Socio-economic Impact Assessment - Head of Lake Whakatipu Adaptation Strategy - Phase 1

Prepared for Otago Regional Council
Prepared by Beca Limited

3 April 2024

Contents

Appendices

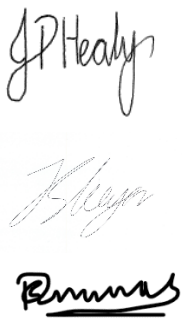
Glossary of defined terms and acronyms

ADT	Annual Daily Travel
DAPP	Dynamic Adaptive Planning Pathways
DoC	Department of Conservation
CDEM	Civil Defence Emergency Management
CRG	Community Response Group
CRP	Community Response Plan
IAIA	International Association of Impact Assessment
IPCC	International Panel for Climate Change
EMO	Emergency Management Otago
GDP	Gross Domestic Product
ORC	Otago Regional Council
QLDC	Queenstown Lakes District Council
SA2	Statistical Area 2
SAR	Search and Rescue
SEIA	Socio-economic Impact Assessment
The Head of the Lake	The area that is the focus of the Head of Lake Whakatipu Natural Hazard Adaptation Strategy
The Strategy	The Head of Lake Whakatipu Natural Hazard Adaptation Strategy

Revision History

Revision Nº	Prepared By	Description	Date
1	Jo Healy, Kaitlyn Stringer, Danielle Goodall	Draft issued for client comment	15 December 2023
2	Jo Healy, Kaitlyn Stringer, Danielle Goodall	Draft issued for client comment	15 March 2024
3	Jo Healy, Kaitlyn Stringer, Danielle Goodall	Final copy issued	3 April 2024

Document Acceptance

Action	Name	Signed	Date
Prepared by	Jo Healy, Kaitlyn Stringer, Danielle Goodall		3 April 2024
Reviewed by	Jerry Khoo, Charlotte Lee and Laura Robichaux		3 April 2024
Approved by	Charlotte Lee		3 April 2024
on behalf of	Beca Limited		

Executive Summary

The Otago Regional Council (ORC), in collaboration with Queenstown Lakes District Council (QLDC), iwi, Department of Conservation (DoC) and local communities, is developing a Natural Hazards Adaptation Strategy (the Strategy) for the Head of Lake Whakatipu. The Head of Lake Whakatipu area and its communities are exposed to multiple natural hazard risks, including floods and earthquakes. The landscape is also dynamic and some of the risks are evolving over time. An "Adaptation Pathways" framework called Dynamic Adaptive Planning Pathways (DAPP) is being used to develop the Strategy.

Beca Ltd has been engaged to undertake Phase 1 of a Socio-economic Impact Assessment (SEIA). Specifically, the SEIA examines the social and economic baseline of the local community, and the potential social and economic consequences of three indicative natural hazard scenarios in relation to the status quo (the current community and the natural hazard management measures currently in place).

The SEIA is a key piece of work to support decision making pertaining to the Strategy, by contributing to answering the first two question within the DAPP framework:

- What is happening?
- What matters most?

The SEIA involved a combination of primary and secondary research to enhance the understanding of the local communities' social and economic baseline. In November 2023, a number of interviews, and several focus groups were undertaken with stakeholders, residents and businesses in the Head of Lake Whakatipu, both in-person and online. This was followed up with an online residents and businesses survey from 24 November to 8 December 2023.

This SEIA identifies that 'the Head of the Lake' is a well-functioning and motivated community that self-organises to meet community aspirations. The natural environment is the major reason why people want to live in the area, and why tourists visit.

The community is largely aware of the unpredictability of nature and that living in the area means being susceptible to natural hazard events. Most research participants demonstrated a high level of preparedness. However, the SEIA notes that some newcomers to the community may not be as resilient in terms of preparedness and tolerance of natural hazard events, compared to long standing residents with experience of more isolated times.

The SEIA also notes that the community has become more reliant on the hospitality and tourism trade over time and these industries are very susceptible to natural hazard events, as the environment and access are often impacted and take time to recover. A major natural hazard event also has a potential to impact visitor confidence to return to the area. A key issue for the community both socially and economically is therefore the resilience of access to/from, and within the Head of the Lake area, as this is key to the community's social and economic wellbeing.

The information in this SEIA can be used to consider both the adaptation needs of the Head of the Lake community, and the consequences of potential adaptation responses under consideration as part of ORC's programme of work to develop the Strategy. The SEIA should be read alongside other technical reports that have been prepared to support the development of the Strategy.

1 Introduction

The Head of Lake Whakatipu area and its communities are exposed to multiple evolving natural hazard risks. ORC, in collaboration with QLDC, iwi, DoC, and local communities, is leading a programme of work to develop a Natural Hazards Adaptation Strategy (the Strategy) for the area at the Head of Lake Whakatipu. As part of the programme of work being undertaken to develop the Strategy, Beca Ltd has been engaged to undertake Phase 1 of a Socio-economic Impact Assessment (SEIA). This report examines the social and economic baseline of this community, and the potential social and economic consequences of three indicative natural hazard scenarios in relation to the status quo (the current community and the natural hazard management measures currently in place).

1.1 Project Description

1.1.1 Location

The Head of Lake Whakatipu is an area located at the northern end of Lake Whakatipu. It includes the township of Glenorchy, as well as the surrounding rural areas of Kinloch, Paradise, Routeburn, Caples, Greenstone and the Dart and Rees Valleys (refer to Figure 1-1). This area is the focus of the Strategy and is collectively referred to as the Head of Lake Whakatipu, or more informally as 'the Head of the Lake'. Throughout this report, the project area is referred to as 'the Head of the Lake'.

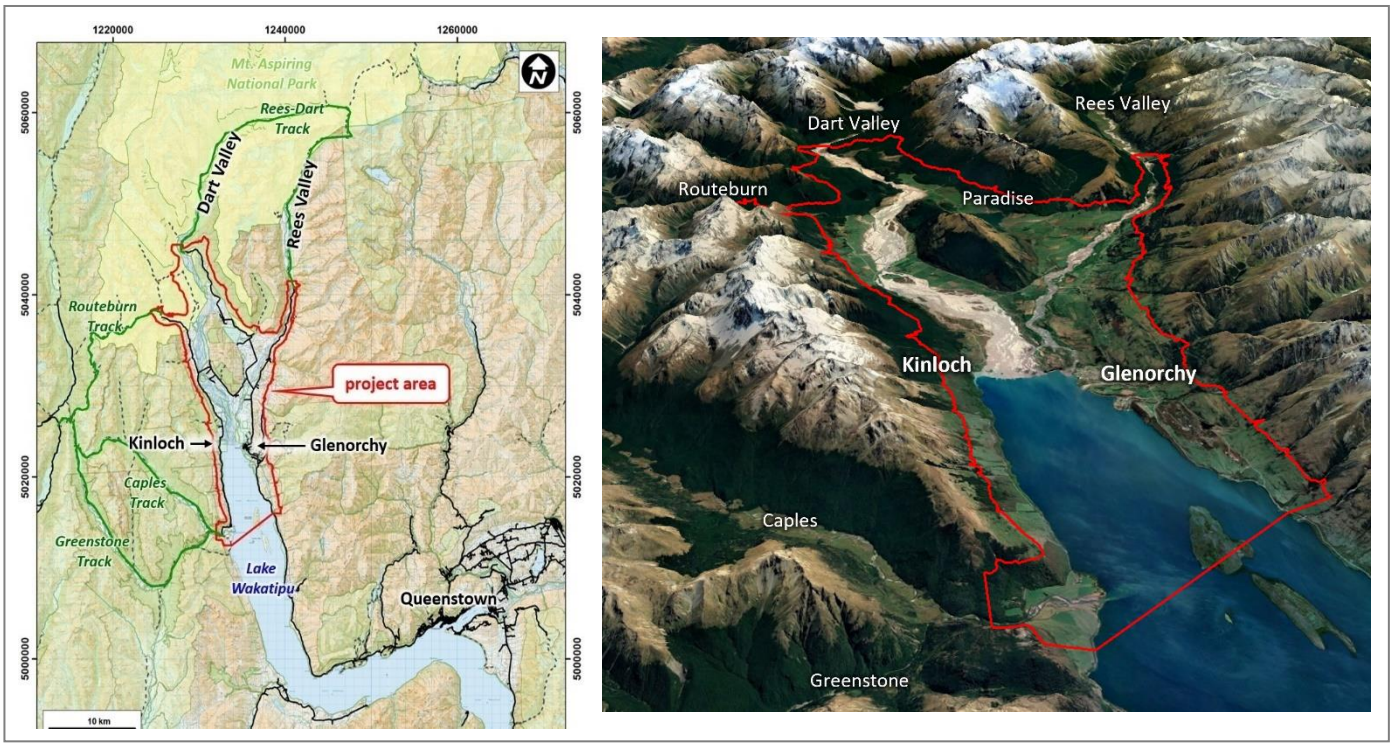


Figure 1-1: Geographic context of the SEIA study area (referred to as "the project area" in the figure). Source: (ORC Project Documentation, 2023)

1.1.2 Natural Hazards

ORC reports that the Head of the Lake are exposed to a complex range of flooding, slope-related and seismic hazard events (Tonkin & Taylor, 2021). The occurrence of some of these natural hazards are

relatively frequent and can be disruptive to the community. Future climate change and landscape changes will also increase the potential frequency and severity of consequences.

In regard to seismic risks, a specific study (Tonkin & Taylor, 2023) on the susceptibility of the Head of the Lake concluded that significant damage due to liquefaction and lateral spreading could be expected at "50 to 100 year" level earthquake shaking (40-60% chance of occurring over the next 50 years).

Damwatch Engineering (Webby, 2022) reported that the floodplains and delta associated with the Dart and Rees Rivers at the Head of the Lake are subject to both flooding and erosion hazards which impact on the townships of Glenorchy, Kinloch and Greenstone through disruption to road access. These hazards are increasing over time due to landscape-scale geomorphic changes and future climate change effects. Glenorchy township is also subject to flooding from Lake Whakatipu and Buckler Burn.

1.1.3 Adaptation Strategy Background Information

ORC has selected an "Adaptation Pathways" framework called Dynamic Adaptive Planning Pathways (DAPP) to develop the Strategy. The DAPP approach helps communities to plan and adapt for situations where the future is uncertain by enabling flexible and adaptive decision-making as conditions change.

The DAPP approach in Aotearoa New Zealand, as defined in the 2017 Ministry for the Environment Coastal Hazards and Climate Change Guidance for Local Government, consists of a 10-step decision cycle centred around 5 phases/questions, as per Figure 1-2 below:

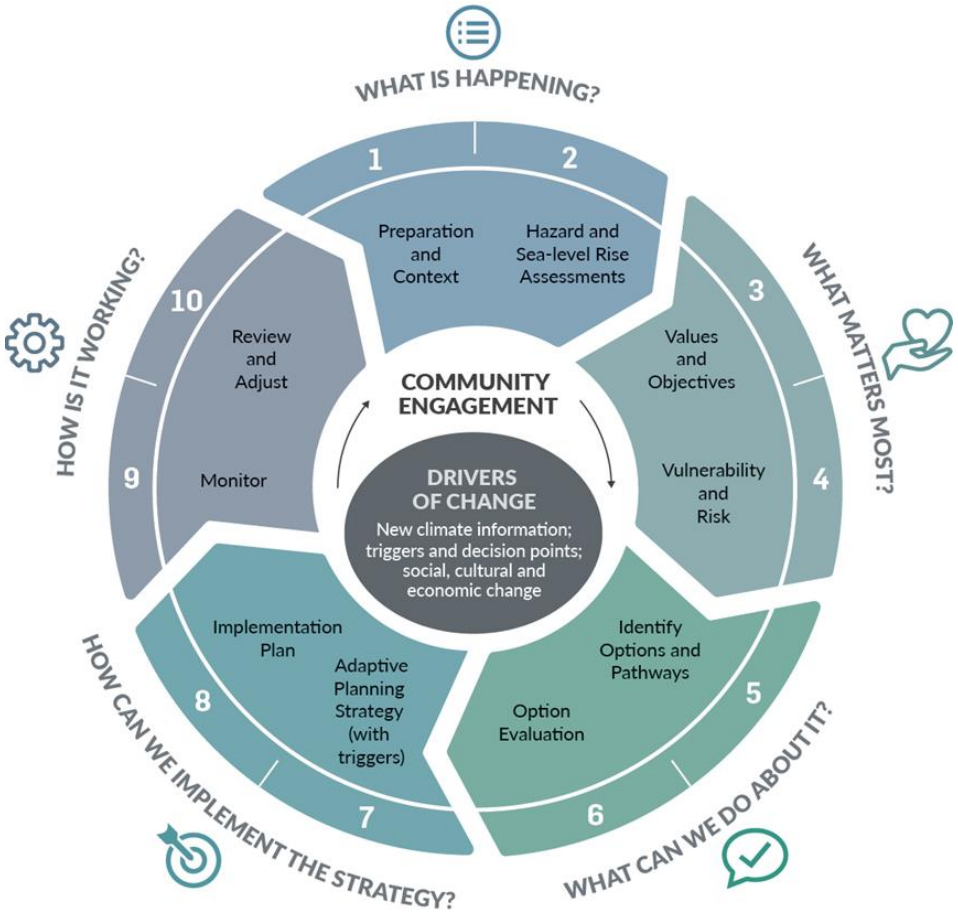


Figure 1-2: Dynamic Adaptive Planning Pathways (DAPP) 10-step decision cycle group around 5 questions. Source: (Ministry of Environment, 2017)

Figure 1-3 below shows how the Strategy's key activities are arranged around answering the five questions of DAPP.

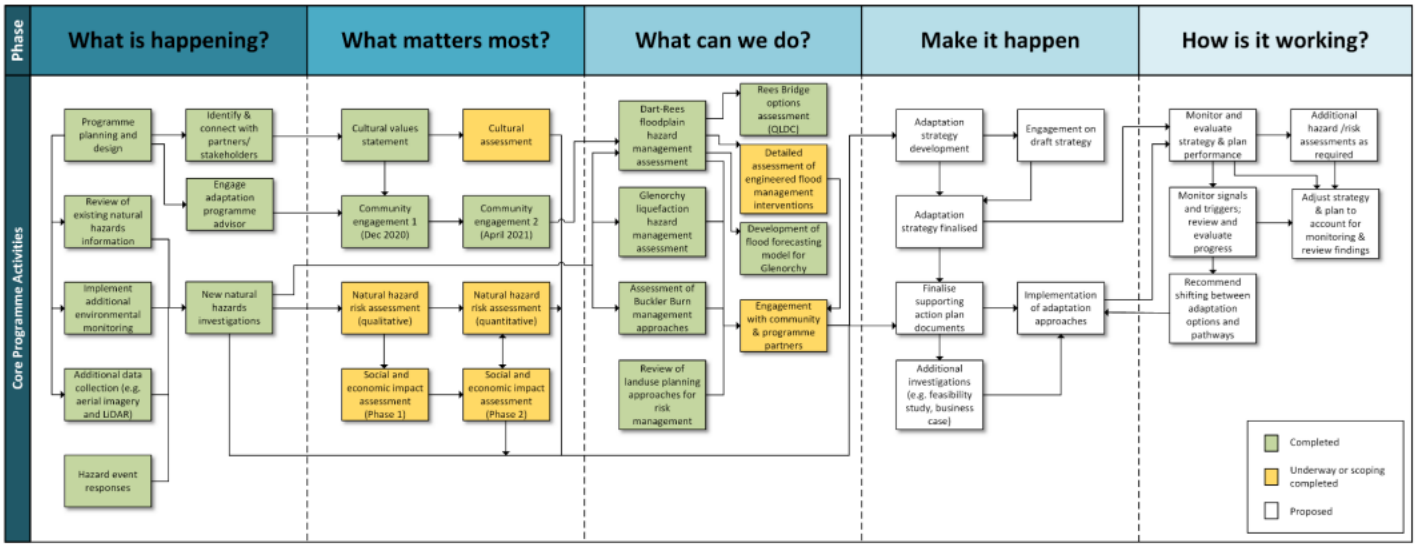


Figure 1-3: Dynamic Adaptive Planning Pathway Process key activities for the Head of Lake Whakatipu Natural Hazards Adaptation Strategy programme – updated February 2024. Source: (Otago Regional Council, 2024)

The Strategy's development and decision-making process is underpinned by an extensive programme of supporting technical work and community engagement. A large number of studies have been completed over the last few years, and others are in progress.

The first iteration of the Strategy is expected to be delivered in November 2024.

1.2 Socio-economic Impact Assessment

As part of the programme of work being undertaken to develop the Strategy, Beca Ltd has been engaged to undertake Phase 1 of a SEIA. The scope of Phase 1 is to better understand the social and economic baseline, and the potential impacts of potential natural hazard scenarios on the wellbeing of people and communities at the Head of the Lake. Phase 1 of the SEIA is based on indicative natural hazard scenarios (specified by Otago Regional Council) which assume status quo measures are in place for managing natural hazards.

The SEIA is a key piece of work to support decision making for creating the Strategy. Within the DAPP framework, the SEIA will contribute to answering the first two questions:

- What is happening?
- What matters most?

This report should be read alongside the other technical reports that have been prepared to support the development of the Strategy. Programme information and reports are published on the ORC website[1].

[1] https://www.orc.govt.nz/managing-our-environment/natural-hazards/head-of-lake-whakatipu

1.3 Report structure

The report is structured to assist in assessing the potential social impacts of the potential natural hazard scenarios on the relevant receiving community. To do this, the assessment is structured as follows:

- Methodology
- Assumptions and limitations
- Social area of influence
- Community baseline
- Assessment
- Conclusion.

2 Socio-economic Impact Methodology

In accordance with the International Association of Impact Assessment (IAIA) best practice guidelines, a social impact assessment includes "the processes of analysing, monitoring and managing the intended and unintended social consequences, both positive and negative, of planned interventions (policies, programs, plans, projects) and any social change processes invoked by those interventions" (IAIA, 2015).

While social impact assessment and economic impact assessment are often undertaken separately and use specific methods, they are complementary and sometimes overlap (Australian Government 2005). A SEIA is therefore a useful tool to help understand the potential range of social **and** economic consequences if a 'change' occurs.

In this case, the SEIA methodology has been developed to enhance the understanding of the Lake Whakatipu communities' social **and** economic baseline; and to identify the key social and economic impacts of the indicative natural hazard scenarios (specified by ORC) under status quo conditions. 'Status quo' conditions can be understood as the current community and the natural hazard management measures currently in place.

The following guidelines have been used to inform the methodology:

- Dynamic Adaptive Planning Pathway Framework (Ministry for the Environment, 2017)
- Social Impact Assessment: Guidance for Assessing and managing the Social Impacts of Projects (International Association of Impact Assessment, 2015)
- MOVE framework (Birkmann et al., 2013)
- Intergovernmental Panel on Climate Change – Sixth Assessment Report (2023).

The sections below outline the key steps in the methodology, and how these steps work alongside and within the DAPP to support the work completed to date, and the work to be undertaken proceeding Phase 1 of this SEIA.

2.1 Step 1: Understand the ORC Adaptation Programme for the Head of Lake Whakatipu

The objective of this step is two-fold; firstly, to fully understand the work to date on the Strategy, and secondly, to fully understand the broader community and hazard context (from a socio-economic[2] perspective). This process included a review of:

- Reports completed as part of the Strategy's programme of work
- Social and economic reports on the area
- Media coverage of the area in relation to natural hazards
- Literature pertaining to the socio-economic impacts of natural hazards, focusing on New Zealand, flooding and earthquakes (where available)
- Community plans and policies (e.g., the Glenorchy Community Plan 2001, and Glenorchy Community Visioning Report 2016).

2.2 Step 2: Identify the preliminary socio-economic area of influence

Using the data gathered at the previous step, the socio-economic area of influence was identified. The socio-economic area of influence is the area in which there are likely to be social and economic impacts from both natural hazards and the potential adaptation pathways. This included scoping and developing an understanding of the social and economic reach of potential impacts, including interdependencies with the wider area. In this case, the socio-economic area of influence includes both local and regional impacts:

- **Local Community**: Includes the Glenorchy township, and the surrounding rural areas of Kinloch, Paradise, Routeburn, Greenstone and the Dart and Rees Valleys
- **Regional**: This primarily refers to Queenstown (as the nearest town) but also in terms of the social and economic interdependencies, such as Queenstown-based tourist operations and other services.

Once the socio-economic area of influence was identified, a stakeholder mapping exercise was undertaken to inform the data collection method. This involved identifying the stakeholders, groups, and communities likely to experience social and economic impacts. This list was tested and refined with ORC staff, a Glenorchy-based Councillor, and a representative of the Glenorchy Community Association with local knowledge of the Head of the Lake community.

2.3 Step 3: Understand the social and economic baseline

A range of qualitative research methods were undertaken to develop an understanding of the social and economic baseline at the Head of the Lake. The social research team spent five days gathering primary data at the Head of the Lake (9-10th November and 12-14th November 2023). This was supplemented by a follow up resident and business survey, and a desktop review of secondary data.

The primary data methods included:

- **Interviews** with:

[2] The term socio-economic in the context of this report relates to the interaction of social and economic factors. Where the report focuses on just social or economic factors, the central focus is that factor, rather than the interaction between the two.

  - Key stakeholders (e.g., QLDC staff, Emergency Management Otago staff, DoC, emergency services providers, Glenorchy Community Nurse, Glenorchy Primary School Principal, Glenorchy Community Association).
  - Community organisation/club/group representatives.
  - Business owners/operators.
- **Semi-structured 'drop-in' interviews** with residents.
- **Focus groups** with:
  - Queenstown-based businesses operating at the Head of the Lake[3]
  - community representatives (e.g., residents and representatives of community organisations/clubs/groups)
    Glenorchy Primary School students.
- **Survey** of residents and businesses.
- **Site observations**.

The social research team spoke to 70 people (summarised in Table 2-1 below), accounting for instances where people participated in more than one research method.

Table 2-1: Primary data

Research method	Detail	Number of participants
Interviews	Key stakeholders (e.g., QLDC staff, Emergency Management Otago staff, DoC, emergency services providers, Glenorchy Community Nurse, Glenorchy Primary School Principal, Glenorchy Community Association)	17
	Community organisation/club/group representatives	5 (3 also attended a focus group)
	Business owners/operators	4 (1 also interviewed as a resident)
	Semi-structured 'drop-in' interviews with residents	14
Focus groups	Queenstown-based businesses operating at the Head of the Lake	2
	Community representatives (e.g., residents and representatives of community organisations/clubs/groups)	7
	Glenorchy Primary School students	14
TOTAL		59
Survey	Survey of residents and businesses	23 responses (11 businesses, 12 residents)[4]

[3] Businesses based at the Head of the Lake were also invited to participate in an online focus group, however there was no uptake.

[4] Four people also participated in an interview or focus group.

The focus groups were all undertaken in-person, while the interviews included a mix of online and in-person meetings. Both research methods were conducted in a semi-structured manner, guided by key themes and questions (provided in Appendix A) to help explore:

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

The focus group with Glenorchy Primary School Students included a mapping exercise, using sticky notes and a map of Glenorchy township. The students were asked to brainstorm and identify on a map what they like about living in the area (refer to Figure 2-1).

Figure 2-1: One of the maps produced at the focus group with Glenorchy Primary School students.

The semi-structured 'community drop-in' interviews were a mix of interviews at dedicated times, which were pre-arranged through an online booking system, and interviews conducted at the Glenorchy Playgroup, which the social research team attended on 14th November 2023.[5]

[5] The social research team also made themselves available for Glenorchy Primary School parents to 'drop-in' for an interview at the School on 13th November, however there was no uptake.

Figure 2-2: Push chairs parked outside the Community Hall for the Glenorchy Playgroup on 14th November 2023

The resident and business survey was undertaken from 24th November – 8th December 2023. The survey questions explored resident's and businesses' reliance on accessing wider areas such as Queenstown, and their vulnerabilities and resilience to natural hazards (refer to Appendix B for a copy of the survey questions). The survey was designed to supplement the research that had been undertaken to date and gather additional insights from the community. The survey also asked business questions to develop a stronger understanding of the business community (e.g., number of employees, revenue).

The secondary social and economic data sources that were used are summarised in Table 2-2 below.

Table 2-2: Secondary social and economic data

Social secondary data	Economic secondary data
• 2018 Census data • Social reports about the area (e.g., local history) • Community plans (e.g., the Glenorchy Community Plan 2001, and Glenorchy Community Visioning Report 2016) • GIS maps	• Queenstown Infometrics data (e.g., number of jobs, number of business units, GDP for Industry, GDP for Tourism) • Glenorchy Infometrics data (e.g., number of jobs, number of business units, GDP for Industry) • Visitor Survey data • QLDC population and visitor projections 2023-2053 • QLDC visitor spending data by sub-area

Social secondary data	Economic secondary data
	• QLDC tourism data • QLDC transport data (e.g., daily road/trip numbers in and out of Glenorchy township) • Destination Queenstown tourism data • DOC track and hut estimates

2.4 Step 4: Identify and evaluate social and economic impacts of indicative natural hazard scenarios (specified by Otago Regional Council)

The International Panel for Climate Change (IPCC) provides a framework to identifying risks in relation to climate change and natural hazards. Part of this processes is understanding how the community currently experiences natural hazards in terms of exposure, sensitivity and adaptive capacity.

This step is an assessment of the potential socio-economic consequences of indicative natural hazard scenarios (specified by Otago Regional Council) under status quo conditions. Status quo conditions can be understood as the current community and the natural hazard management measures currently in place.

Figure 2-3 details the assessment process from a socio-economic perspective and how it fits into the Strategy's wider process. This framework has been adapted from Birkmann et al. (2013).

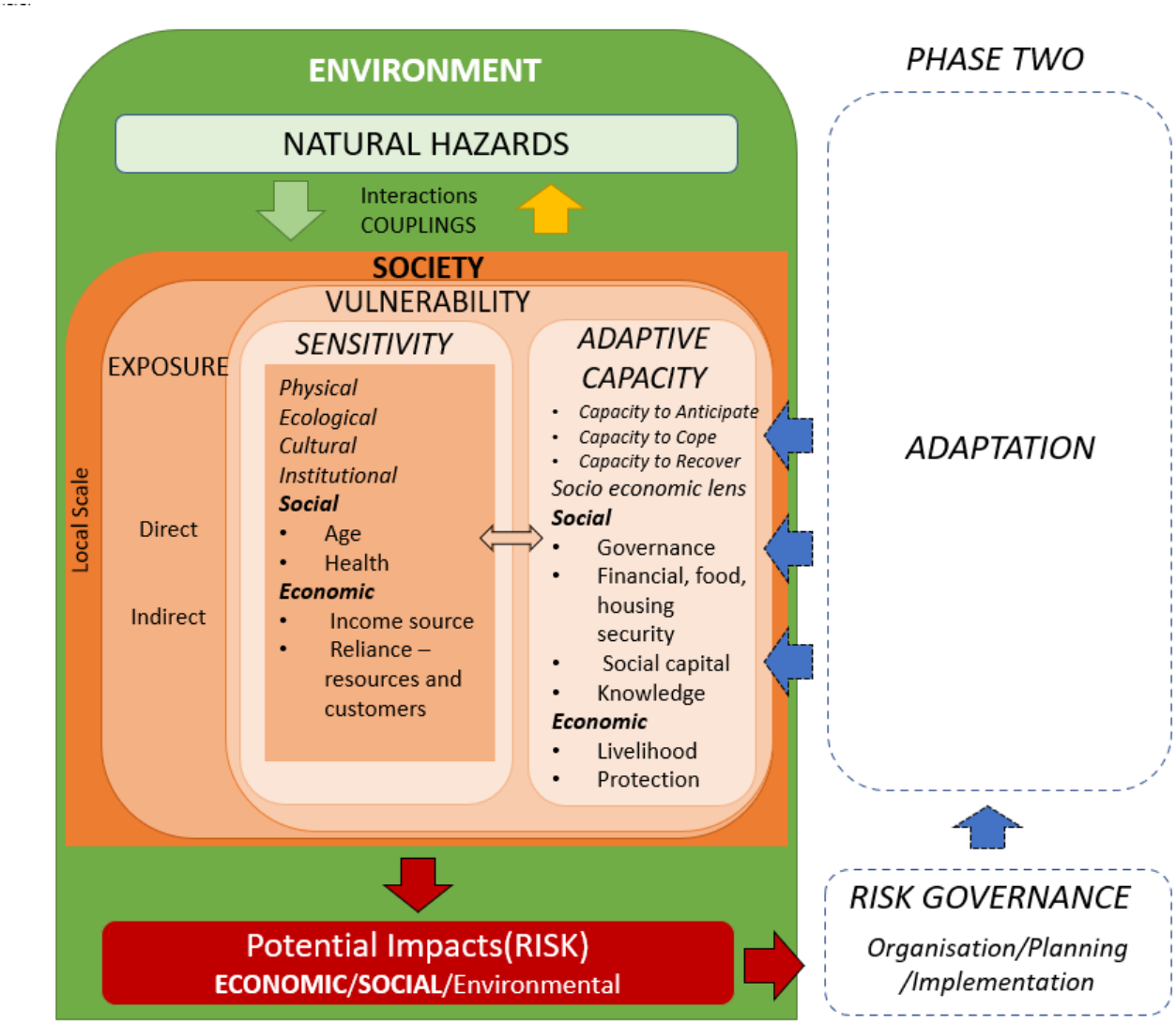


Figure 2-3: Assessment process. Source: (Adapted from Birkmann et al., 2013)

The assessment process was undertaken in two parts:

- **Part 1:** Identifying the current sensitivity and adaptive capacity of the community with regards to social and economic factors. Guidance for social and economic factors was taken from the Social Vulnerability Indicators for Flooding in Aotearoa (Mason et al., 2021) and Economic Vulnerability and Resilience (Briguglio et al., 2008).
- **Part 2:** Socio-economic impact assessment of indicative natural hazard scenarios (specified by Otago Regional Council). Three indicative natural hazard scenarios were provided by ORC, and are detailed in Appendix E.

2.4.1 Identification of potential social impacts

A high-level assessment of the potential social consequence of a natural hazard event was undertaken. The following changes were considered. According to Vanclay (2003), social impacts are changes to one or more of the following:

- People's way of life – this is how they live, work, play and interact with one another on a day-to-day basis.
- Their political systems – the level in which people are able to participate in decisions that affect their lives.

- Their environment – the quality of the air and water people use, the availability and quality of the food they eat, the adequacy of sanitation, their physical safety and their access to resources.
- Their health and wellbeing- health is a state of complete physical, mental, social and spiritual wellbeing.
- Their personal and property rights – particularly whether people are economically affected or experience choice in decision made over their property.
- Their fears and aspirations – their perceptions about their safety, their fears about their future of their community and aspirations for the future of their community.

The social impact assessment methodology considers the impact, cause, people affected, extent, duration and severity.

2.4.2 Identification of potential economic impacts

A high-level assessment of the potential economic consequence of a natural hazard event was undertaken. Economic impacts can be direct or indirect impacts. Types of direct impacts include physical infrastructure damage and loss, and displacement of crops or animal stock, while indirect impacts capture changes to economic activities as a result of these changes. The relevant economic impacts are summarised as:

- Damage to households
- Repair of capital infrastructure
- Cost of response and relief
- Short-term economic losses
- Long-term economic losses
- Employment
- Insurance losses
- Less investments.

The economic assessment methodology considers the impact, cause, people affected, extent, duration and severity.

3 Assumptions and limitations

In the process of this assessment the following assumptions have been made:

- This assessment is high level, only due to the level of information on natural hazard risks that was available at the time the indicative natural hazard scenarios (specified by ORC) were formed. A separate piece of work is being undertaken by Beca Ltd in parallel to this SEIA to quantify natural hazard risks at the Head of the Lake. This report will be finalised in mid 2024.
- This SEIA is not a cultural impact assessment; potential cultural impacts will be screened through a te ao Māori lens by Aukaha, an iwi-owned environmental consultancy group on behalf of Otago rūnaka.
- Replacement costs of the road network are estimated at 0.7 million per km for local roads, and 4.5 million per km for State Highways (Te Manatū Waka, 2023). This is an indicative cost based on the national average, and considers land, formation, pavements, drainage, traffic facilities, bridges, culverts and subways, as well as other structures.
- Median house price of $900,000 in Glenorchy in 2023 (OneRoof, 2023).

4 Socio-economic area of influence

The socio-economic area of influence is the area in which the potential social and economic impacts are considered. This area includes the communities within the SEIA study area (the Head of the Lake) and the communities within the wider area, in relation to economic and social interdependencies. The spatial approximation of these areas is outlined in Figure 4-1 below:

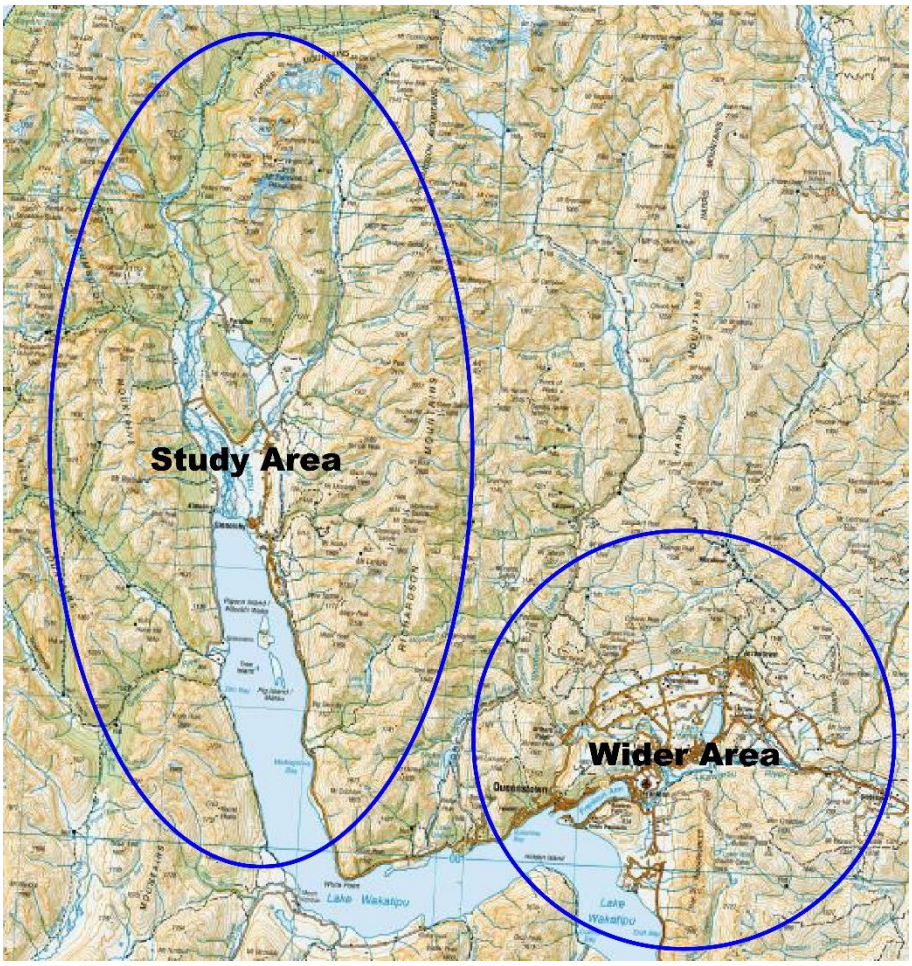


Figure 4-1: Socio-economic area of influence

- **SEIA study area** (the Head of the Lake): this includes the township of Glenorchy and the surrounding rural areas of Kinloch, Paradise, Greenstone, Routeburn, Dart Valley, and Rees Valley.
- **Wider area:** this includes the businesses (and some employees) based in Queenstown, or the wider area that are dependent on the Head of the Lake to operate their business.

5 Community baseline - Head of Lake Whakatipu – Whakatipu-wai-Māori

The SEIA study area (the Head of the Lake) comprises both the Glenorchy township and the greater Glenorchy area, also known as the Head of Lake Whakatipu, or more informally as the 'Head of the Lake'. This encompasses the surrounding rural areas of township of Kinloch, Paradise, Routeburn, Greenstone, Caples, Te Awa Whakatipu / Dart River Valley, and Puahiri/Puahere / Rees River Valley. (refer to Figure 5-1). The project area is referred to throughout this report as 'the Head of the Lake'.

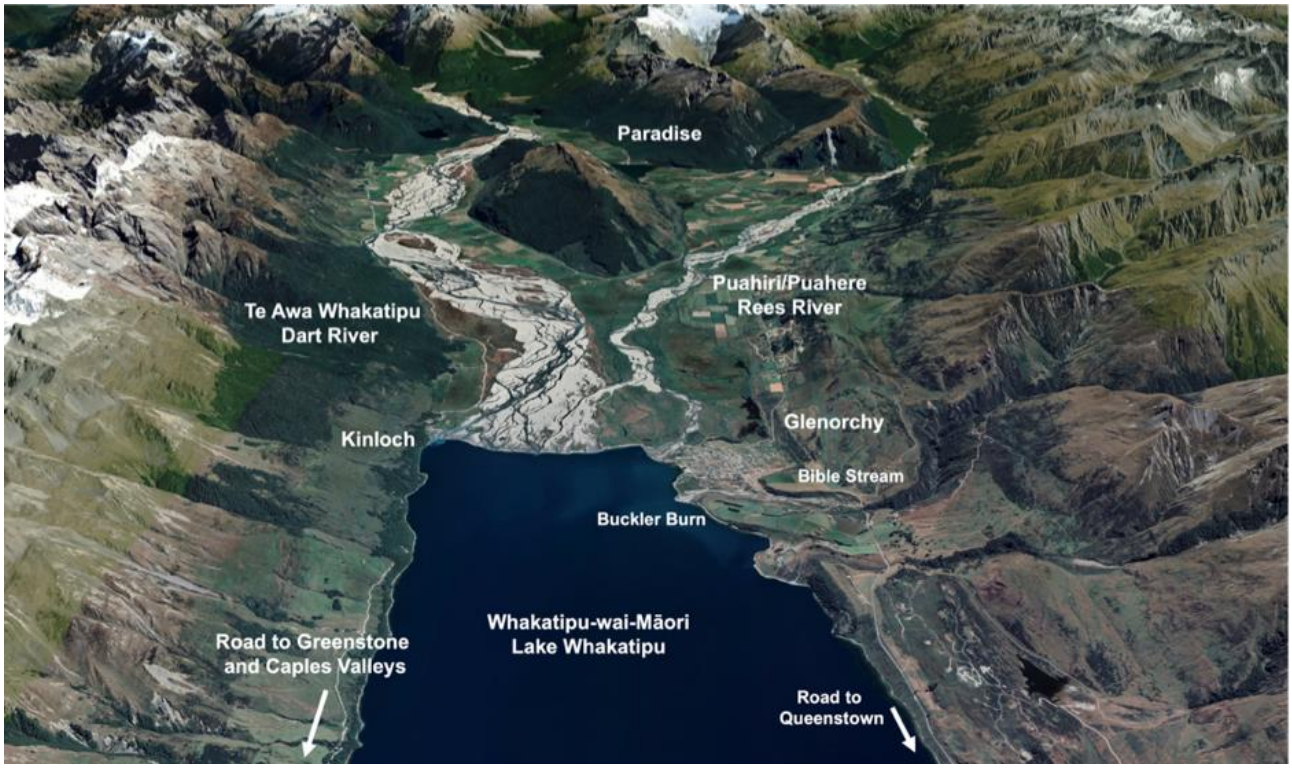


Figure 5-1: Head of Lake Whakatipu area. Source: (MacKenzie, 2023)

To the western side of the Head of the Lake is the Kinloch settlement, and the Greenstone, Caples, Routeburn, and Dart River Valleys. This side of the Head of the Lake is sparsely populated, centred around farming, outdoor pursuits (in particular notable walks such as the Routeburn track) and corresponding accommodation provisions.

The Rees and Dart River Bridges are critical pieces of infrastructure connecting the western side of the Head of the Lake with the greater Glenorchy area, via the Kinloch, Routeburn, Glenorchy-Routeburn and Glenorchy-Paradise Roads. The bridges were constructed in 1920 and 1974 respectively (Access Glenorchy, n.d.; Glenorchy Community, n.d.b). The journey from Glenorchy to Kinloch takes approximately 25 minutes.

On the eastern side of the Head of the Lake area is the Glenorchy township, with additional residences to the south (back towards Queenstown) and to the north up the Rees Valley, including Paradise.

The Glenorchy-Queenstown Road is the only road connecting the Head of the Lake with Queenstown. It was opened in 1962 and the journey from Glenorchy to Queenstown takes around 45 mins to 1 hour (46km). Access to Queenstown is also possible by boat and plane.

Table 5-1 details the road distance and travel times from Glenorchy to the main towns/cities in the wider region.

Table 5-1: Road distances and travel times from Glenorchy to the main cities/towns in the wider region

City/town	Road distance from Glenorchy	Travel time from Glenorchy
Queenstown	46 kilometres	45 mins/ 1 hour
Te Anau	217 km	3 hours
Gore	212 km	2 hours 50 minutes
Dunedin	328km	4 hours 30 minutes

5.1 Mana whenua

Information for this section has largely been sourced from the Cultural Values Assessment prepared by Takau (2021) on behalf of the rūnaka of Otago. This assessment does not assess the potential Māori cultural impacts of natural hazards in the area. This requires a specific cultural impact assessment.

Mana Whenua refers to those who hold the mana or authority over a specific area. In the Queenstown Lakes District, mana is held by seven papatipu Rūnaka:

- Otago Rūnaka
  - Te Rūnanga o Moeraki
  - Kāti Huirapa Rūnaka ki Puketeraki
  - Te Rūnanga o Ōtakou o Hokonui Rūnanga
- Murihiku Rūnaka
  - Te Rūnanga o Waihōpai
  - Te Rūnanga o Awarua
  - Te Rūnanga o Ōraka-Aparima.

These rūnaka are represented by two rūnaka-owned environmental consultancies; Aukaha (the four Otago rūnaka) and Te Ao Marama Incorporated (the three Southern rūnaka). The Cultural Values Assessment was prepared by Takau, only on behalf of the rūnaka of Otago.

5.1.1.1 Significance of the area to Mana Whenua

As described in the Takau (2021) Cultural Values Assessment, the Head of the Lake contains many landscapes and places of significance to mana whenua. Wāhi Tūpuna[6] include Te Awa Whakatipu (the Dart River) and Puahiri/Puahere (the Rees River), Ōturu (Diamond Lake) and Wāwāhi Waka (Pigeon Island) (Takau, 2021). Notably, Te Awa Whakatipu (the Dart River) and Puahiri/Puahere (the Rees River) were once well-used ara tawhito (trails), particularly to pounamu sources in the area. Te Awa Whakatipu was also part of a well-known network of ara tawhito which connected Whakatipu-wai-Māori with Whakatipu Waitai (Martins Bay). The network of trails also included Te Komama (Routeburn), Whakatipu-ka-tuku/Ōkare (Hollyford River) and Tarahaka-Whakatipu (Harris Saddle) (Takau, 2021).

As detailed by Takau (2021):

> "*Traditionally, the wider Whakatipu-wai-Māori area, along with its associated valleys and waterways*
>
> *held significance as places to recuperate in between seasons and after conflicts. There were several nohoaka (temporary camp sites) at the head of Whakatipu-wai-Māori (Lake Wakatipu) and different*

[6] Wāhi Tūpuna are landscapes and places that embody the relationship of mana whenua and their culture and traditions with their ancestral lands, water, sites, wāhi tapu (sacred places), and other taoka (treasure).

kāika (permanent settlements) located throughout the wider Whakatipui-wai-Māori area. An extensive network of ara tawhito (traditional travel routes) followed the several awa (rivers) and roto (lakes) and these travel routes became the arteries of economic and social relationships for Kāi Tahu.

Many of today's key transportation routes follow these traditional trails. There was also an abundance of kai (food resources) in the area as well as other traditional resources such as tussock, raupō, tī kōuka and harakeke which were often harvested to make mokihi (temporary reed rafts), for medicinal purposes, weaving and clothing."

5.2 History

5.2.1 Cultural history

According to Takau (2021), it is written that the Waitaha people arrived in Te Wai Pounamu on a great canoe called Uruao. The Uruao was captained by Rākaihautu, the son-in-law of the Waitaha chief Matiti. There is a proverb associated with Rākaihautū which reads; "Ko Rākaihautū te takata nāna i timata te ahi ki tenei motu." (It was Rākaihautū who lit the first fires on this island.)

The oral tradition of "Kā Puna Wai Karikari o Rākaihautū" tells of how the great lakes of Te Wai Pounamu (the South Island) were dug by Rākaihautū. It is said that Rākaihautū used his famous kō (Polynesian digging tool) called Tū Whakaroria to perform divination rituals and subsequently form the major lakes of Te Wai Pounamu, which included Whākatipu-Wai-Māori, Wānaka and Hāwea. Thus, the genealogies of the Waitaha people can be traced from Rākaihautu through to his living descendants, the modern day Kāi Tahu (Takau, 2021).

5.2.2 Pioneering history

Scheelite mining, gold mining, saw milling, farming and tourism are all features of the collective history of the Head of the Lake and what has contributed to the current sense of place and community.

Europeans first settled in the area during the mid-late 19th century, initially establishing farming activity. This was followed by the gold rushes of Central Otago in 1862 which brought prospectors to the district. Later, the Glenorchy township developed to a visitor industry centred around the Routeburn Track in the 1870s (Access Glenorchy, 2023). The pioneering history of the Head of the Lake is summarised in Figure 5-2 below.

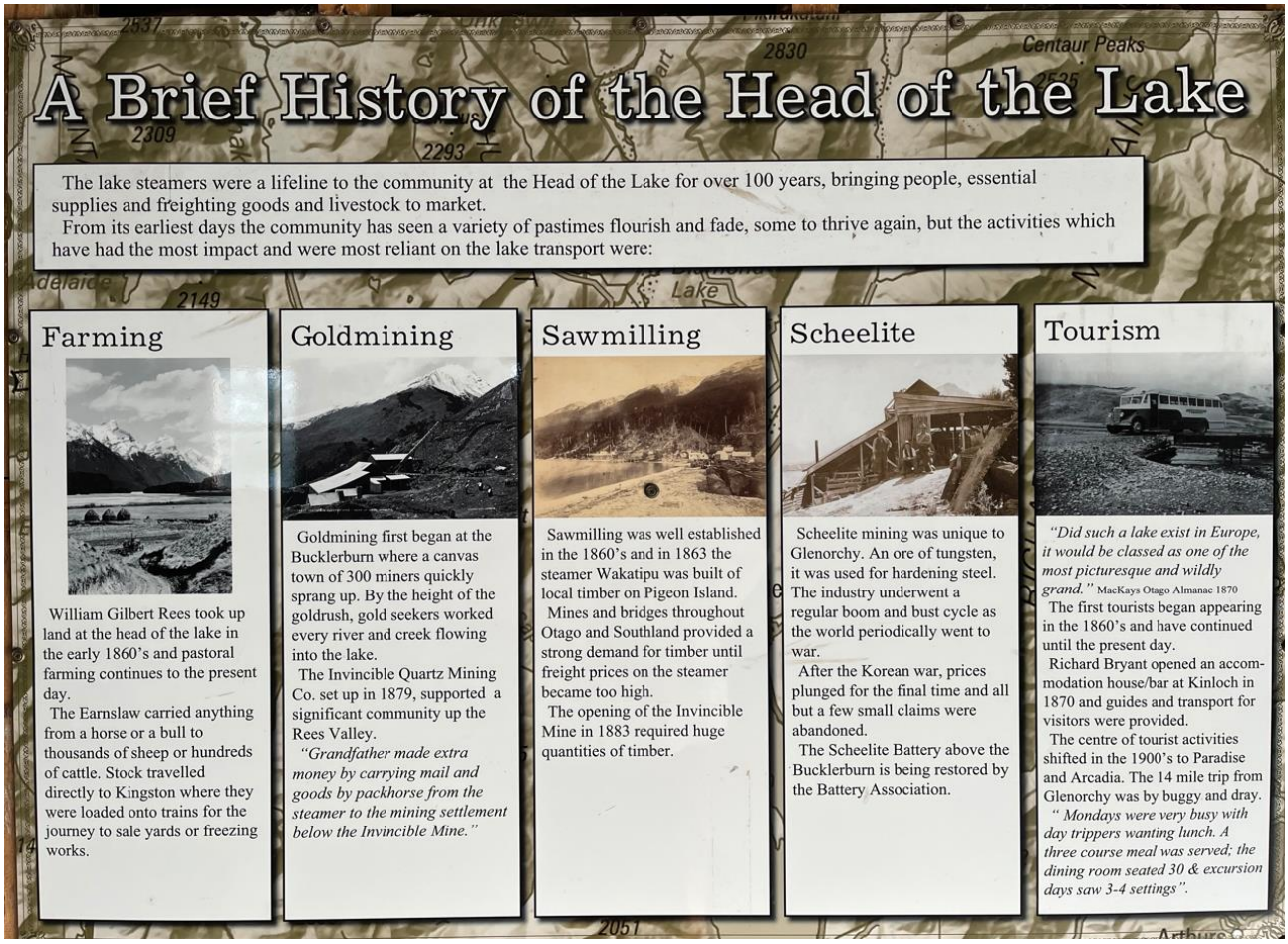


Figure 5-2: Photo of community history poster located in the Glenorchy Wharf Shed (taken during a site visit)

Glenorchy township was surveyed in 1864 and Kinloch in 1880. Initially, the Glenorchy township was a service town for local industry with just a hotel and store. The first school was established in Kinloch in 1884. After being relocated to several other locations, the Glenorchy School was established in its current location in 1939 (Glenorchy School, 2023). Glenorchy acquired its first community hall in 1943 (Access Glenorchy, 2023).

The Glenorchy-Queenstown Road was constructed in 1962 (Queenstown Lakes District Council, 2005). This provided road access to and from the Glenorchy township for locals and visitors. Prior to the construction of the road, lake steam ships served as a lifeline to the community for over 100 years, transporting people, livestock, and essential supplies and freighting goods to market. Notably, early visitors to Head of the Lake would arrive on the TSS Earnslaw, which took two hours, and departed from Queenstown three times a week (Glenorchy Community History, 2023).

5.3 People

The New Zealand Census collects data per spatial area. For the Head of the Lake, the relevant spatial area is referenced as Glenorchy Statistical Area 2 (SA2), however this geographically covers the broader area outlined in Figure 5-3.

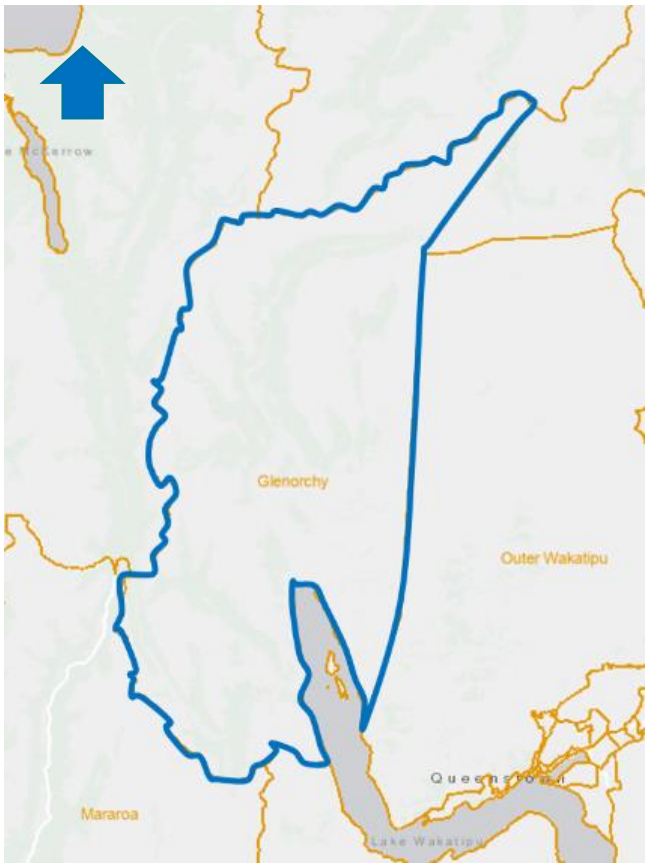


Figure 5-3: Glenorchy SA2 Statistical Area. Source: (Stats NZ, 2022)

As of 2018, the median age at the Head of the Lake is 40 years[7]. This is 3 years older than the New Zealand median age of 37 years (StatsNZ, 2018). Compared to New Zealand and the Otago Region, there are fewer older (11% of the population are aged 65 years and older) and younger (11% of the population is between 0-15 years of age) members of the community. In Otago as of 2018, approximately 17% of the population are aged under 15 years, while 16% are aged over 65 years. In New Zealand 20% are aged under 15 years and 15% are aged over 65.

The largest ethnic group at the Head of the Lake is European (92%) followed by Māori (5%). Compared to the national population, the Head of the Lake has a higher portion of European (70% of the national population) and a lower portion of Māori (17% of the national population) (StatsNZ, 2018).

Approximately 64% of people residing at the Head of the Lake were born in New Zealand and 36% of the population was born overseas, this is almost 10% higher than the national population, of which 27% were born overseas (StatsNZ, 2018). The locals that participated in interviews and focus groups as part of this research spoke of the community being diverse and made up of people from a range of nationalities and backgrounds.

> *"Radically different people – diverse people from many backgrounds and walks of life, however everyone respects each other"* – *Research participant*[8]

Based on discussions with research participants, there appears to be a relatively stable core part of the community. However, due to the nature of the work available (seasonal hospitality and tourism work), and those who live in the area part-time, there is turnover of some of the population. At the time of the 2018 Census, approximately 70% of the population had the same address as they did in 2017 (compared to 79% nationally). Of those with a different address in 2018, approximately 7% had relocated from overseas and 21% had relocated from elsewhere in New Zealand (StatsNZ, 2018). Some of the reasons for moving to the

[7] Statistical information unless specified otherwise has been sourced from the Statistics New Zealand Tatauranga Aotearoa (Stats NZ) Census Data. The last published Census data is 2018. It is acknowledged that there are limitations to this data and the population has changed since this time. Where possible more recent data has been sourced.

[8] Quotations from research participants are from the interviews and focus groups with stakeholders, residents and businesses that were conducted as part of this research.

area cited by research participants were the environment, outdoors, lifestyle and removing oneself from the stressors of an urban/busy lifestyle.

"If you are here for long enough, it gets under your skin - its a lovely place" – *Research participant*

5.3.1 Residential population growth

Between 2013 and 2018 the population grew by approximately 19%. This represents a high rate of population growth, compared to the Otago region, which grew 10% over the same period (StatsNZ, 2018). There has been steady growth over time as illustrated in Figure 5-4 below.

Population growth in the Head of the Lake 2006-2012

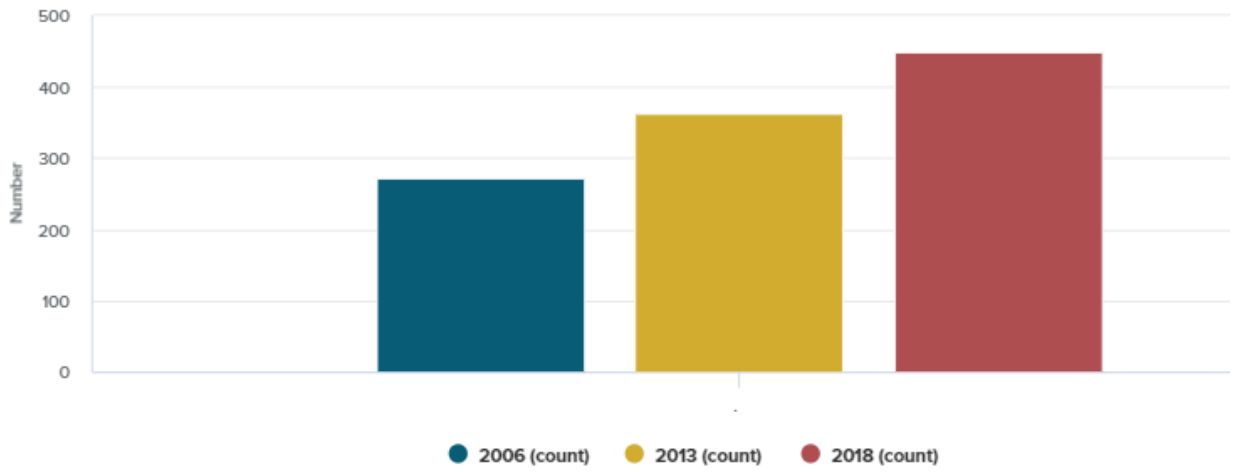


Figure 5-4: Population growth data for the Glenorchy SA2 Source: (StatsNZ, 2018)

Following the 2018 Census, the resident population in the Head of the Lake was recorded at 450 people. In 2023, it was estimated that the combined population of 'Glenorchy township' and 'Glenorchy Other' is approximately 560 residents (QLDC, 2023a). This reflects a growth of around 110 people in the last 5 years (QLDC, 2023a) (refer to Appendix D for population estimates).

From 2023 to 2053, this pattern of residential growth is expected to continue, with an annual estimated increase of approximately 2.3%. By 2053, the combined population of 'Glenorchy township' and 'Glenorchy Other' is forecasted to reach 840 residents (QLDC, 2023a).

These figures highlight a steady and anticipated growth in the resident population within the area over time, and potential for increased development and infrastructure requirements within this community should this forecasted growth occur.

5.3.2 Visiting Population and Growth

In 2023, the anticipated combined total daily visitors in the areas defined as 'Glenorchy township' and' Glenorchy Other' is estimated to be 390 people on an average day, and up to 1040 people on peak days (QLDC, 2023a). Looking ahead to 2053, there is projected growth of 2.9% annually in the number of average daily visitors, resulting in an estimated combined visiting population of about 650 people. On peak days, visitor numbers are also projected to increase by the same rate, reaching around 1690 people (QLDC, 2023a).

It is worth noting that a significant portion of the visiting population growth is expected to occur between 2023 and 2033, at a rate of 6.8% annually on average days and 6.1% annually on peak days.

5.3.3 Education

At the time of the 2018 Census, 10% of the population were in full-time study and 3% in part-time study (StatsNZ, 2018). The proportion of the population with a higher education degree (Bachelor's degree or higher) was 29%, which is higher than the than the Otago region (14%) and national population (15%) (StatsNZ, 2018).

In 2023, approximately 34 children were enrolled at Glenorchy Primary School.

5.3.4 Health

There are few indicators of health available for the Head of the Lake area. At the time of the 2018 Census, no residents aged 65 or over recorded experiencing activity limitations. However, 2.6% of the total resident population reported to have one or more activity limitations (the highest percentage being those 5-15 years of age at 11%). This represents a lower percentage when compared to the Otago region, where 6.6% of the population reported having an activity limitation (StatsNZ, 2018). Similarly, participants in the most recent QLDC Quality of Life Survey self-reported relatively high levels of physical health (74%), compared to Queenstown (61%) (Versus, 2024).

With regards to mental health, there are limited statistics for the Head of the Lake. Glenorchy participants in the QLDC Quality of Life Survey self-reported relatively high levels of mental health (63%), compared to Queenstown (43%) (Versus, 2024). However, based on discussions with research participants, there are mental health issues present amongst the population. Social isolation can be a contributor to this as it can limit the primary care interventions available. Glenorchy participants in the QLDC Quality of Life Survey cited cost (47%), time off work (18%), and location (12%) as the largest barriers to accessing health care.

Primary care at the Head of the Lake is limited to a Practice Nurse (refer to 'Services and amenities' section). Therefore, those in the area with a high level of health needs may need to move out of the area to seek the require health care. There is no public transport and limited services within the area so those with mobility limitations would require assistance to access services. Based on discussions with research participants, it appears the population is not an overly 'healthcare seeking' population and often self-manage health concerns due to the distance to many of the required health services.

5.4 Households

At the time of the 2018 Census, there were 195 occupied dwellings, 72 unoccupied dwellings and 3 under construction (StatsNZ, 2018). Since 2018, most residential growth has occurred in Alfred's Terrace; a 60-lot residential development located on the eastern side of Glenorchy on Oban Street as you enter the township from Queenstown.

Figure 5-5: Alfred Terrace Development. Source: (Alfred Terrace Website, 2023)

Some lifestyle blocks have also been developed, particularly around the Glenorchy-Paradise Road area, as well as large homes in private gated communities or estates (largely catering to overseas owners).

Based on site visit observation, the housing stock in the Head of the Lake consists of standalone homes, some tiny homes, caravans, campervans and house buses. Most homes rely on a wood burner for heating. 33% of households have heat pumps, but less would have this as their sole source of heating for the home (StatsNZ, 2018). Due to potential power cuts, most homes have alternate heat sources that are not reliant on power (e.g., wood or gas burners).

Approximately 72% of households in the Head of the Lake own or partly own their home, either privately or through a family trust. Based on discussions with research participants, a portion of these are holiday homes that are either used by the owners or rented out to holidaymakers. Historically, there has not been a large long-term rental market in the area, however this has changed slightly in response to changes to the Residential Tenancies Act 1986. Previously, property owners would rent their home on a short-term basis, to allow them to use it seasonally, or as a holiday home. However, this has not been possible in recent times due to the new regulations which increase the amount of notice landlords must give to end a tenancy.

A portion of the community are 'temporary residents', those who own holiday homes or live there part-time. Approximately 37% of privately owned homes were unoccupied as of the 2018 Census (StatsNZ, 2018).

5.5 Community

5.5.1 Values and aspirations

The Head of the Lake community has a strong and clear set of shared values and aspirations, which are documented in 'Glenorchy – Head of the Lake 2001 Community Plan' and 'Shaping our Future: Glenorchy Community Visioning Report 2016'.

As documented in the 2001 Community Plan, the Head of the Lake is:

"…a vibrant community where lifestyle and 'freedom' are highly valued together with the peaceful, unspoilt rural environment and the dynamic interaction of the spectacular landscape, heritage and wilderness".

In this 2001 Community Plan, residents identified values of being safe, caring, self-reliant, working together, being welcoming to visitors, and having residents who respect the environment (QLDC, 2001). In regard to the social, cultural and natural environment, residents valued the history of the area, the rural atmosphere, peacefulness, magnificent landscape, and wilderness 'at its doorstep'. As part of the process of developing the 2016 community vision, these values were identified as still being relevant to the community.

Attendees also valued having a community that:

- is unified in maintaining and enhancing the unique, diverse and innovative characteristics of the community
- supports and embraces a local boutique economy, values their 'Head of the Lake' brand and works together to promote and protect Glenorchy's unique environment and attractions
- values all sections of its population and promotes health, wellbeing and continued education
- has the right infrastructure in the right place to support residents and their interests and businesses and allows for tourism without placing undue strain on the resident population.

These values were incorporated in the 2016 community vision for the area:

> *"A unique, inclusive community that fosters and embraces individuality, diversity and innovation, encourages resilience* and promotes community vitality and collaboration. The Glenorchy community has a collective strong voice that advocates for positive change.*
>
> *Glenorchy has the infrastructure to support a thriving boutique local economy in keeping with the rural landscape, actively respects and enhances the natural environment, collectively works towards providing their own resources (self-sufficiency)."* (Shaping our Future, 2016):

Specifically, the community vision includes (of relevance):

- All aspects of the community (including new members) are engaged in decision making, and collectively work towards achieving our vision for the future.
- A community that is largely self-sufficient in food and energy.
- The collective community voice is heard and listened to by relevant agencies e.g., QLDC.
- Glenorchy village culture is retained - safe, welcoming, communal, caring and a 'muck in together' attitude.
- A healthy village with all essential community services e.g., health, education for residents and visitors.
- Glenorchy is well connected, with viable transport options and access to the latest technology (e.g., phone and internet) (Shaping our Future, 2016).

The values and 2016 vision are consistent with the research undertaken as part of this assessment. The values cited in discussions with research participants are summarised in Figure 5-6.

Figure 5-6: What research participants said they value about the area and/or what they like about living in the area.

From discussions with research participants, residents highly value the strength of the local community, which comes together in difficult times. Community spirit is particularly strong amongst older locals and as described by a research participant, this "rubs off" on others (e.g., new residents). Community spirit is also reflected in the relatively vast number of community volunteers, groups, organisations, events, and celebrations of the European heritage of the area, cited by the research participants.

Based on discussions with research participants, residents value knowing lots of people in the community and feeling cared for by the community (e.g., a research participant recalled incidences where people checked up on ageing members of the community).

> *"Everyone helps each other out like family because if your car broke down on the road, you would hope people stopped for you, and you would stop for people".* – *Research participant*

Research participants also valued how welcoming the community is. A large proportion of residents have lived elsewhere or come from other parts of the country or world, and have been welcomed into the community. This is reflected in the results of the most recent QLDC Quality of Life Survey, whereby 92% of Glenorchy participants assessed their community as "welcoming" (Versus, 2024). Having places to come together and opportunities for connection and belonging was identified as being important to the community.

Whilst isolation, "the number eight wire", and self-sufficient lifestyles were valued, people also valued local services and amenities such as Glenorchy Motors, the Community Nurse, the School and the Library. People also valued internet access, access to the lake, river and mountains, and roading access to Queenstown; particularly to access health and medical care. Many research participants voiced the desire for local and central government to consider the importance of road connectivity (or sustainable alternatives during closures) for both the local and wider community.

5.5.2 Arts, culture and heritage

Based on discussions with research participants, arts, culture and heritage is strongly valued by the community. Community groups have done a lot of historic archiving and expressed a desire to be more collaborative and connected to other heritage groups in the Queenstown Lakes District. The community was recently involved in developing a vision for the future of arts, culture and heritage in the Queenstown Lakes District. A visual summary of engagement with the Glenorchy community is provided in Figure 5-7.

Figure 5-7: QLDC's visual representation of engagement with the Head of the Lake on a vision for the future of arts, culture and heritage in the Queenstown Lakes District. Source: (QLDC, 2023b)

The community has expressed to QLDC that they would like more space for the local museum. Research participants also shared that there is a community group working through an application to achieve 'Dark Sky' status. Based on site observations, historic monuments (e.g., the First World War Memorial) and the local cemetery are points of interest in the community, particularly in relation to the potential impacts of natural hazards.

5.5.3 Social Cohesion

Based on discussions with research participants, it appears that the community regularly comes together to achieve community goals and create the community they want for themselves. This is evident in the wide range of clubs and organisations formed (refer to the 'Clubs/Organisations section), considering the population size and component of temporary residents. Overtime, as more new members have arrived the familiarity factor of 'everyone knowing each other' is likely to have lessened, however based on discussions with research participants, most new members to the community find a way to connect in one form or another (e.g., through the play centre and school or other local interests). Some research participants

considered that the 'pioneering spirit' of the community is more evident in longer standing members of the community who have lived through higher degrees of isolation and lower levels of access to amenities. It can therefore be inferred that newer members may be more reliant on conveniences and constant connectivity with Queenstown. Information on the community website[9] provides people with advice on how to settle into the community and how to 'survive' with advice on resources and readiness required. Although it was recognised by research participants that there is a range of members within the community with different views and opinions, most agreed that the community come together when required as illustrated by some of the quotes from research participants in Figure 5-8 below.

Figure 5-8: Research participants sentiments on community cohesion and diversity

5.5.4 Governance

The Head of the Lake is situated within the Queenstown-Wakatipu Ward of the Queenstown Lakes District (refer to Figure 5-9 - left), which forms part of the Otago Region (refer to Figure 5-9 - right). It is therefore governed by the Otago Regional Council (ORC) and the Queenstown Lakes District Council (QLDC) (refer to Figure 5-10). The Mayor of the area covers the whole Queenstown Lakes District. The Member of Parliament for the area is part of the Southland Electorate.

[9] https://www.glenorchycommunity.nz/

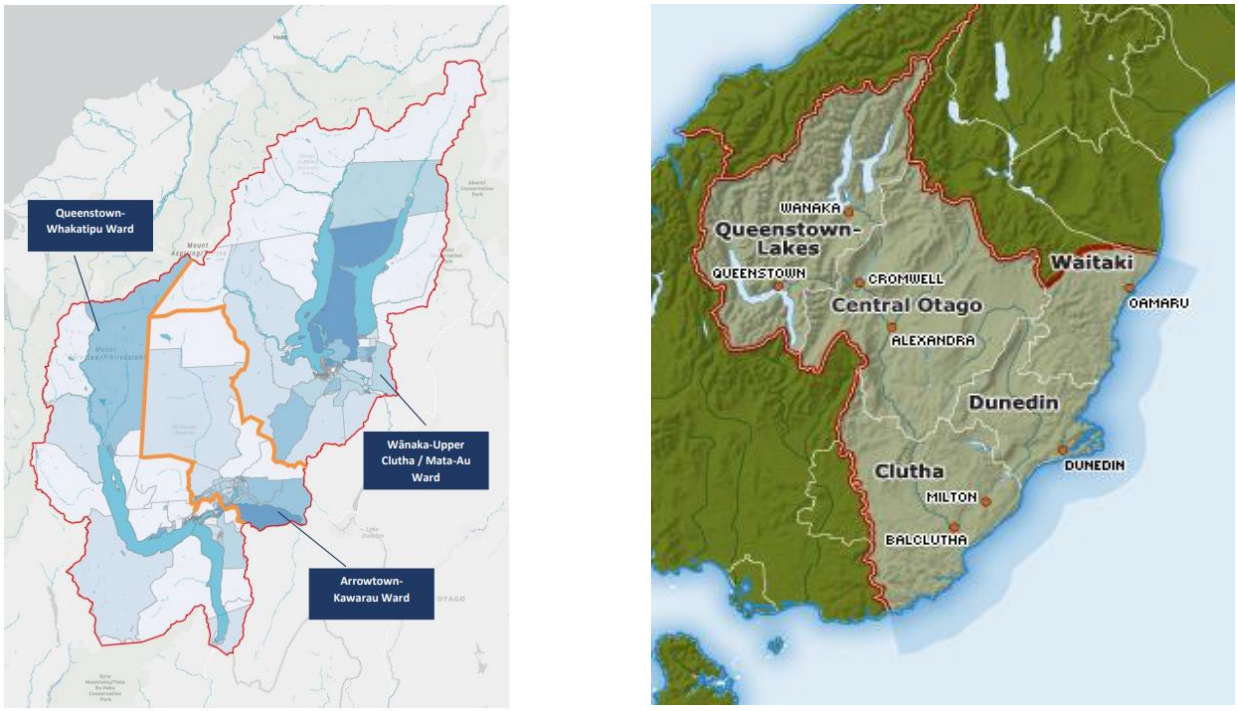


Figure 5-9: Left: Queenstown-Wakatipu Ward within the Queenstown Lakes District (QLDC, n.d.), Right: Otago Region boundary. Source: (localcouncils.govt.nz, n.d.)

This governance structure is illustrated in Figure 5-10 and discussed in further detail below.

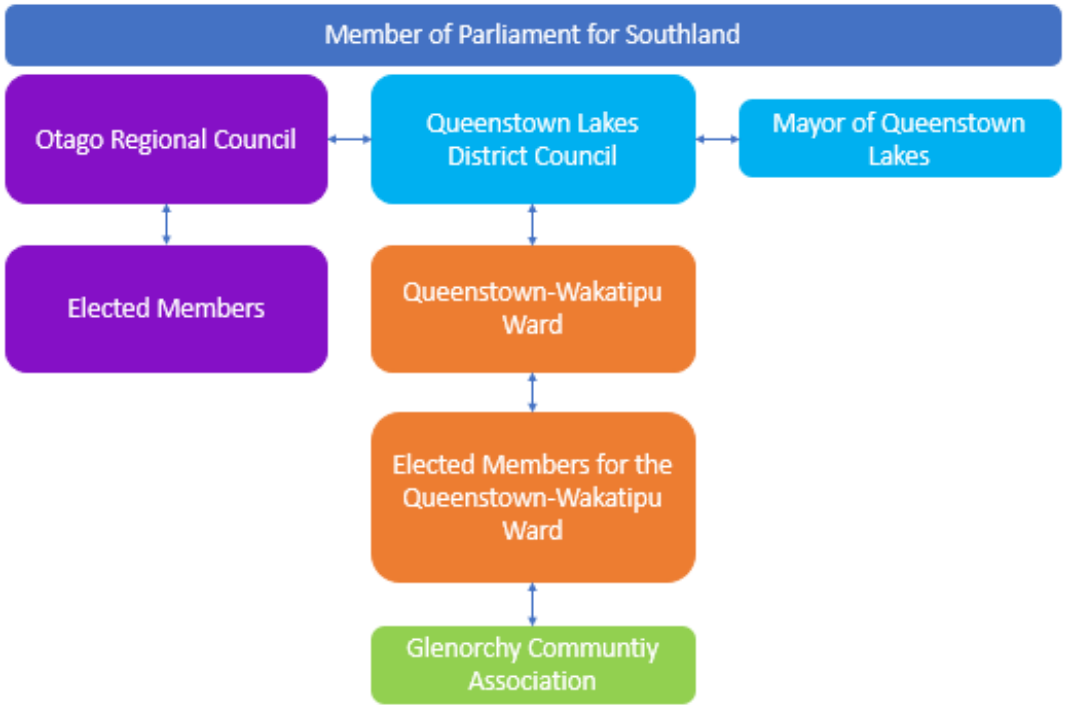


Figure 5-10: Governance structure of the Head of the Lake (figure created for the purposes of this report)

5.5.4.1 Otago Regional Council

As a Regional Council, ORC is responsible for sustainably managing Otago's natural resources of land, air and water on behalf of the community. ORC is also responsible for promoting the economic, social, cultural and environmental wellbeing of the region (Otago Regional Council, n.d.)

ORC is governed by 12 councillors, who are elected by residents every three years to represent the regions four constituencies. There are currently three councillors for the Dunstan constituency which covers the Central Otago District and Queenstown Lakes District territorial areas (Otago Regional Council, n.d.).

In relation to natural hazard management, ORC administers the Otago Civil Defence Emergency Management (CDEM) Group as part of its Civil Defence Emergency Management responsibilities. There are six partner councils who make up the CDEM Group:

- Otago Regional Council
- Central Otago District Council
- Dunedin City Council
- Clutha District Council
- Waitaki District Council
- Queenstown Lakes District Council.

The Group has Emergency Management Advisors in each of these councils, who are responsible for development and delivery of emergency management activities to their communities (Emergency Management Otago, n.d.a).

5.5.4.2 Queenstown Lakes District Council

As a Territorial Authority, QLDC is responsible for roading, reserves, sewerage, building consents and land use and subdivision. It also has a general duty to monitor the state of the environment of the district, the efficiency and effectiveness of policies and methods in policy statements and plans, the efficiency and effectiveness of local authority processes (including timeliness, cost, and overall satisfaction) and the exercise of resource consents within the district (Environment Guide, n.d.).

QLDC is governed by Councillors and Community Board Members, which are elected every three years. Whilst the Head of the Lake area does not have a designated QLDC Councillor, currently one of the four elected members for the Queenstown-Wakatipu Ward is Glenorchy-based.

In relation to natural hazard management, QLDC is required under the Civil Defence Emergency Management Act 2002 to provide a coordinated and integrated approach to the way significant risks and hazards are managed in the district across the 4R's (reduction, readiness, response, recovery). The Otago CDEM group works closely with QLDC, emergency services and the Head of the Lake community to prepare for civil defence emergencies, such as floods and earthquakes (Emergency Management Otago, n.d.b).

5.5.4.3 Glenorchy Community Association

The Glenorchy Community Association (GCA) is a community-based incorporated society. The GCA's primary function is to promote the interests, needs and well-being of the Glenorchy community to decision makers, including government and other local decision makers. The GCA also supports community initiatives and collects community views to advocate and negotiate specific matters on behalf of the community, when requested. Membership is made up of residents and property owners living in the Glenorchy township and the Head of the Lake. The Board is annually elected, and anyone can attend the GCA's monthly meetings, held at the Community Hall on the first Thursday of each month (except January). The Board consists of duty elected officers, being a Chairperson, Treasurer/Secretary and general committee members.

a. Glenorchy Community Response Group

A Glenorchy Community Response Group (CRG) has been convened which comprises a number of CDEM trained community volunteers, coordinated by an Otago Emergency Management Advisor (EMA) (refer to 'Services and amenities' section for further detail).

The Head of the Lake's emergency management governance structure is illustrated in Figure 5-11 below.

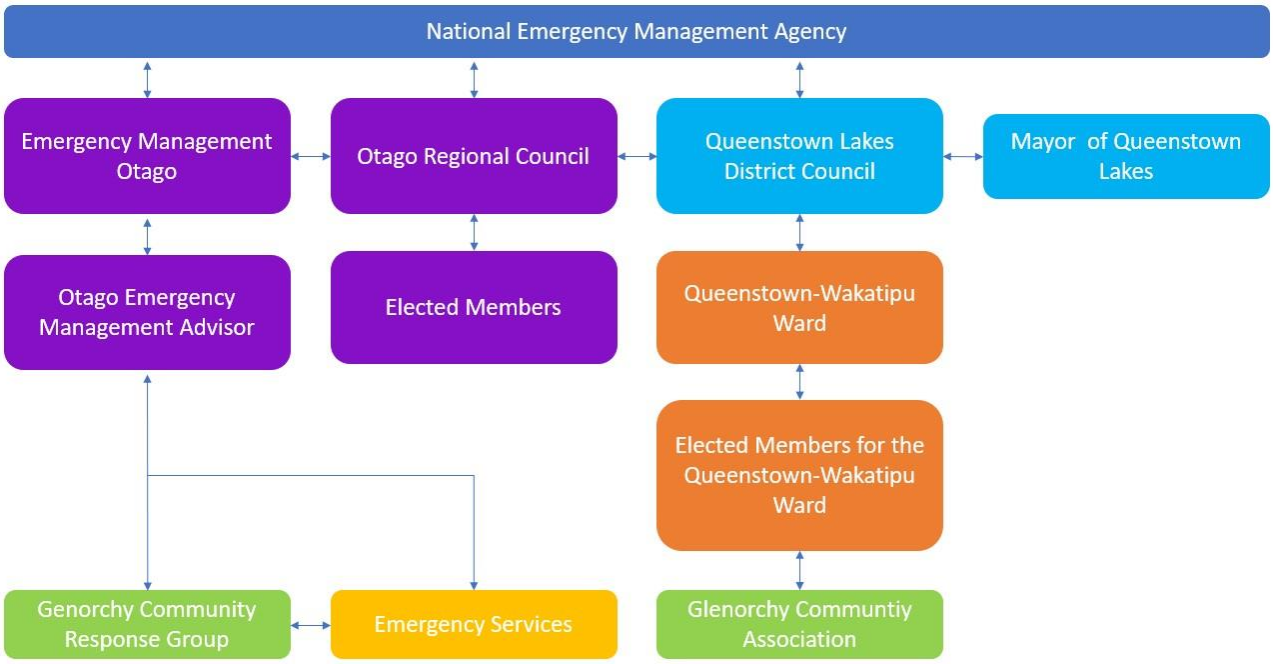


Figure 5-11: Emergency Management governance Structure (figure created for the purposes of this report)

5.5.5 Clubs/Organisations

Glenorchy is a vibrant community that offers a variety of amenities and activities for residents and visitors. Among these are a golf course, skate park, marina, scenic reserve, playground, library, waterfront, and community hall. The town is also home to a number of sporting, social, and environmental clubs that contribute to the community's culture and lively atmosphere. The clubs on offer have changed as the community has grown and evolved. Current clubs/groups/organisations include, but are not limited to:

Lakeside Rugby Club	Darts Club	Rural Women's Group
Netball Club	Community Nursery	Women's Book Club
Golf Club	Heritage & Museum Group	Coffee Club
Riding Club	Dark Skies Sanctuary Group	MenzShed
Home Brew Club		

Different clubs/organisations take on responsibility for community events and raising funds and distributing funds or providing financing for community projects. Major events include the annual Glenorchy Races, the Glenorchy Flower Show and the Glenorchy Fishing Competition.

> *"Culture of volunteering is an invisible but pervading characteristic of the community."* – *Research participant*

5.5.6 Services and amenities

Most services and amenities at the Head of the Lake are located in the Glenorchy township. These include:

Glenorchy Primary School	Glenorchy Fire Station	Glenorchy Cemetery
Glenorchy Museum	Glenorchy Skate Park	Glenorchy Marina
Glenorchy Information Centre	Glenorchy Petrol Station	Glenorchy Community Hall
Glenorchy School Playground	Glenorchy St John's Ambulance	Mission Hall (Head of the Lake Community Church)
Glenorchy Motors	Glenorchy Waterfront Reserve	Glenorchy Library
Glenorchy Community Native Plant Nursery	Glenorchy Post Office	

Basic grocery items can be purchased from the Mrs Woolly's General Store. However, people need to travel further afield (e.g., Queenstown) for other household items or order in.

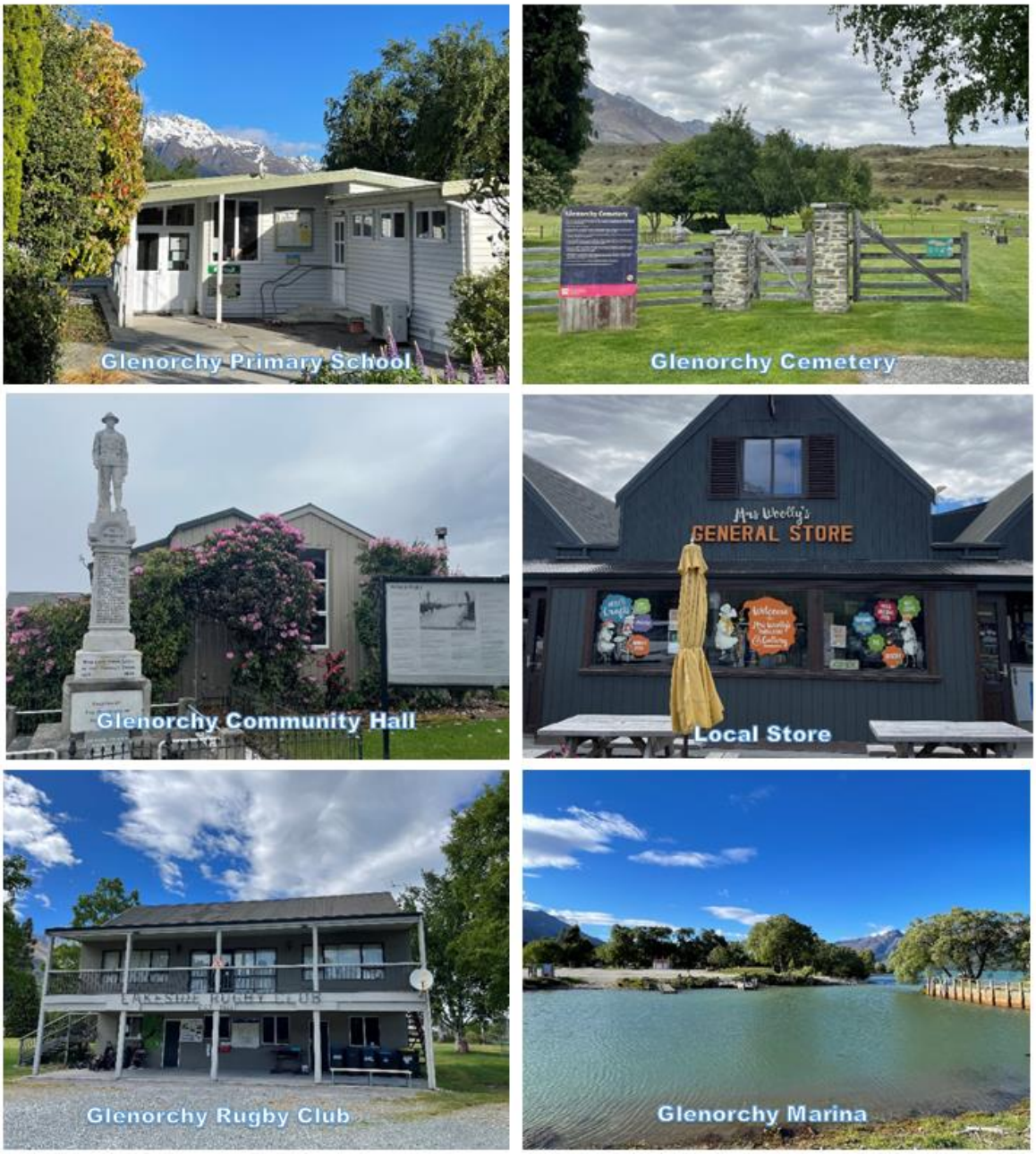


Figure 5-12: Images of community assets/services in the Glenorchy township

Figure 5-13 provides a high-level map of these services and amenities. It excludes any services and amenities outside the Glenorchy township.

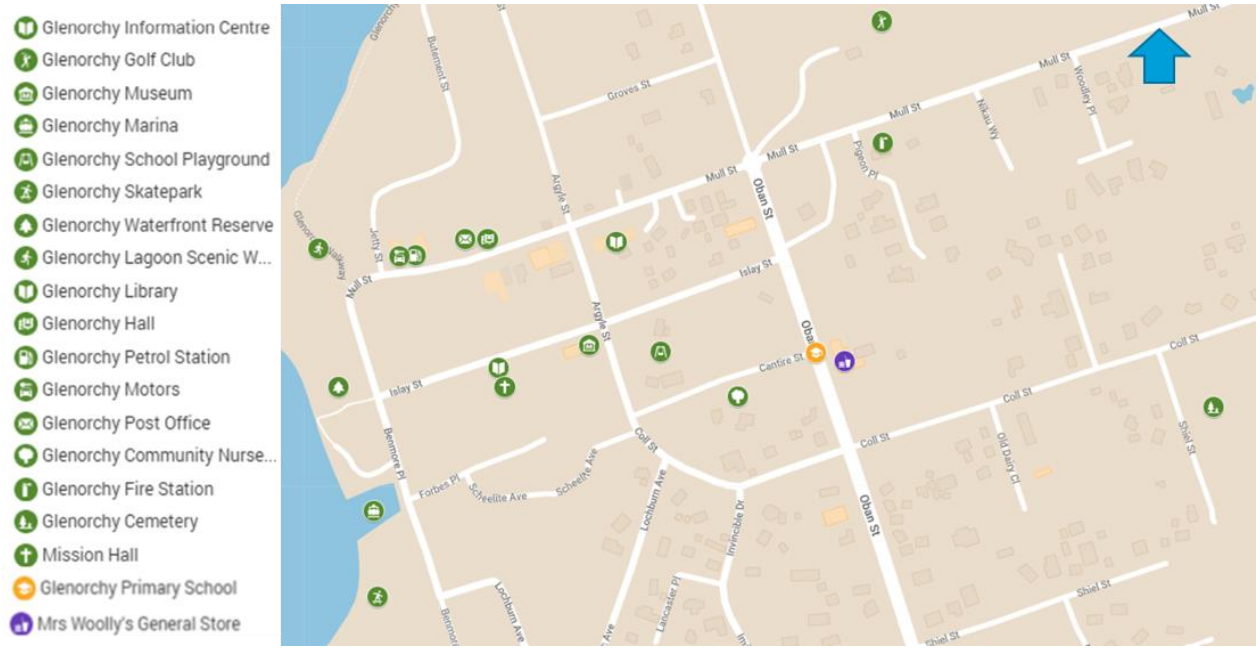


Figure 5-13: Community services/assets in the Glenorchy township (map created for the purposes of this report using data sourced from Google Maps (Google, n.d.) and confirmed by site visits

5.5.6.1 Health services

A Practice Nurse currently operates a non-funded, Registered Nurse-led Health Clinic in Glenorchy for one hour every second Wednesday (this time can vary depending on the Nurse's availability). Home visits are also available before or after clinic times by prior arrangement with the Nurse.

The Practice Nurse has been operating the Health Clinic in Glenorchy for 8 years. Services include, but are not limited to, providing medications, wound assessments, taking bloods, wellbeing checks (e.g., detox patients), and coordinating transport for patients to attend appointments outside the area.

The clinic is a non-funded service; however, the Nurse currently receives an annual Community Trust grant for petrol costs. The Glenorchy Branch of Rural Women New Zealand played a key role in sourcing local funds when the Clinic was threatened with disestablishment in 2011. The Southern Primary Health Organisation (PHO) previously funded the service; however, funding was ceased in 2011.

In addition to the Practice Nurse, a pharmacist occasionally attends the fortnightly Health Clinic. Glenorchy also has a visiting Chiropractor and Hospice Nurse.

A few St John's first responders also live in the area and provide urgent medical care. If the patient requires a hospital, the Lake District Hospital in Queenstown is closest (approximately 1 hour drive - 54km) More extensive primary care is available in Queenstown, including doctors, nurses, psychologists, physiotherapists, and other health providers. Residents must travel to Clyde, Dunedin, or Invercargill for specialist services.

5.5.6.2 Education

a. Playgroup

There is a Glenorchy Playgroup for under-fives that meets every Monday and Thursday from 10am-12pm. The Playgroup provides a place where pre-school children and parents can regularly meet, with the aim of giving parents and caregivers the opportunity to learn new ways to encourage their children's learning in a friendly, supportive, and fun group. Approximately 30 children are registered to attend the Play Group.

b. Early & After School Childcare

There are currently no services at the Head of the Lake that provide early or after school childcare. Currently, parents and caregivers that require some childcare support 'must make it work' outside of formal childcare arrangements. From discussions with research participants, it appears some parents and caregivers have arrangements with other parents and caregivers, where they share childcare responsibilities. 'Glenorchy Early Childhood Centre Project' is currently fundraising to build an Early Childcare Centre on some land in the Glenorchy township, which is owned by the Glenorchy Play Group.

c. Primary School

There is one Primary School in the Head of the Lake, situated in the Glenorchy township. Glenorchy Primary School is a public school, providing education for student's years 1 - 8.

There are currently 34 students enrolled at the Glenorchy Primary School. The junior class (years 1-3) account for half the school roll, which is reflective of the growing number of young families in the area. Four new entrants are planning to start in 2024, and a further eight planned to start in 2025.

Glenorchy Primary School offers a school bus to those students who meet eligibility criteria. Eligible students are those aged under ten years, who live more than 3.2 km away from the school, and those aged over 10 years, who live more than 4.8km away from the school.

d. High School

Children years 9-13 must attend a high school outside of the area or be home schooled. From discussions with research participants, most high school aged children at the Head of the Lake attend Wakatipu High School, which is a public school approximately 1 hour drive / 55 kilometres from Glenorchy. There is a free school bus, provided by the Ministry of Education that collects and returns students to/from six different bus stops in Glenorchy.

5.5.7 Utilities

5.5.7.1 Roads

Car travel is the dominant mode of transport at the Head of the Lake. There is no formalised public transport. Bus services run for primary and secondary school students as detailed in the above sections. There are several key roads at the Head of the Lake that provide access to, from and around the community (see Figure 5-14). These include:

- Queenstown-Glenorchy Road / Oban Street,
- Mull Street / Glenorchy-Paradise Road,
- Glenorchy-Routeburn Road,
- Kinloch Road, and
- Routeburn Road.

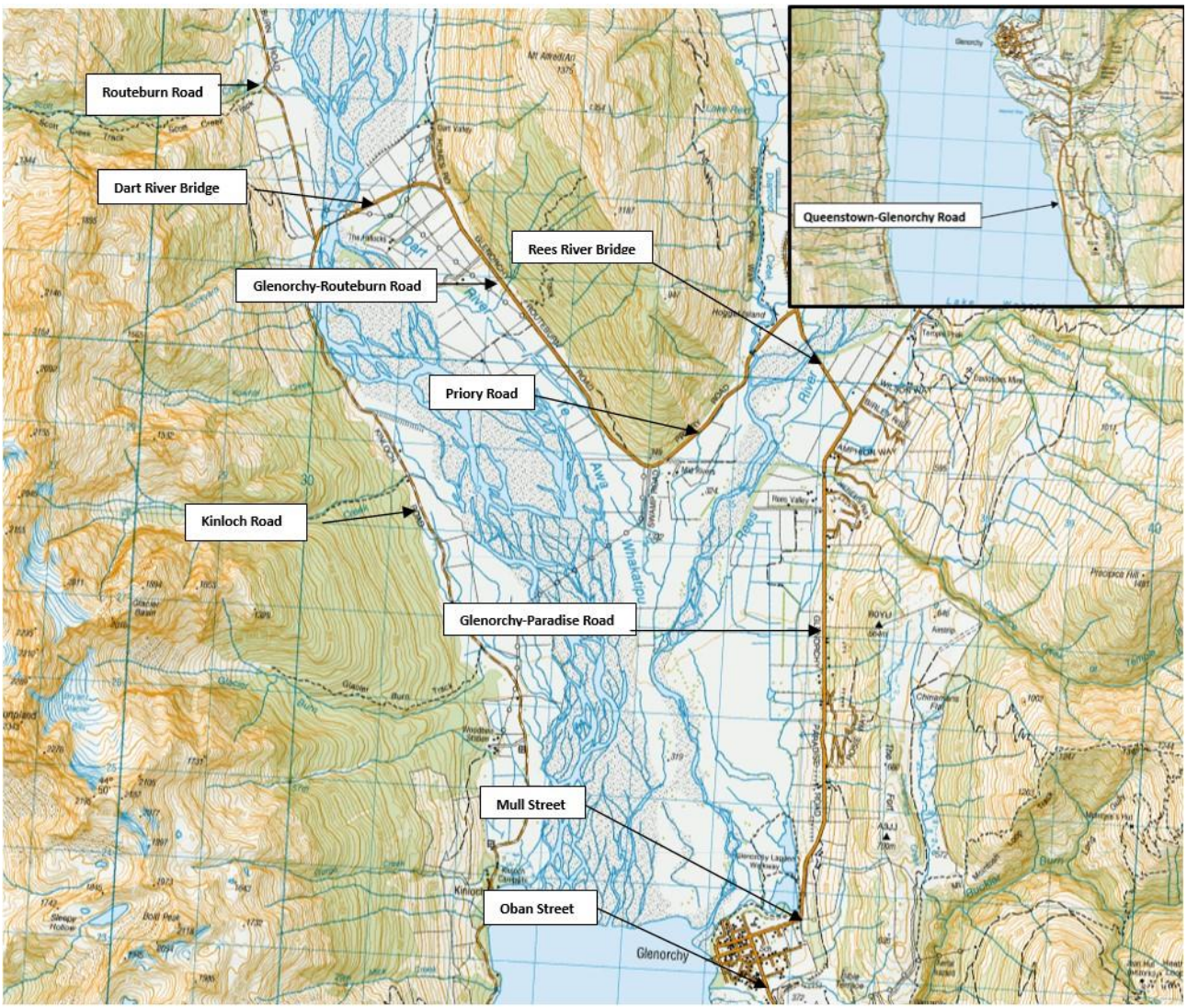


Figure 5-14: Local road network. Source: (NZ Topo Maps, 2023)

The Glenorchy-Queenstown Road is a particularly important road, as it provides the only road access in and out of Glenorchy. The community therefore relies heavily on the Glenorchy-Queenstown Road to access goods, services, employment, education, recreation, and health care outside the area.

Approximately 82% of business survey participants indicated that their business is dependent on the ability to transport people and/or resources into and/or out of the Head of the Lake, of which 66% were dependent to do so weekly. Figure 5-15 below provides a summary of what business survey participants are reliant on accessing outside the Head of Lake Whakatipu area. Participants that selected “other” cited services, parts and fuel.

What business survey participants said they are reliant on accessing outside of the Head of the Lake

Figure 5-15: Business survey response to "what are you reliant on accessing outside the Head of Lake Whakatipu area?"

25% of resident survey participants indicated that they travelled outside the Head of the Lake several times a week, 50% weekly, and 25% fortnightly. Figure 5-16 below provides a summary of the reasons why resident survey participants travel outside the Head of Lake Whakatipu area. 'Other' reasons included travelling to the Queenstown Airport, and for meetings.

The reasons why resident survey participants travel outside the Head of the Lake

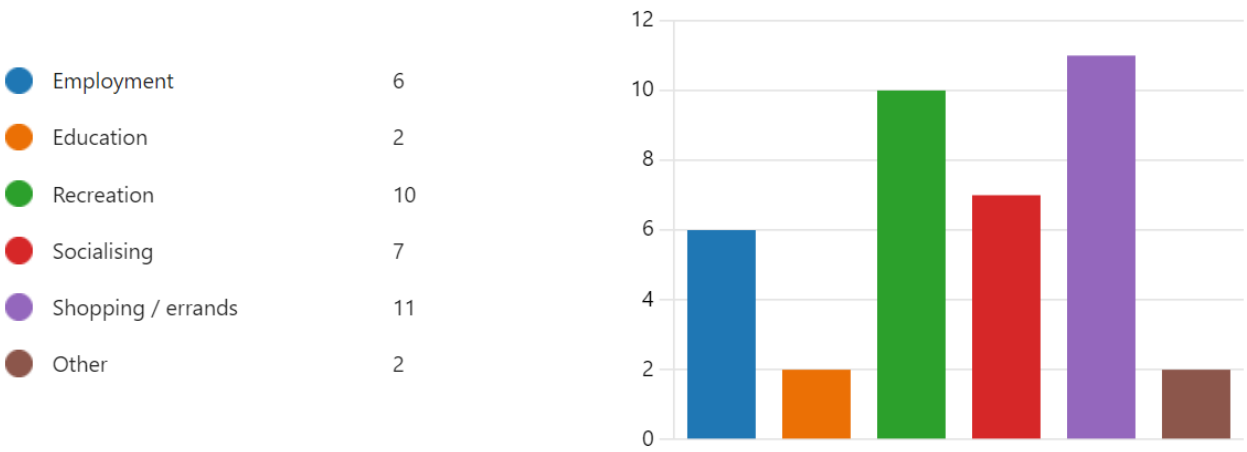


Figure 5-16: Resident survey response to "of the following, what do you and/or your household travel outside of the Head of Lake Whakatipu area for?"

In the last 10 years, the Glenorchy-Queenstown road's Average Daily Traffic[10] (ADT) ranged from approximately 705 to 5,650 (both lanes) (refer to Figure 5-17).

[10] ADT is the average 24-hour traffic volume at a given location for a period of time (e.g., a month, or a week, or several days).

Glenorchy-Queenstown Road - Average Daily Traffic (2013 - 2023)

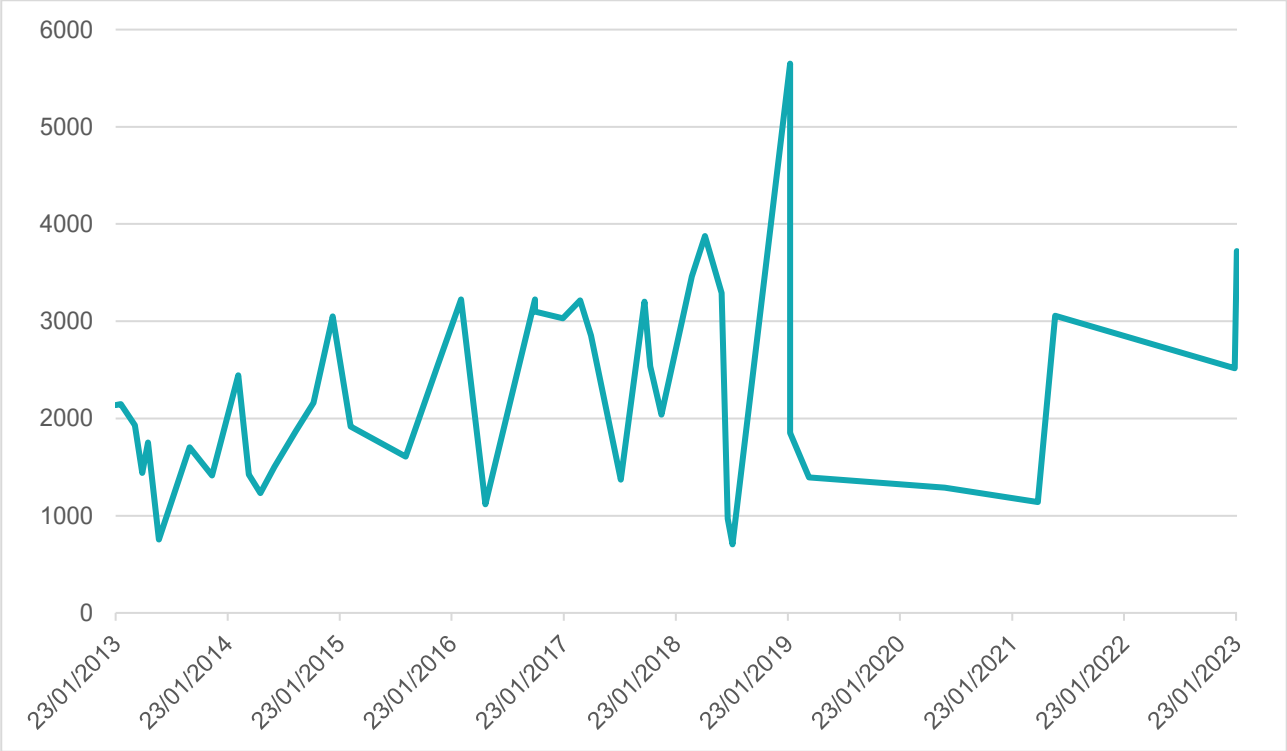


Figure 5-17: Glenorchy-Queenstown Road - Average Daily Traffic (2013-2023). Source: (QLDC, 2023c)

From discussions with research participants, the Glenorchy-Queenstown road is vulnerable to flooding. In these cases, the road can be closed for several days to clear debris. We were told that the road is also occassionally closed following vehicle crashes, other weather events (i.e. snowfalls), or for maintainance.

A number of research participants commented on the dangers of the Glenorchy-Queenstown Road. Anecdotally, there were a growing number of serious road crashes occurring on the road prior to the COVID-19 pandemic. These numbers slowed during the pandemic, but have anecdotally picked up again. This trend is evident in crash data for the Queenstown Lakes District (refer to Figure 5-18).

Crash Data for Queenstown Lakes District (2013-2022)

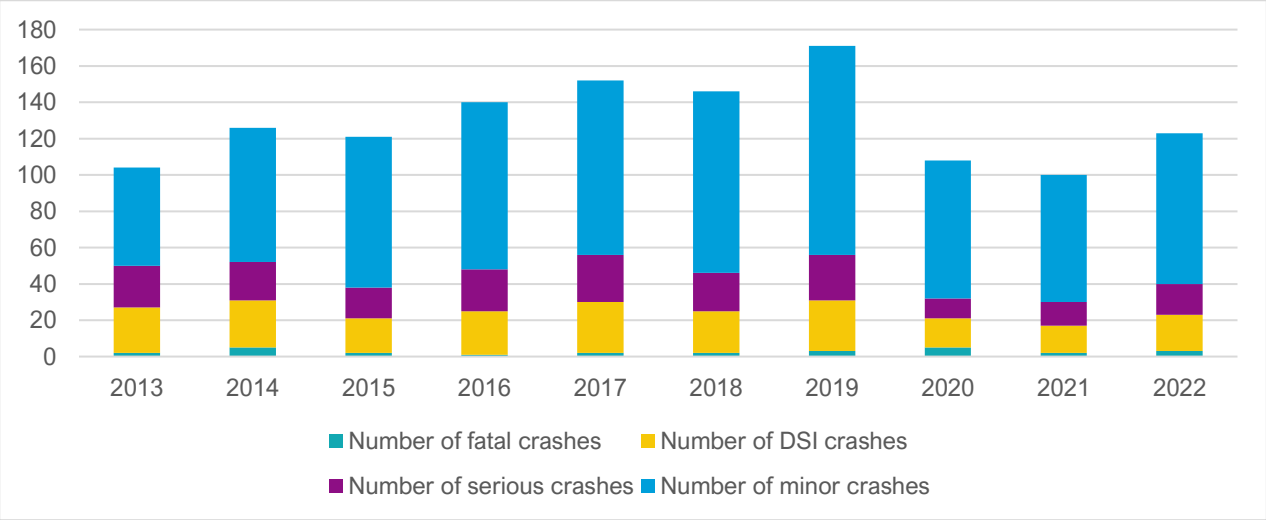


Figure 5-18: Queenstown Lakes District Crash Data. Source: (Ministry of Transport, 2023)

The Glenorchy-Paradise Road also provides an important link to people and businesses located in Paradise and the Rees Valley. It also provides access to Kinloch, and the Routeburn, Rees-Dart, Lake Sylvan, and Greenstone Caples tracks via the Glenorchy-Routeburn, Kinloch and Routeburn Roads, which are popular tourism and recreation destinations. In the last 10 years, the road's Average Daily Traffic (ADT) ranged from approximately 121 to 1,211 (both lanes) (QLDC, 2023c).

The Rees River and Dart River bridges are also important pieces of roading infrastructure, as these provide access to Kinloch and other locations on the west side of the Rees and Dart Rivers. From discussions with research participants, aggradation of silt and gravel beneath the Rees River Bridge is ongoing due to the high sediment supply from the catchment. Flooding has also been observed to flow over the approach roads (outflanking the bridge), so the bridge opening is only convey part of the flow at those times.

5.5.7.2 Power

Aurora Energy is the Head of the Lake's local electricity distribution company. Aurora Energy is partway through a large, five-year work programme investing over $500 million to upgrade the existing network in lake Whakatipu and Queenstown (Glenorchy Community, 2023). These new powerlines are intended to provide flood resilience due to stronger structures and will allow for increased electrical capacity for future growth.

As advised on the Glenorchy Community website[11]: *"With the many storms that come across the mountains, Glenorchy occasionally has power cuts. Keep a supply of candles, torches, kettle (suitable for gas or fire) and anything else you can think of that will make your time without electricity comfortable. Usually, the power is not down too long. To help preserve your cold and frozen foods, try not to open your fridge doors for longer than necessary."* (Glenorchy Community, n.d.)

5.5.7.3 Wastewater

Currently households across the Head of the Lake manage and treat their own wastewater at their properties.

[11] https://www.glenorchycommunity.nz/

5.5.7.4 Drinking water

There is town water supply and two large water reservoirs have recently been installed on Bible Terrace. Rural properties provide their own water supply.

5.5.7.5 Telecommunications

There are three telecommunication providers that service the Head of the Lake: Vodafone, Spark and Lakes Internet. The Glenorchy community website[12] notes the reliability of these services varies depending on what area you are living in (Glenorchy Community, n.d.). From discussions with research participants, it appears some residents have access to Starlink, which provides satellite internet access. Approximately 85% of the population have access to internet and 90% access to cellphones (StatsNZ, 2018). Approximately 3% have no access to communication systems (StatsNZ, 2018).

5.5.7.6 Emergency Services

Glenorchy has a Fire Station, volunteer Fire Brigade, Ambulance, and several St John's First Responders. Calling 111 will direct local help. The Fire Brigade and St John's volunteers attend regular training, usually in Queenstown but sometimes further afield.

Glenorchy also has a Community Response Group (CRG), which comprises a number of CDEM trained community volunteers, coordinated by an Otago Emergency Management Advisor (EMA). From discussions with research participants, the CRG's role is to provide information and support to the community whilst supporting Emergency Management Otago's official CDEM response. In a rapid-onset event, the CRG will provide quality local information to the EMA. During a slow-onset event, key information is likely to come from the EMA in the form of official assessments from regional and national sources.

In addition to emergency services and management, Glenorchy has several skilled volunteer Search and Rescue (SAR) personnel[13]. These people are part of the Wakatipu Area SAR team, which comprises Bush, Alpine Cliff Rescue, Avalanche and Wilderness Search dogs and Swift Water rescue teams. The team is managed by the NZ Police with assistance from NZ LandSAR volunteers. Helicopters are relied on for much of SAR's work in the area because of the mountainous and sometimes isolated nature of incidents.

Whilst SAR does not have national remit or funding to respond in natural disaster events, research participants advised that local volunteers typically respond anyway. SARs equipment can get damaged or contaminated in natural disaster events, however the repair and replacement of important PPE is not funded by local or central government due to the absence of a local or national remit to respond. This limits their ability to respond to future events. SAR volunteers are also not trained in natural disaster-related rescues, for instancefloods in urban areas. The research participants see SAR as an important part of any CDEM response, however there is nothing in place to formalise this. We are advised that this is currently being worked on between LandSAR and CDEM.

5.6 Economic overview

This economic overview primarily references Infometrics Quarterly Economic Monitoring data supplied by QLDC (Infometrics, 2023). This data source summarises a range of economic insights for the Queenstown Lakes District, including employment, spending, and GDP across the region. For clarity, Infometrics data for 'Glenorchy' is referenced as the Head of the Lake.

[12] https://www.glenorchycommunity.nz/

[13] It was noted in discussion with research participants that Glenorchy-based SAR skilled personnel are older, and no longer attend training.

Tourism spending[14] by sub-regions (Glenorchy being one of five sub-regions in the region) was supplied by Queenstown NZ (Queenstown NZ, 2023a). This has been used to disaggregate regional tourism estimates for the Head of the Lake, as the Infometrics data cited above does not include tourism statistics.

5.6.1 Employment

In 2022, an estimated 240 people were employed in the Head of the Lake (Infometrics, 2023). This figure excludes the tourism sector as tourism employment statistics were not directly available for the Head of the Lake. Using the proportional tourist spending activity within the Glenorchy sub-region relative to the Queenstown Lakes District, tourism employment for the Head of the Lake is estimated based on the total regional employment for the tourism sector[15]. In the Head of the Lake, there are approximately 149 people employed in the tourism sector. Employment over the past five years is summarised in Figure 5-19.

Estimated number of employees in the Head of the Lake 2018-2022

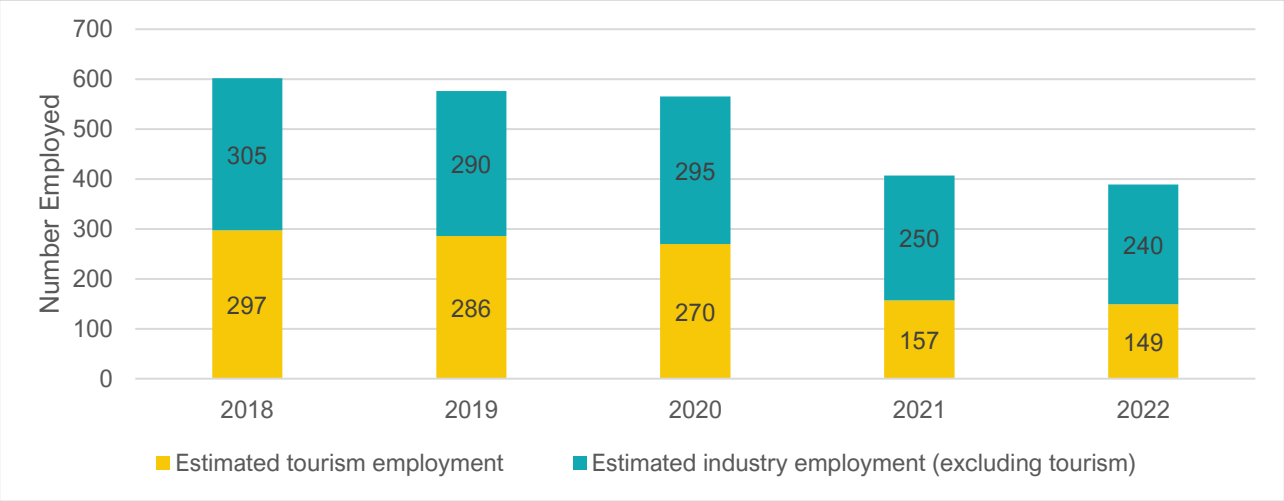


Figure 5-19: Estimated tourism and industry employment in the Head of the Lake. Source: (Infometrics, 2023; Queenstown NZ, 2023a)

As shown in Figure 5-19, tourism makes up a considerable proportion of employment in the Head of the Lake. The five largest employment industries (excluding tourism) are shown in Figure 5-20 (Infometrics, 2023). Accommodation and food service (hospitality) as well as arts and recreation services (primarily film production), also contribute significantly to employment in the Head of the Lake. Other key industries include farming and trades (i.e., transport equipment manufacturing and building construction) (Infometrics, 2023).

[14] Tourism spending by sub-region is based on transaction data.

[15] Tourism employment data for the Head of the Lake was not provided. Instead, tourism employment was estimated based on the proportion of tourism spending activity occurring within the Head of the Lake relative to the wider Queenstown Lakes District (Queenstown NZ, 2023a). This proportion was then applied to the tourism employment estimate for the Queenstown Lakes District (Infometrics, 2023).

Industry Contribution to Employment in the Head of the Lake in 2022

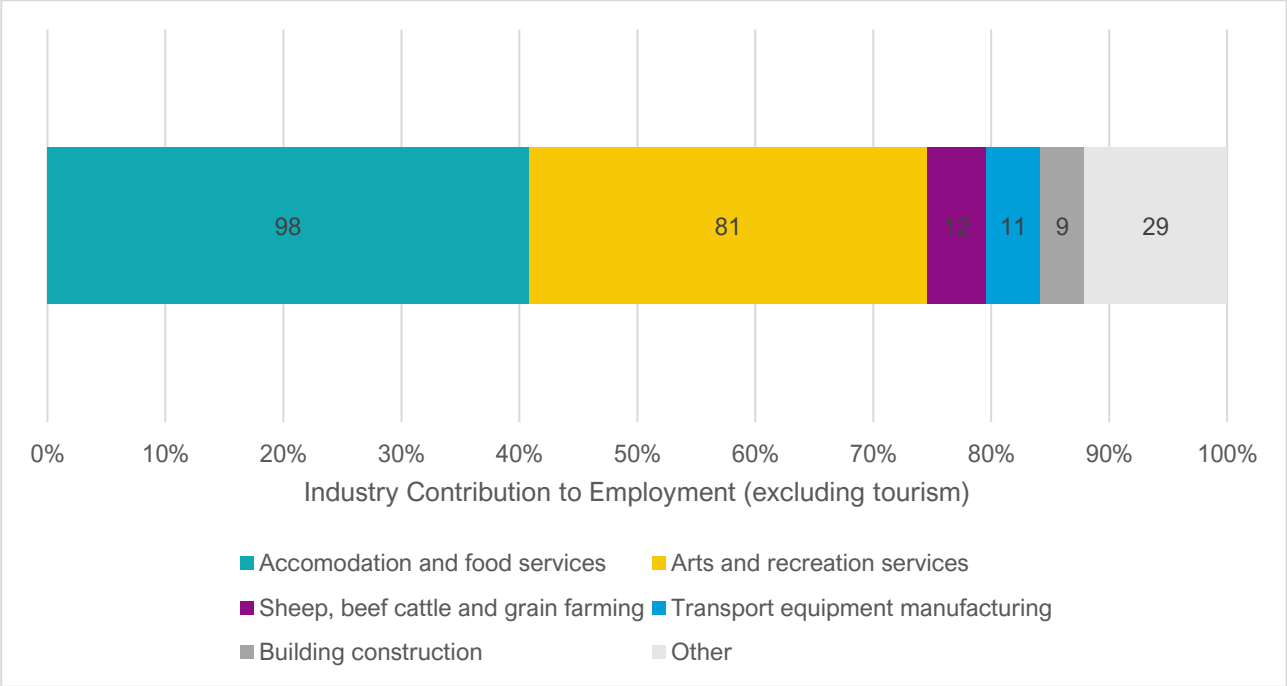


Figure 5-20: Estimated contribution to employment by industry (excluding tourism) in the Head of the Lake (Infometrics, 2023)

The New Zealand Census collects data per spatial area. For the Head of the Lake, the relevant spatial area is referenced as Glenorchy Statistical Area 2 (SA2). An outline of this area is provided in the 'People' section of this report.

As of 2018, approximately 70% of the population aged 15 years and older at the Head of the Lake are employed full time, 15% part time and 1.5% are unemployed (StatsNZ, 2018). 'Managers' made up the largest proportion of workers, followed by 'Professionals' and 'Technician and trade workers' (refer to Table 5-2 below).

The occupation profile of the area is reflected in the large proportion of people that work from home. 70% of resident survey respondents that were employed, indicated that they work from home some or all of the time. In discussion with residents, working from home or remotely has become more common in recent years.

Table 5-2: Occupation of Workers in Glenorchy. Source: (StatsNZ, 2018)

Occupation	% of the working population – Glenorchy Area
Managers	25
Professionals	15
Technician and trade workers	18
Community and service workers	12
Clerical and administrative workers	8
Sales workers	6
Machinery operators and drivers	5
Labourers	13

5.6.2 Income

As of 2018, the median income in the Head of the Lake was $38,000, which is higher than the median income of the Otago region ($30,000). However approximately 69% percent of residents aged 15 years and older in the Head of the Lake earn less than the New Zealand average ($49,000). 17.4% of the resident population aged 15 years and over earned more than $70,000, compared to 14.4% of the Otago region population (StatsNZ, 2018).

17% of resident survey participants indicated that their property generates a part of their income (e.g., from farming, horticulture, or providing accommodation). An additional 17% indicated that their property is their main source of income.

5.6.3 GDP

In the Head of the Lake, the local GDP for 2022 was estimated to be $42.42 million (Infometrics, 2023). The GDP per capita for 2022 was therefore approximately $75,735 NZD, which is consistent with the national average (Statista, 2023). Figure 5-21 compares the estimated GDP generated by the tourism industry[16], relative to all other industries for the past 5 years (Infometrics, 2023). This indicates the significance of the tourism industry to the Head of the Lake GDP.

Industry and Tourism Contribution to GDP in the Head of the Lake (2018-2022)

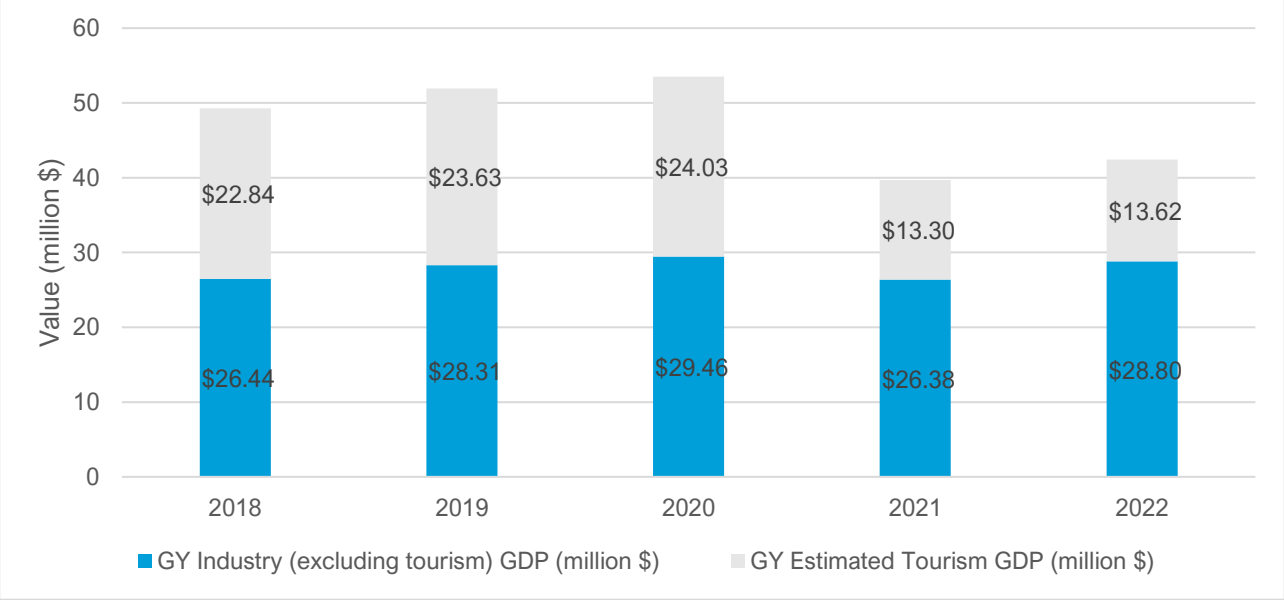


Figure 5-21: Head of the Lake industry and estimated tourism GDP (Infometrics, 2023; Queenstown NZ, 2023a)

The five largest GDP industries (excluding tourism) are shown in Figure 5-22 (Infometrics, 2023). These follow a similar pattern to employment, with key industries being hospitality, film, agriculture, and trade.

[16] Tourism GDP for the Head of the Lake was not provided. Instead, tourism GDP was estimated based on the proportion of tourism spending activity occurring within the Head of the Lake relative to the wider QLDC area (Queenstown NZ, 2023a). This proportion was then applied to the available tourism GDP estimate for QLDC (Infometrics, 2023)

Industry Contribution to GDP in the Head of the Lake (2022)

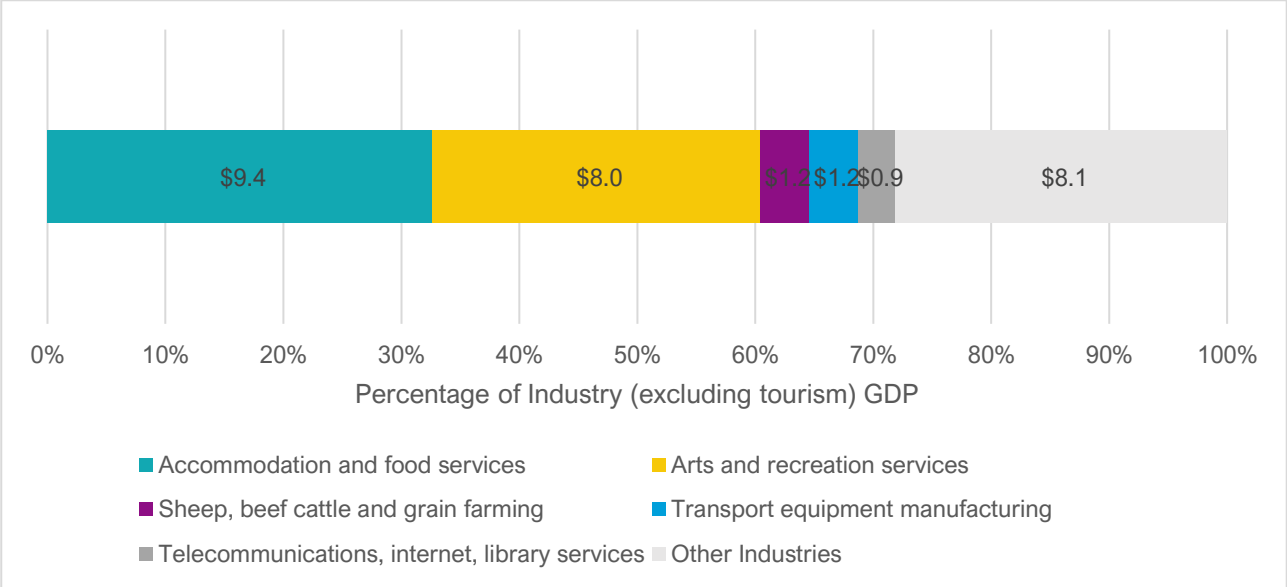


Figure 5-22: The Head of the Lake industry percentage contribution to GDP (excluding tourism) (Infometrics, 2023)

Research participants noted that spring and summer months are the busiest time of year for business whilst late autumn and winter is less busy.

5.6.4 Tourism

The Head of the Lake is a popular tourist destination that offers a range of activities for visitors to enjoy. Among these activities are jet boating, tramping (hiking), fishing, hunting, horse trekking, skydiving, farm tours, 4WD safaris, kayaking, scenic flights, photo safaris, and Lord of the Rings tours. Visitor numbers show that approximately between 300-800 people visit the Glenorchy township daily, while an additional 90-240 people visit the wider area within the Head of the Lake (e.g., Paradise, Kinloch, Routeburn) (QLDC, 2023a). Tourism operators in the Head of the Lake are based at the Head of the Lake, Queenstown, and further afield.

Many research participants voiced the desire for local and central government to acknowledge the Head of the Lake as an important location for the wider region (as a visitor destination).

From discussion with research participants, tourists are drawn to the pristine environment that looks "exactly like the set of the Lord of the Rings." The area also provides a beautiful backdrop for photos. For this reason, the Head of the Lake is a popular destination wedding venue. Hitched in Paradise, Paradise Trust, Blanket Bay, and Headwaters Eco Lodge are some of the operators catering to weddings in the area. One wedding vendor that was interviewed works with local celebrants, florists, and helicopter businesses to offer these services as part of its wedding packages.

Trekking and day walking are major activity attractions of the area:

- The Routeburn Track is a New Zealand 'Great Walk' which is accessed from the Head of the Lake. The Routeburn Track has three huts and two campsites, which must be booked well in advance during the Great Walks season. The Routeburn Track has approximately 20,000 overnight trampers per year. This excludes day visitors, which can reach 200 walkers per day over the height of the season from the entrance to Routeburn Flats (DoC, 2022).
- The Rees-Dart Track has three huts and sees approximately 1638 overnight trampers per year. It also attracts 10-20 day visitors per day (DoC, 2023).

- The Greenstone and Caples Tracks have three huts and see approximately 3861 overnight trampers per year. In high season, it also attracts 20-30 day visitors per day (DoC, 2023).
- Glenorchy day walks located close to town include the Glenorchy Walkway (5km loop), Whakaari Conservation Area (10km), and Mt Judah (6.6km). The Glenorchy Walkway sees approximately 22,000 day visitors per year (DoC, 2023).
- Lake Sylvan Track (5.3km), located slightly further from the township (22 km away), attracts 10,900 day visitors per year (DoC, 2023).

To facilitate hiking adventures in the region, there are several transport providers operating in the area that provide transportation to/from walking tracks.

5.6.5 Film

The Head of the Lake is a popular filming location for the Queenstown Lakes District's film industry. From discussions with research participants, there are not many film businesses located in the area, however a lot of film activity occurs in Glenorchy and surrounds. Arcadia Station, Paradise Trust, the Rees Valley, and locations in the Glenorchy township (e.g., the jetty and waterfront) are particularly popular filming locations.

In the last year, there were approximately 129 productions in Queenstown Lakes District. This included a mix of television content, feature film content, TV commercials, documentaries and more (QLDC, 2023d).

From discussion with research participants, most production teams are based in Queenstown, so rely on travelling in and out of Glenorchy, using the Glenorchy-Queenstown Road. However, some production teams base themselves in Glenorchy temporarily, and therefore rely on local accommodation.

5.6.6 Hospitality

Hospitality is one of the largest industry employers in the Head of the Lake, in 2023 there were 98 people employed in the industry (Infometrics, 2023). This is shown as employment for 'accommodation and food services' in Figure 22. In addition, hospitality generates approximately $9.4 million in GDP for the Head of the Lake (excluding tourism) (refer to Figure 22) (Infometrics, 2023).

Short-term accommodation providers are located across the Head of the Lake, including the Glenorchy Hotel, Glenorchy Motel, Mount Earnslaw Motel, Headwaters Eco Lodge, Glenorchy Lake House, the Great Glenorchy Alpine Base Camp, Mrs Woolly's Campground, and Kinloch Wilderness Retreat.

At the time of writing, there are several bars, restaurants and cafes in Glenorchy, including Mrs Woolly's, Mr Glens Tapas and Tap House, Queenies Dumplings, the Trading Post, and the Glenorchy Hotel Pub. The Great Glenorchy Alpine Base Camp also takes external bookings for their communal style dinners. Outside of the Glenorchy Township, the Kinloch Wilderness Retreat also has a restaurant.

5.6.7 Agriculture

Whilst many research participants described the Head of the Lake as 'rural', less than a third (approximately 27% of households: 80 households) in the Head of the Lake are located outside the Glenorchy township (QLDC, 2023a). Based on discussions with research participants and site visits, the majority are either countryside living (large residential lots) or lifestyle properties which do not rely on agriculture as a primary source of income. Farming in the area is predominately high-country station farming consisting of cattle and sheep farming, either in the beef and lamb industry or the wool industry. From discussions with research participants, there are six stations in the Head of the Lake. These stations are a mix of family and iwi owned stations. From discussions with research participants, many of the family-owned stations have been owned by the respective family for multiple generations. Most stations have diversified in some way, mostly in the

hospitality or tourism industry whether that be tours, accommodation (very few) or providing a venue for tourist activities.

Farming represents 5% of industry employment in the Head of the Lake (excluding tourism), as indicated in Figure 22. As discussed with research participants, these are largely family operated cattle and sheep farms that do not have high staffing requirements throughout the year. Instead, contract workers are used for seasonal tasks such as shearing and lambing. Approximately 4% of the Head of the Lake's GDP ($1.2 million) is produced from the agriculture industry (excluding tourism) (refer to Figure 22) (Infometrics, 2023).

5.6.8 Trade

From discussions with research participants, there are a variety of trades people operating or employed within the Head of the Lake, or who travel to Queenstown for trades work. There is a steady stream of new builds in the area including the recent residential development of Alfred Terrace. Approximately 29 industry jobs are attributed to construction in the Head of the Lake (refer to Figure 5021). GDP produced by trades is reported as part of the $8.1 million GDP for the Head of the Lake attributed to "other industries" (refer to Figure 22).

6 Natural Hazards

This section is largely a summary of the data collected through interviews and focus groups, supplemented by desk-top research where required.

6.1 Community experience of natural hazards

The Head of the Lake is at risk of several natural hazards, including seismic and flooding hazards (Tonkin & Taylor, 2021). The natural hazardscape at the Head of the Lake is illustrated in Figure 6-1).

In the last 30 years, there has been three notable flooding events: the 1994 Race Day flood, 1999 flood, and 2020 Rees/Dart River flood. Climate change is expected to exacerbate the consequences of flood events due to increased rainfall. NIWA forecasts a significant rise in the mean annual flood in parts of Otago, with projections suggesting a potential 50-100% increase by the century's end under a representative concentration pathway (RCP) 8.5 scenario[17] (NIWA, 2019).

[17] RCP 8.5 is a scientific scenario that models a future characterised by exceptionally high greenhouse gas emissions. It envisages a trajectory where reliance on fossil fuels such as coal and oil continue unabated, and efforts toward adopting renewable energy solutions are minimal.

Figure 6-1: Head of the Lake natural hazardscape. Source: (MacKenzie, 2023)

6.1.1 2020 Rees/Dart River Flood

The Rees/Dart River flooded on February 3rd and 4th, 2020. According to a report by Gardner (2022), the wetland area at the Head of the Lake filled and overflowed the Glenorchy stopbank near its eastern end, resulting in flooding of the northern part of Glenorchy township.

Residential areas at the northern ends of Oban and Argyle Streets, as well as parts of Butement Street, were affected by the flooding. This inundation led to damage and required precautionary evacuations of several houses. Landslides forced road closures and roads washing out across the Head of the Lake including the Queenstown-Glenorchy Road.

Based on discussions with research participants, the 2020 Rees/Dart River flood was a good test of the emergency management system. The community largely self-organised, as demonstrated by the following quotations.

> *"Emergency services were half an hour ahead of everyone because they had already received information and acted"* – *Research participant*

> *"A natural hierarchy kicks in"* – *Research participant*

Figure 6-2: Aerial image of the February 2020 floods, taken prior to the maximum floodwater extent at about 6:30pm of 4 February 2020. Source: Luke Hunter (Done Rite Contracting)

6.1.2 1999 Flood

In November 1999, a period of prolonged heavy rainfall resulted in extensive flooding across Otago, Southland, Canterbury, and the West Coast. This event led to high lake levels in Lake Whakatipu, causing significant inundation in the Glenorchy township. The floodwaters also resulted in road damage that isolated Kinloch from Glenorchy (NIWA, 2018). Based on discussions with research participants, this resulted in the flooding of some homes in the township. The community helped affected households with sand bagging and moving furniture.

6.1.3 1994 Race Day Flood

In the 1994 Race Day flood, a significant amount of rainfall resulted in widespread flooding as several streams burst their banks, and the lake levels rose. This led to flooding of some areas along the lakeside. Over 400 individuals had to be evacuated by boat back to Queenstown for their safety (NIWA, 2018b).

Based on discussion with research participants, the flooding was quite sudden and caused a lot of damage due to the amount of debris. The Glenorchy-Queenstown Road was also washed out in several places and closed for a month. Research participants recalled how the community shared supplies and supported one another during this time. According to research participant, DoC initiated the emergency management

response, however DoC's time was quickly absorbed responding to bridges that had washed out on the DoC tracks.

6.1.4 1999 Flood

In November 1999, a period of prolonged heavy rainfall resulted in extensive flooding across Otago, Southland, Canterbury, and the West Coast. This event led to record high lake levels in Lake Whakatipu, causing significant inundation in the Glenorchy township. The floodwaters also resulted in road damage that isolated Kinloch from Glenorchy (NIWA, 2018a). Based on discussions with research participants, this resulted in the flooding of some homes in the township. The community helped affected households with sand bagging and moving furniture.

6.1.5 2020 Rees/Dart River Flood

A Land River Sea Consulting Ltd report outlines the most recent flood event in the Rees/Dart river area, which occurred on the 3rd and 4th of February 2020 (Gardner, 2022). During this event, the wetland area filled and overtopped the Glenorchy floodbank near the eastern end, leading to floodwaters flowing into the recreation grounds.

Residential areas at the northern ends of Oban and Argyle Streets, as well as parts of Butement Street, were affected by flooding. This inundation led to damage and required precautionary evacuations in several houses. Significant rainfall forced road closures due to landslides and roads washing out across the Head of the Lake including the Queenstown-Glenorchy Road. Based on discussions with research participants, the 2020 Rees/Dart River flood was a good test of the emergency management system. The community largely self-organised, as demonstrated by the following quotations.

> *"Emergency services were half an hour ahead of everyone because they had already received information and acted"* – *Research participant*
>
> *"A natural hierarchy kicks in"* – *Research participant*

6.2 Existing natural hazard mitigation and preparedness

There are several emergency management response personnel, plans and processes in place to increase community preparedness and resilience to natural hazard events at the Head of the Lake.

6.2.1 Personnel

Key emergency management personnel for the Head of the Lake include:

- the Otago Emergency Management Advisor for the Queenstown Lakes District - this person is responsible for CDEM in the Queenstown Lakes area, including the Head of the Lake. The EMA's primary objective is to increase social and economic resilience in the community.
- The Glenorchy Community Response Group (refer to 'Services and amenities' section for further detail)
- Emergency Services personnel (e.g., Fire Brigade, St John's, Police).

6.2.2 Plans

There are two key emergency management documents for the Head of the Lake in place:

- The Emergency Management Otago Glenorchy Community Resilience Guide (currently in draft)

- The Community Response Plan (not public facing[18]).

6.2.2.1 Emergency Management Otago Glenorchy Community Resilience Guide for Glenorchy

The draft Glenorchy Resilience Guide (the Resilience Guide) supersedes the Glenorchy Community Response Plan (CDEM, n.d.). The draft Resilience Guide outlines the specific natural hazards in the Head of the Lake area and provides resources and information to help the community prepare for, respond to, and recover from natural hazard events. It also considers the specific needs and vulnerabilities of the community at the Head of the Lake. This includes a template to help households plan for natural hazard events.

The goal of the Resilience Guide is to strengthen community resilience by managing risks, being ready to respond to and recover from emergencies, and by enabling, empowering, and supporting individuals, organisations, and communities at the Head of the Lake to act for themselves and others, for the safety and wellbeing of all.

6.2.2.2 Community Response Plan

The Community Response Plan (CRP) was developed in September 2022 by the Glenorchy Community Response Group (CRG) in conjunction with Emergency Management Otago. This builds upon the Glenorchy Resilience Guide, to specify the pre-determined Action Plans around which the immediate community response will be based. Action Plans for five different hazards (flooding, earthquake, wildfire, extreme weather event, landslip) have been developed and rehearsed by the CRG in conjunction with Emergency Management Otago and other agencies, including local emergency services. Each Action Plan describes actions for Emergency Management Otago, the CRG, emergency services, and affected community members (if necessary). The CRP has been developed primarily for the use of the Glenorchy Community Response Group and Emergency Management Otago. As it contains personal contact information, it is not public facing.

6.2.2.3 Civil Defence Emergency Management Centres / Community Emergency Hubs

As outlined in the Community Resilience Guide, a Civil Defence Centre / Community Emergency Hub may be set up by the community to support those who have been affected by an event. It is a place for the community to come for information, reassurance, to have a hot drink, and to meet with each other and talk. A Community Emergency Hub is:

- Entirely owned and led by the local community within guidelines set by Emergency Management Otago.
- Community resourced
- Local community focused
- In communication with the local Emergency Operations Centre or Incident Control Point
- Not for overnight stays
- Run by members of the community.

There are two locations at the Head of the Lake where a Community Emergency Hub has previously been set up: Camp Glenorchy and Glenorchy Primary School. In discussions with the community, it was learned that Camp Glenorchy is a certified 'Living Building', which means it meets very high sustainability standards. Notably, it utilises solar panels, and has a sophisticated onsite energy and water management system which assists the building in using 50% less water and energy than other similar facilities. The facility is also built to withstand a magnitude 8 Alpine Fault earthquake and has enough food and resources to accommodate 100 people for a couple of weeks. For these reasons, Camp Glenorchy is considered an incredibly valuable

[18] The Community Response Plan has been developed primarily for the use of the Glenorchy Community Response Group and Emergency Management Otago. It is therefore not public facing as it contains personal contact information.

community resource. It is currently held in the Glenorchy Community Trust, which is directed by local community members.

6.2.3 Processes

Based on discussions with research participants, there are several processes in place to manage natural hazard risks in addition to the personnel and plans outlined above:

- 'Otago Gets Ready' emergency alerts – community members can sign up to emergency alerts
- lake and river level monitoring
- road and river maintenance, and
- reactive repair.

The DoC also has processes in place to manage natural hazard risks for tourists / visitors. From discussions with research participants, the DoC closely monitors weather and has closure plans for a range of natural hazards (e.g., rain, wind). If a closure plan is triggered, websites and signage are updated, and people are flown out of DoC tracks by helicopter if there is damage to bridges. In a significant event, the DoC's focus is to get tourists and visitors out of the community as quickly as possible, so not to deplete local resources.

6.3 Community perceptions of natural hazard risk

A range of data was gathered as part of this assessment to help understand the vulnerabilities and resilience of the community at the Head of the Lake.

6.3.1 Understanding of risk

From discussions with research participants, residents generally have a good understanding of natural hazards in the area. Several research participants noted that people "choose to live in the community" and that the risks "come with the territory". This was a common theme raised by research participants; whilst residents are aware of the risks, it was something that they accepted about living in the area.

The top risks to individuals/households identified by resident survey participants were financial risks, loss of access (i.e., to resources, medication, health care), loss of shelter and utilities, loss of life, damage to property, halting of farming and business operations and loss of employment.

The top risks to businesses identified by business survey participants were financial risks (e.g., loss of potential customers and revenue), loss of access to people and/or resources outside the Head of the Lake, loss of access to/from Kinloch, damage to property and equipment, loss of fuel, loss of telecommunication (i.e., to communicate with clients), and reduction in property values.

A number of research participants expressed an understanding that if there was a large event that affected the region (e.g., an Alpine Fault earthquake), the community could be without any external support for an extended period of time (i.e., a week or longer). If the community was to be 'cut off' for an extended period, 27% of resident survey participants thought this would have impacts on their lifestyle / enjoyment life, 20% thought it would have financial impacts, and 13% thought it would impact their health and wellbeing. 40% thought this would have little impact on them/their household.

Of the business survey participants that indicated they are dependent on transporting people and/or resources into and/or out of the Head of Lake, 75% said that their business could not operate and/or would cease to function. One business survey participant said that they could possibly operate out of Queenstown, as they have access to a helicopter.

6.3.2 Preparedness

When asked what they do to prepare, or what plans they have in place for natural hazard events, discussions with research participants were mixed. Some research participants were highly prepared and self-sufficient with back-up generators, radios, solar power supply, and 2-3 weeks of food supplies. Others expressed a desire to be prepared but lacked the motivation or financial resources to set themselves up (i.e., invest in an emergency kit and back-up food supplies). This spectrum was reflected in the resident survey response. When asked what they do to prepare if they are aware a potential storm is coming, one resident survey participant shared that they have enough emergency supplies to last them 3-4 weeks, while another resident survey participant talked about shopping for food in case the Glenorchy-Queenstown Road was closed. The range in levels of preparedness was also evident in discussions with Glenorchy School students.

Comparatively, business survey participants said they prepare for a storm by monitoring the weather, rainfall, and lake and river levels closely and make a call on the day whether or not it is safe to operate. They also ensure batteries are fully charged, move livestock, send staff home (if it is safe to do so), warn their customers and drivers, cancel/postpone/refund customers, and stock up on supplies. One business survey participant said that they have an inhouse procedure in place to prepare for such events.

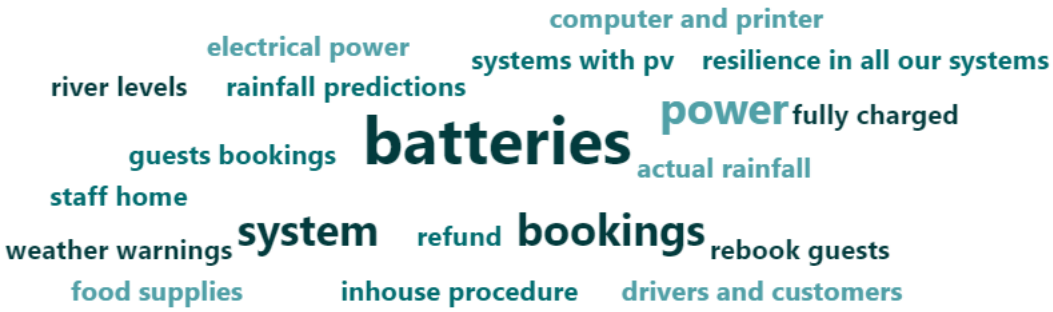


Figure 6-3: Response to business survey question "If you are aware there is a potential storm coming, what does your business do to prepare?"

6.4 Community perceptions of resilience

6.4.1 Community resilience

Our discussions with research participants suggest that the Head of the Lake is a very resilient community.

> *"The community is very resilient; it has gone through some tragedies, and pulled together" – Research participant*

This is reflected in the most recent QLDC Quality of Life Survey results, whereby Glenorchy participants were more likely than any other sub-community in the QLDC area to state that their neighbourhood is prepared for an emergency. Notably, a large proportion of Glenorchy participants indicated that they had joined a community response group (55%), had an emergency plan (73%), and had an emergency kit (67%), compared to 3%, 35%, and 55% of Queenstown participants respectively (Versus, 2024).

Practically, the Head of the Lake has a wide range of assets that they could draw upon in a natural hazard event. These include but are not limited to the assets listed in Table 6-1 below.

Table 6-1: Community assets described by research participants

Asset	Examples
Transport	The lake / water transport – provides an alternative travel route to transport people and resources in/out of Glenorchy. As well, a large number of households also own boats. Helicopters – provide access to remote locations and an alternative means of transporting people and resources in/out of Glenorchy Horses
Flood mitigation	The Golf Course The Glenorchy-Rees floodbank
Alternative energy sources and supplies	Camp Glenorchy Smithy's fuel tanks Food sources (e.g., vegetable gardens, orchards, home kill, fish) Diverse heat sources (e.g., solar) Starlink
Storage space (e.g., for furniture)	Community Hall
Emergency services and skills	Community Response Group Fire Brigade St John's First Responder
Equipment	Machinery Tools (e.g., chainsaws) Rifles Walkie talkies / radios
Social cohesion	Community clubs/organisations/networks
Diverse knowledge and skills	Understanding of the local environment Diverse set of practical skills (e.g., earthworks, hunting)

The community also has a diverse array of skills, and this was highlighted by several research participants as a strength of the community.

> *"Some are good at leading and mobilising others, and other are good at getting stuff done..."* – *Research participant*

> *"It's amazing how many resource and talent thats in it [the community]"* – *Research participant*

The community also has regular power outages, and it appears from our discussions with research participants that residents have adapted to this reality. Many households have back-up generators and wood burners. However, it was noted by some research participants that some of the newly built homes only have heat pumps, therefore would be less resilient depending on the time of the year.

Socially, research participants recalled many times where the community "rose to the occasion" during periods of difficulty and/or isolation.

> *"Glenorchy has a strong and deep community network that is easily called upon in emergencies."* – *Research participant*

As discussed in the 'Community' section of this report, the Head of the Lake has a strong community, whereby everyone comes together and "chips in" in difficult times. In most discussions with research participants, people expressed confidence that the community would pull together and help each other in a natural hazard event. Based on discussions with research participants, locals also have a good understanding of who is most vulnerable or who would need checking on in an emergency. Some locals also have unwritten agreements with neighbours to pool together their resources and live together if they were to become isolated, or if one of their homes were unliveable and they had nowhere else to go.

One research participant talked about the inherent resilience of the community because of where it is located. This was echoed by several other research participants that believe part of the reason why many people move to the area/live in the area is because of its isolation and the particular lifestyle this requires. Others commented that this was likely more a sentiment of older generations, or people who had lived in the area for a long time and had an understanding of what it meant to live in a small, isolated community.

> *"The older generation are very pragmatic about resilience. They understand they are a rural community at "the end of the line", therefore they have to have a certain level of resilience".* – *Research participant*

From discussions with research participants, people that have lived in the community for a long time tend to monitor the weather (e.g., forecasts, lake and river levels) and know when or at what stage they need to take action. In comparison, some research participants expressed concern that newcomers to the community (including visitors and people that stay in the area temporarily) do not understand the risks or are apathetic about the natural hazardscape.

> *"Longer-term residents have demonstrated worry and a sense of responsibility to "school up" newcomers on resilience".* – *Research participant*

Whilst some research participants were confident in people's ability to look after themselves, others thought some parts of the community would require support (refer to 'Vulnerabilities' section of this report). For this reason, some research participants were hesitant to label the community as "resilient" because they believed the community would require support, particularly in the medium-long-term following an event (i.e., when resources were exhausted). Others acknowledged that the community was growing and changing, therefore, things that worked in the past may not work in the future.

> *"Sometimes if you present as resilient and self-sufficient, authority presume you will be fine but that is not necessarily the case"* – *Research participant*

6.4.2 Tolerance

Research participants were asked questions to understand their tolerance of natural hazard events, in terms of what they would need to remain functioning or in place to remain living in the community.

The level of tolerance varied among research participants, however most expressed that they would remain in the community for as long as they feasibly could.

> *"I'd stick around – I'm entrenched in this place"* – *Research participant*

> *"As long as there are still people here, and two thirds of the dwellings are still habitable, I would say we would probably stay put."* – *Research participant*

For some, tolerance would depend on the availability and access to key infrastructure and facilities, such as the Glenorchy School and gas/fuel. For example, children staying connected with other children and being able to play sport oustide the community and connect with other schools in the district (e.g., cross-country, camping) was viewed as important by one research participant.

"It would be important to us later that the school is operating" – *Research participant*

Access to medication and health care was also highlighted by some research participants as important. In a similar vein, several research participants highlighted the importance of moving around the community to access or share resources.

If people lost their homes, one research participant commented that the cost of housing would mean that many people in the community would have to leave the Head of the Lake to source affordable housing (i.e., many long-term residents bought their homes 20 years ago). On this topic, several research participants said they would be open to relocating somewhere else in the community if they had to (i.e., if their home was no longer liveable) and it was made possible. However, from discussions with research participants, there not a lot of viable land to build on. In this sense, one research participant commented that people's tolerance would depend on the certainty and timing of options in relation to housing. Others expressed concerns about the impact that "splitting up" the communtiy would have on social cohesion and community-spirit.

Business owners and operators that participaed in the research expressed little tolerance for medium-long term impacts. As summarised in the 'Utilities' section, many businesses are dependent on transporting people and/or resources into and/or out of the Head of Lake, therefore an extended road closure would impact their ability to operate in the area.

> *"After a month, I would have to find resources to get into town so that the business could continue operating"* – *Research participant*

Simialrly, some research participants seemed to think people could 'get by' financially in the short-term following a natural hazard event, however in the medium-long term, people would need an income stream to afford to remain living in the community.

6.4.3 Vulnerabilities

Based on discussions with research participants, there are several vulnerable sectors of the community:

- **The high-needs community**. Those with mental health challenges, or without adequate resources or plans in place to prepare for and recover from a natural hazard event. This part of the community is mostly likely to rely on other members of the community.
- **Tourists / visitors to the area**. This part of the community would require shelter, resources, and transport out of the area *"…getting tourists and visitors [out of the area] will be the first priority"* – *Research participant*
- **People with multiple low-level, low-income jobs and unemployed**. This part of the community may need support to afford to remain living in the community.
- **Temporary workers**. Those who have short-term jobs in the Head of Lake and are newer/temporary members of the community.
- **The older population**. This part of the community may need support to evacuate their homes safely and are more likely to require health or medical care.
- **Young children and families that do not have wider family in the area**. This part of the community may require support (e.g., physical, economic, mental/emotional).

Several research participants also expressed concerns about the breadth and depth of emergency services personnel in the area. Specifically, research participants were concerned that the people with specialist skills would be spread thin in an emergency. Similarly, one research participant commented on the risk of volunteers "burning out". It was also highlighted that key emergency infrastructure such as the Fire Station and St John's ambulance are located in an area highly susceptible to liquefaction and flooding, which places this service, and communities' access to this service, at risk in these events. From discussions with research

participants, Camp Glenorchy gives many locals confidence in the resilience of the community (assuming this resource is not depleted by tourists / visitors).

7 Wider region dependencies

7.1 Economic

Both domestic and international visitors to the Queenstown Lakes District are arriving with the expectation of an outstanding natural environment and scenery. Visitors seek opportunities to experience the region through recreational and tourism activities.

Carlaw et al. (2018) undertook an analysis to quantify the economic benefits generated by international visitors to the Queenstown Lakes District. This found that tourism to Queenstown Lakes District generated $632 million in GDP. Employment sustained in the district as a direct impact of tourism, was estimated to be 8,600 FTE. This is a significant proportion of international tourism GDP nationally. Carlaw et al. estimated tourism in the Queenstown Lakes District to generate 75% of the national tourism total GDP ($845 million) (Carlaw et al., 2018). Tourism in Queenstown is therefore not only important to the region, but the national economy.

Glenorchy has long been a popular attraction for visitors wanting to explore the natural landscape. Approximately 28% of domestic visitors and 32% of international visitors arriving in Queenstown also visit Glenorchy (QLDC, 2023a). Without access to the landscapes and activities available in areas such as Glenorchy, Queenstown would likely be less attractive to tourists. The prosperity of the region both economically and environmentally, and the sub-areas within it, are therefore highly dependent on one another.

There are several tourism businesses located in Queenstown, which operate in the Head of the Lake. From discussions with local businesses, these include large tour and transport operators, and some wedding vendors. From discussions with a small sample of businesses operating within Glenorchy and Queenstown, most rely on the Glenorchy-Queenstown Road to access the Head of the Lake. However, few businesses have access through water transport. Most operate in all seasons and weather, but do not take risks if it threatens the safety of their staff and customers.

7.2 Social

Some Queenstown residents and tourist operators are dependent on the Head of the Lake as the location of their job, or the location or their business operations. Other industries that work in the Head of the Lake but are based elsewhere include the film industry, wedding industry, construction, logistics and local and central government departments.

Some residents of Queenstown and the wider Otago region have family members located at the Head of the Lake and are therefore dependent on access to and from the Head of the Lake for social connection. Particularly, many older members of the Head of Lake community move to Queenstown, or other locations in Otago, when they require easier access to amenities such as health services. These people often have family members and friends located back in the Head of the Lake community.

Around 27% of dwellings in the Head of the Lake community are unoccupied (StatsNZ, 2018). These are likely to be either holiday homes or part-time residences, which are likely owned by families in the Otago region or further afield, including overseas.

8 Exploring current resilience under natural hazard scenarios

8.1 Indicative natural hazard scenarios (specified by Otago Regional Council)

In this section of the report, the social and economic impacts of three indicative natural hazards scenarios are assessed to better understand the resilience of the Head of the Lake community to potential natural hazard events under 'status quo' conditions. 'Status quo' conditions refer to both the current community, and the natural hazard management measures currently in place (such as emergency management and the existing floodbank).

To enable this assessment to explore the potential social and economic consequences of natural hazard events at the Head of the Lake, ORC provided three indicative scenarios based on available science and information at the time the SEIA was commissioned. The three scenarios pertain to:

1. A major Alpine Fault earthquake
2. A major flood event
3. Repeated, moderate flooding events.

The three scenarios provide context to assess the potential social and economic impacts of a major earthquake[19] and flooding events, and moderate but repeated flooding events. Details of the scenarios which have informed this assessment are provided in Appendix E. The scenarios are descriptive (not predictive or associated with a specific likelihood).

Appendix E details the technical studies that the indicative scenarios have been based on.

As specified in Chapter 3, more detailed qualitative and quantitative natural hazard risk analysis is being undertaken by Beca Ltd in parallel to this SEIA. The risk analysis broadly considers the above hazards.

8.2 Status Quo – Vulnerability and adaptive capacity of community

This section assesses the current status of the community with regards to social and economic vulnerability and adaptive capacity. To achieve this, the current **exposure** of social and economic dependencies (e.g., homes, livelihoods and essential infrastructure) to natural hazards is considered. We then consider the existing social and economic **sensitivities,** and the Head of the Lake community's capacity to **adapt**/withstand an event (refer to the 'Socio-economic impact methodology' section).

8.2.1 Exposure

8.2.1.1 Direct exposure

Based on technical studies on the susceptibility of the Head of the Lake to natural hazards, it appears that the Glenorchy township is the most vulnerable in terms of the number of natural hazards it is exposed to (Tonkin & Taylor, 2023; Gardner, 2022; Gardner & Beagley, 2023). Depending on the severity of the flood, a proportion of houses in the Glenorchy township are likely be impacted by flooding (based on visual interpretation of modelled flood depths in studies by Gardner (2022) and Gardner & Beagley (2023)) (Gardner, 2022). Some houses on rural properties are on areas of higher ground, where possible. However, based on visual interpretation of the modelled flood depths in the Gardener (2022) and Gardner & Beagley

[19] The possible effects of an Alpine Fault earthquake include seismic shaking, liquefaction and lateral spreading.

(2023) studies, sections of these properties nearest the rivers may be inoperable until water resides, and debris is cleared. Properties where there are steep embankments may experience landslips as well.

Figure's 8.1 and 8.2 below show the modelled Rees/Dart Rivers and Buckler Burn 100-year ARI[20] flood depths, in relation to key community services and amenities in the Glenorchy township.

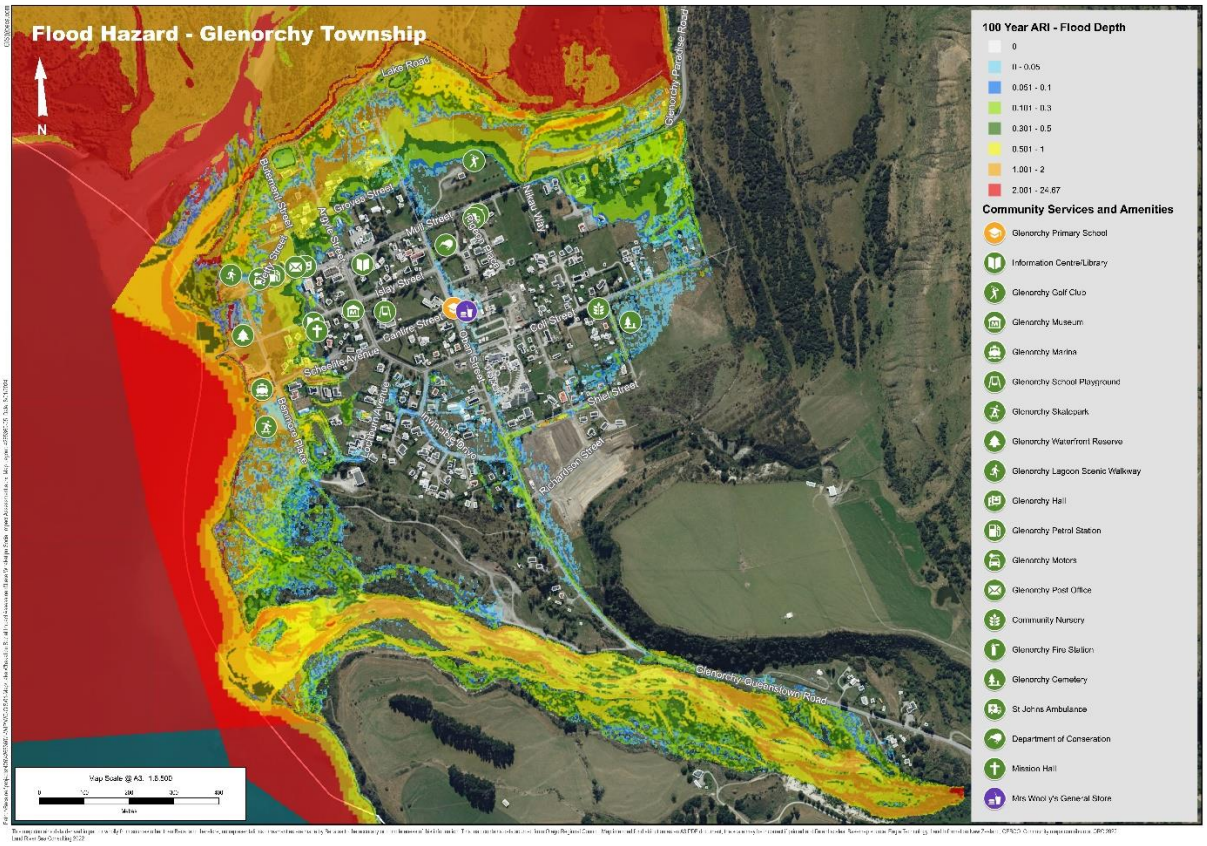


Figure 8-1: Rees/Dart Rivers 100-year ARI – Glenorchy Township (base map created by Beca Ltd, using flood hazard mapping from Land River & Sea (Gardner, 2022; Gardner & Beagley, 2023). Key community services and amenities have been added to the map for the purposes of this report.

[20] ARI is the acronym for 'Average Recurrence Interval'. ARI describes the probability of a flow of a certain size occurring once every 100 years on average.

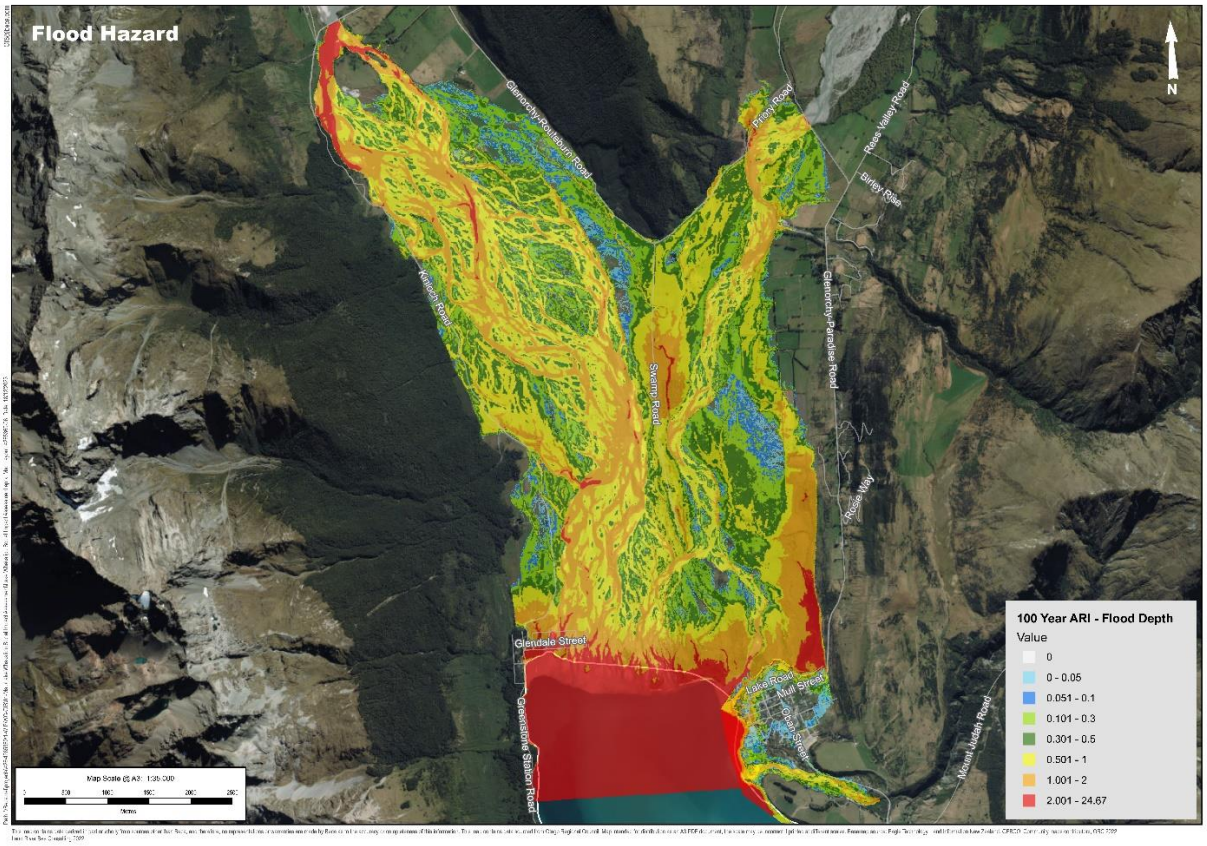


Figure 8-2: Rees/Dart Rivers 100-year ARI – Head of the Lake (base map created by Beca Ltd, using flood hazard mapping from Land River & Sea (Gardner, 2022; Gardner, 2023). Key community services and amenities have been added to the map for the purposes of this report.

Based on the study by Tonkin & Taylor (2023), it appears that a large proportion of the Glenorchy township would be vulnerable to liquefaction and lateral spreading following an Alpine Fault earthquake. The liquefaction and lateral spreading vulnerability of areas outside of the Glenorchy township is less known. Liquefaction and lateral spreading in these areas would likely depend on the shaking intensity experienced, ground conditions, and designs of buildings and infrastructure.

Figure 8.3 below shows varying zones of liquefaction vulnerability and lateral spreading ground damage, in relation to key community services and amenities in the Glenorchy township, It should be noted that the boundaries between the various zones are not precise and that areas of more or less damage could occur on either side of the boundaries.

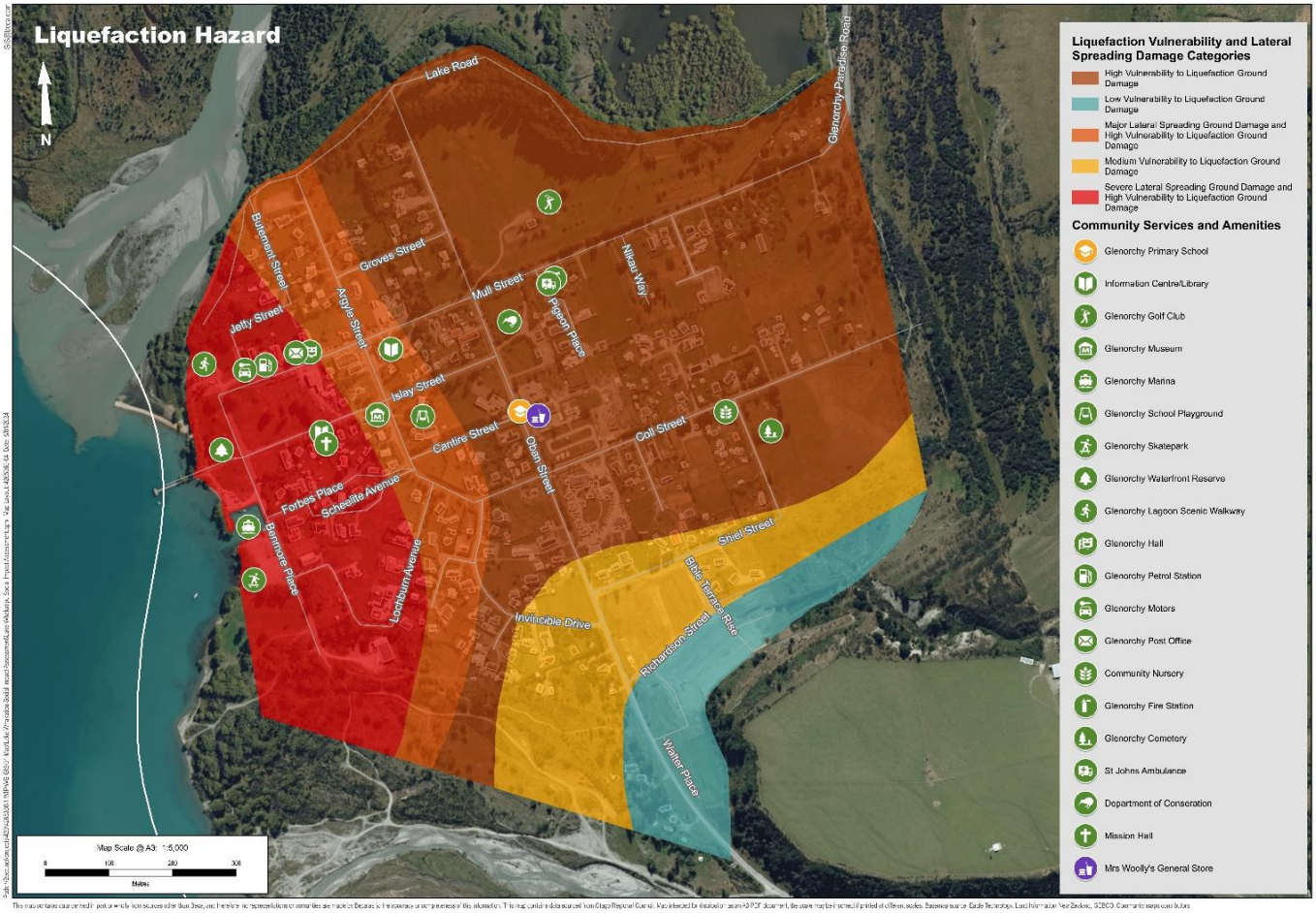


Figure 8-3: Liquefaction vulnerability and lateral spreading ground damage areas, in relation to key community services and amenities in the Glenorchy township (base map created by Beca Ltd, using liquefaction hazard mapping from Tonkin & Taylor (2023)). Key community services and amenities have been added to the map for the purposes of this report.

8.2.1.2 Indirect exposure

As described in the 'Utilities' section of this report, the Glenorchy-Queenstown Road is essential to the functioning and wellbeing of the Head of the Lake community. The community is dependent on the road to access goods and services (i.e., health, education), as well as employment, employees, and consumers of goods and services (i.e., to support local business). The Queenstown-Glenorchy Road is susceptible to damage from both flooding and a seismic event. The level of damage and therefore duration of road closure is likely to increase with the severity of the event both in terms of flooding and earthquakes.

Other roads and bridges are important to connect more isolated areas to the Glenorchy township and beyond (e.g., Mull Street / Glenorchy-Paradise Road, Glenorchy-Routeburn Road, Kinloch Road, Rees River Bridge, Dart River bridge). These are also susceptible to damage and inundation.

As described in the 'Utilities' section of this report, power supply has become more resilient in recent times and works are under way to improve the services. However, it is likely that power services would be compromised during a natural hazard event.

The water supply network in the Glenorchy township and the two reservoirs on Bible Terrace are susceptible to damage from an earthquake. Rural properties in the Head of the Lake provide their own water supply, and most are confident of water being available, based on discussions with research participants.

Currently households across the Head of the Lake manage and treat their own wastewater at their properties, and these wastewater supplies may be damaged during an earthquake.

8.2.2 Sensitivity

8.2.2.1 Social

As described in the 'Community perceptions of resilience' section of this report, there are several sectors of the community that are particularly vulnerable to natural hazards. Namely, the high-needs population, elderly, young people and families, tourists/visitors, people with multiple, low-level, low-income jobs, and temporary workers.

a. Age

From discussions with research participants, the youngest and oldest members of the Head of the Lake community are most vulnerable when facing natural hazards. In this area there are relatively small populations of younger and elderly people. With regards to elderly people, the demands of living in the Head of the Lake requires a level of health and mobility. This is due to limited health care, no formalised support services, no retirement facilities in the area, and the physical demands of the lifestyle. This is reflected in the statistics of the area with no one in the Head of the Lake aged over 65 reporting activity limitations (StatsNZ, 2018).

b. The high needs community

Members of the community without adequate resources or plans in place to prepare for and recover from a natural hazard event are also highly vulnerable to natural hazard events. Depending on the extent of damage / duration of road closures, this sector of the community is likely to rely heavily on local resources for support. Based on discussions with research participants, there are a large number of people in the community that hold down various, low-level, low-income jobs. Based on the latest Census data (StatsNZ, 2018), 1.5% of the population at the Head of the Lake are also unemployed. This sector of the community may also need support in the form of employment or financial support to afford to remain living in the community.

c. Tourists/visitors

Similar to the high-needs community, tourists/visitors are likely to rely heavily on local resources for support in a natural hazard event (e.g., food, shelter, transport). Depending on the extent of damage / duration of road closures, this sector of the community may need to be accommodated within the community for an extended period, until they can be transported out of the area.

d. Health and disability

Again, the demands of living in the Head of the Lake requires a level of health and mobility. These demands are likely to increase in a natural hazard event, therefore those with a high level of physical health needs and disability are likely to be vulnerable. There are currently relatively low levels of physical limitations and disability reported in the community (2.6%) (StatsNZ, 2018). Children aged 5-15 years of age reported the highest levels of physical limitations and disability. The reason for why this group has a higher level of physical limitations and disability is unknown, but a possible explanation could be that one might not choose to move to the area if they have mobility limitations. However, if born into the area with family connections and support this may be more sustainable. It would be more difficult for those who wish to live independently.

As outlined in the 'People' section of this report, there are few statistics reported for health. However, research participants noted that mental health was as concerns for members of the community. One reason given was that the Head of the Lake attracts people hoping to escape the 'rat race' and recover from the mental demands of a busy urban lifestyle, as well as those seeking a more solitary lifestyle. Another reason

given was that living in the area can be socially isolating, which can take a mental toll on people, and the Head of the Lake does not currently have programmes in place to identify these issues early and provide primary care.

Of note is that the Head of the Lake community is a small community and often people “wear many hats”. In a natural hazard event, these people would be susceptible to high levels of fatigue from trying to address both their household and community’s challenges.

Economic

e. Income

Based on the 2018 Census results, there is a large range of incomes in the Head of the Lake (StatsNZ, 2018). Based on discussions with research participants, many residents have a more subsistence or transient lifestyle, taking casual employment where required and living in mobile or rented accommodation. On the other hand, some residents are extremely wealthy. These people often identify the Head of the Lake as their second home or part-time residence, with many being based overseas.

f. Reliance on single industry

As referenced in the ‘Economic overview’ section of this report, the Head of the Lake’s economy is driven largely by tourism (Infometrics, 2023). The next largest industries, being hospitality and film production, are also highly dependent on one another. Based on discussions with research participants, film production generates more tourism in the area (e.g., Lord of the Rings) and depends on hospitality to house and service workers. Similarly, hospitality and tourism operators depend on each other to attract visitors. A business operator interviewed as part of this research commented that, *“People expect things to do when they get here”.* While this dependency is economically beneficial, it leaves the community vulnerable to external fluctuations, such as visitor numbers, infrastructure, and natural resources.

g. Reliance on visitors

Changes in visitor numbers has considerable influence over the community's economic stability. Figure 8-4 shows the reduction of visitor spending in the region (Queenstown NZ, 2023a) as a direct consequence of reduced visitor numbers during this period[21]. This figure shows how post the Covid-19 pandemic in 2020, a reduction in visitor numbers causes reduced visitor spending in the area. The impact of reduced visitor numbers causes large financial pressure on both the local economy and people’s livelihoods. Section 5.6 shows how the number of employees (Figure 5-19) and GDP (Figure 5-21) in the Head of the Lake declines in response to the reduction of tourism post Covid-19.

[21] Visitor numbers for the Head of the Lake was not directly provided. Instead, visitor numbers were estimated based on the percentage of domestic and internationals visitors in Queenstown that also visit Glenorchy (QLDC, 2023a). This percentage was then applied to the available visitor estimates for Queenstown (Queenstown NZ, 2023a).

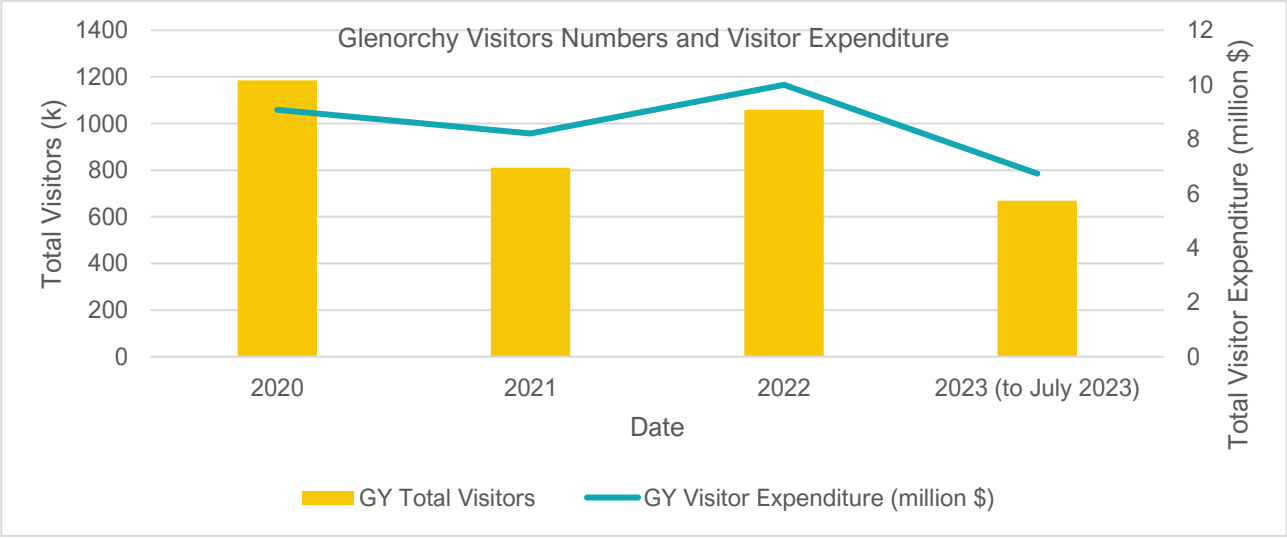


Figure 8-4: Glenorchy total estimated visitors (QLDC, 2023a) and visitor expenditure (Queenstown NZ, 2023a)

h. Reliance on built infrastructure

One of the largest challenges for the area is accessibility. As described in the 'Roads' section of this report, most businesses noted a dependency on roading and telecommunications for operations. For businesses in the tourism and hospitality industries, road closures would cause immediate loss of income. In addition, disruptions in telecommunications limits contact with tourists for bookings.

The Head of the Lake is particularly sensitive to closures along the Queenstown-Glenorchy Road, as this restricts vehicle access to the entire Head of the Lake community. Access may be possible during a natural hazard event by helicopter or boat if it is safe to do so, however based on discussions with research participants, the initial focus is likely to be on transporting tourists/visitors out of the area.

For other industries, operations can operate under disruptions for a short period as usual, unless damage to infrastructure is directly on their land/business.

i. Reliance on natural resources

Many businesses directly or indirectly depend on Head of the Lakes natural resources (e.g., mountains, lake, rivers, landscapes) for the operation of their businesses. Minor changes to the landscape and natural features, such as smaller slips caused by heavy rainfall, are unlikely to cause significant economic impact. For example, a 4WD tourist operator that was interviewed as part of this research noted that they frequently adjusted their operations to accommodate for minor changes to their route such as slips, treefall, and river widening.

On other hand, large-scale changes to natural features (e.g., large slips, widespread liquefaction) caused by natural hazard scenarios have the potential to be critical to all industries. Many tourism operators are dependent on the landscape directly, such as hiking services, land-based activities, and water-based activities. Wedding and film industries are also dependent on the natural features that the Head of the Lake is known for. Large changes to the natural landscape are therefore likely disrupt the operations of such businesses. In addition, tourists are attracted to the area for the beautiful scenery. Large-scale damage to the natural landscape could cause a decline in the area's attractiveness if sustained.

The agriculture industry directly depends on the land. Any damages to agricultural land, would put people's business and livelihoods at risk. As discussed in section 5.6.7, these are predominately high-country station farms. Given the size of these properties, there is more capacity for stock to be moved to undamaged pastures.

8.2.3 Adaptive capacity

This section considers the adaptive capacity of the Head of the Lake community from a social and economic perspective. Adaptive capacity can be understood as the capacity of a community to anticipate, cope with, and recover from the effects of a natural hazard event.

Social

a. Decision making and leadership

The Head of the Lake community has several governance structures in place for decision making and leadership (refer to 'Governance' section of this report). In regard to emergency management, leadership and decision making largely relies upon local volunteers. Namely, the Community Response Group (CRG), the volunteer fire brigade, and volunteer St John's first responders.

As outlined in the Community Response Plan, the CRG's role is to provide information and support to the community whilst supporting Emergency Management Otago's official CDEM response. In a rapid-onset event, the CRG will provide quality local information to the Emergency Management Adviser for the Queenstown Lakes District. During a slow-onset event, key information is likely to come from the EMA in the form of official assessments from regional and national sources. The Community Response Plan also provides guidance with regards to the responsibilities and actions of local emergency services.

In relation to preparedness and recovery, much of the community infrastructure in the Head of the Lake has been created as part of community initiatives and therefore may not have formal or legislative frameworks in place for the recovery and reinstatement of these services. These community-led initiatives give agency to community organisations, such as the Glenorchy Community Association, to be responsible for, and make decisions regarding the community in ways that they know best. Whilst this is a strength of the community, it possibly highlights the need for more formal arrangements for critical community infrastructure. Other community infrastructure and services such as education and emergency services will have organisational decision making and leadership processes in place in regard to the resilience of infrastructure.

b. Financial security

The capacity of the community to cope with economic crises and losses would be dependent on each household's/business's individual circumstances, which would be reliant on the level of damage to property, local and central government decision making, insurance, financial commitments, savings, and the household's/business's ability to continue to earn an income.

Research participants also expressed concerns around the impact of natural hazard information (such as Tonkin & Taylor's report (2022)) on property value, insurances, and investment in the area, and the potential for this to affect their financial security.

> *"While I agree that we should prepare ourselves for possible emergencies from natural hazards I am disappointed and angry that the ORC has publicised Glenorchy as a dangerous place to live. The impact of natural hazards fails in comparison to the damage done to property values and increase in building and insurance costs" – Research participant*

The average national personal income as of 2018 (when Census data was collected) was $49,000 (StatsNZ, 2018). As of 2018, approximately 69% of the Head of the Lake population earned below the national average personal income (StatsNZ, 2018). From discussions with research participants, most people seemed to think that people could 'get by' financially in the short-term (depending on the severity of the event and individual circumstances), however in the medium-long term, people relying on an active income (i.e., not retired) would need a secure income stream to afford to remain living in the community.

For local roles in the hospitality and tourism sectors, these are known to be (excluding managerial roles) lower paying jobs, and there is an element of seasonality and temporality to these jobs which would be most susceptible to economic impacts. When describing the various sectors of the community, research participants indicated that there is a sector of the community was described by a research participant as having a "mosaic of income sources", or multiple, low-level, low-income jobs. Those earning lower wages are likely to have less financial security both in terms of savings and insurances such as income protection.

> *"People cobble together what they can because they have to [in order to live in the area]"* – *Research participant*

As a community, a lot of local clubs and organisations are dependent on volunteerism and fundraising for resources. Whilst there are some funds held by the community from annual events for community projects this is a limited resource.

c. Food and water security

As outlined in the 'Preparedness' section of this report, the levels of preparedness in the community appear to be mixed. Most research participants spoke about having a backup of food supplies that were imperishable due to previous experience of power outages and road closures or weather conditions. Some thought they would have enough backup of food supplies to last 2-3 weeks and access to alternative power and water supply. However, others appeared to be less prepared. These research participants expressed a desire to be prepared but not the imminent urgency or financial resources to set themselves up.

The local water reservoirs and individual water supplies were considered by research participants to be resilient (this may require further assessment). With regards to water and food security some research participants expressed concerns around provisions for visitors who would not have additional food supply, and therefore be reliant on local supplies. Large venues such as Camp Glenorchy has enough food supplies and resources to cater to 100 people for a couple of weeks.

d. Housing security

At present, the majority of residents have access to basic amenities[22] (4% of the Head of the Lake population reported no access, or access to only one basic) (StatsNZ, 2018). This may be those members of the community living in vans and or unconnected tiny homes. In 2018, all homes had access to a source of heating (StatsNZ, 2018). From discussions with research participants, there are some people choosing to live in vans but no reports of homelessness.

An assessment of the resilience of the housing stock has not been undertaken in detail. From discussion with research participants, some residents are aware of homes in areas known to flood. Also, it was noted by research participants that Camp Glenorchy was built to withstand an earthquake and flooding and housed the community generator.

Many research participants spoke of having alternate power sources (such as generators or batteries), manual ways to heat their homes (fires) and ways to cook (gas barbeques). However, some research participants thought that some of the newly built homes in the area only had heat pumps (noting that some were designed to be heated passively).

[22] Data on 'access to basic amenities' was collected as part of the 2018 Census. 'Access to amenities' indicates what basic amenities (e.g., cooking facilities, shower or bath, and electricity) are available inside an occupied private dwelling. The amenities need to be in working order to be counted in the Census.

It is noted that a large portion of the houses within Glenorchy township are within a liquefaction risk area. Research participants spoke of the need to temporarily house visitors during a natural hazard event, but then to also make temporary accommodation available to local residents without shelter.

e. Social connectedness

It was acknowledged by research participants that as the community grows there are likely to be more people that lack local social connections or networks or are less known to the rest of the community. However, in general, our assessment is that this is a very connected community with many different clubs and organisations that bring the community together and can be mobilised to provide functions in a state of emergency. Due to the community's relative isolation and level of self-reliance on meeting community needs, local residents have formed community structures to fill the gaps and are used to coming together to address issues or achieve goals.

f. Knowledge, awareness and skills to face natural hazards

As described in the 'Community resilience' section of this report, the Head of the Lake has a comprehensive set of skills, knowledge, awareness, and assets that they could draw upon in a natural hazard event. From the young to the elderly, there is a high level of awareness of the environment and in particular the rivers in terms of how they morph and change over time, water levels, and subsequent flooding risks.

> *"You can see climate change if you are connected to nature….you can't live here and not be aware of it…you need to be attuned to it" – Research participant*

Whilst there also seems to be a reasonable level of understanding with regards to earthquakes and the fault systems, and the more recent information of lateral spread and liquefaction, there was a sense among research participants that seismic events are more difficult to anticipate and prepare for.

Most research participants appeared to be very knowledgeable in terms of the potential risks of the different river systems and patterns of flooding. In terms of skills to face natural hazard events, research participants spoke of different phases of hazard response including preparedness, the emergency, and the recovery. In regard to preparedness, people spoke of different preparedness activities such as having designated community members who check river levels and plans to move household goods/stock from specific houses/properties if certain risks are evident. This was recounted by both school children and adults. People also spoke of having food and water supplies, alternate power and heating sources, and being aware of their property vulnerabilities.

In terms of an emergency, research participants spoke of being evacuated where necessary, having access to alternate forms of transport (i.e., boat and helicopter), and checking on neighbours. People also identified who would coordinate the emergency management response, who was more vulnerable and living alone, and the ways they would communicate with others. They spoke to the skills and resources of the community in self-managing and having access to heavy machinery to move debris and clear essential pathways.

g. Economic

From discussions with research participants, local business owners and operators are aware of the vulnerability that their geographical location, and reliance on tourism, puts them in. Our assessment is that the business community is highly resilient and do their best to balance the economic benefits of tourism and the landscape, with their way of life and need for economic stability. The businesses community also actively seeks sustainable operations to mitigate risks and ensure resilience in the face of challenges.

As outlined in the 'Sensitivity' section of this report, economic activities in the community are highly reliant on natural resources, critical infrastructure, and access points to wider region, leaving it highly vulnerable to natural hazard events. The immediate aftermath of a natural hazard event is likely to result in disrupted operations, limited mobility, and economic setbacks, therefore the community's ability to adapt in response to

a natural hazard event in the short-term is limited. In the long-term, there lies the potential for adaptation through the development of resilient infrastructure and operations.

9 Assessment of potential social impacts

Refer to Appendix E for the details of the indicative natural hazard scenarios referred to in this chapter of the report.

9.1 Indicative Scenario 1 – Major Alpine Fault earthquake

9.1.1 Way of life

9.1.1.1 Way people live

Figure 8-3 from the Tonkin & Taylor (2023) report shows the vulnerability of the Glenorchy township to liquefaction and lateral spreading damage. Approximately 50% of Glenorchy township falls within 'high' liquefaction hazard vulnerability zones, and an additional 30% within 'major or severe lateral spreading damage' zones.

In this scenario, 50% of buildings within the 'high' liquefaction hazard vulnerability zone suffer severe damage, and 75-90% to buildings within the 'major or severe lateral spreading damage' zone suffer severe damage to the point of being impractical or uneconomic to repair (Tonkin & Taylor, 2023). Depending on the shaking intensity, some buildings will also be damaged by seismic shaking in this scenario. At Modified Mercalli (MM) VIII level, Type 1[23] buildings will be heavily damaged, and some will collapse. Type 2[24] buildings will be damaged, and some will partially collapse, while some Type 3[25] buildings will also be damaged.

Consequently, a number of residents within the Glenorchy township would need to make a decision about whether to repair their properties or relocate. Whilst this would be dependent on decision-making processes, many people would at least require temporary relocation. Whilst the Canterbury Earthquakes and the consequential approach to property damage (Te Ara, 2023) is an example in New Zealand, it is not determined whether this scenario would be applied to the Head of the Lake and would be dependent on the significance of the event and government decision making.

Under this scenario, properties outside the Glenorchy township may also be damaged.

Many residents' lives would be disrupted temporarily, as minor repairs are undertaken, and as decisions are made about the reinstatement of infrastructure. This would have flow-on effects on people's livelihoods, social networks, education and the feasibility of remaining in the community. The level of disruption would

[23] Buildings with low standard of workmanship, poor mortar, or constructed of weak materials like mud brick or rammed earth. Soft storey structures (e.g. shops) made of masonry, weak reinforced concrete or composite materials (e.g. some walls timber, some brick) not well tied together. Masonry buildings otherwise conforming to buildings Types 1 to 3, but also having heavy unreinforced masonry towers. (Buildings constructed entirely of timber must be of extremely low quality to be Type 3) (Geonet, n.d.).

[24] Buildings of ordinary workmanship, with mortar of average quality. No extreme weakness, such as inadequate bonding of the corners, but neither designed nor reinforced to resist lateral forces. Such buildings not having heavy unreinforced masonry towers (Geonet, n.d.).

[25] Reinforced masonry or concrete buildings of good workmanship and with sound mortar, but not formally designed to resist earthquake forces (Geonet, n.d.).

also depend on the availability of temporary accommodation in the community (whilst there are many accommodation and holiday homes in the area, availability would be dependent on how much damage they suffered) and in the longer term, the availability of alternate land to build on and houses to purchase.

Decisions around whether to remain in the community would likely depend on attachment to place, social networks remaining, ability to earn incomes, ability to be housed, roading connections and community infrastructure. Based on discussions with research participants, it is difficult for residents to anticipate these impacts and the consequential decisions they would make, as they are dependent on a plethora of things, including how many people are in their household and the needs of each member of the household.

9.1.1.2 Way people work

Disruptions to the way people work are also likely in this scenario, either as a result of damages to the environments (including buildings) where people conduct business, or to the roads which people rely on to access employment, employees, goods, services, and as consumers of goods and services (i.e., to support local business).

Following the Canterbury earthquakes, many people either lost their jobs or were forced to change their working circumstances (e.g., travel to different premises to work, etc.) due to damage to extensive damage to buildings (Potter et al., 2015).

The duration of disruptions to the way people work in this scenario would be dependent on the extent of damage to environments where people conduct business, such as tourist destinations. Duration could range from the day of the event, to a month, to a permanent disruption if business closure results in job loss. Following the Canterbury earthquakes, there was a sharp decline in the employment rate, with the employment rate falling from 67% in September 2010 to 63% in September 2011 (Potter et al., 2015). This compared with employment growth for New Zealand as a whole of 1.1% during the same period (StatsNZ, 2011). The workforce in the Head of the Lake may reduce significantly in this scenario, depending on how many residents remained in the area.

Other jobs may arise due to the recovery effort that a resident may be able to transfer to and businesses may be able to pivot to cater for the recovery effort. Following the Canterbury earthquakes, the number of people employed in the construction sector increased greatly, with demand particularly high for carpenters, joiners, painters, concreters, plasterers, and general labourers (Potter et al., 2015).

9.1.1.3 Way people recreate

Following the Canterbury earthquakes, some community facilities where people used to meet (e.g., cafes, libraries, marae, cultural centres, schools) were damaged and closed down or relocated. This included the closure of a number of sport and recreational facilities. Furthermore, earth movements caused the closure of a number of tracks and paths that had been used by residents for recreation in the Port Hills, and alongside rivers, parks, and beaches. The threat of earth movements such as slips and falling rocks remained high for an extended period due to on-going aftershocks, restricting the use of these recreational sites (Potter et al., 2015).

In this scenario, disruption to recreation in the Head of the Lake is likely to occur due to local road closure, closures of walking trails, suspension of tourist recreation activities, and damage to the natural environment including cracks on land. This would impact both the local and wider community who use the natural environment for recreation purposes. The duration of disruption to recreation could range from a few weeks to a few months, depending on the activity requirements and the extent of damage to infrastructure that the recreation activity is reliant on.

9.1.1.4 Way people educate

In this scenario, initial disruptions may occur for school students in the Head of the Lake due to local road closures and potential damage to school buildings. For example, some students may not be able to access school (primary or secondary) due to road closures and may temporarily require online alternatives. The viability of Glenorchy Primary School reopening quickly would depend on the level of damage to school buildings and essential infrastructure (e.g., roads, water, power). Fluctuations on the school roll as students move in and out of the area could further affect the school's viability for opening and remaining open.

Within three weeks of the February 2011 aftershock in Christchurch, 84% of school students in the greater Christchurch area were able to attend school. However, more than half of secondary schools were 'site sharing', to enable two schools to use one school facility every day. Over 12,000 school students left their school and enrolled elsewhere, including at schools outside the region (Potter et al., 2015).

If the population in the Head of the Lake declined significantly post-earthquake, the structure of Glenorchy Primary School may need to be re-evaluated to accommodate a smaller roll. Based on discussions with research participants, this may result in some families choosing to relocate for schooling purposes if the size of the school no longer meets their requirements (i.e., a larger social environment for their children). Some families may also consider temporarily locating in Queenstown for secondary education if social resources allow.

9.1.2 Community

9.1.2.1 Community character

In this scenario, there may be disruptions to community character in the Head of the Lake as a result of damage to historic buildings. Heritage buildings were particularly affected by the Canterbury earthquake aftershocks due to the large number of unreinforced masonry structures. The impacts of the damage to these buildings on the community and sense of local identity is evident in the highly debated discussions about whether or not (and if so, how) to restore the Christchurch Cathedral (Potter et al., 2015). It is likely that some of the historic character in the Head of the Lake would be compromised in this scenario, and it would be dependent on the extent of damage as to whether it can be restored.

As evident in many communities such as Christchurch, where major damage occurs as a result of an earthquake, the character of the area often evolves to reflect this point in time when major rebuild occurs. For example, Christchurch's Earthquake National Memorial was a key component of the Central Christchurch Recovery Plan.

The 'feel' of the community may also change in the Head of the Lake in this scenario, as people move out of the area, and the community experience's a large influx of outside input and increased building activity. In the immediate aftermath of the February 2011 Canterbury earthquake there were reports of tens of thousands of people leaving the city. For most people, this was a short-term response to an emergency, as families wanted time out from the aftershocks and from the damage to their homes and workplaces (CERA, 2015). Population loss is likely to unsettle the close-knit community character in the Head of the Lake, and quiet, independent, and isolated sense of place, particularly in the short-term.

9.1.2.2 Community services

Much of the community infrastructure in the Head of the Lake is located in the 'high' liquefaction hazard zones mapped in the Tonkin & Taylor (2022) report. Assessments of the resilience of key community assets (e.g., the school, emergency facilities) is required as these would be essential to the response and recovery of the community.

In this scenario, road closures may impact internal and external access to community services. Whilst many of the community services the community are reliant on are located outside of the community (e.g., the hospital), the services provided within the community are also important for community wellbeing (i.e., emergency services, health clinic), cohesion (i.e., community hall, primary school and library) and convenience (i.e., local gas station and groceries).

The Head of the Lake community is largely reliant on access to the wider region (e.g., Queenstown) to access employment, employees, goods, services, and consumers of goods and services (i.e., to support local business). Most research participants highlighted access both within the community and to Queenstown as was essential to remaining in the community following a natural hazard event.

Road closures within and to/from the community may also impact the ability for the community to assemble to respond to the emergency and/or delay emergency services coming in to assist. Communities in the districts most affected by the Kaikōura earthquakes experienced temporary isolation due to loss of road access (e.g., Kaikoura, Hanmer Springs). Access was only possible by air and sea due to damage to/from road and rail networks. (MCDEM, 2016). It is understood that there is both boat and helicopter resources that could be utilised in the Head of the Lake if required.

Many of the community services in the Head of the Lake are dependent on volunteers who may be personally impacted in this scenario. This could impact the ability of the community to respond to the earthquake. Based on discussions with research participants, it is likely that people would volunteer during an emergency if they are able to, however key members of the community may be forced to relocate (either temporarily or permanently due to damage to residences). As a result, voluntary emergency services (i.e., fire and ambulance) may become short staffed. The ability of the community to self-sustain in short-term would also depend on the number of visitors that need to be taken care of and the number of resources (both human resource and food and accommodation) that would be taken up. Based on DoC track numbers for walks in the Head of the Lake, there could be more than 250 day visitors on any given day, as well as a large number of overnight trampers.

9.1.2.3 Community cohesion

In the short-term, it is very likely that the community would come together to respond, and community cohesion would be very high. Longer term, the community would likely experience large disruptions to the way it operates and comes together. Cohesion would depend on the viability of community members to remain in the community, who is left, and their role in the community. Equally, if some local businesses close down permanently, this is likely to impact the way that the community functions, depending on the community's reliance on the business/service.

Canterbury residents reported that the earthquakes helped increase sense of community, and also contributed to improving social connectedness immediately following the earthquakes, however some community connectedness was also lost as a result of people being forced to leave their homes and relocate to other areas within or outside the region (Potter et al., 2015).

The Head of the Lake community has historically been smaller and 'more remote and rural', however the makeup of the community it is likely to undergo significant changes, as other communities suffering earthquakes have. Following the Canterbury earthquakes, the proportion of children and young people leaving Christchurch city was estimated to be higher than it was for other age groups. This was a result of families with young children leaving the city and the outflow of students choosing not to return to Christchurch to study (Potter et al., 2015).

It is likely some key roles in the Head of the Lake community may need to be reallocated, and how the community performs certain roles may need to be re-evaluated. This may be difficult if population numbers decline, and key people leave the area.

Based on discussions with research participants, leaving the Head of the Lake is not an option for some community members due to attachment to people and place, and these people would adapt as required. For other community members, the decision would depend on the futures they can envision for themselves and/or their families, and the availability of the required resources and incomes sources.

9.1.3 Political systems

Much of the appeal for many people living in the community is the ability to make decisions for themselves and actions these. To demonstrate this, one research participant said, "If we want something to happen in the community, we do it ourselves as we cannot rely on it being provided for us" .The initial emergency response would likely be a combination of local decision making by the Community Response Group and wider CDEM support. In the longer term, a lot of the decision-making would be dependent on local and central government, and insurance companies. For a community that prides itself on independence and managing things for themselves, there is likely to be a high level of unrest at this stage, as residents would have limited ability to influence decision-making processes. Processes to facilitate both local decision-making, and expedience of local and central government decision-making would help facilitate the community's recovery. One research participant commented that people's tolerance of the living environment following a signficiant natural hazard event would depend on the certainty and timing of options in relation to housing.

9.1.4 Environment

In this scenario, the amenity and quality of the surrounding environment would depend largely on the extent of debris, cracks, liquefaction ejecta and landslips in rural areas and water ways. The amenity of the Glenorchy township would depend on the state of built infrastructure and essential infrastructure such as water supply and wastewater. In addition, sewage could cause an environmental issue if septic systems are damaged.

Damage to critical tourism infrastructure following the 2016 Kaikoura earthquake hampered the recovery of tourism businesses in Kaikōura (Stevenson et al., 2017). Uplift of the coastline resulted in shallowing of the marina and channel area, which stopped whale-watching and dolphin encounter business activity. The inability to provide these experiences had negative flow-on consequences for other tourism and hospitality operators in the township (Stevenson et al., 2017). The ability of locals and tourists to regain access to the Head of the Lake in this scenario would depend on the quality (i.e., required clean up), safety to access, and ability to access tourist and recreation destinations.

9.1.5 Health and wellbeing

In this scenario, the extent of physical injuries in the Head of the Lake would depend on what hazards people are exposed to during the earthquake (e.g., falling objects, landslips). Health may also be temporarily compromised due to damage to sewage systems and contamination of drinking water.

The ability to provide aid to people would depend on the availability of local ambulance officers and access roads around the community being open. Access around the community to check on vulnerable members of the community would be very important. Under this scenario, the community would require medical supplies and services to be flown in while the Glenorchy-Queenstown Road is closed.

Beyond the potential injuries from the event, fatigue would likely be a significant issue. Key members of the community that are part of emergency response services, or response efforts (e.g., operating machinery to clear debris) are most likely to experience fatigue, as there would likely be a high level of reliance on these members of the community. However, this impact would depend on the level of response required, and the

rest afforded to these community members. Outside services would need to relieve community members and provide substitution for key activities.

Essential health services are located in Queenstown or beyond and would need to be provided for. Stress (including financial stress) is likely to exacerbate physical and mental health needs and access issues, and fatigue may make accessing required services more difficult in the short-term.

Following the Canterbury earthquakes, health and welfare services were highly sought after for assistance with general stress symptoms (particularly immediately following the earthquakes), hyper-vigilance and anxiety. In 2012 (following the September 2010 and February 2012 earthquakes), Cantabrians reported suffering moderate or major distress related to aspects such as loss of facilities (34%), on-going aftershocks (42%), dealing with insurance issues (37%) and making decisions about damage, repairs and relocation (29%) (Potter et al., 2015).

Unlike the communities impacted by the Canterbury earthquakes, Kaikoura residents could not move in and out of the region freely, if at all following the 2016 Kaikoura earthquake. This meant that one of the major coping and mitigating factors reported for those involved in the Canterbury earthquakes; the ability to leave the area for respite, was not available for residents in the Kaikōura District (Johall et al., 2015).

9.1.6 Personal property rights

In this scenario, a large proportion of properties, particularly in the Glenorchy township, are likely to be damaged. An initial response would likely be an assessment of the habitability of these buildings and classification ‘stickering’ which indicates the safety of the building for occupation. This approach was taken to buildings damaged in the Hawkes Bay floods and Canterbury earthquakes. During the Canterbury earthquakes, owners could accept either a buyout of their properties from government agencies or negotiate with their insurer (Te Ara, 2023). However, under the current legislation, any buyout process following an earthquake event in the Head of the Lake would be reactive and ad hoc. A similar buyout process to that observed in Christchurch would remove homeowners’ personal property rights, including their ability to make decisions regarding their property. As observed during the Canterbury earthquakes, the process was slow and tedious, and displaced residents for an extended period. However, this process has since been streamlined to improve customer service (EQC, 2021). The potential impacts in this scenario would likely depend on the decision-making processes adopted for the Head of the Lake, and none have been predetermined at this stage. The expedience and communication of a process would be key to providing homeowners with certainty. Pre-determined alternative options for relocation may also assist in provided a wider range of options for landowners.

9.1.7 Fears and aspirations

Due to the uncertainty and predictability of an Alpine Fault earthquake, research participants expressed fears mainly in relation to houses prices, insurances, and perceptions of the community as being an unsafe place to live. However, some research participants expressed fears about how the community would manage in an earthquake event, and the viability, health, sustainability and vibrancy of their community following an earthquake event. Adaptation has the opportunity to address some of these fears and increase community resilience.

The documented vision for the Head of the Lake community is:

> *“A unique, inclusive community that fosters and embraces individuality, diversity and innovation, encourages resilience and promotes community vitality and collaboration. The Glenorchy community has a collective strong voice that advocates for positive change.*

Glenorchy has the infrastructure to support a thriving boutique local economy in keeping with the rural landscape, actively respects and enhances the natural environment, collectively works towards providing their own resources (self-sufficiency)."

Whilst research participants did not express aspirations for major growth or development in the community, people expressed a desire for progression and prosperity, which could be affected by an earthquake event.

The impact of this scenario on this community aspiration is largely unknown, however there is likely to be impacts on community cohesion, infrastructure, and the natural environment. The extent of these impacts would likely depend on the scale of damage, community transitions (members moving to and from the community) and the recovery process.

9.2 Indicative Scenario 2 – Major Flood

Some of the potential social impacts of a major flooding event would be similar to a Magnitude 8 Alpine Fault Earthquake event (Scenario 1). To avoid repetition, this section references the Scenario 1 assessment (refer to section 9.1) where similarities are anticipated, and highlights any differences including the likely extent, severity and duration of impacts.

9.2.1 Way of life

9.2.1.1 Way people live

In this scenario, disruptions to the way people live are likely. Specifically, impacted households may need to temporarily evacuate and access to essential infrastructure (e.g., water, power, telecommunications) is likely to be compromised. As well, road closures would impact daily routines due to loss of access within and to/from the community. These impacts are likely to be short-term (i.e., one to two weeks), and most houses would be able to be repaired depending on the extent of the damage, and the timing of governmental decision making and insurance processes. During this time, some locals may need to be temporarily housed in the township or local accommodation providers.

Depending on advanced warning, the time of year, and the time of day, visitors/tourists to the area may be able to be evacuated prior to the flooding event. Some visitors/tourists may need to be temporarily housed in the township or local accommodation providers (as evidenced in the 1994 Race Day floods). If local accommodation providers are at capacity, this may place strain on local resources and households (i.e., if residents need to accommodate a number of people for an extended period).

9.2.1.2 Way people work

Similar to Scenario 1, disruptions to the way people work are also likely in this scenario, either as a result of damage to the environments (including buildings) where people conduct business, or to the roads which people rely on to access employment, employees, goods, services, and consumers of goods and services (i.e., to support local business).

The duration of disruptions to the way people work in this scenario would be dependent on the extent of damage to environments where people conduct business, such as tourist destinations. In this scenario, roads would likely be closed for up to one month, however visitors/tourists to the area may be suspended for longer depending on the safety of the roads, and tourist destinations such as DoC tracks.

Alternate transport options such as transport by boat may need to be considered in the interim, depending on the timing in the year and duration of road closures.

9.2.1.3 Way people recreate

Similar to Scenario 1, disruption to recreation is likely to occur in this scenario due to siltation in the lake, local road closure, closures of walking trails, suspension of tourist recreation activities, and damage to the

natural environment including from debris and landslips. This would impact both the local and wider community who use the natural environment for recreation purposes. The duration of disruption to recreation could range from a few weeks to a few months, depending on the activity requirements and the extent of damage to infrastructure that the recreation activity is reliant on.

Disruption to recreation would likely occur due to sedimentation in the lake, local road closure, closures of walking trails, suspension tourist recreation activities, damage to the environment from debris and landslides. This would impact both the local and wider community who use this area for recreation. The duration could range from a few weeks depending on the activity requirements to months or more if particular infrastructure that the recreation activity is reliant on is damaged. Walking tracks could be particularly impacted and may be closed for an extended period depending on the required repairs. For example, in 2020, the Routeburn Track was closed for ten months following torrential rain and slips which severely damaged the Track including some of its facilities (DoC, 2020). The duration of track closures in this scenario would be largely dependent on the extent of slips and landslides, and how quickly debris is cleared.

9.2.1.4 Way people educate

Similar to Scenario 1, initial disruptions may occur for school students in this scenario due to local road closures and potential damage to school buildings. The viability of the Glenorchy Primary School reopening quickly would depend on how quickly roads reopen and access to essential infrastructure (e.g., water, power). Fluctuations on the school roll as students move in and out of the area could further affect the School's viability for opening and remaining open.

9.2.2 Community

9.2.2.1 Community character

Similar to Scenario 1, there may be disruptions to community character as a result of damage to historic buildings. It is likely that some of the historic character in the Head of the Lake would be compromised in this scenario, and it would be dependent on the extent of damage as to whether it can be restored.

The 'feel' of the community may also change in this scenario, if people move out of the area (e.g., while their house is being repaired) and the community experiences an influx of outside input. This has the potential to temporarily unsettle the close-knit community character.

9.2.2.2 Community services

In this scenario, much of the community infrastructure is likely to be resilient, or only suffer nuisance flooding and therefore would be able to be restored in reasonable timeframes.

Whilst many of the community services the community are reliant on are located outside of the community (e.g., the hospital), the services provided within the community are also important for community wellbeing (i.e., emergency services, health clinic), cohesion (i.e., community hall, primary school and library) and convenience (i.e., local gas station and groceries).

The largest challenge is likely to be external and internal access to these community services due to road closures. Temporary access is likely to be established through alternate access routes or alternate transport services. Refer to Scenario 1 for more information on reliance on external and internal access.

9.2.2.3 Community cohesion

In the short-term, it is very likely that the community would come together to respond, and community cohesion would be very high. The required effort to recover may impact some community members more than others, depending on their individual circumstances and the level of need to accommodate others.

During, and in the weeks immediately following the devastation of Cyclone Gabrielle, people demonstrated a high-level of care for their community, with many people volunteering their time to help others (Crimp, 2023; RNZ, 2023).

Similar to Scenario 1, in the longer-term, community cohesion in the Head of the Lake would depend on the viability of community members to remain in the community, who is left, and their role in the community. Equally, if some local businesses close down permanently, this is likely to impact the way that the community functions depending on the community's reliance on the business/service. These potential impacts are anticipated to be at a lower level than Scenario 1, as less people are likely to leave the community.

9.2.3 Political systems

As detailed in Scenario 1, much of the appeal for many people living in the community is the ability to make decisions for themselves and actions these. Similar to Scenario 1, the initial emergency response would likely be a combination of local decision making by the Community Response Group and wider CDEM support. In the longer term, a lot of the decision-making would be dependent on local and central government decisions regarding local infrastructure repair, and insurance companies' decisions regarding house repairs. Processes to facilitate both local decision-making, and expedience of local and central government decision-making would help facilitate the community's recovery.

9.2.4 Environment

Refer to Scenario 1 for potential impacts on the environment.

9.2.5 Health and wellbeing

In this scenario, the extent of physical injuries would depend on what hazards people are exposed to during the event (e.g., landslips). With sufficient warning, residents and visitors/tourists should be able to make themselves safe and evacuate if required. However, road closures may cause issues with evacuations, and accessing outside help/services (e.g., medical care). Health may also be temporarily compromised due to damage to sewage systems and contamination of drinking water.

Preliminary findings into the impacts of Cyclone Gabrielle indicate that mental and emotional strain caused by the cyclone is of upmost concern to the community (All Sorts, n.d.). Even among those who did not directly experience the brunt of the extreme weather, two-thirds of survey respondents reported experiencing secondary stress for the hardships of others. Other significant stressors identified included concerns over red or orange weather warnings, anxiety during rainfall, financial burdens, and increased work pressures (All Sorts, n.d.).

Refer to Scenario 1 for potential health and wellbeing impacts. Health and wellbeing impacts are still likely to be high under this Scenario (2) but are likely to impact a smaller proportion of the population, and over a shorter duration, compared to Scenario 1.

9.2.6 Personal property rights

In this scenario, impacts on personal property rights would depend on the extent of damage to properties, and the decision-making process for repairs. This would likely be dependent on both local and central government, and insurance companies. Refer to Scenario 1 for potential impacts. As per Scenario 1, the expedience and communication of a process would therefore be key to providing homeowners with certainty. Pre-determined alternative options for relocation may assist in provided a wider range of options for landowners.

9.2.7 Fears and aspirations

Based on discussions with research participants, most people have a high level of awareness of the environment and in particular the rivers in terms of how they morph and change over time, water levels, and subsequent flooding risks. However, the changing alluvial landscape does come with a level of fear and uncertainty as to the nature of potential flooding events. From discussions with research participants, climate change is also a concern, due to the likely increase in the frequency of flooding events, and the potential impact of this on local infrastructure such as bridges and local roads.

The documented vision for the Head of the Lake community is:

> *"A unique, inclusive community that fosters and embraces individuality, diversity and innovation, encourages resilience* and promotes community vitality and collaboration. The Glenorchy community has a collective strong voice that advocates for positive change.*
>
> *Glenorchy has the infrastructure to support a thriving boutique local economy in keeping with the rural landscape, actively respects and enhances the natural environment, collectively works towards providing their own resources (self-sufficiency)."*

The ability to withstand a major flood would impact the ability of the community to achieve these aspirations.

9.3 Indicative Scenario 3 – Repeated Moderate Floods

It is possible that the community would experience similar social impacts from a moderate, repeated flood (this scenario) to a major flood (Scenario 2), however the extent, severity and duration of the potential social impacts is likely to be less. To avoid repetition, this section references the Scenario 2 assessment (refer to section 9.2) where similarities are anticipated, and highlights any differences including the likely extent, severity and duration of impacts. Different social impacts associated with the cumulative effects of repeated flood events are also highlighted.

9.3.1 Way of life

9.3.1.1 Way people live

In this scenario, disruptions to the way people live are likely to be similar to Scenario 2, however less people are likely to be impacted, and for a shorter duration. Like Scenario 2, some visitors/tourists may need to be temporarily housed in the township or local accommodation providers.

9.3.1.2 Way people work

In this scenario, disruptions to the way people work are likely to be similar to Scenario 2, however less people are likely to be impacted, and for a shorter duration.

9.3.1.3 Way people recreate

In this scenario, disruptions to recreation are likely to be similar to Scenario 2, however the geographic extent of impacts, and the time required to clean up (e.g., clear debris) is likely to be less.

9.3.1.4 Way people educate

Similar to Scenario 2, initial disruptions may occur for school students in this scenario due to local road closures, however less students are likely to be impacted, and for a shorter duration, as it anticipated that roads would be reinstated quickly.

9.3.2 Community

9.3.2.1 Community character

Minimal impacts on community character are anticipated in this scenario. Most of the historic community character should be able to be preserved, and the feel and sense of place within the community is likely to be retained, as outside input would be limited to small areas of damage.

A small number of community members may choose to leave the community temporarily following repeated flooding events, as they may want time away from the damage to their home and/or business. This may temporarily unsettle the close-knit community character; however, this potential impact is anticipated to be minimal given the small number of buildings that are likely to be impacted in this scenario.

9.3.2.2 Community services

Refer to Scenario 2 for potential impacts on community services.

9.3.2.3 Community cohesion

In this scenario, it is very likely that the community would come together to respond, and community cohesion would be very high. Whilst the required effort to recover is likely to be small, repeated flooding may impact some community members more than others, depending on their individual circumstances and the level of need to accommodate others. Community cohesion may be impacted if these people choose to leave the community temporarily or permanently, however this impact is anticipated to be minimal given the small number of buildings that are likely to be impacted in this scenario.

9.3.3 Environment

In this scenario, environmental impacts are likely to be similar to Scenario 2, however the geographic extent of impacts, and the time required to clean up (e.g., clear debris) is likely to be less.

9.3.4 Health and wellbeing

In this scenario, the risk of physical injuries is expected to be low. There is likely to be similar health and wellbeing impacts as Scenario 2, however less people are likely to be impacted.

Community members whose homes and/or businesses are affected by repeated flooding are at higher risk of cumulative mental health and wellbeing impacts. In particular, these people are more likely to experience financial stress and anxiety during rainfall. As evidenced following Cyclone Gabrielle, other members of the community may experience secondary stress for the hardships of others (refer to Scenario 2).

9.3.5 Personal property rights

Refer to Scenario 2 for potential personal property rights.

9.3.6 Fears and aspirations

Refer to Scenario 2 for potential impacts on the community's fears and aspirations. Repeated floods have the potential to exacerbate fears relating to the uncertainty of flooding events.

10 Assessment of potential economic impacts

Refer to Appendix E for the details of the indicative natural hazard scenarios referred to in this chapter of the report.

10.1 Indicative Scenario 1 – Major Alpine Fault Earthquake

10.1.1 Damage to households

Figure 8-3 from the Tonkin & Taylor (2022) report shows the vulnerability of the Glenorchy township to liquefaction. Approximately 50% of Glenorchy township falls within 'high' liquefaction hazard zones, and an additional 30% within 'major or severe lateral spreading damage' zones.

In this scenario, an estimated 50% of buildings within the 'high' liquefaction hazard zone suffer severe damage, and 75-90% of buildings within the 'major or severe lateral spreading damage' zone are likely to suffer severe damage to the point of being impractical or uneconomic to repair (Tonkin & Taylor, 2023).

Depending on the shaking intensity, some buildings will also be damaged by seismic shaking in this scenario. At Modified Mercalli (MM) VIII level, Type 1[26] buildings will be heavily damaged, and some will collapse. Type 2[27] buildings will be damaged, and some will partially collapse, while some Type 3[28] buildings will also be damaged.

Based on the high proportion of buildings impacted by liquefaction and lateral spreading under this scenario and the median house price in the Head of the Lake ($900,000), the total damage to households in Glenorchy would be at least $100 million (OneRoof, 2023). This cost estimate assumes additional costs associated with the damage to buildings from seismic shaking in this scenario.

10.1.2 Repair of capital infrastructure

Large infrastructure repairs and replacements would likely be required in this scenario due to extensive liquefaction and lateral spreading damages. Replacement of roading infrastructure is estimated to cost $700,000 per km for local roads (Te Manatū Waka, 2023). This considers land, formation, pavements, bridges, drainages, culverts, traffic facilities, and other horizontal structures. Based on the length of the road network in Glenorchy that falls within the 'high' liquefaction or 'major or severe lateral spreading damage' zone (approximately 1-3km), repair and replacement of roading infrastructure would cost between $0.7 to $2.1 million in this scenario. This figure may be higher given the challenging terrain and if access via Glenorchy-Queenstown Road is also impacted.

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[26] Buildings with low standard of workmanship, poor mortar, or constructed of weak materials like mud brick or rammed earth. Soft storey structures (e.g. shops) made of masonry, weak reinforced concrete or composite materials (e.g. some walls timber, some brick) not well tied together. Masonry buildings otherwise conforming to buildings Types 1 to 3, but also having heavy unreinforced masonry towers. (Buildings constructed entirely of timber must be of extremely low quality to be Type 3) (Geonet, n.d.).

[27] Buildings of ordinary workmanship, with mortar of average quality. No extreme weakness, such as inadequate bonding of the corners, but neither designed nor reinforced to resist lateral forces. Such buildings not having heavy unreinforced masonry towers (Geonet, n.d.).

[28] Reinforced masonry or concrete buildings of good workmanship and with sound mortar, but not formally designed to resist earthquake forces (Geonet, n.d.).

10.1.3 Cost of response and relief

During the Canterbury earthquakes, clean-up costs were estimated to be $25 million for 500,000 tonnes of liquefaction ejected ejecta (Villemure et al., 2012). Based on observed liquefaction maps in Villemure et al.'s report (2012) these costs were spread over 125 km².

The Tonkin & Taylor (2022) report notes that liquefaction and lateral spreading in the 'high' liquefaction and 'major or severe lateral spreading damage' zones in Glenorchy township is expected to be comparable to or worse than Christchurch's red zones. Based on the clean-up costs for liquefaction ejecta in Christchurch's red zones (Villemure et al., 2012) and the spatial extent of the 'high' liquefaction and 'major or severe lateral spreading damage' mapped in the Tonkin & Taylor (2022) report (estimated 1 km²), this scenario would result in approximately 4,000 tonnes of liquefaction ejecta. This would cost approximately $200,000 to clean up.

10.1.4 Short-term economic losses

In the months following the 2016 Kaikoura earthquake, tourism operators in Kaikōura faced significant ongoing challenges apart from the positive inflow of response personnel. Kaikōura experienced an unprecedented drop in visitor numbers due to road closures and the negative perceptions of travel during a period of high seismicity (Stevenson et al., 2017).

Due to the likely closure of the Queenstown-Glenorchy and local roads for one to two weeks under this scenario, as well as the time required to respond and recover, the local economy would likely halt until usual travel can commence. For the tourism and hospitality industries, this would likely result in a direct loss of income. Based on average daily visitor spending (Queenstown NZ, 2023a), the direct impact of no tourism for one to two weeks could be between $250,000 and $500,000.

For other key industries, including film, agriculture, and trade, usual operations would likely be restricted. However, this would not necessarily result in direct loss of income. From discussion with research participants, these industries are capable of adapting operations in response to large disruptions (such as natural hazard events).

10.1.5 Long-term economic losses

Businesses interviewed as part of this research reported a sustained loss in revenue for three months following the 2020 Dart/Rees River flooding event. Assuming average daily tourism spending in the area (Queenstown NZ, 2023a) reduces by 50% for three months following a major Alpine Fault earthquake, this would be equivalent to a $1.5 million to $3 million loss in income. Due to the extent of damage and economic hardship experienced under this scenario, some businesses may be forced to close or struggle to return to usual operations.

10.1.6 Employment

As a result of the likely impact to the local economy under this scenario, employment would likely decline in the Head of the Lake. Depending on an employees' contract, immediate income may not be guaranteed, causing uncertainty and financial hardship for individuals and households. In the long-term, the impact to businesses may cause reduction in hours or job loss for the employees of affected businesses.

Beyond the direct impact, the impact on the local economy is likely to contribute to a broader reduction in employment across the community, as other dependent businesses may also experience setbacks.

10.2 Indicative Scenario 2 - Major Flood

10.2.1 Damage to households

40 dwellings in the Glenorchy township are anticipated to experience some level of flooding under this scenario, of which 20 are in locations where floodwaters are expected to be greater than 0.5 metres depth. According to Australian Disaster Resilience (AIDR) flooding greater than 0.5 metres has potential to cause moderate/high hazard to structures at moderate flow speeds (Smith & McLuckie, 2015). It is assumed that 50% of the homes at >0.5 metres are severely damage to be impractical or uneconomic to repair. Based on this assumption, 10 homes are unliveable.

Based on 10 houses being impacted to the extent of requiring a retreat and the median house price in Glenorchy being $900,000 (OneRoof, 2023), the cost would exceed $4.5 million. The occupants of the remaining 30 houses would likely experience temporary access restrictions, minor repairs, and debris, however they are likely to be able to return to their homes.

10.2.2 Repair of capital infrastructure

In this scenario, river erosion is likely to impact roading infrastructure and prevent access to some destinations within the community. This may require road repairs, and temporary access routes to be formed. The expected extent of damage is likely less than 1km of local roads, primarily observed around river crossings north of Glenorchy. The cost of replacement for this extent would be approximately $700,000, based on the replacement cost being $700,000 per km for the local roading network (Te Manatū Waka, 2023) which includes land, formation, pavements, bridges, drainages, culverts, traffic facilities and other horizontal structures.

10.2.3 Short-term economic losses

Based on discussions with research participants, the Kinloch Lodge has demonstrated high resilience, with research participants noting potential viability of access by ferry, and the ability to sustain itself independently for an extended period. Roads may also open sooner for temporary 4WD access to allow for the supply of goods and services. However, this would likely be insufficient to enable usual tourism activity. Based on the average daily visitor spending (Queenstown NZ, 2023a), the direct loss of no tourism due to the closure of Kinloch access roads for one month would be approximately $80,000. This is an estimation based on self-reported annual revenue range for businesses operating north of Glenorchy township.

In addition, an average of 55 overnight hikers and 100 day-hikers visits the Routeburn daily. The closure of Routeburn access roads for one month is therefore likely to cause direct loss of income for hiking tourism services, such as transport operators, accommodation, and guided tours. The decline of visitors also has the potential to reduce spending in other industries such as hospitality. Based on the average daily visitor spending (Queenstown NZ, 2023a) and that Routeburn hikers make up 35-40% of visitors to Glenorchy[29], this would result in a $375,000 to $425,000 reduction in tourism spending in the Head of the Lake.

Based on the average daily visitor spending (Queenstown NZ, 2023a), the direct loss of no tourism for one to two weeks due to the closure of the Queenstown-Glenorchy Road would be between $250,000 and $500,000.

[29] This has been estimated based on average daily hiker counts, and average daily visitors to the Head of the Lake

10.2.4 Cost of response and relief

Access roads on the Rees and Dart River plain are likely to be temporarily closed due to flooding in this scenario. In addition, potential debris impacts along the Routeburn and Kinloch access roads is likely to isolate these parts of the community for up to one month. The Queenstown-Glenorchy Road is also expected to experience debris impacts in this scenario, isolating the entire Head of the Lake community from the wider region for up to two weeks. Ferry and helicopter access may be possible to supply residents with essential resources. The estimated long-term economic losses associated with this reduction in access are detailed below.

10.2.5 Long-term economic losses

Under this scenario, business operations are unlikely to return to usual for one to three months. This is estimated based on businesses reporting as part of this research a sustained loss in revenue for 3 months following the 2020 Rees/Dart River floods. Assuming spending in the Head of the Lake reduces by 50% during this time, this would be equivalent to a $0.5 million to $1.5 million loss in income.

Beyond this, most businesses would recover in the long-term, assuming landscape or building damages have not directly impacted operations. Long-term economic losses would likely be less direct, such as increases in insurance premiums and less investment in the Head of the Lake. For more details refer to the ‘Potential economic impact across all scenarios’ section below.

10.2.6 Employment

Depending on an employees’ contract, immediate income may not be guaranteed under this scenario, causing uncertainty and financial hardship. In the long-term, business impacts may cause reductions in hours, but is unlikely to cause large job instability.

10.3 Indicative Scenario 3 – Repeated Moderate Flood

10.3.1 Damage to households

Approximately 10 dwellings are expected to experience flooding above floor level under this scenario. This would likely cause damage to both buildings and personal property, however, would likely not require complete relocation in the short-term. Owners of these affected properties would bear the financial burden of repairing the damage and replacing any contents that may have been lost or damaged, and face uncertainty and concern in the longer-term.

10.3.2 Repair of capital infrastructure

There is unlikely to be severe damage to capital infrastructure in this scenario. However, repeated flooding events have the potential to result in cumulative damage that requires ongoing repairs and maintenance. Continual investment in restoration is likely to become costly and is unlikely to mitigate risk, assuming infrastructure remains exposed to future inundations.

10.3.3 Cost of response and relief

In this scenario, some parts of the community are likely to be isolated for up to one week due to Rees and Dart River flooding and erosion, and debris impacts on Routeburn and Kinloch access roads. The Queenstown-Glenorchy Road is also expected to experience debris impacts in this scenario, isolating the entire Head of the Lake community from the wider region for up to two days. Ferry and helicopter access may be possible to supply residents with essential resources. The estimated short-term and long-term economic losses associated with this reduction in access are detailed below.

10.3.4 Short-term economic losses

Based on the average daily visitor spending (Queenstown NZ, 2023a), the direct loss of no tourism due to the closure of Kinloch access roads for one month would be approximately $20,000. This is an estimation based on self-reported annual revenue range for businesses operating in Kinloch. Furthermore, the closure of Routeburn access roads for two days would cause direct loss of income for hiking tourism services, as well as other businesses servicing hikers. Considering Routeburn hikers make up 35-40% of visitors to the Head of the Lake, this would result in a $85,000 to $95,000 reduction in income in the Head of the Lake based on daily visitor spending (Queenstown NZ, 2023a).

Based on the average daily visitor spending (Queenstown NZ, 2023a), the direct loss of no due to the closure of the Queenstown-Glenorchy Road for two days would be between $250,000 and $500,000.

10.3.5 Long-term economic losses

Whilst there is likely to be a short-term loss of income in this scenario, most businesses are likely to recover in the long-term. Long-term economic losses would likely be less direct, such as increases in insurance premiums and less investment in the area. In addition, repeated flooding events in this scenario may lessen public confidence in the environment, discouraging visitors and tourists. This could have flow on impacts on tourism and GDP. For more details refer to the ‘Potential economic impact across all scenarios’ section below.

10.3.6 Employment

Depending on an employees’ contract, immediate income may not be guaranteed under this scenario, causing uncertainty and financial hardship. In the long-term, the impact to businesses may cause reductions in hours, but is unlikely to cause large job instability.

10.4 Potential economic impact across all scenarios

10.4.1 Insurance losses

Following previous natural hazard events in Aotearoa, the insurance market has weakened due to the surge in claims and widespread property damage (e.g. Cyclone Gabrielle (Tibshraeny, 2024)). Insurance premiums are likely to increase as risk of natural hazard increases.

10.4.2 Less investments

Similarly, there is often a decline in both the value and number of investments following natural hazard events in Aotearoa, due to increased uncertainty and perceived risks of owning property in the area (Ministry for the Environment, 2020; Morton, 2022; Bell, 2023). The aftermath of natural hazard events can create an atmosphere of economic instability, causing potential investors to adopt a more cautious approach.

11 Conclusion

This report provides an overview of the Head of the Lake community in terms of its economic and social profile. It is noted that this is a well-functioning and motivated community that self-organises to meet community aspirations. The environment is the main reason why people live and visit the area. Part of living at the Head of the Lake is being aware of the environment and its changes. This community is largely aware of the unpredictability of nature and that living in the area does mean being susceptible to the dynamic environment, and in particular the fluvial environment. Climate change adds another level of complexity and is likely to increase the frequency and severity of flood events.

Over time, the community has become more reliant on the hospitality and tourism trade, and these industries are very susceptible to natural hazard events as the environment and access are often impacted and take time to recover. A major natural hazard event also has an impact in terms of visitor confidence to return to the area. A key issue for the community both socially and economically is the resilience of access t/from, and within the Head of the Lake area, as this is key to the community's social and economic wellbeing.

It is noted that the community is changing as it grows, and as new people settle in the area. Whilst much of the sense of place and values of the community appear to have been retained, the awareness of the environmental risks and corresponding preparedness may not be as front of mind for newcomers to the community as those who have experienced issues in the past. Therefore, newcomers to the community may not be as resilient in terms of preparedness and tolerance. This would need to be factored into planning for the future.

This information can be used to consider both the adaptation needs of the Head of the Lake community and the consequences of potential adaptation responses under consideration as part of ORC's Head of Lake Whakatipu Natural Hazard Adaptation Programme.

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A

Appendix A – Interviews and focus groups guides

Interviews

Participant(s)	Themes	Questions
Key stakeholders - QLDC	- Role - Functions - Description of the community from their perspective - Community values - Arts, culture and heritage - Tourism economic contribution - Film economic contribution - Key employment industries - Community objectives - Community concerns - Growth and development - Future investment in the community - 'Status quo' emergency management response - Role in emergencies - Community resilience - Risks - Challenges - Opportunities	- What is your role? - How would you describe the community at the Head of the Lake? - What is the tourism industry's contribution to the economy? - What is the film industry's contribution to the economy? - What does the community value in relation to arts and heritage? - What are the objectives or plans, if any, for arts and heritage at the Head of the Lake? - What are the challenges or biggest threats to arts and heritage, in relation to natural hazards? - If/what planning for growth or development has occurred in the area? - Is there any future investment and/or development planned for the community? E.g., community social infrastructure - What are the strengths of the community? - What are the vulnerabilities?
Key stakeholders - DoC	- Significance of the area to DoC - Operations in the area - Track / hut / visitor numbers - Potential impacts of natural hazard scenarios - Needs for operation - Access requirements	- What is your role in the community? - What are the average track/hut/visitor numbers? - How do natural hazards impact your operations? - If/what role do you have in emergencies / how do you respond in natural hazard emergencies? - Do you have a natural hazard plan? - What do you rely on accessing? - How do natural hazards impact the population you are responsible for? - What are the strengths of the community? - What are the vulnerabilities?
Key stakeholders – emergency service providers	- 'Status quo' emergency management response - Community resilience - Tolerance - Risks - Challenges	- What is your role in the community? - How would you describe the community at the Head of the Lake?

	- Opportunities	- If/what role do you have in emergencies / how do you respond in natural hazard emergencies? - Do you have a natural hazard plan? - What do you rely on accessing? - How long could you manage with the road in and out of Glenorchy closed? - How do natural hazards impact the population you are responsible for? - What are the strengths of the community? - What are the vulnerabilities?
Key stakeholders – community service providers (e.g., Community Association, Community Nurse, School Principal)	- Role in the community - Functions - Description of the community from their perspective - Access requirements - How road closures impact them (i.e., their tolerance for closure) - Role in natural hazard events - Impact of past and future events on role - Tolerance - Resilience - Concerns regarding the community (in relation to their role i.e., education, health etc)	- What is your role in the community? - How would you describe the community at the Head of the Lake? - What do you rely on accessing? - If/what role do you have in emergencies? - Do you have a natural hazard plan? - How do natural hazards impact your operations? - How do natural hazards impact the population you are responsible for? - How long could you manage with the road in and out of Glenorchy closed? - What are the strengths of the community? - What are the vulnerabilities?
Community organisation/club/group representatives	- Role in the community - Functions - Description of the community from their perspective - Access requirements - How road closures impact them (i.e., their tolerance for closure) - Role in natural hazard events - Impact of past and future events on role - Tolerance - Resilience - Concerns regarding the community (in relation to their role i.e., education, health etc)	- What is your organisation's role in the community? - How would you describe the community at the Head of the Lake? - What does your community organisation rely on access to? - If/what role does your community organisation have in emergencies? - What are the strengths of the community? - What are the vulnerabilities?
Business owners/operators	- Business activity - Reliance on connections into and outside of Glenorchy - Experience of natural hazards - Tolerance - Resilience	- Can you please provide an overview of your business activities in Glenorchy? - Are your operations for 2023, reflective of a 'usual' state? - Can you please describe any external connections that are crucial for the success of

	- Role in emergency management planning/response	your business, such as suppliers or customers outside of Glenorchy? - To what extent does the community at the Head of the Lake rely on your business? - To what extent do you rely on other local businesses to operate? - Has there been any significant natural hazard events in the past that have directly impacted your business? - How did your business cope with and recover from any previous natural hazard events? - In what ways (if any) has your business adapted (this could be operational or infrastructure) to mitigate vulnerability impact of natural hazards? - Are there specific natural hazards that pose a higher risk to your business, what is the risk and how do you address these concerns? - What strategies or measures does your business have in place to build resilience against natural hazards? - Are there specific resources or expertise that your business can contribute to the broader emergency management efforts in Glenorchy? - What are some of the challenges and opportunities do you see in conducting business within the Glenorchy area?
Semi-structured 'drop-in' interviews with residents	- Description of the community from their perspective - Values - Challenges of living in the area - Experience and impacts of natural hazard events - Resilience - Tolerance - Access requirements - How road closures impact them (i.e., their tolerance for closure) - Community vulnerabilities and resilience to natural hazards	- What is your occupation? - How long have you lived here? - Do you have any roles in the community? - What do you value about living in the area? - What are the challenges of living in the community? - If there was to be a flood or earthquake event in Glenorchy, what are the key things that you need to sustain yourself here? - What would make it unliveable/unsustainable? - What are the strengths of the community? - What are the vulnerabilities?

Focus groups

Queenstown-based businesses operating at the Head of the Lake	- Business activity - Reliance on connections into and outside of Glenorchy - Experience of natural hazards - Tolerance - Resilience	- What is your business? - What makes Glenorchy a unique and sought after destination? - If/how are you reliant on the Queenstown-Glenorchy Road? - How do you operate when you know there's big rains coming?

	- Role in emergency management planning/response	- How resilient is your business to natural hazard events?
Community representatives (e.g., residents and representatives of community organisations/clubs/ groups)	- Values - Sectors of the community - Assets in the community - Natural hazard vulnerabilities and resilience	- What's most important to the community? - What are the different sectors or clusters of the community? - What are the community's assets? - What are the community's vulnerabilities? - What are the community's strengths?
Glenorchy Primary School students	- Values - Movement (in, out and around the community) - Experience and impacts of natural hazards	- What do you like about living at the Head of the Lake? (brainstorm) - Where do you like to go in Glenorchy and why? (mapping activity) - What do you leave Glenorchy for and how often? (brainstorm) - What is your experience of when the roads have been closed or power has been cut?

B

Appendix B – Survey questions

Residents and businesses survey

1. Are you responding to this survey as a resident or a local business. *If you would like to respond as a resident AND a business owner, please fill out this survey twice, once as a resident, and once as a business.*
    - Resident
    - Business.

Business questions

1. Where is your business based?
    - Glenorchy
    - Kinloch
    - Paradise
    - Campbelltown
    - Rees Valley
    - Dart Valley
    - Greenstone Valley
    - Queenstown
    - Other
2. Where is your business based? (tick all that apply)
    - Glenorchy
    - Kinloch
    - Paradise
    - Campbelltown
    - Rees Valley
    - Dart Valley
    - Greenstone Valley
    - Queenstown
    - Other (free text box)
3. Where do you carry out your business?
    - Glenorchy
    - Kinloch
    - Paradise
    - Campbelltown
    - Rees Valley
    - Dart Valley
    - Greenstone Valley
    - Queenstown
    - Other (free text box)
4. Is your business dependent on its location (i.e., it relies on the land or specific local attractions)? Or you could operate your business from anywhere / you work remotely?
5. What sector does your business operate in?
    - Tourism
    - Hospitality
    - Retail
    - Horticultural
    - Agricultural
    - Construction
    - Home business (workshop/services)
    - Home business (office-based work)
    - Other (please state)

6. What are the primary products or services offered by your business? E.g., a construction company may offer construction materials, construction equipment, construction services, and/or project management services.
7. Is your business dependent on its location or could it operate anywhere (e.g., your business is location specific if it relies on the land or specific local attractions or you could operate your business form anywhere / you work remotely)
    a. Your business is dependent on its location.
    b. Your business could operate anywhere.
    c. Other
8. How long has your business been operating?
    - Less than a year
    - 1-5 years
    - 5-10 years
    - More than 10 years
9. How many staff does your business employ?
    - None
    - Less than 5
    - 5-10
    - 10-20
    - 20 +
10. Do your employees live in the Head of the Lake Whakatipu area?
    - Yes
    - Some
    - None
11. What is the Full-Time Equivalent of your staff (calculated by combining full time and part time staff)?
    - Less than 5
    - 5-10
    - 10-20
    - 20 +
12. Is your business seasonal? If yes, select all that apply.
    - Summer
    - Autumn
    - Winter
    - Spring
    - No, my business is not seasonal.
13. Which of the following revenue range options best represents your business's annual sales?
    - Less than $50,000
    - - $50,000 to $100,000
    - - $100,000 to $500,000
    - - $500,000 to $1 million
    - - More than $1 million
    - - Prefer not to state.
14. Is your business dependent on the ability to transport people and/or resources into and/or out of Head of Lake Whakatipu area?
    - Yes
    - No
    - Unsure
15. If yes to Q9, what are you reliant on accessing outside of Head of Lake Whakatipu area? Select all that apply.

- Staff
- Customers
- Goods in
- Goods out
- Other (please specify)

16. If yes to Q9, how often does your business rely on the ability to transport people and/or resources into and/or out of Head of Lake Whakatipu area?
    - Daily
    - Several times a week
    - Weekly
    - Fortnightly
    - Monthly
    - Less than monthly
17. If your business was unable to transport people and/or resources into and/or out of Head of Lake Whakatipu area, please describe how this would impact your business and/or the community?
18. If you are able to, please describe the top three risks to your business if there were to be a significant flooding event? E.g., financial costs, damage to property, road isolation
19. If you are able to, please describe the top three risks to your business if there were to be a significant earthquake event?
20. Has your business been impacted by natural hazards previously?
21. *If yes to Q15,* please tell us about the impacts you experienced.
22. If you are aware there is a potential storm coming, what does your business do to prepare?
23. Is there anything else you would like to let us know about the possible impacts of a natural hazard event on your business and / or community?
24. Would you be happy for a member of our team to phone you to discuss some of your responses in more detail? Note that we will only be carrying out follow-up interviews (approx. 10 minute long) with a sample of the community.
25. *If yes to Q19* please provide your name and phone number so that we can get in touch.

Resident questions

1. How old are you?
    - Under 15 years
    - 15-29 years
    - 30-64 years
    - 65 years or older
2. What is your gender?
    - Male
    - Female
    - Non-binary
    - Other
    - Rather not say.
3. What is your ethnicity?
    - European
    - Māori
    - Pasifika
    - Asian
    - Middle Eastern/Latin American/African
    - Other
4. What area do you live in?
    - Glenorchy

- Kinloch
- Paradise
- Campbelltown
- Rees Valley
- Dart Valley
- Greenstone Valley
- Other

5. How long have you lived at your current property?
   - Less than a year
   - 1-5 years
   - 5-10 years
   - More than 10 years
   - My whole life
6. How long have you and your family/whānau lived in the area?
   - Less than a year
   - 1-5 years
   - 5-10 years
   - 10+ years
   - My whole life
   - Multiple generations
7. Which of the following best describes your household situation?
   - Living alone
   - Couple, no children.
   - Group flatting
   - Couple with children living at home.
   - Couple with no children at home (i.e., children have left home)
   - Living with extended family
   - I'd rather not say.
   - Other (please state)
8. Do you work from home?
   - Yes – I work exclusively from home/my business is based at my home.
   - Yes – I work from home most of the time.
   - Yes – I work from home several days a week.
   - Yes – I work from home occasionally (less than once a week)
   - No – I am employed, but I never work from home.
   - No – I am not employed so I never work from home.
   - No – I am retired so I never work from home.
9. Do you generate any income from your property (e.g., accommodation, farming, horticulture etc.)
   - Yes – this is my main source of income.
   - Yes – this makes up part of my income.
   - No
10. Of the following, what do you and/or your household travel outside of Head of Lake Whakatipu area for? Please select all that apply.
    - Employment
    - Education
    - Recreation
    - Social activities
    - Shopping / errands
    - Health

- Other (please specify?)

11. How often do you travel outside of Head of Lake Whakatipu area to access the places and/or people you have identified above?
    - Daily
    - Several times a week
    - Weekly
    - Fortnightly
    - Monthly
    - Less than monthly
12. If you and/or your household were unable to travel outside of Head of Lake Whakatipu area for an extended period of time (i.e., a week or longer), please indicate what impacts (if any) this would have on you and/or your household.
    - Impact on health and wellbeing
    - Impact on lifestyle / enjoyment of life
    - Financial impacts
    - Other (please specify)
13. If you are able to, please describe the top three risks to you and/or your household if there were to be a flooding event? E.g., financial costs, damage to property, road isolation
14. If you are able to, please describe the top three risks to you and/or your household if there were to be an earthquake event?
15. Have you and/or your household been impacted by natural hazards previously?
16. *If yes* to Q12, please tell us about those impacts you experienced.
17. If you are aware there is a potential storm coming, what do you and/or your household do to prepare?
18. Is there anything else you would like to let us know about the possible impacts of natural hazards on yourself, your household, or your community?
19. Would you be happy for a member of our team to phone you to discuss some of your responses in more detail? Note that we will only be carrying out interviews (approx. 10 minute long) with a sample of the community.
20. *If yes to Q16* please provide your name and phone number so that we can get in touch.

C

Appendix C – Demographics

Theme	Metric / %	Glenorchy / Head of Lake Whakatipu	Queenstown-lake District	Otago Region
Population	Number of People	450	39,153	225,186
Sex	Males	222	19,971	110,970
	Females	225	19,182	114,219
Age	Median Age	40.2	34.4	38.2
	Under 15 – usually resident population (%)	11.3	16.6	16.5
	15 - 29 years - usually resident population (%)	18.6	23.5	22.95
	30 - 64 years - usually resident population(%)	58	49.3	44
	65+ years - usually resident population (%)	10.6	10.5	16.5
Birthplace	Birthplace – NZ (%)	64.2	40.7	78.1
	Birthplace – overseas (%)	35.8	59.3	21.9
Ethnicity	Ethnicity – European (%)	92	83.6	86.9
	Ethnicity - Māori (%)	5.3	5.3	8.7
	Ethnicity - Pacific Peoples (%)	2.0	1.0	2.7
	Ethnicity - Asian (%)	3.3	9.9	7.1
	Ethnicity - Middle Eastern / Latin/ American / African (%)	2	4.7	1.8
	Ethnicity - Other Ethnicity (%)	1.3	1.3	1.4
	Māori Descent - Don't Know (%)	1.9	2.3	2.5
Religious Affiliation	No Religion (%)	66.7	61.2	55.8
	Religious affiliation – Buddhism (%)	1.2	1	0.7

	Religious affiliation – Christian (%)	45.3	29.1	33.4
	Religious affiliation – Hinduism (%)	0	1.6	0.8
	Religious affiliation – Islam (%)	0	0.4	0.7
	Religious affiliation - Judaism (%)	0	0.2	0.1
	Religious affiliation - Māori religions, beliefs, philosophies (%)	0	0.1	0.2
	Religious affiliation - spiritualism, new age (%)	0.7	0.4	0.5
	Religious affiliation – Other (%)	1.3	1.8	1.5
	Religious affiliation - refuse to answer (%)	5.3	4.6	6.4
Disability Data	One or more activity limitations (%)	2.6	2.8	6.6
Home Ownership	Home ownership - Own or partly own (%)	57.6	39.1	52.2
	Home ownership - In family trust (%)	13.6	23.6	15.8
	Home ownership - Do not own and do not hold in a family trust (%)	30.5	37.3	32
Types of heating	No heating use (%)	0	0.6	0.6
	Heat Pump (%)	30.4	57.2	60.7
	Electric Heater (%)	33.9	43.4	43.8
	Fixed Gas Heater (%)	5.4	17.4	7.2
	Portable gas heater (%)	3.6	2.4	3
	Wood burner(%)	78.6	54.2	51.6
	Pellet Fire (%)	1.8	0.7	2.4
	Coal Burner (%)	3.6	1.3	4.9
	Other types of heating (%)	7.1	10.9	5.9

Years since arrival in New Zealand for the usually resident population	Less than 1 year (%)	17.3	12.9	9.6
	1 year (%)	9.6	13.6	8.5
	2 years (%)	7.7	10.2	6.6
	3 years (%)	7.7	7.4	5.4
	4 years (%)	3.8	5.7	4.1
	5 – 9 years (%)	15.4	18.2	16.5
	10 – 19 years (%)	15.4	19.5	23.4
	20 years or more (%)	19.2	12.5	25.8
Income	Median Income	38,0000	40,600	30,0000
	Income over $70,000 (%)	17.4%	19.9%	14.4%
	Loss (%)	0.8	0.3	0.5
	Zero (%)	3	2.7	4.9
	$1,000-$5,000 (%)	5.3	4.4	6.8
	$5,001-$10,000 (%)	5.3	3.7	5.8
	$10,001-$15,000 (%)	5.3	4.4	7.1
	15,001-$20,000 (%)	7.6	6	10.1
	$20,001-$25,000 (%)	6.8	6	8.7
	$25,001-$30,000 (%)	6.1	6.3	6.2
	30,001-$35,000 (%)	6.8	7	5.4
	$35,001-$40,000 (%)	8.3	8.4	6
	$40,001-$50,000 (%)	13.6	13.2	9.9

	$50,001-$60,000 (%)	10.6	10.3	8.2
	$60,001-$70,000 (%)	6.1	7.4	6.1
	$70,001-$100,000 (%)	10.6	10.7	8.6
	$100,001-$150,000 (%)	5.3	5.1	3.5
	$150,001 or more (%)	1.5	4.1	2.2
Source of Income	Sources of income - no source (%)	8.0	8.3	8.6
	Sources of income - NZ super or veteran's pension, other super/pensions (%)	14.9	11.0	10.5
	Sources of income - Jobseeker support (%)	5.5	9.9	10.4
	Sources of income - Sole parent support (%)	1.5	2.4	2.6
	Sources of income - Supported Living Payment (%)	1.5	2.1	2.0
	Sources of income - student allowance (%)	2.5	2.6	2.4
	Other government benefits, govt income support payments (%)	3.6	4.6	4.6
Occupation	Unemployed (%)	1.5	1.1	3.2
	Not in the Labour Force (%)	12.9	18.3	31.4
	Employed Full Time (%)	69.7	66.4	49.2
	Occupation – Managers (%)	25	21.5	17.7
	Occupation - Professionals (%)	15.2	16.5	20.2
	Occupation - Technicians and trade Workers (%)	17.9	16.4	13.2
	Occupation - Community and administrative workers (%)	11.6	11.8	10.7
	Occupation - Clerical and administrative workers (%)	8	8.8	9.8
	Occupation - Sales workers (%)	6.2	10.6	9.6
	Occupation - machinery operators and drivers (%)	4.5	4.5	5.5

	Occupation – labourers (%)	12.5	9.9	13.2
Means of Travel to Work	Means of travel to work – bus (%)	0	3.2	
	Work at home (%)	21.4	15.7	14.3
	Means of travel to work – train (%)	0	0.1	0
	Means of travel to work - Passenger in a car, truck, van or company bus (%)	0.9	3.5	4.3
	Means of travel to work – bicycle (%)	3.6	3	2.2
	Means of travel to work - drive a private car, van or truck (%)	44.6	48.9	54.6
	Means of travel to work - Walk or jog (%)	19.6	11.1	9.1
	Means of travel to work - Drive a company truck, car or van (%)	9.8	13.6	11.8
Means of Travel to Education	Means of travel to education - school bus (%)	28.6	19.1	9.1
	Stay at home (%)	14.3	9	5.4
	Means of travel to education - public bus (%)	0	3.2	0
	Means of travel to education – train (%)	0	0	0
	Means of travel to education - passenger in car, truck or van (%)	14.3	37	33.3
	Means of travel to education – bicycle (%)	19	8.2	3.9
	Means of travel to education - drive a private car, truck or van (%)	9.5	8.5	10.3
	Means of travel to education - walk or jog (%)	9.5	13.9	33.4
Marital status	Married (not separated) (%)	37.1	47.8	45.8
	Separated (%)	3.8	1.9	2.8
	Divorced or dissolved (%)	10.5	6	7.4
	Widowed or surviving civil union partner (%)	2.9	2.9	5.4

	Never married and never in a civil union (%)	46.7	41.4	38.6
Qualification	No qualification (%)	9.9	8.6	17.6
	Bachelor's degree and level 7 qualification (%)	18.2%	19.2	13.6

D

Appendix D – Population Projections

					2023 to 2033			2023 to 2033		
Variable	2023	2033	2043	2053	Change	Annual change	% change	Change	Annual change	% change
Glenorchy Other										
Residents	150	170	180	190	20	2	1.3	40	1	0.8
Total Houses	80	80	90	100	0	0	0.0	20	1	0.7
Total Visitors (Average Day)	90	120	120	120	30	3	2.9	30	1	1
Total Visitors (Peak Day)	240	310	320	330	70	7	2.6	90	3	1.1
Total Population (Average Day)	240	280	300	320	40	4	1.6	80	3	1
Total Rating Units	170	180	190	200	10	1	0.6	30	1	0.5
Glenorchy Township										
Residents	410	490	570	650	80	8	1.8	240	8	1.5
Total Houses	220	270	310	350	50	5	2.1	130	4	1.6
Total Visitors (Average Day)	300	440	490	530	140	14	3.9	230	8	1.9
Total Visitors (Peak Day)	800	1130	1250	1360	330	33	3.5	560	19	1.8
Total Population (Average Day)	710	940	1060	1180	230	23	2.8	470	16	1.7
Total Rating Units	330	390	440	500	60	6	1.7	170	6	1.4

(QLDC, 2023a)

E

Appendix E - Indicative natural hazard scenarios

11.1 Major[30] Alpine Fault Earthquake

This indicative scenario was formed using the available science and natural hazards information at the time this SEIA was commissioned, including the following technical reports:

- DJA Barrell (2019)
- Murashev et al. (2004)
- ORC (2015)
- Robinson & Davies (2013)
- Tonkin & Taylor (2021)
- Tonkin & Taylor (2022)
- Tonkin & Taylor (2023).

The following information is descriptive (not predictive or associated with a specific likelihood) and has been provided for the purposes of exploring the potential social and economic consequences of natural hazard events at the Head of the Lake.

- **Seismic shaking –** with reference to the Modified Mercalli Intensity Scale, MMVII – MMVIII shaking intensities are anticipated. Within this range, shaking will be felt by all, and people are likely to experience difficulty standing. Steering of motor vehicles may also be difficult.
    - At level MMVII, there will be substantial damage to fragile contents of buildings, and furniture will move. Unreinforced stone and brick walls will crack, and Type 1[31] buildings will crack with some masonry falls. There will be some damage to type 2[32] buildings; unbraced parapets and brick gables and architectural ornaments will fall, and roofing tiles will become dislodged. Many unreinforced domestics chimneys will be damaged and there will be a few instances of damage to brick veneers and plaster or cement-based lining. At this level, water will be made turbid by stirred up mud, there will be small rock falls from steep slopes, and instances of unconsolidated, wet or weak soils. Some fine cracks will appear in sloping ground and there will be a few instances of liquefaction.
    - At MMVIII level, Type 1 buildings will be heavily damaged, and some will collapse. Type 2 buildings will be damaged, and some will partially collapse, while some Type 3[33] buildings will

[30] 'Major' is used to describe a magnitude 8 Alpine Fault earthquake which has a 40-60% chance of occurring over the next 50 years (Tonkin & Taylor, 2022; Tonkin & Taylor, 2023)

[31] Buildings with low standard of workmanship, poor mortar, or constructed of weak materials like mud brick or rammed earth. Soft storey structures (e.g. shops) made of masonry, weak reinforced concrete or composite materials (e.g. some walls timber, some brick) not well tied together. Masonry buildings otherwise conforming to buildings. Types 1 to 3, but also having heavy unreinforced masonry towers. (Buildings constructed entirely of timber must be of extremely low quality to be Type 1) (Geonet, n.d.)

[32] Buildings of ordinary workmanship, with mortar of average quality. No extreme weakness, such as inadequate bonding of the corners, but neither designed nor reinforced to resist lateral forces. Such buildings not having heavy unreinforced masonry towers (Geonet, n.d.)

[33] Reinforced masonry or concrete buildings of good workmanship and with sound mortar, but not formally designed to resist earthquake forces (Geonet, n.d.)

also be damaged. There will damage to some pre-1965 infill masonry panels, post-1980 brick veneers, decayed timber piles of houses and unreinforced domestic chimneys. There will also be a few instances of damage to structures Type 4[34]. Houses not secured to foundations may move, and monuments and many unreinforced domestic chimneys will be brought down. In the natural environment, there will be cracks on steep slopes and in wet ground and small-moderate slides. There will also be small water and sand ejections and localised lateral spreading adjacent to streams, canals, lakes, etc.

- **Liquefaction and lateral spreading (Glenorchy township) –** areas in the Glenorchy township mapped as 'high liquefaction vulnerability' (Tonkin & Taylor, 2022; 2023) could experience widespread liquefaction. This would cause damage to buildings and infrastructure (e.g., water supply, roading) (Tonkin & Taylor, 2022). Approximately 50% of buildings in this 'high' liquefaction hazard area suffer severe damages (Tonkin & Taylor, 2023). Areas in the Glenorchy township mapped as 'major or severe lateral spreading damage' could experience widespread lateral spreading. This is likely to cause severe damage (impractical or uneconomic to repair) to 75-90% to buildings within the lateral spreading hazard areas.

- **Liquefaction and lateral spreading (rural areas) –** rural areas outside the Glenorchy township have been mapped as having 'low to moderate liquefaction potential' (GNS, 2019). However, actual susceptibility could be higher. Liquefaction and lateral spreading could cause damage to dwellings and infrastructure (e.g., roads, bridges) in liquefaction-prone areas.
- **Slope stability (landslide, rockfall) -** landslides and/or rockfalls are expected at locations on the Queenstown-Glenorchy Road. This could result in the closure of the Queenstown-Glenorchy Road for 1-2 weeks.

11.2 Major Flood Event (Greater than 100-year ARI)

This indicative scenario was formed using the available science and natural hazards information at the time this SEIA was commissioned reports:

- Gardner (2022) - Rees/Dart river
- Gardner & Beagley(2023) – Buckler Burn
- Mohssen, M (2021).

The following information is descriptive (not predictive or associated with a specific likelihood) and has been provided for the purposes of exploring the potential social and economic consequences of natural hazard events at the Head of the Lake.

- **Rainfall** - Local nuisance flooding due to exceeded drainage capacity.
- **Rees River Flooding** - About 40 dwellings in Glenorchy township are within the flooded area, of which about 20 are in locations where floodwaters are >0.5 metres depth. Access roads on the Rees floodplain are closed due to flooding - the approaches to the Rees River bridge are inundated, the Paradise Road and Priory road are also closed.

[34] Buildings and bridges designed and built to resist earthquakes to normal use standards, i.e., no special collapse or damage limiting measures taken (mid-1930s to c. 1970 for concrete and to c. 1980 for other materials) (Geonet, n.d.)

- **Dart River flooding and erosion** - Kinloch Road may close due to high river flows and lake levels (for up to 1 week). River erosion directly impacts the road and prevents access at localised sites and requires temporary access routes to be formed.
- **Buckler Burn** - Floodwaters flow into the residential areas around Oban Street, Shiel Street and Invincible Drive, but are generally relatively shallow (<0.5 metres depth)
- **Debris flows and slope stability** - Debris impacts on Routeburn and Kinloch access roads (road closed up to 1 month). Debris impacts on Queenstown - Glenorchy road (closed up to 2 weeks).

11.3 Repeated, moderate flood events (about 20-year ARI)

This indicative scenario was formed using the available science and natural hazards information at the time this SEIA was commissioned:

- Gardner (2022) – Rees/Dart
- Gardner & Beagley (2023) – Buckler Burn
- Mohssen, M (2021)
- ORC (2020)
- Shaw et al. (2022).

The following information is descriptive (not predictive or associated with a specific likelihood) and has been provided for the purposes of exploring the potential social and economic consequences of natural hazard events at the Head of the Lake.

- **Lake Wakatipu and Rees River flooding -**O Overtopping of the Glenorchy floodbank and flooding into the township with similar extents to Feb 2020 event. About 10 dwellings are within the flooded area, and some are flooded to above floor level. A similar magnitude flood is repeated within a relatively short period (5 s years).
- **Dart River flooding and erosion -** Road closure due to flooding of up to 3 days. Localised river erosion threatening the roadway, which would result in loss of access if not immediately addressed through emergency works actions.
- **Buckler Burn -** No impact on township area
- **Debris flows -** Debris impacts on Routeburn and Kinloch access roads (road closed up to 1 week/10 days). Debris impacts on Queenstown - Glenorchy Road (closed up to 2 days)