

## 9.1. Roxburgh Debris Flow Hazard Management Update

**Prepared for:** Science and Resilience Committee

**Report No.** HAZ2507

**Activity:** Safety & Hazards: Natural Hazards

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### PURPOSE

- [1] To update the Council on the Roxburgh Debris Flow Hazard Management Programme progress, engagement and programme planning.

### EXECUTIVE SUMMARY

- [2] The Roxburgh area is highly exposed to alluvial fan hazards, including debris flows. The Otago Regional Council (ORC) has a specific work programme to investigate and manage the debris flow hazard and risk in Roxburgh.
- [3] The Roxburgh Debris Flow Hazard Management Programme has two concurrent technical projects: 1) the interim creek monitoring and maintenance plan, and 2) the Roxburgh debris flows detailed hazard and risk assessment. A programme of regular engagement with the community, Central Otago District Council (CODC), and other stakeholders/partners underpins the technical work programme.
- [4] The interim creek monitoring and maintenance plan is progressing. LiDAR acquired in late 2024 has allowed for geomorphic analysis of the lower reaches of the Roxburgh creeks. These results were utilised by ORC Natural Hazards and ORC Engineering to identify areas requiring channel maintenance.
- [5] Information gathering stages of the detailed debris flow hazard and risk assessment are now complete. However, the qualitative risk assessment has identified that more alluvial fans than originally scoped require a quantitative risk assessment. The final results of this investigation will be ready to present to Council in a briefing likely in November/December 2025.
- [6] Engagement planning is also underway. Engagement activities, which aim to share and discuss the technical findings and implications with the community are planned for September to December 2025 using a variety of mechanisms to allow for maximum

inclusion. Engagement planning and activities are a collaboration with other ORC teams as well as CODC staff.

- [7] The Roxburgh Debris Flow Hazard Management Programme aligns with Council's Strategic Directions, "*Otago builds resilience in a way that contributes to community and environmental wellbeing through planned and well-managed responses to shocks and stresses, including natural hazards*" and "*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*".

## RECOMMENDATION

*That the Committee:*

- 1) **Notes** this report and the work programme update.
- 2) **Endorses** the next steps and engagement activities for the next 6 months described below.

## BACKGROUND

- [8] The Roxburgh area, from Coal Creek Flat to north of Ettrick (Figure 1), is exposed to alluvial fan<sup>1</sup> hazards, including debris flows<sup>2</sup>, where steep creek catchments exit the Old Man Range towards the Clutha River<sup>3</sup>.
- [9] 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<sup>4</sup>. In conjunction, debris flows are initiated by high-intensity rainfall events driven by thunderstorms, so typically provide little warning time.
- [10] 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.<sup>5</sup>
- [11] 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 (installation of a new rain gauge, LiDAR and aerial imagery capture) of the catchments, as well as a New Zealand Transport Agency Waka Kotahi (NZTA) Response.
- [12] 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,

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<sup>1</sup> Also referred to as debris fans depending on their dominant process regime.

<sup>2</sup> 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).

<sup>3</sup> 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.

<sup>4</sup> Golder. 2019a. Management and reduction of debris flow risk in Roxburgh, Otago – geomorphological assessment report. Report prepared for Otago Regional Council.

<sup>5</sup> Wright and van Woerden. 2024. Roxburgh Natural Hazards Management. Report to the ORC Safety and Resilience Committee, 7 November 2024.

Reservoir, and Golfcourse Creeks<sup>6,7</sup>. 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.

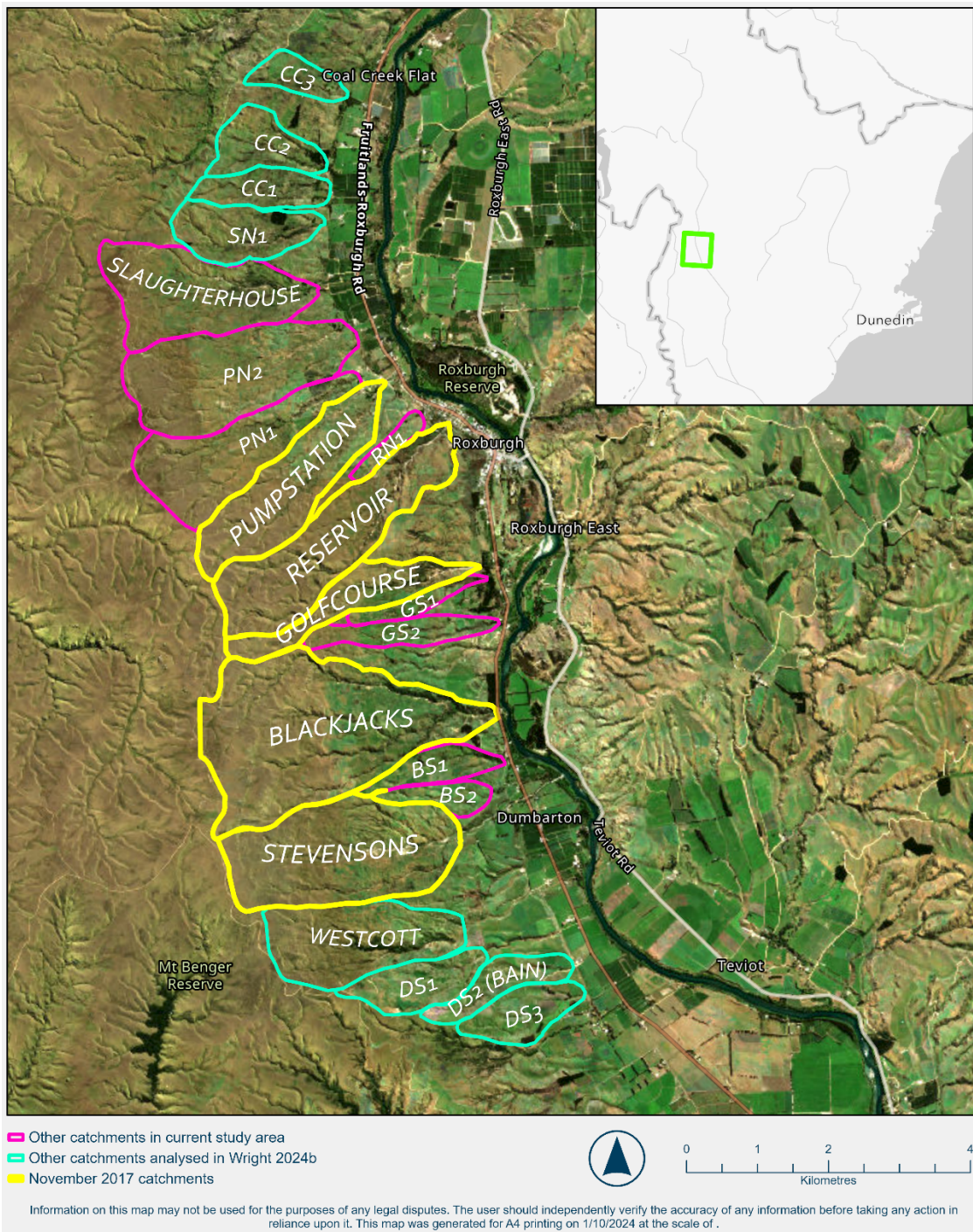
- [13] The ORC Natural Hazards team has also identified additional catchments in the Roxburgh area where a debris flow hazard may be present, in addition to those active in November 2017. This identification process included a prioritisation based on a catchment's geomorphic characteristics, history of debris flows, and the exposure of infrastructure and property to potential flows. These additional catchments have been included in the work programme scope<sup>8</sup> (Figure 1).
- [14] The previous update (November 2024) to the Safety and Resilience Committee described the Roxburgh Debris Flow Hazard Management Programme (the Programme), which has two parallel works that implement 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.

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<sup>6</sup> Golder. 2019a. Management and reduction of debris flow risk in Roxburgh, Otago – geomorphological assessment report. Report prepared for Otago Regional Council.

<sup>7</sup> Golder. 2019b. Management and reduction of debris flow risk in Roxburgh, Otago – Engineering options report (conceptual design). Report prepared for Otago Regional Council.

<sup>8</sup> Wright, J. 2024. Roxburgh debris flow catchments prioritisation using morphometrics and hazard exposure analysis. June 2024. Internal Otago Regional Council report.

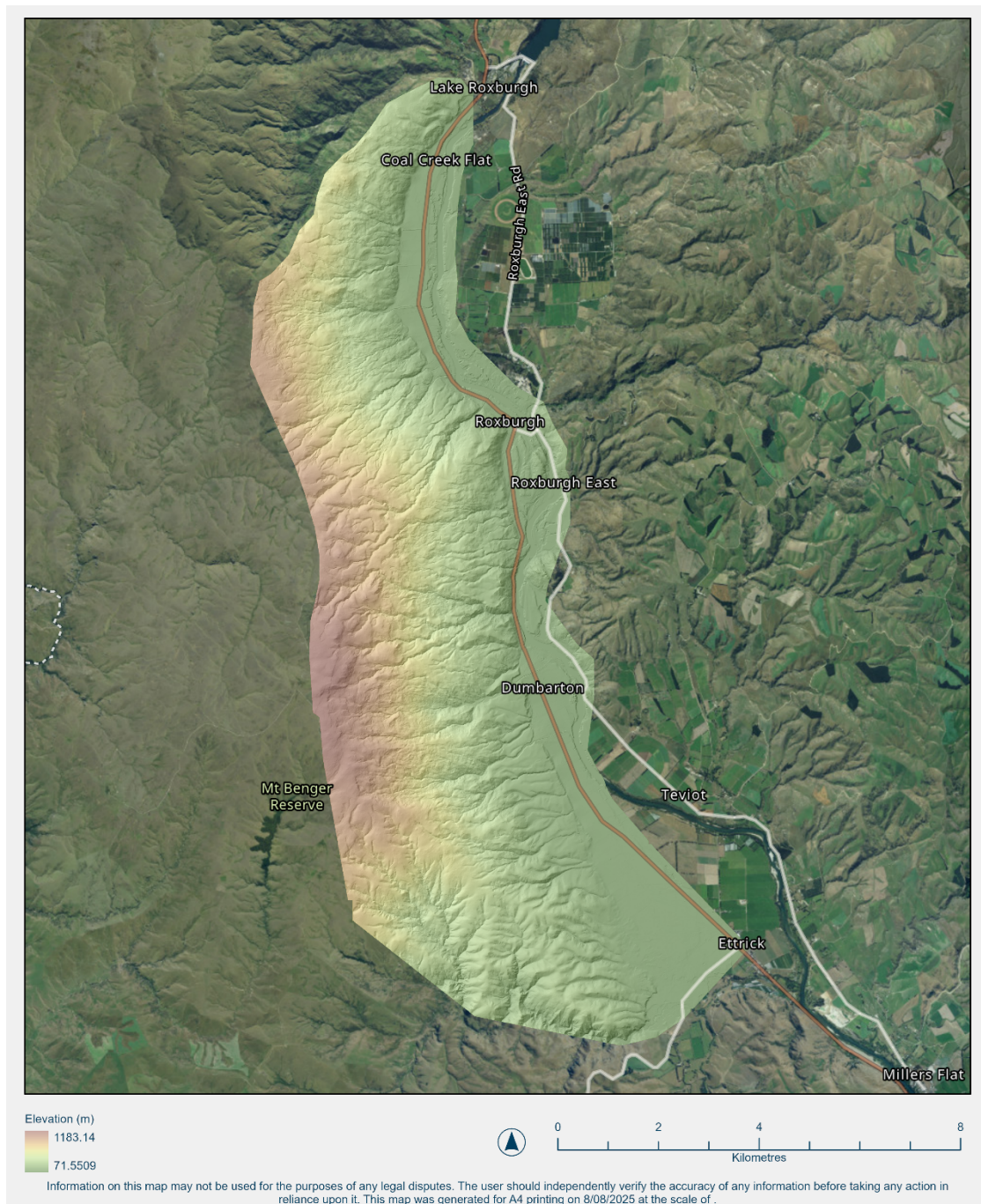


**Figure 1: Map of the catchments susceptible to debris flows in the Roxburgh area. Yellow indicates the catchments active during the November 2017 events (these are analysed as part of the interim management plan), pink indicates the additional catchments incorporated in the detailed debris flow hazard and risk assessment, and blue indicates the other catchments assessed during the prioritisation process but not included within the scope of the current investigations.**



## CURRENT WORK PROGRAMME PROGRESS (TECHNICAL PROJECTS)

- [15] To provide recent detailed topographic information to inform both the interim channel maintenance and monitoring plan and the detailed hazard and risk assessment, an updated LiDAR survey and capture of high-resolution aerial imagery were delivered in December 2024 to provide topographic data for the full Roxburgh debris flow/alluvial fan hazard area (Figure 2). This LiDAR acquisition also acted as a survey of recent channel morphology to inform potential channel maintenance.



**Figure 2: 'Hillshade' Digital Elevation Model (DEM) from the 2024 LiDAR acquisition of the Roxburgh debris flow hazard area of interest.**



*Interim channel monitoring and maintenance plan*

- [16] As described in the November 2024 update to the Safety and Resilience Committee paper, the purpose of this plan is 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 plan is designed to inform the ORC Engineering team's river management activities and act as an interim measure whilst detailed hazard and risk assessments are completed.
- [17] By comparing the new 2024 LiDAR to a LiDAR survey from 2022, the ORC Natural Hazards Team conducted a Geomorphic Change Detection (GCD) analysis for the lower reaches of Pumpstation, Reservoir, Golfcourse, Blackjacks, and Stevensons Creeks. GCD is a tool that enables a systematic assessment of changes to channel bed and land levels (geomorphic changes) between two periods. Minor geomorphic changes were found in the last two years; the greatest magnitude of change was ~ 1 m of channel aggradation in Stevensons Creek downstream of the State Highway 8 bridge.
- [18] The results of this analysis, complemented with site visits, were then used to identify and plan ORC creek maintenance activities.
- [19] To address the geomorphic changes that may impact creek capacity, minor creek maintenance works are planned to be completed by November 2025, for the sediment deposition lobe in the Clutha River downstream of the concrete chute in Reservoir Creek (Figure 3) and the reach of Stevensons Creek, downstream of the State Highway 8 bridge.



**Figure 3: The Reservoir Creek sediment deposition lobe at the Clutha River (background) confluence. Image date 26/03/25.**

#### *Detailed debris flow hazard and risk assessment*

- [20] As described in the previous update paper, a detailed natural hazard and risk assessment will be carried out to inform the community, potential CODC spatial planning measures, as well as possible physical mitigation options. This risk assessment includes developing an understanding of potential debris flow runouts and a comprehensive, spatial understanding of the natural hazard risk characteristics. In addition, climate change impacts will be considered. Study findings will be of value to a range of stakeholders (e.g., community members, ORC, Otago Civil Defence Emergency Management (CDEM), CODC, and NZTA).
- [21] The investigation focuses on debris flow hazard and risk from 13 of the 22 catchments in the Roxburgh area (Figure 1). These catchments have been identified and prioritised based on factors including their known history of debris flow occurrences, geomorphic indices which indicate susceptibility to debris flow generation, and the exposure of buildings and infrastructure<sup>9</sup>.
- [22] In late November 2024, ORC contracted WSP New Zealand Limited to undertake the detailed debris flow hazard and risk assessment. Beca Limited was also contracted by ORC as the external peer review for this project. Beca has provided a review at the end of each stage completed to date.
- [23] WSP is undertaking the detailed debris flow hazard and risk assessment investigation in five technical stages:
1. Gap analysis, to identify data and knowledge gaps for the remainder of the investigation.
  2. Geomorphic assessment, to provide the necessary background information on the physical processes to allow for hydrogeomorphic modelling and risk assessment.
  3. Hydrogeomorphic modelling, to model debris flow runouts (inundation depth and velocity) under three hazard magnitude/frequency scenarios.
  4. Qualitative risk assessment, to provide knowledge on the debris flow hazard risk characteristics and to 'screen' which alluvial fans require quantitative risk assessment as per APP6 of the ORC Regional Policy Statement<sup>10</sup>.
  5. Quantitative risk assessment, to provide a quantitative and detailed spatial understanding of the debris flow hazard risk (risk to life and risk to property).
- [24] Stages 1 – 3 are complete. Preliminary qualitative risk assessment results (Stage 4) were presented to the ORC Natural Hazards Team in July 2025. More alluvial fans than originally scoped required a quantitative risk assessment because the qualitative risk assessment indicates that the risk may be 'significant', or other factors have highlighted the need for a quantitative understanding of risk.
- [25] Quantitative risk assessment (Stage 5) is underway; due to the scope change, the results are not yet available. Note that the scope change is not surprising, given that one of the purposes of the qualitative risk assessment is to allow for a well-informed and robust decision on which alluvial fans should undergo a quantitative risk assessment.

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<sup>9</sup> Wright, J. 2024. Roxburgh debris flow catchments prioritisation using morphometrics and hazard exposure analysis. June 2024. Internal Otago Regional Council report.

<sup>10</sup> ORC. 2021. Proposed Otago Regional Council Policy Statement June 2021. Track Appeals Version.

- [26] The results from the full completed study will be shared with the Science and Resilience Committee members in a briefing, likely in November – December 2025.

## **OVERVIEW OF ENGAGEMENT PLANNING**

- [27] ORC's Natural Hazards team is working closely with internal teams, including Partnerships and Engagement, and Communications, as well as with Central Otago District Council (CODC) staff from Policy and Community Engagement teams to develop a coordinated engagement plan.
- [28] The primary goal of the engagement plan is to share and discuss the technical findings and implications of the Roxburgh detailed hazard and risk assessment.
- [29] The plan establishes six objectives:
1. Present the key findings of the technical investigations clearly and share key messages through various channels (social media, media release or new Roxburgh page on ORC website) before the in-person engagement.
  2. Provide ways for the community to connect with technical experts and key agencies.
  3. Build understanding and awareness of the debris flow hazards and risks for the community and organisations.
  4. Understand reactions and implications of the new technical findings and listen to concerns of the community and organisations.
  5. Gather feedback from the community and organisations on the results.
  6. Strengthen relationships and build trust with community members, organisations and stakeholders.
- [30] Engagement planning will use a multi-channel approach to:
- Ensure the technical information is accessible and shared widely
  - Hear a range of perspectives to inform the next steps of the Programme
  - Build understanding and awareness of debris flow hazards within the community and among key partners
- [31] Planned engagement activities include:
- Technical findings workshops (for ORC staff and Councillors, and stakeholders, staff from CODC, NZTA, and CDEM)
  - Meetings with mana whenua representatives
  - Community engagement event (in-person) in the Roxburgh area
  - Community presentation and Q&A (online) with the Roxburgh residents and associated local organisations
- [32] Planned communications activities include:
- A plain-language summary of the technical findings report
  - Technical finding documents published on the ORC website and Natural Hazards Portal
  - ORC media releases
  - New Roxburgh Programme webpage- featuring the background, hazards history, new technical findings and feedback channels

- [33] These engagement and communications activities will involve both external and internal stakeholders and partners.
- [34] Key external stakeholders and partners include:
- Roxburgh and surrounds community members
  - Local social, economic and educational organisations
  - Iwi Māori residents and mana whenua representatives
  - CODC, NZTA and CDEM Otago
- [35] Key internal stakeholders include:
- ORC Councillors, and ORC Executive Leadership Team
  - ORC Engineering, Catchment Advisors, Engagement and Partnership, Policy, and Communications teams
- [36] Engagement and communication activities associated with the detailed debris flow hazard and risk assessment are scheduled to occur from September to December 2025. They will be delivered by the ORC Natural Hazards team in close collaboration with ORC's Partnerships and Engagement and Communications teams, and with CODC's Community and Engagement team.

## DISCUSSION

- [37] The 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.
- [38] The detailed debris flow hazard and risk assessment is near completion, with many of the key stages finished. Whilst preliminary qualitative risk assessment results have indicated the need for more quantitative risk assessment than previously scoped, taking the time to complete the additional work will deliver important spatial details on the debris flow hazard risk for alluvial fans where this is necessary.
- [39] The detailed hazard and risk assessment will inform an assessment of the need for and the nature of natural hazard management for the Roxburgh area, including any potential CODC land use planning responses. The work to investigate potential management options will be scoped in the latter half of the 25/26 financial year. This work will inform the preparation of the next ORC Long-Term Plan and Infrastructure Strategy.
- [40] The purpose of this Roxburgh natural hazards work programme is to identify, assess, and potentially implement, natural hazard risk management responses for debris flow hazards in the Roxburgh area. A range of complementary hazard mitigation responses may be required, which can be summarised and explained using the PARA framework;<sup>11</sup>
- **Protect:** Remain in existing high-risk locations by effectively managing the hazard through the building of protection measures, e.g. floodbanks or other structural defences.

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<sup>11</sup> Ministry for the Environment. 2023. Community-led retreat and adaptation funding: Issues and options. Ministry for the Environment, August 2023.



- **Avoid:** Staying away from areas where the risks are considered too high, e.g. restricting or preventing the placement of new assets or activities in higher-risk locations.
- **Retreat:** Purposefully moving people, assets, and activities away from areas where the risks are considered too high, to safer locations.
- **Accommodate:** Support people, assets and activities to remain in existing higher-risk locations by making changes to the infrastructure and buildings to improve resilience, e.g. river management activities, flood warning systems, or modification of existing buildings or assets.

[41] The interim monitoring and maintenance plan is underway, which enables ORC to progress in-channel management whilst the technical investigations and engagement planning are conducted.

[42] Engagement is a vital part of ORC's work and will play an important role throughout the Programme. It will help ensure the community, stakeholders and partners are well informed, able to provide input, and supported to understand and manage risks. The Engagement Plan will be revised and updated as the work programme progresses.

## CONSIDERATIONS

### Strategic Framework and Policy Considerations

[43] This natural hazards investigation programme aligns with Council's Strategic Directions, where the 'Resilience' focus area has the aspiration that *"Otago builds resilience in a way that contributes to community and environmental wellbeing through planned and well-managed responses to shocks and stresses, including natural hazards"*.

[44] The programme contributes to achieving the following goal of the Strategic Directions: *"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"*.

### Financial Considerations

[45] The work is funded and is specified in the ORC Long-Term Plan 2024-2034 as key natural hazards work for years 1 to 3 of the Long-Term Plan.

### Significance and Engagement

[46] A preliminary Engagement Plan for the Roxburgh Debris Flow Hazard Management Programme has been developed in collaboration with CODC.

[47] The Engagement Plan will be revised and updated as the work programme progresses.

### Legislative and Risk Considerations

[48] 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

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

## Communications Considerations

[50] ORC will make all findings from the debris flow hazard and risk investigation available to the Roxburgh area community and other stakeholders. Including through the approaches/channels specified in paragraph 31.

## NEXT STEPS

- [51] The key next steps of the work programme over the next 6 months are focused on:
- Completion of the detailed debris flow hazard and risk assessment, including peer review.
  - Consideration of the implications of the new findings by staff in key work areas at ORC (Natural Hazards, Engineering, Policy, CDEM), and at CODC (Planning) and NZTA. This step will include implications for the next stages of the programme and how to inform the preparation of the next ORC Long-Term Plan and Infrastructure Strategy.
  - Briefing to ORC councillors on the new findings.
  - Briefing of CODC councillors, if requested.
  - Publishing the new findings on multiple communication channels.
  - Community engagement activities (in-person and online) to share the new findings, answer questions, and listen to community concerns and feedback.
- [52] A high-level timeline for key programme and engagement activities over the next 6 months is given in Table 1.

**Table 1: High-level timeline for key programme and engagement activities over the next 6 months**

Approximate timing	Programme Activity	Community and stakeholder engagement
September	Progress update to S&R committee	Go-live new webpage
September-December	Staff in ORC, CDEM, CODC, and NZTA teams consider the implications of new findings from the Detailed Hazard and Risk Assessment	
November/December	Briefing to ORC councillors on new findings  Briefing to CODC councillors on new findings if required	
October-December	Advertising and engagement activities delivery  Public and community information	In-person and online community engagement activities (mid-October)  Publish findings in various formats and multiple channels Update webpage

## **ATTACHMENTS**

Nil