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 flood assessment, a 2D hydraulic model has been constructed using the Tuflow software package. The purpose of the model is to provide minimum floor level recommendations and quantify any effects of development as a result of floodplain displacement, which may be required to form building platforms that adequately mitigate the flood risk. This model is an iteration of our peer reviewed calibration model which is provided in Appendix B.

Model Build

The model build is largely as described in our calibration report. In summary, the model has been constructed using the Tuflow package and is predominantly a 2D solution with some 1D elements for pipes and culverts.

The model digital terrain model (DTM) has been constructed with a combination of LIDAR flown in 2018 and cross-sections survey in 2020. 2011 LIDAR has also been employed where coverage for the 2018 dataset was not available. A post developed DTM surface was constructed using a surface file of the proposed subdivision which has been provided by McKenzie and co[1]. This surface includes the proposed subdivision surface, a proposed wetland and proposed stormwater attenuation facilities.

Roughness values have been adopted from the calibration model and boundary conditions from the calibration model have also been retained. Additional hydrological events have been added including the mean annual flood, 10YR, 50YR, 100YR and 500YR events. All events have a 42.5% increase for climate change which represents 3.68°C of warming at 11.5% per 1°C increase. This increase has been applied to both rainfall depths and the Waiteti flow boundary. The 42.5% increase is consistent with BOPRC 2022 study for the neighbouring Ngongotaha Stream.

Stage 1: Effects on flooding

As a result of floodplain filling for stage 1, the following observations have been made regarding effects on flooding. Flood hazard was assessed for the 50YR, 100YR and 500YR events using the Australian Rainfall and Runoff flood hazard curves:

- In all events assessed (50YR, 100YR and 500YR), no increase in flood hazard for lifeline utilities (SH36 or the railway line);
- No increase for in flood hazard for habitable dwellings in either the 50YR or 100YR flood events;

[1] Email from James Dufty (McKenzie and Co) to Ben Throssell (PDP) on 21 March 2023

- For the 500YR event, there is an increase in the flood hazard classification for three buildings south of the railway embankment. Closer inspection of this figure shows that for two of the three increases are for buildings that are unlikely to be inhabited (garden sheds, garages or small outbuildings). Therefore, the increase in flood risk is limited to one habitable dwelling which is predicted to increase from H2 (unsafe for small vehicles) to H3 (unsafe for vehicles children and elderly).

Negligible differences for velocity and duration of flooding were observed as a result of development. Differences in flood elevation are minimal for the 50YR and 100YR events. For the 500YR event, the changes are more significant and comprise of:

- Approximately 50 to 60 mm for the flooded extent south of the railway embankment. For context, much of this area will be inundated to depths exceeding one metre in the 500YR pre-development event;
- The rural area north of the railway embankment and west of Stage 1 is predicted to experience flood elevation increase of just over 100 mm in some locations. Again, flood depths in this location already reach over 1.5 m; and,
- Downstream of the SH36 bridge, flood elevation increases are less than 20 mm.

The 500YR effects are predominantly driven by the removal of an overland flow path which provides conveyance from Te Toto Stream to the Waiteti stream in this large flood event. The development of Stage 1 blocks this overland flow path.

Stage 1 with mitigation: Effects on flooding

For mitigation option 1, the following works (as presented in Figure 18) are proposed:

- Enhancement of the drain adjacent to the proposed wetland. This drain currently provides conveyance for floodwaters discharge from the railway culvert and additional floodwater that breaks out of the Waiteti Stream. The proposed works include widening the drain as shown and lowering the existing ground levels by approximately one metre (200 mm above the current invert of the drain). This is intended to provide a dedicated area to maintain any sediment accumulation that may inhibit the capacity of the floodway or wet; and balance flows between overflows to Te Toto overflow and main stream that may be affected by uncontrolled upstream changes to land use or sedimentation that may impact on floodplain flow patterns;

- Provision of additional conveyance from Te Toto stream to Waiteti Stream to reinstate the flow path that will be cut-off by Stage 1. This overland flow path is around 10 m wide and 500 mm deep. This is proposed to provide compensatory conveyance to the floodplain impeded by the stage 1 development layout.
- Building platform levels are proposed above RL 286.20m

The following observations are made for this scenario:

- In all events assessed (10YR, 50YR, 100YR and 500YR), no increase in flood hazard for lifeline utilities (SH36 or the railway line) and no increase for in flood hazard for habitable dwellings;
- Negligible differences for velocity and duration of flooding for the 10YR, 50YR, 100YR and 500YR events; and,
- Minimal changes for differences in flood elevation, less than 20 mm increases for habitable dwellings and up to 50 mm on some rural land.

In conclusion, the effects on flooding for the Stage 1 option with mitigation are considered less than minor.

Model Sensitivity

The model has been used to determine the effects of development on flooding and also provide minimum floor level and building platform advice. Therefore, when conducting the sensitivity assessments, they have been split into two categories consistent with the stated purposes of the model.

The absolute water levels at Stage 1 were used to inform minimum floor levels and building platform levels. These are most sensitive to Manning's roughness. This parameter was increased and decreased by 25% and produced a 200 mm variation in water level. The model was also sensitive to the hydrological assumptions. Doubling the rainfall depth and Waiteti flows for the 500YR event produced a 200 mm increase in flood elevation from the 500 YR event. Recommendations regarding floor levels were not considered sensitive to bridge blockages, the downstream lake boundary, the wetland operating level, infill development, rainfall profiles, attenuation of stormwater on the development site or antecedent conditions.

The sensitivity of effects regarding hazard and flood elevation were tested against the in channel roughness. The same effects were produced as the base model, despite increases and decreases of 25% to the roughness parameter. Therefore, conclusions regarding effects on flooding are not considered sensitive to the roughness assumption.

Floor Levels

The proposed Stage 1 subdivision surface (building platforms) is located above an elevation of 286.2 mRL. This is 250 mm above the Q500 event and 50 mm above the Q500x2 flood event (286.15 mRL). Therefore, finished floor levels can be 250 mm above the building platform. Care should be taken to ensure there is adequate fall away from the buildings to ensure avoidance of nuisance flooding.