14 September 2026
Job No: 1092556.0020

**Commercial in Confidence**

Gisborne District Council
PO Box 747
Gisborne 4010

Attention: Joss Ruifrok

Dear Joss

**Te Karaka Bridges**
**Preliminary Assessment of Flood Loading**

## 1 Introduction

This letter presents the findings of a preliminary engineering assessment which assesses the changes to the loads on the Rangatira Bridge and Kanakanaia Bridge resulting from the proposed stopbank upgrade.

The assessment quantifies the increase in flood-induced hydraulic loads and scour depth caused by the 5,625 $m^3/s$ design flood event under the proposed upgraded stopbank scenario, relative to the existing stopbank conditions. The 5,625 $m^3/s$ design flood corresponds approximately to the 1% Annual Exceedance Probability (AEP) event under present-day climate, as advised by GDC. This was assessed by GDC to be approximately the Cyclone Bola flow plus 25%. This preliminary assessment only analysed hydraulic loads and scour for the design flood.

The load comparison assessment was also used to check the horizontal load capacity at the top of each bridge pile cap and compare it with the demands from each event. It is important to note that the bridges are defined as Low Volume and Access on ONRC (One Network Road Classification), which puts both bridges at Importance level 2 in accordance with the NZTA Bridge Manual, Third Edition (NZTABM) Table 2.1. This importance level requires the bridge to be capable of withstanding a corresponding SLS Flood event of 1/50 years and a ULS flood event of 1/500 years (flows estimated under present-day climate). The ULS is concerned with prevention of collapse and loss of structural stability under extreme actions.

The assessment was based on the modelled design water level and velocities summarised in Table 1.1 which were provided by DHI:



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**Table 1.1: Design flood water levels and velocities (5,625 m³/s flow)**

| | Kanakanaia Bridge | | Rangatira Bridge | |
|---|---|---|---|---|
| | Existing Option | Proposed Upgrade | Existing Option | Proposed Upgrade |
| Water Level [mRL] | 41.78 | 42.26 | 44.81 | 45.30 |
| Velocity [m/s] | 4.17 | 4.21 | 3.30 | 3.50 |

Detailed structural assessments of the bridges have not been completed as part of the load assessment.

## 2 Key Findings

Based on the flood level and flow velocity above, lateral and vertical loads, and pile and pier bending moments on the structure were calculated in accordance with the New Zealand Bridge Manual, 3rd Edition, Amendment 4[1].

A summary of the changes in loads and associated bending moments is provided in Table 2.2 below:

**Table 2.2 : Comparison in structural demands**

| Design Actions on Superstructure per m length | Kanakanaia Bridge | | | Rangatira Bridge | | |
|---|---|---|---|---|---|---|
| | Existing Option | Proposed Upgrade | Increase % | Existing Option | Proposed Upgrade | Increase % |
| Drag Force [kN/m] | 23.6 | 30.4 | 29% | 14.6 | 21.0 | 44% |
| Downward force [kN/m] | 22.2 | 22.7 | 2% | 14.4 | 15.7 | 9% |
| Uplift force [kN/m][1] | -48.7 | -62.7 | 29% | -38.6 | -54.1 | 40% |
| Bending moment [kNm/m] | 47.5 | 85.0 | 79% | 31.2 | 62.9 | 101% |
| ***Horizontal Force acting on the Pier [kN]*** | | | | | | |
| Fd, pier superstructure[2] | 768 | 989 | 29% | 467 | 674 | 44% |
| Fd, pier headstock[3] | 21.9 | 22.3 | 2% | 3.2 | 3.6 | 12% |
| Fd, pier Column/Wall | 85.9 | 87.6 | 2% | 38.2 | 43.0 | 12% |
| F_d, pier Cap beam | 27.4 | 27.9 | 2% | 5.7 | 6.4 | 12% |
| ***Flexural Demands*** | | | | | | |
| Flexure at the base of the pier [kNm] | 10169 | 13405 | 32% | 5204 | 7788 | 50% |
| Flexure at the top of piles [kNm] | 11482 | 15054 | 31% | 5823 | 8667 | 49% |
| Flexure at the pile with 1.0m scour [4][kNm] | 12406 | 16202 | 31% | 6854 | 10125 | 48% |

Notes:

1. Uplift forces are denoted as negative numbers when acting upward.
2. Demand from hydraulic drag force on the superstructure at the top of each pier
3. Demand from hydraulic drag force on the pier headstock is at the scour depth below the cap beam
4. Piles flexural demand at the scour depth below the cap beam

[1] Waka Kotahi NZ Transport Agency. (2022). *Bridge manual* (3rd ed., Amendment 4; SP/M/022). https://www.nzta.govt.nz

# 3 Capacity Checks

To supplement the calculation of design actions above, preliminary limited capacity checks of the piles for both the Kanakanaia Bridge and Rangatira Bridge were undertaken. These limited capacity checks do not provide a full indication of where the weakest point of the bridges will be, nor if the bridges comply with current Bridge Manual requirements.

Our assessment indicates that the Rangatira Bridge blade wall pier has adequate structural capacity to sustain the design loads currently and under the proposed upgrade. Critically, the weakest element of the bridge will very likely be either above or below the pier (e.g. the piles, pile cap, or superstructure). A 3D analysis and full multi-element assessment is required to accurately quantify the risk, and any strengthening/remediation options for the proposed upgrade to the stopbank.

Our assessment indicates that the Kanakanaia Bridge piers have insufficient capacity under design flood loading for both the existing option and proposed upgrade.

# 4 Scour assessment

Comparative scour assessment resulted in scour depth increases of up to 0.7 m (~10% of total scour depth) in Rangatira Bridge, where the piles are keyed into bedrock, providing significant resistance to undermining. The scour at Kanakanaia Bridge increases by up to 0.8 m (~10% of total scour depth) where the piles are not founded on rock but extend up to 20 m into underlying materials.

The increase in bending moment demands at the top of the piles resulting from scour for both bridges is approximately 8% for the Kanakanaia Bridge and 18% for the Rangatira Bridge.

# 5 Material limitations & assumptions

The following caveats are material to this assessment:

- Only one structural element for each bridge (pier flexural capacity at the top of the cap beam) has been assessed. Shear capacities of these elements have not been assessed. It is likely that there are other elements that may be more critical, particularly for the Kanakanaia Bridge.
- Material strengths have been adopted in accordance with assessment guidance from NZTA Bridge Manual Section 7.3. These material properties are selected based on the period of construction. Drawings did not provide material strengths.
- The assessment only considers flood loading based on a single flow scenario (5,625 $m^3/s$). Other design load scenarios, including debris raft forces, pressure (compression) scour, abutment scour, and seismic loading have not been considered. Some of these load cases (e.g. seismic or debris loading) may be more critical. No design load combinations have been assessed (e.g. bridge self-weight concurrent with flood loading).
- Serviceability Limit State (SLS) checks have not been considered.

## 6 Summary

The preliminary assessment findings calculated significant increases in structural demand on both bridges due to the proposed stopbank upgrade, with increases in bending moments on the superstructure of 101% and 79% for the Rangatira Bridge and Kanakanaia Bridge respectively.

The assessment calculated significant increases in shear and flexural demands on the substructure of around 40% and 30% for the Rangatira Bridge and Kanakanaia Bridge respectively. The assessment indicates that the Kanakanaia Bridge piers columns likely have inadequate capacity even under existing conditions.

The Kanakanaia columns will require strengthening if the increased risk from the additional imposed loads is to be mitigated. A full assessment would likely conclude that strengthening of the columns would be required to withstand the existing design flood load to meet modern standards also.

Although the Rangatira pier wall has sufficient flexural capacity, the pile foundations have not been assessed. Given the blade wall pier's high in-plane stiffness and capacity, significant lateral demands will be transferred to the piles, and pile capacity is considered the most likely critical element for the Rangatira Piers. A full assessment is required to confirm this.

As discussed above, the capacity assessment undertaken is limited to a single failure mode of one element (flexural capacity of one of the piers elements) under a single design flood load. Detailed assessment of the bridges was not undertaken, and accordingly, we cannot exclude if either bridge requires strengthening for either the substructure or superstructure. Accordingly, we also cannot currently confirm the extent or likely costs of these strengthening works.

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.

We understand and agree that our client will submit this report as part of an application for resource consent and that Gisborne District Council as the consenting authority will use this report for the purpose of assessing that application.

Yours sincerely

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Principal structural engineer

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Project Director

14-Sept-26
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