SOUTH DUNEDIN FUTURE
WORKSTREAM 4: ADAPTATION
STAGE 3:
POTENTIAL ADAPTATION FUTURES

BACKGROUND CONTEXT TO SUPPORT MICRO-BUSINESS CASES

3 March 2025

SOUTH DUNEDIN FUTURE | DUNEDIN CITY COUNCIL kaunihera a-rohe o Ōtepoti | Otago Regional Council | WSP | Beca | Tonkin+Taylor

SOUTH DUNEDIN FUTURE

POTENTIAL ADAPTATION FUTURES – CONTEXT SUMMARY

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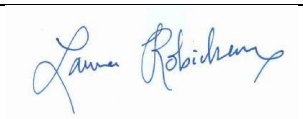
Technical Reviews by:	Laura Robichaux, Liam Foster	03/03/2025	
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1 Introduction

1.1 Programme Overview

Adapting to our changing climate is a big challenge with increasing severe weather events such as the heavy rain that occurred in October 2024 placing strain on the stormwater and water supply infrastructure of South Dunedin and elsewhere. Emergency management and welfare services implemented recovery and support measures for the affected areas. This event underscored the community's vulnerability and the urgency to act, as outlined in the ongoing South Dunedin Future Programme.

South Dunedin Future is about understanding how the environment is changing, considering how that will affect us, and looking at what we can do about it. The five stages of this programme are summarised in the ribbon below and the relevant components of the Adaptation workstream (Workstream 4) are expanded on below.

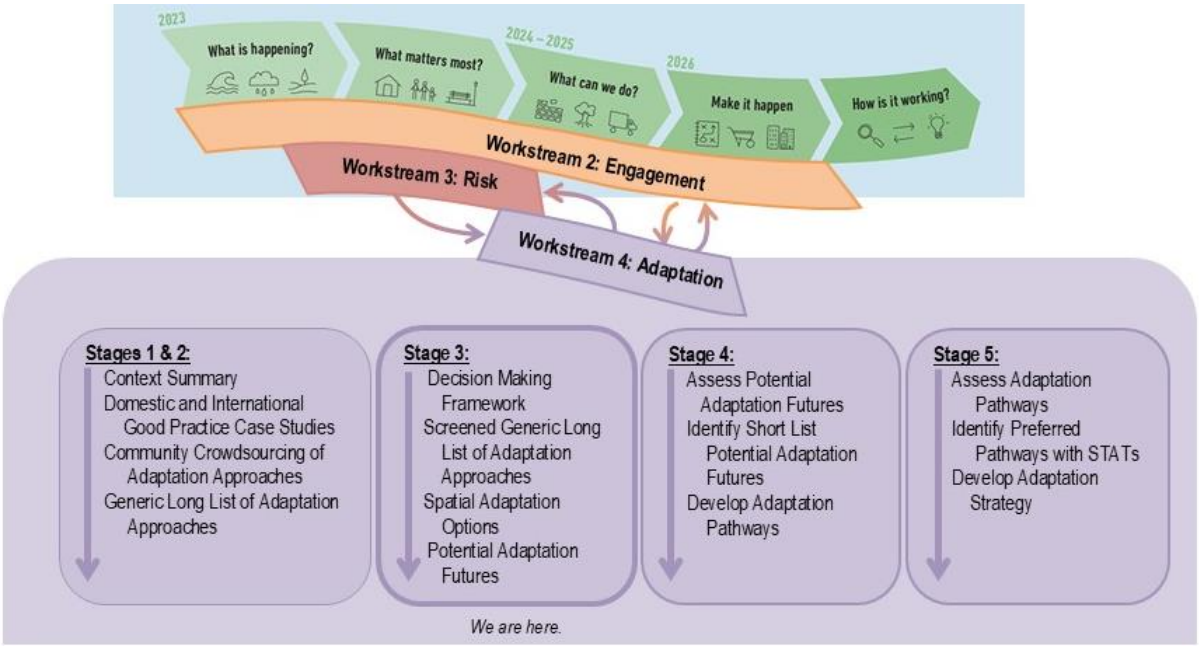

Figure 1: Programme Overview (note STATs in Workstream 4 are signals, triggers, and adaptation thresholds)

The programme follows the five main questions that reflect the 10-step decision cycle for adaptation planning provided in the Ministry for the Environment Coastal Hazards and Climate Change Guidance (2024). The steps allow for both short- and long-term planning via adaptive pathways and decision-making for South Dunedin.

The five main questions in the 10-step cycle are:

- What is happening?
- What matters most?
- What can we do about it?
- How can we implement the strategy? (Make it Happen)
- How is it working?

It is noted that this Context Report reflects the current stage in the process, which is the third of five iterations of the "what can we do about it" stage. In the fourth and fifth iterations, additional analysis, detail and short-, medium-, and long-term pathways of shortlisted and preferred futures will be provided. The following describes how answers to the key questions are reflected in this stage.

What is happening?

The South Dunedin risk assessment summarises the natural hazards affecting South Dunedin and outlines how these are expected to change over time, including in response to climate change. The risk assessment also considers South Dunedin's exposure to these changing hazards, analysing the resulting risk now and in future.

What matters most?

The risk assessment sets a baseline, outlining the risks faced by communities within the South Dunedin study area and the associated consequences for people, places, and assets that are important. This baseline has allowed a consideration of the residual risk that may remain for each Adaptation Future. This is a picture of what could happen if appropriate action is not taken in response to the escalating hazards. However, there are many things that can be done to mitigate and manage risk, including reducing both the likelihood of those risks occurring and the consequences should they occur.

Community engagement (Workstream 2), along with the visions and objectives documented in relevant strategic documents, has been used in the micro-business case evaluations to assess the potential Adaptation Futures against what matters most. For example, during this stage high level costs and benefits of each Adaptation Future have been provided (see Table 8, Section 6 of this report). These high-level evaluations will become progressively more detailed as we move into future stages and adaptation pathways preferred by the community are narrowed down. The Adaptation Futures developed during this stage will be used through Workstream 2 to continue discussions with the community around what matters most to them and the level of risk and associated implications with each to allow that narrowing down in focus.

What can we do?

There are many things that can be done to manage and mitigate the risk affecting South Dunedin. This could include infrastructure protections like pumps and pipes or parks and wetlands, property-based interventions like raising or water-proofing houses, changing plans and rules to avoid building in risky places, and retreating or relocating to move people and property out of harm's way.

In December 2023, councils released a list of sixteen approaches for helping South Dunedin adapt to flooding and future climate change. The list was made by merging around 280 ideas crowd-sourced from the community and stakeholders and informed by the best approaches from around the world. The sixteen approaches were presented for feedback from the community in March and April 2024. Community feedback has helped refine the approaches and test how they could be combined in different ways to manage and mitigate flood risk in South Dunedin. This has resulted in the Potential Adaptation Futures in Stage 3 (see Section 1.2). They include a 'status quo' future - essentially the path we're currently on if we do not change anything - and six other futures representing a spectrum of responses, with a focus on infrastructure at one end and land use change at the other.

Figure 2: Sixteen approaches to manage risks in South Dunedin

Mana Whenua partnership and collaboration

Both councils have Māori partnership and collaboration commitment policies. A Mana Whenua Panel (the 'Panel') has been formed to provide Kāi Tahu inputs and oversight to the programme on behalf of rūnaka.

Te Taki Haruru – the DCC's Māori Strategic Framework – was utilised to guide how inputs and direction from the Mana Whenua Panel could be incorporated into the programme, including both the risk assessment and adaptation options planning workstreams. Initial engagement with the mana whenua panel involved formulating a cultural values framework that aligned with the four principles of Te Taki Haruru. These values provided the basis for the Panel and Aukaha to define mana whenua specific risks within the South Dunedin Futures Programme area, and to define vulnerability rating statements using the same scale as used in the main risk assessment (very low risk, low risk, moderate risk, high risk, extreme risk).

The 'very low vulnerability' statements for each Te Taki Haruru value were then translated across to the adaptation planning workstream as the Best Outcome Statements for each of the seven potential adaptation futures. These inputs have been incorporated into the evaluation criteria presented in Appendix A.

Based on the cultural values framework and a subsequent assessment of risk from a mana whenua perspective, each of the seven potential futures were evaluated through this lens by Aukaha with Panel input and direction. These evaluations have been incorporated into the overall

micro-business case evaluations to ensure they capture rūnaka values, associations and aspirations for the programme area.

Throughout the assessments, a number of te reo words and concepts are used. These have been included in Appendix C - Glossary and include:

- Wai - water
- Moana - ocean
- Mahika kai - food and resource gathering sites and practices
- Mauri - life force and vitality
- Te Mana o Te Wai - concept that protecting the health and mauri of water bodies is paramount to the health of wider natural ecosystem environment and health of people
- Ki Uta Ki Tai - a holistic, inter-connected and or catchment-wide approach to natural resource management
- Marae - meeting area hosted by mana whenua in front of a wharenui (meeting house), also used to refer to surrounding land and buildings
- Kaitiakitaka – exercise of guardianship by mana whenua
- Hauora – health and wellbeing.

1.2 Adaptation Stage 3 Introduction

This report presents the methodology and outputs of Stage 3 - developing spatial potential adaptation futures. This report builds on the draft South Dunedin Futures Risk Assessment Report (February 2025) and the previous generic longlist of approaches. The purpose of this report is to provide context to Dunedin City Council and Otago Regional Council readers on the methodology used in Stage 3 and to document decisions made as background to the microbusiness cases of potential adaptation futures delivered under Workstream 4 in this stage (Stage 3). As shown in Figure 3, Adaptation Futures will be continuously refined over the course of the programme, including considering options over different timescales, to allow more detailed assessment and ultimately recommend preferred adaptation futures and pathways.

The report provides the following:

1. Methodology for screening the generic longlist of adaptation options to identify the spatial options and Potential Adaptation Futures for South Dunedin
2. Brief description of spatial adaptation options in the context of South Dunedin
3. An introduction and description of “Potential Adaptation Futures” for South Dunedin.
4. Next steps.

Adaptation Planning Steps 1-5
Research and development of 16 adaptation approaches

The diagram to the right outlines how the SDF programme is moving through the five steps of "What can we do?" on the way to producing an Adaptation Strategy for South Dunedin.

Steps 1 & 2
Research on climate adaptation around the world was combined with ideas crowd-sourced from the community and stakeholders to develop 280 options consolidated into a list of 16 generic adaptation approaches. Community engagement on the 16 approaches occurred in early-2024.

Step 3: 7 Potential Adaptation Futures (Longlist)

The 16 adaptation approaches have been refined and categorised as shown in the diagram on the next page, following community feedback and further technical analysis, then combined in different ways to form seven potential adaptation futures. Each of the seven possible adaptation futures represents what South Dunedin could look like in 75 years (the year 2100), noting that as conditions change over time, these futures could be realised earlier or later than 2100. Community engagement on the seven futures is planned for early-2025.

Step 4: 3-4 potential adaption futures and pathways (Shortlist)

Feedback from community engagement, and further technical and economic analysis, will be used to refine the seven potential adaptation futures into a shortlist. Each of the shortlisted futures will include pathways showing what changes could look like at 2050, 2075, 2100 and beyond with more detailed information regarding the useful life for adaptation actions over time. New actions along the pathway begin when conditions signal the need for change. Community engagement on the shortlisted futures and pathways is planned for early-2026.

Step 5: Preferred adaptation futures and pathways

Feedback from community engagement and a final round of technical and economic analysis will be used to refine the shortlist into a preferred adaptation future and pathway. As shown, the other pathways still remain "on the table" if the climate or communities change in unexpected ways. Community engagement is planned for late-2026. The final version of the preferred adaptation future and pathway will be presented in an Adaptation Strategy for South Dunedin, which is expected by the end of 2026.

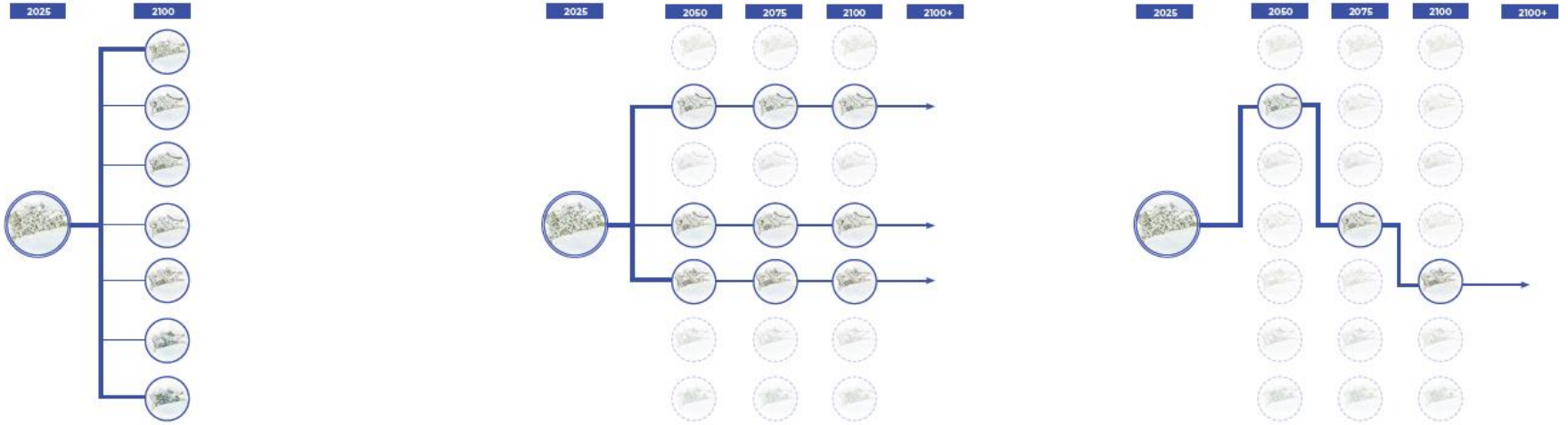

Figure 3: Adaptation planning steps 1 to 5 show how the South Dunedin Futures programme is moving through the five stems of “What can we do?” on the way to predicting an Adaptation Strategy for South Dunedin.

2 Overview of risk assessment

2.1 Integration of risk and adaptation

Within the wider programme context, the purpose of the South Dunedin Risk Assessment is to "assess the potential for elements at risk (people, places, assets) to be negatively affected by pluvial flooding, coastal inundation, coastal erosion, groundwater, landslide and liquefaction natural hazards in South Dunedin". This is required to support two aims:

- Outline the case for change - The baseline risk profile illustrates the consequences of a 'status quo' or 'do nothing' scenario.
- Spatial adaptation planning - Spatial risk quantification helps identify locations where adaptation measures are more likely required to reduce risk. The changing risk profiles over time helps inform when adaptation may be required. The risk profile for South Dunedin provides a baseline against which the merits of potential risk mitigations (e.g. adaptation options) can be assessed.

The risk assessment and adaptation planning workstreams have been deliberately designed with integration in mind. Places and spaces of importance from the risk assessment will be considered as adaptation planning continues to understand how the community will need to transform over time retaining the functionality of these places and spaces of importance. The risk assessment ultimately forms the "case for change" and an understanding of the potential impacts of continuing down current path.

The potential adaptation futures in the longlist phase of developing the adaptation strategy present what South Dunedin could look like in late century with a range of combinations of adaptation actions. These futures are assessed using the same categories as within the risk assessment – medium term (2060-2070) and long-term (2100) timeframes using two greenhouse gas emissions scenarios representing mid-range (SSP2-4.5) and high end (SSP5-8.5) projections - at a high level to begin to better understand residual risk associated with each future. This understanding can aid discussions around risk appetite and enable decisions to be made considering costs, risk reduction and wider environmental, social and cultural considerations.

2.2 Overview of risks

The South Dunedin Risk Assessment (Kia Ropine, 2025) examined the hazard scape affecting South Dunedin to assess the direct physical risks for a range of 'elements' - including people, places and assets. The risk assessment also examined how these risks might change over time, moving from a present-day assessment to mid-century and end-of century climate scenarios.

At present, risk across South Dunedin is driven largely by groundwater and pluvial flooding. Approximately 60% of buildings within South Dunedin are rated medium to high risk due to at least one of the assessed hazards but < 1% are at medium to high risk to three or more hazards. At the coastal edge, erosion poses a medium to high risk to parks. More broadly, the roads and wastewater assets have the highest proportion of assets rated at high risk.

- 35% of roads are subject to groundwater levels requiring unsustainable maintenance.

- 50% of wastewater pipes are leaky and past their useable life, resulting in reduced level of service.

Many of these risks are realised day-to-day across South Dunedin, such as shallow groundwater reducing the liveability of residential properties and negatively affecting the level of service of roads, stormwater, and wastewater. They are also occurring periodically, such as the heavy rainfall events in June 2015 and October 2024, which caused widespread pluvial flooding and damaged buildings and infrastructure across South Dunedin. There are a range of cascading risks and impacts that result from these direct physical risks, many of which are observable at present day. For example, flood damage negatively impacts housing quality, insurability, and market value, and costs of flood repairs can increase cost of living, affect mental health, and increase inequality.

At mid-century, significant increases in medium to high risk arise in sports fields due to coastal erosion (increase from 0% at present day to 20% at mid-century), buildings due to groundwater (increase from 23% at present day to 71%-78% at mid-century) and contaminated land due to groundwater (19% at present day to 36%-60% at mid-century).

At mid-century, approximately 20% of South Dunedin buildings are rated medium or high risk arising from a single hazard and 60% from at least two hazards, but < 1% are at medium to high risk to three or more hazards. The chronic effects of high groundwater will cause increasingly widespread decline in building condition, stability, and healthiness, sports fields, and roads, as well as reduction in level of service of stormwater and wastewater systems. Increased spread of contaminants is likely as a result of these risks as well as due to the effect of high groundwater on large number of contaminated sites. Increased event-based impacts will result in damage to increased numbers of buildings. These increasing risks carry cascading impacts, including health risks, environmental damage, significant reduction in sports field area, decline in building performance and increased road maintenance.

At late century, risk arising from groundwater coastal inundation and pluvial flooding is widespread, with 69-84% of all buildings at high risk to these hazards. Additionally, most other elements at risk have a high percentage of assets that are at high or medium risk to these hazards. Approximately 90% of South Dunedin buildings are rated at medium or high risk due to one or more hazards. In the case of groundwater, 80-84% of buildings will be subject to medium or high risk, where widespread emergent groundwater could cause instability to foundations, increase dampness and mould, and reduce level of service of stormwater, wastewater, and other utilities servicing these properties. As the number and severity of risks increase, the functionality or level of service of the places and assets within South Dunedin will decline. This will bring complex and interrelated cascading impacts on the social, economic, and environmental systems in South Dunedin. Many of these impacts will affect broader Dunedin city and wider region, given the interconnected nature of activities, services, and infrastructure in South Dunedin (e.g. the majority of Dunedin's wastewater is treated in South Dunedin).

Analysis in the risk assessment shows that South Dunedin has high exposure to natural hazards and a correspondingly high baseline risk profile. Anticipated changes in climate and associated increases in exposure to natural hazards are expected to materially increase risk across all elements assessed in the risk assessment. As this exposure and direct physical risk increases, the adverse consequences for South Dunedin's buildings, infrastructure, and communities also increase to a point where much of the key infrastructure, functions, and services experience declining functionality, loss of service, or complete failure. These risks will have significant adverse effects on the South Dunedin community, Dunedin city, and the economy unless appropriate risk mitigation is employed.

While further work is planned on determining risk tolerance and thresholds, community reactions to floods in June 2015 and October 2024, and public and official discourse surrounding these events indicates this level/frequency of flooding is likely intolerable - and that change is required. The next phase of engagements around possible adaptation futures will assist in further confirming the current level of community risk tolerance.

The risk assessment illustrates that flood events such as June 2015 and October 2024 are likely to become more frequent in South Dunedin. It also indicates these periodic floods will likely be more severe, due to the compounding effect of gradual onset hazards such as rising sea-levels and groundwater.

This paints a confronting picture of hazard, risk, and consequence for South Dunedin. The possible adaptation futures presented in this report illustrate a range of options for managing these risks across South Dunedin and reducing these to tolerable levels. However, it should be noted that each adaptation future addresses risks to certain levels and depending on the rate and scale of change in climatic conditions (i.e. the differing climate scenarios) some futures may reach the end of their range of effectiveness sooner than others. The report explores the merits of various adaptation options, the trade-offs involved, and the type of future they could lead to in South Dunedin. This is intended to enable partners, stakeholders, and affected communities to compare various options and discuss risk tolerance and favoured futures to allow a more detailed assessment of combinations of options in the short-listing stage.

Summary of Risks to South Dunedin

Buildings, Parks & Transport

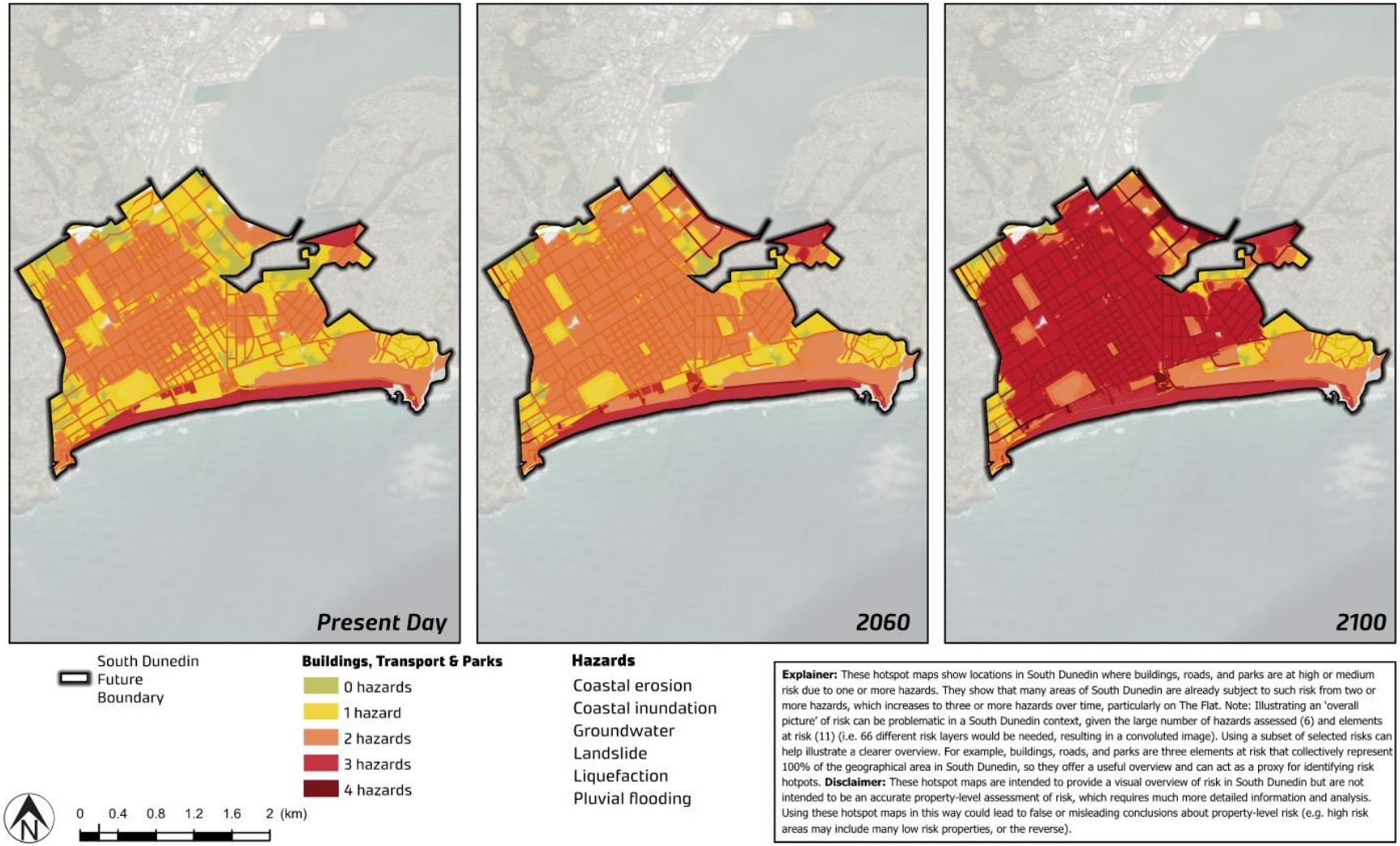

Figure 4 Summary of risks to South Dunedin, including buildings, transport and parks

3 Methodology

The section below presents the process for how the Kia Rōpine team shaped the sixteen adaptation approaches into seven potential adaptation futures. The seven potential adaptation futures for South Dunedin presented in this report reflect different ways to manage flood and other risks in South Dunedin. They include a 'status quo' future – essentially the path we are currently on if we do not change anything with a focus on individual actions by property owners – and six other futures representing a spectrum, with a focus on infrastructure at one end and land use change at the other.

Each of the seven potential adaptation futures represents a different combination of the approaches for helping South Dunedin adapt to flooding and future climate change. There are different costs and benefits associated with each future, and these are described as assessed in the micro business cases to support comparison. We note that these are only initial assessments with future detail to be provided in the shortlist and preferred stages.

3.1 Refining generic approaches to spatial options

First, the longlist of generic adaptation approaches was expanded to the forty-two individual options within the generic approaches to evaluate options through a cascading screening process. This process screened out options considered in a parallel process in St. Clair/St Kilda (e.g., dune management or reshaping) as well as options that presented significant technical or logistic challenges rendering them technically unfeasible (e.g., tidal barrier for coastal flood management). This process is shown in Figure 5.

The remaining options all provide some level of relevant and suitable risk management for places, spaces and assets within South Dunedin. To better reflect how these options would be implemented, they were categorised into the following:

1. Individual property or asset-level interventions that could be undertaken by individuals on a site-by-site basis to reduce risk
2. Existing or planned actions by local, regional or national government including regulatory frameworks, initiatives, or programmes which do not require new allocation of resources.
3. Short-term interventions that will require new allocation of resources and funding by Councils to support risk reduction.
4. Enabling actions that may be required to implement future adaptation options or pathways.
5. Viable large scale community interventions spatially distributed that require further technical assessment.

All categories of interventions are likely to be combined with other options to support reduction in risk. Groups 1-4 above represent actions that should be taken forward and incorporated into individual and Council actions moving forward as soon as practical as low-regrets short-term initiatives that will support long-term risk management.

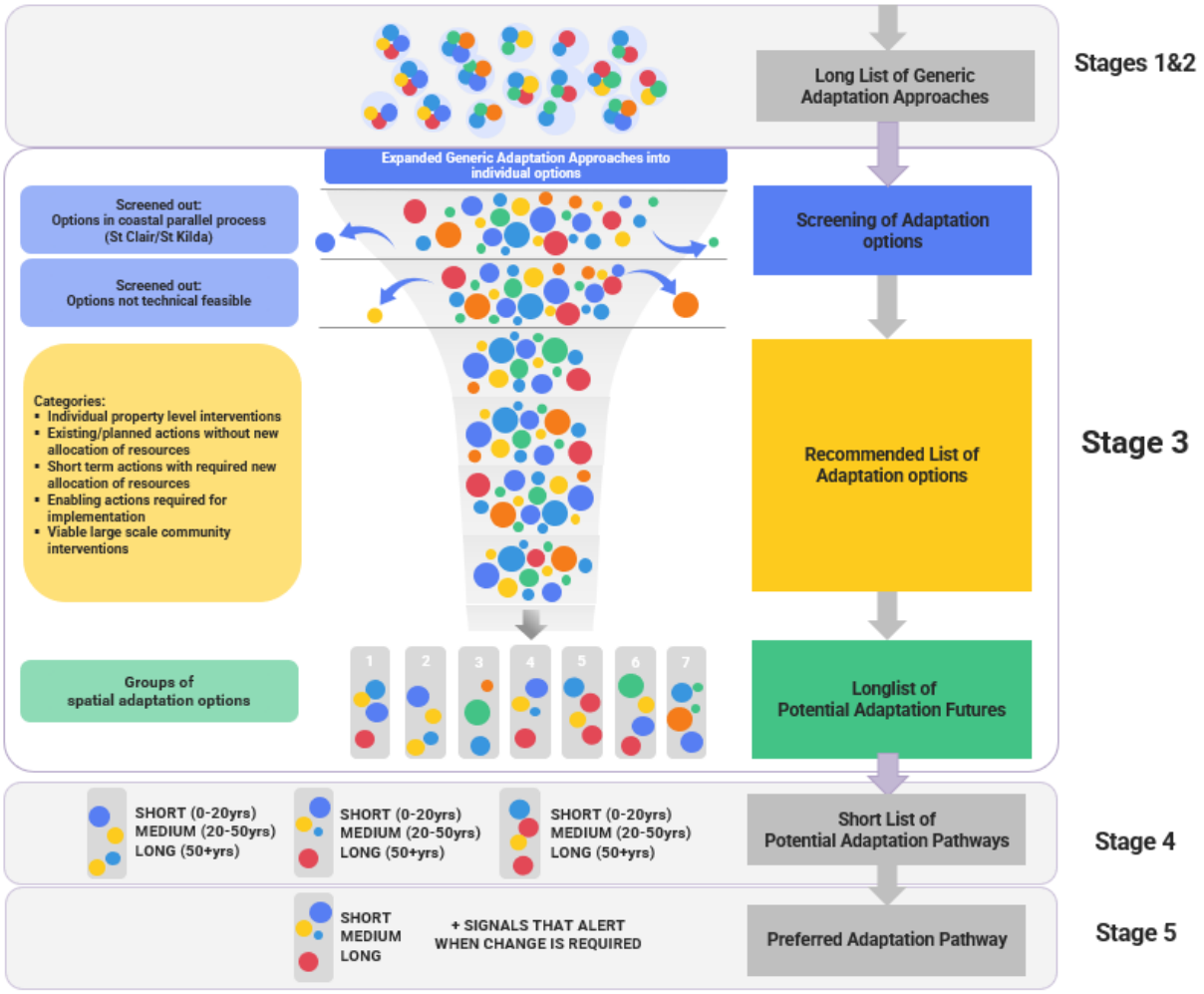

Figure 5: Screening of the expanded generic list of adaptation approaches to develop spatial adaptation options and Potential Adaptation Futures.

Due to the complexity and interconnection of hazards, their impacts, and local geography, various interventions will be needed to adapt in the future. Therefore, the viable large scale community options have been grouped into seven "potential adaptation futures" providing examples of what South Dunedin could look like in the late century (e.g. 2090-2100). These futures would be implemented gradually over time to reduce risk as climate change continues and would be supported by the other individual, existing, short-term and enabling actions as indicated in Groups 1-4. To do this, South Dunedin was divided into four “cells” that represent key areas of particular risks as presented in Section 5 to understand which community-scale options are most appropriate in which locations and the futures were developed to represent the variability of potential options across the cells.

3.2 Selecting a shortlist and preferred options

As the South Dunedin Future Programme continues, making transparent, repeatable decisions aligned with Council strategies and community aspirations is paramount. To support this, a decision-making framework was developed (Appendix A) in alignment with the strategic objectives presented in the November 2023 Generic Adaptation Approaches Context Summary.

The criteria were developed through distilling the Strategic Objectives into measurable components. It is recommended that potential adaptation futures should be assessed in two ways:

- Against individual criteria using rubrics (presented in the framework in Appendix A)
- Against overall objectives using a high-level assessment (presented micro-business cases)

Strategies, plans, and policies represent a selection of local, regional and central government direction to inform the rubrics for each criterion. These strategies are presented alongside the information gathered through community consultation to provide context for the assessment.

The seven potential adaptation futures will be assessed and scored from -3 to +3 using the decision-making framework at the start of the shortlisting phase (Stage 4), using a refined understanding from community feedback on the potential adaptation futures and their residual risk (which will guide an understanding of risk tolerance) determined from updated modelling (if available). These scores will then be combined using weighting methods and sensitivity testing to shortlist potential adaptation futures.

The 'potential adaptation futures,' presented in microbusiness cases, will serve as a tool for informed discussions with the community in this phase about how a combination of adaptation options may help reduce risk, as well as what residual risks remain and their likely implications.

To further develop the short list of potential adaptation futures, pathways will be developed with short-, medium- and long-term actions to enable the potential adaptation futures selected for the short list. Further community engagement will occur on these short-listed pathways (Stage 4) prior to selection of preferred pathways.

The additional short list criteria will be assessed at the preferred pathways phase (Stage 5), and scores will be updated using the refined understanding from community feedback. Finally, preferred pathways will be recommended based upon combined scoring.

Table 1: Strategic objectives with assessment criteria from Decision Making Framework

Objective	Criteria
Sustainable Urban Development: Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Reduce emissions and waste*
	Well-functioning and liveable urban environment, including serviceable infrastructure and appropriate levels of service
	Promotes water sensitive urban design and enhances amenity
	Suitable phasing over time*
Environmental and cultural restoration: Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place.	Restore the natural environment
	Enhance mana whenua connections to place
	Aligns with Te Taki Haruru values (Autūroa, Auora, Autaketake, Autakata)
Just transition: Respond to climate change in ways that empower communities and promote fairness and equity.	Reflect community preference
	Minimise impacts on all vulnerable communities
	Empowers communities
	Vulnerable communities are not left behind
	Promotes intergenerational equity
Social and economic resilience: Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back	Preserve and enhance community cohesion and community values
	Minimises economic risk to communities
	Increases community adaptive capacity
	Minimises economic risk to individuals
	Minimises impacts to business
Promote community safety: Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Promote community wellbeing
	Promote community safety
	Reduced natural hazard risk*
*Criteria that contains measurements to only be assessed during the short list to preferred pathways stages	

4 Spatial longlist of adaptation options

The longlist of options identifies the interventions likely to reduce risk in South Dunedin. These options have been sourced through the previous Stages 1 & 2 Generic Long List of Adaptation approaches. Following the methodology presented above, the forty-two options within the sixteen generic approaches have been screened into the categories presented Figure 6.

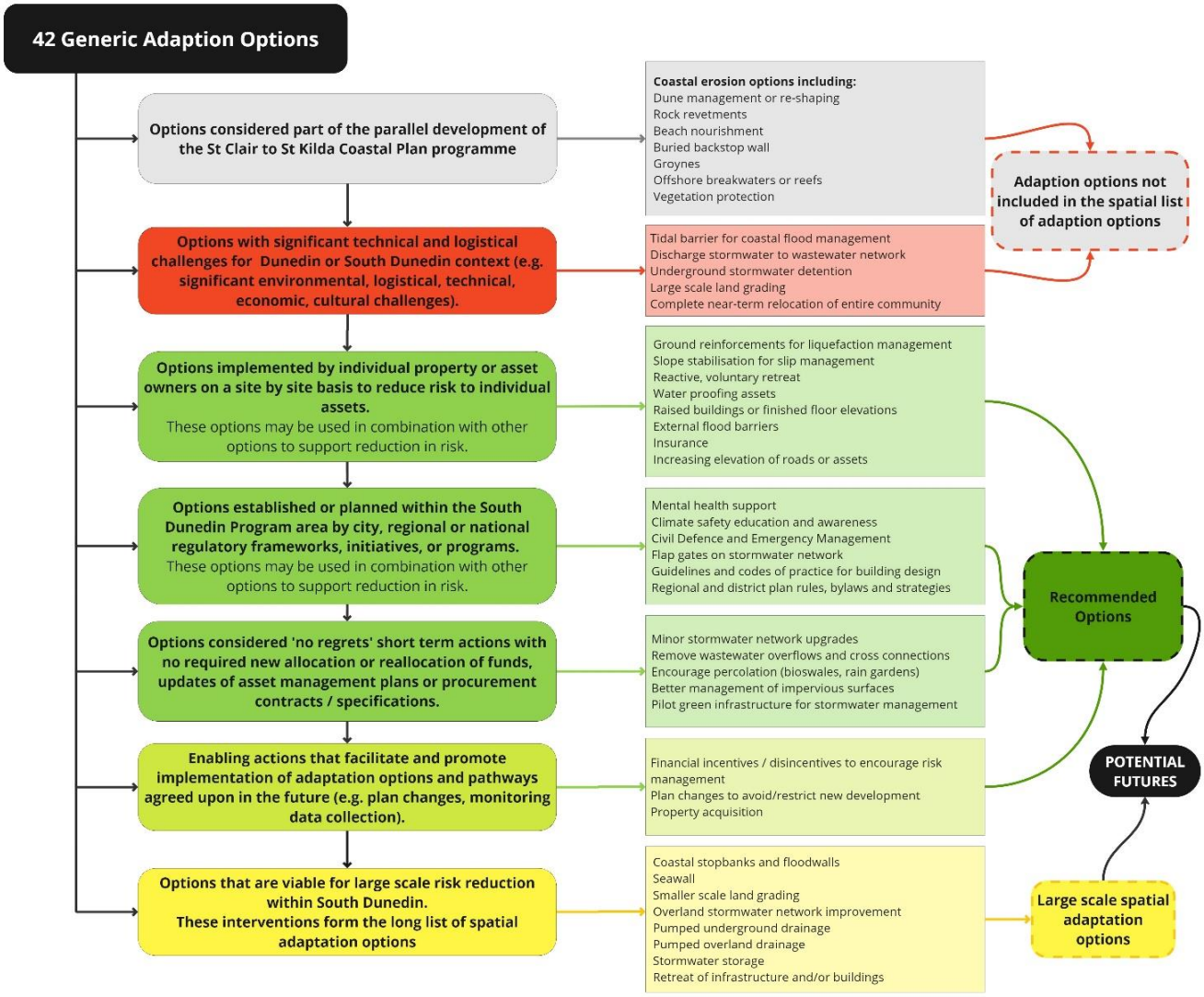

Figure 6: Assessment flow chart for screening expanded Longlist of Generic Approaches into spatial adaptation options for consideration in suggested futures.

Below, we present a description of all options taken forward and an explanation of their relevance for South Dunedin. For options not taken forward, including those considered through the St Clair to St Kilda Coastal Plan programme and those not technically feasible, an overview of these options is presented in Appendix B.

4.1 Recommended options

Recommended options are foundational actions that do not require additional assessment and should be incorporated by Council and communities into risk management moving forward, and that will, in combination, support the long-term Adaptation Strategy for South Dunedin. These range from interventions that individual owners can consider, existing interventions or options already planned or in progress, and short-term actions (no regrets) that provide significant benefits that require further or new investment.

While these options are presented separately from the possible adaptation futures, the scale, extents and efficacy of the options below will vary depending on which potential adaptation future is selected. For example, raising buildings on piles can reduce risk of pluvial or coastal flooding to the properties; however, without management of groundwater, the systems that property owners rely on (e.g. water network, road, etc.) will be increasingly difficult to use and maintain.

In areas where land is raised, raising buildings on piles would not be required but raising buildings that remain in the Flats may be advisable. Despite the uncertainty around scale, extend or efficacy, it is likely that in some form, the options below will be incorporated to adapt in the future.

Civil Defence Response and Readiness importantly will continue in all future scenarios, noting that where hazards are less well managed, more frequent and larger Civil Defence responses will be required.

INDIVIDUAL PROPERTY OR ASSET INTERVENTIONS

The following options are for individual asset, property and business owners to consider on a site-by-site basis to reduce risk to their assets. These options are a mix of engineering, financial, and social interventions that may be used in conjunction with other options to support reduction in hazard risk.

The following are options to be considered as site-specific interventions. These options have not been considered at the community scale due to the variability of site-specific characteristics of individual assets and to allow individual risk tolerance to dictate the need to undertake such measures.

As previously stated, these options are for property or asset owners to consider. It is acknowledged that this is a limitation for the South Dunedin community as there is a high proportion of renters in this area. As such, while property level interventions can meaningfully reduce impacts of hazards, without funding support, reliance on individual interventions is likely to increase inequity as those with ability to improve properties will adapt these measures and vulnerable populations may remain at risk.

Investments in publicly owned assets, like roads or pump stations, would need to be considered in a system view to understand functionality of those assets during hazard events.

Table 2: Individual property or asset interventions that are recommended options

Generic approach	Individual Interventions	Description
Ground Reinforcement	*Ground reinforcements*	Property owners can consider different types of ground reinforcements (e.g., piles, stone columns, grouting, etc.) to prevent settlement and other types of damages caused by

Generic approach	Individual Interventions	Description
	for liquefaction management Hazard: Liquefaction	liquefaction. The effectiveness of ground reinforcements depends on the specific site conditions, including soil type, groundwater levels, and seismic activity. This sort of intervention is a long-term, significant modification, likely constructed for new physical works or when significant modifications are underway for other purposes.
Ground reinforcement	*Slope stabilisation for slip management* Hazard: Slips	Slope stabilisation can help prevent slips in areas where steep slopes and unstable soils can pose significant risks. This could look like planting, soil nailing or retaining walls. by reinforcing slopes and improving their stability, individual owners can reduce the likelihood of slips and protect valuable infrastructure and property. Examples of this intervention can already be seen across South Dunedin in the hilly parts of the catchment like along the bank at the southern end of esplanade at St Clair.
Reactive retreat	*Reactive, voluntary retreat* Hazard: All hazards	Reactive or voluntary retreat involves residents making a voluntary decision to relocate themselves or their assets away from vulnerable areas to safer locations. This intervention is often considered when the risks of flooding, erosion, or other hazards become too severe to justify continued development or occupation. currently this is the most seen intervention in South Dunedin as renters retreat from impacted areas following major floods. When homes are red or yellow stickered or even when in proximity, some residents reach the limits of their risk tolerance and may opt to move outside of the flood prone area. This process is effectively reactive, voluntary retreat and will likely occur more frequently in the future without substantial intervention.
Property level interventions	*Water proofing assets* Hazard: Pluvial and coastal flooding	Water proofing assets include a variety of techniques and materials depending on the specific asset and the nature of the water exposure. The aim is to enhance the durability of new and existing buildings or structures, making them more resistant to flood damage and potentially extending their lifespan. For example, this could include waterproof first floors, installing pumped drainage systems around basements, or floodable asset design to allow for fast recovery post an event. These sorts of interventions build resilience and allows people to stay in their homes for longer, maintaining a sense of place. Many residents of South Dunedin already have small pumps to dewater their yards.

Generic approach	Individual Interventions	Description
Property level interventions	*Raised buildings or finished floor elevations* Hazard: Pluvial and coastal flooding	Individual property owners may opt to raise their houses, businesses, or assets to reduce in-situ consequences from flooding. This intervention is on a property level, as each property would need a feasibility assessment to test viability to be raised. However, raising homes can happen relatively quickly and is a tangible solution for residents that considerably reduces their risk of future flooding. This improves individual properties level of resilience to maintain a sense of place while improving living conditions. For example, following the 2015 flood, new minimum floor levels for new builds based on measured water levels during that event were imposed for all construction from that date. However elevated buildings may not reduce the risk of flooding for services, utilities, and amenities that property owners rely on in the community (NIWA, 2023). Depending on how buildings are raised, there can be negative impacts for neighbours if water is just shifted onto their properties. To avoid cases like these, this could be supported by a measure like Tauranga Plan Change 27 which does not allow properties to impact stormwater flow beyond their property without resource consent authorisation.
Property level interventions Readiness and response	*External flood barriers* Hazard: Pluvial and coastal flooding	External flood barriers are physical structures or barriers placed around a house to protect it from flooding. These barriers can be temporary or permanent, designed to divert water away from the building or prevent it from entering. This type of intervention is relatively simple, quick to implement, and renter friendly. Temporary barriers such as sandbags are commonly used across South Dunedin during high rain event warnings. More significant moveable barriers or gates are used beyond South Dunedin to prevent flood waters from entering buildings.
Behavioural and societal changes	*Insurance* Hazard: All hazards	Insurance services involve individual property owners paying insurance premiums to receive compensation for damages from their insurance after a hazard event. For instance, after the 2015 flood, 1200 homes and businesses were affected, with insurance payouts reaching $28 million (Mitchell, 2019). This insurance payout offset the cost to individuals to repair their properties, and insurance would continue to support residents in funding repairs post-flood event. However, affordability of premiums can affect disproportionally vulnerable socio-economic residents

Generic approach	Individual Interventions	Description
		resulting in sales of property. Further, renters may not have contents insurance and therefore can be disproportionately affected during flood events. The risk of insurance retreat due to repeated events or flood risk more generally becoming uninsurable could mean that property owners in South Dunedin are no longer able to access funds for mortgages. Considerations related to long-term provision and affordability of insurance should be included within adaptation planning.
Land grading Property / Asset level interventions	*Increasing elevation of roads or assets* Hazard: Pluvial and coastal flooding	This intervention involves raising a road level or other asset level to reduce flooding during heavy rainfall. Benefits of this intervention is that people and assets are removed from the floodplain, increasing safety and community confidence. For South Dunedin, increasing elevation of roads or assets is only considered at the individual asset level due to potential for wider impacts. While assets like roads could be elevated, doing this in isolation may "protect" the transport network but it is likely that there would be flow on impacts to properties and without building-level interventions, impacts would continue, this could be useful for smaller infrastructure like pump stations.

EXISTING OR PLANNED INTERVENTIONS

These approaches have been established and planned within the South Dunedin Programme area by city, regional or national regulatory frameworks, initiatives, or programmes. These interventions do not require policy changes or significant new investment allocations and can support risk reduction in combination with other adaptation approaches. As such, these approaches are applicable across all potential adaptation futures and scenarios. They provide a foundation that supports various adaptation strategies. The following are approaches considered part of the foundational actions. Depending on the reliance on these interventions to manage risks, more funding may be required in the future; for example, without action to reduce flood risk, more frequent Civil Defence response and therefore funding will likely be required.

Table 3: Existing or planned interventions

Generic approach	Existing or Planned Intervention	Description
Behavioural and societal changes	*Mental health support*	This is an essential aspect of hazard risk response and proactive adaptation intervention, providing individuals and communities with the resources they need to cope

Generic approach	Existing or Planned Intervention	Description
	Hazard: All hazards	with the psychological impacts. This support can help people manage stress, anxiety, depression, and other mental health challenges that often arise during and in the aftermath of disasters and community interventions, overall increasing community wellbeing. Currently, Dunedin City Council (DCC) has online resources directing individuals to the health system in New Zealand and the medical services in Dunedin (Dunedin City Council , 2024). Additionally, DCC offers grants to groups providing activities and facilities for the well-being of the residents. Te Whatu Ora Southern offers a range of services to support community members through short-term assistance and ongoing care (Te Whatu Ora , 2024).
Behavioural and societal changes	*Climate safety education and awareness* Hazard: All hazards	Education and awareness of climate hazards and their impacts are part of multigenerational efforts with the South Dunedin community led by DCC and ORC. These efforts include working with schools, community groups, and organisations, providing them with environmental lessons and digital tools that suit individuals, businesses, and communities. DCC and ORC have provided community events and online resources devoted to informing the community about the science behind South Dunedin. Benefits of this include increasing community resilience and preparedness, and evidence of this was seen during the October 2024 floods where in an interview with RNZ, a woman remarked that her son learned about flooding in South Dunedin at school and made her aware of this risk.
Readiness and response	*Civil Defence and Emergency Management* Hazard: All hazards	Civil defence and emergency management are coordinated by local, regional, and national organisations often involving collaboration with community organisations, businesses, and individuals. These activities include: • Readiness: Planning for and preparing for potential emergencies, such as developing emergency plans, training personnel, and stockpiling supplies via Emergency Management Otago (EMO). • Response: Coordinating and managing emergency response activities, including search and rescue, evacuation, and disaster relief. EMO's website has information about online media channels during a disaster and evacuation plans. Readiness and response activities help minimise injury, loss of life, and property damage during an event whilst also supporting recovery after an event. The Civil Defence Response during the October 2024 floods provided ongoing communications, sandbags, an

Generic approach	Existing or Planned Intervention	Description
		evacuation shelter and other support services to the community to minimise impacts.
Water flow improvements	*Flap gates on stormwater network* Hazard: Pluvial flooding	Flap-gates on outlets control the flow of water reducing backflow. These gates are typically hinged at the top and are designed to automatically open or close based on water pressure. When the water level upstream exceeds the downstream level, the flap gate opens to allow discharge. Stormwater outfalls in South Dunedin already have flap gates. The existing flap gates reduce "backflow" of seawater into the stormwater network. These should be maintained in the future.
More restrictive building or development standards	Guidelines and codes of practice for building design Hazard: All hazards	Guidelines and codes of practice are essential tools for helping buildings in South Dunedin be designed and constructed to withstand present and future challenges posed by natural hazards. These documents provide current requirements and recommendations for building design, construction, and maintenance including, for example: • Building Code of New Zealand (BCNZ): This is the primary building code for New Zealand, covering a wide range of building types and construction methods. It includes provisions for hazard mitigation, such as earthquake and flood resistance. • New Zealand Standards: Various standards that provide specific guidance on building design and construction, these include structural design for timber, concrete, and steel building including for earthquakes (NZS 3604, NZS 3605, NZS3606) and stormwater drainage and management (NZS 1160). • Dunedin City Council: Council introduced minimum floor levels (MFL) for mainly residential buildings, including new homes, house extensions, rest homes, schools and halls across several low-lying parts of the city. Compared to most other areas of the city, South Dunedin has specific methods to establish MFLs which involve historic flood water levels (2015).
More restrictive building or development standards	Resource management policies, regional and district plan rules, bylaws and strategies	Regional and district plans, bylaws, and strategies are important tools for managing land use and development in South Dunedin, particularly in relation to flood risk. These documents provide guidelines and regulations for land use development and sub-division, as well as infrastructure development.

Generic approach	Existing or Planned Intervention	Description
	Hazard: All hazards	These include rules for housing density, building in hazard areas, site coverage, impermeable surfaces and setbacks. Examples include: • New Zealand Coastal Policy Statement 2010: national policy requiring identification of areas in the coastal environment that are potentially affected by coastal hazards over at least a 100-year planning horizon and requires a precautionary approach to the management of coastal hazards. • The Regional Plan - Coast for Otago (the Coast Plan): regional policy promoting the sustainable management of resources in the coastal marine area through a regional policy framework. • 2nd Generation District Plan (2GP): district plan providing a framework for using, managing, or protecting land and its natural and physical resources. These include regulations for density housing, building codes, or setback rules. • Future Development Strategy (FDS) for Dunedin: primary document promoting long-term strategic planning for the next 30 years. The next FDS review will integrate the South Dunedin Futures Project results. • DCC 3-Waters Integrated Systems Planning: Currently under development, strategy setting the vision of how water infrastructure will be managed by council over the next 50 years. This provides an opportunity to align the needs of South Dunedin regarding water infrastructure and services.

SHORT-TERM INTERVENTIONS

These options are considered 'no regrets' interventions that will require additional allocation of resources and funding by local and regional councils to support hazard risk reduction. These interventions may require update of asset management plans, procurement contracts and specifications. For certain locations, such actions may be the short-term actions (present to 20 years) to begin progress towards the selected future. The following are options considered part of the foundational actions and implementation of these could begin as soon as practicable. Some of these interventions may be beyond the geography of South Dunedin but could have material impacts on the risks within the project area, particularly as South Dunedin is the "bottom" of many stormwater and wastewater catchments where slowing, capturing or diverting flows in the upper part of the catchment could reduce impacts downstream.

Table 4: Short-term interventions

Generic approach	Short-term Interventions	Description
Water flow improvements	*Minor stormwater network upgrades (e.g. check valves, removing bottlenecks*) Hazard: Pluvial flooding	Minor stormwater network upgrades include upgrades and maintenance of gutters, mud tanks, pipes, manholes, pump stations, detention ponds, stormwater reserves, inlet and outlet structures and some watercourses. The aim of network upgrades is to reduce the frequency, duration, and volume of stormwater runoff, mitigating the risks of nuisance flooding and moderate post-development flows to watercourse. These minor upgrade approaches are conventional and as such, this are likely a palatable option as they are well known by Dunedin residents with various three waters upgrades happening in areas across the city. Previous assessments have identified specific locations where increasing capacity could relieve known bottlenecks or other minor upgrades, noting however that these minor upgrades would be helpful for improving performance of the stormwater system in frequent events but may provide limited benefits in more severe rainfall events.
Removal of wastewater network overflows and cross connections	Remove wastewater network overflows and cross connections Hazard: Pluvial flooding	Measures to remove wastewater overflows include fixing cracked pipes or manholes as well as removing cross connections. Removing wastewater network overflows and cross connections would avoid wastewater spilling out from gully traps, manholes, or engineered / constructed overflow points when the network has reached full capacity protecting people from health risks associated with flooding. As well as supporting people's health and safety, the communities' cultural and recreational connections with natural water bodies and natural heritage are maintained. Linkages between the stormwater and wastewater networks in South Dunedin as well as in Kaikorai Valley are suspected to contribute to flooding issues in South Dunedin. There has been wet-weather overflow from the wastewater networks in Surrey Street.
Increasing permeability	Encourage percolation (bioswales, rain gardens, permeable surfaces) Hazard: Pluvial flooding	Encouraging percolation involves implementing measures to assist the movement of water through soil. Methods include bioswales which are shallow vegetated channels designed to capture, treat, and infiltrate stormwater runoff allowing the delay of stormwater runoff and treatment of the water quality. Rain gardens are another means of encouraging percolation, they help remove pollutants, slow stormwater flow and filter contaminants. Additionally, increased permeable spaces can enhance local biodiversity, which not only supports ecological function but fosters cultural wellbeing, and can promote greater access to green and blue spaces which offer mental health and wellbeing benefits and

Generic approach	Short-term Interventions	Description
		recreational opportunities. The imperviousness of the South Dunedin catchment is a major influence on the quantity of runoff generated and the contaminants carried. Encouragement of percolation through measure like bioswales, raingardens, and permeable surfaces will help to address the issue of stormwater runoff in South Dunedin. This is most relevant in elevated parts of South Dunedin where there is not already groundwater near the surface. If measures to capture rainfall were implemented at a community scale particularly in the upper catchment beyond South Dunedin, this could slow the flow of water in regular rainfall events but would be less effective during extreme storms.
Increasing permeability	Better management of impervious surfaces (rain tanks, green roofs*)* Hazard: Pluvial flooding	Managing impervious surfaces involves improving the environment's ability to absorb excess rainwater, which reduces the volume and rate of runoff going into the stormwater network. Managing impervious surfaces can be achieved through methods like introducing more rain tanks to capture rainwater, to reduce the flow into the stormwater network. Another method is introducing green roofs, which allow water to be stored by the substrate to then be absorbed by the plants. This allows for a reduction of water entering the stormwater network and at a delayed rate, therefore collectively referred to as components of a Sponge City. These components not only increase absorption capacity for stormwater but can also increase local biodiversity through providing habitat, improve air quality by removing pollutants therefore improving public health outcomes, and act as carbon sinks by absorbing carbon dioxide. Slowing the flow of runoff to the stormwater network, particularly in the upper catchment that flows into South Dunedin could improve system performance during regular rainfall events but would be less effective during extreme storms. While tanks could be at the property scale, high uptake would be required for a meaningful reduction in risk.
Stormwater storage	*Pilot green infrastructure for stormwater management* Hazard: Pluvial flooding	Stormwater storage includes permanent (wetlands, ponds) and temporary (parks, other floodable infrastructure) areas for intentional water detention that is connected to the pumped drainage network for discharge following rainfall events. There are also currently regulatory tools in place to protect areas of flood protection vegetation under the ORC Flood Protection Management Bylaw. Permanent green

Generic approach	Short-term Interventions	Description
		infrastructure for stormwater management requires a large land area which would reduce the area of public space available for other activities. A pilot on existing Council owned land, such as Forbury Park, could provide the opportunity to develop and test stormwater storage in blue-green spaces so that communities can provide feedback on the usability of these spaces while also providing flood risk reduction benefits.

ENABLING ACTIONS FOR FUTURE IMPLEMENTATION OF ADAPTATION OPTIONS

These actions will facilitate and promote the implementation of the adaptation options and pathways agreed upon in the future. They require local, regional and/or central government support by allocating resources and funding and hence don't appear on the short-term interventions list, despite them being no regrets options. The following options could be considered part of the foundational actions and internal investigations required for adaptation pathways and therefore DCC and ORC should begin to evaluate and plan for these enabling actions.

Table 5: Enabling actions for future implementation of adaptation options

Generic approach	Enabling Actions	Description
Behavioural and societal changes	Financial incentives or disincentives to encourage risk management Hazard: All hazards	For South Dunedin, these can be applied to motivate individuals, businesses, and communities to adopt measures that reduce their vulnerability to hazards, such as flooding. For instance, incentives such as subsidies for floodproofing or penalties/fines for individuals or businesses that violate risk reduction regulations. Using a combination of incentives and disincentives, local government can encourage individuals and businesses to take proactive steps to manage risks and reduce their vulnerability to hazards.
More restrictive building or development standards	*Plan changes to avoid/restrict new development* Hazard: All hazards	These interventions refer to changes made to land use plans or zoning regulations to prevent or limit new construction in areas considered at high risk. These could help avoid increasing risks for the South Dunedin community and promote new development in safer locations. There are future intensification areas outlined in Dunedin's Future Development Strategy of which South Dunedin is not included. However, currently there are also no restrictions for development in this area.
Managed relocation	Property acquisition Hazard: All hazards	Managed relocation could involve the planned and gradual acquisition of property as required to directly or indirectly support risk reduction and adaptation actions. Acquired property could be utilised for a

Generic approach	Enabling Actions	Description
		range of purposes, including: to limit or avoid maladaptive activity, as a strategic hold or revenue generating asset (until risk becomes intolerable), to enable new or upgraded infrastructure, to facilitate temporary or permanent land use change (e.g. intensification or deintensification/retreat). For South Dunedin, this intervention would be a strategy to reduce the risk by purchasing properties in high hazard zones which can then be used for other adaptation approaches such as increasing permeability. Purchase must occur alongside this in low hazard zones to enable intensification or in areas to make space for risk management infrastructure. For example, Carlton Hill, Concord, Corstorphine, and Andersons Bay are currently named in the Dunedin Future Development Strategy to intensify which would contribute to the success of this approach. While it is unclear what scale of property acquisition will be required, a minimum level of buyout will be required to make space for Council infrastructure like pump stations. Under more transformative futures, neighbourhood scale property acquisition could be required to enable retreat.

VIABLE LARGE-SCALE INTERVENTIONS

These interventions form the longlist of adaptation options that have been evaluated during this phase of work for South Dunedin due to their potential efficacy in reducing risks associated with coastal hazards and pluvial and groundwater flooding on a large scale[1]. These interventions would not be deployed uniformly across South Dunedin but rather in specific zones or cells.

The following are the individual approaches included in the potential adaptation futures.

Table 6: Viable large-scale interventions

Generic approach	Viable large-scale interventions	Description
Coastal protection	*Coastal stopbanks and floodwalls* Hazard: Coastal flooding	Coastal stop banks and floodwalls provide a coastal inundation defence to manage flood risk to communities. For this option, an inland alignment is considered to protect South Dunedin from flooding via the harbourside as an alternative to a seawall exposed to frequent wave action. It would be designed to keep seawater out and would include mechanisms for discharge of stormwater through the coastal defences. This would be designed to mitigate the 1% AEP likelihood of a high-emission scenario coastal inundation event to 2150 risk of a coastal flood in 2150 but could be constructed in stages. This option would

[1] There are many other risks present within South Dunedin including those related to tsunami, liquefaction and landslips. These can be addressed by property level or other targeted interventions as described in the above sections.

Generic approach	Viable large-scale interventions	Description
		not manage risk arising from groundwater or pluvial flood and would not address coastal inundation hazard on the seaward side of the floodwall. There is residual risk due to over-design events or failure. There is also added complexity when considering the interface with work happening outside SDF project area, particularly the St Clair – St Kilda Coastal Plan.
Coastal protection	*Seawall* Hazard: Coastal flooding	A seawall is a coastal defence which is designed to experience wave action and manages risk of erosion and flooding. They are designed to stabilise a shoreline as well as to be an impermeable structure to keep floodwaters out (e.g. not a rock revetment). This would be designed to prevent coastal inundation in the 1% AEP likelihood of a high-emission scenario coastal inundation event to 2150 but could be constructed in stages. A seawall could provide coastal inundation protection to South Dunedin from harbourside coastal inundation. Sea walls are a feasible option in South Dunedin as they provide large scale risk reduction. However, a seawall would not protect from groundwater risks, pluvial flooding, and landslide hazards. Further, loss of connection to the coast could result in negative social, cultural, and ecological outcomes and may also exacerbate flood hazard, predominantly in the Andersons Bay catchment. The seawall would require extension beyond the South Dunedin boundary to tie in with raised land and would need to coordinate with work outside the SDF project area.
Land grading	*Neighbourhood scale land grading* Hazard: All hazards	Neighbourhood scale land grading involves building up blocks of land / elevating land through placement of fill material to raise ground levels above future flood level and groundwater elevations. This could be designed to varying elevations to mitigate the risk of a coastal flooding over time. The option could allow for increased housing density, which responds to a key objective for the area. It also reduces pluvial flood, coastal inundation, and groundwater risk to raised land. Overall, the option could produce a large-scale risk reduction. However, smaller scale land grading does not provide a risk reduction for land that has not been raised and may exacerbate flood risk to adjacent land that has not been raised by reducing the floodplain area. Residual risk remains due to potential over-design events. There is potential complexity when interfacing with services of areas that are not raised.
Stormwater overland network improvements	*Overland flow improvement* Hazard: Pluvial flooding	Overland drainage involves improvement / strategic management of above ground drainage networks when drainage capacity is exceeded. This may involve re-contouring to enable overland flows and may include depressed crown streets which provide overland flow and temporary storage capacity during low frequency events.

Generic approach	Viable large-scale interventions	Description
		To effectively manage stormwater, these improvements will likely require pumping. The approach addresses pluvial flooding risks in South Dunedin. Works are also confined to the road corridor and therefore are unlikely to negatively impact private property. Overland stormwater improvements may interrupt existing transport routes. Lowering roads also increases the risk from groundwater hazard. The approach does not address coastal inundation, groundwater, or liquefaction and may not effectively reduce flooding on private properties, particularly on flat or depressed areas. It may also result in increased flood frequency of the road, leading to disruptions for users. This option could provide a large-scale risk reduction for the South Dunedin area but should be considered alongside the "preparedness and response", "dedicated water storage" and "floodable infrastructure" approaches.
Water flow improvements	*Pumped underground drainage* Hazard: Groundwater and pluvial flooding	Pumped underground drainage involves an underground drainage network which may be via pipes or permeable underground layers to encourage drainage. To adequately manage groundwater and stormwater in low lying parts of the catchment, the network will require pumping. This approach reduces nuisance flooding (associated with 10% AEP events), results in some reduction in pluvial flood hazard, reduces groundwater hazard, and produces co-benefits like reducing the potential increased future liquefaction potential. Other benefits also include a maintained sense of place. However, the option is likely to require extensive spatial coverage to be effective at lowering groundwater (on its own). It may require alignment through private properties to lower groundwater to the necessary level. In addition, groundwater drainage systems tend to have relatively high maintenance requirement and relatively short useable life due to clogging and (20-year replacement cycle). This approach could provide large scale risk reduction for South Dunedin.
Water flow improvements	*Pumped overland drainage* Hazard: Groundwater and pluvial flooding	Pumped overland drainage involves implementing an above-ground drainage network, which may be via canals, streams (e.g., daylighting of streams), or lined channel layers to encourage drainage. This approach requires pumping to manage groundwater and stormwater in low lying parts of a catchment. Pumped overland drainage reduces pluvial flood hazard and groundwater hazard. Daylighting streams involves identifying where pipes have replaced historic streams, removing the pipes and restoring the historic, naturalised flow of water. For this to provide functionality in South Dunedin, it is likely that pumping would be required to improve the flow of water.

Generic approach	Viable large-scale interventions	Description
		There are also likely co-benefits achieved in reducing the potential for increased future liquefaction potential that would otherwise occur with rising groundwater. The channel corridor within South Dunedin would require land area, this would either remove access (if confined within the road corridor) or require private property acquisition.
Dedicated water storage and groundwater management	*Stormwater storage* Hazard: Groundwater and pluvial flooding	Stormwater storage involves implementing permanent and temporary (parks or other floodable infrastructure) areas for intentional water detention connected to the pumped drainage network for discharge following rainfall events. The approach reduces pluvial flood hazard, groundwater hazard, and it is likely that co-benefits are achieved in reducing the potential for increased future liquefaction potential that would otherwise occur with rising groundwater. The large area required would mean reduced area of public space for other activities, including use of the recreation facilities in South Dunedin. This approach would mean the potential for a change in recreation in the area. Water storage alone is unlikely to reduce pluvial flood hazard across all exposed areas of South Dunedin.
Managed relocation, under retreat	*Retreat of infrastructure and/or buildings in areas of unmanageable risk* Hazard: All hazards	Retreat of infrastructure and/or buildings involves strategic acquisition of property or removal of assets, communities, and infrastructure from areas of unmanageable risk. This assumes the ability to compensate property owners and the ability for residents to relocate nearby. Moving exposed assets, people and places from natural hazard risk can be a highly effective way of reducing risk to the community. However, the retreat process can be very complex and have significant challenges (economic, social, cultural) for all partners and stakeholders to result in a just transition. Should retreat not be via strategic, proactive acquisition, this may disproportionately impact vulnerable populations who lack the means or resources to effectively adapt or recover. There is significant complexity in establishing alternative land areas for development (e.g. for housing).

5 Spatial Cell Definition

The following section outlines the use of defined cells to identify potential management areas for particular risks for adaptation planning purposes. By dividing the SDF Programme area into smaller, manageable units (termed “cells” for this programme), climate impacts and adaptation options can be reviewed at an appropriate level of detail. This prevents a one-size-fits-all approach and could support the delivery of targeted interventions (as described in Section 4) tailored to the specific conditions of each cell. Presently, there is uncertainty relating to the efficacy of these interventions at this point of the overall SDF study area.

Working with the wider SDF Programme team, these cell definitions are translated into a spatial representation to describe which longlist options are relevant in each cell. The Detailed Risk Assessment report has guided the transition areas between the cells, as shown in Figure 7. The characteristics of the areas in the cells are recorded below:

- Cell 1 – represents the land parcels and road segments that are identified to be exposed to at least a medium risk of groundwater emergence (levels with 0.5m of the surface) for the 2060 SSP5-8.5 scenario that show a broadly similar pattern to the pluvial exposure – to represent the potential areas that would likely require specific similar options to address both these hazards.
- Cell 2 – covers the remaining area within the SDF project area that is lower than the water level of the 2100 SSP5-8.5 scenario (1.1m of sea level rise) and 1% coastal AEP event – to represent the maximum identified area of exposed area to coastal inundation mapped.
- Cell 3 – is represented by all other areas within the SDF project area higher than the level set for Cell 2.
- Cell 4 – is the area to the seaward side of the southernmost key road that traverses the SDF programme area, from the intersection of Bedford St & Beach St, along Victoria Road, Tahuna Road and through to Tomahawk Road, representing that this area is aligned to an adaptation planning process for the St Clair to St Kilda Coastal Plan.

Table 7 below includes a summary view of the type of interventions taken from the recommended list of adaptation options and incorporated within each of the identified Potential Adaptation Futures. The table shares how the recommended adaptation options could be included within each of the defined spatial cells. These were identified based upon local knowledge, previous assessments and understanding of which the most significant hazards were to be managed and functionality of large-scale adaptive actions.

Over time, the proportion of land contained within each of these cells would change in line with the potential options and futures invested in as the risk profiles change, with options that include land raising taking land from Cells 1 or 2 into Cell 3. This shift in risk profiles shows the outcome from the investment made to raise land which also enables identified mixed-use neighbourhoods to establish within South Dunedin providing greater housing choice and opportunities for residents to relocate within South Dunedin itself.

Table 7: Spatial longlist of interventions by cell and potential adaptation future

Potential Adaptation Futures	Cell 1	Cell 2	Cell 3
Potential Adaptation Future 1			
Potential Adaptation Future 2			
Potential Adaptation Future 3			
Potential Adaptation Future 4			
Potential Adaptation Future 5			
Potential Adaptation Future 6			
Potential Adaptation Future 7			

Key:

- Overland flowpath
- Sub-surface drainage
- Inland coastal defences
- Storage
- Land grading
- Retreat
- Coastal protection
- Pump
- Open channels
- Civil Defence and Emergency Preparedness
- Better management of impervious surfaces
- Property-level intervention
- Minor stormwater network upgrades

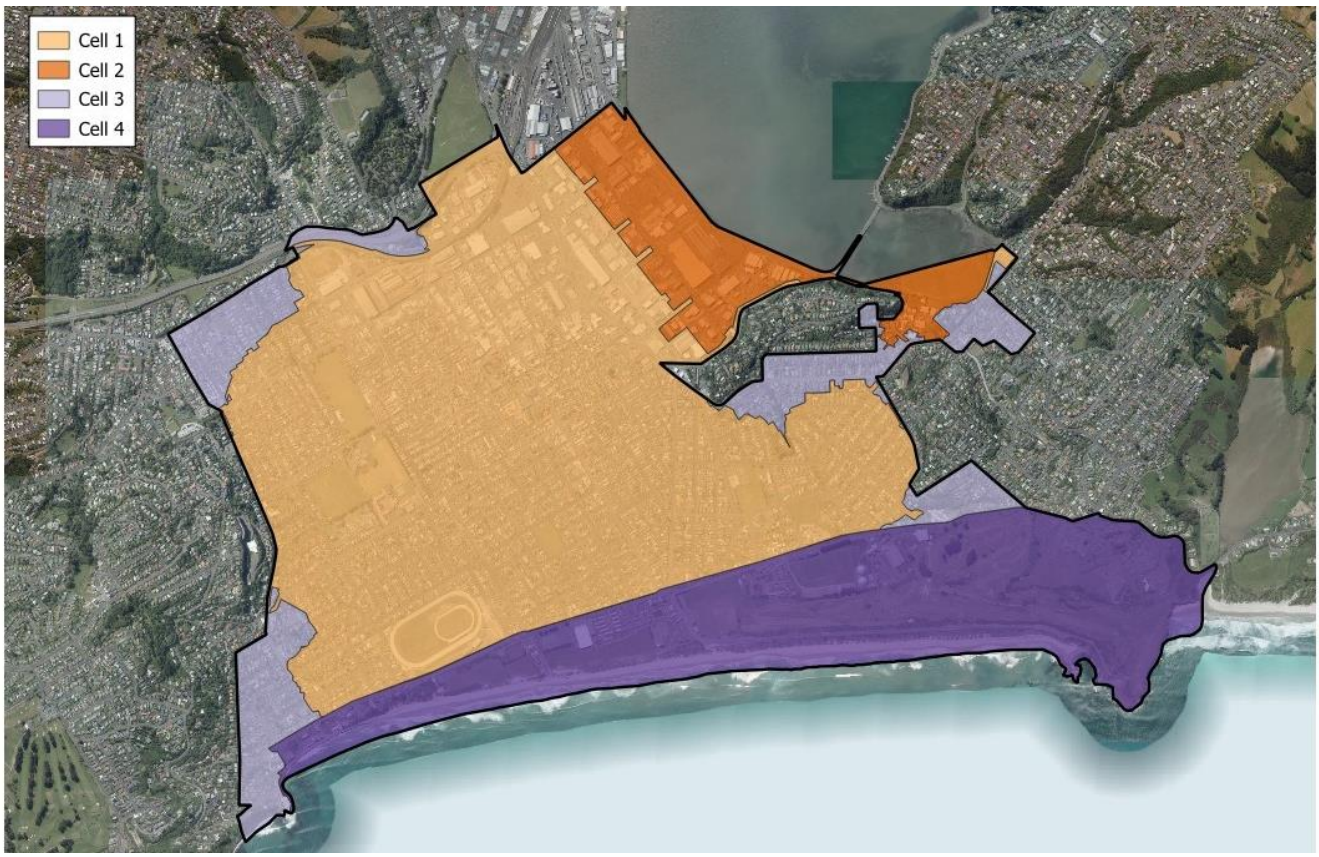

Figure 7: Spatial cells for South Dunedin Future project area to support adaptation programme activities.

6 Potential Adaptation Futures

The complexity and interconnection of hazards, their impacts, and local geography means that individual options need to be evaluated in an integrated way. Combining these large-scale interventions into Potential Adaptation Futures is a way to consider combinations of interventions to the multi-hazard environment of South Dunedin. The technical impact assessment and descriptions of these grouped interventions as Potential Adaptation Futures are presented as microbusiness cases in Appendix A.

The spatial longlist of recommended adaptation options presented above identifies the types of interventions that are likely to reduce risk in South Dunedin. The "Potential Adaptation Futures" provide examples of what South Dunedin could look like in the late century (e.g. 2090-2100) which are combinations of the spatial longlist of viable large-scale options presented in Section 4. These potential adaptation futures will serve as the foundation for community engagement. The graphics and information provided in the micro-business cases have been specifically prepared to inform consideration of the implications associated with each potential adaptation future. Ultimately, these potential adaptation futures will be shortlisted to allow for additional detailed assessments of the pathways of options (short-, medium- and long-term), including their associated impacts and benefits. The futures that are not shortlisted do remain "on the table" but are not considered likely or recommended based upon present understanding.

These futures would be implemented gradually over time with incremental change to reduce risk as the climate continues to change, and the approach would include watching for signals to avoid adapting too early, unnecessarily or too late, resulting in significant damage/impacts. These potential adaptation futures are not an "end state" but rather a stop along the way as South Dunedin will continue to change over time, as shown in Figure 8, which may be accelerated (e.g. happen sooner) or slowed (not be required until later) to respond as conditions change.

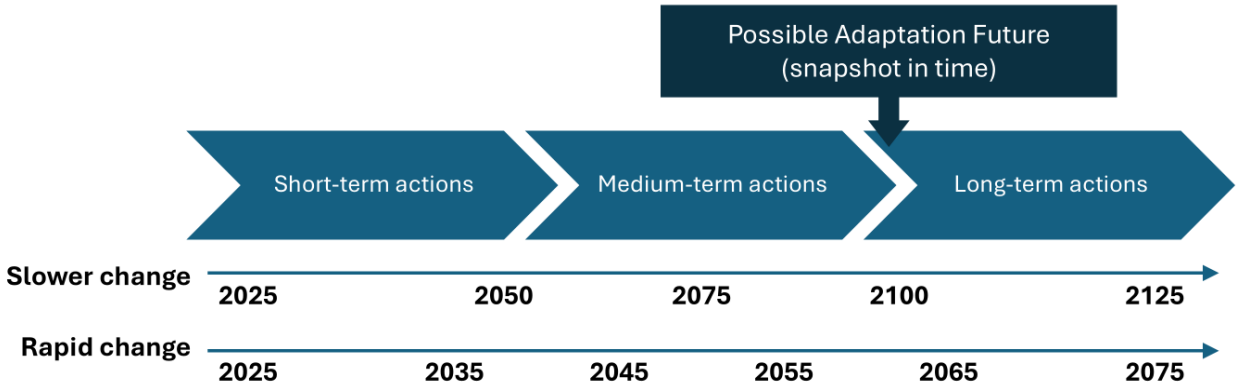

Figure 8: Position of potential adaptation future within a pathway

Each potential adaptation future has a different level of residual risk associated. With these futures, there will be increasing residual risk over time, requiring additional action in response. To respond to these escalating risks, actions over time will be taken to move towards one or more of these futures based upon risk appetite of communities, affordability of actions as well as willingness to pay, and other factors.

The visualisations of each of the seven potential adaptation futures is intended to show how South Dunedin *could* look in 75 years (the year 2100) to assist in engagement with the community on the

potential futures. The illustrations are indicative and high-level and are based on best available information and expert analysis to date and offer a good early indication of where change might be required and what it could look like. However, more detailed work is required to confirm exact locations and timing of any future changes. This work is planned over the next two years as the South Dunedin Future Programme team works towards producing an adaptation strategy for South Dunedin.

The six potential adaptation futures and a "Future 1" are presented below. Future 1 essentially represents continuing without significant further intervention and so is considered the 'status quo'. The potential adaptation futures give examples of a snapshot in time, and there are infinite combinations between these futures where there are shifts in the balance between water and people along a continuum to capture the range of options available.

Alignments of options (e.g. seawalls, inland defences, waterways, elevated areas) have not been designed but are presented based on a high-level understanding of geography, hazards and land use in South Dunedin. The hazards, risks and consequences are not uniform across South Dunedin, but vary spatially; therefore, the adaptation options need to as well.

Adaptation of urban environments for climate or flooding related events is difficult to achieve due to institutional and governance challenges, social and equity considerations and the existing fabric and value of property and assets across the urban environment. While a range of benefits can be quantified (and can be more definitively refined with further investigations on the efficacy of the short-listed options), there are a number of non-quantifiable benefits. This is typical for a long-list potential adaptation futures phase.

6.1 Estimates of costs and benefits

Costs and benefits have been provided in the micro business cases to enable consideration of the possible implications of each potential adaptation future. The costs are based on a spatial mapping exercise undertaken to create one potential visualisation of the Potential Future scenarios presented in the microbusiness cases – noting that each 'Future' consists of multiple Adaptation Options. The identified options / assets incorporated within each potential future are one possible version of the quantity and type of options / assets included, their alignments, and locations. These have been utilised to create the quantities of each type of option (intervention) and the totals presented as the likely costs for each potential future.

The costs are high-level estimations and are intended to be comparative only at this long-list stage of the SDF Programme given the high associated uncertainty, particularly in relation to the pathways of short-, medium- and long-term options that may combine as part of each scenario. The cost estimates will become more accurate as the project progresses as options are further refined.

Each cost estimate is based on a typical detail for that option, calculated in accordance with available rates from a range of similar projects across New Zealand. The cost estimates follow established good practice methodologies adopted in Better Business Case processes in New Zealand. Costs are assumed to occur within the near future, with the costs presented at 2024 present values.

Costs include:

- Construction capital costs – a build-up of costs per option included within each potential future. The costs include for demolition and site clearance, utility services replacement and reinstatement.
- Construction preliminaries.
- Operation and maintenance costs.
- Professional and internal fees.
- Contingency and optimism bias.
- Acquisition of properties - landholdings and buildings purchase.

Capital costs have been adjusted including an optimism bias for a non-standard civil engineering project at this stage in accordance with Better Business case practice. Given the nature of this work and the early stage in an investment cycle, an upper bound for this bias range has been applied. This increases the expected net costs by 66% . This is in line with Treasury advice for projects at this stage of development and this factor can be progressively reduced.

Exclusions at this stage of development include GST, contaminated waste disposal, unexpected ground conditions, rebuild of existing properties in new location, escalation or operational costs/downtime due to operations.

Unit costs do not reflect the potential opportunities to offset costs, for example through property acquisition via renting or through selling land suitable for intensification after elevating it. For this phase of the study, the costs provided are those that are likely to be funded through Council (or rather through 'public funding'), although alternative funding mechanisms could be put in place as opportunities are captured into the future. The cost estimates do not include costs borne by individual property owners to reduce risk.

Failing to adapt will result in widening inequalities, with Potential Adaptation Future 1, showing a future where responses are primarily driven by individual actions and responses with minimal planned Council (or public) investment. This has been estimated to result in a $2 billion cost when accounting for damage to properties (insured and uninsured), lost productivity, work to fix infrastructure, etc. Notably, it is expected that the costs will climb higher still once social costs including stress suffered by affected residents and business owners are factored in, or in response to major weather events where the costs of recovery could be substantially higher still. Estimated loss of income is related to the number of displaced houses over the same period.

It is worth noting that economic assessments of benefits and costs are one method for evaluating potential benefits and disbenefits of actions, but given the complexities associated with changing urban environments, benefit cost ratios of 0.8 are generally accepted as being a good return on investment (based on experience from other jurisdictions and New Zealand). Additionally, other benefits that are traditionally hard to monetise could easily add further impetus to one of the potential adaptation futures.

The PV was calculated as the discounted sum of the annual average damages over the project horizon, where: ·

- The discount rate applied is 2%, consistent with the social rate of time preference (SRTP) as prescribed by the New Zealand Treasury for cost-benefit analysis purposes.
- The project horizon applied is 75 years.

The identified cost profiles for Potential Adaptation Futures 2 to 7 range from $2 billion to $10 billion. The scale of the intervention options included within each Potential Adaptation Future explains why the range is so large, with those that include land raising accounting for the higher estimates and uncertainties. The range is influenced by the status of the work, given that the location and scale estimated to date of each of the potential options applied in each Potential Adaptation Future could change. The costs would be further refined during future stages of the project as more certainty in the efficacy, scale and possible layout/location of the options is identified for the masterplan.

Table 8 below shares the ranges of costs and benefits for these options with a wider range allowed for those that involve land raising due to the uncertainties around scale of earthworks and the source of material to be utilised for raising ground. Similarly, the potential range of benefits for these futures are wider because of removing properties from the hazard zone (lower elevation land) and the potential for raising the land to support the future transformation of South Dunedin.

The main sources of benefits are monetised and grouped broadly as follows:

- Benefits associated with avoided fatalities
- Avoided residential and commercial property damages
- Avoided trauma
- Improved water quality
- Ecosystem Services benefits
- The value of new open spaces created
- Hedonic analysis – changes in property values and redevelopment premia within South Dunedin
- Avoided income loss from displacement
- Avoided emergency services costs.

Each potential adaptation future will have a different mix and makeup of the above monetised benefits, but the benefits are measured using the same methodology between the potential adaptation futures to ensure comparability between the scenarios.

Irrespective of which potential adaptation future pathway is followed, these additional costs represent a considerable future delivery challenge for the local market when contrasted with the current Dunedin City Council capital delivery budget of $200m per annum for the entire city. If these costs were spread evenly over the next 50 years, the additional capital investment would be between $50m to $220m per annum within South Dunedin only.

Table 8 Potential Adaptation Futures and Council costs for implementation over 75 years (e.g., individual owner costs excluded)

Potential Adaptation Future	Estimated Benefits (2024 PV)	Estimated Cost (2024 PV)	Estimated Benefit Cost Ratio
Future 1: Status Quo	$0.2b ($0.1b - $0.3b)	$2b ($1.5 - 2.5b)	0.05 - 0.2

Future 2: Keep the land dry - pipes and pumps	$2.3b ($1.5b - $2.5b)	$3.2b ($2.5b - $4.0b)	0.3 – 1.0
Future 3: Keep the land dry with raised land	$3.8b ($3.5b - $4.5b)	$5.8b ($5.0b - $8.0b)	0.4 - 0.8
Future 4: Space for water - waterways and wetlands	$2.8b ($2.5b - $3.5b)	$2.8b ($2.0b - $4.0b)	0.6 – 1.6
Future 5: Space for water - waterways and raised land	$4.5b ($4.0b - $5.5b)	$7.1b ($6.0b - $10.0b)	0.4 - 0.9
Future 6: Let water in - some retreat and raised land	$3.7b ($3.5b - $5.5b)	$6.8b ($6.0b - $10.0b)	0.3 - 0.9
Future 7: Large scale retreat	$3.7b ($3.5b - $4.5b)	$5b ($4.5b - $8.0b)	0.4 - 1.0

ESTIMATED BENEFIT TO COST RATIO – 'BCR'

For each of the seven potential adaptation futures, costs and benefits have been estimated based on present value (PV) in '$ billions of dollars'. This helps understand the 'estimated benefit to cost ratio' (BCR), whereby a BCR of zero or just above that is not viable and not likely to be funded, and a BCR close to 1 or more demonstrates more positive outcomes and as such more likely to be funded. Notably, it is acknowledged that the BCR should not be 'the' determining factor in the options selection process. Rather, it is one of the factors informing the evaluation of options through a multiple criteria assessment (MCA) exercise. BCR focuses on quantifiable costs and benefits. It may not capture important qualitative factors like environmental impact, social equity, or strategic alignment.

In summary, the BCR is a valuable tool for evaluating the financial viability of projects and decisions. However, it should be used in conjunction with other analyses and a thorough consideration of qualitative factors to make informed and well-rounded decisions.

Going forward, potential futures with a stronger performing BCR could be further refined through participatory public engagement and consideration of potential value uplift opportunities.

7 Properties potentially affected

The ‘properties potentially affected’ information presented on the dashboard represents the number of properties likely to be part of a managed relocation effort to enable reduction of risk to the surrounding area.

We have based our analysis on GIS overlays for residential and commercial property boundaries provided by Dunedin City Council. Overall, it has been assessed that there a total of 5,800 residential properties within South Dunedin (within the study area). For Potential Future 1, we have assumed that some 2,500 residential properties may need to be retreated with the total number of properties likely affected overall exceeding 5,000 properties. For Potential Futures 2 – 7 involving interventions, we have assessed the indicative number of properties likely to be part of a managed relocation effort to enable reduction of risk to the surrounding area. These are shown as follows:

- Potential Future 2: 700 – 900 properties
- Potential Future 3: 800 – 950 properties
- Potential Future 4: 600 – 700 properties
- Potential Future 5: 800 – 950 properties
- Potential Future 6: 2500 – 3000 properties
- Potential Future 7: 3500 – 4000 properties

We note that some of the affected properties may intersect with an identified option such as a potential wetland or a potential blue green corridor. An intersection may require relocation to enable the option to be delivered.

Ultimately, the true number of properties to be affected will only be known later once efficacy studies undertaken to test the place, size and number of adaptation options required. This will also determine the efficacy of the interventions and enable the benefits to be firmed up.

8 Next steps

The Potential Adaptation Futures presented in the micro-business cases provide an initial assessment to inform the shortlisting process. Immediate next steps include continuing engagement with Rūnaka and local communities on the Potential Adaptation Futures.

This engagement will include the ability to comment on potential adaptation futures and specific questions where community feedback will be incorporated into the assessment of futures in the decision-making framework. During this same engagement period, engagement on thresholds and risk tolerance will occur to inform when actions will be required over time. At a high level, next steps are expected to involve:

- Stage 4: Shortlist of adaptation pathways
  - Assessment of Potential Adaptation Futures using community feedback and scoring metrics in the Decision-Making Framework alongside more detailed technical and economic analysis.
  - Identification of shortlist of Potential Adaptation Futures and refinement of adaptation options following community feedback.
  - Development of short-, medium- and long-term spatial pathways for each of the shortlisted potential adaptation futures.
- Stage 5: Preferred pathways
  - Assessment of short-, medium- and long-term pathways for the shortlisted futures using the Decision-Making Framework and community feedback.
  - Identification of the preferred pathway.
  - Development of an Adaptation Strategy for South Dunedin with signals, triggers, and adaptation thresholds, expected by mid-2026.

In refining the seven Potential Adaptation Futures to a short-list of futures, the options presented in this report will become increasingly specific and targeted to the needs of South Dunedin, culminating at the end of the process in a recommended (preferred) adaptation pathway.

Working in parallel with the ongoing South Dunedin Future Programme to develop an adaptation plan, there are several 'no regrets' interventions, that can reduce present risk and help prepare for future adaptation. The following short-term interventions require prompt consideration and where practical, implementation, to support risk reduction for South Dunedin Communities:

- Minor stormwater network upgrades (e.g. check valves, removing bottlenecks)
- Remove wastewater network overflows and cross connections
- Encourage percolation (bioswales, rain gardens, permeable surfaces)
- Better management of impervious surfaces (rain tanks, green roofs)
- Pilot green infrastructure test site for stormwater storage.

Developing the adaptation plan, including the signal and triggers associated with adaptation pathways, will require consideration of the time needed for implementing enabling actions (e.g., financial incentives, plan changes to avoid/restrict new developments, property acquisition) for as these may be complex processes requiring iwi, local, regional and central government support as well as additional technical investigation and regulatory processes. National direction on land-use planning for hazard prone areas and a national adaptation framework are anticipated in 2025 and will likely inform the implementation of these enabling actions.

9 References

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APPENDIX A: Decision Making Framework

South Dunedin Future: Decision-making Framework

This document provides guidance to inform assessment of adaptation options at the long list and short list phases. Subject matter experts from Kia Rōpine, Aukaha, Dunedin City Council and Otago Regional Council will assess options against the criteria presented herein considering a whole of life approach – e.g. from option construction through to use and ultimately demolition or removal.

How were criteria developed?

The criteria were developed through segmenting the Strategic Objectives into measurable components. This provides detail for a robust, transparent, repeatable assessment but does risk losing the overarching understanding of how the option performs across the objectives. Therefore, we recommend assessing options in two ways:

- Against individual criteria using rubrics (presented in this framework)
- Against overall objectives using a high-level assessment

This allows consideration of how the detail of how options perform against objectives while also providing a simple sense check.

Strategies, plans and policies herein represent a selection of local, regional and central government direction to inform the rubrics for each criteria. These strategies are presented alongside what we have heard from communities during recent engagement events. The team has tried to balance usability with detail, and therefore we recommend reviewing scoring options using the rubric provided with the context of the strategies, plans, and community feedback presented.

Pending confirmation from the Rūnaka advisory panel, criteria related to mana whenua connections to place as well as mana whenua aspirations as it relates to other criteria have been included in the decision-making framework below.

How is this decision-making framework used?

To use this decision-making framework, we have created a spreadsheet for tallying scores, and we recommend including comments with each score providing rationale. Kia Rōpine subject matter experts will work with identified Council subject matter experts to score the criteria relevant to their expertise, with subject matter experts (SMEs) presented alongside an overview of the criteria on the next page. We have also identified communities as the 'SMEs' to score particular criteria as presented. The process for scoring is:

- Review the community sentiments and strategic objectives to understand the context of the assessment.
- Assess the individual option against the rubric, assign a score and document rationale.

These scores have been collated in three ways:

- All criteria have equal weighting.
- All objectives have equal weighting, and criteria equal weighting within objectives.
- All criteria can be assigned a weighting and a weighted average is determined.

This provides a mechanism for sensitivity testing – e.g. are the options with the highest overall scores consistent regardless of weightings or will the preferred option likely change as weightings shift?

This scoring methodology can also be combined with a 1000minds approach whereby individuals can assign their own weightings and scores so that various assessments can be compared and/or combined. This alternative is under consideration by the DCC and ORC.

We recommend that there is consideration of how we can build a collective understanding with community members of why SMEs are scoring the way that they did and provides an opportunity for community members to identify where SMEs may not be fully appreciating some facet of the community and how it may be impacted.

When is this decision-making framework used?

The decision-making framework is used to scope the information provided in the micro-business cases for the spatial long list. This enables the South Dunedin Future team to implicitly begin to assess the long list against these criteria and to present a clear, repeatable understanding of the relative benefits and disbenefits of various options.

The spatial long-list will be scored against the decision-making framework at the start of the short listing phase, using a refined understanding from community feedback and updated modelling (if available). These scores will then be combined via the various weighting methods to enable sensitivity testing to identify the short list.

The additional short list criteria will be assessed at the start of the preferred pathways phase, and scores will be updated using the refined understanding from community feedback. These scores will then be combined via the various weighting methods to enable sensitivity testing to identify the preferred pathways.

Objective	Criteria	Measurements	SME
Sustainable Urban Development: Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Reduce emissions and waste	Carbon emissions (of option itself) Circularity / waste reductions Planetary boundaries*	Decarbonisation and circular economy specialists, urban designer
	Well functioning and liveable urban environment	Provides for a well functioning, compact urban form including provision of functional infrastructure Provides places and spaces that are liveable, walkable with good connectivity	Urban designer, urban economist
	Promotes water sensitive urban design and enhances amenity	Alignment to Development plans and strategies	Urban designer, landscape architect
	Suitable phasing over time	How it functions as a pathway system or process*	Urban designer, urban economist, water engineer
Environmental and cultural restoration: Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place	Restore the natural environment	Connectivity and scale of green spaces Level of disturbance to existing ecological biodiversity	Ecologist, landscape architect
	Aligns with Te Taki Haruru values (Autūroa, Auora, Autaketake, Autakata)	Rakatirataka fully realised, community empowered and resilient Mauri flourishes, ki uta ki tai approach embedded Tikaka and Kawa are embedded into social structure and used to restore and maintain balance Past/future connections to place strengthened & celebrated	Aukaha
	Enhances cultural connections to place	Impacts to heritage sites /features Impacts to community cultural hubs	Risk specialist, urban designer
Just transition: Respond to climate change in ways that empower communities and promote fairness and equity.	Reflect community preference	Community preferences	Communities
	Minimise impacts on all vulnerable communities, with vulnerable communities not left behind	Community access to education, quality and affordability of housing	Social impact specialist, urban designer
	Empowers communities	Having choices Enables access beyond / within South Dunedin	Communities
	Vulnerable communities not left behind	Impacts to disabled communities, elderly communities, low-income groups, culturally and linguistically diverse communities, refugees, and Pacific Communities	Social impact specialist
	Promotes intergenerational equity	Benefits and costs are shared equitably across generations	Social impact specialist
Social and economic resilience: Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back	Preserve and enhance community cohesion and community values	Impacts to social networks measured through accessibility (walking/cycling/public transport/) Exposure of community features	Risk specialist, social impact specialist, urban designer
	Minimises economic risk to communities	Cost of options versus benefits provided	Economist
	Increases community adaptive capacity	Contributes to wider community knowledge and understanding of risk	Social impact specialist
	Minimises economic risk to individuals	Ability to access funding/debt	Economist
	Minimises impacts to business	Exposure of commercial and industrial buildings to hazards/stressors	Risk specialist
Promote community safety: Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Promote community wellbeing	Community concerns	Communities
	Promote community safety	Exposure of roads to climate hazards/stressors Exposure of critical infrastructure and lifelines facilities	Risk specialist
	Reduced natural hazard risk	Exposure of residential buildings to climate hazards/stressors Cross cell impacts*	Risk specialist, economist
	Promote community health	Contributes to healthy living and working social conditions Impact to health and health services	Social impact specialist, economist, public health specialist (UoO)

Note:

* Items are proposed to only be assessed from short list to preferred pathways.

All criteria align with feedback, plans, strategies and policies presented.

Objective: Sustainable urban development

Description	Criteria	Measurement
Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	**Reduce emissions and waste**	**Carbon emissions (of option itself)** **Circularity / waste reductions** **Planetary boundaries***
	Well-functioning and liveable urban environment	Provides for a well functioning, compact urban form including provision of functional infrastructure Provides places and spaces that are liveable, walkable with good connectivity
	Promotes water sensitive urban design and enhances amenity	Alignment to Development plans and strategies
	Suitable phasing over time	How it functions as a pathway system or process*

*Assessed at short list only

Assessment requirement aligned with:

Community feedback:

Community feedback commented on the 'sustainability' of options – e.g. "it's important to think more about sustainability, not just protection."

Dunedin Waste Management Plan (2020) vision and targets:

Vision: The project is actively committed to zero waste inclusive of a circular economy to enhance the health of the environment and people by 2040.

- Reduce the municipal solid waste generation per capita by at least 15% by 2030 compared to 2015.
- Reduce the amount of municipal solid waste disposed to landfill and incineration by at least 50% by 2030 compared to 2015.
- Increase the diversion rate away from landfill and incineration to at least 70% by 2030.

Dunedin City Emissions Management and Reduction Plan (2022):

- NetZero emissions of all greenhouse gasses other than biogenic methane by 2030
- 24-47% reduction below 2017 biogenic methane by 2050
- Emissions reductions consistent with achieving Science Based Targets consistent with limiting warming to 1.5^{o}C (as in the Compact of Mayors coalition commitments)

Ōtepoti donut (2023):

- Supports effort to reduce water consumption
- Influences better decisions through the power of art and culture
- Supports businesses to quantify and achieve environmental targets
- Enables parks and recreation to drive ecological outcomes

2nd Generation Dunedin City District Plan Objectives (2018):

Dunedin reduces its environmental costs and reliance on non-renewable energy sources as much as practicable, including energy consumption, water use, and the quality and quantity of stormwater discharge, and is well equipped to manage and adapt to changing or disrupted energy supply by having:

- Increased local renewable energy generation
- Reduced reliance on private motor cars for transportation
- Housing that is energy efficient

Criteria from Waka Kotahi Resource Efficiency Guide:

- >10% reduction in whole-of-life emissions from base case
- >10% reduction in energy use across construction and operational phases
- >10% use of materials with recycled content

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Achieves a substantial reduction in whole of life emissions and energy use across construction and operational, while also incorporating a significant amount of recycled materials or minimising material demands.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Sustainable urban development

Description	Criteria	Measurement
Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Reduce emissions and waste	Carbon emissions Circularity / waste reductions Planetary boundaries*
	Well functioning and liveable urban environment	**Provides for a well functioning, compact urban form** including provision of functional infrastructure **Provides places and spaces that are liveable, walkable with good connectivity**
	Promotes water sensitive urban design and enhances amenity	Alignment to Development plans and strategies Enhances amenity with space for water
	Suitable phasing over time	How it functions as a pathway system or process*

*Assessed at short list only

Assessment requirement aligned with:

Community feedback:

Respondents noted that connections to parks, shops and schools from homes were important. Engagement identified key walkways as places of importance and disability representatives highlighted public transport as a key connector to the rest of Dunedin. Another comment noted that it is the South Dunedin facilities and land that make it attractive to many age groups and abilities, and how they don't want to 'drive people away from this awesome place'.

Future Development Strategy – Strategic Directions for Ōtepoti Dunedin (2023)

- Is a compact and accessible city.
- Maintains and enhances its vibrant and welcoming [...] suburban and town centres.
- Neighbourhoods are attractive and support resilient and healthy communities.

2nd Generation Dunedin City District Plan Objectives (2018):

- Dunedin stays a compact and accessible city with resilient townships based on sustainably managed urban expansion.
- Urban expansion only occurs if required and in the most appropriate form and locations.
- The multi-modal land transport network, including connections between land, air and sea transport networks operates safely and efficiently.

National Adaptation Plan (2022)

- Achieve compact urban form that is well linked to public transport and jobs (NAP).
- New and existing places are planned and managed to minimise risks to communities from climate change.

National Policy Statement on Urban Development (2020)

- Help to achieve a well-functioning urban environment by enabling intensification in areas with good accessibility to services and amenities
- Homes, buildings and infrastructure are climate resilient and meet social and cultural needs.

New Zealand Urban Design Protocol

- Make New Zealand town and cities more successful through quality urban design.
- Proponent of the 7Cs: Context, Character, Choice, Connections, Creativity, Custodianship and Collaboration.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Provides an excellent support for well-functioning and liveable urban environment with a compact, functional urban form where it is safe and comfortable to walk and cycle, with easy access to public transport, community and commercial services and jobs. An urban environment that has vibrant town centres with high quality urban spaces that incentivise the establishment of a diversity of economic and community activities, and promotes social interaction.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Sustainable urban development

Description	Criteria	Measurement
Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Reduce emissions and waste	Carbon emissions Circularity / waste reductions Planetary boundaries*
	Well functioning and liveable urban environment	Provides for a well functioning, compact urban form including provision of functional infrastructure Provides places and spaces that are liveable, walkable with good connectivity
	Promotes water sensitive urban design and enhances amenity	**Alignment to Development plans and strategies** **Enhances amenity with space for water**
	Suitable phasing over time	How it functions as a pathway system or process*

*Assessed at short list only

<u>Assessment requirement aligned with:</u>

Community feedback:

Community feedback raised that solutions that reinvigorate the natural environment while helping the urban environment are preferable, with a comment on the chance to “beautify our urban places”. As part of this people valued making South Dunedin more vibrant and less of a ‘grey’ built environment.

Future Development Strategy – Strategic Directions for Ōtepoti Dunedin (2023)

- Protects its landscapes, natural features and wāhi tūpuna from harmful development.
- Celebrates its relationship with the Otago Harbour.
- Neighbourhoods are attractive and support resilient and healthy communities.

Draft wellbeing outcomes and indicators (Council meeting 25 September 2023)

- Environmental: People enjoy, connect to and celebrate the natural world – proportion of population living within 300m of park space or green space at least 1 hectare in size.

Te Ao Turoa | The Natural World: Dunedin’s Environment Strategy 2016-2026

- Give Dunedin people every opportunity to feel connected to and look after the environment.

ORC Natural Hazards Plan (2014)

- Principle 2: Create communities in which people can live, work and use the land without undue stress or fear of natural hazards.
- Principle 7: New development and hazard-management measures will not exacerbate the risks or effects of natural hazards elsewhere. This applies at all scales, from localised ‘property to property’ effects, through to the community or catchment scale.

Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy 2020

- Enables community driven restoration projects.
- Communities are connected with nature and supports and actively contributes to protection and restoration.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Promotes using natural systems and water sensitive design as a key component of its land-use/ infrastructure planning. It provides easy access to green and blue spaces to provide strong connections between communities and the natural environment.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Sustainable urban development

Description	Criteria	Measurement
Urban development accounts for the changing environment in South Dunedin, providing better spaces for people, water, and wildlife.	Reduce emissions and waste	Carbon emissions Circularity / waste reductions Planetary boundaries*
	Well functioning and liveable urban environment	Provides for a well functioning, compact urban form including provision of functional infrastructure Provides places and spaces that are liveable, walkable with good connectivity
	Promotes water sensitive urban design and enhances amenity	Alignment to Development plans and strategies Enhances amenity with space for water
	Suitable phasing over time	**How it functions as a pathway system or process***

*Assessed at short list only

<u>Assessment requirement aligned with:</u>

Community feedback:

Community feedback recognised that timing choices for options can cause more or less disruption and so is an important consideration. In particular, some options were identified as being more challenging due to the phasing required. Some approaches were noted as being suitable as 'backstops', others suitable for implementing 'over time' and some 'too slow'. As part of this, the community were interested in the pace of change and understanding the implications of options on future adaptation (e.g. "what approaches does a hard engineering tactic exclude from future adaptation"). There was an identified need for a combination of adaptation options rather than a single approach.

Future Development Strategy – Strategic Directions for Ōtepoti Dunedin (2023)

- Protects its landscapes, natural features and wāhi tūpuna from harmful development.
- Maintains and enhances its vibrant and welcoming [...] suburban and town centres and celebrates its relationship with the Otago Harbour.

ORC Natural Hazards Plan (2014)

- Principle 4: Adopt a broad scale, adaptive approach over the long term. The ability to respond to changes in the nature and extent of risk, ease of transitions and provide the level of safety desired by the community is essential.
- Principle 5: It is important to address the entire risk spectrum when managing the effects of natural hazards. This principle recognises that whatever event is planned for, there will be a larger, major event. The risk from these major events also needs to be recognised and managed.
- Principle 7: New development and hazard-management measures will not exacerbate the risks or effects of natural hazards elsewhere. This applies at all scales, from localised 'property to property' effects, through to the community or catchment scale.
- New and existing places are planned and managed to minimise risks to communities from climate change.
- Adaptation planning requires a flexible approach that can accommodate change but keep us moving in the right direction. Inevitably, actions in the later years of this plan are less clearly defined.
- Actions will also ensure we do not lock in or exacerbate future impacts on communities, such as accessibility issues, and that we manage potential impacts of regulatory change.

National Policy Statement on Urban Development (2020)

- Help to achieve a well-functioning urban environment by enabling intensification in areas with good accessibility to services and amenities.
- New and existing places are planned and managed to minimise risks to communities from climate change.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Pathway system/process is highly efficient with minimal impact transitions between options and resilience.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Environmental and cultural restoration

Description	Criteria	Measurement
Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place	**Restore the natural environment**	**Connectivity and scale of green spaces** **Level of disturbance to existing ecological biodiversity** RR
	Aligns with Te Taki Haruru values (Autūroa, Auora, Autaketake, Autakata)	Rakatirataka fully realised, community empowered and resilient Mauri flourishes, ki uta ki tai approach embedded Tikaka and Kawa are embedded into social structure and used to restore and maintain balance Past/future connections to place strengthened & celebrated
	Enhances cultural connections to place	Impacts to community cultural hubs RR Impacts to heritage sites /features RR

Assessment requirement aligned with:

Community feedback:

Community respondents valued approaches that benefit biodiversity and the natural environment, and this was a key theme from the engagement. There was strong support for green spaces and ecological values with the potential for "the greening of South Dunedin". Reference was also made to opportunities for wildlife like sea lions and eels.

Te Ao Turoa | The Natural World: Dunedin's Environment Strategy 2016-2026

- Draw on science, mātauraka Māori and good environmental practice
- Identify and protect areas of ecological significance, establish biodiversity and ecosystem health measures and establish integrated planning for key environmental areas including air, water and soil standards.
- Work with landowners to integrate biodiversity into productive environments and to help sustain ecosystem services.
- Objectives: sustain ecosystem services, increase indigenous biodiversity, restore areas of ecological value by:
    - safeguard the life-supporting capacity (mauri) of indigenous and taoka species' habitats
    - protect important ecological areas
    - protect areas of importance to Kāi Tahu
    - take a landscape-scale approach to protecting ecosystems and increasing biodiversity

Future Development Strategy – Strategic Directions for Ōtepoti Dunedin (2023)

- Protects its landscapes, natural features and wāhi tūpuna from harmful development.
- Protects and prioritises the mauri and health of water bodies, including coastal waters, with mana whenua exercising their role as kaitiaki.

Otago Regional Council Strategic Directions

- Protect and enhance biodiversity and ecosystems.
- Protect our land, water and coast from inappropriate activities.

2nd Generation Dunedin City District Plan Objectives (2018):

- Dunedin's significant indigenous biodiversity is protected or enhanced, and restored; and other indigenous biodiversity is maintained or enhanced, and restored; with all indigenous biodiversity having improved connections and improved resilience.
- Dunedin's outstanding and significant natural landscapes and natural features are protected.
- The natural character of the coastal environment is preserved or enhanced.
- Policies, planning and regulation should protect, enhance and restore nature, and any impacts on nature should be mitigated as much as possible.
- Ecosystems are healthy and connected where biodiversity is thriving.

Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy 2020

- Protecting, maintaining and restoring biodiversity, including requiring councils and landowners to consider creating ecological corridors.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Maximizes protection and restoration of indigenous biodiversity, substantially improves ecosystem connectivity, providing a network of protected areas for important species and habitats, and safeguarding areas of importance to Kāi Tahu.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Environmental and cultural restoration

Description	Criteria	Measurement
Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place	Restore the natural environment	Connectivity and scale of green spaces Level of disturbance to existing ecological biodiversity [RR]
	Aligns with Te Taki Haruru values (Autūroa, Auora, Autaketake, Autakata)	**Rakatirataka fully realised, community empowered and resilient** **Mauri flourishes, ki uta ki tai approach embedded Tikaka and Kawa are embedded into social structure and used to restore and maintain balance** **Past/future connections to place strengthened & celebrated**
	Enhances cultural connections to place	Impacts to community cultural hubs [RR] Impacts to heritage sites /features [RR]

Assessment requirement aligned with:

Community feedback:

A member of the community remarked – ""Māori understand this best. What would their solution be?"

Future Development Strategy – Strategic Directions for Ōtepoti Dunedin(2023)

- The mauri and health of water bodies are protected and prioritized, with ana whenua exercising their role of kaitiaki.

Te Taki Haruru (2023)

- Future for mokopuna based in vitality and abundant wellbeing.
- Mana whenua are leaders, influencers and partners.
- The mauri of Ōtepoti is restored and enhanced.
- Balance is restored, and the future of our people and resources is protected.
- The traditional authority of mana whenua in Ōtepoti is recognised through partnerships based on reciprocity and respect.

Te Ao Turoa | The Natural World: Dunedin's Environment Strategy 2016-2026

- Purpose: Improve and maintain the health of Dunedin's natural environment.
- Enjoy, connect to and celebrate the natural world by honouring and supporting the kaitiaki role of Kai Tahu.
- Improve access to our special places and spaces.

2nd Generation Dunedin City District Plan Objectives (2018):

- Kāi Tahu can exercise kaitiakitaka over resources within their takiwā.
- Kāi Tahu can occupy, develop and use land in areas originally set aside for that purpose, in accordance with their culture and traditions and economic, social and cultural aspirations.
- Wāhi tūpuna (including wāhi tapu and wāhi taoka) and their relationship with Kāi Tahu is acknowledged and protected.

Te Mana o te Taiao – Aotearoa New Zealand Biodiversity Strategy 2020

- Treaty partners, whānau, hapū, iwi and Māori organisations are leading the way as rangatira and kaitiaki and are ensuring the restoration of mātauranga Māori.

National Adaptation Plan (2022)

- Support kaitiaki communities to adapt and conserve taonga/cultural assets.
- Uphold Te Tiriti o Waitangi, work in partnership with Māori to address climate risk, maximise opportunities and avoid disproportionately affecting Māori or locking in existing inequities.
- Māori connections to whenua and places of cultural value are strengthened through partnerships.
- Threats to cultural heritage arising from climate change are understood and impacts are minimised.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Rakatirataka fully realised, community empowered and resilient. Mauri flourishes, ki uta ki tai approach embedded. Tikaka and Kawa are embedded into social structure and used to restore and maintain balance. Past/future connections to place strengthened & celebrated.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Environmental and cultural restoration

Description	Criteria	Measurement
Restore and regenerate natural environment, renew urban spaces, and re-energise cultural connections to place	Restore the natural environment	Connectivity and scale of green spaces Level of disturbance to existing ecological biodiversity RR
	Aligns with Te Taki Haruru values (Autūroa, Auora, Autaketake, Autakata)	Rakatirataka fully realised, community empowered and resilient Mauri flourishes, ki uta ki tai approach embedded Tikaka and Kawa are embedded into social structure and used to restore and maintain balance Past/future connections to place strengthened & celebrated
	Enhances cultural connections to place	**Impacts to heritage sites /features RR** **Impacts to community cultural hubs RR**

Assessment requirement aligned with:

Community feedback:

Community engagement highlighted that they value South Dunedin as being "very historical" with architectural features and heritage places of importance like the facades on the main street, Mayfair theatre, gasworks, and dinosaur park. Engagement highlighted concerns over future hazard impacts causing rapid deterioration of important cultural locations. Community spaces were considered important both for culture and recreation. Comments included considerations of how the community could get more involved in adaptation measures and options could act as a 'catalyst for community cohesion'. Respondents noted "people are wanting a sense of community now more than ever".

A Heritage Strategy for Dunedin City (2007)

- Retention of Dunedin's heritage is integral to the character and identity of Dunedin
- By encouraging and providing for the adaptive reuse, and therefore economic viability of, heritage buildings they can be sustainably managed and retained for future generations
- Work in partnership with New Zealand Historic Places Trust, Kai Tahu ki Otago, property owners and community organisations to identify heritage items that need protection, and co-ordinate resources to give effect to that protection
- Promote and facilitate the continuing sustainable use of heritage items, as well as sympathetic design and development within townscape precincts

Draft wellbeing outcomes and indicators (Council meeting 25 September 2023)

- Cultural: Dunedin has inclusive and connected communities that actively engage people in cultural activities and experiences – sense of belonging in adults and youth; number of DCC places and open spaces which can be used as cultural spaces

Dunedin Social Wellbeing Strategy (2013)

- Priority 1.1: Dunedin people feel included in their local communities and wider city
- Priority 2.2: Dunedin celebrates its identity and cultural diversity.

2nd Generation Dunedin City District Plan Objectives (2018):

Dunedin's heritage is central to its identity and is protected and celebrated as a core value of the city, through the heritage conservation and retention of important heritage items, and the maintenance and active use of built heritage.

National Adaptation Plan (2022)

- Conserve cultural heritage
- Enable communities to maintain and protect their taonga and assets
- Threats to cultural heritage arising from climate change are understood and impacts are minimised.

Migrant Settlement and Integration Strategy (INZ)

- Participation and Inclusion: recent migrants and their families are welcomed and have a strong sense of belonging and acceptance in their communities and in Aotearoa New Zealand. They feel confident and safe to participate in different aspects of their lives.
- Housing: recent migrants and their families live in homes and in communities that meet their long-term needs and goals.
- Education, Training and English Language: recent migrants and their families achieve their education, training and English language goals.

Ministry of Pacific Peoples Strategic Intentions (2023)

- Thriving Pacific languages, cultures and identities
- Prosperous Pacific communities
- Resilient and healthy Pacific peoples.
- Confident, thriving and resilient Pacific young people.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Significantly improves or enhances heritage sites or features and cultural hubs, reducing risk and ensuring their preservation for future generations. Increases the resilience of cultural heritage, implementing measures to protect against natural disasters, climate change, and other threats.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Just transition

Description	Criteria	Measurement
Respond to climate change in ways that empower communities and promote fairness and equity.	**Reflect community preference**	**Community preferences**
	Minimise impacts on vulnerable communities	Community access to education and quality and affordability of housing
	Empowers communities	Having choices
	Vulnerable communities are not left behind	Impacts to disabled communities, elderly communities, low-income groups, culturally and linguistically diverse communities, refugees, and Pacific Communities
	Promotes intergenerational equity	Benefits and costs are shared equitably across generations

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Strongly aligns with community preferences, incorporating feedback and input from diverse community members. Reflects a clear understanding of community needs and desires.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Note: We suggest this criteria is assessed by members of the community where they indicate how well the option does or does not align with their individual preference as well as if they believe the option reflects a clear understanding of community needs and desires.

<u>Assessment requirement aligned with:</u>

Community feedback:

The engagement clearly identified that communities want their needs to be reflected in the design of South Dunedin's future, particularly with regards to how they might be able to get involved. Engagement to date has highlighted several elements communities like/dislike about each adaptation approach.

DCC Significance and Engagement Policy (2024) considers engagement based upon:

- Importance to Dunedin levels of service, long term impacts and opportunity costs
- Community interest related to the number of individuals, business, groups, communities and sectors affected by or interested in the matter
- Consistency with existing policy related to community outcomes, Strategic Framework priorities and policies.
- Impacts on Council finances, capability and capacity.

2nd Generation Dunedin City District Plan Objectives (2018):

- There is a range of housing choices in Dunedin that provides for the community's needs and supports social well-being.

National Adaptation Plan (2022)

- Adapt in partnership with iwi, hapū, Māori and all New Zealanders.
- Enable communities to prepare for the unique risks and opportunities they face, and tailor interventions to the local situation.
- All critical and supporting actions are current, which means they have funding and mandate.

Objective: Just transition

Description	Criteria	Measurement
Respond to climate change in ways that empower communities and promote fairness and equity.	Reflect community preference	Community preferences
	Minimise impacts on vulnerable communities	**Community access to education** **Quality and affordability of housing**
	Empowers communities	Having choices
	Vulnerable communities are not left behind	Impacts to disabled communities, elderly communities, low-income groups, culturally and linguistically diverse communities, refugees, and Pacific Communities
	Promotes intergenerational equity	Benefits and costs are shared equitably across generations

<u>Assessment requirement aligned with:</u>

Community feedback:

Cost to community was a clear fear identified in the engagement process to date. This centred around the cost of adaptation approaches (or lack of adaptation) as well as the associated implications on affordability, rates and property values. At a wider scale, living conditions were a key consideration for many respondents, referencing housing quality as well as access to schools, work, healthcare, churches, community activities, and businesses. As part of this, there was commentary on how this is amplified for vulnerable communities and making sure costs aren't pushed on to future generations.

Future Development Strategy – Strategic Directions for Ōtepoti Dunedin(2023)

- Ōtepoti Dunedin has a range of quality housing choices that provides a home for everyone

Draft wellbeing outcomes and indicators (Council meeting 25 September 2023)

- Social: People experience a reasonable standard of living and quality of life – DCC surveyed question re: ability to cover costs of everyday needs
- Social: People life in affordable and healthy homes – DCC surveyed questions re: if home is suitable, affordable, and damp
- Social: The quality of physical & mental health, education and social services is maintained and approved – DCC surveyed question

Dunedin Social Wellbeing Strategy (2013)

- Priority 3.1: All people have good access to health services.
- Priority 5.1: Dunedin people live in warm and healthy homes
- Priority 5.2: Affordable housing options are available to all.

ORC Our Lands and Water Regional Proposed Plan (2023)

- Recognising the need for transitions in the use of resources over time and to manage the impacts of these transitions on communities.
- Strategic Policy Direction: Prioritise the health and well-being of water bodies and freshwater ecosystems in all decision-making, to restore and preserve the balance between the water, the wider environment, and the community.

ORC Natural Hazards Plan (2014)

- Principle 2: Create communities in which people can live, work and use the land without undue stress or fear of natural hazards.
- Principle 3: Create and maintain a including infrastructure and lifelines, which takes into account the risks from natural hazards so that it can operate effectively while still being affordable.
- Understand where our most vulnerable people are and what they need and value, and provide them with support, knowledge and resources.

National Policy Statement on Urban Development (2020)

Have good accessibility for all people between housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantially improves community access to quality education, and housing.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Just transition

Description	Criteria	Measurement
Respond to climate change in ways that empower communities and promote fairness and equity.	Reflect community preference	Community preferences
	Minimise impacts on vulnerable communities	Community access to education and quality and affordability of housing
	Empowers communities	**Having choices**
	Vulnerable communities are not left behind	Impacts to disabled communities, elderly communities, low-income groups, culturally and linguistically diverse communities, refugees, and Pacific Communities
	Promotes intergenerational equity	Benefits and costs are shared equitably across generations

<u>Assessment requirement aligned with:</u>

Community feedback:

Feedback highlighted interest in community involvement in adaptation so as to "build community skills". This allows for people to "help in [their] our own way". Furthermore, comments referred to taking a "whole of community approach where landowners can contribute and be empowered in the process".

Dunedin Social Wellbeing Strategy (2013)

- Priority 4.2: Dunedin people can afford to exercise genuine choices.

ORC Natural Hazards Plan (2014)

- Principle 8: Increasing community awareness is essential to assist people in taking natural-hazard risks into account when undertaking development.

National Adaptation Plan (2022)

- Set clear, stable policies that provide predictability for communities and businesses, allowing them time to plan, respond and seize opportunities.
- Support workers to adapt by transitioning to quality jobs at lower risk from the effects of climate change.
- Adapt in partnership with iwi, hapū, Māori and all New Zealanders.
- Enable communities to prepare for the unique risks and opportunities they face, and tailor interventions to the local situation.
- Use the best available evidence including science, data, local knowledge and māturaka Māori.
- Support asset owners to evaluate, understand and manage the impacts and risks of climate change on their physical assets and the services they provide.
- Understand where our most vulnerable people are and what they need and value, and provide them with support, knowledge and resources.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Enables communities to have the knowledge and resources to have and make individual choices to reduce climate risk in accordance with their personal risk tolerances from a range of options.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Note: We suggest this criteria is assessed by members of the community where they indicate whether they feel that the option enables them to make choices for themselves in the future.

As an alternative, we could ask a similar question in every engagement moving forward to measure whether communities feel empowered to contribute to and influence the SDF programme to track empowerment.

Objective: Just transition

Description	Criteria	Measurement
Respond to climate change in ways that empower communities and promote fairness and equity.	Reflect community preference	Community preferences
	Minimise impacts on all vulnerable communities	Community access to education and quality and affordability of housing
	Empowers communities	Having choices
	Vulnerable communities are not left behind	**Impacts to disabled communities, elderly communities, low-income groups, culturally and linguistically diverse communities, refugees, and Pacific Communities**
	Promotes intergenerational equity	Benefits and costs are shared equitably across generations

<u>Assessment requirement aligned with:</u>

Community feedback:

Community feedback raised fears around the future of South Dunedin leaving 'only the vulnerable behind' and reiterated the need to consider vulnerable groups (including elderly, disabled people, pregnant women, young children and people with less socio-economic means to recover from climate risks) in adaptation planning. Disability representatives further reinforced that the most vulnerable groups must be a high priority for emergency management and adaptation. This included considering access and accessibility for all approaches.

Dunedin Social Wellbeing Strategy (2013)

- Priorities: Dunedin people feel included in their local communities and wider city

National Adaptation Plan (2022)

- Work inclusively with affected groups to understand their need
- Take opportunities to reduce inequalities and support communities and regions to promote resilience in line with local objectives
- Prioritise support to those most affected and least able to adapt, particularly lower income households
- Adapting our homes and buildings to be resilient, be fair, equitable and inclusive and helps our most vulnerable communities thrive.
- Consider the needs of all groups who may be disproportionally impacted by climate change, or who are least able to adapt. These include Māori, people of lower socio-economic status, disabled people, women, older people, youth and migrant communities.
- Understand where our most vulnerable people are and what they need and value, and provide them with support, knowledge and resources.

Further plans, strategies and policies related to specific vulnerable groups are presented on the next page.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantially improves quality of life and resilience of vulnerable communities through design of adaptation which improves accessibility.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Disability Strategy – Office for Disability Issues (2016)

- Principles: Ensure disabled people are involved in decision-making that impacts them
- Principles: Take a whole-of-life and long-term approach to social investment
- Respect for inherent dignity, individual autonomy including the freedom to make one's own choices, and independence of persons
- Provides for full and effective participation and inclusion in society
- Respect for difference and acceptance of disabled people as part of human diversity and humanity
- Provides equality of opportunity and accessibility
- Respect for the evolving capacities of disabled children and respect for the right of disabled children to preserve their identities.
- Provides a twin track approach to support services providing for universal design and reasonable accommodation
- Enables working with the Disability Support Network to enable disabled people to participate in emergency recovery and adaptation planning

Better Later Life Strategy – Office for Seniors (2019)

- Value people as they age, keep people safe, recgonise diversity, take a whole of life and whanau centred approach to ageing, and take a collective responsibility to plan and act for later in life.
- Consider older people, diversity and flexibility when designing – recgonising potential for co-design
- Provide functional, affordable housing options with good access to transport and services and universal design
- Provide accessible built environments and community spaces to address loneliness and social isolation
- Provide safe transport options including age friendly spaces, improved public transport and safe footpaths, cycle lanes and crossings.

Migrant Settlement and Integration Strategy (INZ)

- Participation and Inclusion: recent migrants and their families are welcomed and have a strong sense of belonging and acceptance in their communities and in Aotearoa New Zealand. They feel confident and safe to participate in different aspects of their lives.
- Housing: recent migrants and their families live in homes and in communities that meet their long-term needs and goals.
- Health and Wellbeing: former refugees and their families achieve their health and wellbeing goals and thriving in their lives
- Education, Training and English Language: recent migrants and their families achieve their education, training and English language goals.
- Employment and Self-Sufficiency: Former refugees and their families achieve their employment and self-sufficiency goals, building on their skills and experiences.

Objective: Just transition

Description	Criteria	Measurement
Respond to climate change in ways that empower communities and promote fairness and equity.	Reflect community preference	Community preferences
	Minimise impacts on all vulnerable communities	Community access to education and quality and affordability of housing
	Empowers communities	Having choices
	Vulnerable communities are not left behind	Impacts to disabled communities, elderly communities, low-income groups, culturally and linguistically diverse communities, refugees, and Pacific Communities
	Promotes intergenerational equity	**Benefits and costs are shared equitably across generations**

Assessment requirement aligned with:

Community feedback:

When discussing the programme with children, they want everyone to consider impacts on their futures.

A guide to just transitions for communities in Aotearoa New Zealand (MBIE, 2023)

- A just transition can restore and rejuvenate mauri life force to bring social, economic and environmental systems and supports into balance.
- It addresses injustices. It is inclusive and based on shared principles, values and visions. Its outcomes support oranga wellbeing for all.

Bringing an intergenerational perspective into policy (NZ Treasury, 2023)

- Te Tai Waiora also outlines how future New Zealanders will inherit relatively high and growing stocks of physical capital, human capability, and social cohesion. However, New Zealand has tended to build these aspects of wealth through activities that depleted our natural environment. Environmental deterioration cannot continue indefinitely without posing major risks to future wellbeing.
- If tipping points in the climate trigger irreversible changes, future generations may be prevented from accessing the wealth of past and present generations.
- The economic and social impacts of climate change also create pressures for government spending. The Treasury estimates that more frequent droughts, storms and flooding will add around 4% of net debt to GDP over the next 40 years. The compounding effects of the increasing frequency and severity of events are expected to put further pressure on our fiscal resilience
- How we respond to a changing climate will have impacts across generations. For example, New Zealand faces choices around how – including how quickly – we transition to a low emissions economy. Evidence suggests that reducing emissions earlier is likely to reduce overall transition costs by avoiding the need for more dramatic reductions later. Similarly, wise investments in building climate resilience now may avoid costs of damage from extreme weather in the future.
- One of the most important things we can all do for current and future generations is to improve the performance of our public systems.
- More work is needed to ensure that intergenerational equity is considered in policy advice. While a couple of agencies have medium- and long-term service and infrastructure plans, we urgently need to build more systematic long-term planning for services and infrastructure at an agency level. By planning for the big trends we face, and linking this to performance and funding cycles, we can collectively as a country think about, and plan for, future generations as well as our own.
- 'Titiro Whakamuri, Haere Whakamua – Let us walk into the future, with our eyes open to the past'.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Long term benefits and costs are shared equitably across generations.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Social and Economic Resilience

Description	Criteria	Measurement
Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back	**Preserve and enhance community cohesion and community values**	**Impacts to social networks measured through accessibility (walking/cycling/public transport/) [RR]** **Exposure of community features [RR]**
	Minimises economic risk to communities	Cost of options versus benefits provided
	Increases community adaptive capacity	Contributes to wider community knowledge and understanding of risk
	Minimises economic risk to individuals	Ability to access funding/debt
	Minimises impacts to business	Exposure of commercial and industrial buildings to hazards/stressors [RR]

<u>Assessment requirement aligned with:</u>

Community feedback:

Adaptation options were identified as a possible “catalyst for community cohesion”. Engagement identified several community features or places of importance that contribute to their sense of belonging/place.

Draft wellbeing outcomes and indicators (Council meeting 25 September 2023)

- Economic: People have access to essential infrastructure that meet their needs – DCC measures average travel time by bus/car on key urban routes

Dunedin Social Wellbeing Strategy (2013)

- Priority 1.2: Dunedin communities are connected to the places they need to go by safe, affordable and user-friendly transport options.

2nd Generation Dunedin City District Plan Objectives (2018):

> The elements of the environment that contribute to residents' and visitors' aesthetic appreciation for and enjoyment of the city are protected and enhanced.

ORC Natural Hazards Plan (2014)

- Principle 2: Create communities in which people can live, work and use the land without undue stress or fear of natural hazards.

National Adaptation Plan (2022)

- Set clear, stable policies that provide predictability for communities and businesses, allowing them time to plan, respond and seize opportunities.
- Understand where infrastructure assets and their services are exposed and vulnerable to climate impacts.
- Build community resilience through social cohesion

National Policy Statement on Urban Development (2020)

- Have good accessibility for all people between housing, jobs, community services, natural spaces, and open spaces, including by way of public or active transport

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantially reduces risk to social networks and community features.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Social and Economic Resilience

Description	Criteria	Measurement
Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back	Preserve and enhance community cohesion and community values	Impacts to social networks measured through accessibility (walking/cycling/public transport/) [RR] Exposure of community features and areas of significance [RR]
	Minimises economic risk to communities	**Cost of options versus benefits provided**
	Increases community adaptive capacity	Contributes to wider community knowledge and understanding of risk
	Minimises economic risk to individuals	Ability to access funding/debt
	Minimises impacts to business	Exposure of commercial and industrial buildings to hazards/stressors [RR]

Assessment requirement aligned with:

Community feedback:

Engagement feedback noted large investments need to be "worth the greater cost" particularly by considering benefits for future generations.

DCC Stormwater Integrated Catchment Management Plan Objectives (2017)

- Affordability – meet strategic objectives while limiting cost increases to current affordability levels where practical.

2nd Generation Dunedin City District Plan Objectives (2018):

- Public infrastructure networks operate efficiently and effectively and have the least possible long term cost burden on the public.

Dunedin Economic Development Strategy (2013)

- Infrastructure should support business growth and adaptability.
- Dunedin should use its industrial and research strengths to develop alliances to build commercial opportunities and drive innovation.
- Investment should create job and training opportunities for youth, reduce economic inequality, retain skilled students as workers, attract migrants to Dunedin, maintain the relatively high knowledge and skills base that exists, and encourage our labour force to continually up-skill.
- Actions should attract investment, make better international connections through our diaspora, link Dunedin internationally, and play our part in supporting the wider South Island.
- We should maintain a high quality of life, including ensuring environmental sustainability. It also means leveraging our sport, public art, cultural, leisure and recreational amenities to improve wellbeing and attract visitors, residents and commercial opportunities.

Treasury Background Paper for the 2021 Statement on the Long-term Fiscal Position (2021)

- To support intergenerational wellbeing, fiscal strategy choices must be both sustainable and equitable. Consider the likely impact of fiscal strategy on present and future generations.
- Achieve and maintain prudent public debt levels.
- Ensure that, on average, total operating expenses do not exceed total operating revenues.
- Achieve and maintain total net worth at levels that provide a buffer against future changes.
- Manage fiscal risks facing the government prudently.
- When formulating revenue strategy, have regard to efficiency and equity, including the predictability and stability of tax rates.

Treasury Climate and Fiscal Assessment (2023)

- There will be large economic and fiscal costs. The choices governments, businesses and households make today will influence how prepared we are to manage the impact of climate change.
- The scale, nature and complexity of these costs [of climate change] highlight the need to be flexible and manage our public finances prudently.
- The overall cost of climate change will be influenced by how flexible and adaptable both the economy and decision-makers are.
- The costs from the increased severity and frequency of natural hazards due to climate change are likely to increase over time, expanding New Zealand's already significant natural hazard risk profile.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Benefits substantially outweigh the costs of the option.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Social and Economic Resilience

Description	Criteria	Measurement
Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back	Preserve and enhance community cohesion and community values	Impacts to social networks measured through accessibility (walking/cycling/public transport/) Exposure of community features and areas of significance to hazards/stressors RR
	Minimises economic risk to communities	Cost of options versus benefits provided
	Increases community adaptive capacity	**Contributes to wider community knowledge and understanding of risk**
	Minimises economic risk to individuals	Ability to access funding/debt
	Minimises impacts to business	Exposure of commercial and industrial buildings to hazards/stressors RR

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantial increases the understanding of risk and options to enable individual planning and decision making.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Assessment requirement aligned with:

Community feedback:

Engagement feedback valued building community skills as part of adaptation measures so that the community are involved in the change. Feedback noted that this would create a stronger, closer community who can 'look out for each other'.

Dunedin Social Wellbeing Strategy (2013)

- Priority 2.3: Dunedin communities are resilient and have good access to information and resources
- Priority 1.4: Dunedin people have access to lifelong learning opportunities.

National Adaptation Plan (2022)

- Raise awareness of climate hazards to make emergency preparedness apart of everyday life.
- Provide access to the latest climate projections data to give New Zealanders the information they need to assess climate risk.
- Build community resilience through social cohesion

Objective: Social and Economic Resilience

Description	Criteria	Measurement
Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back	Preserve and enhance community cohesion and community values	Impacts to social networks measured through accessibility (walking/cycling/public transport/) RR Exposure of community features and areas of significance to hazards/stressors RR
	Minimises economic risk to communities	Cost of options versus benefits provided
	Increases community adaptive capacity	Contributes to wider community knowledge and understanding of risk
	Minimises economic risk to individuals	**Ability of community members to access funding/debt (e.g. mortgage / loans)**
	Minimises impacts to business	Exposure of commercial and industrial buildings to hazards/stressors RR

Assessment requirement aligned with:

Community feedback:

Feedback included concerns on self-funded adaptation options, and individuals having the ability to source funding to complete activities. Insurance availability or affordability was highlighted as a key threshold for when major future change may be needed. Some noted that insurance premiums are already unaffordable. Climate risks were also flagged to have other implications for people's finances including unhealthy, deteriorating housing and inability to grow own food.

Draft wellbeing outcomes and indicators (Council meeting 25 September 2023)

- Economic: People can meet their daily needs and are free from economic deprivation – monthly and annual data available for Deposit Affordability Indicators, Mortgage Serviceability Indicators, and Rent Affordability Indicators, insurance premiums.

National Adaptation Plan (2022)

- Develop options for home flood insurance.
- Reduce and manage the impacts of climate hazards on homes and buildings.
- Explore co-investment for flood resilience. A resilient financial system underpins economic stability and growth. Participants can identify, disclose and manage climate risks
- Insurance access and affordability is understood and managed.

Insurance Council of New Zealand's views on climate change and the role of local government (2021)

- ICNZ and its members have been seeing the impacts of climate change and how this affects people, businesses and communities for some time.
- We also have a keen interest given our knowledge and experience when it comes to identifying and engaging with climate change risks and risk management, the role insurance plays in this context, and our desire to ensure this remains available and affordable (including to support lending).
- We advocate local governments take a long-term view and act in a proactive, coordinated and resilient manner when it comes to climate change, with regard to risk mitigation, adaptation, risk transfer options and setting appropriate risk signals. Particular attention should be had to avoiding developments in areas vulnerable to flooding, rising sea levels or coastal erosion.
- Local government must adopt a holistic and flexible approach when working through these matters, leveraging a risk management framework and an adaptive pathways approach.
- Ensure buildings are resilient to climate change impacts, specifically making sure that any new building work approved contributes to reducing emissions and is more resilient to climate change impacts alongside other natural hazard risks.
- Support vulnerable groups or areas particularly adversely impacted climate change, including potentially subsidising resiliency improvements or managed retreat, noting that climate change has the potential to exacerbate existing inequalities.
- If proactive action to reduce risk occurs, this will
    - Ensure that insurance remains available and affordable for people and businesses within your community.
    - Avoid a situation where climate change related risks become too great to be transferred to insurers and must be self-insured instead. This would put considerable strain on people, businesses and/or local and central government, particularly when financial resources are already stretched. This may also involve situations when the burden of covering losses falls with local and central government (and in turn ratepayers and taxpayers generally), because the specific people and businesses impacted lack sufficient resources to cover these losses themselves.
- There is asymmetry in the term of lending (several decades) and insurance (annually and can be withdrawn if risk is too high). If the risk of insurance withdrawal increases, lenders may require higher deposits and reduce loan terms therefore restricting growth and devaluing property.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Option enables members of communities to access debt such as mortgages and commercial loans.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Social and Economic Resilience

Description	Criteria	Measurement
Strengthen communities and businesses so they are well-prepared for floods and other hazards, able to cope and bounce back	Preserve and enhance community cohesion and community values	Impacts to social networks measured through accessibility (walking/cycling/public transport/) RR Exposure of community features and areas of significance to hazards/stressors RR
	Minimises economic risk to communities	Cost of options versus benefits provided
	Increases community adaptive capacity	Contributes to wider community knowledge and understanding of risk
	Minimises economic risk to individuals	Ability to access funding/debt
	Minimises impacts to business	**Exposure of commercial and industrial buildings to hazards/stressors RR**

Assessment requirement aligned with:

Community feedback:

The community raised concerns around impacts to businesses, including access to businesses and loss of income. Engagement feedback considered this would most impact those working and owning businesses in the area. Feedback valued protecting homes and businesses, as well as suggesting that businesses can help lead adaptation efforts alongside local and central government.

Draft wellbeing outcomes and indicators (Council meeting 25 September 2023)

- Economic: Number of applications for opening and closing of businesses in South Dunedin (tracked by DCC)

DCC Stormwater Integrated Catchment Management Plan Objectives (2017)

- Development – Adapt to fluctuations in population while achieving key levels of service and improving the quality of stormwater discharges, Ensure new development provides a 1 in 10 year level of service, avoids habitable floor flooding during a 1 in 50 year event.
- Natural hazards – Ensure there will be no increase in the numbers of properties at risk of flooding from the stormwater network.

ORC Natural Hazards Plan (2014)

- Principle 2: Create communities in which people can live, work and use the land without undue stress or fear of natural hazards.
- Principle 5: It is important to address the entire risk spectrum when managing the effects of natural hazards. This principle recognises that whatever event is planned for, there will be a larger, major event. The risk from these major events also needs to be recognised and managed.
- Principle 7: New development and hazard-management measures will not exacerbate the risks or effects of natural hazards elsewhere. This applies at all scales, from localised 'property to property' effects, through to the community or catchment scale.

National Adaptation Plan (2022)

- Sectors, businesses and regional economies can adapt. Participants can identify risks and opportunities and take action.
- A resilient financial system underpins economic stability and growth. Participants can identify, disclose and manage climate risks.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantially reduces risk to commercial and industrial buildings.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Promote community safety

Description	Criteria	Measurement
Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	**Promote community wellbeing**	**Community concerns**
	Promote community safety	Exposure of roads to climate hazards/stressors [RR] Exposure of critical infrastructure and lifelines facilities [RR]
	Reduced natural hazard risk	Exposure of residential buildings to climate hazards/stressors [RR] Cross cell impacts*
	Promote community health	Contributes to healthy living and working social conditions Impact to health and heath services

**short list only*

Assessment requirement aligned with:

Community feedback:

Community feedback commented on destabilisation of everyday life from climate risks having a significant impact on mental wellbeing "of family and wider community and negative effect on children's ability to take part in education and play". Some adaptation approaches were noted to be able to provide possible community wellbeing benefits while others commented on options causing a lot of stress and trauma.

Draft wellbeing outcomes and indicators (Council meeting 25 September 2023)

- Social: People are safe and feel safe in their homes, neighbourhoods and public places (surveyed by DCC)

Dunedin Social Wellbeing Strategy (2013)

- Priority 3.3: People are safe and feel safe in their homes, neighbourhoods and public places

Living Standards Framework, individual and collective wellbeing (2021)

- Health - Being in good mental and physical health and exhibiting health-related behaviours and lifestyles that reduce morbidity and mortality, such as eating well and keeping active.
- Knowledge and skills - Having knowledge and skills appropriate to one's life stage and continuing to learn through formal and informal channels.
- Cultural capability and belonging - Having the language, knowledge, connection and sense of belonging necessary to participate fully in one's culture or cultures, and helping others grow their cultural capability and feel a sense of belonging.
- Work, care and volunteering - Directly or indirectly producing goods and services for the benefit of others, with or without compensation.
- Engagement and voice - Participating in democratic debate and governance at a national, regional or local level, such as through membership of a charitable society, political party or school board.
- Income, consumption and wealth - Using income or in-kind transfers to meet today's needs and save for future needs, as well as being protected from future shocks by adequate wealth, private insurance and public insurance (the social safety net).
- Housing - Having a place to call home that is healthy, suitable, affordable and stable.
- Environmental amenity - Having access to and benefiting from a quality natural and built environment, including clean air and water, green space, forests and parks, wild fish and game stocks, recreational facilities and transport networks.
- Leisure and play - Using free time to rest, recharge and engage in personal or shared pursuits.
- Family and friends - Loving and supporting close friends, family and community members, and being loved and supported in turn.
- Safety - Being safe from harm and the fear of harm and keeping oneself and others safe from harm.
- Subjective wellbeing - Being satisfied with one's life overall, having a sense of meaning and purpose, feeling positive emotions, such as happiness and contentment, and not feeling negative emotions.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Addresses nearly all community concerns related to climate hazards and associated disruptions. Substantially improves wellbeing.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Note: this element will be scored by members of communities.

Objective: Promote community safety

Description	Criteria	Measurement
Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Promote community wellbeing	Community concerns
	Promote community safety	**Exposure of roads to climate hazards/stressors** [RR] **Exposure of critical infrastructure and lifelines facilities** [RR]
	Reduced natural hazard risk	Exposure of residential buildings to climate hazards/stressors [RR] Cross cell impacts*
	Promote community health	Contributes to healthy living and working social conditions Impact to health and heath services

**short list only*

Assessment requirement aligned with:

Community feedback:

Community feedback raised fears about the impact of climate change and adaptation approaches on their ability to reach the services they want and need. There was a clear requirement that chosen adaptation options must take a safety first approach and work for the South Dunedin context.

DCC Stormwater Integrated Catchment Management Plan Objectives (2017)

- Development – Adapt to fluctuations in population while achieving key levels of service and improving the quality of stormwater discharges, Ensure new development provides a 1 in 10 year level of service, avoids habitable floor flooding during a 1 in 50 year event.
- Natural hazards – Ensure there will be no increase in the numbers of properties at risk of flooding from the stormwater network.

ORC Natural Hazards Plan (2014)

- Principle 1: Prevent death or injury from natural hazards, ensure public health.
- Principle 3: Create and maintain a including infrastructure and lifelines, which takes into account the risks from natural hazards so that it can operate effectively while still being affordable.
- Principle 5: It is important to address the entire risk spectrum when managing the effects of natural hazards. This principle recognises that whatever event is planned for, there will be a larger, major event. The risk from these major events also needs to be recognised and managed.
- Principle 7: New development and hazard-management measures will not exacerbate the risks or effects of natural hazards elsewhere. This applies at all scales, from localised 'property to property' effects, through to the community or catchment scale.

National Adaptation Plan (2022)

- Strengthen resilience – this means taking action that strengthens the way people and systems cope with immediate climate impacts, as well as building capacity for learning and transformational adaptation.
- Prioritise the risk management of assets so that services can continue if disruption occurs.
- Ensure communities can continue to access the healthcare services they need, even in the face of climate change adversity.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantially reduces risk to roads, critical infrastructure and lifeline facilities.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Promote community safety

Description	Criteria	Measurement
Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Promote community wellbeing	Community concerns
	Promote community safety	Exposure of roads to climate hazards/stressors RR Exposure of critical infrastructure and lifelines facilities RR
	Reduced natural hazard risk	**Exposure of residential buildings to climate hazards/stressors RR** **Cross cell impacts***
	Promote community health	Contributes to healthy living and working social conditions Impact to health and heath services

**short list only*

Assessment requirement aligned with:

Community feedback:

Community responses with regards to acceptability thresholds included that 'people should not live in locations which frequently put them in danger during daily life" alongside support for protecting homes and being able to remain in South Dunedin by managing risk in place. Community feedback placed importance on protecting public health and putting safety first, including through measures like reducing house dampness and preventing wastewater contamination.

Dunedin Social Wellbeing Strategy (2013)

- Priority 1.2: Dunedin people are connected to the places they need to go by safe, affordable and user-friendly transport options.

DCC Stormwater Integrated Catchment Management Plan Objectives (2017)

- Development – Adapt to fluctuations in population while achieving key levels of service and improving the quality of stormwater discharges, Ensure new development provides a 1 in 10 year level of service, avoids habitable floor flooding during a 1 in 50 year event.
- Natural hazards – Ensure there will be no increase in the numbers of properties at risk of flooding from the stormwater network.

2nd Generation Dunedin City District Plan Objectives (2018):

- The risk to people, communities, and property from natural hazards, and from the potential effects of climate change on natural hazards, is no more than low.
- The risk to people's health and safety from contaminated sites, hazardous substances, and high levels of noise or emissions is minimised

ORC Natural Hazards Plan (2014)

- Principle 1: Prevent death or injury from natural hazards, ensure public health.
- Principle 3: Create and maintain a including infrastructure and lifelines, which takes into account the risks from natural hazards so that it can operate effectively while still being affordable.
- Principle 5: It is important to address the entire risk spectrum when managing the effects of natural hazards. This principle recognises that whatever event is planned for, there will be a larger, major event. The risk from these major events also needs to be recognised and managed.
- Principle 7: New development and hazard-management measures will not exacerbate the risks or effects of natural hazards elsewhere. This applies at all scales, from localised 'property to property' effects, through to the community or catchment scale.

National Adaptation Plan (2022)

- Strengthen resilience – this means taking action that strengthens the way people and systems cope with immediate climate impacts, as well as building capacity for learning and transformational adaptation.
- Work with community housing providers to enable effective climate hazard responses.
- Homes and buildings are climate resilient, and meet social and cultural needs.
- New and existing places are planned and managed to minimise risks to communities from climate change.
- Ensure all new infrastructure is fit for a changing climate.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantial reduces risk to residential buildings. Enhances performance of actions in other cells.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

Objective: Promote community safety

Description	Criteria	Measurement
Promote community safety in South Dunedin by reducing flood and other risks, despite increasing natural hazards.	Promote community wellbeing	Community concerns
	Promote community safety	Exposure of roads to climate hazards/stressors RR Exposure of critical infrastructure and lifelines facilities RR
	Reduced natural hazard risk	Exposure of residential buildings to climate hazards/stressors RR Cross cell impacts *
	Promote community health	**Contributes to healthy living and working social conditions** **Impact to health and heath services**

**short list only*

Assessment requirement aligned with:

Community feedback:

Concerns were also raised regarding the mental health and wellbeing implications if adaptation is not well managed, particularly in how this may result in stress, anxiety and "feelings of abandonment, anger". Community feedback placed importance on protecting public health and putting safety first, including through measures like reducing house dampness and preventing wastewater contamination.

ORC Natural Hazards Plan (2014)

- Principle 1: Prevent death or injury from natural hazards, ensure public health.
- Principle 3: Create and maintain a including infrastructure and lifelines, which takes into account the risks from natural hazards so that it can operate effectively while still being affordable.

National Adaptation Plan (2022)

- Objective: Health sector is prepared and can support vulnerable communities affected by climate change.
- Objective: Homes and buildings are climate resilient, and meet social and cultural needs
- Understand where our most vulnerable people are and what they need and value, and provide them with support, knowledge and resources.

New Zealand Health Strategy (2023)

- Conceptual framework to addressing individual and community determinant of health.
- Priority 2: linking services that support people's wider wellbeing and contribute to housing and good employment, such as Individual Placement and Support
- Priority 5: A resilient and sustainable system: timely access to health care that is responsive to the needs of older people and focused on building and maintaining people's physical and mental function.

Pae Tū: Hauora Māori Strategy (2023)

- Priority 4: Enabling culturally safe, whānau centred and preventive primary care
- Priority 5: Ensuring accountability for system performance for Māori

Te Mana Ola: The Pacific Health Strategy (2023)

- Priority 2: Te pāruru'anga, te apii'anga, e te akateretere'anga no te ora'anga meitaki - Disease prevention, health promotion and management for good health
- Priority 3: Soalaupule | Autonomy and determination - The health system better understands the needs and aspirations of Pacific peoples and communities and enables them to exercise authority over their health and wellbeing.
- Priority 4: Haitiaaga moui malolo | Access. The health system ensures that timely, high-quality services are reaching Pacific peoples, wherever they live

Health of Disabled People Strategy (2023)

- Priority 2: Ensure the health system is designed by and accessible for disabled people and their whānau, and provides models of care that suit their needs

Women's Health Strategy (2023)

- Priority 3: Better outcomes for mothers, their whānau (families) and future generations.
- Priority 4: Living well and ageing well.

Rating Scale						
Based on the measurement criteria, to what extent do you agree or disagree that the adaptation option aligns with the following best outcome statement?						
Best-outcome statement: Substantially enhances health of living and working conditions; reduces the risk to climate-related diseases; and decreases the impact to health services for Māori, Pacific communities, disabled people, and women.						
Agree very strongly	Agree Strongly	Agree	Neutral	Disagree	Disagree strongly	Disagree very strongly
+3	+2	+1	0	-1	-2	-3

APPENDIX B: Adaption options not included in the spatial longlist of recommended adaption options

OPTIONS UNDER COASTAL PARALLEL PROCESS

The following coastal options are considered part of the parallel development of the St Clair to St Kilda Coastal Plan programme. These options aim to reduce the risks associated with coastal hazards along the South Coast, such as coastal flooding via waves, sea level rise and storm surge as well as coastal erosion. Along the harbourside, the primary coastal hazards are related to flooding rather than erosion due to the sheltered nature of the harbour. Therefore, these coastal erosion management options are less relevant for the harbourside. All options presented below were included in the coastal protection generic approach.

DUNE MANAGEMENT OR RE-SHAPING

Dune management involves altering or protecting existing sand dunes to enhance their ability to withstand coastal erosion. This approach can be particularly effective in areas with sandy coastlines, like St Clair and St Kilda. Dunes are natural barriers against waves reducing the impact of coastal erosion on infrastructure and properties. This option has not been taken forward as part of SDF because there are not natural dune features along the harbourside to manage, enhance or re-shape.

ROCK REVETMENTS

Rock revetments are structures used to dissipate wave energy to prevent erosion and fix the shoreline location. They are sloped walls made from large rocks or boulders place along a shoreline. This option is not suitable to manage flooding along the harbourside, as they are typically permeable structures. This means that coastal flooding can flow through revetments (without a substantial, impermeable core) rendering it ineffective for flood risk management.

BEACH NOURISHMENT

Beach nourishment involves the addition of sediment within a coastal system. This approach replaces sand lost through erosional processes and is most useful for high energy sandy coastlines such as St Clair and St Kilda. Beach nourishment is not relevant to the harbourside area as its primary aim is to protect against erosion and improve the amenity value of beaches, and erosion risk along the harbourside is limited.

BURIED BACKSTOP WALL

Buried backstop wall is a partially or entirely buried wall designed to prevent erosion and stabilise soil. It is unsuitable for the harbour given the limited erosion risk.

GROYNES

Groynes are hard structures extending perpendicular to the shoreline, to protect against erosion by trapping sediment from longshore drift and reducing the energy of waves hitting the shore. Groynes are unsuitable for the harbour given the limited erosion risk.

OFFSHORE BREAKWATERS OR REEFS

Offshore breakwaters or reefs are coastal structures designed to protect shorelines from erosion, through sediment accumulation, and absorption and dissipation of wave energy. The option was not relevant to the South Dunedin area and was more suited to the high energy, erosive coastal environments of St Clair / St Kilda than the harbour area.

VEGETATION PROTECTION

Vegetation protection involves utilising vegetation for erosion control by attenuating waves and currents and resulting in sedimentation. Vegetation protection is not relevant as there is limited erosion risk along the harbourside.

OPTIONS NOT TECHNICALLY SUITABLE

Options considered within the South Dunedin Future Programme were assessed for technical suitability. If the adaption option presented significant technical and logistical challenges, the option was excluded from consideration. The following are options not considered further in the process.

TIDAL BARRIER FOR COASTAL FLOOD MANAGEMENT

Tidal barriers are structures designed to control water flow protecting communities and infrastructure from elevated water levels. They are sometimes used in coastal areas prone to flooding from storm surges or high tides. During extreme weather events or high tides, the barrier can be closed to prevent seawater from entering the protected area. When the threat of flooding has passed, the barrier can be opened to allow normal water flow. This option was part of the longlist of adaptation options for coastal protection. In the South Dunedin context, this tidal barrier would likely be placed near the opening of the Ōtākou harbour with movable gates that would close during elevated tidal conditions.

Tidal gates are used overseas to close off channels or inlets and “shorten the line of defence”. Large tidal barrages like the Thames Barrier (London, United Kingdom), Maeslantkering (Rotterdam, Netherlands) or the tidal barriers in New Orleans can function within shipping channels remaining open most of the time but closing to protect against extreme sea levels. In these cases, they defend against several meters of storm surge and are used infrequently. These examples cost more than $1B to construct in today’s dollars and protect large ports and economic centres.

The coastal hazardscape in Dunedin is different than the UK, Dutch or US Gulf Coast examples because of the relatively small storm surge elevation (est. 1m in a 1% AEP event) versus the tidal range (1.5-2m) in Dunedin, whereas in the areas where tidal barriers have been constructed, the tidal range can be an order of magnitude more or less than an extreme storm surge.

The challenges with South Dunedin’s flooding are less so due to the catastrophic effects of extreme high water and more so due to the ongoing, increasingly nuisance flooding that will occur as sea levels rise. This would mean that the tidal gates would need to close daily to stop high tide at the coast from flowing into the harbour, significantly disrupting the natural system and still would not protect from rising pluvial and groundwater compound flooding exposure across South Dunedin.

The size of Ōtākou harbour would require a combination of sector gates or similar structures that open to allow ships to pass and smaller sluice gates that can open and close as required. The system would cost billions of dollars and provide limited benefits that could not be provided by a seawall while significantly disrupting the natural and economic systems within the harbour. In comparison, the cost of the seawall to protect South Dunedin against a similar event is less than

20% of the cost of tidal gates, noting however that tidal gates would protect the entire inner harbour shoreline.

These tidal gates would negatively impact coastal and marine biodiversity, mana whenua values, mahika kai, and industries relying on shipping through Port Otago by changing flow patterns and potentially restricting access. Tidal gates are complex, expensive solutions, and these factors coupled with economic and environmental impacts mean that this option is technical unsuitable for South Dunedin.

DISCHARGE STORMWATER TO WASTEWATER NETWORK

In a combined sewer system, wastewater, and stormwater flow into the same pipe. This option was considered as part of the longlist of adaptation options for water flow improvements. Cities all over the world use combined sewers, typically due to legacy infrastructure from prior to the 1970s. By 2005, the US Environmental Protection Agency deemed that blending stormwater, and wastewater was likely to have unacceptable environmental and public health outcomes due to the risks associated with wet weather overflows. The US government spent an estimated $50B over 20 years to upgrade infrastructure either by decoupling the wastewater and stormwater systems or constructing large scale water treatment facilities to handle the wet weather flows to an appropriate standard.

In South Dunedin, the wastewater network is already overwhelmed during wet weather conditions. Without significant upgrades to the wastewater pipe network, it would overload the sewage systems and treatment facilities, leading to increased flooding and pollution. A new wastewater treatment facility in Dunedin would likely cost on the order of $500M to $1B, and this is in addition to the $1.5B to upgrade and operate the pipe network.

To accommodate the volume of water required, both the pipe network and wastewater treatment facilities would require significant upgrades resulting in higher costs than upgrades to the stormwater network (which would provide for pipes but would not require the extensive treatment facilities) alone. Therefore, this option has not been taken forward.

UNDERGROUND STORMWATER DETENTION

Underground detention systems are used to hold and slowly release stormwater. This option was considered as part of the longlist of adaptation options for dedicated water storage.

Underground stormwater detention is used around the world from a large scale “floodwater cathedral” below Tokyo to smaller detention systems under roadways and carparks around New Zealand. These systems range significantly in cost depending on the scale of the system but are most equipped to handle high intensity rainfall, capturing flow, holding it until the peak passes and then discharging, typically via slow infiltration to the water table but sometimes via pumps.

Most of the smaller systems require groundwater deeper than 1m lower than the base of the underground detention system to encourage infiltration at a suitable rate. Given the high groundwater in South Dunedin, an underground detention system would need to be impermeable so that it would not fill with groundwater and pumped to facilitate drainage.

Further, the scale of system required would be significant as the stormwater that flows into South Dunedin from upper parts of the catchment is a key contributing factor to flooding. This means that in addition to a stormwater network managing the rain that falls directly on the area, it should also be able to handle incoming flows. The resulting underground tanks would be substantial and likely considerably more expensive to construct, operate and maintain than above ground detention ponds (which would still require pumping).

Therefore, underground stormwater detention was deemed technically unfeasible in the South Dunedin context as high groundwater levels in the area would fill tank systems if they were permeable reducing the capacity to store water during rainfall events. Due to the flat nature of Dunedin, to drain these tanks, pump stations would be required. The high groundwater significantly reduces the efficacy of these tanks and therefore this option has not been taken forward.

LARGE SCALE LAND GRADING

Land grading involves building up land to raise the ground above the floodplain. This option was part of the longlist of adaptation approaches for land grading.

Land grading across the entirety of South Dunedin to increase the project area to an elevation above a 2130 coastal flood would be prohibitively disruptive and expensive. It would require total buyout of South Dunedin, substantial earthworks, likely taking decades to complete, and would change South Dunedin likely beyond recognition.

Raising land across the entirety of South Dunedin was deemed technically unfeasible as it is an extremely high-cost and disruption. However, land grading on a smaller scale has remained a potential option to enable "low risk" development in South Dunedin.

COMPLETE NEAR-TERM RELOCATION OF ENTIRE COMMUNITY

Complete near-term relocation of the South Dunedin community involves the relocation of communities and assets from the area, to remove exposure to hazards. This option was considered as part of the longlist of adaptation approaches for managed relocation.

Relocation of entire communities is a costly, challenging process. To retreat 20-30 households on an island called Isle de Jean Charles in the United States to a lower risk area further inland cost more than $40M USD and has taken nearly a decade to reach agreements and construct the "New Isle". The process was hugely disruptive and had significant negative impacts on the community; however, remaining in place was no longer an option due to the life-threatening flooding from hurricanes on nearly an annual basis and the increasingly disrupted access as the road connecting the island to the mainland was under water regularly due to high tides.

Relocation of Matata due to risk to live was approximately 40 households, took several years of contested processes and had significant social impacts due to the uncertainties of where to move and how the community cohesion would be retained.

Requiring relocation of South Dunedin in its entirety within the next 20 years would likely significantly fracture the community, would disrupt the City's housing market, and would have severe negative consequences on vulnerable populations due to the pace and scale of retreat.

This option is not technically feasible due to the significant costs involved, including social, cultural, and financial, to relocate an entire community in the short-term. Longer term retreat from the areas of highest risk however provides time to plan and change gradually over time to minimise impacts on communities.

Appendix C: Glossary/acronyms

Term / Acronym	Definition
Adaptive Capacity	The ability of systems, institutions, humans, and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences.
Climate Adaptation (also referred to as Adaptation)	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects.
Climate Change	Climate change refers to a change in the state of the climate that can be identified (for example, by using statistical tests) by changes or trends in the mean and/or the variability of its properties, and that persists for an extended period, typically decades to centuries. Climate change includes natural internal climate processes or external climate forcings such as variations in solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land-use.
DCC	Dunedin City Council
Element at Risk	People, places, assets within South Dunedin that are potentially vulnerable or exposed to hazards.
Exposure	The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected (IPCC, 2021).
Flooding	The covering or submergence of an area of land below water. In this report, flooding includes coastal flooding (temporary submergence during storm events), coastal inundation (when sea levels rise and the land is now intertidal or permanently submerged), surface or pluvial flooding (caused by rainfall events), and groundwater flooding (when groundwater rises and emerges above the surface). The report does not include riverine or fluvial flooding due to geography of South Dunedin.
Hauora	Health and wellbeing
Hazard	The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.
Impacts	The consequences of realized risks on natural and human systems. Where risks result from the interactions of climate-related hazards (including extreme weather/climate events), exposure, and vulnerability. Impacts generally refer to effects on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including ecosystem services), and infrastructure (IPCC, 2021).
Kaitiakitaka	exercise of guardianship by mana whenua
Ki Uta Ki Tai	A holistic, inter-connected and or catchment-wide approach to natural resource management
Land use	Refers to the purpose or activity for which a particular area of land is utilised or managed. It describes how land is allocated and used by individuals, communities or institutions for various specific purposes.
Liquefaction	Liquefaction is a phenomenon that occurs in saturated, loose, or poorly compacted soil during seismic events, such as earthquakes. It refers to the transformation of solid soil into a liquid-like state, temporarily losing its strength and ability to support structures and foundations.
Mahika kai	Food and resource gathering sites and practices
Mana Whenua	Refers to the authority, power and connection to the land that Māori hold as traditional custodians.

Term / Acronym	Definition
Marae	Meeting area hosted by mana whenua in front of a wharenui (meeting house), also used to refer to surrounding land and buildings
Mauri	Life force and vitality
Moana	Ocean
ORC	Otago Regional Council
Pathways	Sequences of actions over time to reduce risk of climate change impacts
Physical risk	Risks that result from dynamic interactions between hazards with the exposure and vulnerability of the affected human or ecological system to the hazards (IPCC, 2021). In this project context, these are also called 'direct risks' and are those that may result from physical contact with the hazard.
Resilience	The capacity of social, economic, and environmental systems to cope with a hazardous event, trend or disturbance by responding or reorganising maintaining essential function, identity, and structure, while also maintaining capacity for adaptation, learning, and transformation.
Risk	The potential for adverse consequences for human or ecological systems (IPCC, 2021). Risk includes the following related concepts and terms: Physical risk: Risks that result from dynamic interactions between hazards with the exposure and vulnerability of the affected human or ecological system to the hazards (IPCC, 2021). In this project context, these are also called 'direct risks' and are those that may result from physical contact with the hazard. When realised, results in impacts.
Risk Assessment	The overall qualitative and/or quantitative process of risk identification, risk analysis and risk evaluation, with multiple entry points for communication and engagement and monitoring and reviews (AS/NZS ISO 31000:2009, Risk Management Standard).
SDF	South Dunedin Future programme
Sea Level Rise	Sea level rise refers to the long-term increase in the average global sea level relative to the land. It is primarily driven by two main factors: thermal expansion of seawater and the melting of land-based ice.
STAT	Signals, triggers and adaptation thresholds
Te Mana o Te Wai	Concept that protecting the health and mauri of water bodies is paramount to the health of the wider natural ecosystem environment and health of the people
Three waters	Refers to drinking water, wastewater and stormwater infrastructure.
Threshold	A critical limit where a system responds drastically when exposed to an external forcing, resulting in the system changing into a different state.
Uncertainty	A state of incomplete knowledge that can result from a lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from imprecision in the data to ambiguously defined concepts or terminology, or uncertain projections of human behaviour.
Vulnerability	The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.
Wai	Water