



Impacts of coastal hazards on travel in the Lyttelton Harbour

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Introduction

Coastal communities across Aotearoa New Zealand are increasingly being impacted by more frequent and severe coastal flooding, erosion, and rising groundwater as a result of more intense storm events and long-term sea level rise (NIWA, 2019).

The Whakaraupō / Lyttelton Harbour to Koukourarata / Port Levy area has multiple roads that act as key access points and connections across the area, as well as the main road access to get to Ōtautahi Christchurch. Low-lying roads through Teddington, Allandale, Charteris Bay, Purau, and Port Levy are particularly at risk of coastal hazards (Christchurch City Council, 2021b; Tonkin and Taylor, 2021).

The research question *‘how could the potential loss of coastal roads impact the Whakaraupō to Koukourarata communities and how could the impacts be mitigated?’* aims to assess communities’ risk tolerance and understand the impacts that potential prolonged loss of main road access may have on communities. This understanding will help make decisions when planning for the future (Christchurch City Council, 2021a).

A community-centric approach was taken during the research with both a survey and interviews conducted to understand the impact that prolonged road closures may have on travel needs, travel adaptability, and risk tolerance, as well as potential solutions to mitigate community impact, such as road maintenance and upgrade, water transport, and community self-sufficiency.

Background

The area from Whakaraupō / Lyttelton Harbour to Koukourarata / Port Levy is made up of long rock-walled inlets along the northern part of the Te Pātaka o Rākaihautū / Banks Peninsula. There are multiple bay heads with shallow low-lying tidal flats surrounded by hill slopes, as seen in Appendix 1.

As seen in Figure 1, the main access road that connects these bays and the communities that live here follows along the coast and is being increasingly affected by coastal flooding, coastal erosion and rising groundwater (Christchurch City Council, 2021b). The most low-lying and high-risk sections run through Allandale, Teddington, Charteris Bay, Purau and Port Levy (Tonkin and Taylor, 2021).

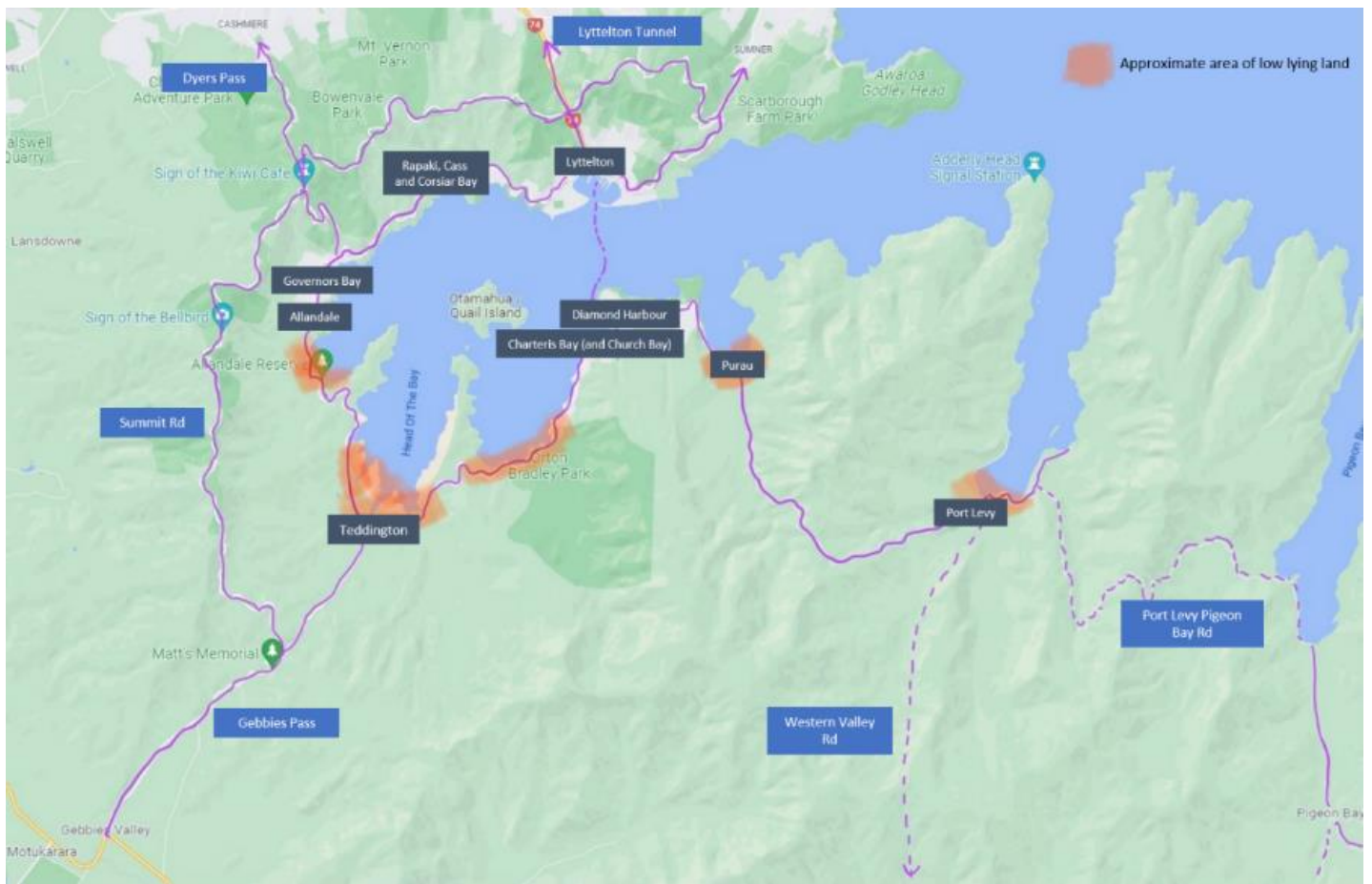


Figure 1: The study area and main access routes.

Methodology

The report focused on community perspectives to understand the impact on road users, with a survey offered to residents and interviews conducted with essential services and community members who volunteered through the survey.

The survey was conducted for Whakaraupō to Koukourarata area residents over the age of 16 asking about their travel needs, coastal hazard awareness, travel adaptability, risk tolerance, self-sufficiency, and community involvement. The survey asked about travel needs and perspectives on coastal hazards relating to travel with a focus on how individuals may be impacted rather than the community as a whole.

Semi-structured interviews were also conducted with essential services which included the only supermarket in the study area, the Four Square, the main passenger ferry operator, Black Cat Cruises, and the Diamond Harbour Fire Brigade. The only medical centre in the study area, the Diamond Harbour Medical Centre was approached and chose to answer in the form of a questionnaire.

Qualitative data from the survey, semi-structured interviews and questionnaires were analysed by identifying themes and complimenting them with the quantitative survey data.

Results

Survey and community interview analysis

The survey received 151 responses with an 80% completion rate. As seen in Figure 2, 58 of the respondents lived between Lyttelton to Governors Bay, and 77 lived between Allandale to Port Levy, hereafter referred to as the ‘target communities’. To aid in determining dependence on the road, residents were asked if this location was their main residence or if they stayed temporarily in the area. Visitors stated they either stay some of the time (i.e. 3 - 6 months per year in total) or stay occasionally (i.e. weekends or multiple weeks at a time). Occasional stayers were not asked about their travel needs as they were unlikely to have as many ties to the study area.

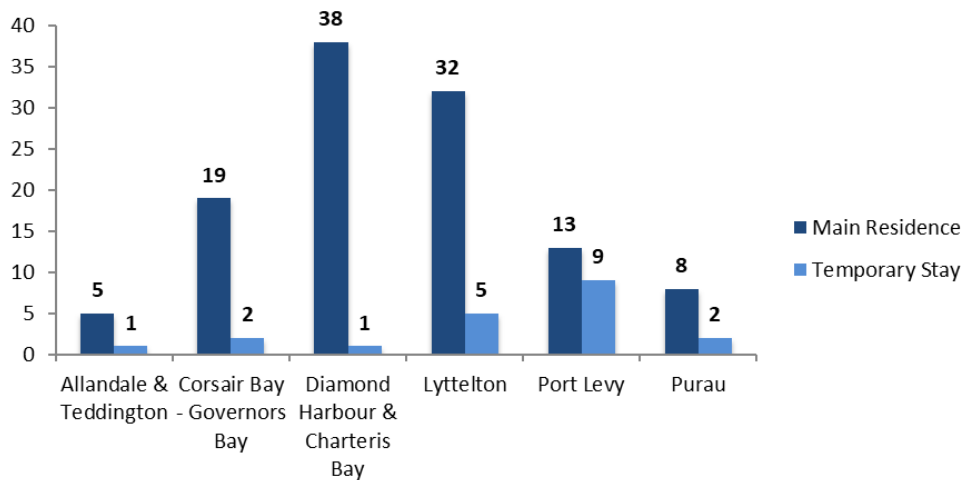


Figure 2: Response count per location in the study area.

Age and gender representation

Compared to the wider Whakaraupō population, survey responders were from a slightly older demographic, with a bias towards those aged 50 to 64. The age comparison by area can be seen in Table 1 and the age comparison by gender can be seen in Figure 3.

Table 1: Age comparison of survey participants to the 2018 Census data of Lyttelton Harbour.

		Area			
		All Respondents	2018 Census Lyttelton Harbour*	Target Communities	2018 Census Target Communities**
Age	20-34	6%	12%	5%	9%
	35-49	28%	23%	23%	21%
	50-64	44%	33%	43%	32%
	65+	23%	17%	29%	22%

*Using data from the Lyttelton, Governors Bay, Teddington and Diamond Harbour SA2 areas.

** Using data from the Teddington and Diamond Harbour SA2 areas.

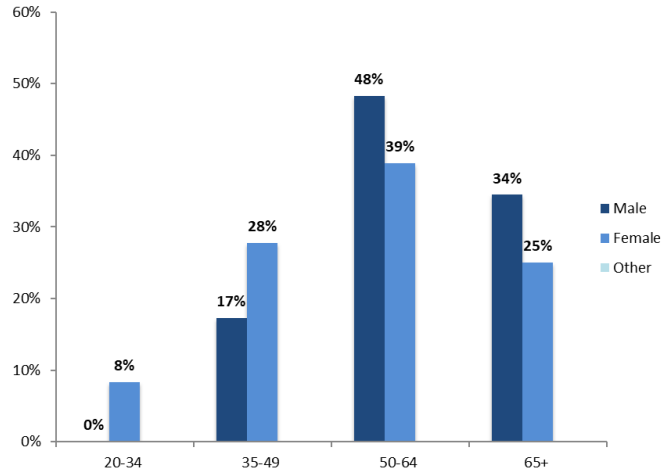


Figure 3: Age and gender demographics of target communities, n=65.

Awareness of coastal hazards

As seen in Figure 4, the target communities have a high awareness of coastal hazards overall with 80% considering themselves aware or highly aware, with Port Levy the most likely to say that they were aware (8 out of 10 rated themselves as highly aware). The Lyttelton to Governors Bay communities ranks themselves as having slightly less awareness.

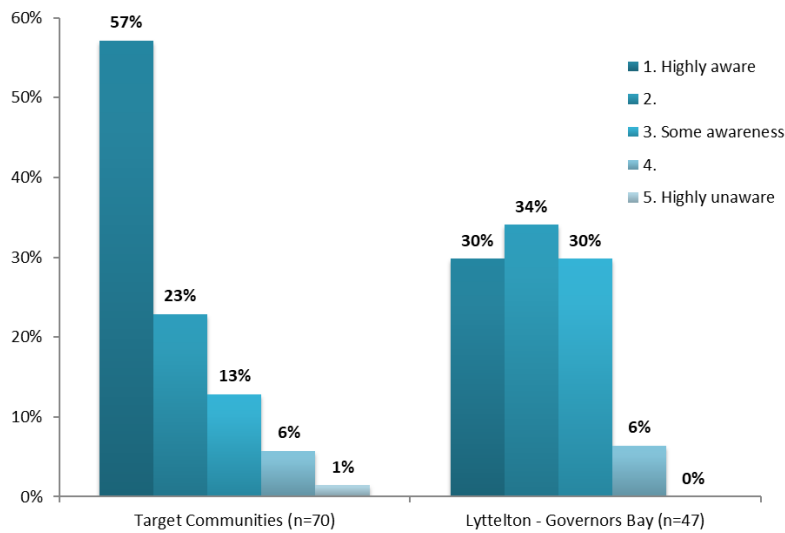


Figure 4: Awareness of coastal hazards in the target communities and the Lyttelton to Governors Bay communities.

To gauge primary concerns about natural hazards, respondents were asked which natural hazard event was most likely to temporarily close the main access roads in the area. Results were analysed by assigning a likelihood score (1 - 6) for the rank given (6 given if ranked first) and then determining the average score. As seen in Table 2, on average, both areas gave coastal flooding and coastal erosion their top two rankings respectively, with the target communities more likely to rank coastal flooding as number one (61%, n=67) compared to the Lyttelton to Governors Bay area (35%, n=46).

It was also seen that earthquakes are still a concern for the Lyttelton to Governors Bay communities, giving a higher average ranking and 50% of the community ranking earthquakes as the most likely or second likely natural hazard.

Table 2: The average likelihood score for each hazard.

		Average likelihood score for each hazard			
		Target Communities (n=67)		Lyttelton – Governors Bay (n=46)	
Order ranked	1 st	Coastal flooding (excluding tsunami)	5.4	Coastal flooding (excluding tsunami)	4.8
	2 nd	Coastal erosion	4.7	Coastal erosion	4.5
	3 rd	Tsunami	3.3	Earthquakes	4.2
	4 th	Rising groundwater	3.2	Rising groundwater	3.1
	4 th (or 5 th)	Earthquakes	3.2	Tsunami	3.0
	6 th	Other (please specify)	1.3	Other (please specify)	1.4

Some of the suggestions from respondents for ‘other’ were:

- Storms (including high winds, slips, flooded streams)
- Flooding undermining bridges
- Car accident, a gas leak in the tunnel, or explosion of stored fuel/chemicals in the port
- Poor maintenance, rock falls and landslides
- Fire

The majority (70%, n=118) of the study area respondents agree coastal flooding and erosion will become a reality in the next 50 years and only 13% disagree. There was no significant difference across the two study groups.

Communities can see that low lying areas will be impacted

Many respondents were able to identify a section of road or area they foresee being impacted by coastal hazards that also has been identified as an area at risk in the 2021 Coastal Hazard Assessment commissioned by the Christchurch City Council (the Council). The area they named was often an area that they personally connect with and therefore indicates concern about the impact of coastal hazards.

Across the target communities, a majority of respondents recognised that coastal hazards could impact their travel patterns in some way. Some participants acknowledged that there may be travel delays due to one-way traffic lights or only being able to drive at low tide, while other respondents recognised that sections of the road could be permanently flooded and wanted to see the road permanently relocated.

Respondents who indicated that they had already seen changes in their area from sea level rise often showed a higher level of concern for sea level rise.

“The beach at Purau has eroded extremely quickly over the past 5 years. So much so, the 2 benches that look out to sea have been totally undermined. If the sea encroaches onto the road, I don't know how a temporary closure will work, the flooding will be permanent.”

“I whakapapa to Rāpaki and am 28 years old and in my time have witnessed the erosion already starting with travelling by foot around my pā”.

Concern for the future and an urge for planning

When asked how sea level rise would impact their travel patterns, some respondents expressed a lot of concern for the future, and urged for planning to mitigate the impact on a growing population.

“I am 29, and disappointed at the rhetoric in my community [Diamond Harbour] around sea level rise. We bought our first house here and moved from within the four [avenues] and want to live here for many years. We know global warming and climate change will see significant impacts on this area - please, for the sake of us and the generations younger than us, put plans in place and ACTION them, so our city is liveable into the future.”

On the other hand, a few responses indicated a lack of concern, either because they had not seen any changes themselves, and also more typically with the belief that it would not affect them in their lifetime.

“Personally: very little as I am elderly, so the extent of sea level rise is unlikely to be beyond adaptation in my lifetime.”

A theme that emerged was the acknowledgment that sea level rise can be planned for and that risks could be mitigated. Many urged the Council to plan for the future and highlighted the Council's responsibility to address the impacts of coastal hazards. If a solution was mentioned, it usually involved moving or modifying the road to maintain access.

“It seems the road network will be more of an issue than the inundation of homes in the harbour, than for other parts of the city. The latest studies show the problem areas for the road network, and under which conditions the adverse impacts are likely. Please start planning and act to protect the road network accordingly.”

Travel patterns of those between Allandale and Port Levy

The survey asked about an individual's travel patterns to destinations that were deemed essential in the categories of employment and/or education, medical care, and the care of any dependents. It is recognised that some individuals may have other essential travel needs unique to them that were not asked about. Nearly 80% of the respondents were employed or studying (n=68), which is a factor closely tied to needing to travel. As seen in Table 3, of those that work and/or study, the majority (60%) travel outside the study area to do so, while 19% work from home at least periodically and 17% work in a similar area to their place of residence.

Table 3: Location of the survey participant's workplace or study.

		Location of Workplace or Study					
		Work/Study From Home	Outside of Area	Lyttelton to Governors Bay	Diamond Harbour	Purau	Port Levy
Place of Residence	Allandale & Teddington	2%	2%	4%	4%		
	Diamond Harbour	9%	42%	4%	13%		
	Purau	4%	8%	2%		2%	
	Port Levy	4%	9%	2%			2%
	Total	19%	60%	11%	17%	2%	2%

As seen in Table 4, those that work or study outside of the study area, preferred Dyers Pass followed by Gebbies Pass and then the Lyttelton tunnel as travel routes.

Table 4: Preferred routes for travelling outside of the area for work and/or study.

Preferred routes	Response
Dyers Pass	55%
Gebbies Pass	28%
Lyttelton tunnel	18%

A quarter of the respondents travel on the coastal roads for work purposes (n=53). Some of the occupations or reasons for this were:

- Truck Driving
- Cleaning
- Deliveries
- Real Estate Agent
- Driving between sites for conservation or construction
- Kaiwhakairo (Māori Carving)

Almost half the respondents in the target communities stated that they can work remotely for a few weeks at a time or more. This indicates some resilience in their employment situation, however, a quarter stated that they could not work remotely at all (n=53). A common theme was the mention of the internet being inferior quality, with one person saying that was the barrier to working from home.

When asked how sea level rise may impact future travel, there were comments about how employment could be affected as well as social activities.

“It will totally affect me as my [business] is based in Port Levy and Diamond Harbour so getting to clients could be very tricky.”

“I would seek access to theatre, community engagement & banking 2-5x/week.”

Road reliance

The respondents are not heavily reliant on public transport. Of the 72 respondents, 97% stated they had access to a motor vehicle and could drive, with only two respondents indicating they could either not drive or chose not to drive.

As seen in Figure 5, when asked whether journeys could be replaced by ferry and/or bus from Lyttelton, 56% of respondents from the target communities and 57% from the Lyttelton to Governors Bay area disagreed or strongly disagreed, indicating a reliance on the road network. There were, however, also 31% and 37% that agreed or strongly agreed with the statement in the target communities and the Lyttelton to Governors Bay area respectively.

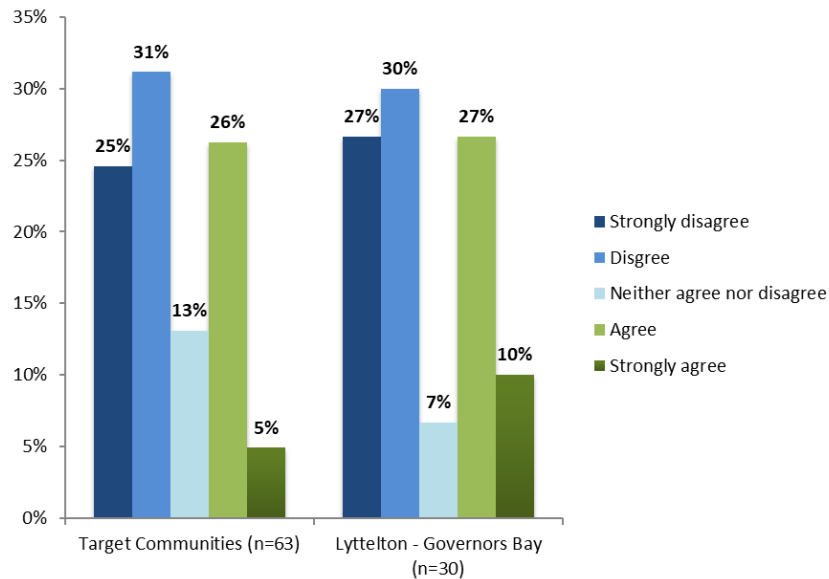


Figure 5: Agreement to statement 'Many of my journeys are, or could be replaced by ferry and/or public bus from Lyttelton'.

When respondents were asked whether their lifestyles were adaptable to frequent road closures, 44% of respondents from the target communities and 30% from the Lyttelton to Governors Bay area disagreed or strongly disagreed, while 38% and 53% agreed or strongly agreed with the statement in the target communities and the Lyttelton to Governors Bay area respectively, as seen in Figure 6 below.

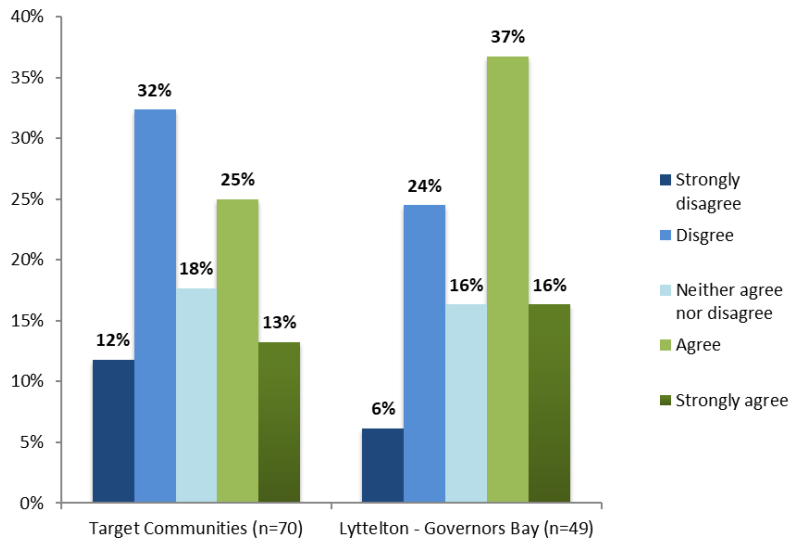


Figure 6: Agreeance to statement 'My lifestyle means I can easily adapt to potentially frequent road closures'.

Those that agreed to their lifestyle being adaptable, were more likely to agree that the benefits of their residential location outweighed potential road closures (35% across the target communities, n=67). This is not surprising when a lifestyle that is more adaptable to road closes is likely to feel less of the burden of them. Additionally, as seen in Figure 7, respondents from the Lyttelton to Governors Bay area had stronger weighting towards the benefits of their location of residence outweighing the negatives of potentially frequent road closures, likely from being less impacted by road closures.

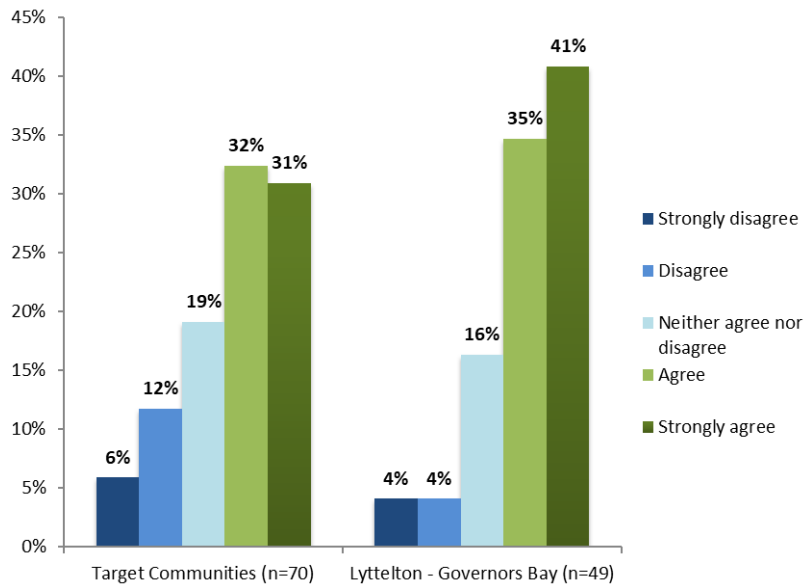


Figure 7: Agreeance to statement 'The benefits of where I live outweigh the negatives of potentially frequent road closures'.

When asked about how coastal hazards will impact travel, some respondents also gave opinions on what could be done to reduce the impacts. Most solutions were orientated around moving or modifying the road indicating a

reliance and preference for the road. The counts of solutions offered from the target communities can be seen in Table 5.

Table 5: Possible solutions to potential impacts given in comments from residents in the target communities.

Possible solutions to potential impacts	Count
Modify the road	6
Enhance community or self sufficiency	5
Improve water transport	4
Better public transport	2
Build a seawall	2
Better internet	1
Car ferry	1
Slow sea level rise	1

Road and rates

Another theme that emerged from the comments was the belief that the road is already in poor condition, and some commented that additional rates should not be paid with the road in its current condition.

“We pay a lot, and the roads are poor. Would not expect to have to pay more for what should be already there.”

However, when forced to choose between high quality roads with higher rates or lower quality roads with lower rates, the response was dominated by the preference for higher quality roads, as seen in Figure 8. It is noted that the question did not specify a targeted rate or higher rates for the whole district.

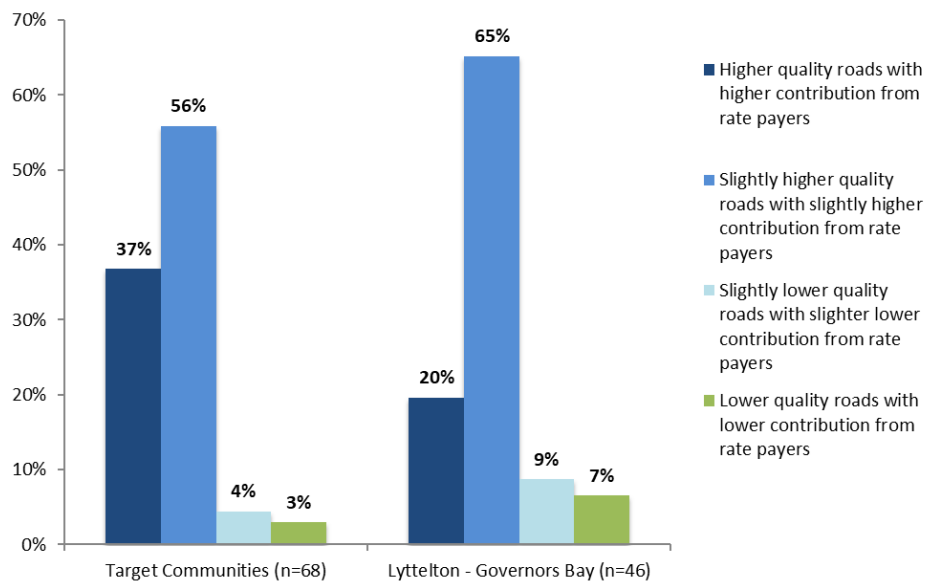


Figure 8: Indicated of preference road quality maintenance in the study area in the future with rate contribution.

Acceptable detour times

Most of the respondents were understanding of road delays in the event of temporary road closures, however, they have less appetite for a permanent closures. Of those that said a more than one hour detour was acceptable for a temporarily, a third were from Port Levy and a quarter each from Diamond Harbour and the Corsair Bay to Governors Bay area.

While three quarters of respondents from the target communities accept a 15 minute detour permanently, there was little appetite for more than 30 minutes for a permanent solution with only 16% (n=58) selecting this. A breakdown into smaller areas can be found in Appendix 3 and 4.

Water transport

When asked about the likelihood of using water transport, the target communities had split opinions. After removing the 18% (n=62) that already use water transport, 18% stated that they were extremely unlikely to use water transport if the roads were closed temporarily (for up to 72 hrs), while nearly a third indicated they were likely to use it (n=51).

In the situation of permanent road closure, the community were more certain in their likeliness, with 2 out of 10 expressing an extreme unlikeliness to use water transport, however, half said they were extremely likely (n=62). Improvement to public transport on both sides of the harbour was indicated as something that would encourage usage of water transport in both respondent comments and community interviews.

Community resilience and self-sufficiency

A strong theme was the sense of unity and the community pulling together when needed. When asked in the survey about their sense of community, it was positive overall, with 85% agreement to the statement “I feel a sense of community with others in my neighbourhood or local area” across the study area (n=114). In the target communities, 6% disagreed with feeling a sense of community (n=68).

As seen in Figure 9 below, target communities reported being more prepared with supplies for an emergency or road closure than those on the mainland side of the harbour with at least two thirds of the target communities prepared for at least a week and everyone having supplies for 48 hours.

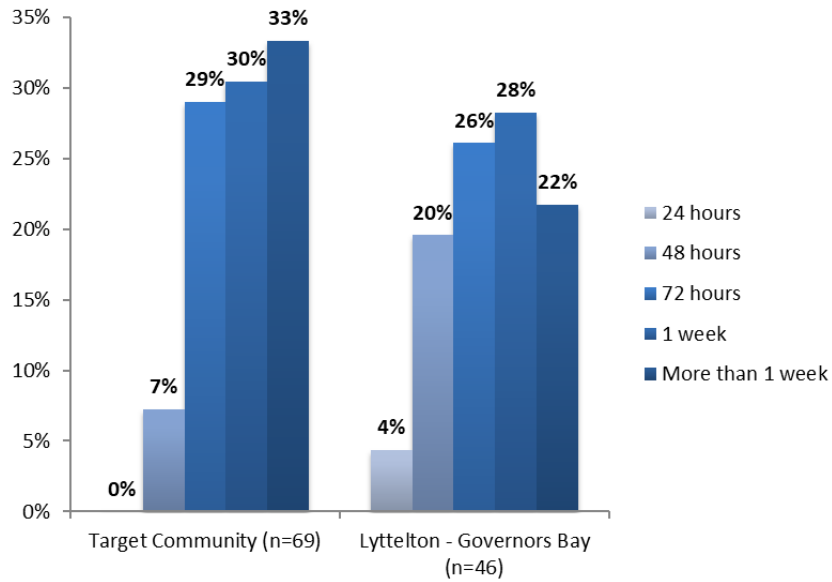


Figure 9: Duration the participants are prepared for in the event of an emergency such as a flood.

Respondents were asked to rank the following services in order of importance if the road was closed for a prolonged amount of time (for all respondents n=115), these were the averaged results.

1. Power
2. Internet access
3. Supermarket
4. Diamond Harbour ferry
5. Medical centre
6. Pharmacy
7. Petrol station
8. Vet

Other suggestions were:

- Rural fire & St John's
- Animal feed supply
- Water and sewage
- Social gathering & news

“We do not have a phone line or cell phone coverage so currently access to the neighbour's internet is our only communication if needed.”

“There needs to be transport to the ferry from Charteris Bay. This is too far to walk as a daily distance. Should there be a shuttle ferry access would be a perfect solution to any flooding as the road is higher.”

Essential service analysis

Some points that were consistent across the essential services interviews were:

- All essential services based in the target communities have sufficient staff living locally that if the road was closed unexpectedly, it would have minimal staff impact.
- There is strong sense of community, and passion to serve the community, with trust that the members of the community would assist if required.
- “We will make it work” whatever happens. Some were willing to use water transport if the road was closed but, in an emergency, there is a high expectation of helicopter use.
- Road access is essential for deliveries. The Diamond Harbour Four Square and medical centre both receive deliveries frequently and require temperature-controlled containers.

Awareness of coastal hazards and hazard preparedness

The Four Square and Medical Centre, both located in Diamond Harbour, have a high awareness of coastal hazards as they are heavily reliant on road access for deliveries. While they are both prepared for alternative deliveries during temporary road closure (less than 3 days) by using water transport, there is currently no feasible or secure alternative delivery plan for greater than 3 days, so long-term hazard preparedness is low.

The Fire Service has a high level of concern for coastal hazards and have planned responses to these. They have practiced multiple scenarios, and have held meetings to plan and learn from past events. However, it was stated that 95% of the time they operate reactively.

The Black Cat Ferry service had a high level of awareness, although they were confident in their abilities to operate and support other essential services during a flood event. However, their emergency responses in the past have been short term.



Figure 9: The Diamond Harbour ferry service “Black Cat Ferry” connects Diamond Harbour and Lyttelton.

Impact of road closure

The Four Square indicated that their biggest concern for potential prolonged road closures was their ability to continue to receive their regular deliveries, three times per week. The Four Square currently receives these deliveries in trucks from Christchurch City usually via Dyers Pass. It was believed that there is currently no feasible or secure alternative road or water transport for the deliveries that would meet the supply demand if the main access road was closed. Limitations are the size of each delivery and the need for temperature-controlled containers. Water transport is not realistic permanently with the current conditions due to the difficult access down to and then on to the Diamond Harbour jetty. Small deliveries of essential items by ferry are possible. From experience during the COVID-19 lockdowns, the Four Square can remain open for up to three days by rationing food and supplies but longer than that could see essential supplies run out.

The medical centre’s main concern for road access loss is their ability to provide medical care to their patients. The main form of emergency medical transport is by ambulance, although a helicopter or boat could be used depending on availability. One of the two doctors and one of the three nurses do not live in Diamond Harbour so staffing could

also be an issue if the road was closed on a day either of those staff members were rostered on. Although, the medical centre pointed out that doctors who live locally and work in the city have helped the medical centre in the past. A high proportion of Diamond Harbour residents are not registered with the medical centre and may place additional demand on the centre. Phone appointments and/or house visits from Teddington to Port Levy are possible. The medical centre has regular deliveries, with mail every day via vehicle and urgent supplies could be delivered by ferry if approved by the supplier, although some may require refrigeration, similar to the Four Square. As a rural practice they are well stocked and could remain open for up to 3 days but past this would be inconvenient.

The Black Cat Ferry indicated a low level of concern for potential prolonged road closures as they do not expect to be significantly impacted. In response to past temporary road closures, they have seen no increase in travellers. Generally, they see lower patronage as road closure usually corresponds with bad weather. As the number of travellers via ferry increases during the summer months, the Black Cat Ferry service has a large staff base with many casual workers. Most live in Lyttelton or Christchurch City, with a few in Diamond Harbour or other areas. The ferry operates in weather conditions below 40 knots, although conditions other than wind could also prevent its travel. However, in the last five years, there has been only one full day that the ferry did not operate, and a few half days. The ferry can transport goods to the Four Square or medical centre temporarily but only small amounts of supply due to capacity and no specialist loading equipment. They could also transport injured people if an ambulance could not get through, as has been done in the past.

The Fire Service indicated a concern for coastal hazards preventing road access to certain communities. Their area of responsibility extends from Governors Bay to Pigeon Bay. In previous flooding events, road closures or blockages have proved difficult for accessing different locations and transporting people out of the area. However, helicopters, navy boats and tugboats are always an option for alternative transport access, but the fire service must share those resources with other communities, especially if an emergency extends beyond Lyttelton Harbour (such as a large storm). Helicopter landing pads are both in Diamond Harbour at Laurenson Park and the rugby grounds at the domain. Both are frequently used and great locations for trucks, ambulances, and helicopters to meet. The Fire Service has recently upgraded to own a 4WD vehicle to be able have more capability on rough terrain.

Current community resilience

The community resilience within the study area is mostly high, with both the Four Square and medical centre representatives emphasising the community strength in Diamond Harbour. During the COVID-19 lockdowns, the Four Square received many volunteers for home deliveries to help those in their community in need. While, during the 2010 and 2011 earthquakes, local nurses and doctors that were not employed by the Diamond Harbour Medical Centre offered their help to those in need.

The Black Cat Ferry service indicated that in the event of an emergency there are lots of people with boats, or backup ferries that have in the past helped move supplies to those in need.

Considerations for future planning

Maintaining road access

The Four Square strongly preferred maintaining road access due to the frequency and size of its deliveries.

The Fire Service indicated that road access is essential for emergency travel within their responsible area. Although they have planned for a 4WD vehicle that will allow them to travel through high water, their fire trucks cannot get through difficult places or high water. Thus, the movement or raising of the low-lying roads would be preferred for the Fire Service to support the movement of emergency vehicles.

The Diamond Harbour Medical Centre also indicated a preference for a road focus. This supports both their patients travel to the medical centre, as well as themselves to their patients. Road access also allows ambulances to get directly where they need to go.

The quality of current roads was a consistent concern from some of the essential services and focus group participants. Maintenance of current roads before building new roads to maintain was also raised.

Water transport

The only locations the Black Cat Ferry can go to are Lyttelton and Diamond Harbour as no other bays have suitable wharfs. In preparation for future potential prolonged road access loss, it was suggested that the Council investigate adding another facility. However, the location of this would prove difficult as many of the bays such as Governors Bay and Charteris Bay are shallow, and the ferry would only be able to access during high tide.

The Black Cat Ferry service indicated a car ferry would require a significant upgrade as the current structures at the Lyttelton wharf and particularly the Diamond Harbour wharf are not fit to support it. It would take major infrastructure changes to make a car ferry possible.

Discussion

Current reliance on roads

There is a high level of concern about losing road access and a fear of being isolated. Based on interviews and a high number of comments, calling for the road to be modified, to maintain road access, it would be easy to interpret that roading should be prioritised over other modes of transport in adaptation planning. However, a limitation of this study was that it was very difficult to accurately seek the perspectives of the community relating to what they would want or need in a future context. Responses were predominately based on current travel patterns and it is important to acknowledge that Ōtautahi Christchurch is a very car-focused city, with a strong driving mind-set. Public transport is only used for 2.5% of peak hour journeys in Greater Christchurch (Environment Canterbury, 2018), so it is unreasonable to expect high interest in Banks Peninsula.

The current car-focussed mind-set should not be the sole factor in transport and adaptation planning. Given that sea level rise has been driven by carbon emissions, and transport is one of the highest carbon emitters, making decisions based on current driving patterns may slow efforts to decrease carbon emissions. There was interest in public transport and water transport, especially if the road was closed for a prolonged amount of time, and the barrier to driving was higher.

Respondents were asked questions about future travel patterns in a silo, which didn't account for other possible factors such as rising fuel costs, changes in healthcare needs, and property value changes, to name a few. The study also did not explore the option of voluntary retreat due to the sensitivities of the topic, however, if the road closures become too frequent and burdensome, some of the community may choose to move rather than adapt their travel

lifestyle. This may be more likely for residents in Diamond Harbour with a higher percentage rating their lifestyle as less adaptable and the benefits of their home location being less strong against the frequency of road closures. Those living between Lyttelton and Governors Bay, indicated a better balance towards the benefits of their community, likely not because of greater benefits, but rather, fewer experiences and likelihood of road closures.

This study only focused on road closures caused by coastal hazards, however, several respondents showed they still had the memory of earthquakes where the harbour was cut off from Christchurch. This experience and fear of isolation has most likely impacted respondents' preferences. Additionally, the Royal New Zealand Navy was able to help Lyttelton during the 2011 earthquake response, which from responses, may have set an expectation that the Navy will support during future emergency responses.

The emergency services interviewed had a high dependence on the road and are aware of this. They had a preference to maintain road access, however, they held attitudes that maintaining their operations was the highest priority and would find a way to adapt if road closures were too significant.

If no modifications were made to the road, road closures would become more frequent, which may change attitudes and behaviours with road closure experiences. When asked about the longer term, the respondents appeared to split into two groups: one group who would adapt to continue to maintain a similar lifestyle and the other group with a greater reliance who may be less patient with road closures. From the survey respondents, there are about equal amounts of people in each group with a high concentration of the second group in the Diamond Harbour and Charteris Bay area, who may be more strongly opinionated about the road. Without the road, some of the second group may also choose to leave living in the study area.

Increasing adaptive capacity

A strong difference in the target communities' mind-set between temporary and permanent loss of road access has been seen. There is a high level of flexibility from both the community and essential services to temporary road closures, with the ability to use water transport for supply deliveries and travel in a short-term scenario. However, the loss of the main access road for longer than three days significantly declines the communities' adaptability, particularly in Diamond Harbour. Despite the strong current reliance on road transport, the results also show that there is room to increase the adaptive capacity of these target communities in the future. Factors such as improved public transport, water transport, and internet access could potentially drive a change in the behaviour of these target communities and their reliance on road transport. Wider and future thinking such as “what are the opportunities, not the losses”, as suggested by a community member, must be done.

Despite the communities showing a preference for road transport, they also had an appetite for water transport. The adaptive capacity of the target communities could be increased by encouraging increased ferry usage by making the ferry as one community member said, “more affordable, frequent, and easier to get to town quickly via ferry”. The ferry is currently more difficult to use and access in comparison to private cars. A community member also highlighted that the ferry is particularly difficult for the elderly and people with mobility challenges which is important given the slightly older population in the study area.

While there are currently plans to increase the ferry's capacity and upgrade the wharf to floating pontoons, the whole journey from house to destination must be improved, to make the experience accessible and to increase usage. The Diamond Harbour wharf is a single point in a large transport catchment area. The distance to the Diamond Harbour

wharf from the wider Diamond Harbour area (6km from Anderson Rd, Charteris Bay and 3km from Purau) is not walkable nor bike-friendly. Enhancing the efficiency of public transport within the study area such as frequency, transport down to the Diamond Harbour wharf, and more frequent connection buses from the Lyttelton wharf to Ōtautahi Christchurch could potentially increase the number of residents willing to use water transport both currently and in the situation of road closures.

A Governors Bay interviewee discussed the efforts of the Governors Bay Transport Trust running a community bus that offers rides to residents from Governors Bay to out of the study area. They highlighted that it did not have as good ridership as planned as many residents already had cars for transport. It could be worthwhile to better understand the community bus usage barriers as there may be overlap for water and public transport.

Sole reliance on water transport to potentially create 'islands' between the different bays may be an option but needs further research in the feasibility and would require a large change in thinking for residents as they are very accustomed to the road. Port Levy has a jetty but many of the bays have shallow waters, making water based public transport hard.

A few comments suggested a car ferry, again highlighting the current preference for driving, as well as to be able to use a car in Christchurch as opposed to other modes. When the Black Cat Ferry service was asked how realistic a car ferry would be, many challenges were cited, including the need to significantly upgrade the wharf at Diamond Harbour, and build infrastructure relating to car movements at Diamond Harbour. They also noted that sea level rise will impact the land at the wharf. There were no questions nor suggestions about a ride share or an equivalent that would enable people to drive to and within Christchurch which may be an alternative to a car ferry that reduces reliance on the roads.

Internet access was also highlighted as an issue within the study area. With no fibre, the connection within the area is considered "average on most days" by an interviewee. Improvements to internet connection could better enable some people to work from home, which is becoming more acceptable after COVID-19 lockdowns. A community member had been told that it was not cost effective to install fibre in Purau, however, this may become more cost effective if weighed up against alternative transport plans. A limitation is also that the survey was only distributed online (therefore excluding those without access to the internet or a technology device), and there may be some people who prefer face to face interactions rather than relying on digital technologies.

Planning considerations

Results from this research indicate a preference for maintaining the road. However, no costs or funding mechanisms for completing this were discussed. While this discussion was out of scope for this research project, people's preference for upgrading the road may change depending on where funding comes from.

When engaging with the community in the future, it is important to recognise that some of the communities are highly aware of the risks of sea level rise already, while some respondents' comments indicated that they thought the road may only be temporarily or intermittently closed, although timeframes were not discussed. Therefore, when discussing solutions to prolonged loss, it is recommended to highlight the full risk to the road. Additionally, there were indications of some attitudes that future coastal hazards would not affect them personally as they may not see the effects within their lifetime, making it even more important to have a range of ages in engagement.

Despite this, there was a significant amount of appreciation from the communities towards the Council's decision to have high community engagement in this issue and plan early for the future, and there is currently a large number of community members that want to be involved in decision making. It must, however, also be considered that several participants indicated distrust in the Council's intention to consider the communities opinions and needs.

Before making decisions towards adaptation in the Whakaraupō to Koukourarata area, conversations with existing landowners must be considered. An interviewee believed that the study area has a significant amount of cultural and historical land such as the Governors Bay jetty and along the coastal foreshore. These sites will need to be identified in discussion with Ngāi Tahu and local rūnanga as cultural values need to be considered in adaptation planning.

Conclusion

This research sought to understand the community perspective of how the potential loss of coastal roads will impact the Whakaraupō to Koukourarata area communities and how the impact could be mitigated. It is clear from this project's community engagement that potential prolonged main road closure will have a significant impact on the travel patterns and livelihood of the communities within the study area. The essential services within the study area will struggle to maintain regular and secure deliveries, as well as the level of service they currently provide, should the road be closed permanently or for a prolonged period. The maintenance and upgrade of road transport could mitigate these impacts based on the communities' current travel needs. However, other solutions to increase their adaptive capacity could also prove effective, such as water transport and internet enhancements. Allowing the road to be impacted by coastal hazards is an option but would shape the harbour to become vastly different to what it is today, and would require significant community engagement and compromising. During adaptation planning, the road network cannot be considered in isolation as it is only one of the complex factors. This was preliminary engagement to understand the risk tolerance of communities regarding future road closures and the next step would be to share possible feasible travel options with cost estimates as pricing may create a different set of perspectives. The Diamond Harbour ferry already provides some travel redundancy, and moving forward, it will be even more important for the Council to work with Environment Canterbury on how public transport can improve the adaptive capacity of the area.

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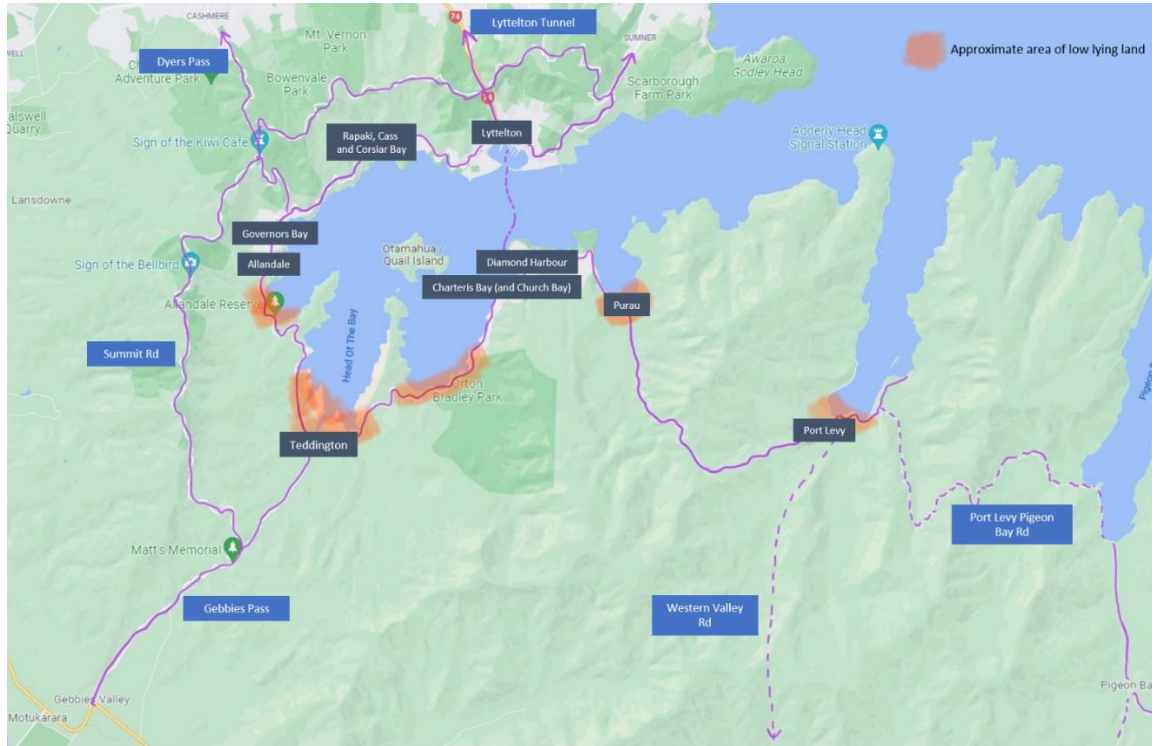
Appendix

1. Topographical map of area for context of altitudes

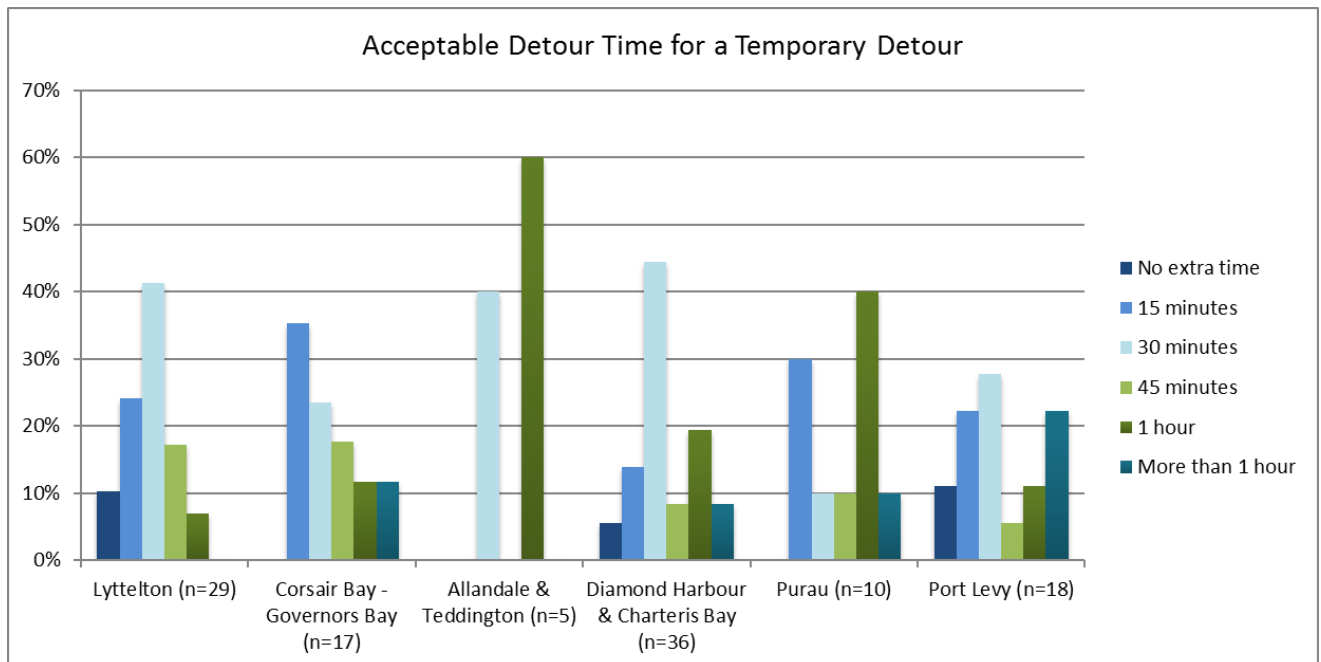
<https://www.topomap.co.nz/NZTopoMap?v=2&ll=-43.635083,172.740447&z=13>.



2. Map of travel routes in study area



3. Break down per location of acceptable times for temporary detours



4. Break down per location of acceptable times for permanent detours

