river flows, will assess the effects of "maximum credible" events and will incorporate geo-hazards (e.g. landslides) due to their impact on the channel capacity and floods.

[57] One of the outcomes of the investigations phases is the development of a flood mitigation plan for the Lindsay Creek catchment. The plan will not only focus on hard engineering measures and will consider all the approaches available to reduce the flood hazard in accordance with the New Zealand Standard 9401:2008 Managing Flood Risk and the PARA framework.

[58] It is proposed to have a decision point in 2027/28 (year 4) to consider the following options (as described in the Infrastructure Strategy 2024-2054):

- Status quo: ongoing maintenance of waterway and existing infrastructure, update of flood hazard information and collaboration with DCC as required, emergency response planning
- Implement flood mitigation options that focus on nature-based solutions where practicable
- Build a flood protection scheme that consists of hard engineering infrastructure

[59] Depending on the decision made, it is proposed to start the implementation of the flood mitigation works from 2028/29 (Year 5). The implementation will span several years.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[60] The proposed programme aligns with both the current ORC Strategic Directions and the draft Strategic Directions 2024-2034 (focus area: Communities' resilience in the face of natural hazards and climate change). Refer to the Discussion section also.

Financial Considerations

[61] The proposed budget for this work included in the draft Long-Term Plan 2024-2034 is approximately $800,000 for the investigations phases (2024/25 until 2026/27), $3.5M for the implementation phases in Years 5-10, and further funding through the remainder of the Infrastructure Strategy (refer to Figure 11 for details).

Significance and Engagement

[62] Engagement planning will consider and be designed to be consistent with organisational commitments made through He Mahi Rau Rika: ORC Significance, Engagement and Māori Participation Policy.

Legislative and Risk Considerations

[63] Powers contained in the Local Government Act and in the Soil Conservation and River Control Act provide legal authority to investigate flood mitigation works.

[64] The proposed programme for investigations into reducing the flood risk in North East Valley contributes to fulfil ORC's responsibilities under the Resource Management Act and the Civil Defence Emergency Management Act.

Climate Change Considerations

[65] The effects of climate change will be considered in flood hazard assessments for Lindsay Creek and in the assessment of risks and potential hazard management responses.

Communications Considerations

[66] Communication is a key component of the proposed programme of work. A comprehensive communications plan will be developed as part of this work programme.

[67] Communications and engagement planning will be integrated, complementary and build off each other.

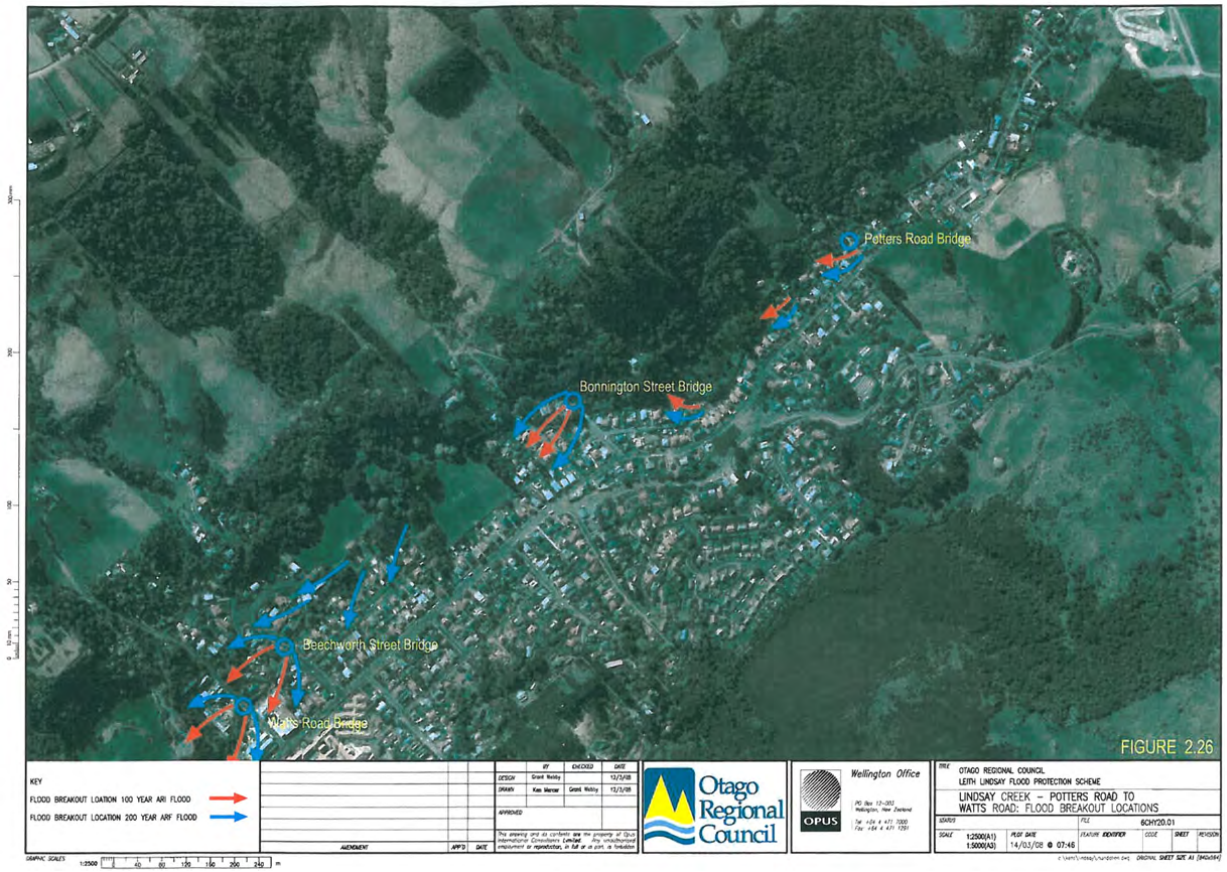
NEXT STEPS

[68] Refer to the Discussion section.

ATTACHMENTS

1. NEV Flood hazard Appendices [**9.3.1** - 8 pages]

Appendix 1: Overtopping locations in the Lindsay Creek catchment from Potters Road to the confluence with the Water of Leith (prepared by OPUS for ORC, 2008)


Potters Road Bridge
Bonnington Street Bridge
Beechworth Street Bridge
Watts Road Bridge
FIGURE 2.26
KEY
FLOOD BREAKOUT LOATION 100 YEAR ARI FLOOD
FLOOD BREAKOUT LOCATION 200 YEAR ARF FLOOD
Otago Regional Council
OPUS
Wellington Office
OTAGO REGIONAL COUNCIL
LEITH LINDSAY FLOOD PROTECTION SCHEME
LINDSAY CREEK – POTTERS ROAD TO WATTS ROAD: FLOOD BREAKOUT LOCATIONS
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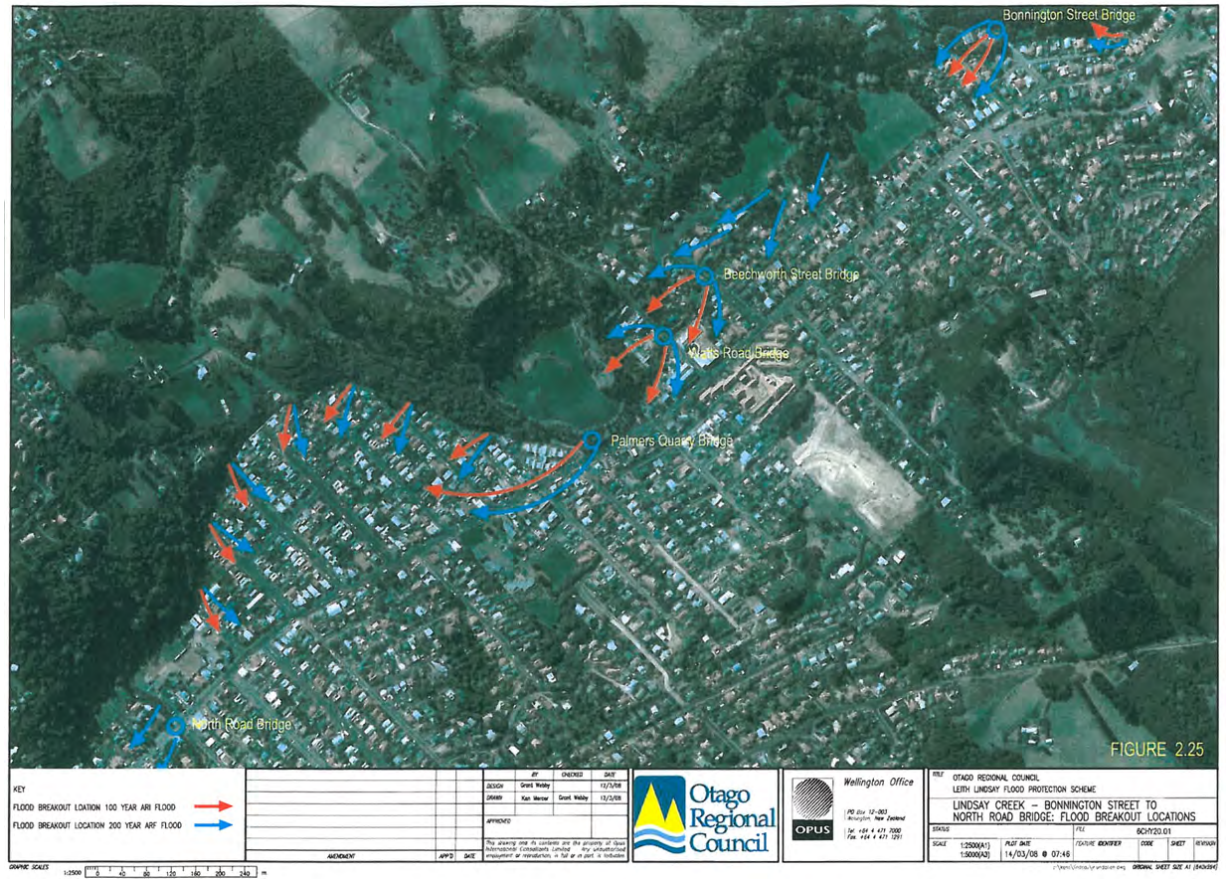
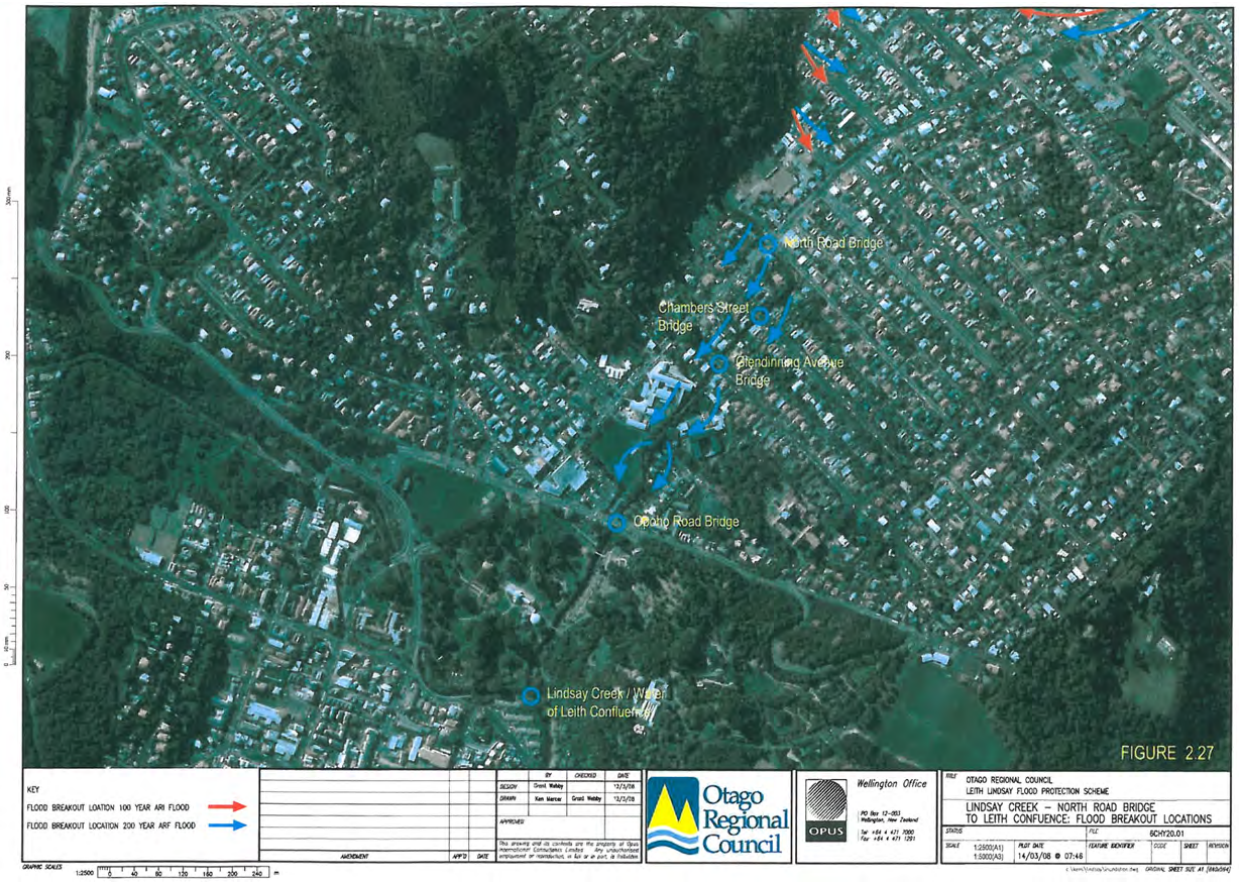

Bonnington Street Bridge
Beechworth Street Bridge
Wells Road Bridge
Palmers Quarry Bridge
North Road Bridge
FIGURE 2.25
KEY
FLOOD BREAKOUT LOCATION 100 YEAR ARI FLOOD
FLOOD BREAKOUT LOCATION 200 YEAR ARF FLOOD
Otago Regional Council
Wellington Office
OPUS
OTAGO REGIONAL COUNCIL
LEITH LINDSAY FLOOD PROTECTION SCHEME
LINDSAY CREEK – BONNINGTON STREET TO NORTH ROAD BRIDGE: FLOOD BREAKOUT LOCATIONS


North Road Bridge
Chambers Street Bridge
Glendinning Avenue Bridge
Otano Road Bridge
Lindsay Creek / Water of Leith Confluence
FIGURE 2.27
KEY
FLOOD BREAKOUT LOATION 100 YEAR ARI FLOOD
FLOOD BREAKOUT LOCATION 200 YEAR ARF FLOOD
Otago Regional Council
OPUS
Wellington Office
OTAGO REGIONAL COUNCIL
LEITH LINDSAY FLOOD PROTECTION SCHEME
LINDSAY CREEK – NORTH ROAD BRIDGE TO LEITH CONFUENCE: FLOOD BREAKOUT LOCATIONS
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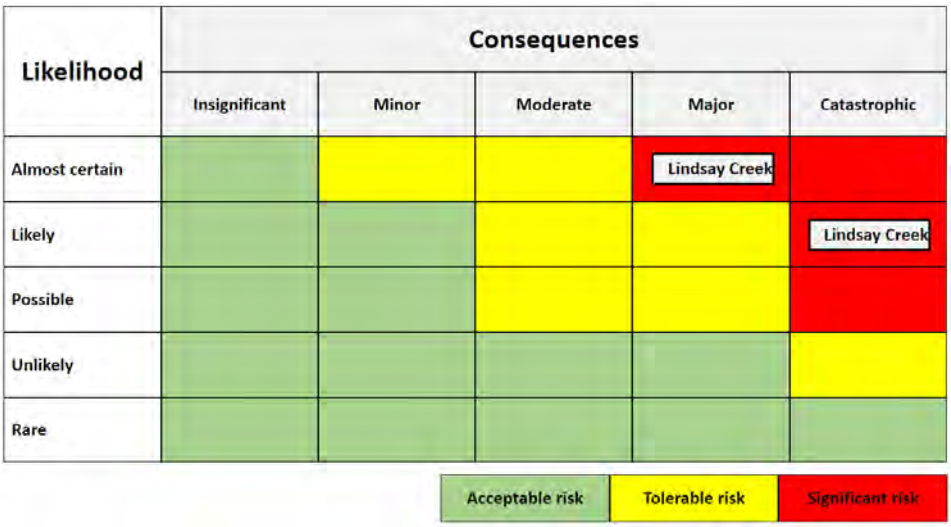
Appendix 2: Preliminary flood hazard risk assessment for the Lindsay Creek mapped flood hazard area using the ORC proposed Regional Policy Statement (2021)


Likelihood
Consequences
Insignificant
Minor
Moderate
Major
Catastrophic
Almost certain
Likely
Possible
Unlikely
Rare
Lindsay Creek
Lindsay Creek
Acceptable risk
Tolerable risk
Significant risk

Appendix 3: Historic work along the Lindsay Creek channel (Lindsay Creek Flood Hazard Report, ORC, 2001)

4. Existing Works

Flood protection works in Lindsay Creek have generally been constructed in response to issues arising from specific flood events. Protection works are therefore in areas that were most badly affected in earlier floods. As a result there are no continuous protection works, with the exception of the channel downstream of North Road, and protective walling is of varying age and quality.

The most significant works in Lindsay Creek were undertaken following the 1929 flood. Work involved the realignment, deepening and reinforced walling of the channel from Chambers Street to the Water of Leith. The reach from Opoho Road to the Water of Leith through the Botanic Gardens has stone pitched batters with grouted stone weirs. The channel between Opoho Road and Chambers Street is fully concrete lined.

In 1962, the Dunedin City Council submitted a proposal to the Soil Conservation and Rivers Control Council, through the Otago Catchment Board, to extend and realign the concrete channel from Chambers Street to the North Road Bridge. The work included a minor realignment in the vicinity of North Road to eliminate the need for a bridge on Craigleith Street and the renewal of the North Road Bridge. While there was some debate over the design flow for the works, an amended proposal was approved in late 1963 and the works were completed by the end of 1965.

Following the flood in March 1968, the concrete lined channel was extended immediately upstream of North Road. This was done to prevent further erosion of the bridge approaches.

In 1974, the Dunedin City Council submitted a further proposal to the Soil Conservation and Rivers Control Council, through the Otago Catchment Board, to construct a concrete flood wall on the left bank of Lindsay Creek between Allen Street and Selwyn Street. This proposal was extended in 1975 to include the upgrading of the full length of Lindsay Creek from North Road to Bonnington Street. Works were to be carried out in stages over a 10-year period. Stage One of the works was proposed in 1974 and resulted in the walling of the left bank between Allen Street and Selwyn Street, with limited widening and trimming of the right bank. This work was approved and completed by the end of 1976. The balance of the work outlined in the 1975 proposal, including further widening and walling on the right bank between Allen Street and Selwyn Street, was never carried out. Subsequent works have been piecemeal in response to localised erosion or flooding.

Numerous minor protective works of varying age and quality are scattered along the length of Lindsay Creek above North Road.

9.4. Otago Region Natural Hazards Prioritisation

Prepared for:	Safety and Resilience Committee
Report No.	HAZ2405
Activity:	Safety & Hazards: Natural Hazards
Author:	Tim van Woerden, Senior Natural Hazards Analyst, Acting Manager Natural Hazards Andrew Welsh, Spatial Analyst Jean-Luc Payan, Manager Natural Hazards
Endorsed by:	Tom Dyer, General Manager Science and Resilience
Date:	7 November 2024

PURPOSE

[1] To present the approach developed for the prioritisation of future natural hazards activities within the Otago region.

EXECUTIVE SUMMARY

[2] This paper presents the proposed regional approach developed for prioritising natural hazards adaptation planning for the Otago Regional Council (ORC) Natural Hazards team.

[3] The prioritisation approach developed is intended to enable a systematic identification and definition of key projects and allocation of work within the Natural Hazards work programme.

[4] Implementation of the prioritisation approach will commence in the 2024-25 financial year, and is expected to be completed by the end of Year 2 of the ORC Long Term Plan (2025/26).

RECOMMENDATION

That the Committee:

1) ***Notes** this report.*
2) ***Notes** the proposed scope and intent of the natural hazards prioritisation framework*

BACKGROUND

[5] Since the 2021/22 financial year, the Otago Regional Council (ORC) Natural Hazards team have been progressing work on a regional-scale natural hazards risk assessment programme. The programme is aiming to work towards a comprehensive, regional-scale, spatial understanding of Otago's natural hazards and risks. The background to the work programme is outlined in a paper presented to the ORC Safety and Resilience committee in May 2023.[1]

[6] The previous ORC Long-Term Plan (LTP 2021-2031) specified a performance measure specified for this work programme, which is to; "*Complete regional natural hazards risk assessment (NHRA) and **develop a regional approach for prioritising adaptation and***

[1] orc.govt.nz/media/14219/agenda-src-20230510.pdf

informing adaptation planning and implementation". This paper presents the proposed regional approach developed for prioritising natural hazards adaptation.

[7] The findings of the prioritisation work programme will contribute towards the performance measure in the current ORC Long-Term Plan (LTP 2024-2034): "*Implement the findings of the regional natural hazards risk assessment and inform adaptation planning and implementation*".

PURPOSE OF THE NATURAL HAZARDS PRIORITISATION FRAMEWORK

[8] The prioritisation approach described here will be used as a project planning tool for the ORC Natural Hazards team, to assist with allowing ORC to systematically identify and define key projects and allocation of work within the overall Natural Hazards work programme.

[9] It is intended to enable consistent and transparent, assessment and comparison of relative hazard/risk characteristics across different project locations. A well-defined proactive approach for prioritisation reduces the need for reactive or ad-hoc decision-making.

[10] There are expected to be two key outputs from the implementation of the prioritisation approach;

a. A prioritised list or classification, which identifies project areas which are to be prioritised when developing the work plan for future Natural Hazards activities by ORC, such as development of adaptation or hazard management projects.
b. Information on the scale and approach of the future work activities which may be required for each potential project area location.

[11] These outputs from implementation of the prioritisation approach will be a key factor in the development of ORC's Natural Hazards work programme through the Long-term Plan (LTP) process, through providing a guide to the relative priority and scale of the possible projects considered for inclusion.

DEVELOPMENT OF THE PRIORITISATION APPROACH

[12] The prioritisation approach presented here has been developed by the ORC Natural Hazards team, in discussion with other ORC teams and Emergency Management Otago.

[13] Notes towards development of this approach were presented to ORC councillors at a workshop session in May 2024,[2] and their feedback has been incorporated.

PROPOSED NATURAL HAZARDS PRIORITISATION FRAMEWORK

[14] The proposed prioritisation approach is summarised as the six-step process summarised in Table 1, with each step described and discussed in the sections below.

[15] This prioritisation process is envisaged as one component of a wider work programme, illustrated in Figure 1.

[16] A technical report summarising natural hazards exposure and a preliminary high-level risk analysis for the region is also being developed. That natural hazard analysis report is one source of information which will inform the prioritisation approach, but the

[2] Safety and Resilience Committee workshop, 9 May 2024 (https://www.youtube.com/watch?v=opqk8vN-9mE).

prioritisation will also include reference to a much wider range of other information available (Figure 1).

Table 1: Natural Hazards prioritisation process.

Step 1	Compilation of a 'long-list' of all locations where adaptation/hazard management may be required
Step 2	Develop a risk classification for all 'long-list' locations
Step 3	Assess urgency based on natural hazard and risk characteristics
Step 4	A phase of additional data collection and consideration of additional factors
Step 5	Identify priorities for future adaptation or hazard management work
Step 6	For each location, decide the appropriate scale and type of response

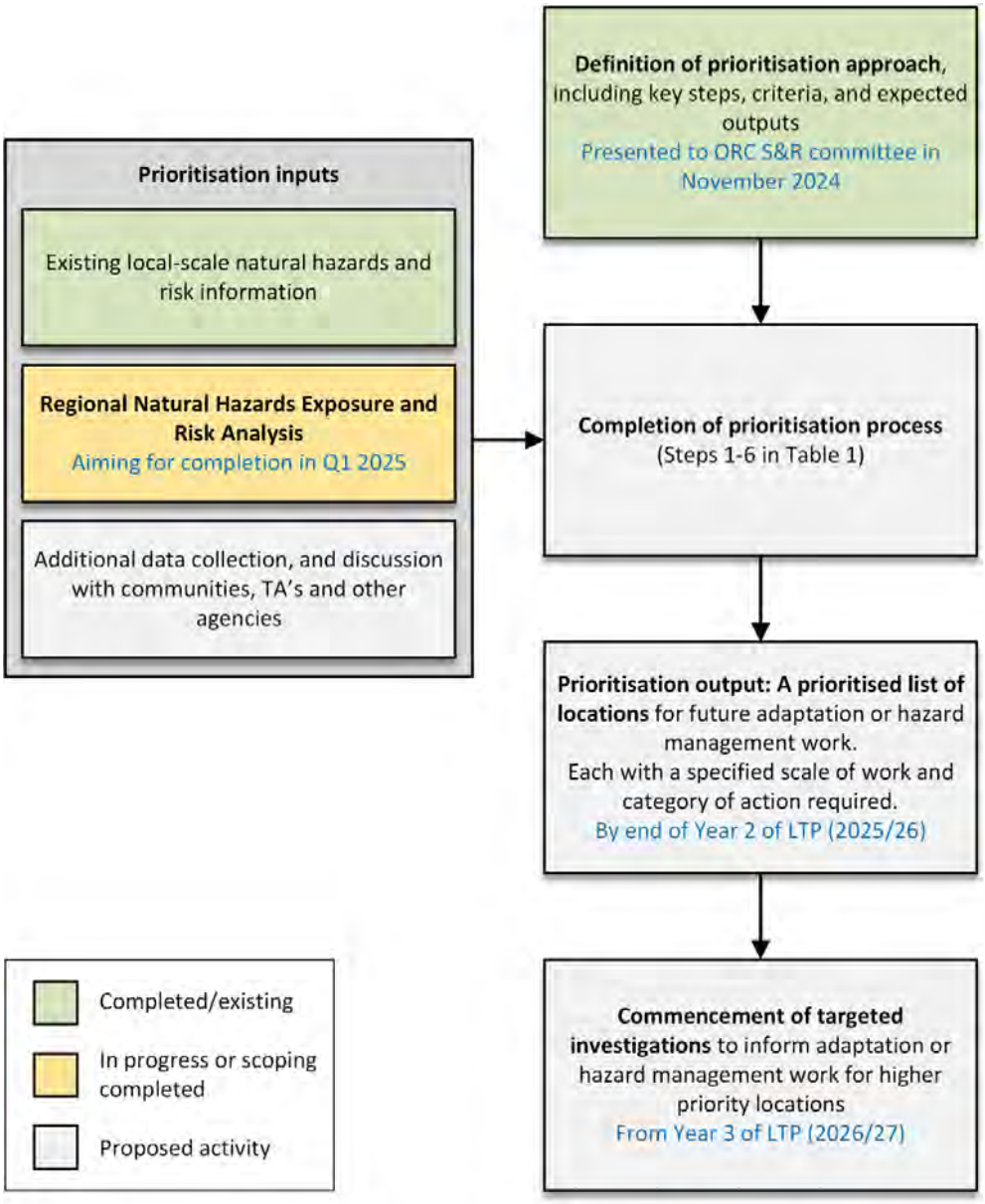


Figure 1: Flow chart showing key activities and programme sequencing in the natural hazards risk assessment and prioritisation programme.

Step 1: Compilation of a 'long-list' of locations where adaptation/hazard management may be required

[17] The first step required is to develop a 'long-list' of locations to be assessed in the following Steps 2-6. It is intended to focus on those locations primarily exposed to flooding, alluvial fan or coastal hazards, as these are the natural hazard types expected to be most impacted by future climatic changes, sea level rise, or geomorphic change.

[18] A natural hazards adaptation work programme would typically target a geographically-defined area with similar natural hazards and community characteristics. For example, these could be a catchment area, floodplain,[3] or a coastal plain.[4]

[3] e.g. the Head of Lake Whakatipu programme focussing on the Dart-Rees floodplain.

[19] The geographic locations identified are expected to range in scale and character from relatively small-scale urban areas (e.g. North East Valley flooding hazard) through to relatively large floodplain areas which may include multiple urban settlements (e.g. Taieri Plain, Clutha Delta).

[20] The identification of 'long-list' locations will be based on all available information, which will include ORC's mapping datasets of natural hazards extents, the in-progress region-wide review of Otago's natural hazards exposure and risks, and other local-scale natural hazards information where available.

Step 2. Develop a risk classification for all 'long-list' locations

[21] Following definition of a 'long-list' of geographic locations, a preliminary natural hazards risk classification will be undertaken. Risk classification will be carried out using the framework specified in the proposed ORC Regional Policy Statement (RPS 2021, Table 2).[5]

[22] Natural hazard risk assessments will be based on all available natural hazards information, including findings from the in-progress regional-scale natural hazards exposure and risk analysis for Otago, expected to be completed in Q1 2025.

[23] Risk assessment will also make use of other natural hazards information available, for example;

a. Local-scale natural hazards investigations or hazards modelling studies, and observations from previous natural hazard events (e.g. photographs and anecdotal reports).
b. Local-scale targeted natural hazard risk assessments previously undertaken. For example, those completed or in-progress for the Roxburgh,[6] Glenorchy,[7] and South Dunedin[8] areas.

[24] The RPS risk assessment approach also considers a range of other factors, such as the available risk reduction and hazard mitigation measures, lifeline utilities, potential impacts on social, cultural and economic well-being.

[25] This step would provide an estimate of the natural hazard risk levels for that geographic area as a whole, and would result in each geographic location being classified into one of four possible risk categories;

a. Acceptable,
b. Tolerable,
c. Significant, or
d. Not enough information to classify.

[26] Although the risk classification terminology implies a measure of 'tolerability' of the natural hazards risks, it is noted that this step is not intended to develop a thorough

[4] e.g. the South Dunedin Future programme, focusing on the South Dunedin coastal plain.
[5] Appendix 6 (APP6) of the notified RPS: https://www.orc.govt.nz/media/od1d1qbz/300824-clean-annotated-decisions-version.pdf
[6] Golder Associates Ltd, 2019. Management and Reduction of Debris Flow Risk in Roxburgh, Otago: Geomorphological Assessment Report.
[7] Beca Ltd, 2024. Glenorchy and Kinloch Natural Hazards Analysis.
[8] Tonkin + Taylor Ltd, in prep. South Dunedin Future risk assessment report.

understanding of risk tolerance for each location assessed. Risk tolerance is a 'social' question of the acceptability of those risk levels to different stakeholders (e.g. to a community, to a council, mana whenua), and would require significant engagement with those stakeholders.

Table 2: Natural hazard risk assessment framework of the ORC RPS (2021).

Likelihood	Consequences				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost certain					
Likely					
Possible					
Unlikely					
Rare					
Green, Acceptable *Risk*: Yellow, Tolerable *Risk*: Red, Significant *Risk*					

Step 3. Assess urgency based on natural hazard and risk characteristics

[27] The natural hazard risk assessment detailed in Step 2 is a relatively coarse classification, with natural hazard risks classified into only four categories (*Acceptable, Tolerable, Significant,* or *Not enough information*), so further sub-classification is required for findings to be of use as a prioritisation tool.

[28] In this step, three criteria relating to natural hazard/risk characteristics are used to assess 'urgency for action' in terms of the need for potential adaptation or hazard management activities (Table 3). It is acknowledged that these criteria are also an input to the risk assessment phase (Step 2), but it is valuable to specifically consider these specific aspects of the risk profile separately also.

Table 3: 'Urgency for action' criteria.

Factor	Project characteristics	Examples
Historical hazard impacts	Locations where there are known severe historical impacts from natural hazard events (e.g. flooding/debris inundation to above floor level or around dwellings)	South Dunedin flooding (2015, 2024), Queenstown CBD flooding (1999), Roxburgh debris flows (1978), Water of Leith/Lindsay Creek flooding (1920s), Taieri Plain flooding (1980), Clutha Delta flooding (1978)
Hazard warning	Locations where natural hazards may have a rapid onset, and therefore little warning time is possible prior to hazard impact	Roxburgh debris flow hazard, Water of Leith or Lindsay Creek flooding hazard
Known community vulnerabilities	Locations where it is known that vulnerable populations are exposed to potential natural hazard impacts (e.g. school, rest home)	Lindsay Creek (rest home), South Dunedin (schools)

Step 4. Further data collection and consideration of additional factors

[29] This step of additional data collection may involve further work to assess natural hazards or risk where it was identified that the currently available information was not of sufficient detail to allow for a clear identification of risk levels.

[30] However, 'technical' factors such as natural hazard/risk characteristics are not the only driver of prioritisation for adaptation or hazard management activities, which should also consider a range of additional social/political factors such as those shown in Table 4.

[31] To ensure that those additional factors are well-considered, a key component of this step is expected to involve discussions and engagement with communities, territorial authorities and other agencies.

Table 4: Additional factors to be considered in natural hazards prioritisation.

Additional Factors	Examples
Desire from community for a hazard management or adaptation work programme ("*ORC should do something*").	Strath Taieri Community board requesting ORC carry out flood hazard assessments following flooding in Middlemarch.[9]
Support from a Territorial Authority or other agencies to collaborate for a hazard management/adaptation work programme.	ORC collaboration with TA's for adaptation work programmes at South Dunedin (with DCC),[10] and the Clutha Delta (with CDC).
Appropriate timing to inform land-use planning processes (possible information flow towards District/Spatial/Future Development Strategy planning processes).	Hazards and risk assessments for Roxburgh debris fans, being undertaken by ORC as an input to the CODC Spatial Planning process.[11]
Availability of external funding opportunities, or potential for opportunistic responses due to alignment with other investment.	MfE's 'Nature-based solutions' funding programme,[12] or the Regional Infrastructure Fund,[13] announced in May 2024.
High awareness of risks due to occurrence of recent hazard events.	Flooding hazard in Middlemarch, which was impacted by recent flooding events in November 2018 and January 2021.

Step 5. Identify priorities for future adaptation or hazard management work

[32] This prioritisation step will result in all of the geographic locations identified in Step 1 being classified for priority, based on consideration of all information compiled in Steps 2-4.

Step 6. For each location, decide the appropriate scale and type of response

[9] WSP, 2024. Taieri Gorge Railway Culvert Floodwater Conveyance Assessment
[10] The South Dunedin Future work programme (https://www.dunedin.govt.nz/council/council-projects/south-dunedin-future)
[11] This investigation is currently being procured, and is intended to commence by the end of the 2024 calendar year.
[12] e.g. this funding was used to support feasibility studies for floodplain hazard mitigation in the Dart-Rees floodplains (Damwatch Engineering, 2024).
[13] https://www.growregions.govt.nz/new-funding/regional-infrastructure-fund

[33] In addition to understanding the relative prioritisation for each potential project area location, information on the scale and approach of the potential future work activities will also be valuable to inform planning for natural hazards activities.

[34] All natural hazards challenges vary in geographic scale, complexity, and potential hazard management approaches suitable, and consequently there is no 'one size fits all' approach for management of those natural hazards.

[35] The two key criteria to be defined for each location are;
a. Type of approach
b. Scale of work

[36] Together these factors will provide an indication of the general scale of resourcing and timeframes which may be required. For each geographic project area location, these factors will be classified using the definitions in Table 5 and 6 as a guide.

Type of approach

[37] Natural hazards programmes can be categorised as either: Adaptation or Hazard Mitigation (Table 5), with each of these approaches being better suited for addressing natural hazards challenges with specific characteristics. It is noted that there is not a clear-cut distinction between these categories, and in reality all projects will be somewhere on a spectrum from '*mostly Adaptation*' to '*mostly Hazards Mitigation*'.

[38] ORC is currently managing several larger-scale 'adaptation' work programmes focusing on locations of complex natural hazards challenges (e.g. South Dunedin, Head of Lake Whakatipu, Clutha Delta). However, not every natural hazards risk will require an 'adaptation' response of this type. In some cases a more conventional 'hazard mitigation' or 'hazard risk management' approach may be more suitable, for example the Water of Leith flood risk management completed from 2005.[14]

Table 5: Description natural hazards work programme approaches, 'Adaptation' and 'Hazard Mitigation'

"Adaptation"
• A response to natural hazards challenges involving **significant complexity** in hazard-scape and social/ political settings, and expected (but highly uncertain) future increases in hazard risk. • Due to complexity and uncertainty, **a holistic approach is required, with significant engagement/collaboration needed** in development of possible management approaches. • Implementation of possible management interventions is expected to require multiple complementary approaches, and would need to be led by a range of organisations (potential for trade-offs?) • **Can't "Engineer" the natural hazard problem away** • Option development requires all stakeholder input. **Examples:** South Dunedin, Clutha Delta

[14] https://www.orc.govt.nz/media/9576/leith-flood-protection-2021_pdf.pdf

"Hazard mitigation"
• A response to natural hazards challenges, which are simpler in terms of hazard-scape and social/political setting. • These may still be high risk, but any implementation of hazard management approaches is expected to be **largely implemented by ORC.** • **Option development is mostly an 'engineering exercise'** **Examples:** Water of Leith flood hazard management.

Scale of work

[39] The work completed to address a particular natural hazards risk should be proportional to the scale of the issue. Table 6 is a guide to the classification of 'scale of work' for potential natural hazards adaptation or hazard mitigation projects.

Table 6: Classification of the 'scale of work' for potential natural hazards adaptation or hazard mitigation projects.

	Possible scale of work and indicative activities required	Project characteristics	Examples
Small	Simple hazards assessment, monitoring, and development of community awareness and readiness	Small scale hazards, localised potential impact, and generally managed through ORC's 'business as usual' activities	Local-scale landslide, debris flow or erosion issues.
Medium	Modelling study (or other analysis) and basic risk assessment. Followed by simple hazards management/ adaptation optioneering studies. Also including work to develop community awareness and readiness, and enable community input	Single hazard type or a simpler natural hazards setting, but potential serious impact	Middlemarch flooding hazard, Roxburgh area debris flow hazards.
Large	Comprehensive adaptation / hazard management programme development (deep community engagement, detailed risk assessment etc).	Complex project which may include; multiple, severe hazards, ongoing issues, large exposure, expected future risk increases, complex hazards interactions and deep uncertainty.[15]	South Dunedin natural hazards, Water of Leith flood hazard management, Head of Lake Whakatipu natural hazards adaptation.

DISCUSSION

[40] The prioritisation approach described here will be used as a project planning tool for the ORC Natural Hazards team, to assist with allowing ORC to systematically identify and define key projects and allocation of work within the overall Natural Hazards work programme.

[15] Deep uncertainty is the 'Uncertainty where what is known is only that we do not know or cannot agree upon amongst experts or is contested by stakeholders with no consensus on what the future might bring. Requires robust decision-making methods and tools to support decisions and policy analysis (Walker WE, Lempert RJ, Kwakkel JH, 2013. Deep uncertainty. In: Encyclopedia of Operations Research and Management Science).

[41] The outputs from implementation of the prioritisation approach will be a key factor in the development of ORC's Natural Hazards work programme through the Long-term Plan (LTP) process, through providing a guide to the relative priority and scale of the possible projects considered for inclusion.

[42] ORC has an ongoing work programme of in-progress or planned natural hazards investigations and adaptation activities, and is not waiting for the findings of the prioritisation analysis to proceed with any of these projects. For example, ORC already has natural hazards activities or work programmes in-progress or planned for locations including South Dunedin, the Clutha Delta, Roxburgh debris flow hazards, Lindsay Creek flooding hazards, and the head of Lake Whakatipu.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[43] The proposed natural hazards prioritisation framework described in this paper will enable a systematic approach to identification and definition of key projects for the ORC Natural Hazards team, in strong alignment with Council's Strategic Directions, "*Otago builds resilience in a way that contributes to the wellbeing of our communities and environment through planned and well-managed responses to shocks and stresses, including natural hazards*"

Financial Considerations

[44] The forward work programme is included in the 2024-34 Long-Term Plan budget, with a total proposed budget for the 2024/25, 2025/26 and 2026/27 financial years of $150,000.

Significance and Engagement Considerations

[45] Engagement with territorial authorities, communities, and other stakeholders will form a key component of the prioritisation process (refer to Step 4, Table 1).

Legislative and Risk Considerations

[46] The work described in this paper helps ORC fulfil its responsibilities under sections 30 and 35 of the RMA.

[47] The Government is currently developing a National Direction for Natural Hazards, which is expected to be in place by mid-2025.[16] This new legislation is expected to provide direction to councils on how to identify natural hazards, assess the risks, and respond through their planning and consenting.

Climate Change Considerations

[48] Climate change and sea level rise effects are a consideration included in any natural hazards and risk assessments completed by ORC.

Communications Considerations

[49] The Natural Hazards team will work with the Communications team to ensure any communications and engagement activities for this work programme are aligned and integrated.

[16] https://environment.govt.nz/acts-and-regulations/national-direction/natural-hazards/

NEXT STEPS

[50] Commence implementation of prioritisation assessments following the approach framework shown in Table 1 and Figure 1.

[51] Continue with the regional-scale natural hazards exposure and risk analysis, which is expected to be finalised and presented to the Safety and Resilience Committee in February 2025.

ATTACHMENTS

Nil