Executive Summary

Pattle Delamore Partners Ltd (PDP) has been engaged by Watchman Residential Ltd to prepare a flood assessment for a proposed residential subdivision located in Ngongotahā, Bay of Plenty.

To complete this assessment, PDP have constructed a hydraulic model using the Tuflow software package. This report specifies the build and calibration of that hydraulic model. A second report will be issued discussing the design runs and provide further detail of the proposed floor levels and quantify the effects of floodplain filling to achieve those floor levels.

The purpose of this model is to determine suitable calibration parameters that can be employed in the design model.

Hydraulic Model

The hydraulic model has been constructed using Tuflow and calibrated against the 28/29 April 2018 flood event. This event is close to the 100YR design event and the largest available calibration event. The Digital Terrain Model (DTM) has been derived from predominantly the 2018 Bay of Plenty LIDAR series, although in some small areas where this series is unavailable, the 2011 series was employed.

The model has three boundary conditions:

- Lake Rotorua water level as the downstream boundary for the Waiteti River and a normal flow boundary at the downstream model extent;
- Waiteti Stream inflow as an upstream boundary; and,
- Direct rainfall for the internal catchment area which captures the local inflows.

Of all the boundary conditions, previous modelling has shown that the Waiteti Stream inflow has the most significant effect on calibration model results and the largest degree of uncertainty. We have estimated this boundary condition by applying a transformation to the flow recorded in the neighbouring Ngongotahā catchment for the 28/29 April 2018 event. Investigations show that catchment characteristics (size, shape and landuse) of both the Waiteti and Ngongotahā are very similar, and, the total April 2018 event rainfall depth was also similar (variation of less than 15% between catchments with the Waiteti catchment possibly receiving more rainfall).

Given the similar catchment characteristics and rainfall, a flow transformation was obtained by estimating the 100YR TM-61 flows for the Waiteti and Ngongotahā catchments and taking the ratio between these flows (0.84) and applying it to the recorded and verified flow (72 m^3/s) in the Ngongotahā Stream for the April 2018 event. This provides a flow estimate in the Waiteti Stream of 60.4 m^3/s for this event.

Other methods for estimating the Waiteti flow boundary condition were also investigated, including rainfall-runoff and the empirical regional characteristics method. As a result of this investigation, we attach an uncertainty interval of -10%/+15% to this estimate and additional calibration model runs have been completed to explore the sensitivity of the model to the flow uncertainty.

Lake Rotorua levels and rainfall depths were obtained from Bay of Plenty Regional Council (BoPRC).

Roughness values were derived from standard literature sources and were consistent with calibrations in the Ngongotahā Stream. Roughness values for the Waiteti Stream were refined via the calibration process. For the Waiteti Stream, roughness values ranged from 0.03 to 0.1.

Calibration Results

The model calibrated well to the April 2018 event. Of the 17 surveyed calibration points, the model was within 100 mm for 14 of them, within 200 mm for an additional one and just over 200 mm for the final two points. The calibration model was sensitive to both the roughness and flow in the Waiteti Stream.

Two alternative calibrations were also tested by increasing the Waiteti Stream flow by 15% and decreasing the flow by 10%. Roughness values were altered until the calibration performance was acceptable. We found that:

- For a flow increase of 15% at the Waiteti Stream boundary, roughness values needed to decrease by 25% to achieve a similar calibration performance; and,
- For a flow decrease of 10% at the Waiteti Stream boundary, roughness values needed to increase by 25% to achieve a similar calibration performance.

The variation in roughness values provides an upper and lower bound that will be employed in the design model as a sensitivity assessment.

Conclusion

In conclusion, the model has been calibrated to the April 2018 event and sensitivity tested to a range of flows which envelops the inherent uncertainty of the upstream Waiteti flow estimate. The range in roughness values (-25% and +25%) which have been derived for this calibration model will be used in the subsequent design model to assess performance and sensitivity of the model to this assumption. We conclude that this model is suitable for use in the next (design) stage for the purposes of determining minimum floor levels and the effects of any proposed floodplain modification.