BMT WBM

PLANS AND DOCUMENTS referred to in the PDA DEVELOPMENT APPROVAL

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27 June 2016

Economic Development Queensland
Department of Infrastructure, Local Government and Planning
Level 7, 63 George St Brisbane QLD 4000

Attention: Tallis Ashley

Dear Tallis,

RE: THE VILLAGE, OONOONBA – ENTIRE SITE ADDITIONAL FLOOD ASSESSMENT

1.0 Introduction

This report presents the findings of additional flood investigations for "The Village' development located at Oonoonba, Townsville. The investigation represents all the stages of the development. Assessment has been carried out for both local and regional design flood events to assist in responding to information requests received from EDQ Development Assessment. The extent of development considered in this assessment is provided in the Bazier Motti Master Plan drawing provided as an attachment to this report. The Master Plan drawing shows the areas already constructed, those under application and future application areas.

2.0 Local Catchment Flooding

To assess local catchment flooding (i.e. no Ross River Flooding) a WBNM hydrologic model was developed for the site to provide localised catchment runoff input for the flood model. The WBNM model was based on the previous work by AECOM who conducted the original analysis of the site and is detailed in their September 2010 report 'Oonoonba Flood and Stormwater Management Study'. Figure 2-1 shows the adopted local catchment extents based on the original AECOM study. Catchment parameters were also adopted from the AECOM study and used for input into the WBNM model.

Table 2-1 compares the WBNM model output to that of the original AECOM report. The results show a similar match in terms of peak local catchment runoff.

To represent the proposed development, the WBNM hydrologic model catchments were adjusted to represent the proposed drainage flow paths as represented in Design Flow's report entitled 'Oonoonba Development – The Village Updated Stormwater Quality Management Plan' dated June 2016. Figure 2-2 shows the overall development catchment layout.

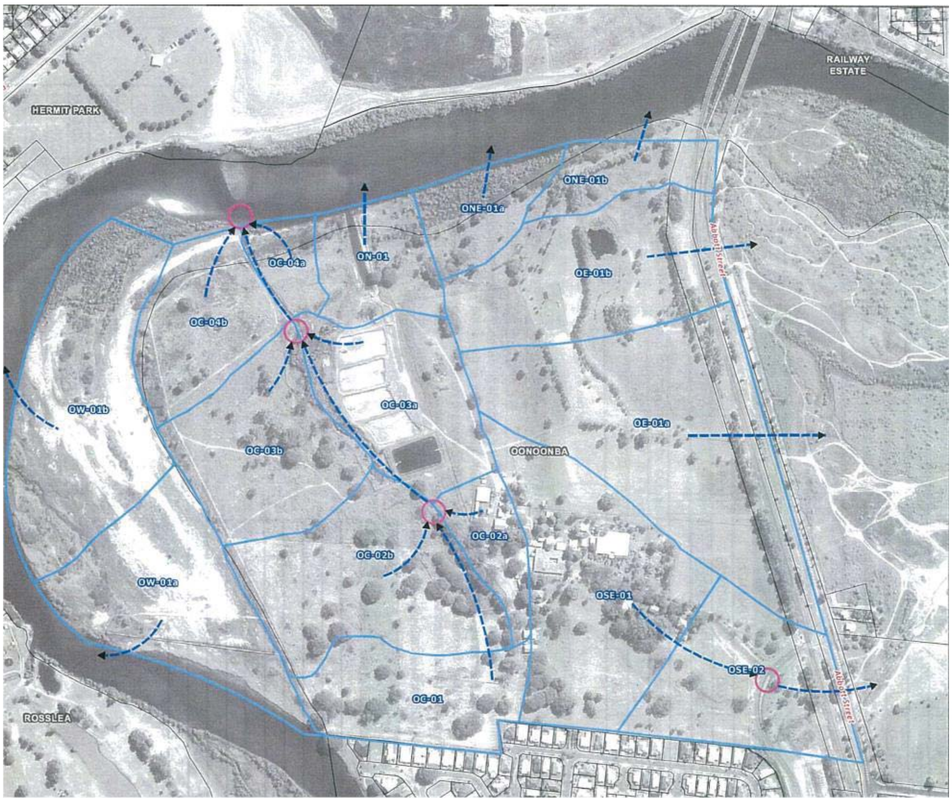


Figure 2-1 Existing Local Catchments

Table 2-1 Peak Flow Comparison

Catchment	AECOM RAFTS Q100 Local Flows (m^3/s)	WBNM Q100 Local Flows (m^3/s)
LOW-01B	3.1	3.1
LOW-01A	2.5	2.6
LOC-01	1.9	1.8
LOC-02A	1.0	1.0
LOC-02B	2.5	2.8
LOC-03A	2.4	2.4
LOC-03B	2.3	2.3
LOC-04A	0.7	0.6
LOC-04B	1.7	1.7
LONE-01A	1.1	1.1
LONE-01B	1.0	1.0
LOE-01A	3.2	3.9
LOE-01B	2.3	2.7
LOSE-01	2.9	3.9
LOSE-02	1.6	2.4
LON-01	1.2	1.3

Figure 2-2 Overall Development Catchment Layout

For the entire site application modelling, the WBNM model includes developed catchments for the areas shown in the Brazier Motti drawing. Table 2-2 presents the post catchment peak runoff for the site.

The subsequent local catchment flows were used to update both the existing and current application flood models.

Figures 2-3 and 2-4 show the peak water levels for the pre and post development cases for the ARI 100 year flood event.

Figure 2-5 shows the resultant impacts for the 100 year local flood event.

As shown in Figure 2-5, no adverse impacts are predicted on the adjacent transport corridor or on adjacent properties. Peak water levels for the local 100 year design event are also below the adjacent rail and road levels and therefore are not predicted to impact on the adjacent transport corridor.

Figure 2-6 indicates that peak velocities adjacent to the transport corridor are less than 0.5m/s. This magnitude of velocity is low and not predicted to result in scouring of the adjacent embankment.

Table 2-2 Developed Local Catchment Flows

Catchment	WBNM Q100 Local Flows (m^3/s)
D1	1.8
D2	0.9
G1	6.4
C4	1.4
C3	2.4
C5	1.9
C2	1.6
C6	1.7
Central Swale (S1)	1.4
C1	1.6
C7	1.3
C8	2.7
A1	2.5
Swale S2	1.2
G2	2.5

Figure 2-3 100 Year ARI Peak Existing Local Flood Levels

Figure 2-4 100 Year ARI Peak Developed Local Flood Levels

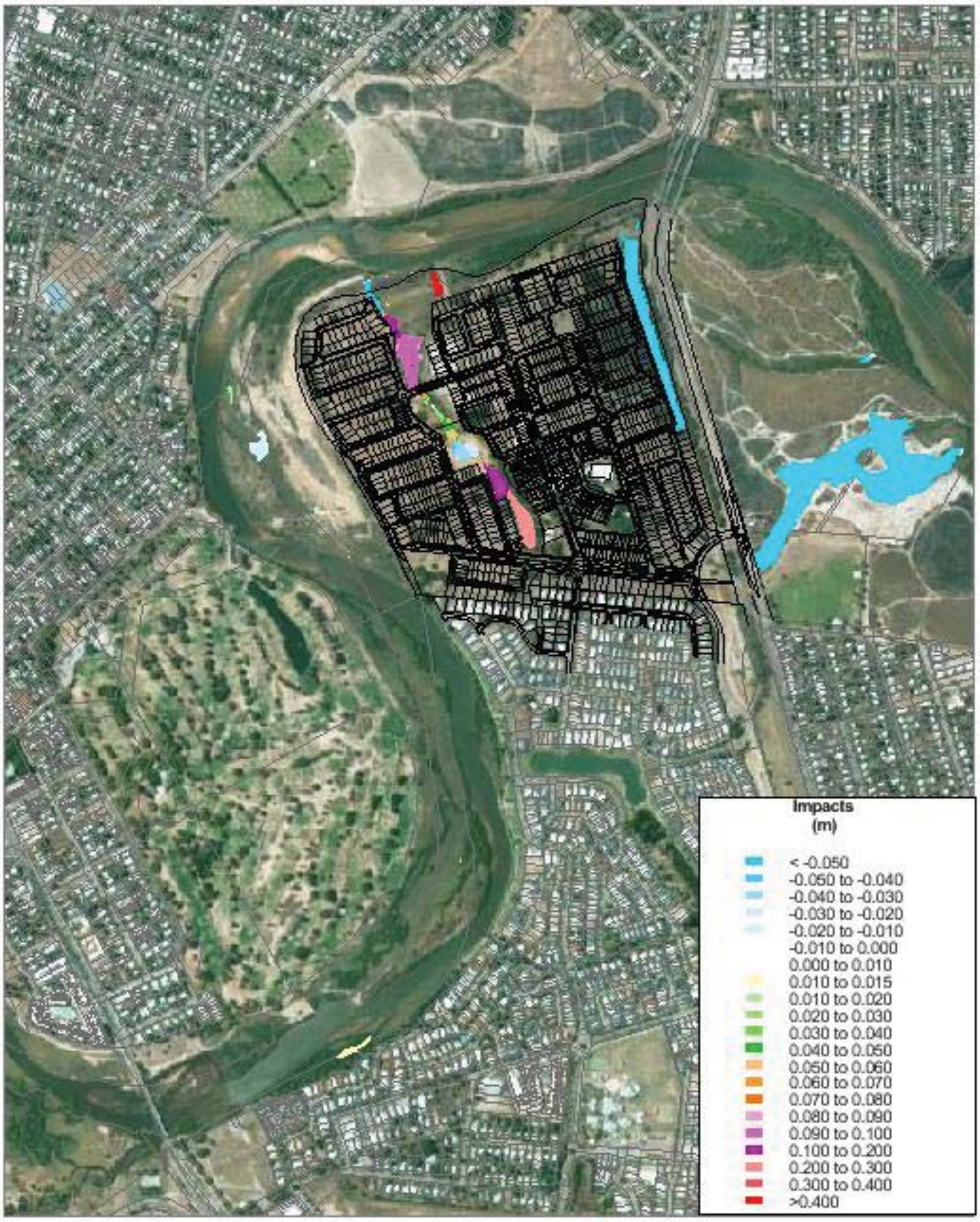


Figure 2-5 100 Year ARI Peak Developed Local Flood Impacts

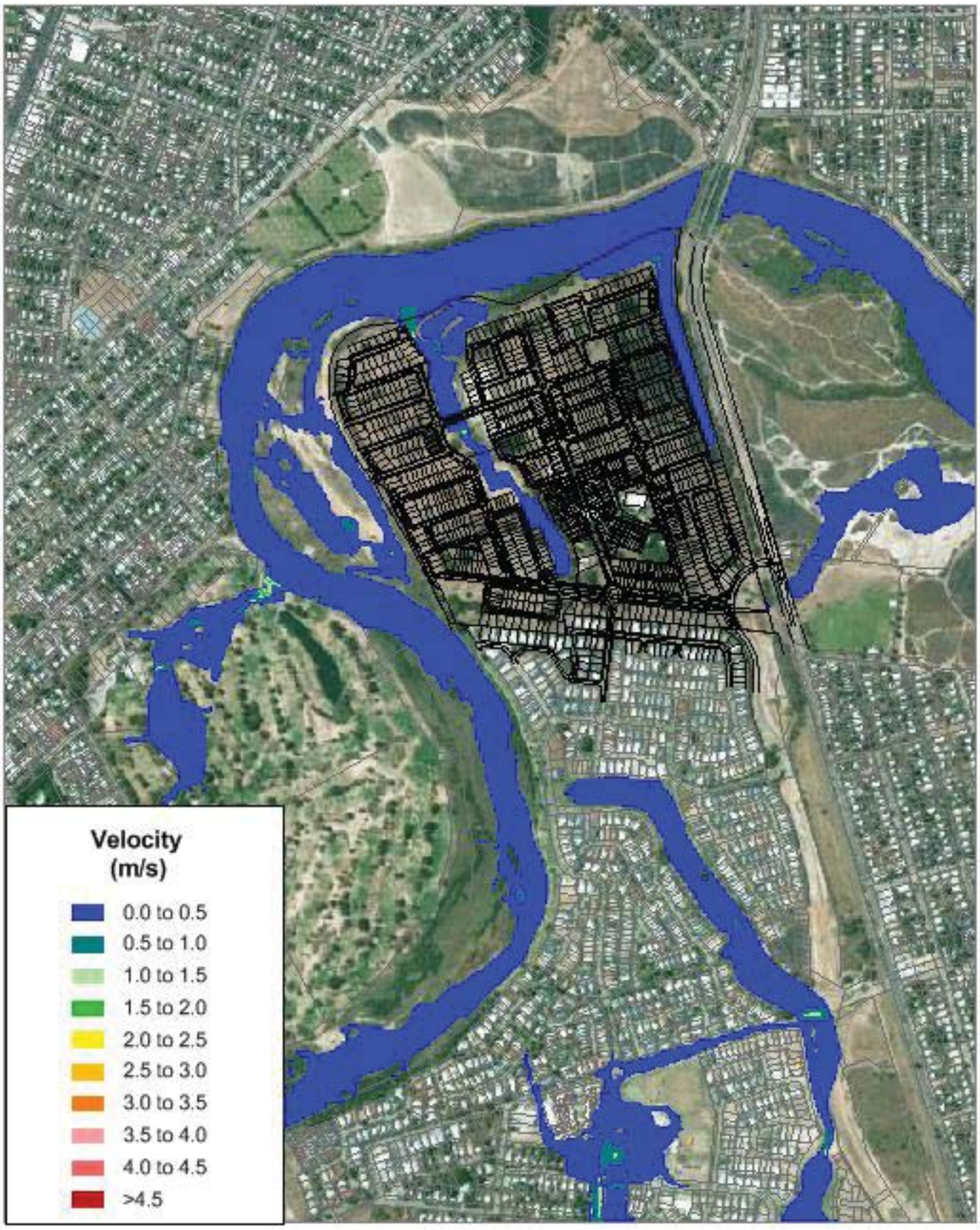


Figure 2-6 ARI 100 Year ARI Peak Developed Local Flood Velocities

3.0 Regional Flooding

To assess the full development scenario against regional Ross River flooding, BMT WBM utilised the same MIKEFLOOD model used for the above local catchment flooding and incorporated the Ross River boundary conditions to represent the regional flood flows and levels.

The model was run for both the pre and post development scenarios for the ARI 100 and 50 year design flood events.

Peak water levels for the ARI 100 year existing case are presented in Figure 3-1 and the design case in Figure 3-2.

Figure 3-3 presents the peak water level impacts for the proposed development.

The impact results from Figure 3-3 show that there is a portion of the transport corridor that experiences some increase in water level during the 100 year flood. This area of impact covers approximately 350m out of a total inundated length of 870m along the transport corridor and south of the river during this event. Maximum impacts on the rail corridor are less than 200mm (for approximately 220m) tapering off significantly to less than 20mm. The adjacent road has a very isolated impact (approximately 30m) of less than 100mm but generally less than 20mm. Reductions in peak water levels are observed on both the rail and road in the southern portion of the site to the site entrance.

It should be noted that reductions in peak flood levels of at least 50mm are experienced on flood affected residential properties external to the site. In particular the areas to the north east and west of the site experience these reductions.

In relation to the impacts on the transport corridor, the predicted impacts occur on an already inundated portion of the corridor. The lowest section of the rail line is located on the Ross River bridge at RL 3.235m AHD. Rail levels at the area of impact range from RL3.4 to 3.6m AHD. As such, the limiting area in terms of flooding over the rail line is the Ross River rail bridge. Therefore with regards to the timing of inundation, the bridge will be the first location to be inundated during a regional Q100 flood event with approximately 560mm peak depth. Following inundation of the bridge, the rail line at the southern extent of the site will next inundate with approximately 200mm peak depth after which the remainder of the rail line adjacent to the site inundates to an approximate peak depth of up to 400mm.

Figure 3-4 shows a long section of the peak Q100 depths along the rail line and road commencing at the southern extent of the Ross River bridges. With regards to the rail, the long section results show that the highest area of impact is within the 60 to 100m section however, these depths are still comparable those experienced further along the line (270m and 450m areas.) where depths of close to 400mm are already experienced, prior to the proposed development.

It is our understanding that trains are suspended once track inundation occurs due to potential washouts. As a result, trains are most likely to be suspended due to bridge inundation prior to inundation of the section of rail adjacent to the development. Due to these circumstances, the relatively short portion of increased inundation within rail corridor, adjacent to the proposed development, is not considered to have an adverse effect on functionality of the transport corridor.

The long section representing Abbot Road in Figure 3-5 demonstrates that impacts on the road are minimal and that depths are less than 200mm along the length of the road. The Depth x Velocity (DxV) product is calculated to be less than 0.3. Therefore these depths are considered trafficable

Analysis of velocities was also conducted with peak ARI 100 year velocities presented in Figures 3-5 and 3-6 for the base and proposed development scenarios.

These results indicate that whilst there is a slight increase in velocity which corresponds with the area of impact described above, velocities generally remain below 1m/s across this area. At these velocities, scour is not predicted. Similarly the DxV product shows a minor increase but remains less than 0.4 along the rail corridor. Appropriate scour protection can be provided within the proposed drainage channel and adjacent to the transport corridor to provide additional protection if required.

Assessment of the ARI 50 Year regional flood event shows that this event results in no inundation of the site or transport corridor. Figures 3-7 and 3-8 show the regional ARI 50 year peak water levels for both pre and post development scenarios respectively.

An assessment to determine the actual flood event at which the rail bridge becomes inundated shows that this occurs approximately in an ARI 90 year flood event.

Figure 3-1 ARI 100 Year Peak Existing Regional Flood Levels

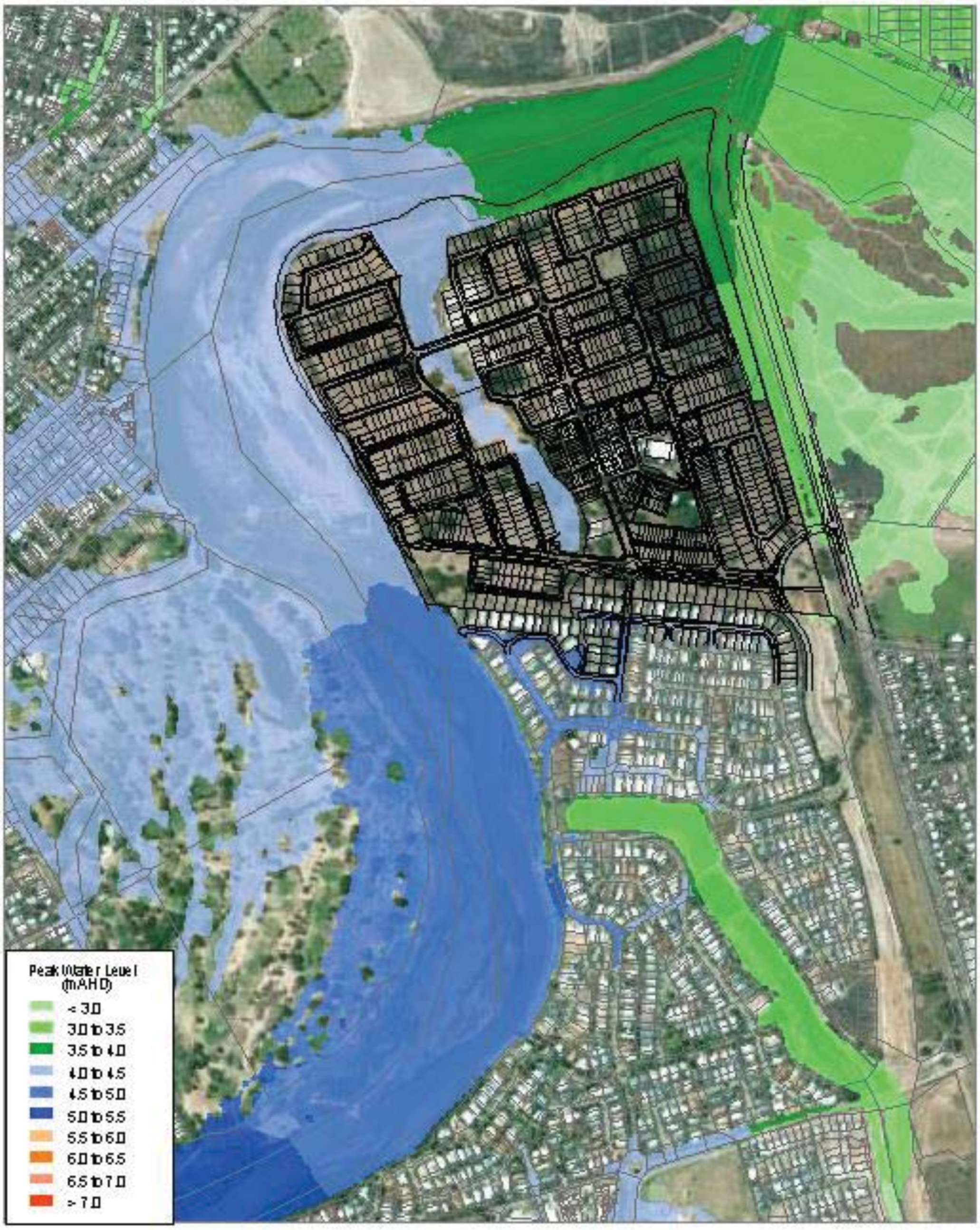


Figure 3-2 ARI 100 Year Peak Developed Regional Flood Levels

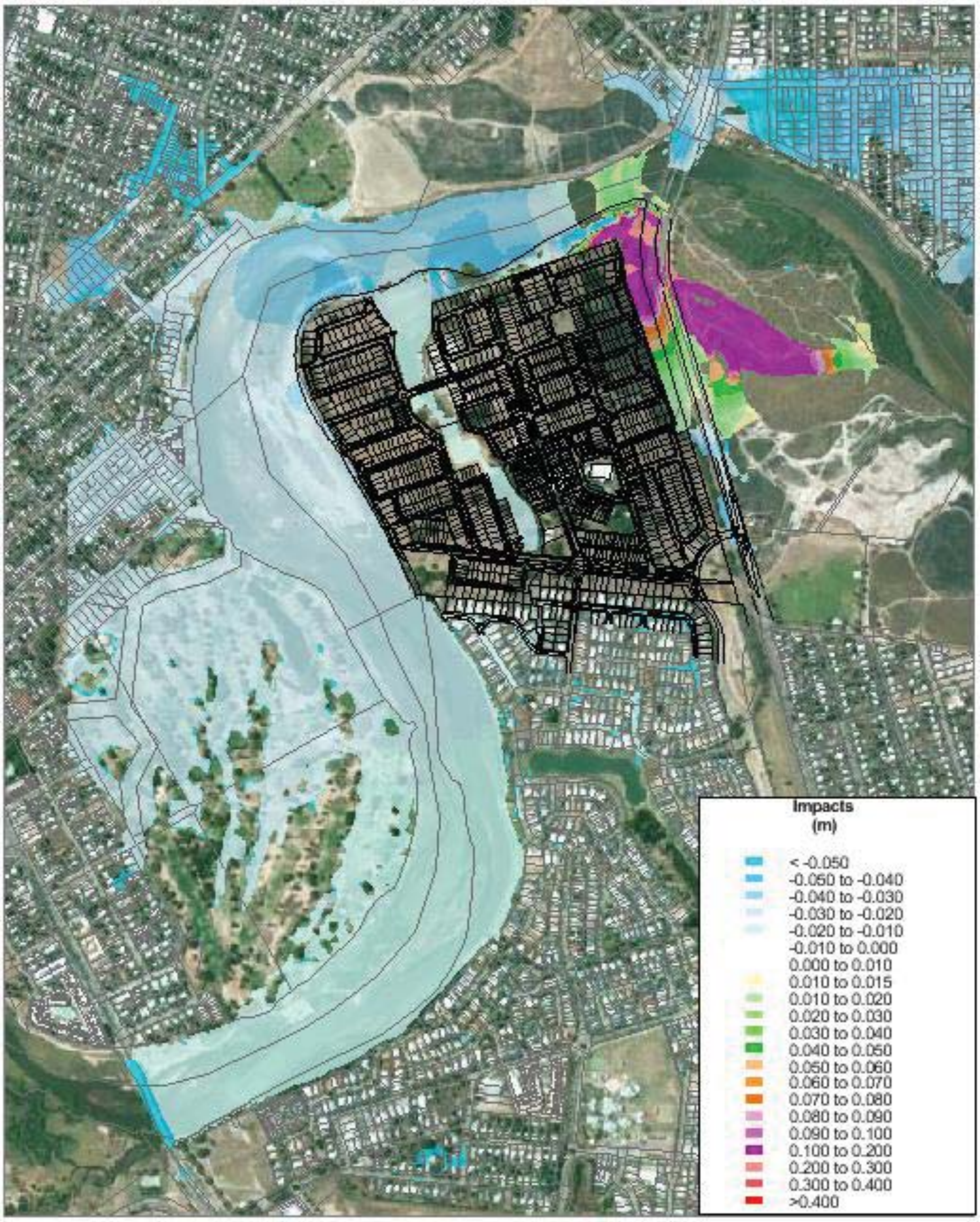
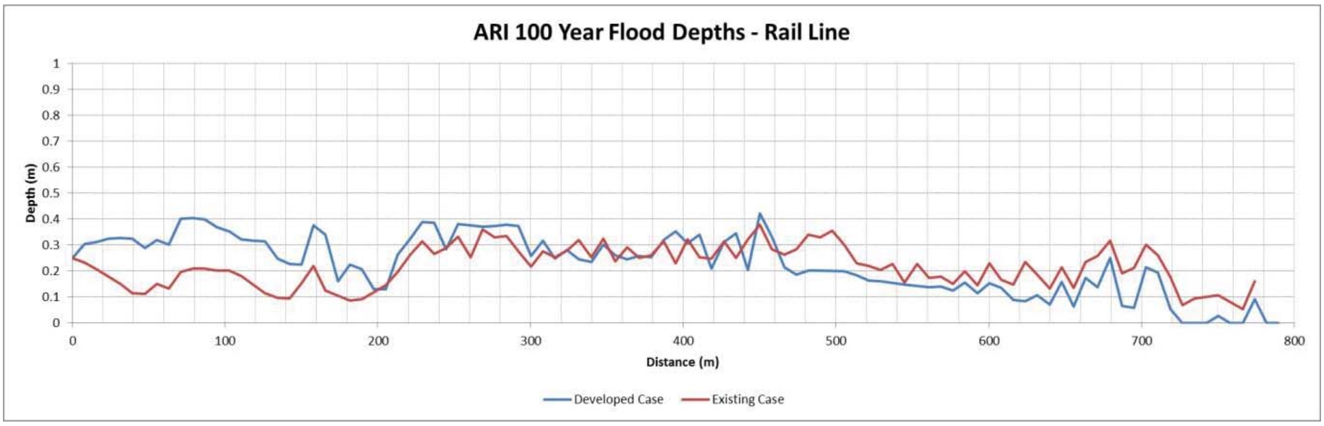


Figure 3-3 100 Year ARI Peak Developed Regional Flood Impacts



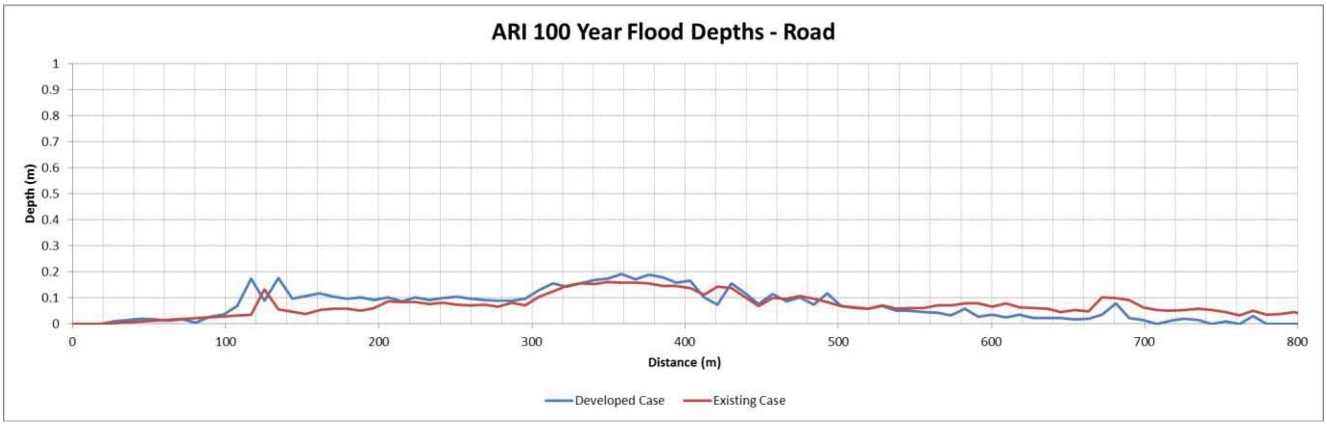


Figure 3-4 100 Year ARI Peak Depth Long Sections

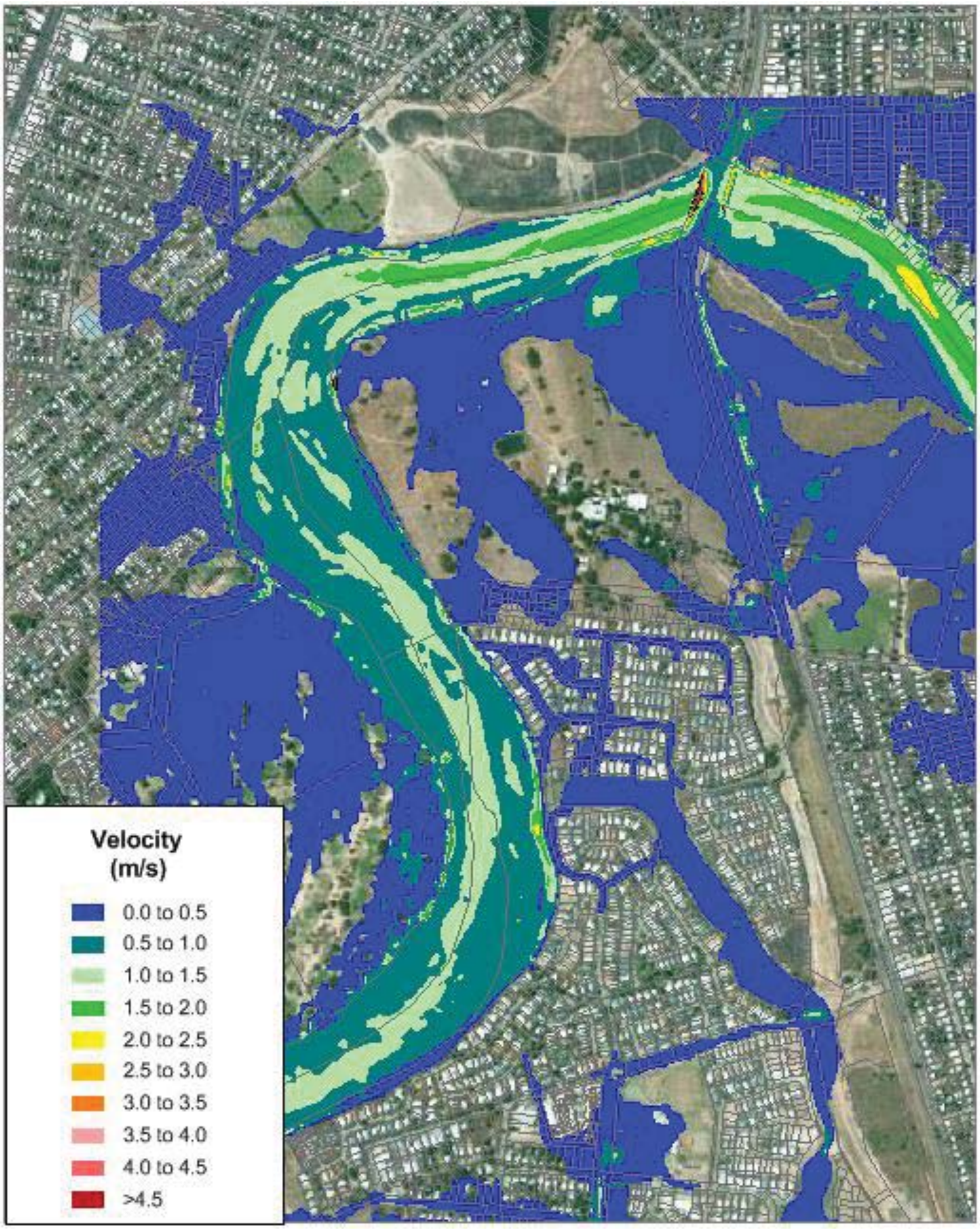


Figure 3-5 ARI 100 Year ARI Peak Existing Regional Flood Velocities

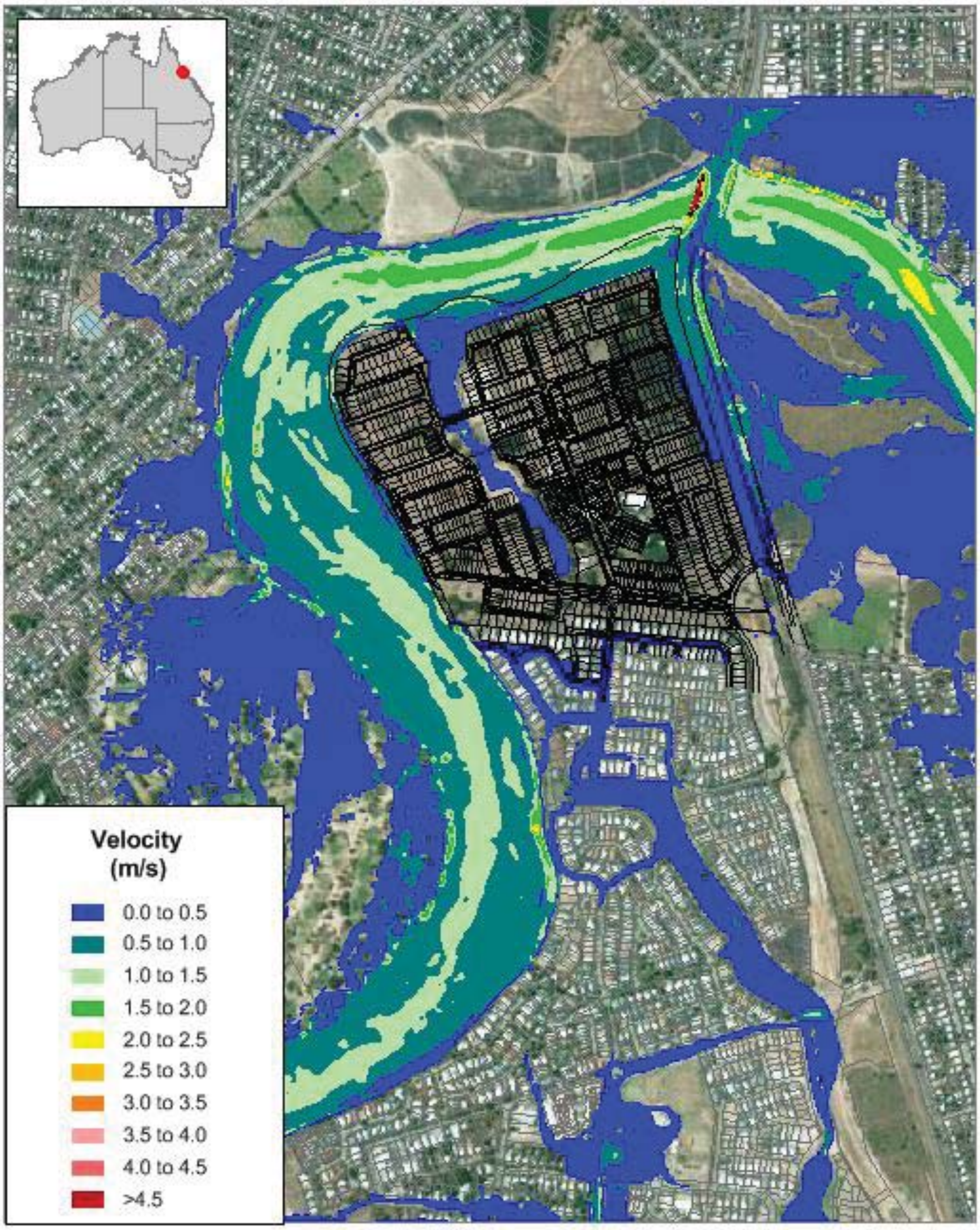


Figure 3-6 ARI 100 Year ARI Peak Existing Regional Flood Velocities

Figure 3-7 ARI 50 Year Peak Existing Regional Flood Levels

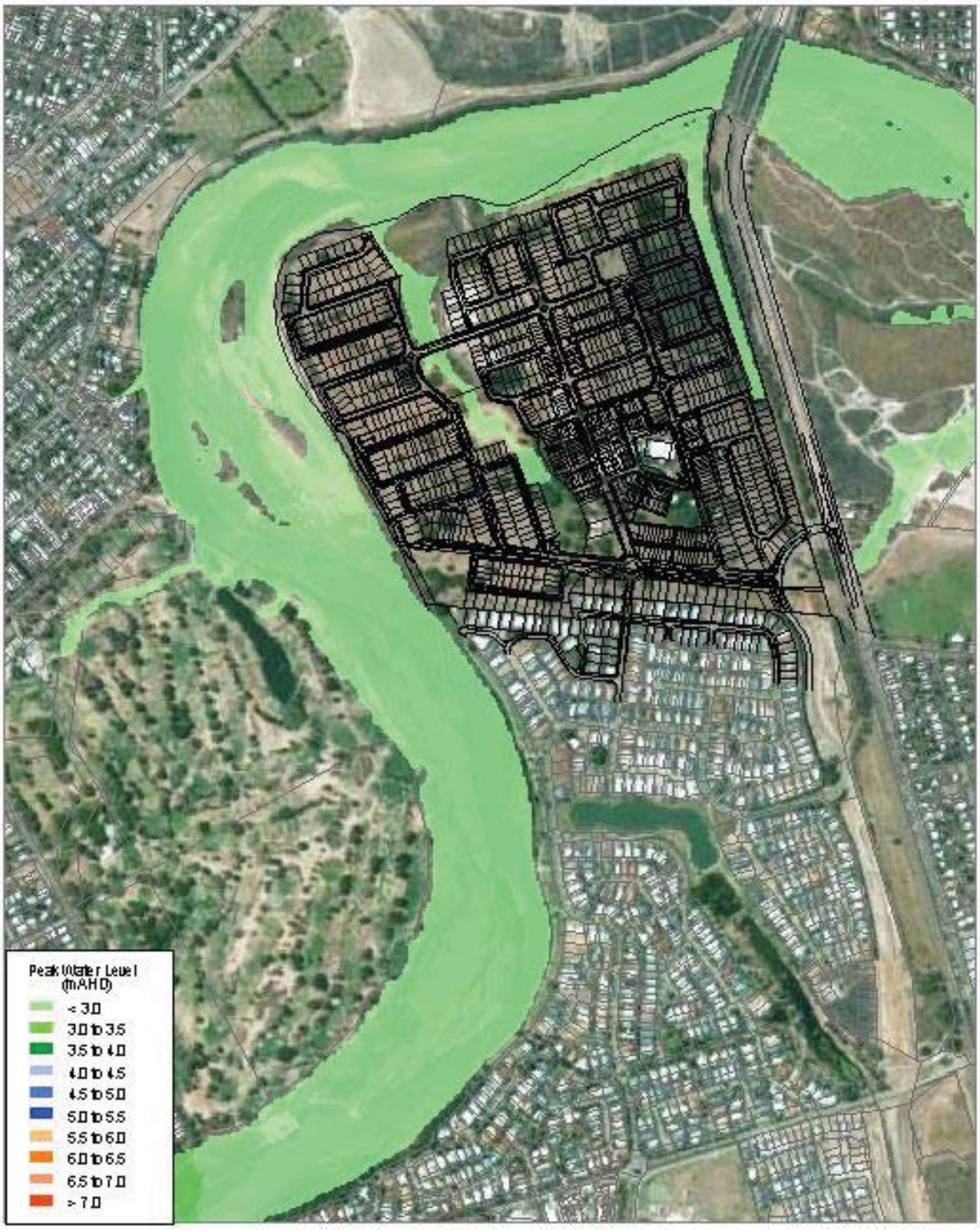


Figure 3-8 ARI 50 Year Peak Developed Regional Flood Levels

4.0 Conclusions

The analysis presented above describes an assessment into flooding and flood impacts associated the full application for the Village Development located at Oonoonba, Townville.

Assessment includes investigations into the effects of both local catchment flows and regional, Ross River flood events.

With respect to local catchment flood events, it can be concluded that:

- The proposed development results in no adverse peak water level impacts on adjacent properties, including the transport corridor to the west, for flood events up to and including the 100 Year ARI design event.
- Velocities are low at less than 0.5m/s.

For regional, Ross River flood events:

- The site (and adjacent transport corridor) is only subject to flooding during the ARI 100 year design flood event;
- The actual event at which the rail bridge begins to be inundated is approximately an ARI 90 year flood event;
- A relatively small portion of rail corridor, 350m out of 870m of inundation experiences peak water level increases of less than 200mm during the 100 Year flood event;
- The localised area of increase is not predicted to impact on the functioning of the rail line as inundation of this section of track occurs after both the Ross River bridge and the portion of rail to the south of the site. Peak Q100 depths at the bridge are predicted to be up to 560mm, 200mm at the southern portion of rail and up to 400mm over the rail adjacent to the site. Predicted peak depths at the area of impact are predicted to be up to 400mm. Rail traffic will already be suspended due the bridge inundation. No water level increases are predicted at the bridge;
- No significant increase in peak velocity and DxV product are predicted. Peak velocities generally remain below 1m/s and DxV products are less than 0.4.

Yours Faithfully
BMT WBM

Ian Clark
Principal Scientist

Encl. Brazier Motti Master Plan drawing

THE VILLAGE
Riverside. Cityside.

MASTER PLAN

This plan is conceptual and for discussion purposes only. All areas, dimensions and land uses are preliminary, subject to investigation, survey, engineering, and Local Authority and Agency approvals.

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