

## ITEM 4 DUCK CREEK FLOOD STUDY (2019)

The Duck Creek Flood Study (2019) has been finalised following public exhibition between 1 April and 13 May 2019. It is recommended Council adopt the Duck Creek Flood Study (2019) which will inform land use planning, planning certificates and be used for the development of a floodplain risk management study and plan.

The study improves the accuracy and reliability of flood levels and flood behaviour in the Duck Creek Catchment. The reports and flood models for the Duck Creek Flood Study (2019) will be placed on the NSW Flood data portal so that they can be publicly accessed. This will lead to a greater understanding of flood behaviour and risk and wiser decision making.

### RECOMMENDATION

That the Duck Creek Flood Study (2019) be adopted.

### REPORT AUTHORISATIONS

Report of: Mike Dowd, Manager Infrastructure Strategy + Planning

Authorised by: Andrew Carfield, Director Infrastructure + Works (Acting)

### ATTACHMENTS

- 1 Duck Creek Flood study (2019) - Executive Summary

### BACKGROUND

The NSW Government's Floodplain Development Manual provides a framework to ensure the sustainable use of floodplain environments and incorporates the NSW Flood Prone Policy. Under the Policy, the management of flood liable land remains the responsibility of Local Government with State Government subsidising flood mitigation works to alleviate existing problems and providing specialist technical advice to assist Councils in performing their floodplain management responsibilities.

The Policy provides for technical and financial support by the State Government through five stages:

- 1 **Flood Study** –Determines the nature and extent of flooding.
- 2 **Floodplain Risk Management Study** – Evaluates risks and management options for the floodplain in respect of both existing and proposed development.
- 3 **Floodplain Risk Management Plan** – Involves formal adoption by Council of a plan of management for the floodplain.
- 4 **Implementation of the Plan** – voluntary house purchase, flood readiness and response plans, construction of flood mitigation works to protect existing development and use of planning controls (LEP, DCP) to ensure new development is compatible with the flood hazard.
- 5 **Review** – reviews are recommended on average every 5 years and are also generally recommended after significant flood events, policy changes, or land use changes and where impediments to flood management plan implementation exist that warrant a review.

### Duck Creek (Yallah-Marshall Mount)

In 2017 Rhelm was commissioned by Wollongong City Council (WCC) to review the Duck Creek Flood Study (2012) to take into consideration Council's updated Conduit Blockage Policy (2016). The review incorporates new survey data, more detailed modelling techniques and the updated blockage factors.

The results of the study revised the design flood levels to be generally 100mm-200mm lower than the 2012 study. There are also isolated locations with minor increases in flood levels. Changed flood levels are the result of the updated blockage policy, more detailed survey, more precise design rainfall and improved flood modelling. Due to the confined nature of the Duck Creek floodplain, the flood extents are mostly unchanged.

## PROPOSAL

The Duck Creek Flood Study (2019) be adopted. After adoption, the following actions will be undertaken:

- Update the flood planning levels – Planning and Environment
- Update of the relevant Section 10.7 planning certificate – Planning and Environment
- Provide Flood level information advice in accordance with the new study results – Infrastructure + Works
- Preparation of the Floodplain Risk Management study and Plan within 5 years – Infrastructure + Works

## CONSULTATION AND COMMUNICATION

The final draft report went on public exhibition from 1 April 2019 to 13 May 2019. A drop in session at the Dapto Ribbonwood Centre on Monday 8 April 4pm – 5:30pm and was attended by 6 community members.

A newsletter to 104 residents and property owners in flood affected areas (all properties within the extent of the probable maximum flood) was mailed out to advise of the public exhibition process and seek feedback on the document.

A notification of the public exhibition was also placed in the local newspaper. Hard copies of the Flood Study were placed in the Library and PDFs were available through Council's "Have Your Say" page. 27 people downloaded the documents from the Website. No feedback forms were submitted throughout the 6 weeks exhibition period. These low rates of feedback are not unexpected due to there being very limited development within the catchment.

## PLANNING AND POLICY IMPACT

This report contributes to the delivery of Our Wollongong 2028 goal "We value and protect our environment". It specifically delivers on the following:

Community Strategic Plan	Delivery Program 2018-2021	Operational Plan 2018-19
Strategy	3 Year Action	Operational Plan Actions
1.1.3 The potential impacts of natural disasters, such as those related to flood and landslips are managed and risks are reduced to protect life, property and the environment	1.1.3.2 Establish effective urban stormwater and floodplain management programs	Develop and implement Floodplain Risk Management Plans

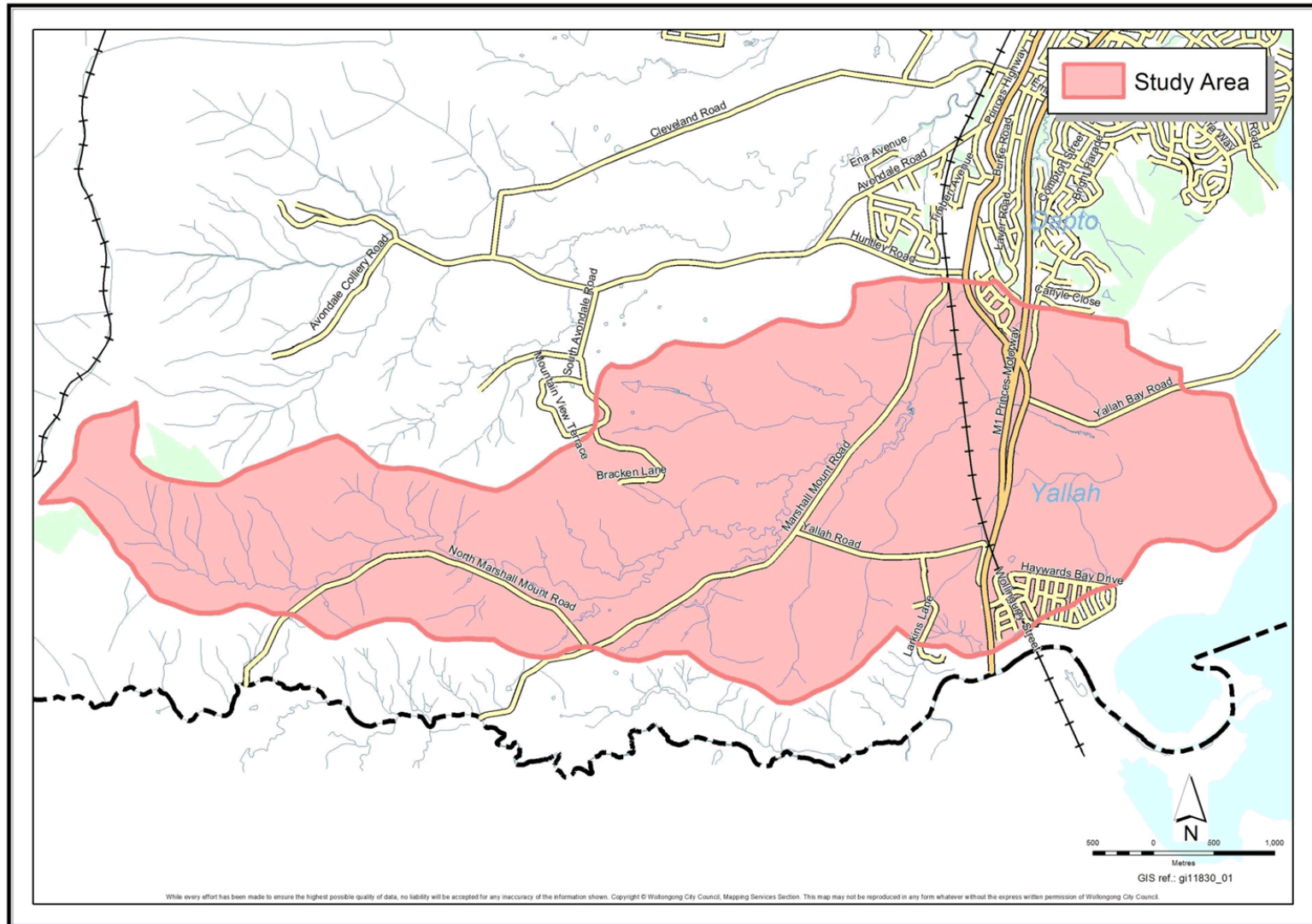
## FINANCIAL IMPLICATIONS

The Duck Creek Flood Study (2019) has cost \$119,680.

## CONCLUSION

The Duck Creek Flood Study (2019) was prepared with the cooperation, assistance and support of many stakeholders, including community members and State government representatives.

The study improves the accuracy and reliability of flood levels and flood behaviour in the Duck Creek Catchment. The reports and flood models for the Duck Creek Flood Study (2019) will be placed on the NSW Flood data portal so that they can be publicly accessed. This will lead to a greater understanding of flood behaviour and risk and wiser decision making.





## Duck Creek Flood Study

### Executive Summary

The Duck Creek Flood Study has been prepared for Wollongong City Council (Council) to define the existing flood behaviour in the Duck Creek catchment and establish the basis for subsequent floodplain management activities.

The Duck Creek catchment encompasses an area of approximately 19km<sup>2</sup> located in the Yallah region on the New South Wales South Coast. Duck Creek flows in a general east direction from its headwaters below the Illawarra Escarpment to its confluence with Lake Illawarra at Yallah (Figure i).



**Figure i. Duck Creek Catchment**

This project is a flood study, which is a comprehensive technical investigation of flood behaviour that provides the main technical foundation for the development of a robust floodplain risk management plan. It aims to provide a better understanding of the full range of flood behaviour and consequences. It involves consideration of the local flood history, available collected flood data, and the development of hydrologic and hydraulic models that are calibrated and verified, where possible, against historic flood events and extended, where appropriate, to determine the full range of flood behaviour.

A comprehensive engagement strategy was undertaken throughout the development of the flood study. This involved:

- Engaging agency and industry stakeholder to obtain details of historical flooding, survey data and other relevant data sets. Stakeholders have also been invited to provide feedback on the draft flood study during public exhibition.
- Community engagement has been undertaken through the mail out of an information brochure and brief survey. The purpose of the engagement was to raise awareness of the study and flood risk in the catchment, as well as obtain observations of historical flooding to assist in model calibration. Respondents were contacted for further information by phone and email, as required.
- The Flood Study has been overseen by the Southern Floodplain Risk Management Committee which includes representatives from community and state agencies.





## Duck Creek Flood Study

- This document will be placed on public exhibition for a period of four weeks. During this time an information session will be held for community members to get information and ask questions.

Flood behaviour has been assessed using a WBNM hydrological model and TUFLOW hydraulic model. These models were originally developed as part of a flood study undertaken for the catchment in 2012 (BMT WBM). Minor modifications have been made to these models to account for changes in the catchment since 2012 and additional available survey data.

A calibration and validation of the hydraulic model has been undertaken for the March 2017, March 2011 and February 1984 events. The outcome of the calibration found that the model was able to represent the historical events to a reasonable level, providing confidence in the model to produce design flood event results.

The hydrological and hydraulic models were analysed for the Probable Maximum Flood (PMF), 0.2% AEP, 0.5% AEP, 1% AEP, 2% AEP, 10% AEP and 20% AEP events. The models were analysed for 90, 120, 360, 540 and 720 minute duration storms. These storm durations were identified based on initial model runs to understand the critical durations throughout the catchment.

The models represent the catchment conditions at the time of survey, being 2017. This study represents the flood behaviour driven by the Duck Creek catchment. In the downstream areas of the study area, this flood study should be read in conjunction with the Lake Illawarra Flood Study (Lawson & Treloar, 2001) and the Lake Illawarra Floodplain Risk Management Study and Plan (Cardno Lawson Treloar, 2012).

An overview of the flood behaviour is provided for the PMF, 1% AEP and 20% AEP events in **Figures ii to ix**.

It should be noted that a localised area of fill occurred at Haywards Bay which was not identified in the survey input to the models. This is shown in the various maps.

The upper part of the catchment is located within a relatively steep sided valley, with a large macro-channel that is bordered to the south by North Marshall Mount Road. Due to the relatively steep sides, the flow from Duck Creek is generally contained within the macro-channel up to and including the PMF, with no backwater reaching North Marshall Mount Road. Critical durations in the 1% AEP event through this area are generally 2 hours.

In the central floodplain the creeks and tributaries are generally less steep than the upper catchment, and there are more cross catchment flows that occur between the creeks.

There are three key tributaries that originate upstream (south) of Yallah Road. These tributaries cause flooding of Yallah Road in the 20% AEP event and above. Several tributaries cross the rail line, with overtopping occurring in the 0.2% AEP event.

There are three key waterway crossings of the M1 Motorway. Shallow overtopping of the north bound lanes starts to overtop in one location from the 20% AEP and increases to depths greater than 1 metre in the 10% AEP. The other crossings are only overtopped in the 0.5% AEP event and larger.

Downstream of the Princes Highway, the floodplain is primarily within low lying wetland areas, as well as the former Ash Ponds for the Tallawarra Power Station. These Ash Ponds have relatively high embankments that exclude overtopping in all flood events. A localised low point on the northern Ash Pond results in some overtopping in events greater than the 1% AEP flood event, although this is relatively minor.



## Duck Creek Flood Study

To the north of Yallah Bay Road, a local tributary flows through farmland and is then held behind a former railway line embankment, before meeting with Yallah Bay Road. This starts to overtop in the 1% AEP event, with significant flooding of Yallah Bay Road occurring in the larger events.

In order to provide Council with an indication of future flood behaviour arising from further development within the catchment, a future development scenario was modelled. This scenario incorporated major works that are currently being planned or currently in construction, as well as a general assumption that all land within the catchment area would become fully developed in line with Council's planning controls. A preliminary assessment was undertaken representing the incorporation of these developments.

Three major developments within the study are currently in a planning stage, namely:

- West Dapto Masterplan;
- Tallawarra Concept Plan; and,
- Albion Park Rail Bypass.

Under the future development scenario, water level increases as a result of the developments were typically observed in the upstream portion of the catchment where development is proposed, as a result of increased impervious areas, and a higher riparian roughness due to revegetation works. The increases were generally contained within the development area. This in turn resulted in lower peak levels downstream, as a result of lower peak flows. The exception was the PMF, that saw further increases in the vicinity of the M1, due to the proposed bypass reducing conveyance.

Due to the generally confined nature of the flowpaths, the bulk of the catchment has overland escape routes available. There is one region in the central floodplain, along Marshall Mount Road upstream of the railway that is classed as flooded, isolated and submerged.

The major Duck Creek flowpath is classed as H5 and H6 with respect to hazard, as a result of both depths and flows. The tributaries are typically H1 and H2, with some pockets of H3 along the larger flowpaths, or deeper sections of ponding.

Sensitivity testing was undertaken on model roughness, inflows and blockage. It was found that overall, the model is relatively insensitive to model roughness assumptions, with potential variation in water levels in the order of +/- 0.2 metres arising from +/- 20% changes in roughness values. The model was more sensitive to hydrological assumptions on flows, with levels potentially increasing up to 0.5 metres as a result of a 20% increase in flows in the 1% AEP event.

With respect to blockage, the results showed a generally minimal differences between the Risk and Design Scenarios of Council's new policy, with typical changes in the order of 0.1 metres. The key exception to this is around some of the tributaries and the smaller culverts, which experience higher blockage factors under the Risk Scenario and therefore higher differences. These increases are up to approximate 0.5 metres upstream of the rail line (where the Risk Scenario is higher than the Design Scenario).

The Risk Scenario results in levels that are generally up to 0.2 metres lower than the levels produced by applying the superseded policy. The key exception to this is the secondary culvert crossing of the rail line, where the tributary in that location has levels approximately 1.5 metres lower than the superseded blockage Policy, as this culvert was completely blocked under the superseded policy.



#### Duck Creek Flood Study

This report provides an understanding of the flood risk within the Duck Creek Catchment and provides Council with the tools for planning. This study provides a baseline against which a Floodplain Risk Management Study and Plan can be prepared.

R h e i m

Duck Creek Flood Study

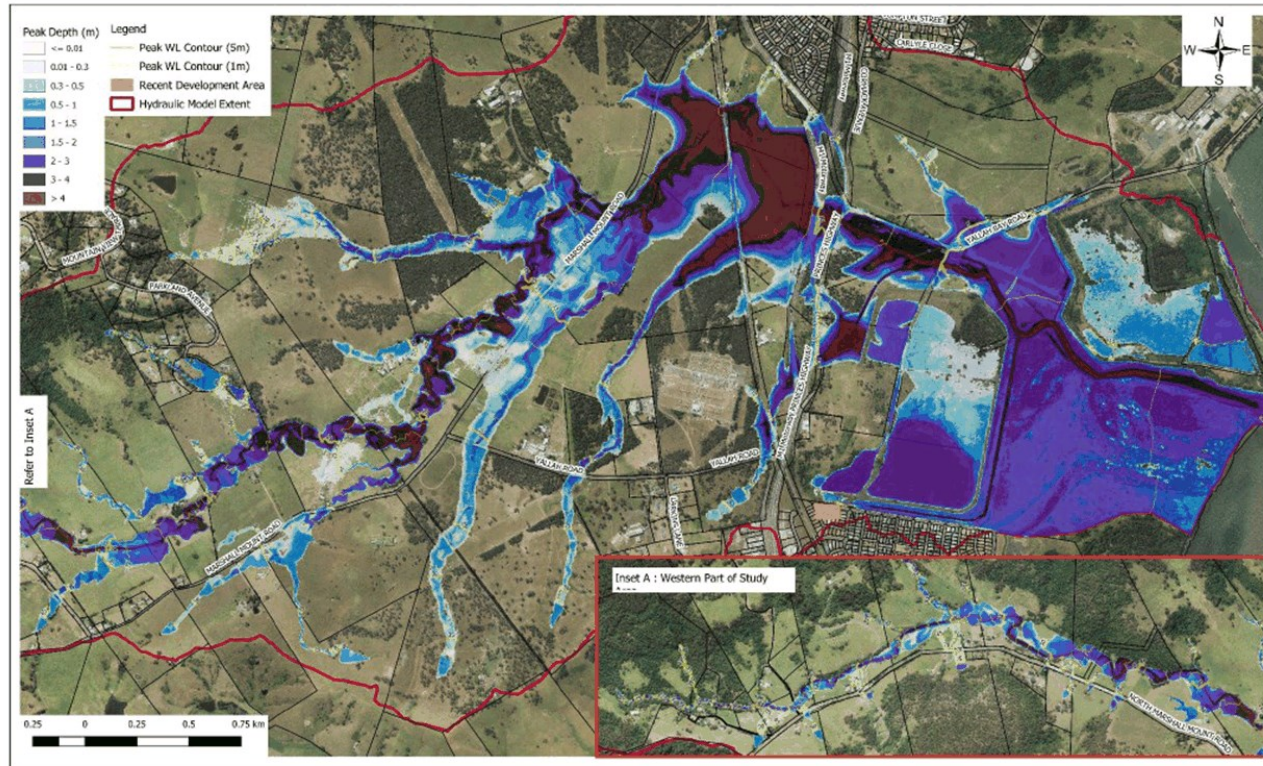


Figure ii. PMF Flood Depths and Water Levels – Risk Blockage Scenario



R h e l m

Duck Creek Flood Study

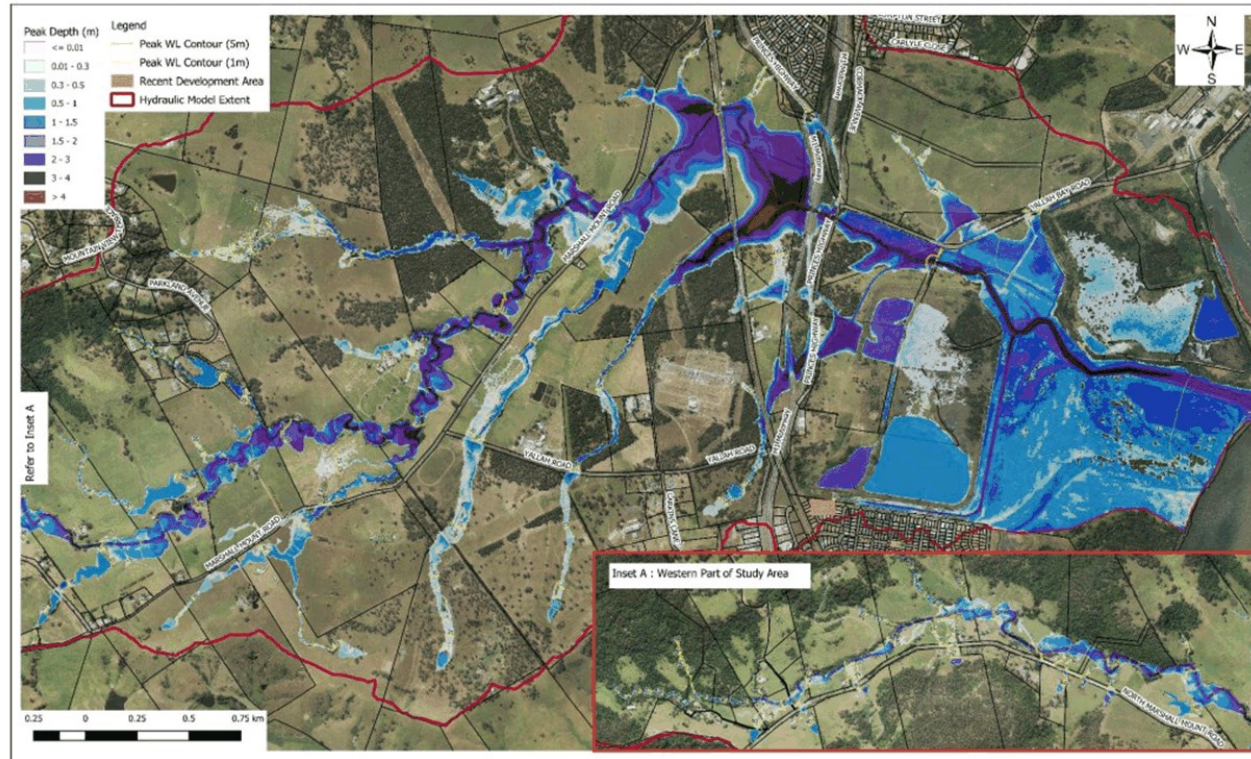


Figure iii. 1%AEP Flood Depths and Water Levels – Risk Blockage Scenario

R h e l m

Duck Creek Flood Study

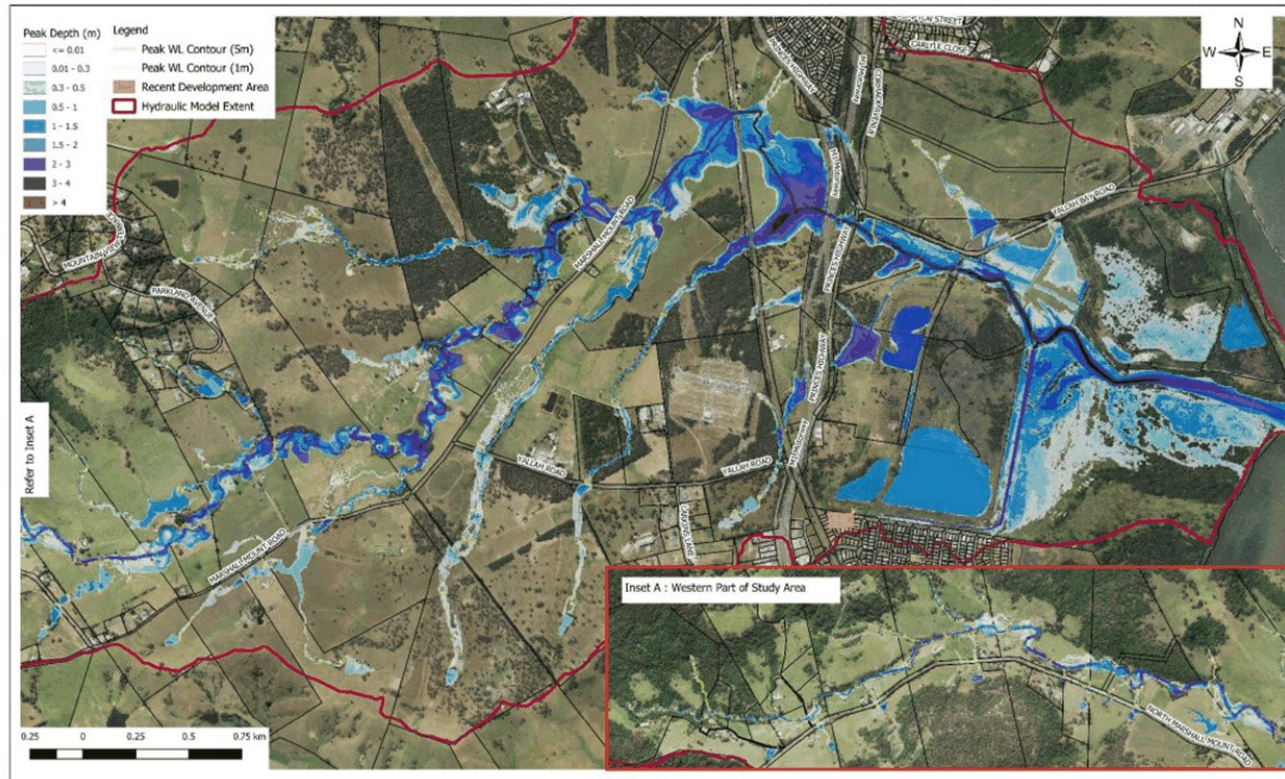


Figure iv. 20%AEP Flood Depths and Water Levels – Risk Blockage Scenario