Milford Sound/Piopiotahi Tsunami Risk Advice

Discussion Document

Purpose

To confirm the scope of further commissioned assessment of landslide-induced tsunami risk at Milford Sound/Piopiotahi. This document aims to ensure the proposed approach, structure, and content are collectively agreed and fit for purpose in the current context.

Background

The risk of a landslide-induced tsunami at Milford Sound/Piopiotahi has been a focus of research since at least 2012. Over the past decade, the context and urgency of this risk have evolved:

1. Increased understanding of Seismic Risk and its consequences
    - Recent work suggests that the central Alpine Fault has a 75% probability of rupture in the next 50 years (Howarth et al. 2021). The southern onshore portion of the Alpine Fault does not seem to have ruptured for ~307 years and therefore is relatively late in its recurrence cycle. Future ruptures on the Alpine Fault are expected to be either MW 7–8 or MW ≥8 but work to date is unable to define which mode of earthquake will occur next (Howarth et al., 2021), nor on which segment(s) of the fault.
    - A landslide capable of generating a tsunami could occur as a result of an Alpine Fault or may occur independently of an Alpine Fault event and at any time. For example, submarine slope failures can also generate large tsunamis in the area (Porter, 2024)
2. Growth in Visitor Numbers
    - Annual visitors to Milford Sound/Piopiotahi have increased from 462,000 in 2014 to 827,000 in 2025 (pre-COVID, 883,000). By 2030, visitor numbers are anticipated to surpass 1 million. These figures exclude cruise ship passengers which were estimated to be 220,000 in 2019.[1]
    - Research conducted in 2024 estimated that up to 3,500[2] people could be exposed to a tsunami event at one time. Modelling suggests few, if any, would be able to evacuate before the arrival of the first wave.
3. Intolerable Societal Risk

[1] Visitor numbers provide by Milford Sound Tourism Limited.
[2] Olivia L. Harris, Tom R. Robinson, Thomas M. Wilson, Agent-based modelling of evacuation scenarios for a landslide-generated tsunami in Milford Sound, New Zealand, International Journal of Disaster Risk Reduction, Volume 113, 2024.

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- Research calculated the societal risk to life at Milford Sound/Piopiotahi as intolerable. Further analysis suggests the societal risk to life is more than twice that of Whakaari/White Island.

There are multiple risk 'lenses' which could be considered, including residents, employees, day visitors (individual risk) and societal risk (mass fatality). GNS Science was engaged in 2024 to provide a proposal to address knowledge gaps. This proposal is summarised in s9(2)(j)

Roles & Responsibilities

Commented [AF1]: Each party to contribute their own views on their roles & responsibilties here.

There are a number of parties with responsibilities or interest in the risk associated with landslide-tsunami:

National Emergency Management Agency is the interim risk coordinating agency for tsunami in New Zealand. In that capacity, NEMA is responsible for working with DPMC to provide coordinated cross-agency advice to the National Hazards Board on strategic risk management gaps or opportunities.

NEMA also supports the Director of Civil Defence Emergency Management in the exercise of their functions under the CDEM Act, including the monitoring of the performance of those who have responsibilities under the Act. The purpose of the CDEM regime includes to "encourage and enable communities to achieve acceptable levels of risk".

Milford Sound Tourism Limited is a tourist infrastructure provider in Piopiotahi/Milford Sound pursuant to a concession agreement granted by the Minister of Conversation (in respect of all the relevant land, which forms part of the public conservation estate that the Department of Conservation is responsible for managing). MSTL operates the harbour, wharves, visitor terminal and parking in Piopiotahi/Milford Sound. MSTL also runs the wastewater plant and the rubbish and recycling systems.

MSTL employs approximately 21 staff in the summer season and 19 in the winter. MSTL licenses the six tourist boat operators at Piopiotahi/Milford Sound.

Department of Conservation manages Fiordland National Park of which Milford Sound is a national significant visitor destination, for both domestic and international visitors. DOC also authorises a large number of concession agreements for various commercial activities to be undertaken at Milford Sound. DOC has responsibility to assess hazards and the level of risk and inform visitors to the places that it manages. It also has responsibility when authorizing other parties (e.g. tourism concessionaires) to undertake activities to share information with them about hazards. DOC along with the other agencies has a shared responsibility in understanding and informing people but is not the lead agency in emergency management.

Emergency Management Southland

Tourism New Zealand is a Crown Entity responsible for marketing New Zealand as an international visitor destination to maximise the long-term benefit to New Zealand. Tourism New Zealand is able to provide advice on ways of communicating risk to potential visitors and its channels (including but not limited to newzealand.com and communication with travel trade in key markets) can be used to disseminate messages throughout the visitor experience of

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discovering New Zealand, to planning and booking their travel. In an emergency management situation TNZ participates in the VSEAG (Visitor Sector Emergency Activation Group). VESAG is led by MBIE and TNZ supports with communications related to international visitors.

Ministry of Business, Innovation & Employment (Tourism Portfolio)

What do we need to act on the risk?

In our assessment there are three questions which must be answered to progress management of risk at Milford Sound/Piopiotahi. They are:

1. Is there an unacceptable risk to be managed?
2. If the risk is unacceptable, what are the management options?
3. Once the management options are in place, is the residual risk acceptable?

These questions include the fundamental components:

- What is the measured risk?
- How does it compare against other known risks? (tolerability)
- What are mitigation options?

Why further work is required

The entirety of the risk is not well understood, and therefore the scale of the action required and best options for that action are unclear.

Specifically, although the general magnitude of the landslide-generated tsunami risk has been well-described in existing work, notable uncertainties remain due to limitations in available data and modellin s9(2)(j) the current risk assessment of landslide induced tsunami relies on "bathtub" modelling and basic scalar relationships, which do not provide a sufficiently robust foundation to develop effective mitigation measures. This limitation is particularly significant if mitigation efforts are intended to address risks associated with specific return periods (smaller magnitude events).

The National Hazards Board has endorsed the commissioning of additional science for a more detailed risk assessment.

Additionally, there is no clear mechanism by which to assess or compare societal risk in the New Zealand context, which impedes cost benefit analysis of mitigation options, and ultimately whether they are necessary or 'enough' (acceptable). While a framework as to *who* may make these decisions falls outside of the remit of agencies directly involved in this work, there is interest in progressing this through identifying *how* such decisions may be made.

Information Gaps & Technical Capabilities

To support effective risk management there are four key inputs.

- **Tsunami Hazard Modelling**

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Expert tsunami hazard modelling is, in our view, critical to support informed and evidence-based decision-making. While it might appear that further understanding of the hazard offers limited value given the constrained mitigation options for worst-case scenarios, modelling could provide valuable insights into potential mitigation strategies for more moderate events. For the modelling to be reliable and actionable, a robust deterministic assessment of the hazard potential is required.

- **Exposure, Vulnerability, Risk Frameworks, and Metrics**
  Work on exposure, vulnerability, and risk frameworks and metrics could be completed in-house by members of the group. Existing exposure data, such as the work undertaken by s9(2)(j) upport this component of the project.

- **Risk Evaluation Framework**
  Our capacity to undertake work on risk evaluation frameworks is limited, and we recommend that this aspect be contracted out. Priority should be placed on assessing societal risk, as frameworks for evaluating individual and PCBU risk are already well defined (for example, s9(2)(j) esigned risk modelling for the individual risk from existing data Feedback from group members on this approach would be helpful to confirm whether this assumption is suitable.

- **Potential Mitigation Options**
  Although there is some scope for work on mitigation options to be explored in-house, we consider it more appropriate to engage an external contractor for this phas s9(2)(i) s9(2)(j)

Options & Recommendations

At a high level, we propose four options are available:

1. **Full Risk Assessment –** commission the full risk assessment proposed by s9(2)(j) s9(2)(j) which includes an international best practice literature review and a comprehensive end-to-end risk modelling and assessment. This approach is anticipated to cost upwards of s9(2)(i) While this may be the most straightforward option, there could be efficiencies if certain components are completed in-house by members of the group. Additionally, consideration should be given to the

s9(have low, medium and high risk-tolerance thresholds. Milford Sound would be a low-risk tolerant visitor site - a visitor experience where the visitor has no intention of taking any life-threatening risks/doesn't expect to encounter or have to manage risk. The thresholds were developed through work with s9(2)(j this work outlined and established various risk comparators for s9(and provided advice on setting risk tolerability criteria. In particular the risk comparators have been used for decisions on risk settings. The comparators have been tested against risk levels at various s9(ites and helped to set the quantitative thresholds for the differing visitor groups or site /experience type.
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work already completed as part of the recently finalised communications project s9(2)(s9(2)(j)

2. **Minimum Viable Product (Recommended) –** address the key barriers to action – hazard modelling, mitigation options and how societal risk might be modelled & assessed in New Zealand *(similar to parts of* s9(2)(j) Hazard modelling does not necessarily need to be at the standard proposed in the s9(proposal. Calculating individual risk is then done s9(2)(j) using existing methodology s9(2)(j) and exposure & vulnerability information.

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3. **Phased Approach:** As for Option 2, but phased to undertake hazard modelling first. This would allow for calculation of inundation probability before subsequent investment is made to take further action. This is ultimately not recommended, as may further delay action taken to mitigate risk should that be required.

4. **Do Nothing Further.** Recent work commissioned by this group has offered guidance on communication strategies based on the current understanding of risk. Furthermore, published research by Harris, as well as Davies and Dykstra, has provided additional insights into exposure and the broader issue of societal risk, including the trade-offs that must be managed. While these contributions have been valuable in informing risk management, we do not believe they are sufficient on their own to enable effective risk management.

Next Steps

Once an approach has been decided, s9(2)(j) to test what's feasible and decisions can be made on appropriate processes to meet procurement rules, which may necessitate going to market. Commissioning different providers for different elements may be appropriate.

There is benefit in work being able to be delivered by 30 June 2026, both for timeliness of action and eligibility for the NEMA-administered Resilience Fund.

NEMA & DOC will continue to coordinate across agencies and organisations with responsibility or interest in Milford tsunami risk regarding commissioning and appropriate funding arrangements.

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