HAWKE'S BAY
REGIONAL COUNCIL

IN THE MATTER OF	the Resource Management Act 1991
AND	
IN THE MATTER OF	of an application pursuant to s 88 of the Resource Management Act 1991 (RMA)
APPLICATION BY	Gisborne District Council, (Land Rivers and Coastal Section)
FOR	An upgrade to the Waipaoa Flood Control Scheme

STATEMENT OF SUPPLEMENTARY EVIDENCE OF CRAIG CAMERON GOODIER

Introduction

1. My name is Craig Cameron Goodier. I am a Principal Engineer in the Engineering Section of the Hawke's Bay Regional Council.

2. I am a Chartered Professional Engineer, a Member of Engineers New Zealand, and have 22 years' experience practising as a Registered/Chartered Engineer. My qualifications and experience are set out in my previous Statement of Evidence in this matter dated 21 November 2017.

3. I repeat again that I have read the Code of Conduct for Expert Witnesses contained in the Environment Court Practice Note 2014 and agree to be bound by it. In particular, I confirm that the evidence I am giving is within my area of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

Background and Role at this Hearing

4. I was contracted by the Applicant to undertake analysis on the hydrodynamic aspects of the Waipaoa River, in relation to the proposed stopbank upgrade application. The hydrodynamic modelling of the River was undertaken in order to determine recommended upgrade heights to the existing stopbanks, and to determine potential effects of the proposed upgrade on properties within and upstream of the scheme area.

5. Several iterations of models have been completed for this project, originally starting from a 1-Dimensional model, then moving to a fully 2-Dimensional model,

then after recommendation from a peer review of previous models, the decision was made to use a coupled 1D/2D model. The coupled 1D/2D model was peer reviewed by DHI – Water & Environment (DHI), the suppliers of the modelling software.

6. The conclusion of the peer review stated that "*Overall, the Waipaoa MIKE FLOOD model has been constructed to a very high standard, which serves to only make minor issues more noticeable. Model results compare extremely well with the observations from the Cyclone Bola Storm event, however, it is not possible to comment on the robustness of this calibration without additional calibration or validation storm event simulations.*"

7. A description of the hydrodynamic modelling undertaken is more fully canvassed in my earlier statement of evidence and subsequent further report submitted on behalf of the Applicant in August 2018.

8. I also attended the expert witness caucusing session in Gisborne on August 8 2018, and note that technical matters associated with the flood model and stopbank design were largely resolved. This matter has been highlighted in the Officer's supplementary s42A report (paragraphs 5 and 41).

9. I incorporated all recommendations from the expert witness caucusing session, and produced the final reports included in the package of further information submitted by the Applicant, namely, *Waipaoa River Flood Control Scheme Hydrodynamic Model Calibration* HBRC Report 4992, AM1805 and *Waipaoa River Flood Control Scheme Design Flood Hydrodynamic Analysis* HBRC Report 5016, AM1806.

10. In this evidence I will briefly summarise the results of the reports and the computer modelling, as well as comment on some of the matters raised in the Technical Reports attached to the Supplementary s42A Report (particularly from Mr Kouvelis).

Justification for the use of a Hydrodynamic Computer Model

11. Computer models provide an excellent means to simulate events which are difficult or impossible to reproduce in the field. Computer models are particularly useful to provide comparative results from multiple simulations which keep all variables fixed apart from the item being tested, which in this case will be the stopbank heights.

12. The particular type of model used in this investigation uses a 1-dimensional component for the main river channel, and a 2-dimensional component for all out-of-channel flow over large flat areas, but within the confines of the stopbanks or high ground where no stopbank exists.

13. This type of coupled 1D/2D model allows for a good representation of the main river flow, taking into account bed friction, river slope and channel dimensions, while also allowing for a good representation of out of channel flow. The out-of-channel flow takes into account the storage aspects of large flat areas as well as friction associated with the typical land cover on farmed land.

14. The software suppliers, DHI, have recommended this approach to analyse the river for the purposes desired, and they consider this to be best practice at present. Once developed to an acceptable level of accuracy, a model can be

used to examine past events, or to provide guidance on the predicted water levels, discharges, velocities and other hydraulic output for simulated design events. The model is also able to be used to compare the potential changes in flood levels and other hydraulic output given a change in physical conditions of the flood protection scheme, for example the raising of the stopbanks.

The Waipaoa Computer Model

15. In this particular analysis, the computer model developed for the Waipaoa River was calibrated to observed peak water levels for a previous event, Cyclone Bola, which occurred in March 1988.

16. I consider the calibration to Cyclone Bola is within acceptable tolerances compared with similar modelling results from other projects completed by HBRC, where typical variations between modelled and observed flood levels are in the order of ±300 mm.

17. The calibrated model was used to simulate a design event with a peak discharge larger than Cyclone Bola. Based on the current flood frequency analysis, the peak discharge of 4500 m^3/s for Cyclone Bola has been estimated to have an average recurrence interval (ARI) of approximately 100 years.

18. The design event was chosen based on the 100 year return period design event plus an increase of 25% to account for an increase in rainfall intensity due to the effects of climate change. The peak discharge of the design event was set at 5625 m^3/s. The design event was run with simulated infinitely high stopbanks, also referred to as a 'glass wall' model in order to determine the required stopbank height to contain the design discharge.

19. The design event was also run using the existing stopbank heights in order to provide a comparison between the model results, such that the effects of the proposed stopbank upgrade may be determined.

20. The model results indicate a variety of stopbank height increases are required along the extent of the scheme.

21. Limitations of the model have been canvased in my earlier evidence and report, and the underlying assumptions are agreed in section 4.1 of the caucusing statement.

22. In the Technical Memo from Brian Kouvelis included in the s42A report, Mr. Kouvelis concludes in section 8 that "*By and large, it is considered the updated Waipaoa Flood Control Scheme proposed upgrade works and programme, based on the revised hydraulic modelling, is now fit for purpose, subject to a set of appropriate consent conditions.*"

Model Results and issues raised in relation to model and further information requests

23. The model results were used to compare peak water levels and velocities at several locations of particular interest. Model results are available throughout the entire scheme, however, we have focussed on particular locations where submitters have asked for further information or clarification of the effects of the proposed upgrade, including 7 locations requested by Wi Pere Trust, and upstream of the scheme, as requested by Mr. Dave Peacock. The results of this

analysis are included in the design report submitted with the further information from the Applicant.

24. I note that Mr. Peacock (engineer for Wi Pere) has previously raised an issue that the results presented in the design report present a comparison of peak flood levels, which may not represent the scenario which results in the greatest differential impact on a property (i.e. the 'tipping point'), and in particular on the Wi Pere infrastructure. Item 4.14 in the caucusing notes has the subject of "Inclusion of the full range of floods for assessment of flood hazard/damages."

25. Subsequently, I have extracted results from the design model which show a point in the flood where the discharge is less than the maximum design discharge of 5625 m^3/s. I chose the point of comparison to be the time when the water level was just below the floor level of the staff house near the packing sheds on the Wi Pere property, and is also estimated to be the time when the water level is just below overtopping the irrigation dam structure. At this point in time, the discharge at Kanakanaia is approximately 5000 m^3/s, taking into account the delay and attenuation from Kanakanaia to the Tangihanga terraces.

26. The comparison between the existing scenario versus the proposed scenario show the proposed scenario results in a water level which is approximately 200 mm higher than the existing scenario at that point in time, for the stated discharge.

27. I note that the scenario presented in the design report and Applicant's Report, was slightly deeper than that because it used the comparison at the peak water levels.

28. Based on the analysis of flood frequency presented in the design report, the discharge of 5000 m^3/s has a return period of approximately 200 years in today's climate, and a return period of approximately 50-80 years in 2090, considering climate change to the year 2090.

Issues Raised in the Technical Memo by Brian Kouvelis

29. In the Technical Memo from Brian Kouvelis attached to the Supplementary s42A report, Mr. Kouvelis comments in section 2, paragraph 5 that additional modelling is required at and around the bridge structures, and in particular the Applicant should continue to liaise with NZTA with regard to the Matawhero Bridge, given its importance to the state highway network. I note that at technical caucusing the experts agreed that the current level of modelling and analysis around the bridges is acceptable at this stage, however further attention to design is required at a later date. (Item 4.6).

30. I agree with Mr. Kouvelis' conclusion, and consider that the results presented in the design modelling report[1] provide sufficient detail to be confident the proposed stopbank heights at the cross sections immediately upstream (200 m distance) and downstream (160 m distance) of Matawhero Bridge are correctly represented.

[1] *Waipaoa River Flood Control Scheme Design Flood Hydrodynamic Analysis, 2018 (Design Modelling Report)*

31. The additional modelling suggested will provide guidance on the local effects at the bridge, and the effects the bridge may have on the local flood levels. The effects of debris build up on the bridge will be included. I do not consider this detailed modelling will substantially change the overall design of the proposed stopbank upgrade, and I note the evidence of Mr Ruifrok that consultation with NZTA is ongoing in relation to this aspect but can be dealt with at detailed design stage.

Further modelling at river mouth

32. Mr. Kouvelis (section 2, paragraph 6) also suggests additional modelling is required at the Waipaoa River mouth. The river mouth is a very dynamic environment, being the interface between two quite variable systems (river and ocean). I note that Mr Kouvelis considers that the additional modelling could take place at detailed design stage in order to finalise the design for actual construction plans.

33. I consider that the results presented in the Design Modelling Report provide sufficient detail to provide a level of confidence that the proposed stopbank heights at the cross sections just upstream of the river mouth are represented well.

34. Any additional modelling would provide guidance into the detailed design stage in order to ensure the stopbanks and flood control system are robust and fit for purpose in this particular environment. However, while it might be helpful, I do not consider this detailed modelling will substantially change the overall design of the proposed stopbank upgrade.

Flooding effects at Ormond

35. Although not mentioned in Mr Kouvelis's report I note that there is some discussion in the report by Ms Thompson and Mr Murphy that the Ormond Bypass "… goes beyond the scope of the original project." and has "potential to create adverse effects beyond that described in the original application". (pg. 29, s42A report). There is no further elaboration of what those effects might be. I wish to note one point, which is that at expert caucusing it was agreed that "The bypass did not disadvantage the houses around Ormond." The elevation of the banks of the Muhunga Stream at Ormond, upstream of the existing floodgates are lower than the existing stopbanks (and floodwalls) in the bypass area. In terms of flood risk, this results in floodwaters escaping the Muhunga Stream and causing flooding in Ormond solely from the Muhunga Stream, prior to any water from the Waipaoa River causing flooding in Ormond. The original proposal to raise the Waipaoa stopbanks along the existing banks and floodwalls would not have altered this situation. The current proposal also does not alter this situation. Based on this observation about the hydraulics in this area, my opinion is that the current proposal is consistent with the scope of the original proposal in terms of effects from flooding. The proposal to construct what has been referred to at the Ormond Stopbank Bypass will result in an increased level of protection for the properties in Ormond and the wider community. I note Mr. Ruifrok expands on other benefits of the Ormond Stopbank Bypass in his statement of evidence, section "Stopbank Bypass across Muhunga Stream". I agree with Mr. Ruifrok's conclusions, and provide further comments in the following paragraph.

36. I note that Ms. Thompson and Mr. Murphy pose a question relating to this topic as "What is the long term plan for the stopbanks upstream of the proposed new floodgate location?". My understanding is that the applicant will continue to be required to maintain the flood walls and stopbank in the bypassed area to at least the existing level of service currently provided, which will require the banks to be at least the same height as the banks of the Muhunga Stream upstream of the existing floodgates, in order to continue to provide the same differential level of protection to the properties in the bypassed area. While not stated explicitly in the application, I understand that any future change to the stopbanks upstream of the proposed new floodgate would require consents at the time of any proposed changes. This future consenting process would require appropriate hydraulic analysis and public consultation in order to provide confidence the desired outcomes may be achieved. Based on my understanding of the nature of the hydraulics and flood risk to the area, the current proposal will not alter any possible future changes to the bypassed length of stream.

Equal protection philosophy

37. Although not specifically covered in Mr. Kouvelis's report I note that some discussion was undertaken at caucusing relating to the issue of equal protection versus dedicated spillway philosophy for the scheme (refer Item 4.10 in the caucusing statement). I understand that Mr. Peacock's position is that he considers a dedicated spillway location to be preferable.

38. As recorded in the caucusing statement Mr. Kouvelis and myself consider that such a decision needs consideration of external factors, such as the impacts on the land and infrastructure in the area covered by the flow path leading from the spill location, and that such a decision was outside the scope of the current application.

39. I do note that the current scheme has a dedicated spill location at Ford Road, albeit not specifically from a lowered section of stopbank, rather from a section with zero freeboard (as opposed to 300 mm freeboard throughout the scheme).

40. The proposed stopbank upgrade promotes the idea of equal protection, as opposed to an equal increase in protection. There is additional potential benefit to the area formerly identified as the overflow pathway. The identification of such differences in benefits was outside of the scope of this analysis.

41. I also note in the October 2017 Findings of the independent review into Rangitaiki River Scheme[2] the Summary of Recommendations (under the heading of "Long-term strategy and design philosophies"), contains the following recommendation (Regional Council in this reference is to the Bay of Plenty Regional Council) (aa):

> "*The work the Regional Council is currently undertaking to examine the feasibility of spill compartments and an additional outlet from Reid's Floodway as well as a lower fixed crest for Reid's Spillway should be pursued using all of the tools available including designations (s166-186, Resource Management Act, 1991), and if necessary, the Public Works Act 1981.*"

[2] *Rangitaiki River Scheme Review – April 2017 Flood Event* 18 September 2017

42. Under the heading “Community Engagement” the Report also states:

> *“Engagement of the full community (including Edgecumbe Township) should be undertaken when considering further options for Reid’s Floodway. This should include full notification of any notices of requirement and/or application for resource consent.”*

43. In my opinion, the results of the Rangitaiki Review have the potential to impact on how flood control schemes operate in New Zealand, however, at present there is no clear direction from Central Government to incorporate such items as dedicated spillways into flood control schemes.

44. I accept that in the future there may be a community desire to incorporate a dedicated spillway and overflow path for the Scheme, and if this is to be actioned, then analysis should be completed to show the most appropriate spillway and overflow path location, such that there are clear planning regulations and designations are incorporated into the district plans.

45. At present I consider that the proposed upgrade to the Scheme will not hinder any future establishment of dedicated spillways and overflow locations.

Craig Cameron Goodier
03 September 2018