



MEMO

DATE 19 May 2023

TO Brandon Ballie

RE **Waikare Gorge Realignment APP- TBC S92 Request**

I have been engaged by Hawkes Bay Regional Council (HBRC) to review the flooding and erosion effects of the proposed Waikare Gorge realignment on SH2 near Putorino. I have reviewed the Application and Assessment of Environmental Effects prepared by Stantec NZ Limited (Stantec) on behalf of the Applicant – Waka Kotahi NZ Transport Agency (Waka Kotahi). I have reviewed Appendix C – Stormwater Preliminary Design Report along with the drawings (General Arrangement, Stormwater Drainage Preliminary Plans and Structures).

Scope of the Proposed Activities

A 3.8 km long, two lane state highway realignment with nine new cross drainage culverts, six attenuation/treatments areas as well as connecting swales, stormwater network, open channel diversions and erosion protection.

Review Comments

Hydrology – Peak Flow & Attenuation

I have checked the design hydrology and concur that the flood flow estimates are appropriate and the use of the RCP 8.5 climate change scenario for 2081-2100 is consistent with accepted good practice.

The peak flow attenuation design has been done very approximately by providing an overall treatment area including forebay, wetland and attenuation basin of 10% the contributing catchment area. I noted that the relative increases in flood flows as a result of the project are relatively modest (maximum 7.6% increase) compared to the size of the area provided for attenuation but I have completed an approximate verification to ensure sufficient space has been provided.

I based the approximate verification on a 30 min duration of the increase in peak flows for each attenuation basin assuming it is 60% of the total area of the stormwater treatment facility and can pond to maximum depth of 1.3 m. Based on this conservative analysis, all of the treatment areas have sufficient capacity to store the additional water and are therefore likely to be able to provide the necessary attenuation so that there will be no increase in peak flood flows as a result of the project.

Overall I am satisfied that the hydrological analysis and provision for attenuation to manage peak flood flows is appropriate and in accordance with good practice as well as the appropriate standards.

Hydraulics – Fish Passage & Flood Flow Conveyance

I have checked the calculations of flood flow and fish passage hydraulics and generally concur with the method of analysis and the key assumptions, particularly the use of a Mannings roughness of $n = 0.04$ for the baffled culverts and note that they have been designed to an appropriate width, slope and embedment to be in accordance with the Fish Passage Guidelines.

Two of the culverts not required for fish passage (Ref 2/C12815 and 9/C15830) did stand out as requiring relatively significant upstream headwater depths (>2 m) based on my own verification calculations to pass the design 100-year flood events. It is not clear from the information presented whether these headwater depths would affect property outside of the designation and what risks they

may present to the road embankment. Further information is required to understand these flood related effects. Both of these culverts also have high outlet velocities which is discussed under *Erosion* below.

S92 Request 1 – Please check the capacity of proposed culverts 2/C12815 and 9/C15830 and if they are to remain at their currently proposed sizes (DN450 mm and DN375 mm) then provide an assessment of the effects of upstream flooding due to headwater requirements to pass design flows. Alternatively, if the diameters are increased so headwater depths are less than 1 m then the upstream flooding assessment is not considered necessary.

Erosion

I generally concur with the outline design of the erosion mitigation for the relevant structures. However, culvert 2/C12815 has a very high outlet velocity for the 100-year event (5.19 m/s) which would likely require specific energy dissipation and something more robust than the currently proposed 200 mm diameter rip-rap. The same also applies for culvert 9/C15830 with a design outlet velocity of 2.90 m/s and 100 mm rip-rap proposed.

Similarly, culvert 4/C14200 has relatively high outlet velocity (3.08 m/s) and does not currently have any erosion protection proposed. It is noted from the design report that erosion controls for this culvert, along with the other fish passage culverts will be finalised at the detailed design phase.

S92 Request 2 – If culverts 2/C12815 and 9/C15830 are to remain the same size then further details are required around outlet energy dissipation, particularly for culvert 2/C12815. If these culverts are increased as per above S92 request then standard energy dissipation at the outlets would be considered acceptable.

S92 Request 3 – It would appear that outlet erosion protection is likely to be required at culvert 4/C14200 and possibly at some of the other fish passage culverts. The Applicant to consider providing for this within the Application.

I am happy to discuss these with the Applicants agents and technical advisors.

Prepared by



Kyle Christensen
Director - Christensen Consulting Limited