Ōtākaro Avon River
Stopbank Risk Assessment

Pages Rd to Bridge St

Summary of the GHD report

ccc.govt.nz

Christchurch City Council

Definition of key words used in the report

ANCOLD – (Australian National Committee of Large Dams) the organisation that wrote the guidelines used in this assessment.

AEP – (annual exceedance probability) the chance of an event happening in any particular year.

ARI – (annual recurrence interval) the number of years expected between events of a similar size, averaged over a very long time.

Design level of service – the largest size of event that we design a stopbank to manage. These levels are usually set as a balance of affordability and desired outcome.

Design level – the physical level that we build a stopbank. The design level is the height that the design level of service event reaches, plus any freeboard.

Freeboard – an allowance in the design height for factors that are uncertain or unknown. For example, we don't include wave action in the hydraulic modelling, so we include freeboard to allow for this.

Tolerable risk – this is a risk within a range that society can live with. For example, a risk might be considered tolerable if the consequences are low, or the costs of managing that risk are so high they outweigh the consequences. Tolerable risk is something that the Council reviews regularly, and that we try to reduce further if and when we can.

Individual risk – this means the additional risk to any individual in the community as a result of floodwater that is not managed by the stopbanks. This is assessed by using a 'typical person', rather than a specific individual or household. The ANCOLD guideline tolerable limit for individual risk is an annual frequency of 1 in 10,000.

Residual risk – this means the amount of risk that remains after a control has been put in place (for example, once the stopbank has been constructed).

Societal risk – this means the risk of widespread or large scale impact from the failure or overtopping of the stopbanks. This concept recognises that where the consequence is low, society generally accepts the chance of this happening to be higher than if the consequence was high (for example, if it occurs often but with low consequences people are often accepting of the risk, but if the consequences are high they might only accept it infrequently, or not at all). The societal risk tolerance is higher (more tolerant of something happening) than the individual risk tolerance within the ANCOLD guideline.

Overtopping – this is when the tide/river levels are higher than the top of the stopbank.

Introduction

During the Canterbury earthquakes, the land along the Ōtākaro Avon River sank. To reduce the flood risk to affected houses and roads, new stopbanks were needed. Emergency stopbanks were built soon after the earthquakes and, since then, Council has carried out ongoing maintenance and improvement work. Between 2017 and 2020 a significant amount of work was done to increase the resilience and durability of the stopbanks.

The current stopbanks were built to last 20 years, allowing time to plan, design and build long- term stopbanks. A risk assessment on the current stopbanks was done in 2016, prior to approving their design. The risk assessment confirmed that the risk to life during their 20 year life was tolerable, and the stopbanks would be designed to contain a tide with 100-year ARI with 300 mm freeboard.

The Council periodically recalculates the levels used for design of infrastructure like stopbanks from our high tide records. A series of extreme high tides in 2018 prompted us to review our design high tide levels and, as a consequence, the levels were increased.

The Council uses these levels when setting building floor levels as part of consenting buildings.

We've also used these new levels to reassess the risk to life for the current stopbanks.

Area that this assessment covers

Figure 1 – Avon River Stopbanks Risk Assessment Study Area.

The report covers the area from midway between Pages Road and Bridge Street. This is the area most impacted by the revised tide levels.

Assessment findings

The report concludes that, for the original stopbank design level of a 100-year ARI tide, the risk to life is low. The annual risk of one person dying from a result of the design tide is less than 1 in 900,000.

> **"The risks below the 100 year ARI tide are almost ten times better (below) than the ANCOLD guidelines limit of tolerability. This indicates that these risks are adequately managed… there is low-risk to life from the stopbanks in this study area in relation to their intended purpose to mitigate flood risks below the 100-year ARI tide level."**
>
> *(Page 33, LDRP 507 Stopbank Risk Assessment Pages Road to Bridge Street).*

The report also assessed the risk for events greater than the design 100 year ARI tide, all the way up to a very rare 50,000 year ARI tide.

The greatest risk to life for events greater than the current design level is overtopping, rather than stopbank failure. Overtopping is when water flows over the stopbanks, and the risk to life arises if the water flows into populated areas.

The study found that, when all these events are put together, the societal risk to life goes beyond what ANCOLD guideline suggest could be tolerable. This is not a surprising finding, and could be the same for many stopbanks across the city, as there is always some risk when water levels are higher than the design level of the stopbanks. While the societal risk may be greater, the individual risk to life from all events is still lower (better) than the ANCOLD guideline.

The study looks at some of the key factors that impact on the risk to life. These include loss-of-life rates, flood levels and floor levels. Some of the assumptions made during the study may be conservative and so over-estimate the risk, because it gets increasingly difficult to have certainty when you are dealing with estimates, assumptions and projections. However, it is better to take a more cautious approach and over-estimate the risk, rather than under estimate it.

In summary, the report found that the risk is tolerable for the events that the stopbanks are designed for, but in events greater than the design level of service, the risk is greater than the guideline suggests is tolerable because the stopbanks would be overtopped. All stopbanks are designed to hold water back up to a point, and do have a risk of overtopping in events that are much bigger than their design level.

Residual risk is managed through evacuation plans, District Plan controls, and through construction of the long-term stopbanks. For the current stopbanks the residual risk will gradually grow with increasing sea levels, and if more people live and work the area behind the stopbanks. Even with long-term stopbanks there will still be a residual risk that needs to be managed.

The full report can be found at **ccc.govt.nz/environment/coast/coastalhazards/technical-reports**

The report concludes that, for the original stopbank design level of a 100-year ARI tide, the risk to life is low. The annual risk of one person dying from a result of the design tide is less than 1 in 900,000.

How we will manage the residual risk

The residual risk is managed through stopbank maintenance. We check the stopbanks for any damage or early signs of erosion every year, and after a flood or significant seismic event. Stopbank heights are monitored regularly and we top up any low points.

Together with the Civil Defence and Emergency Management Team, we've also put in place some measures should we ever need to evacuate the area.

This includes a proposed evacuation area along with a pre-prepared Emergency Mobile Alert. The Emergency Operations Centre (EOC) would be activated to support the implementation of any evacuation. The Civil Defence and Emergency Management Duty Officer provides 24/7 coverage to ensure any emergency alerts are sent as quickly as possible in the event of a major disaster.

Long-term planning

The Council sets building floor levels through the building consent process. In the area covered by this report new buildings are built well above flood levels to reduce the damage to property.

We're also planning to build long-term stopbanks as we implement the Ōtākaro Avon River Regeneration Plan. Work in the Waitaki Street area is currently being designed. Subject to consenting, construction is due to start later in 2021. There is also budget in the 2021–2031 Long Term Plan to design and, in some areas, build long-term stopbanks. The majority of the funding for building stopbanks is over 10 years away in the LTP. Implementing the Regeneration Plan will take decades so the current stopbanks will need to be maintained and managed for years to come.

The Council is planning for a future with increasing sea levels and coast hazards. For further information on Coastal Hazard Adaptation Planning see the Council website: **www.coastalfutures.nz**

Methodology

The report follows the ISO 31000-2018 risk management guidelines and uses the Australian National Committee on Large Dams (ANCOLD) Guidelines on Risk Assessment (2003). We do not have any New Zealand guidance on stopbank risk-to-life assessments, so while stopbanks are not dams, the ANCOLD methodology can be applied.

GHD went through the following steps to develop this report:

1. Using the revised tide statistics, various tidal flood scenarios were developed from a frequent event (a 10 year ARI tide) up to a very rare event (a 50,000 year ARI tide).
2. These tides were used to test the stopbanks for both failure and overtopping.
3. Having identified how, and how often, failure and overtopping might happen, the assessment then estimated the number of people that might be impacted during day, as well as during the night. The population at risk is generally within 500 metres of the river and the risk is largely determined by a property's floor level. People in a building with a high floor level won't be at the same risk during a flood as those in a building with a low floor level. Risk is also considered greater at night, when more people are likely to be home and may also be asleep.
4. Having identified the population at risk, the likely evacuation rates (both day and night) were estimated. The potential loss of life (if any) from each event was then estimated.
5. The assessment then calculated the total risk from all the potential failure types and the chance of each type happening. This is shown as the probability that a given number of lives per year are at risk from an event which overtops or breaches the stopbanks.

The full details of the methodology can be found in the report **ccc.govt.nz/environment/coast/coastalhazards/technical-reports**