

7 December 2023

Simon Marshall
simon@blg.nz

Dear Simon

FLOOD HAZARD ASSESSMENT – Lot 20 DP 578956 & Lot 2 DP 501321, SH1/Inland Road, KAIKOURA

The property is located on the Kowhai River fan, adjacent to the western side of the Inland Kaikoura Road (Figure 1). The main trunk railway line passes to the north, and State Highway 1 (SH1) to the south. Ewelme Stream flows ~160 m to the south-west of the property, and the Kowhai River is ~20 m to the east of the property in places. The property is potentially susceptible to Kowhai River overflows as well as surface water runoff. Both the Inland Road and the property may also be susceptible to bank erosion from the Kowhai River.

Kowhai River

River control works on the Kowhai River include stopbanks, echelon (flow return) banks and vegetated berm areas. The flood protection banks are identified on Figure 2, along with the main Kowhai River overland flow paths. Unfortunately, the dynamic nature of the Kowhai River means the works are only designed to provide 'protection' from floods with an Average Recurrence Interval (ARI) of up to ~20 years. In larger events these works are likely to be overwhelmed, with aggradation further increasing the likelihood of bank erosion and breakout flows onto the Kowhai River fan.

Historically, Kowhai River overflows or breakout flows to the south are known to have occurred around Fernleigh Dip on several occasions. Breakouts around this location diverted a large portion of the Kowhai overflows towards Ewelme Stream, and away from the property.

Breakouts downstream of Fernleigh Dip (e.g., at Harnetts Bank) may direct Kowhai River overflows towards the property. Exact amounts of overland flow reaching the property are difficult to predict as it would depend on the location and size of the breakout as well as scour, aggradation and erosion of the Kowhai riverbed and fan.

Documented breakout flows downstream of Fernleigh Dip include the March 1987 flood event when ...*'A major break occurred on the southern side of the Kowhai which affected Mr H. Dalzell's farm. Kennedy's stopbank burst and sent flood water racing towards Dalzell's echelon bank ... Mr Paul Harnett had 400 square metres of fertile farm land eroded by flood waters after his stopbank was demolished.'* Breakouts in the Fernleigh Dip and/or Kennedy's area have also been noted in 1945, 1949, 1952, 1953, 1954, 1966 and 1993.

It is expected that, in a large flood event, such as a 500 year ARI flood event, gravel stored in the upper reaches of the Kowhai River may be mobilised, resulting in bed levels rising and a greater likelihood of the main river channel migrating across the floodplain. Some Kowhai River flood protection banks are likely to fail, allowing flood waters to flow over the Kowhai River fan. The likely extent of riverbed aggradation and/or bank erosion along the Kowhai River reach adjacent to the property is unknown.

Flood Modelling

The Kowhai River fan has been flown by LiDAR, an airborne laser system that surveys the ground topography. Figure 3 shows ground levels at the property and surrounding area, derived from LiDAR data obtained in 2016/17. This LiDAR data has enabled a detailed computer model of the Kowhai River fan to be developed.

Breakout flows onto the Kowhai River fan

For an estimated 500 year ARI breakout flow of 360 m³/s, two breakout locations were modelled along the Kowhai River south bank at:

- Fernleigh Dip/Fernleigh Echelon
- 1.5 km downstream of Fernleigh Dip (at Harnetts Bank)

For the Fernleigh Dip breakout scenario, flood water predominantly flowed across the Kowhai River fan towards Ewelme Stream, while a breakout downstream of Fernleigh Dip (at Harnetts Bank) diverted most flow along the eastern side of the Inland Kaikoura Road – back towards the Kowhai River – with some flow passing along the western side of the Inland Kaikoura Road. At the property, shallow floodwater (arriving from upslope of the railway line) predominantly flows over the railway line and along the eastern property boundary. The main flow paths in the vicinity of the property are shown on Figure 2.

The 500 year ARI maximum flood depth and flow speed maps are available to view at the following link for all breakout and aggradation scenarios:

https://apps.canterburymaps.govt.nz/FloodModelResults/?extent=1648680.0791%2C5303527.0546%2C1653151.6453%2C5305719.8419%2C2193&showLayers=Region_Base_3597%3BAccepted_Scenarios_Depth_7219

The map below shows the 500 year ARI maximum flood depths for a Kowhai breakout downstream of Fernleigh Dip.



Note:

1. To see the flood depths, elevations, and speeds for the worst-case scenario for the property you may need to use the Filter (🔍) and select: Location = Kaikoura Fans, Flood Scenario =

Our Ref: 23672
Contact: Michelle Wild

500 Year ARI, Scenario description = Kowhai breakout downstream of Fernleigh Dip (also see “Kowhai riverbed 1 m aggradation”)

2. If you click on the map, you can get the depth values (or water level or flow speed), and a link to the technical modelling report.
3. The computational model does not account for local surface water runoff, erosion, scour, or aggradation, and it did not model breakouts further downstream of Harnetts Bank.

For an estimated 500 year ARI breakout flow downstream of Fernleigh Dip (at Harnetts Bank), the modelling shows:

- Shallow flood depths of up to ~0.3 m at the property (in the area within ~40 m of the eastern boundary). These modelled flood depths do not account for local surface water runoff or backing up of water against barriers (e.g., buildings).
- The property is not likely to be considered a High Flood Hazard Area [where the water depth (m) x velocity (m/s) is greater than or equal to 1 or where depths are greater than 1 m in a 500 year ARI flood event] unless Kowhai River bank erosion is able to migrate the Kowhai Riverbed to the west and onto the property.
- Evacuation from the property may not be possible during a flood event due to flooding in the vicinity of the property (e.g., Inland Road).
- Flood water flowing over the property may cause scour, erosion and/or deposition of debris, resulting in damage to land and fencing.

Aggradation of the Kowhai River bed

An additional model run simulated 1 metre of aggradation (buildup of gravel) in the main active Kowhai River channel, but no specific breakouts. This produced overflows from the river around Middle Ford and Fernleigh Dip, as well as downstream of the railway line around the property (overtopping river protection banks along both sides of the river but not inundating the property).

Although no overflows are identified as entering the property for this scenario, the Kowhai River flows within ~5 m of the Inland Road and ~20 m of the eastern property boundary. Given the erosive nature of the Kowhai River flood flows, the potential for bank erosion should be considered. Any improvements to the level of protection of the flood protection works on the eastern Kowhai Riverbank, or upstream of the property, may also exacerbate flood depths and flow speeds along the western Kowhai Riverbank adjacent to the property in the future.

Summary

The property is within the Kaikoura District Plan ‘Non-Urban Flood Assessment Overlay’. Constructing new hazard sensitive buildings within this overlay is a permitted activity under the district plan if they are located on land outside of High Flood Hazard Areas and have finished floor levels that is at least 300 mm above the 500 year ARI flood level.

Based on the available flood information above, the property is outside of any High Flood Hazard Area and is not likely to be affected by significant flooding in a 500 year ARI event, as the property is only likely to receive limited overflows from breakouts upslope from the property.

It is also noted that the Kowhai River flows within ~20 metres of the eastern property boundary. Given the erosive nature of flood flows, this should be taken into consideration when determining whether the land along the eastern property boundary meets the definition of ‘good ground’.

Tsunami

The property is located within the 'Orange Zone' for tsunami evacuation. The following link provides detail: <https://canterburymaps.govt.nz/news/tsunami-evacuation-zone-information/>.

Although the property could be flooded by a large tsunami, the average recurrence interval for such a tsunami is likely to be greater than 500 years.

When using the information provided in this letter, it is important that the following points are understood:

- The information is limited to what Environment Canterbury currently has available. The District Council or local residents may have further information about flooding at the property.
- Environment Canterbury's understanding of flooding at the property may change in the future as further investigations are carried out and new information becomes available.
- It is assumed that any flood protection works will be maintained to at least their current standard in the future.
- Stopbank failure can occur at flows less than the design standard, and the location of bank failure/overtopping may affect flood depths at the property.
- Flood depths can also be affected by changes to the bed levels in the water courses (e.g., aggradation or scour), fan topography (e.g., roads, earthworks), structures on the fan (e.g., fences, buildings, culverts), vegetation (e.g., hedges, crops), and antecedent soil conditions.

The prediction of flood depths requires many assumptions and is not an exact science.

If you have any concerns or questions please contact me.

Yours sincerely



Michelle Wild

SENIOR SCIENTIST (Natural Hazards)

Cc: Kaikoura District Council

Encl: Figure 1: Location map
Figure 2: Flood protection bank and main flow path map
Figure 3: LiDAR (ground level) map

Our Ref: 23672
Contact: Michelle Wild