Tonkin+Taylor

11 September 2026
Job No: 1092556.0020

Gisborne District Council
PO Box 747
Gisborne 4010

Attention: Joss Ruifrok

Dear Joss

Te Karaka Flood Management Optioneering
Future flood levels and aggradation

1 Introduction

We have been asked to prepare this letter in response to submitter concerns that the flood modelling for the proposed Te Karaka stopbank upgrade assessed changes in flood levels, velocity, and hazard between the status quo and proposed stopbank scenarios using only the present-day channel bed and present-day floodplain levels.

This letter report provides a brief geomorphic perspective on future flood levels and aggradation in the Waipaoa River at Te Karaka. The letter provides insights and opinion from a qualified geomorphologist (CEnvP Geomorphology) in light of the concerns raised. This letter report builds on the High-Level Geomorphic Assessment report prepared by Tonkin & Taylor Ltd (T+T) in September 2025 (T+T, 2025a[1]) and the Letter Report on the Te Karaka stopbank upgrade considering berm sediment accretion assessment (T+T, 2025b[2]), as well as literature referred to therein.

2 Context

The present-day channel and current floodplain morphology used in the flood modelling to assess flood levels, velocities, and hazard at Te Karaka for the proposed stopbank upgrades is unlikely to represent the future state of the river in the decades to come. Rates of geomorphic change in the Waipaoa River are high. In particular, rates of sediment delivery from the catchment are especially high: the sediment regime is described in T+T (2025a). The relevance for Te Karaka is that the channel and floodplain in this part of the catchment is likely to be subject to ongoing aggradation, with ~0.85 m of aggradation in the riverbed within the next ~50 years, based on modelling

[1] Tonkin & Taylor, (2025a). High Level Geomorphic Assessment, Te Karaka Flood Management Optioneering, September 2025
[2] Tonkin & Taylor, (2025b). Letter Report: Te Karaka stopbank upgrade – berm sediment accretion assessment, December 2025

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Undertaken by Gomez et al. (2009[3]) (T+T, 2025a). Significant erosion sources due to ongoing erosion remain in the catchment, despite efforts to mitigate catchment erosion (T+T, 2025b). Furthermore, the Waipaoa River channel will continue to rework substantial stores of sediment that have accumulated in the valley floors in response to catchment-wide erosion driven by post-European clearance of indigenous forest in the late 1800s and early 1900s. This reworking of sediment within the active channel will result in ongoing elevated sediment delivery to the lower catchment, including Te Karaka (T+T, 2025b).

An assessment of potential berm and floodplain accretion was prepared by T+T (2025b). The focus of T+T (2025b) was to inform GDC on the potential future loss of service of the stopbanks at Te Karaka as a consequence of projected sediment aggradation. Four scenarios were presented to inform future change at Te Karaka, based on historic changes in channel cross sections between 1958 and 2017, as well as published modelling (Gomez et al., 2009) (T+T, 2025b). To summarise, estimated total vertical accretion in the channel over the next ~50 years ranges between 0.30 and 1.2 m, while total accretion on the floodplain ranges between 0.9 and 3.58 m (Table 3.2, T+T, 2025b). This work was based on the preferred option alignment of stopbanks at that time. The status quo was not assessed.

3 Implications of geomorphic trends

The scenarios presented in T+T (2025b) represent a range of channel and floodplain accretion totals, which take into account forecast changes in sediment and mean flow of the Waipaoa River. These results suggest that the present-day channel morphology on which the flood modelling to inform stopbank upgrade was based is simply a snapshot in time. The channel and floodplain form will continue to adjust to the sediment supplied from the catchment, in conjunction with the flow regime. Ideally, assessing the flooding impacts of the proposed stopbank upgrade would also take account of the future states of the channel and floodplain. This would require assessment of the status quo scenario (existing stopbank) because this current arrangement would also be subject to future aggradation.

The range of possible accretion scenarios for the proposed stopbank alignment in the work already done underscores the considerable uncertainty involved when predicting future geomorphic change in any river system. Uncertainty arises because it is impossible to predict the timing, magnitude, or frequency of flood events. There are also uncertainties in the response of a river channel and floodplain to discrete flood events. For example, in Cyclone Bola, flow velocities were sufficiently high that floodplain accretion in parts of the Waipaoa floodplain (McPhails Bend) was limited. There is considerable complexity in the relationship between flood discharge and sediment loads, with the exact response and behaviour of a river contingent upon the timing and relationship between flood volumes and sediment load, with the latter dependent upon timing of sediment pulses derived from a complex array of sediment sources within both the main channel and wider catchment (slopes and tributaries). In laymen's terms, this means that a sequence of 'moderate' floods could progressively build-up the channel bed and floodplain, while a larger event may add very little. Some events could result in sediment removal and stripping from the river corridor.

In order to better understand the impacts imposed by the complexity of natural processes in any river catchment, and particularly the Waipaoa, an approach that dynamically models the interactions between flow and sediment in the catchment, channel, and floodplain

[3] Gomez, B., Cui, Y., Kettner, A.J., Peacock, D.H., Syvitski, J.P.M., (2009). Simulating changes to the sediment transport regime of the Waipaoa River, New Zealand, driven by climate change in the twenty-first century. *Global and Planetary Change*. 67, 153-166.

(a morphodynamic or 'movable bed' model) would be required. Any such model would need to consider a range of scenarios relating to flood magnitude and frequency, as well as sediment loads, to begin to assess the possible responses of the Waipaoa at Te Karaka, for both status quo and proposed stopbank alignments and levels. Alternatively, a consequence assessment based on the minimum and maximum accretion scenarios could be used to provide a basic envelope of potential effects.

4 Limitations and needs

The accretion scenarios reported in T+T (2025b) are based on existing data and information. The modelling they rely on was published in 2009. To improve certainty of predictions and forecasts, there is a need to update catchment-scale sediment transfer modelling with the latest climate scenario forecasts, particularly with a view to understanding their impacts on flood regime, river channel and floodplain trajectories in the Waipaoa.

In reality any flood and / or dynamic modelling of flow and sediment is based on a range of assumptions, and 'best guesses', because the future is unknowable. Nevertheless, a realistic range of flow and sediment scenarios can provide an envelope encapsulating a range of most likely change in the river corridor, both for status quo and upgraded stopbank scenarios. However, given the geomorphic trends in the Waipaoa catchment, maintaining effective flood protection for Te Karaka faces significant long-term challenges. The lowest-risk strategy may ultimately be a managed retreat from this part of the valley floor, which was also suggested by T+T (2025a).

Ultimately, assessing potential future flooding impacts from the proposed stopbank upgrade would require comparing a number of status quo and upgraded stopbank scenarios. It would not give a single number, but rather a range of possible outcomes. Furthermore, the resulting range of possible outcomes is likely to be large, and includes the possibility that future floodplain accretion and channel bed aggradation worsens flood impacts under the status quo scenario when compared with the proposed stopbank upgrade. This worsened possible outcome reflects the fact that ongoing sediment accumulation in the river corridor presents a scenario where there is progressively less flood capacity.

5 Conclusion

Ideally a range of scenarios, encapsulating envelopes of accretion, should be applied to the status quo, as well as preferred stopbank alignments and levels. This approach would be best delivered using morphodynamic modelling accounting for a range of flows and sediment loads. However, it is recognised that dynamically modelling channel and floodplain behaviour is complex and entails generalisations and assumptions because the future sequence of storms and floods, and the precise response of the Waipaoa River to these events is itself uncertain.

Maintaining effective, long-term flood protection at Te Karaka is significantly challenged due to the township's location on a floodplain and the geomorphic trends of the Waipaoa River. Although the geomorphic changes at a given location are difficult to predict precisely, the trends for rising river bed and berm levels are clear. This is reflected in T+T's findings in its previous work noting that the longevity of structural flood protection measures at this location will be limited.

6 Applicability

This report has been prepared for the exclusive use of our client Gisborne District Council, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Tonkin & Taylor Ltd

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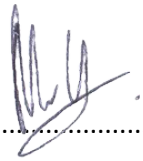	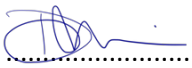
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