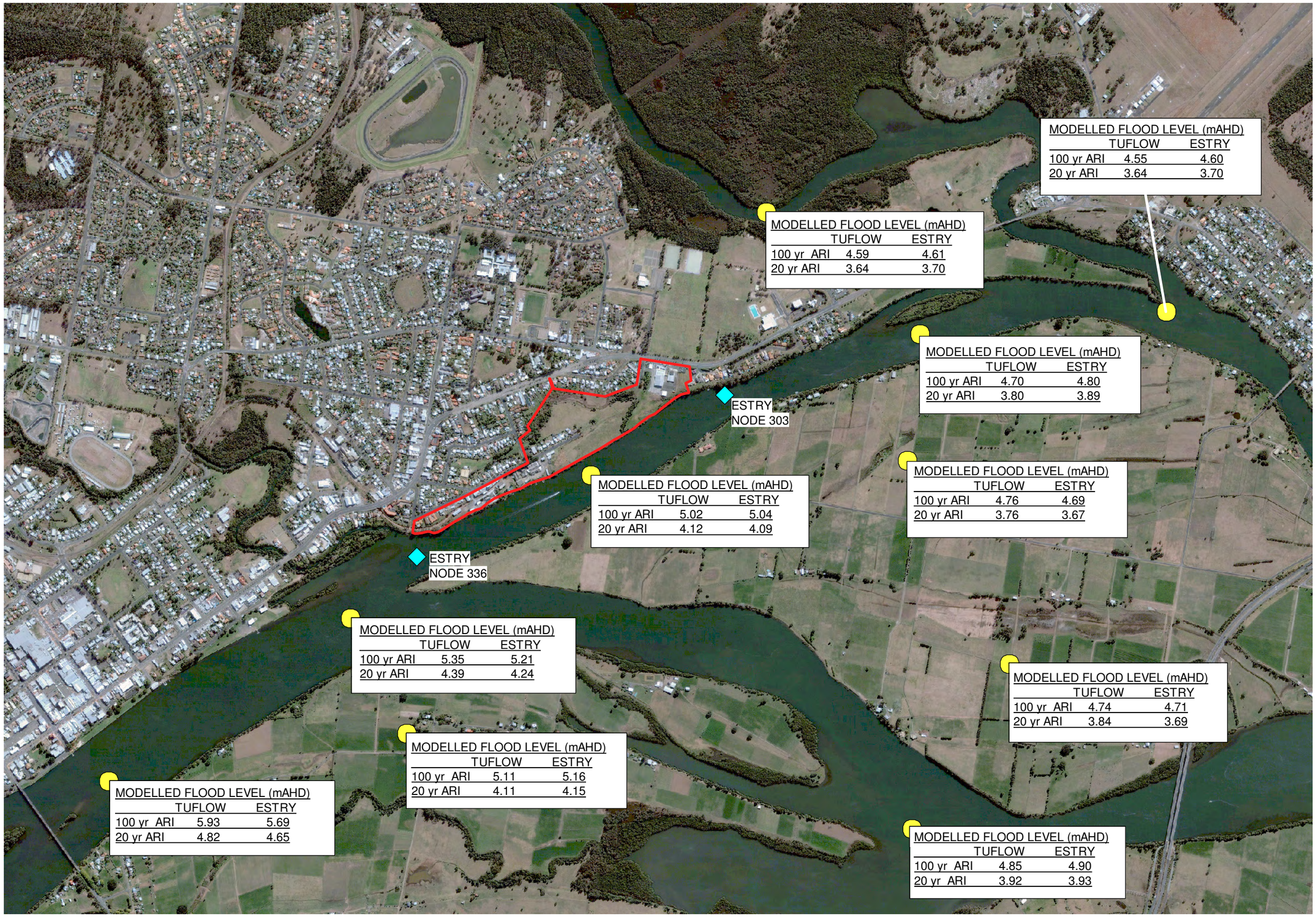
FIGURE 9



LEGEND

- Location of ESTRY Model Node
- Location for Hydrograph Comparison (refer Figures 10 and 11)
- Pitt Street Waterfront Precinct

N

0 0.5 1
kilometres

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Figure 9 - Comparison between 1992 ESTRY Model and 2008 TUFLOW.wor

COMPARISON BETWEEN TUFLOW FLOOD LEVEL RESULTS AND ESTRY MODEL RESULTS

As a further test of the reliability of the TUFLOW model to replicate the results of the original ESTRY model, stage-hydrographs for the entire flood duration were compared at locations upstream and downstream from the Pitt Street Precinct. The results of this analysis are presented in **Figures 10** and **11**. The figures show that the shape of the 100 year recurrence hydrographs, as extracted from the TUFLOW model, suitably reflect the hydrographs exported from the original ESTRY model.

As shown in **Figure 8**, the design flood level along the unnamed drainage channel is approximately constant at 5.0 mAHD, which is likely the result of water "backing-up" from the confluence with the Manning River (*refer* **Figure 8**).

Flow velocities across a majority of the precinct are generally low. However, velocities can reach up to 0.8 and 1.3 m/s at lower areas of the site at the frontage to the Manning River (*refer* **Figure 8**).

2.7.2 Design 100 Year Recurrence Flood with 20 Year Recurrence Tide

Peak flood levels and flow velocities for the 100 year recurrence flood with 20 year recurrence tide are presented in **Figure 12**.

The results indicate that the change in downstream boundary condition to a lesser design tidal event does not have a significant impact on peak 100 year recurrence flood levels or flow velocities at the precinct (*compare* **Figures 8** *and* **12**).

2.7.3 Design 20 Year Recurrence Flood

Peak flood levels and flow velocities for the 20 year recurrence flood are presented in **Figure 13**. Flood levels range between 4.3 and 4.0 mAHD across the length of the precinct.

These levels are considered to suitably reflect the flood levels extracted from the ESTRY model.

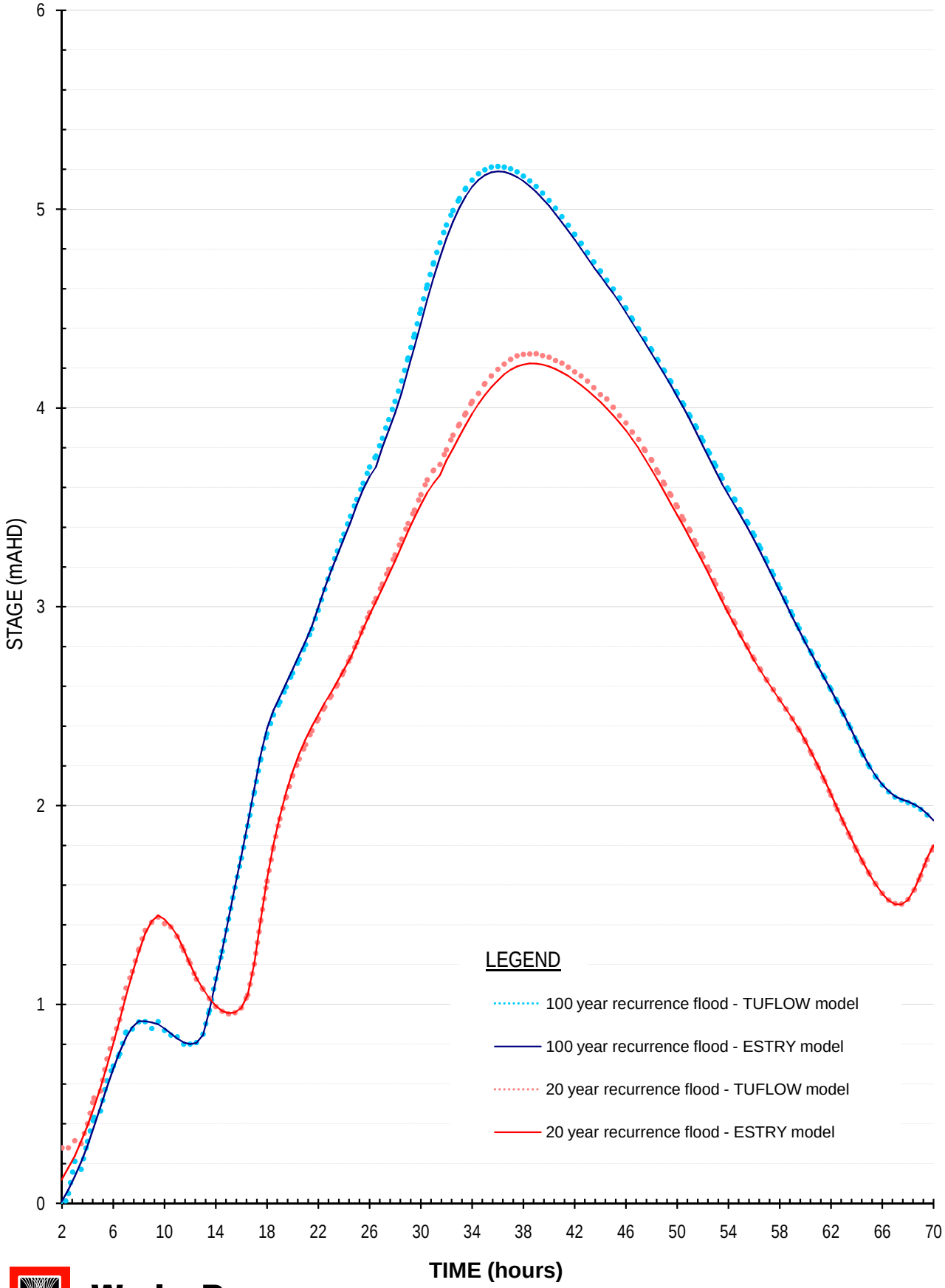
As shown in **Figure 9**, the 20 year recurrence flood levels extracted from the TUFLOW model results are generally consistent with the ESTRY model results, particularly in the vicinity of the Pitt Street Waterfront Precinct.

As discussed above, the larger differences in model results at some locations at overbank areas or near the upstream model boundary are likely the result of the different modelling techniques adopted and also model boundary effects.

Figures 10 and **11**show that the 20 year recurrence TUFLOW stage-hydrographs at locations upstream and downstream from the precinct suitably reproduce the hydrographs taken from the original ESTRY model.

Flow velocities across the precinct reach up to about 0.8 m/s during the 20 year recurrence flood.

FIGURE 10



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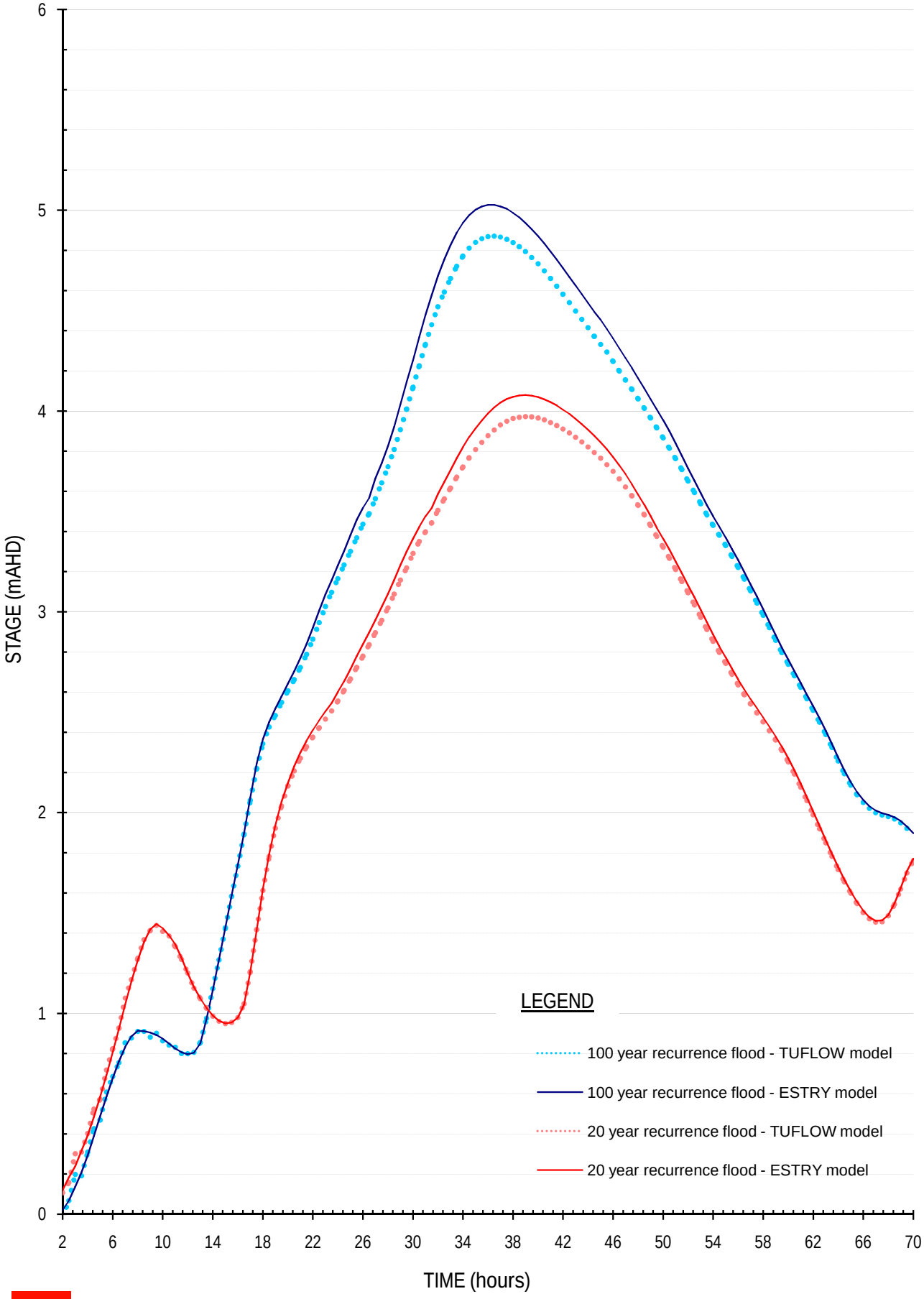
Stage Hydrograph Comparison.xls

COMPARISON OF STAGE HYDROGRAPHS AT ESTRY NODE 336

FIGURE 11



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Stage Hydrograph Comparison.xls

COMPARISON OF STAGE HYDROGRAPHS AT ESTRY NODE 303

FIGURE 12

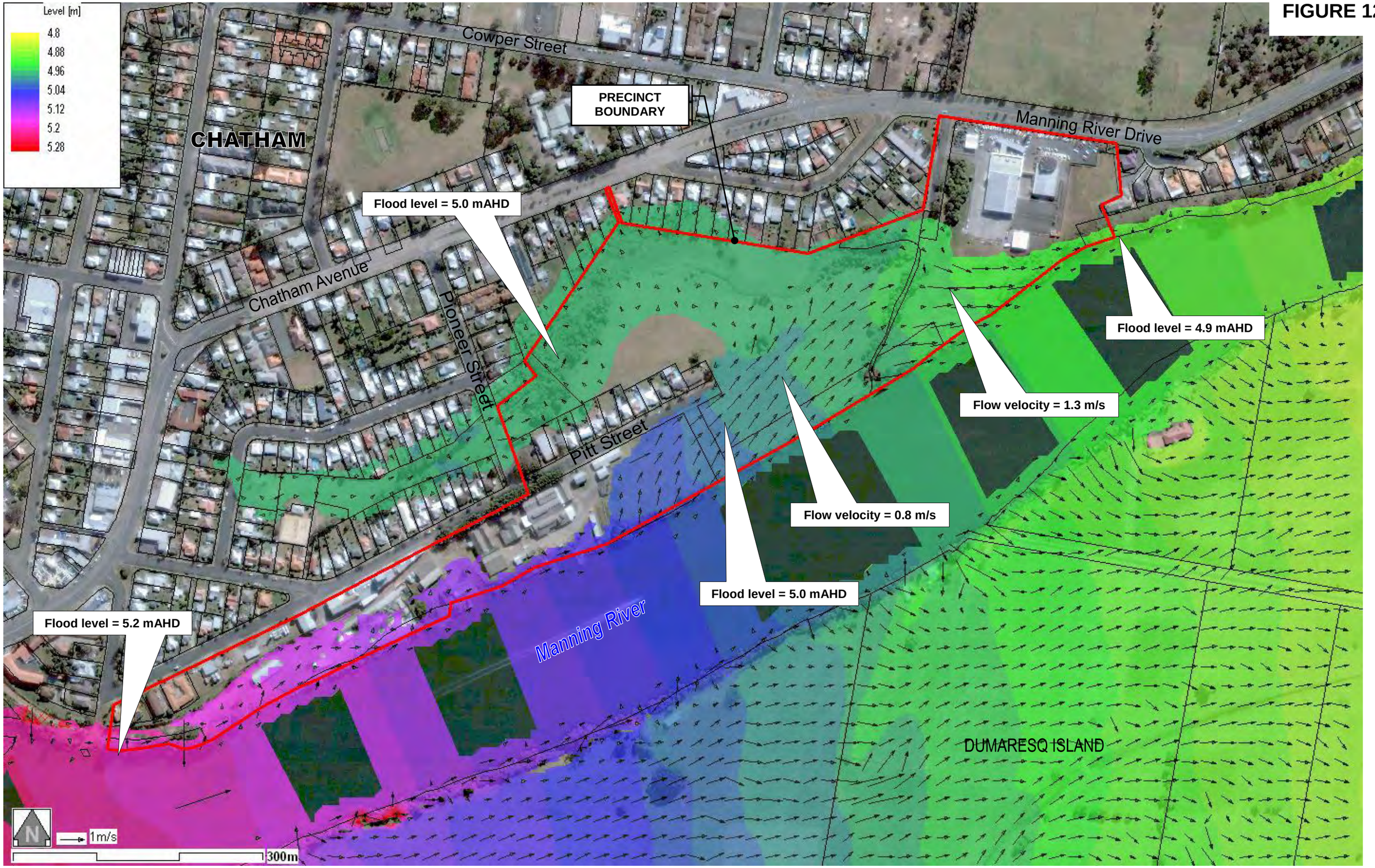

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Figure 12 – 100 year 20 year TWL flood levels.doc

PEAK FLOOD LEVELS AND FLOW VELOCITIES FOR 100 YEAR RECURRENCE FLOOD WITH 20 YEAR RECURRENCE TIDE

FIGURE 13

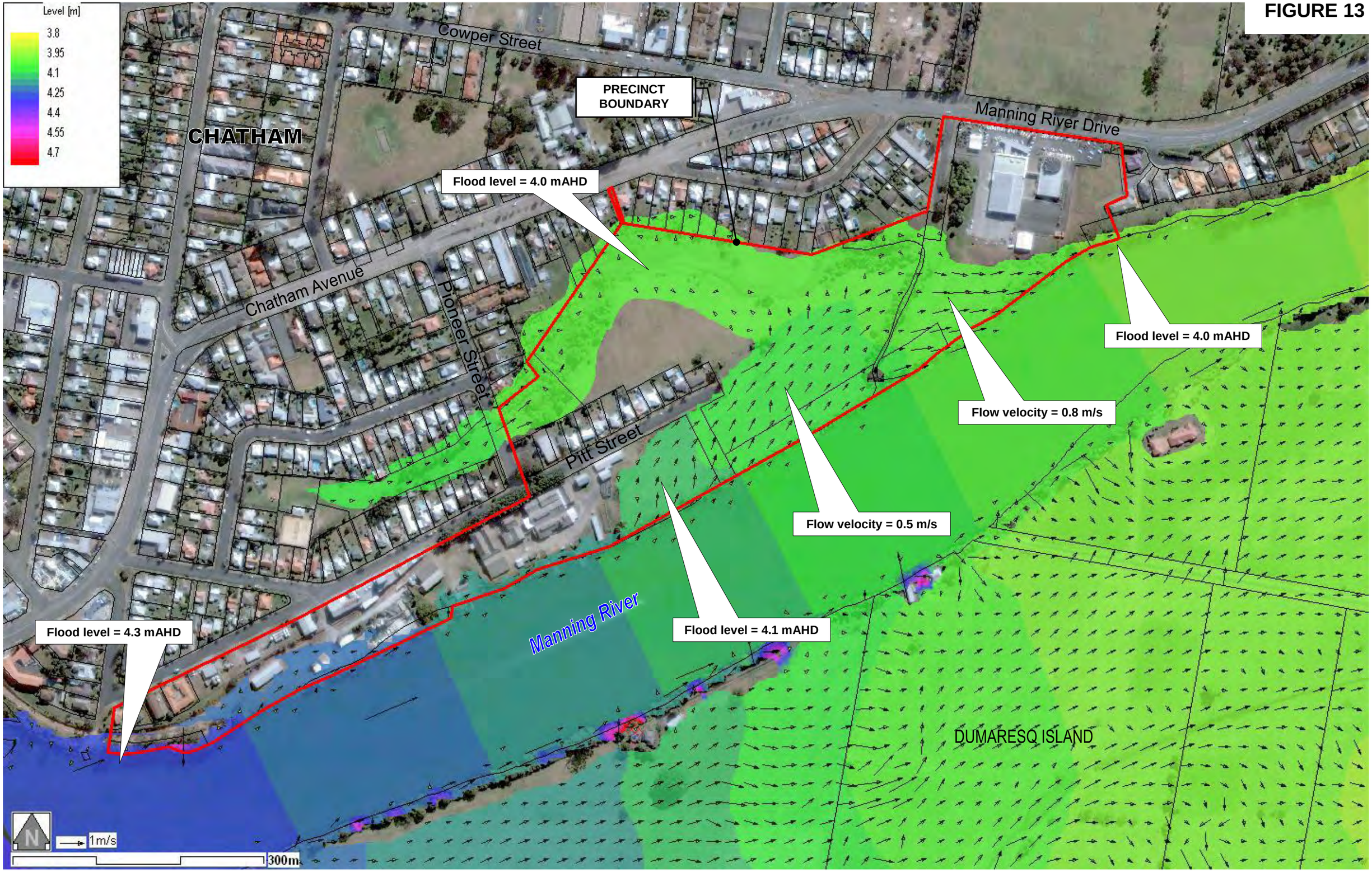

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Figure 13 – 20 year flood levels.doc

PEAK 20 YEAR RECURRENCE FLOOD LEVELS AND FLOW VELOCITIES AT THE PITT STREET WATERFRONT PRECINCT

3. IMPACT OF THE DEVELOPMENT ON LOCAL FLOOD BEHAVIOUR

3.1 PROPOSED DEVELOPMENT

The proposed rezoning and development of the Pitt Street Waterfront Precinct will involve the conversion of existing rural, residential, industrial, special use and open space areas to open space, residential, industrial, commercial and tourism uses, including a marina development.

The layout for the proposed development is shown in **Figure 14**. Up to 57 new buildings will be constructed as part of the development, including residential apartments, shopping malls and entertainment facilities. It is understood that up to four buildings associated with the existing dairy will be retained for historic value.

The proposed buildings are to be constructed on suitable platforms so that finished floor levels are above the 100 year recurrence flood level for the precinct. The layout of the proposed ground floor platforms are shown in the architectural drawings contained in **Appendix C**. As shown, the ground floor level of habitable buildings will be constructed at 6.5 mAHD or higher, which is more than 1 metre above the peak 100 year recurrence flood level of 5.2 mAHD.

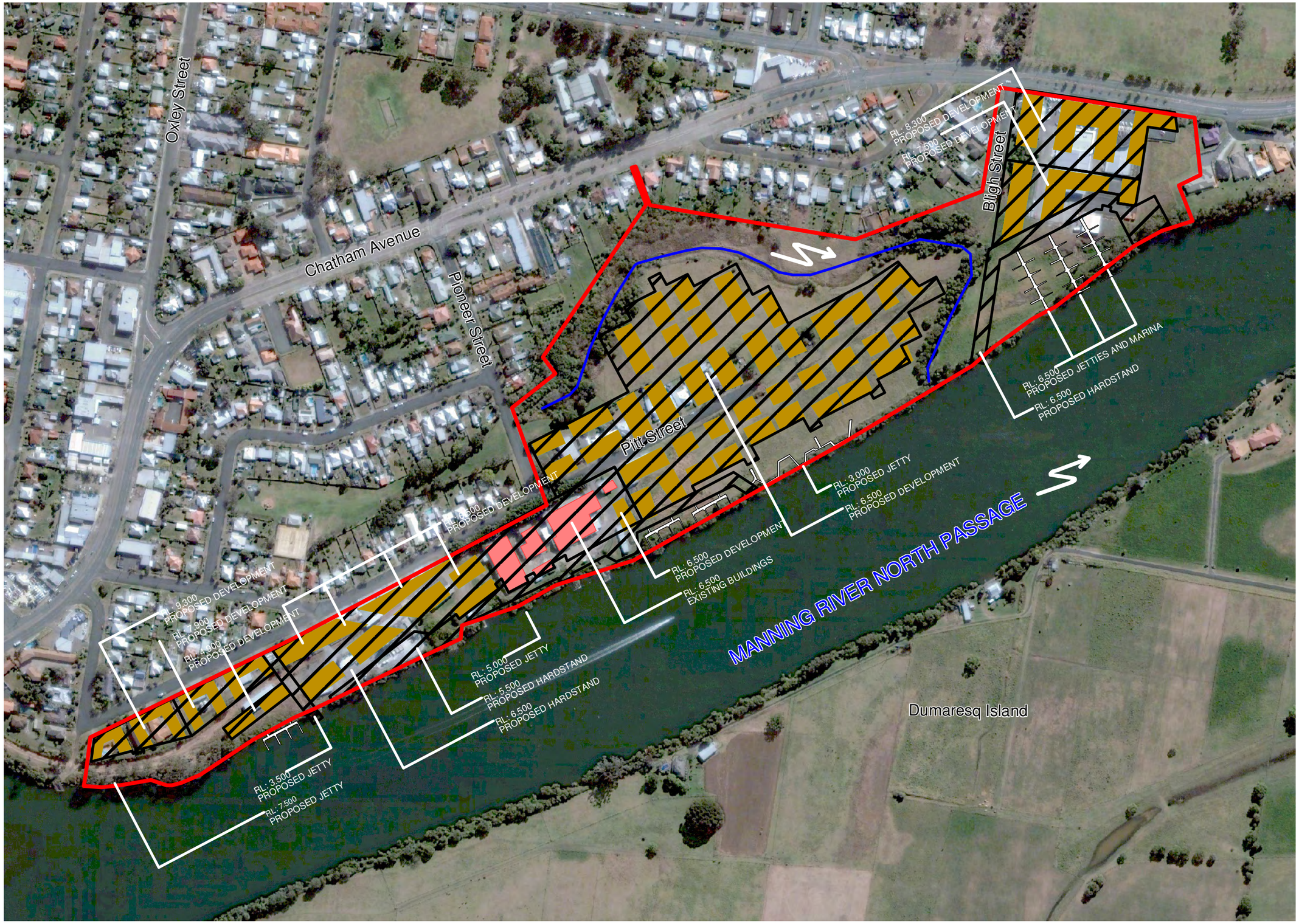
Construction of the platforms to 6.5 mAHD will involve sections of filling across the precinct. However, in many locations, the platforms will be constructed above proposed basement carpark areas which will have a finished floor level of 3.5 mAHD (*refer* **Appendix C**).

For flood modelling purposes, it has been assumed that the basement carpark level will be enclosed, and will therefore prevent floodwaters from freely entering the basement during major flooding. This is considered to be a conservative approach in the assessment of potential flood impacts.

However, it is understood that the final design may incorporate an “undercroft” style carpark that would have open walls and therefore provide flood storage beneath the development footprint. For the protection of vehicles, flood-free conditions at the carpark could be maintained during events up to the 20 or 50 year recurrence flood through the installation of walls up to the appropriate flood level. This is discussed further in the proposed Flood Evacuation Plan for the precinct (*see below*).

Additional site filling will be undertaken across the precinct at proposed hardstand areas and roads between buildings and adjacent to the foreshore of the Manning River. Significant earthworks will also be required to “remove” a section of the site at the proposed marina (*refer* **Appendix C** *and* **Figure 14**).

FIGURE 14



LEGEND

- Unnamed Creek
- Pitt Street Waterfront Precinct
- Development Platform (extent of filling)
- Proposed Building
- Existing Buildings (to be retained)

N

0 100 200

Meters

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Figure 14 - Development.wor

LAYOUT OF PROPOSED DEVELOPMENT

3.2 MODIFICATION OF TUFLOW MODEL TO REFLECT PROPOSED DEVELOPMENT

The proposed development was incorporated into the TUFLOW model network according to the designs contained in **Appendix C**. This involved modification of both the 2-Dimensional network grid and 1-Dimensional channel geometry across the precinct to develop a post-development model network.

The building platform elevations shown in **Appendix C** were incorporated into the grid elevations across the 2D network for the precinct and also into the 1D channel cross-sections for the unnamed creek. This approach to simulation of the post-development scenario is considered to provide a conservative estimate of potential flood impacts as it does not allow for any flow through basement level carpark areas.

It was assumed that the landscaped and open space areas external to the platforms shown in **Appendix C** are to be retained at the existing surface level. It was also assumed that the proposed extension of Pitt Street to meet with Bligh Street would involve the construction of suitable bridging and piers to allow floodwaters to pass relatively unimpeded along the unnamed creek.

It is considered that the 10 metre grid size of the 2D model network allows for sufficient detail of the development to be incorporated into the TUFLOW model. The results of simulations were interrogated to confirm that the post-development network conservatively represents the post-development surface.

Despite being above the peak level of the 100 year recurrence flood, there is potential for sections of the proposed development platform to be inundated during larger, extreme events such as the Probable Maximum Flood (*PMF*). Accordingly, the post-development model network was modified to incorporate the proposed building footprints as areas of “very high” roughness to allow for the effective modelling of buildings as “blocked” sections of the network and the passage of floodwaters between them.

However, it should be noted that a majority of the building platforms are not expected to be overtopped during simulations undertaken as part of this investigation.

The adopted TUFLOW roughness parameters across the precinct for post-development conditions are shown in **Figure 15**. Comparison of this figure with **Figure 6** shows that much of the areas of increased roughness along the unnamed creek and existing pasture land were not adjusted for the post-development network.

This is considered to offer a conservative approach to modelling of the post-development impacts. It is likely that final landscaping works along the creek and paved areas between buildings will actually involve a reduction in roughness across many areas.