

# Hydraulic Impact Assessment



**41-53 Courtney Drive, Upper Coomera**  
**Norfolk Estates Pty Ltd**

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# 1 Introduction

This Hydraulic Impact Assessment has been prepared on behalf of Norfolk Estates Pty Ltd and presents a hydraulic assessment of flooding at 41-53 Courtney Drive, Upper Coomera (Subject Site).

This report has been prepared to accompany a development application for a residential subdivision in order to:

- analyse any change to flood characteristics external to the site as a result of the proposed works; and
- ensure that the development does not result in an increase in peak flood levels or velocities external to the site that would cause adverse offsite impacts.

## 1.1 Site Location

The location of the site is in Upper Coomera and consists of five (5) parcels of land with frontage to Courtney Drive, Reserve Road, and Baileys Mountain Road. Yaun Creek traverses the site from west to east discharging toward the roundabout at the intersection of Reserve Road and Baileys Mountain Road. The location is displayed on Figure 1.1.

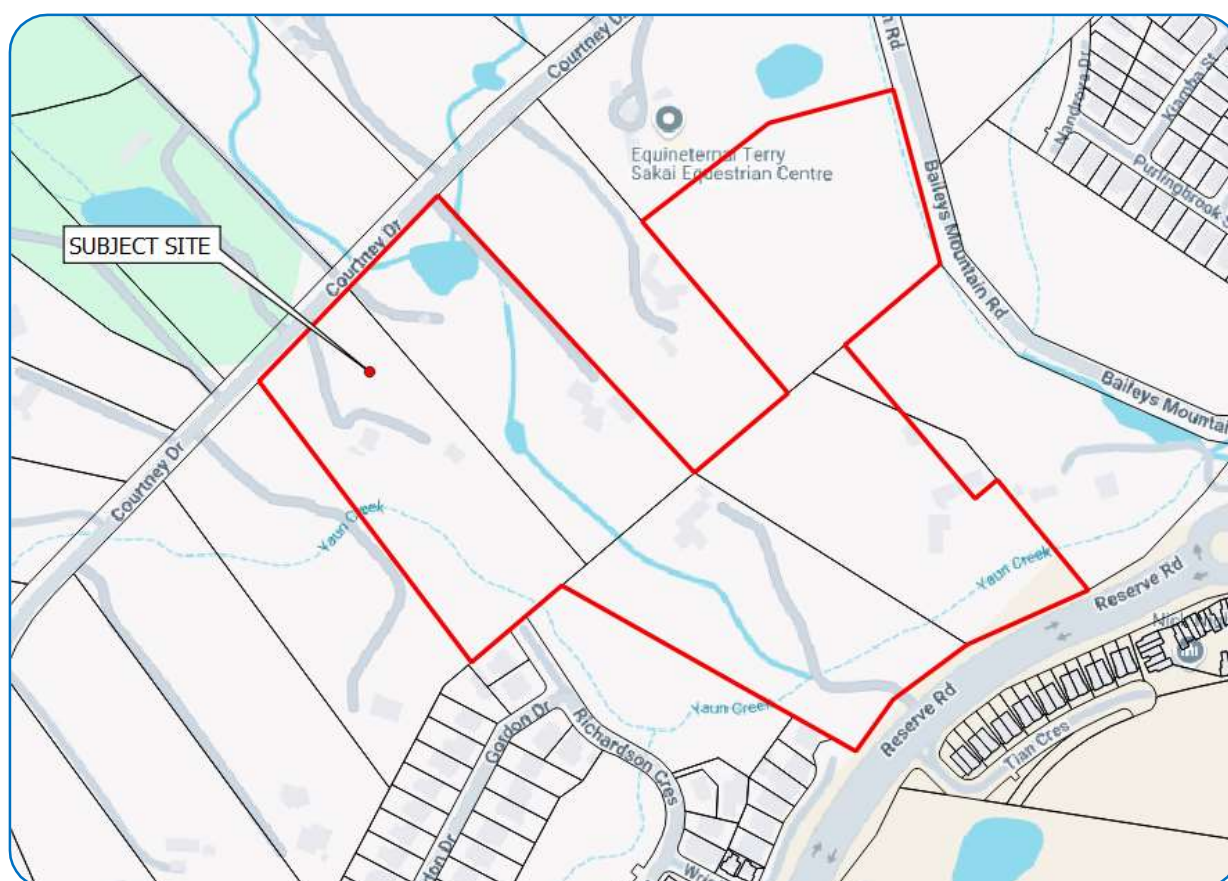


**Figure 1.1 Site Location**



## 2 Hydrological Assessment

WBNM hydrological software has been utilised to generate hydrographs to represent the contributing catchments to Yaun Creek. WBNM is a software package which calculates flood runoff from rainfall hyetographs, utilising sub-catchments and flow routings to estimate flood flows at various points within the catchment.

### 2.1 Catchment Characteristics

The catchment upstream of the site is some 250 ha in size and extends towards the south-west. The catchment is predominantly dense bushland in the upper reaches with low density residential land in the lower reaches. The site itself is currently rural residential. There are several small towns along the river, however the overall imperviousness is very low. Thirty-five (35) sub-catchments have been digitised based on terrain and landuse, which are summarised below in Table 2.1. Figure 2.1 shows the extent of each sub-catchment.



Figure 2.1 Sub-Catchments



**Table 2.1 Catchment Parameters**

| Sub-Catchment Name | Area (ha) | Impervious (%) |
|--------------------|-----------|----------------|
| A                  | 5.53      | 23.9           |
| B                  | 10.75     | 17.3           |
| C                  | 8.51      | 30.6           |
| D                  | 13.00     | 21.6           |
| E                  | 7.28      | 11.1           |
| F                  | 10.37     | 5.7            |
| G                  | 9.38      | 65.0           |
| H                  | 6.26      | 15.5           |
| I                  | 13.68     | 5.3            |
| J                  | 8.00      | 15.1           |
| K                  | 9.27      | 60.0           |
| L                  | 6.46      | 6.6            |
| M                  | 6.88      | 3.9            |
| N                  | 6.61      | 3.3            |
| O                  | 11.99     | 0.0            |
| P                  | 9.57      | 0.0            |
| Q                  | 14.05     | 0.0            |
| R                  | 9.28      | 3.1            |
| S                  | 7.14      | 3.7            |
| T                  | 9.46      | 3.0            |
| U                  | 12.93     | 1.3            |
| V                  | 6.74      | 18.4           |
| W                  | 7.59      | 16.0           |
| X                  | 12.56     | 3.6            |
| Y                  | 5.75      | 5.0            |
| Z                  | 6.19      | 7.1            |
| AA                 | 10.61     | 27.5           |
| AB                 | 15.19     | 9.5            |
| AC                 | 8.59      | 4.5            |
| AD                 | 9.36      | 12.2           |
| AE                 | 6.77      | 51.8           |
| AF                 | 14.63     | 49.0           |
| AG                 | 17.90     | 29.7           |
| AH                 | 19.80     | 36.7           |
| AI                 | 16.34     | 5.0            |

## 2.2 Design Rainfall

Rainfall intensity has been determined from Bureau of Meteorology data and applied using AR&R 2019 temporal patterns. Rainfall intensities have been increased by 20% as an allowance for climate change.

## 2.3 Temporal Patterns

Temporal patterns applied to the rainfall data have been extracted from the Australian Rainfall and Runoff Data Hub for the North East Coast region. Storm durations between 10 minutes and 24 hours have been analysed for each AEP. An ensemble of 10 temporal patterns for each duration has been analysed.

## 2.4 Design Storm Events

This report has analysed a range of storm events which simulate the rainfall from hypothetical storms based on an Average Exceedance Probability (AEP). Table 2.2 lists each modelled AEP storm event and the corresponding Average Occurrence Interval (ARI) and description.



**Table 2.2 Design Storm Events**

| Annual Exceedance Probability (AEP) | Average Occurrence Interval (ARI) | Storm Description                                                             |
|-------------------------------------|-----------------------------------|-------------------------------------------------------------------------------|
| 0.5EY                               | 2 years                           | Storm rainfall total has a probability of 0.5 exceedances in any one year     |
| 0.2EY                               | 5 years                           | Storm rainfall total has a probability of 0.2 exceedances in any one year     |
| 10%                                 | 10 years                          | Storm rainfall total has a 9.5% probability of being exceeded in any one year |
| 5%                                  | 20 years                          | Storm rainfall total has a 4.9% probability of being exceeded in any one year |
| 2%                                  | 50 years                          | Storm rainfall total has a 2% probability of being exceeded in any one year   |
| 1%                                  | 100 years                         | Storm rainfall total has a 1% probability of being exceeded in any one year   |

## 2.5 Land Uses

The land use within the catchment has been determined in accordance with the planning scheme and aerial photography. The majority of the catchment is comprised of pervious surfaces.

## 2.6 Infiltration Losses

Infiltration losses in accordance with AR&R data hub values have been utilised (25 mm initial loss and 2.3 mm/hr continuing loss). The median pre-burst rainfall has been subtracted from the initial losses to represent rainfall prior to a design event. Impervious areas have initial and continuing losses of 0 mm and 0 mm/hr respectively.

## 2.7 Peak Flow Duration Analysis

An analysis of flows through the catchment has been undertaken for each duration, for an ensemble of 10 temporal patterns. Statistical analysis of the peak flows at the site have been used to identify the design storm for each AEP. The selected temporal pattern is the pattern which produces a peak flow closest to the median of all patterns while being above the median value. The selected design storms summarised in Table 2.3.

**Table 2.3 Selected Design Storms**

| Annual Exceedance Probability (AEP) | Storm Duration | Temporal Pattern | Peak Flow (m <sup>3</sup> /s) |
|-------------------------------------|----------------|------------------|-------------------------------|
| 0.5EY                               | 180 minutes    | 9                | 25.74                         |
| 0.2EY                               | 90 minutes     | 2                | 37.25                         |
| 10%                                 | 45 minutes     | 6                | 45.32                         |
| 5%                                  | 45 minutes     | 6                | 57.52                         |
| 2%                                  | 45 minutes     | 5                | 70.07                         |
| 1%                                  | 45 minutes     | 5                | 79.72                         |

The peak flow duration analysis for the 1% AEP is provided below in Figure 2.3 as a sample.

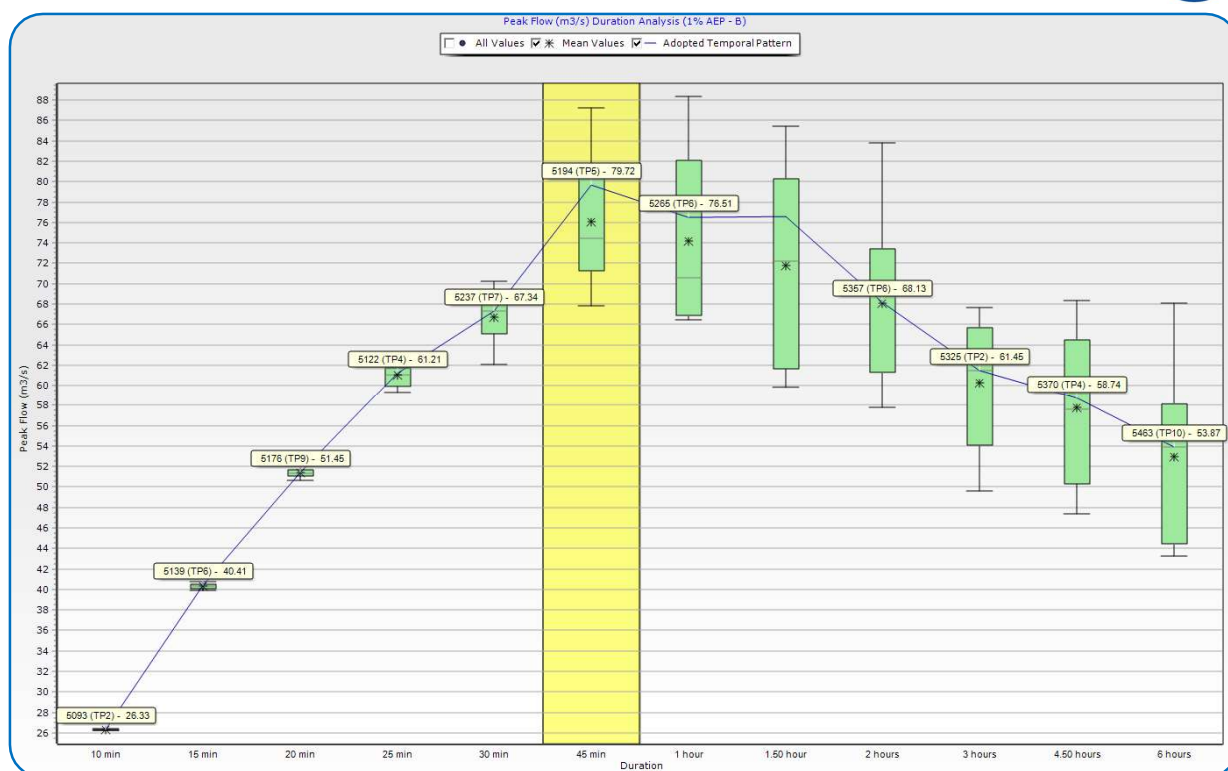


**Figure 2.2 1% AEP Peak Flow Duration Analysis**



### 3 Hydraulic Assessment - TUFLOW

The 1D - 2D hydrodynamic flood model *TUFLOW* has been utilised to route the WBNM inflows through the catchment in order to quantify flood characteristics at the site and analyse the proposed bridge.

#### 3.1 Digital Terrain Model

The following digital terrain model (DTM) form the basis of the hydraulic assessment:

- LiDAR data obtained from the DNRM;
- Design surface of the development upstream; and
- Site survey over the site.

To accurately represent this DTM within the *TUFLOW* model, a grid size of 2 m has been set with sub-grid sampling enabled.

#### 3.2 Model Extent

The extent of the *TUFLOW* model has been selected to accurately represent the flooding behaviour within the area of interest. The model extent is illustrated in Figure 3.1 and extends 400 m downstream of the bridge and approximately 1.8 km upstream.

#### 3.3 Downstream Boundary Condition

The downstream end of the model has been set well downstream of the site to eliminate boundary effects from the results.

#### 3.4 Manning's Coefficient

Based on recommendations from; *Chow. V. T, (1959) Open Channel Hydraulics, Main Roads Drainage Design Manual (1999)*, orthographic photographs, the following Manning Coefficients were applied:

- |                      |       |
|----------------------|-------|
| • Concrete/Road:     | 0.020 |
| • Open water:        | 0.030 |
| • Grassed areas:     | 0.050 |
| • Light Vegetation : | 0.060 |
| • Dense Vegetation:  | 0.080 |

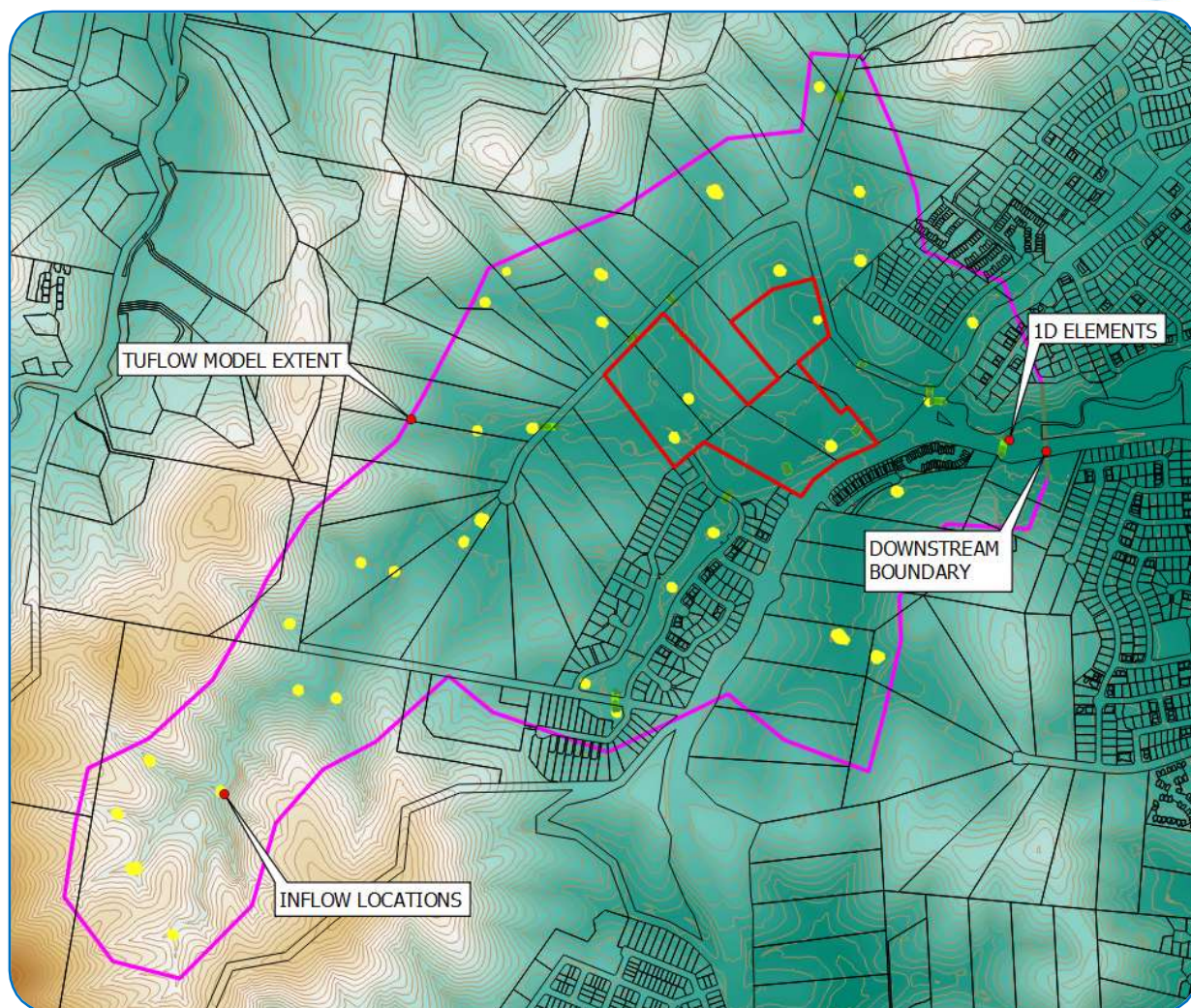


**Figure 3.1 TUFLOW Model Layout**



## 4 Modelling Results – Existing Scenario

The flooding behaviour within the catchment is characterised by largely channelised flow within well-defined watercourses. Yaun Creek enters the western side of the site and merges with two smaller flowpaths from the north and south-west. This flow splits around a high-spot in the site and flows into a low-lying flatter area parallel to Reserve Road. Several existing small bunds and pipes control flow through this area before discharging toward the Reserve Road roundabout.

Flood depths within the main channels are up to 3.5 m in the 1% AEP storm event.

The existing scenario depth plots for the 1% AEP, 10% AEP, and 0.5EY events are shown below on Figures 4.1 - 4.3.



Figure 4.1 1% AEP Existing Flood Depth



**Figure 4.2 10% AEP Existing Flood Depth**



**Figure 4.3 0.5EY Existing Flood Depth**



Peak velocity within the site is up to 2.5 m/s in the steeper sections of the watercourse as shown on Figure 4.4.



**Figure 4.4 1% AEP Existing Velocity**





**Figure 5.2 Proposed Civil Works**



## 6 Modelling Results – Post-Development Scenario

The post-development model scenario incorporates the proposed works as outlined on the OSKA civil drawings. The flooding behaviour is largely similar to the pre-development scenario, and the proposed works provide 1% AEP flood immunity to all lots including 300 mm freeboard. The diversion channel in the north-east of the site conveys flow around the eastern boundary to a new culvert under the main access road.

The post-development scenario depth plots for the 1% AEP, 10% AEP, and 0.5EY events are shown below on Figures 6.1 - 6.3.

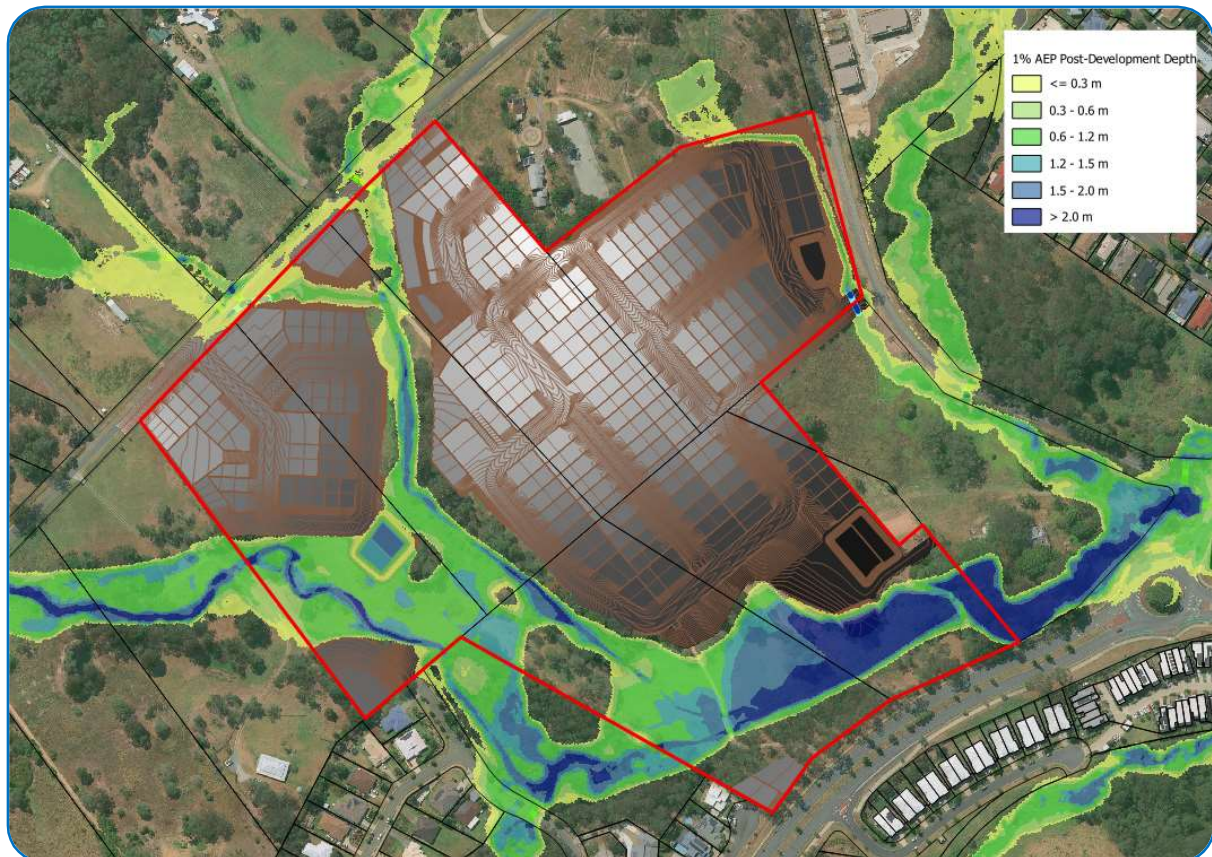


Figure 6.1 1% AEP Post-Development Flood Depth

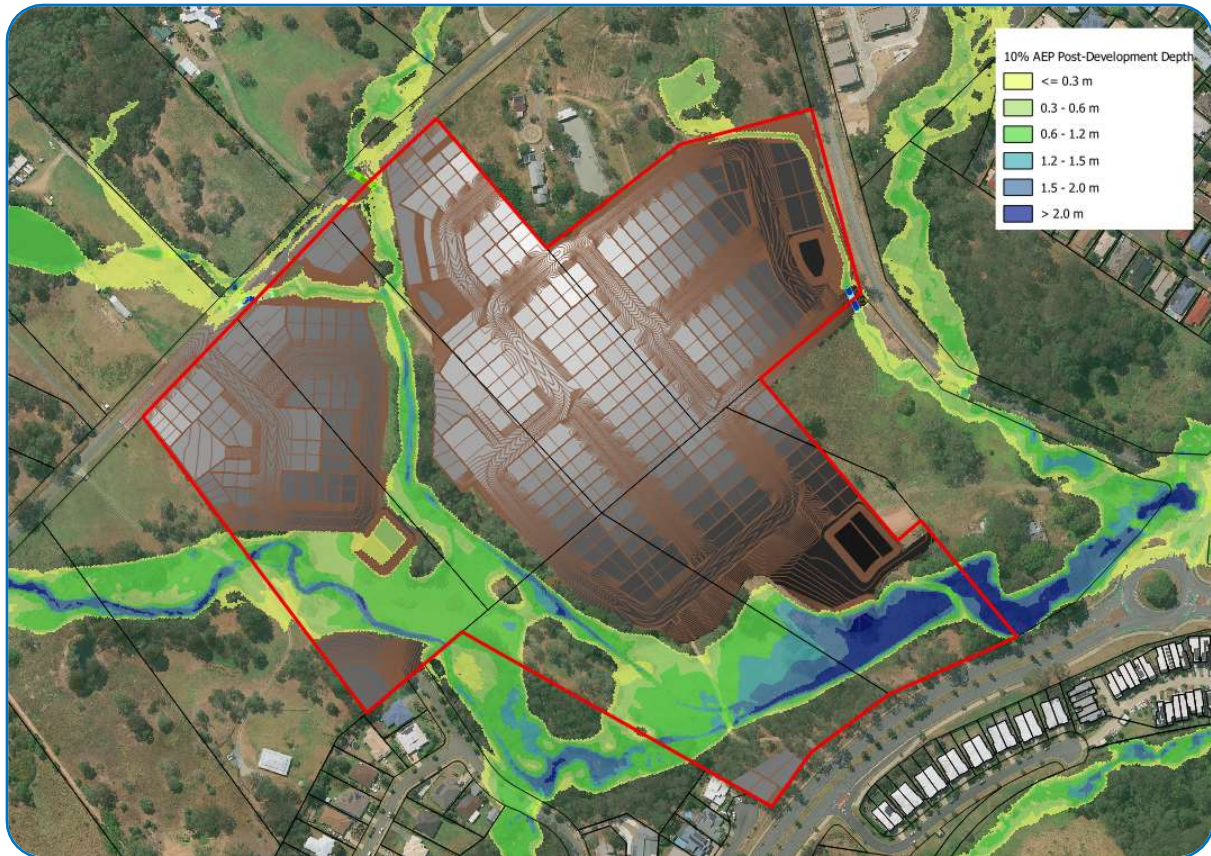


**Figure 6.2 10% AEP Post-Development Flood Depth**



**Figure 6.3 0.5EY Post-Development Flood Depth**



## 6.1 Design Velocity

The design scenario velocity for the 1% AEP is presented below in Figure 6.4. There are areas of high velocity ( $>2$  m/s) within the constructed channels which will require adequate scour protection during the detailed design phase.

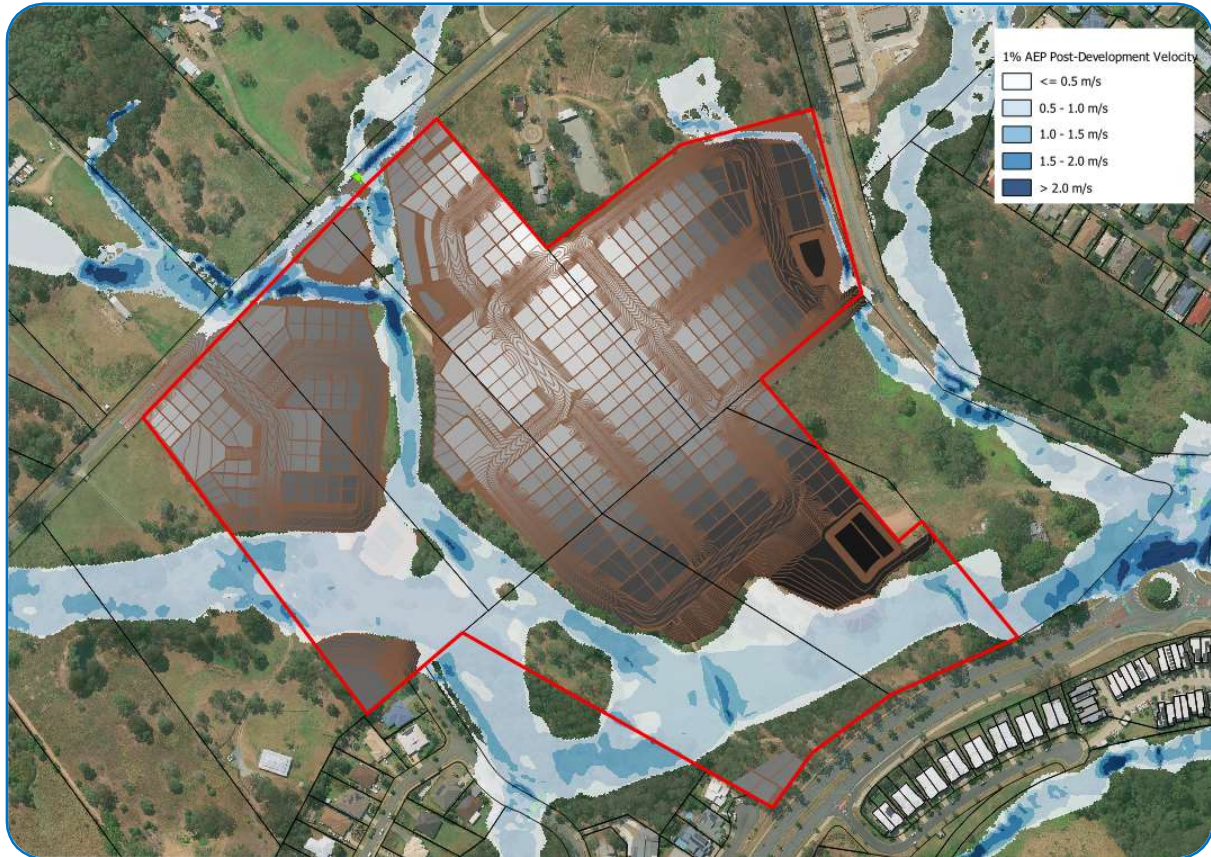


**Figure 6.4 1% AEP Design Velocity**



## 7 Impact Assessment

To quantify the impact of the proposed development on peak flood levels, a spatial analysis of the pre and post-development results has been prepared.

The results of the modelling indicate that the proposed works will not significantly impact on the peak water levels external to the subject site (Figures 7.1 – 7.3). This is largely due to the design of the earthworks which have limited within existing flood extents and as a result of the compensatory works undertaken in the lower reaches.

An isolated area of increased flood depth is noted over a small area of the neighbouring lot to the west. It is understood that the applicant has received permission from the landowner for this increase.

Figure 7.4 also indicates that there are no impacts to peak velocity in the 1% AEP.

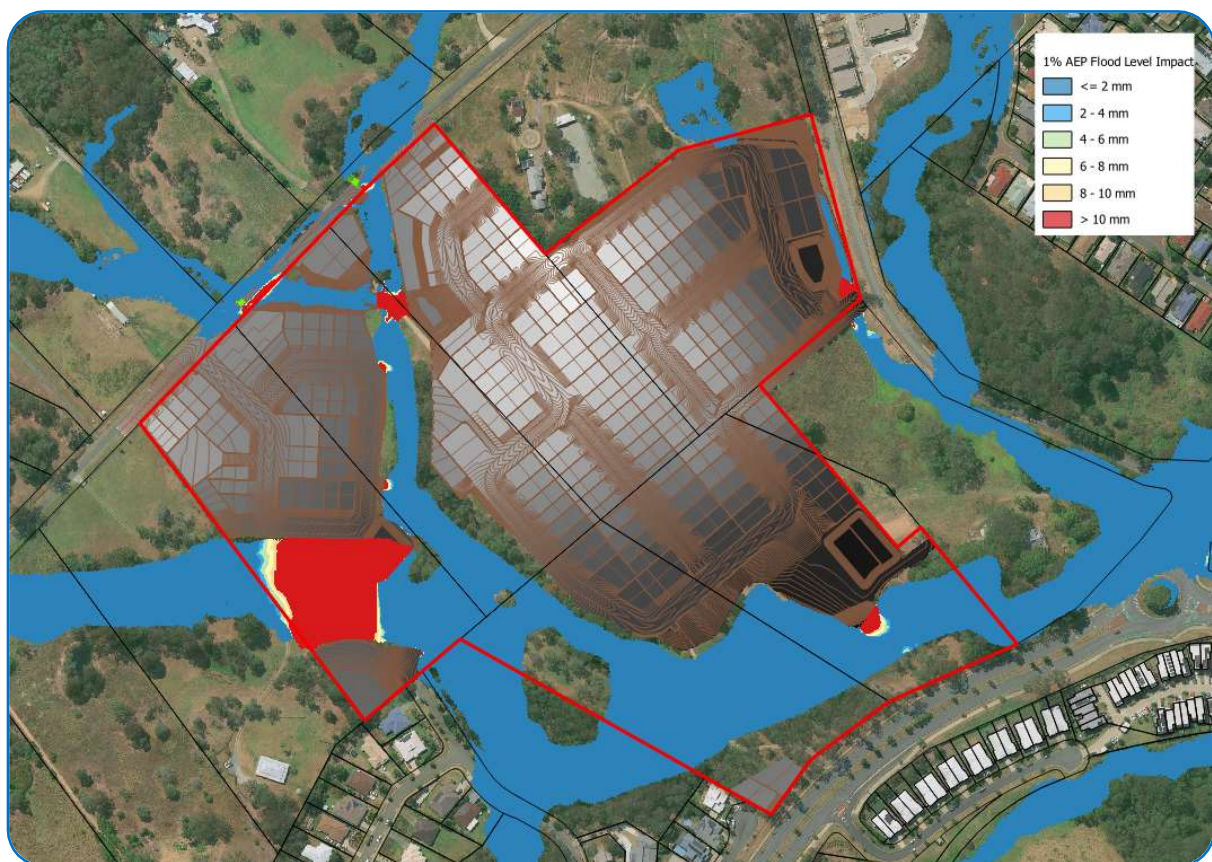


Figure 7.1 1% AEP Flood Level Impact

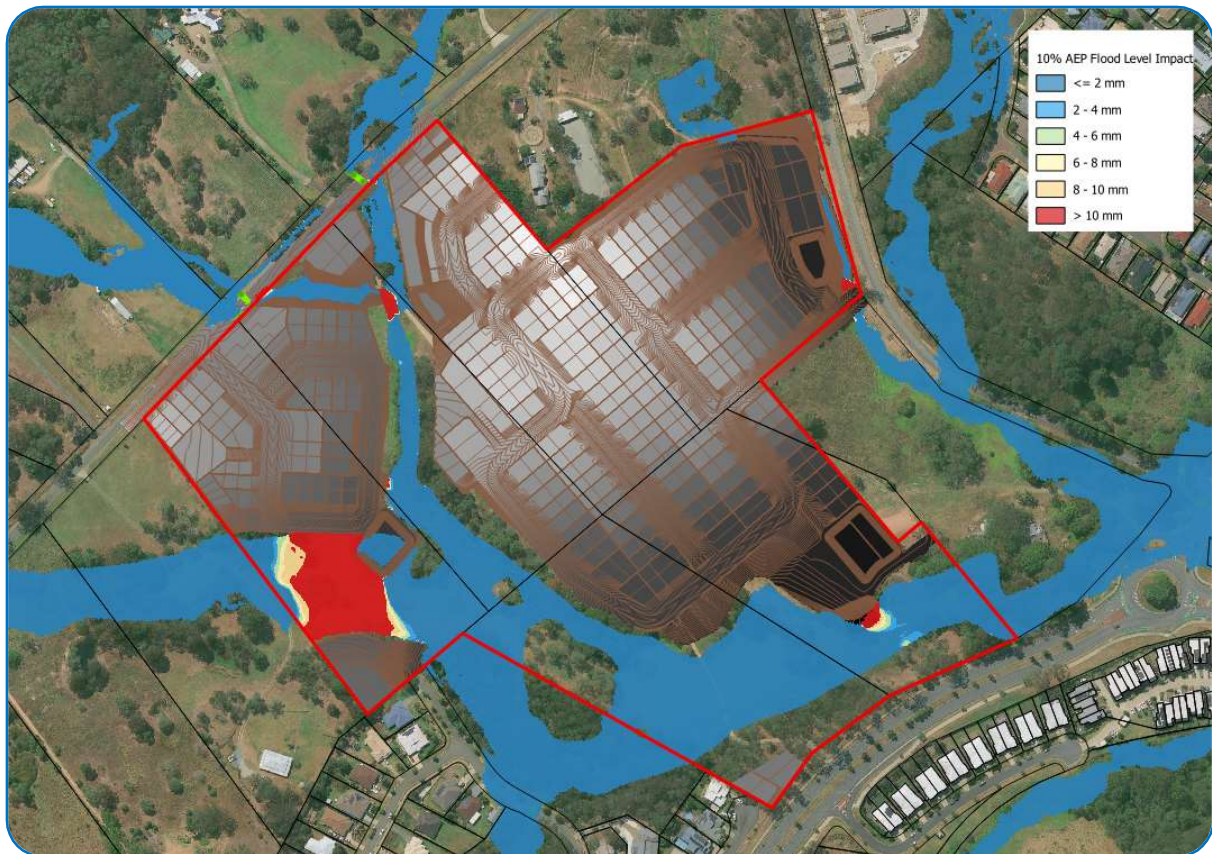


**Figure 7.2 10% AEP Flood Level Impact**

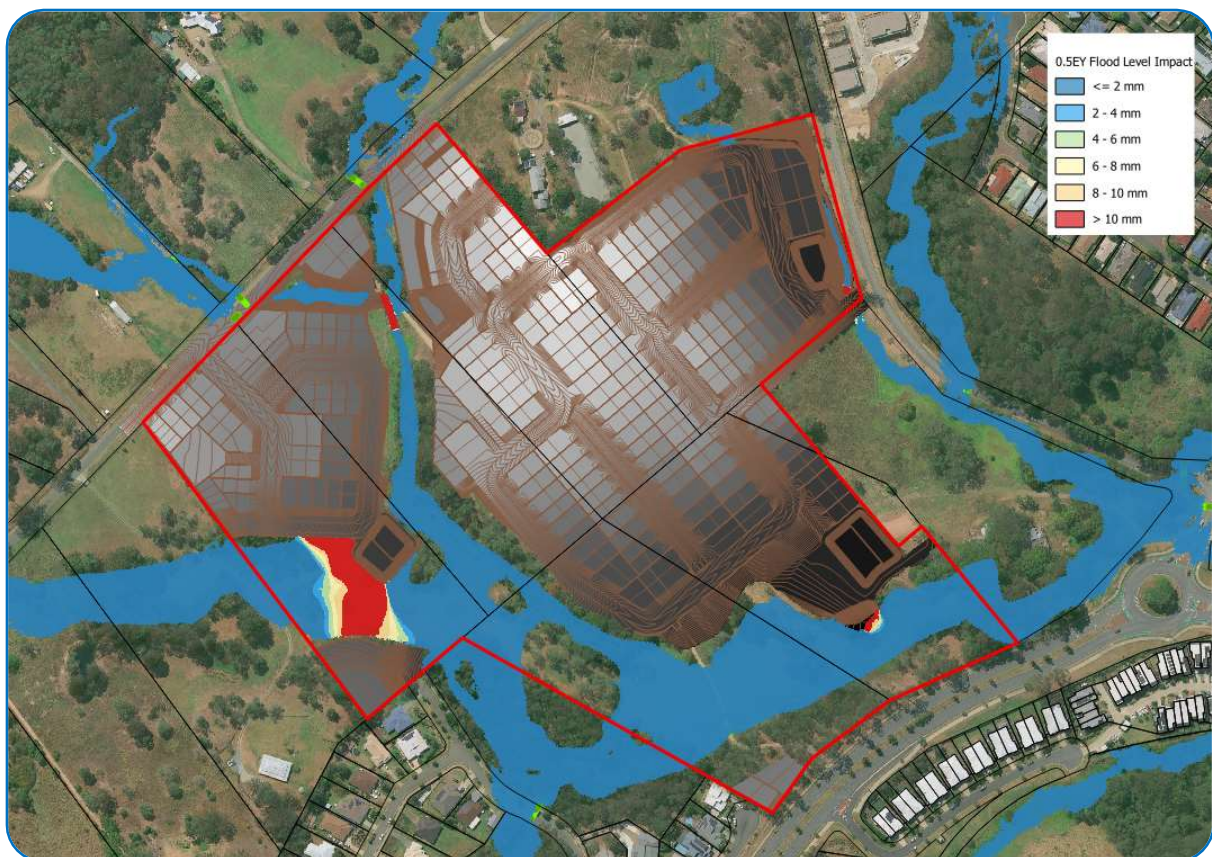


**Figure 7.3 0.5EY Flood Level Impact**



**Figure 7.4 1% AEP Velocity Impact**



## 8 Conclusions

The hydraulic behaviour of Yuan Creek and its tributaries has been analysed based on a TUFLOW flood model with WBNM hydrologic inflows for the upstream catchment. The civil works designed by OSKA have been incorporated into the post-development scenario.

The results of the modelling indicate:

- The watercourses through the site are generally confined to steep-side flowpaths with wide conveyance paths. The peak depth of flooding during the 1% AEP is up to 3.5 m;
- Flow enters the subject site at several locations and discharges toward the roundabout at Reserve Road;
- The proposed civil works include earthworks which provide 1% AEP immune allotments incorporating 300 mm freeboard.; and
- Spatial analysis of results indicates that impacts to peak flood levels are limited to the site itself and a small area upstream of the western boundary. It is understood that the applicant has an agreement in place with the landowner to accept these impacts.

It is noted that high velocities ( $>2$  m/s) are predicted within areas of the constructed channels. During the detailed design phase adequate scour protection will be required within this areas.