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Our Ref: DJL: L.T2643.004.docx

05 March 2025
Albion Farm Gardens
Kate Coren
weddings@albionfarmgardens.com.au

Attention: Kate Coren

Dear Kate

RE: FLOOD IMPACT AND RISK ASSSESSMENT FOR 893 PATERSON RD WOODVILLE

Background

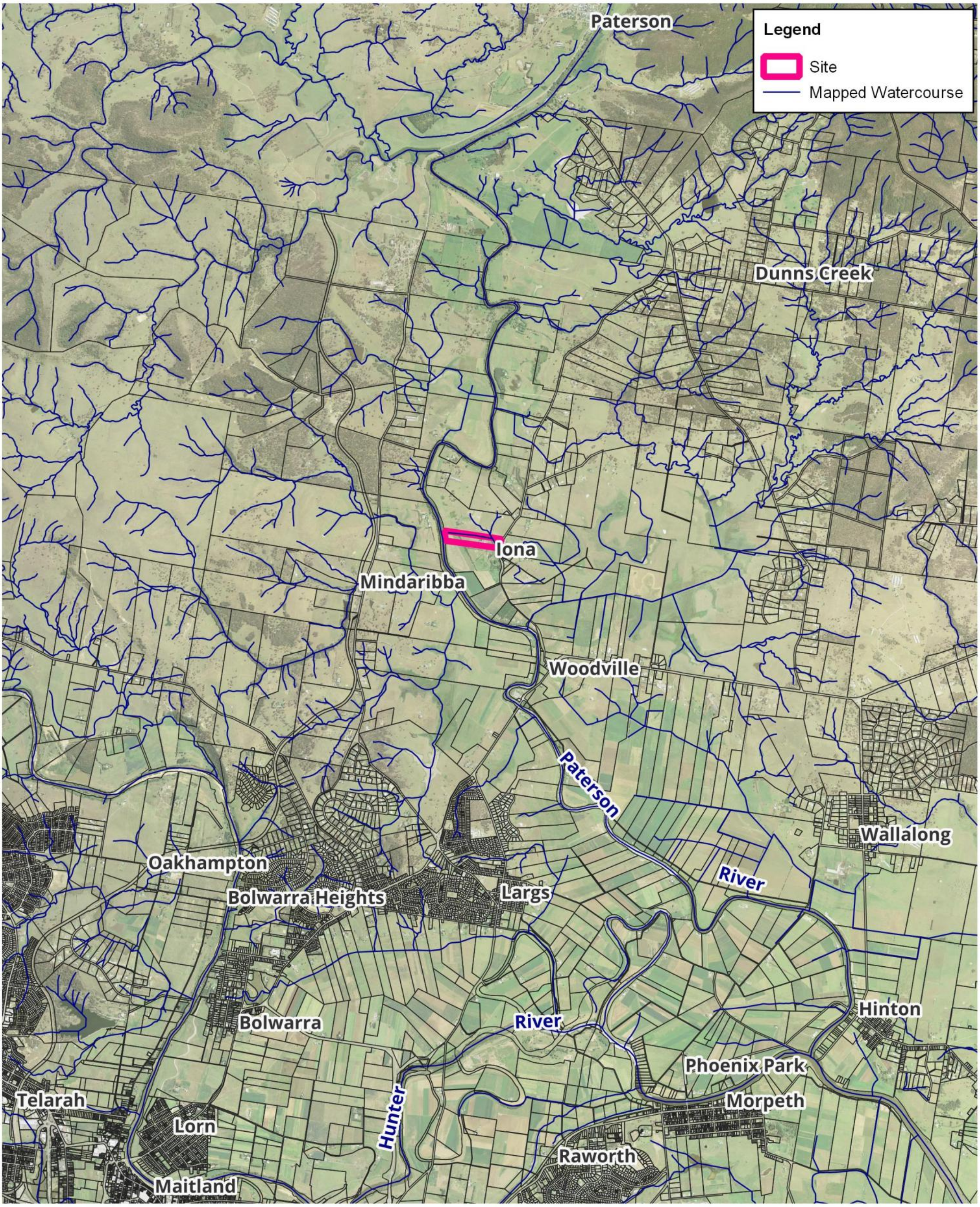
Torrent Consulting was engaged to undertake a Flood Impact and Risk Assessment to assist in the planning and approval process for the proposed 'Gracemere' Function Centre at 893 Paterson Road (Lot 10 DP 1035397), Woodville, NSW (the Site). The development proposal is for the construction of a function venue to accommodate up to 180 guests together with kitchen and toilet facilities. Provision would also be made for a car parking area catering for around 56 vehicles.

A flood report is required by Port Stephens Council (PSC) in line with their Development Control Plan (DCP) requirements. An outline of key tasks undertaken for the FIRA is summarised below:

- Review of existing flood intelligence sources to identify existing flood assessment and mapping relevant to the Site (e.g. Hunter River and Paterson River flood studies and risk management plans).
- Assessment of local flooding characteristics with respect to frequency, timing and duration of inundation for the Site and for key flood access routes.
- Assessment of the compatibility of the proposed development with identified flood risk and planning and development constraints.
- Identification of appropriate Flood Emergency Response strategy for future site operations.

This Site is located on the left floodplain of the Paterson River, around 3km upstream of Dunmore Bridge at Woodville as presented in Figure 1. The topography of the local floodplain is flat and low-lying, characterised by alluvial deposition and raised flood levee embankments, as presented in Figure 2. The western boundary of the Site is adjacent the Paterson River and includes a section of the levee embankment on the left bank of the river at a crest level between 7 to 7.5m AHD. A low-lying flood channel east of the levee ruins through the Site with elevations down to ~1m AHD. The existing residential and farm buildings are located on a higher spur of ground in the centre of the Site typically above 9m AHD elevation. A small local catchment drains through the eastern portion of the Site across the existing access road and bridge structure and through an on-site dam to the crossing of Paterson Road at the south-east corner of the Site. The lowest elevation of the access road is ~4.6m AHD.

The existing design flood conditions at the Site are detailed in the Paterson River Flood Study Vacy to Hinton (WMA Water, 2017) and the Hunter River Branxton to Green Rocks Flood Study (WMA Water, 2010). Information contained in these studies is used to summarise the context of existing flood conditions and risks in relation to the Site and the proposed development. A flood certificate for the Site issues by PSC is included in Appendix A.



Title:

Site Locality

0 1 2 km

approx. scale

Figure: **1**

Revision: **A**

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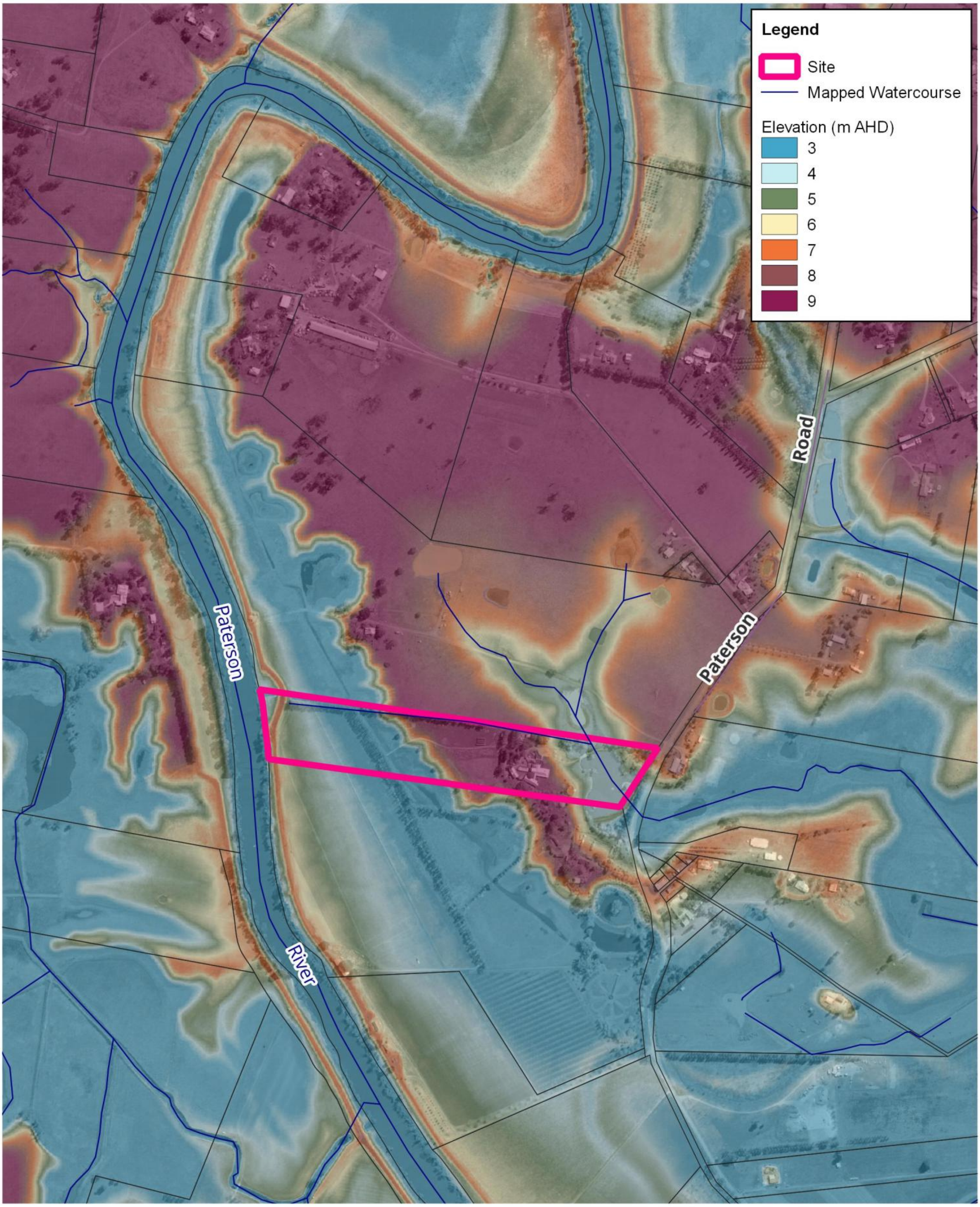

Title:

Local Topography

0 200 400 m

approx. scale

Figure:	2
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Design Flood Conditions – Paterson /Hunter River Flooding

A TUFLOW model of the Hunter, Williams and Paterson Rivers has been developed by Torrent Consulting. The model has been calibrated against the 2007 and 2015 flood events and produces design flood results that are relatively consistent with those of the Paterson River Flood Study Vacy to Hinton (WMA Water, 2017), Williamtown – Salt Ash Floodplain Risk Management Study & Plan (BMT WBM, 2017) and the Hunter River Branxton to Green Rocks Flood Study (WMA Water, 2010). The TUFLOW model has a horizontal grid cell resolution of 20 m and enables a detailed understanding of the local flood velocities and hazards for any floodplain risk management requirements. A summary of the model development is included in Appendix A.

The design flood conditions at the Site are not well represented by the existing flood studies. Being located around Iona, the principal source of flood risk is backwater flooding from the Hunter River, rather than a Paterson River flood event. The Hunter River Branxton to Green Rocks Flood Study provides design flood conditions for the Hunter River at the Site. However, the modelling used for the study does not represent design tailwater levels at Green Rocks. Whilst this does not impact the flood levels at Maitland (which was the focus of the study), the reduced backwater influence provides an underestimation of design flood levels downstream of Maitland, including at the Site.

The TUFLOW model was simulated (using the HPC solver) for the 20% AEP, 10% AEP, 5% AEP, 2% AEP, 1% AEP and 0.5% AEP events to define baseline flood conditions for the purposes of assessing flood risk and as the basis for subsequent flood impact assessment. The PMF flood level derived in the Paterson River Flood Study has also been considered. The modelled peak flood levels at the Site are summarised in Table 1.

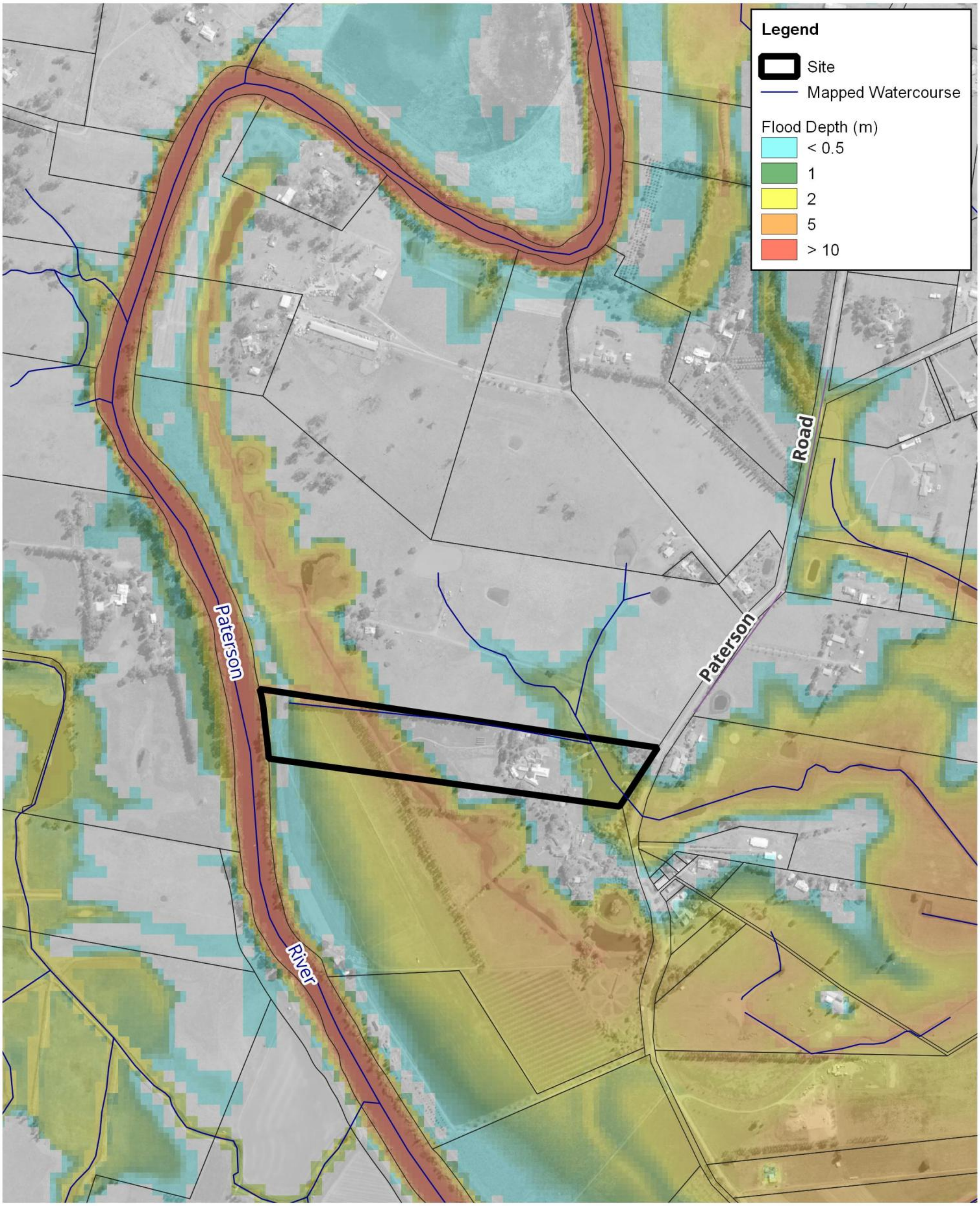
Table 1 – Modelled Peak Design Flood Levels

Design Event	Flood Level (m AHD)
20% AEP	Not inundated
10% AEP	5.9
5% AEP	6.3
2% AEP	6.6
1% AEP	6.9
0.5% AEP	7.5
PMF[(a)]	9.0

Note (a) PMF level from Flood Certificate

The peak flood depths and inundation extents for the 5% AEP, 1% AEP and PMF events are presented in Figure 3, Figure 4, and Figure 5 respectively.

The lower floodplain area of the Site adjacent to the river and the access road across the local waterway are inundated in the 10% AEP event and above. This inundation is predominantly driven by backwater flooding from the combined Hunter River and Paterson River influence. The existing Site buildings and proposed development are flood free for major flood events including the 1% AEP event being located on the spur of high land. This area remains flood free for most event up to almost the PMF event magnitude when inundation is expected to be initiated.



Title:

Modelled 10% AEP Flood Depth and Inundation Extent

0 200 400 m

approx. scale

Figure: 3

Revision: A

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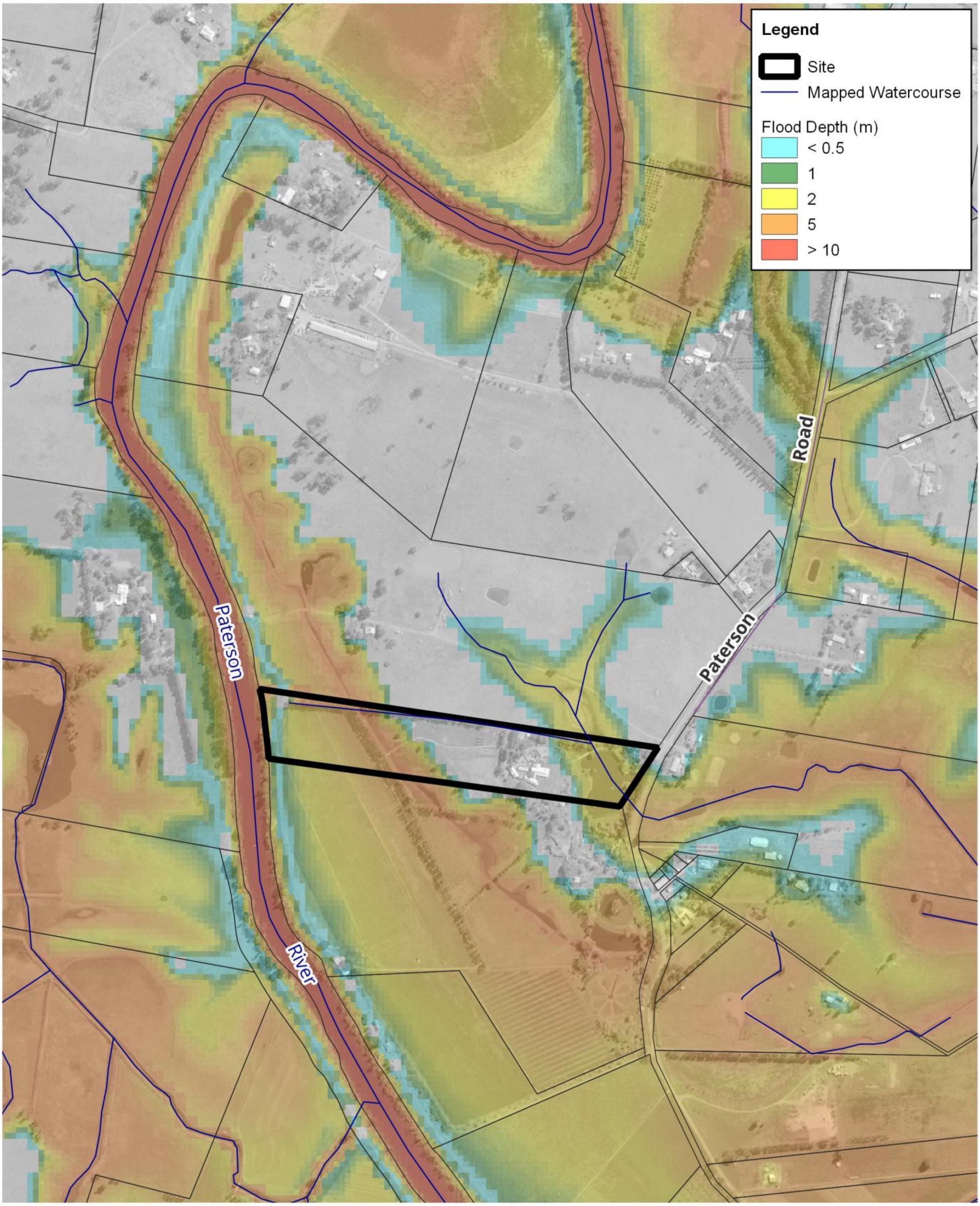

Title:

Modelled 1% AEP Flood Depth and Inundation Extent

Figure: **4**

Revision: **A**

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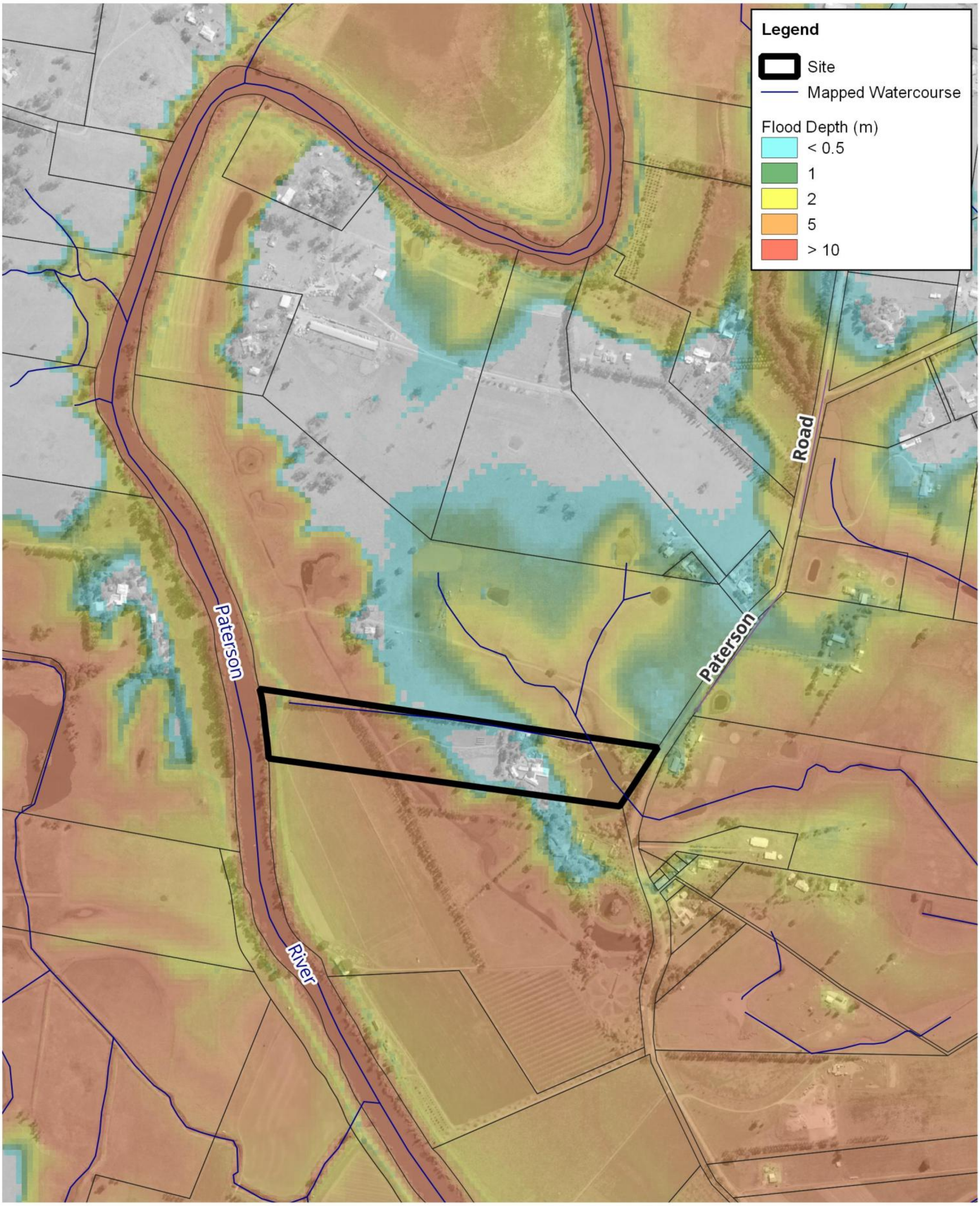

Title:

Modelled PMF Depth and Inundation Extent

0 200 400 m

approx. scale

Figure: **5**

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Design Flood Conditions - Local Overland Catchment

Council raised concerns regarding the flood immunity of the access road including under local catchment flash flood conditions. A TUFLOW model of the local catchment draining through the Site was developed to establish the design flooding conditions under these flash flood scenarios. A summary of the model components is provided below:

- Model Domain and Topography – the model area covers the full local overland flow catchment through the Site and extending to downstream of Paterson Road. The local catchment largely sits north of the Site, with a relatively small contributing catchment area of ~33ha to the northern Site boundary / access road. The model topography is defined from the available LiDAR data as shown in Figure 2, with an adopted TUFLOW model resolution of 2m.
- Hydraulic Structures – the Site access road traversing the lake body incorporates a bridge structure providing for cross drainage of upstream local catchment flows. The bridge structure contains three large circular culverts comprising 2 x 1.65m diameter and 1 x 2.1m diameter barrels. A nominal 1.2m diameter cross drainage culvert was included at Paterson Road at the downstream end of the model, however, with the road overtopping at this point the assumed culvert configuration does not influence flood conditions at the Site upstream.
- Hydraulic Roughness –The land use in the model domain largely represents cleared floodplain / pastureland and the lake waterbody. The adopted Manning's 'n' coefficients for hydraulic roughness are 0.02 for the lake waterbody and 0.05 for the general floodplain. A Manning's' 'n' value of 0.015 was adopted for the culverts.
- Initial Water Level – the lake body was assigned an initial water level of 4.0m AHD for the start of the simulation. This represents the typical lake level as indicated by the Site survey and LiDAR data.
- Design Hydrology – the direct rainfall (rainfall on grid) modelling approach in TUFLOW has been adopted to simulate the catchment rainfall-runoff response. The design hydrology applies the procedures of the Australian Rainfall and Runoff Guidelines 2019 (ARR2019) including design IFD rainfall estimation, rainfall losses and temporal patterns. The Probable Maximum Precipitation (PMP) for the simulation of the Probable Maximum Flood (PMF) condition was estimated using the Generalised Short Duration Method (GSDM) published by the Bureau of Meteorology (BoM). The adopted design rainfalls for the 1% AEP and PMF events are summarised in Table 2.

Table 2 – Design Rainfall Depths

Duration Minutes	1% AEP	PMP
10	35.5	n/a
15	44.5	180
20	51.2	n/a
25	56.5	n/a
30	60.8	260
45	70.7	320
60	78	370
90	89.2	480
120	98.2	560

Design rainfall losses considered the recent NSW-specific guidance with an initial loss of ~4mm (depending on storm event) and a continuing loss of 0.92 mm/h for the undeveloped catchment.

The ARR 2019 guidelines ensemble method to design flood hydrology involves the simulation of ten rainfall temporal patterns for each design event magnitude and duration, with the average condition of the ten being adopted for design purposes. The point rainfall temporal patterns provided for the East Coast South temporal rainfall region were adopted for the ensemble method accordingly.

- Critical Duration – The TUFLOW model was simulated for the 1% AEP design rainfall event for storm durations ranging from ten minutes to 120 minutes. The peak flow results were analysed at the Site to identify the critical duration. The 60-minute duration was identified as being critical for the 1% AEP event, with the design temporal pattern ID 4558 (TP07) was selected as producing hydrographs most representative of the mean design condition from the results of the ensemble method. For the PMF event, the 30-minute duration was identified as the critical design event. The adopted design peak flow through the Site for the 1% AEP is 6.6m^3/s, with the corresponding PMF peak flow of 54.2m^3/s.

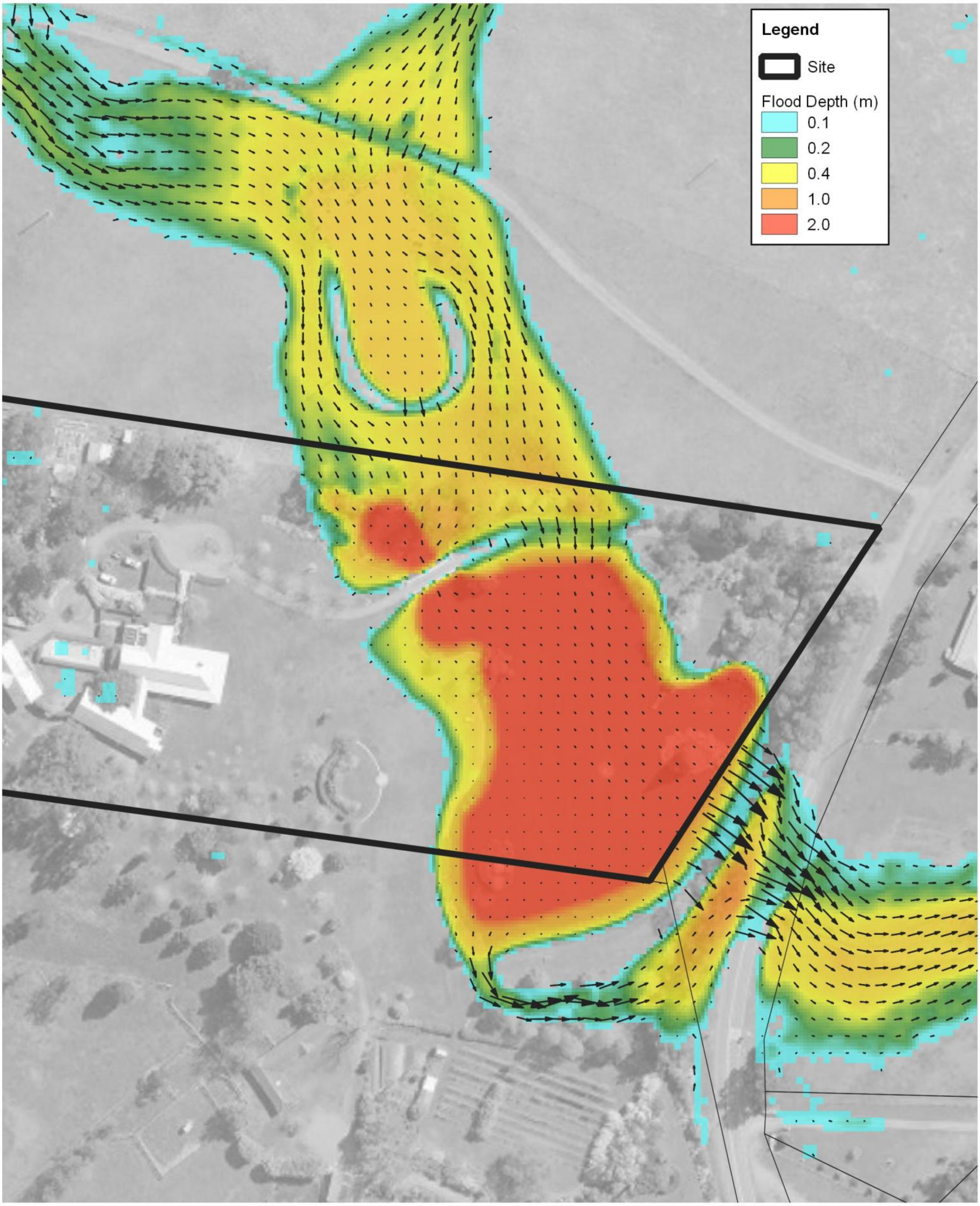
The simulated peak flood depths and inundation extents for the 1% AEP event is presented in Figure 6. The flood mapping shows the Site flood inundation is largely limited to the vicinity of the lake. This is reflective of the local topography as shown in Figure 2 with the land rising relatively steeply up to the Site building areas. The mapping shows the shallow overtopping of the access road on the eastern side of the bridge. The peak flood level at the access road is driven by the backwater condition in the lake controlled by the overtopping of the lake embankment.

The flood mapping shows flow through the lake spillway at the southwest corner; however, the spillway capacity does not convey the 1% AEP design flow. As a result, the lake embankment is overtopped across the low point of the embankment. The low point in the embankment is approximately 4.63m AHD which is equivalent to the low point in the access road. The 1% AEP peak flood level at the overtopping of the lake embankment and at the access road is 4.86m AHD.

The relatively minor depth of flooding and corresponding flow velocity across the access road for the 1% AEP event provides for a low hazard flood condition in which the access road would be trafficable at this flood level. However, there is the opportunity to raise the access road to provide 1% AEP flood immunity to the access road. The access road level at the bridge structure is at 5.0m AHD. Raising the access road to a minimum level of 5.0m AHD would tie into the existing bridge structure and provide for the 1% AEP flood immunity for the local catchment flooding.

Figure 7 shows the simulated 1% AEP flood condition in the local catchment with the access road raised to 5.0m AHD. As evident in the mapping, the access road is flood free at this design magnitude. The peak flood level condition remains controlled by the overtopping of the downstream lake embankment. The large pipe culverts within the existing bridge configuration are of sufficient capacity to convey the 1% AEP peak discharge through the lake system. It is noted that whilst the Site access road has 1% AEP flood immunity for the local catchment flooding, Paterson Road immediately adjacent to the Site is subject to inundation and would not be trafficable.

Figure 8 shows the simulated PMF flood condition for the local catchment flooding. The flood affectation remains limited to the floodplain in the general lake surrounds. The peak PMF level of 5.5m AHD provides for overtopping of the access road for this extreme event.



Title:

1% AEP Local Catchment Flooding
Existing Conditions

0 40 80 m

approx. scale

Figure:	6
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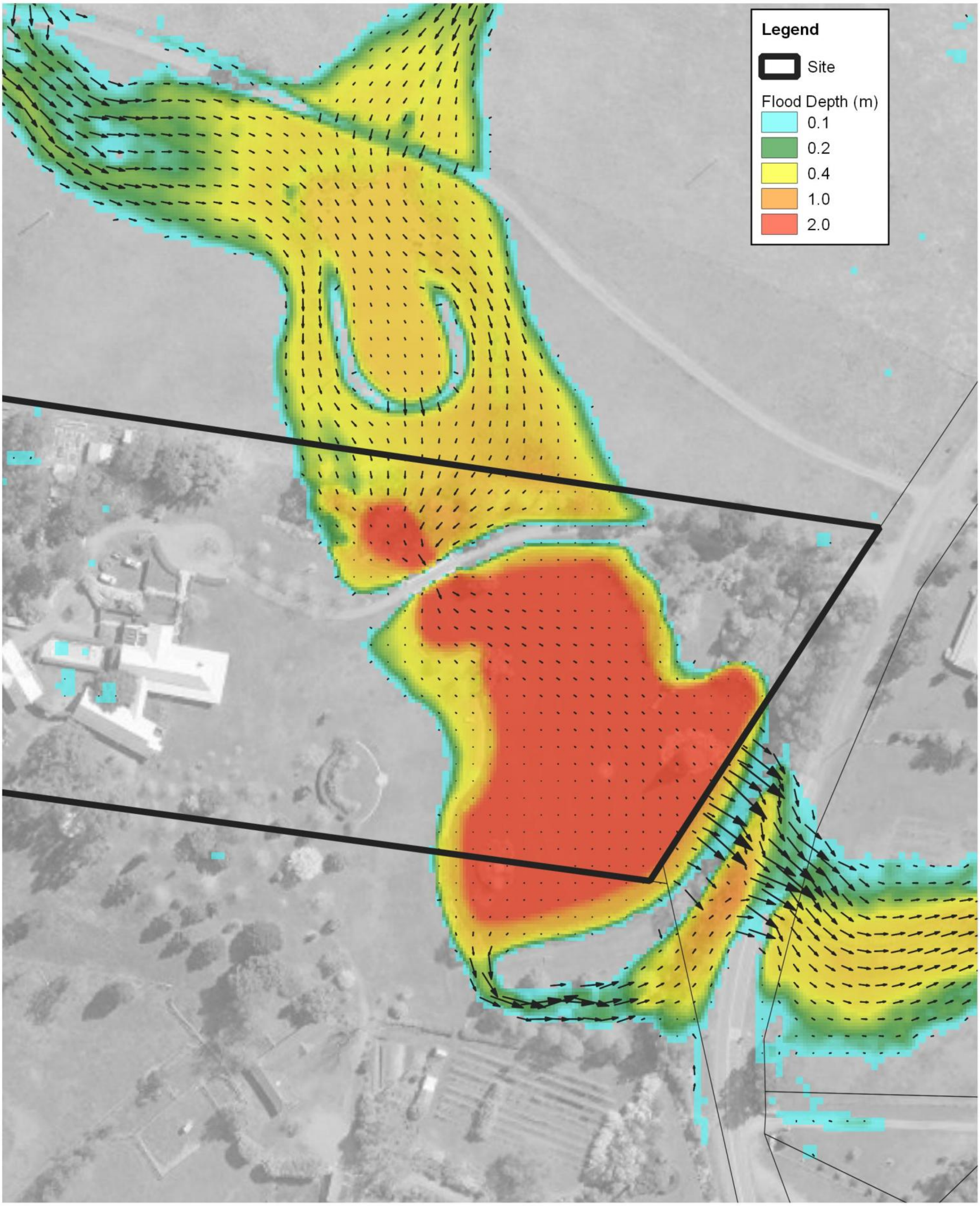

Title:

1% AEP Local Catchment Flooding Proposed Conditions (Access Road Raised)

Figure: **7**

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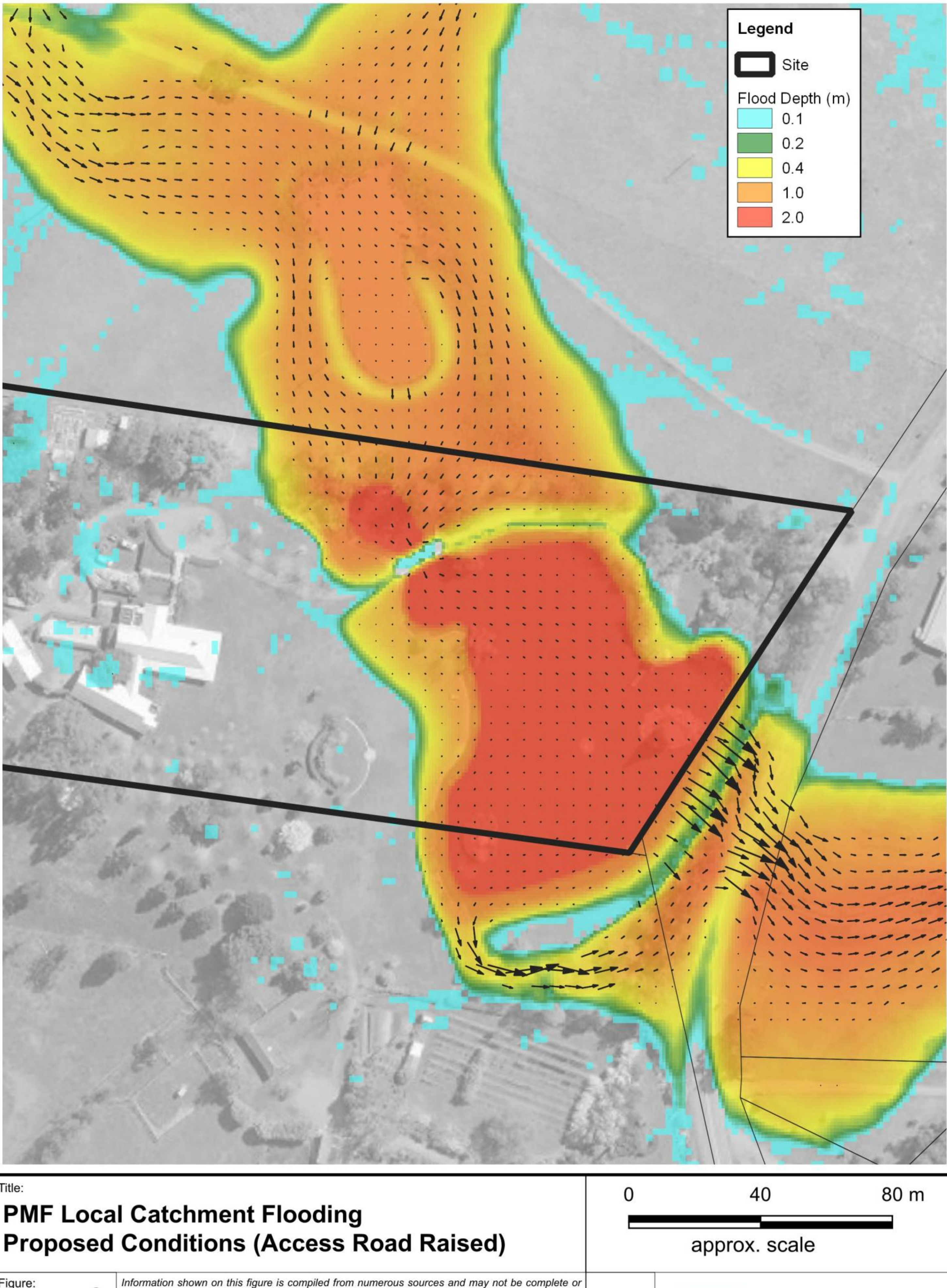

Title:

PMF Local Catchment Flooding
Proposed Conditions (Access Road Raised)

Figure: **8**

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Flood Impact and Risk Management

The development proposal is for the construction of a function venue to accommodate up to 180 guests together with kitchen and toilet facilities, and car parking for around 56 vehicles. The indicative development layout is shown in Figure 9.

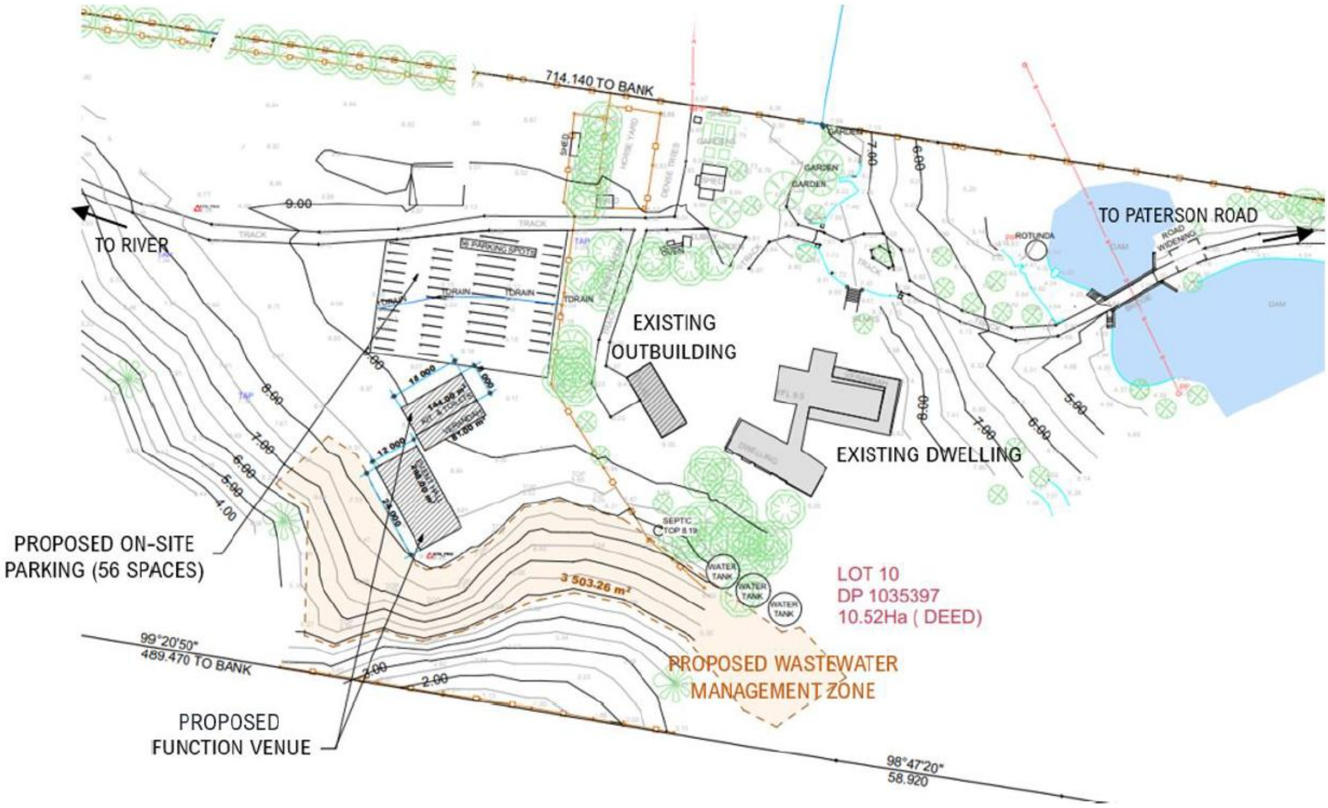


Figure 9 – Concept Site Layout (Punchline Property, 2024)

The proposed development is located on high ground above the 1% AEP design flood magnitude and above the Flood Planning Level of 7.7m AHD advised in the PSC Flood Certificate. Accordingly, the proposed infrastructure is not subject to any direct flood affectation and will have no impact on existing flood conditions.

The proposed development infrastructure remains flood free for major flooding events up to around the 0.2% AEP design flood magnitude. The principal flood risk for the proposed development is the restriction of flood access and potential isolation. The Site access road may be subject to inundation for events above the 20% AEP magnitude for mainstream Paterson River flooding. The 10% AEP flood depth mapping as shown in Figure 3 provides for over 1m depth across the access road and accordingly would not be traversable. Similar flood conditions are noted at locations along Paterson Road providing further flood access restriction remote from the Site.

Flood hazard classification provides further appreciation of the Site access constraints. The flood hazards have been determined in accordance with Guideline 7-3 of the Australian Disaster Resilience Handbook 7 Managing the Floodplain: A Guide to Best Practice in Flood Risk Management in Australia (AIDR, 2017). This produces a six-tier hazard classification, based on modelled flood depths, velocities, and velocity-depth product. The hazard classes relate directly to the potential risk posed to people, vehicles, and buildings, as presented in Chart 1.

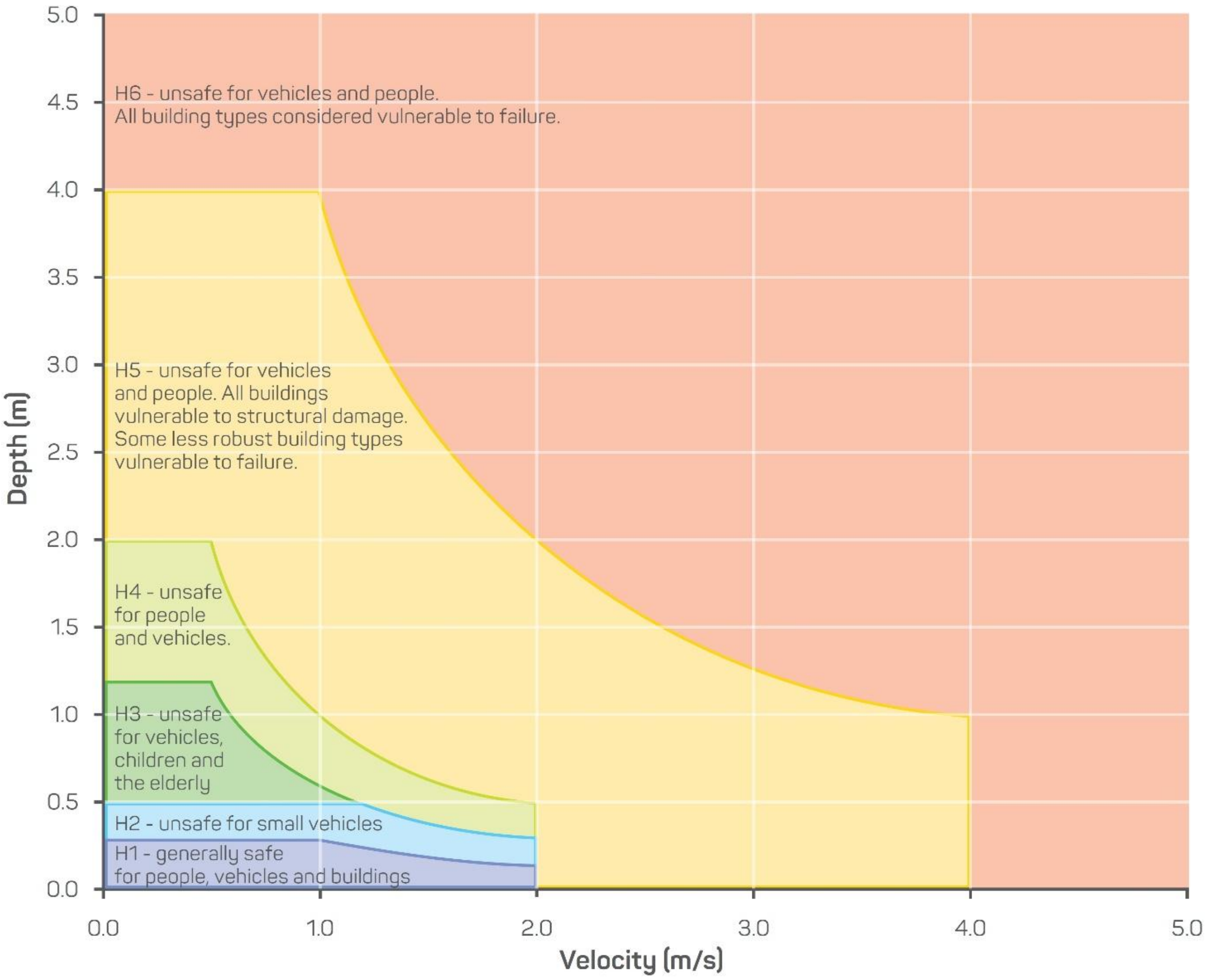
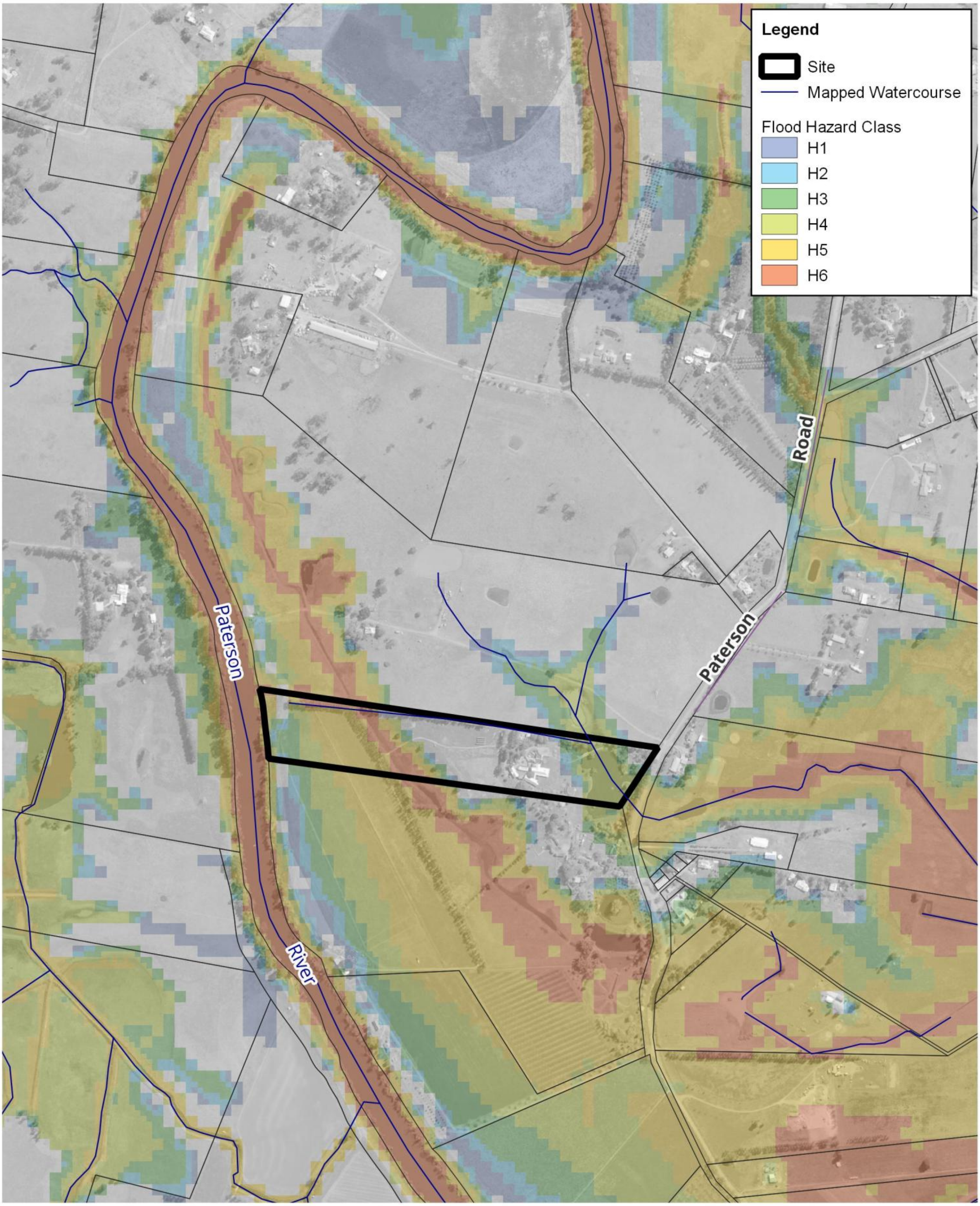


Chart 1 – General Flood Hazard Vulnerability Curves (AIDR, 2017)

Figure 10 presents the flood hazard classification at the Site for the 10% AEP event. The peak flood hazard along the Site access road and parts of Paterson Road is H5 category confirming no effective flood access for the Site at this design flood magnitude and above.

The proposed development provides for flood free area above the PMF level providing for suitable refuge. Accordingly, there is no direct flood risk to patrons on the Site and the proposed development would perform appropriately as a “shelter-in-place” environment.

However, given the potential isolation issues the preferred flood risk management approach is to not have patrons on the Site during major flood events. This is expected to be achieved via Site closure prior to an event or effective flood evacuation with appropriate early flood warning.



Title:

10% AEP Flood Hazard Classification

0 200 400 m

approx. scale

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Figure: 10	*Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarentees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.*
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Flood Warning and Emergency Response

The following official forecasts and warnings related to flooding in NSW are issued by BoM and the SES. These warnings can be communicated through a range of media, including internet (links included below), telephone, radio, television, and print.

Table 3 – Flood Warning Sources

Organisation	Warning / Forecast	Link
BoM	Flood Watch – provides a 'heads up' that flooding is likely.	http://www.bom.gov.au/nsw/warnings/index.shtml
	Flood Warning – warns a community of flooding at a predicted height, time, and location.	
SES	Flood Bulletin – warns of flooding at a predicted height, time and location and the expected risks, impacts, consequences, and the safest actions to take.	https://www.ses.nsw.gov.au/majorwarning/floodbulletin?major=1&active=FloodBulletin
	Evacuation Warning – warns of the potential to evacuate properties, risks to life and property and the safest actions to take.	
	Evacuation Order – orders immediate evacuation of 'at risk' sections of the community from a flood threatened area and advises the safest actions to take.	
	All Clear – advises the evacuated community that it is safe for people to return to the area and any residual risks.	

The Site access can be impacted by flooding of either the Paterson River or Hunter River. The Bureau of Meteorology (BoM) incorporates the Gostwyck Bridge (at Paterson) and Maitland (at Belmore Bridge) gauges into its operational flood warning network. Water level data can be accessed at:

- Gostwyck - http://www.bom.gov.au/fwo/IDN60232/IDN60232.061349.plt.shtml
- Maitland - http://www.bom.gov.au/fwo/IDN60232/IDN60232.061349.plt.shtml

The data presents the current recorded water level at the gauge together with the recorded data over the past five days.

Flood classifications in the form of locally defined flood levels are used in flood warnings to give an indication of the severity of flooding (minor, moderate or major) expected. These levels are used by the SES and BoM in flood bulletins and flood warnings. The flood classification levels are described by:

- Minor flooding: flooding which causes inconvenience such as closing of minor roads and the submergence of low-level bridges. The lower limit of this class of flooding, on the reference gauge, is the initial flood level at which landholders and/or townspeople begin to be affected in a significant manner that necessitates the issuing of a public flood warning by the BoM.
- Moderate flooding: flooding which inundates low-lying areas, requiring removal of stock and/or evacuation of some houses. Main traffic routes may be flooded.
- Major flooding: flooding which causes inundation of extensive rural areas, with properties, villages and towns isolated and/or appreciable urban areas flooded.

The Minor, Moderate and Major flood warning threshold levels at Gostwyck and Maitland are summarised in Table 4. The gauge height in metres corresponds to the elevation in metres above Australian Height Datum (AHD).

Table 4 – Flood Warning Levels (m)

Warning Level	Maitland	Gostwyck Bridge
Minor	5.9	9.1
Moderate	8.9	10.7
Major	10.5	12.2

The Maitland gauge provides warnings for Hunter River flood events, whilst Gostwyck Bridge provides warnings for Paterson River flood events. The Site access point on Paterson Road becomes inundated during a 10% AEP flood event on the Hunter River or a 10% AEP flood event on the Paterson River. The rarity of these design flood events is at or exceeds the Major Flood level at the respective gauges. The design 10% AEP flood level at Gostwyck Bridge is 13.6m AHD (WMAWater, 2017) and the 10% AEP flood level at Maitland is 10.4m AHD (WMAWater, 2010).

Accordingly, evacuation from the Site to prevent becoming isolated by flood waters is required before the Major Flood level threshold is exceeded at either the Maitland or Gostwyck Bridge gauges.

The BoM *Service Level Specification for Flood Forecasting and Warning Services for New South Wales and the Australian Capital Territory* (2015) provides a target flood warning time for quantitative flood level predictions of:

- Gostwyck - 12 hours prior to reaching 9.1m AHD trigger level (Minor flood event classification)
- Maitland - 24 hours prior to reaching 7.1m AHD trigger level (between Minor and Moderate flood level classification).

The service level specifications indicate the Gostwyck gauge for Paterson River flooding to potentially provide the shortest flood warning availability for the Site. However, this is expected to provide at least a 12-hour lead warning time prior to the Paterson Road access to the Site being isolated.

On the Paterson River the modelled travel time between Gostwyck Bridge and Dunmore Bridge is around 12 hours. Therefore, in the event of either a Hunter River or Paterson River flood, a 24-hour warning time may be available prior to the Site access being cut. This lead warning time provides opportunity for events to be cancelled prior to expected flooding or enable the effective evacuation of the Site in the event that patrons are on Site during a flood event.

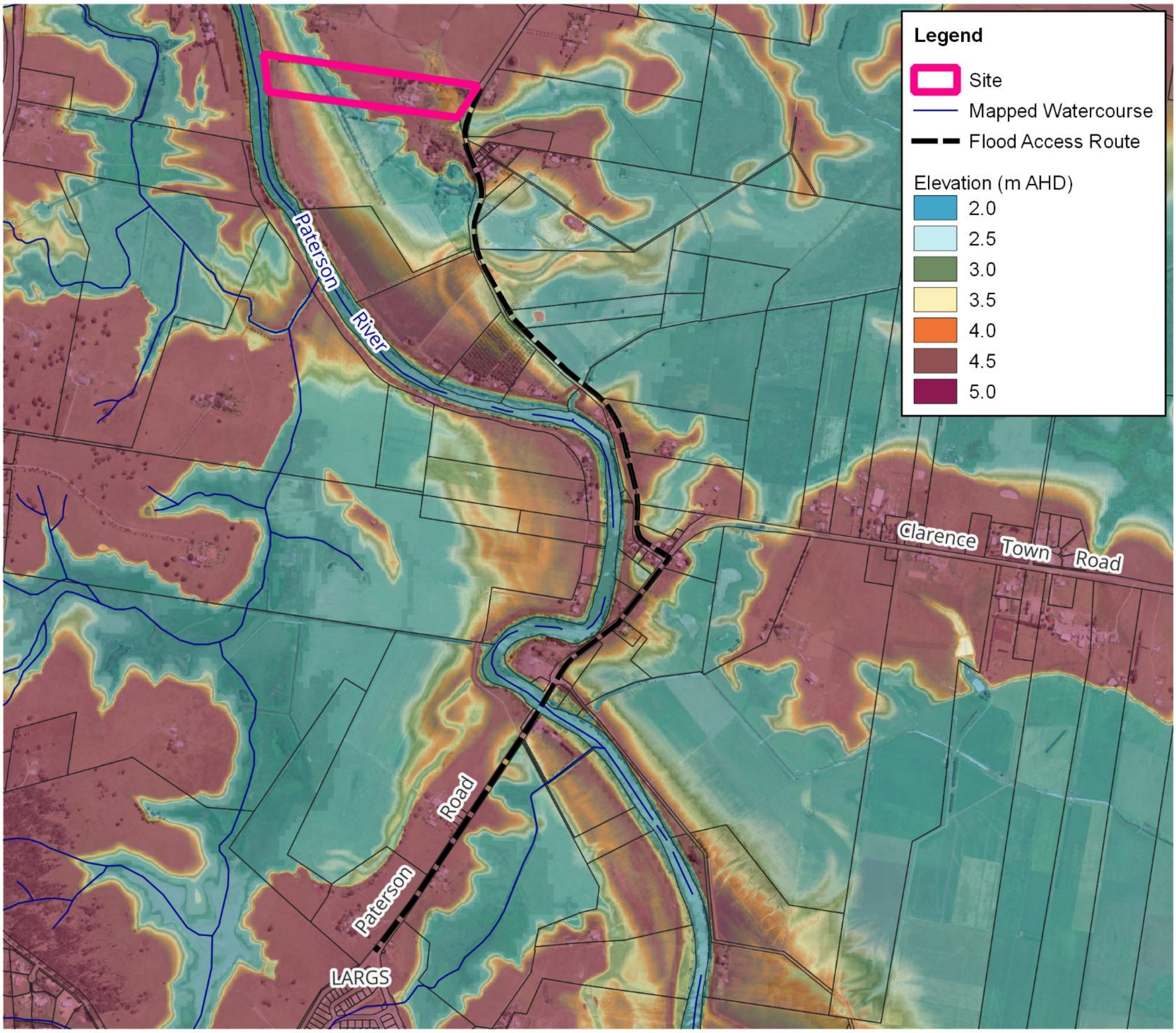
It is envisaged a formal Flood Emergency Response Plan (FERP) may be required as part of development consent conditions. The following response strategy may be incorporated into a FERP:

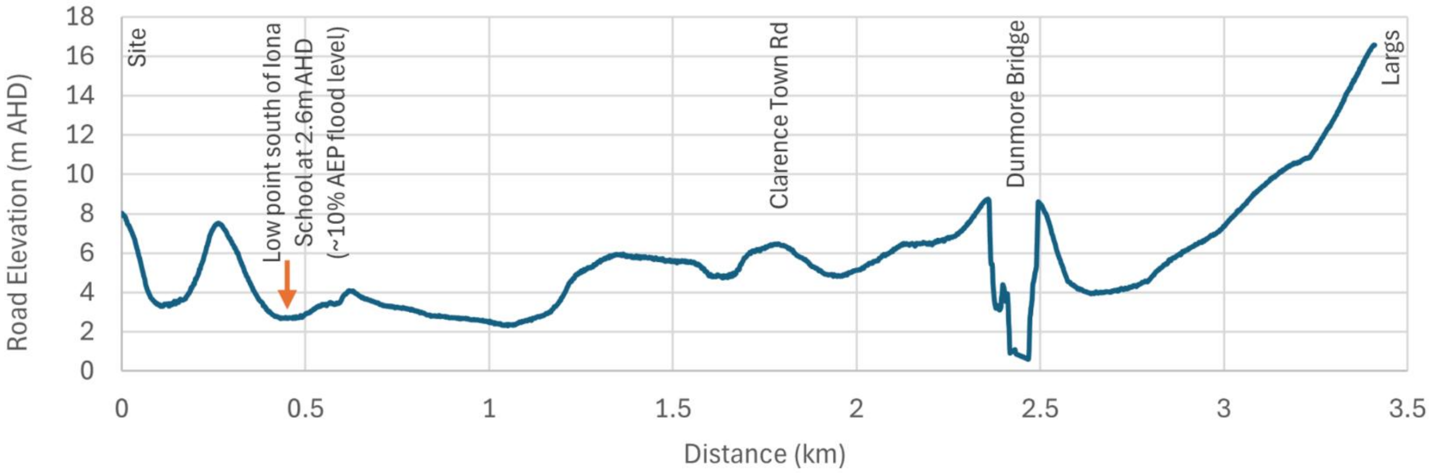
- Flood monitoring – Site management should proactively monitor Flood Watch or Flood Warnings issued by the Australian Bureau of Meteorology (BoM). Water levels for Maitland or Gostwyck Bridge can be monitored, with real-time gauge data available for viewing at
    - http://www.bom.gov.au/fwo/IDN60232/IDN60232.061268.plt.shtml
    - http://www.bom.gov.au/fwo/IDN60232/IDN60232.061349.plt.shtml
- Flood warning - To ensure timely flood warning in advance of a required evacuation, subscription can be made to RSS (Really Simple Syndication) feeds from the BoM New South Wales & ACT Warning service. Alerts are automatically provided to subscribed devices when the feed is updated. This can be set up for both home computers and mobile phones and is customisable (refer http://www.bom.gov.au/rss/rss-guide.shtml).
- Flood response (Stage 1) – Site management may choose to cancel events in advance of a flood event occurring if an initial Flood Watch or Flood Warning is for the Paterson River / Hunter River. It is anticipated that with the available warning time, almost all events may be cancelled prior to commencement such that there are no patrons on the Site.
- Flood Response (Stage 2) - In the instance of a Flood Warning for Maitland or Gostwyck Bridge being issued by the BoM during an active event on the Site, management should actively monitor the gauge levels and prepare for evacuation from the Site. Even if the resultant flood is not rare enough to present a risk to life and property, the Site access could be cut for several days. Given the lead flood warning time and flood travel time from the gauge locations to the Site, there is sufficient time to execute an orderly evacuation from the Site prior to loss of access through the local road network.
- SES directions - in the event of a flood emergency response being initiated by the SES, residents and guests should follow the instructions given accordingly by SES other emergency services. This may include an order to evacuate to a designated flood evacuation centre.

It is significant to note the frequency of a Major flood event is effectively a 10% AEP (long-term average of once every ten years) at Maitland and a 20% AEP (long-term average of once every five years) at Gostwyck Bridge, so false alarms represent an opportunity to practice a flood emergency response, rather than being an excessively frequent nuisance.

Evacuation Route

The nominal evacuation route from the Site is south along Paterson Road to the Clarence Town Road junction. Two alternative routes are available from that junction, being east along Clarence Town Road towards Brandy Hill and Seaham or south along Clarence Town Road-Paterson Road via Dunmore Bridge towards Largs and Maitland. Both routes have a similar design flood immunity to approximately the 10% AEP design flood magnitude. The initial route inundation/low point is on Paterson Road south of the Iona Public School, at a level of 2.6m AHD. The evacuation route and elevation profile from the Site along the Largs route is shown Figure 11.





Title:

Evacuation Route

0 0.5 1 km

approx. scale

Figure: 11

Revision: A

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As noted, there is expected to be significant flood warning time to cancel any Site events prior to expected flooding. However, even if there are patrons on the Site during at the onset of a flood event, there still remains many hours between formal flood warnings (Gostwyck gauge) and flood route inundation. The SES flood intelligence data on the Maitland City Local Flood Plan notes 8-12hours travel time from Gostwyck to Hinton similar to the modelled flood conditions.

The general nature of flood response and flood warning trigger levels at Gostwyck Bridge is demonstrated in the April 2015 event which is the highest most recent event. The April 2015 event is between a 2% AEP and 1% AEP magnitude at Gostwyck Bridge (WMA Water, 2017). The recorded water level time series at Gostwyck Bridge for the April 2015 event is shown in Figure 11. Shown for reference is the Minor Flood Warning threshold of 9.1m AHD and the 10% AEP flood level at Gostwyck Bridge. The 10% AEP level represents the design magnitude at which Site flood access on Paterson Road is compromised.

It is likely a minimum 12hours warning is available from initial flood watch and flood warning at Gostwyck Bridge prior to the minor flood level exceedance. There is then an indicative 3.5hours between the minor flood level threshold and the 10% AEP flood level corresponding to the Site flood access inundation magnitude. This 3.5hours plus the additional 6hours+ travel time from Gostwyck to the Site provides a significant window (9.5hours+) for Site evacuation following the issue of a Minor Flood Warning on the Paterson River at Gostwyck. Given the evacuation route to flood free area is less than 3km from Site, there is no constraint for Site evacuation if a flood warning was issued whilst patrons are on the Site.

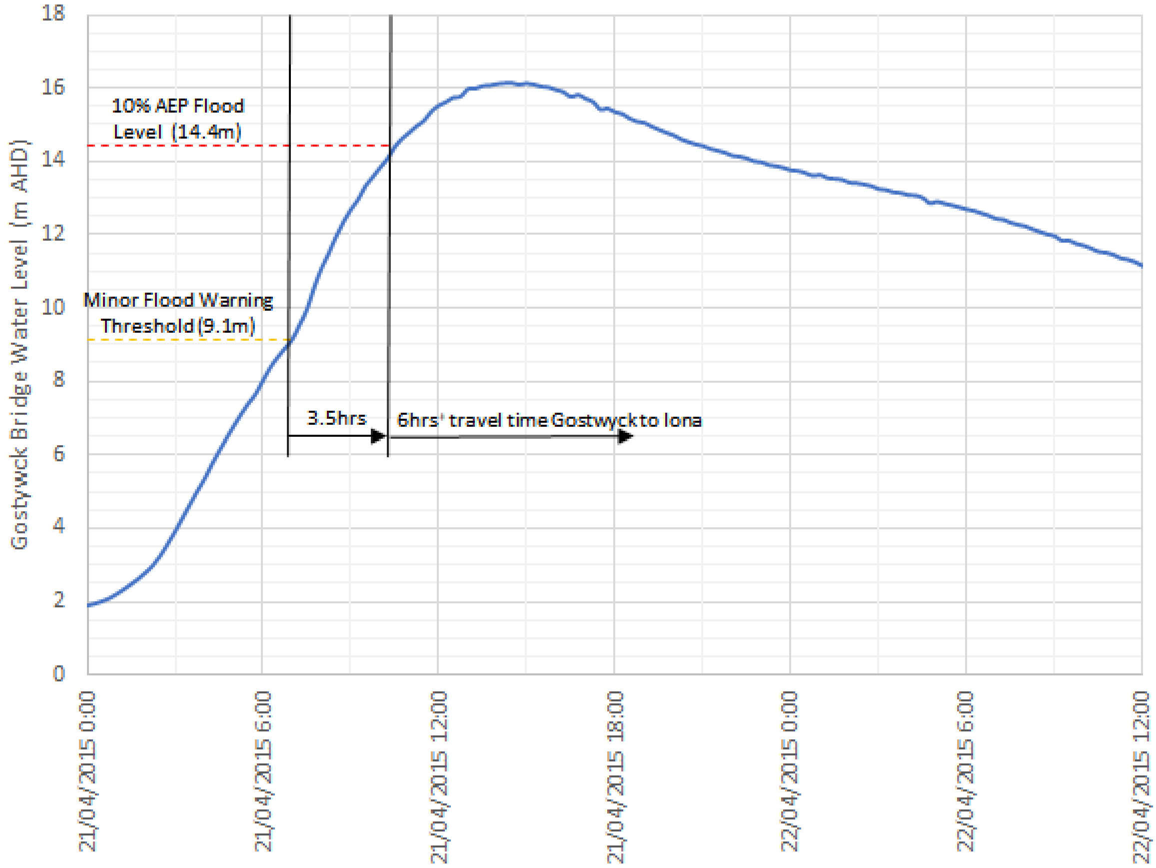


Figure 12 – April 2015 Water Level Hydrograph (Gostwyck Bridge) and Available Warning Time

The Site flood access may be inundated for 1-2 days depending on how the lower floodplain drains away. However, given the available warning time and evacuation plan as demonstrated above, isolation of patrons on the Site is not expected at all.

Flood Planning Constraints

Given the proposed development is effectively flood free at up to the PMF there are no development controls that impact the proposal in addressing a direct flood risk. However, there are higher level planning controls considering the evacuation and isolation risk.

NSW Planning Ministerial Direction 4.1 (the Direction) provides direction on how to consider flooding implications when considering planning proposals on land identified within a flood planning area or below the probable maximum flood (extreme event). The Direction provides for the following clauses:

(4) A planning proposal must not contain provisions that apply to areas between the flood planning area and probable maximum flood to which Special Flood Considerations apply which:

> *(a) permit development in floodway areas,*
>
> *(b) permit development that will result in significant flood impacts to other properties,*
>
> *(c) permit a significant increase in the dwelling density of that land,*
>
> *(d) permit the development of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and seniors housing in areas where the occupants of the development cannot effectively evacuate,*
>
> *(e) are likely to affect the safe occupation of and efficient evacuation of the lot, or*
>
> *(f) are likely to result in a significantly increased requirement for government spending on emergency management services, and flood mitigation and emergency response measures, which can include but not limited to road infrastructure, flood mitigation infrastructure and utilities.*

The FIRA has demonstrated the proposed development is not located in floodway, does not impact on existing flood conditions, does not provide for additional dwelling density or be a sensitive use. The available flood warning provides for a proposed flood emergency response that enables patrons and staff for the proposed function centre to not be on Site during an event either by pre-event cancellation or effective evacuation prior to access road inundation. Accordingly, both of the above conditions are considered to be satisfied.

Conclusion

A Flood Impact and Risk Assessment (FIRA) for the Site at 893 Paterson Road (Lot 10 DP 1035397), Woodville, NSW has been undertaken to support a planning proposal for a proposed function centre.

The assessment has included development of a TUFLOW hydraulic model to simulate design flood conditions at the Site for mainstream Paterson River flooding, whilst maintaining a reasonable consistency with the results of the previous studies. A second TUFLOW model weas also developed to simulate design flood conditions at the Site for local catchment (overland flow) flooding.

The flood assessment has determined that the proposed development is compatible with the existing flood hazard and does not result in adverse off-site flood impacts. The proposed function centre buildings are located above the Flood Planning Level and as such the risk to property is readily managed. The proposed development also provides for flood free area above the PMF level such that there is no major risk to life for occupants of the Site.

The principal flood risk is associated with isolation of the Site as the Site access and local roads are cut at events in excess of the 20% AEP event. However, given the available flood warning time (>12-hours via the BoM Flood warning Network), sufficient lead time is available to evacuate the Site prior to loss of local flood access. Notwithstanding this evacuation opportunity, the availability of early flood warning enables events booked in at the Site to be cancelled prior to commencement.

The local catchment flooding condition represents a "flash flood" scenario with a typically rapid response to rainfall. The proposed function centre buildings are not impacted under this design flood mechanism. The existing access road is subjected to minor inundation at the 1% AEP event. Raising of the low point of the access road to a minimum 5.0m AHD (equivalent to the existing bridge level) provides for 1% AEP flood immunity. However, it is noted that a number of locations along Paterson Road would be subject to inundation at the 1% AEP design magnitude for local catchment flooding conditions.

It is recognised that the local catchment flooding condition is characterised by short durations given the small size of the local catchment. Accordingly, there is no significant concerns with potential isolation in the event patrons are on Site during local catchment flooding.

A Flood Emergency Response strategy has been outlined which demonstrates a suitable management of flood risk for then proposed operations and may form the basis of a formal Flood Emergency Response Plan (FERP) in subsequent approval stages.

Accordingly, the proposed development is considered to be compatible with the known flood risk.

We trust that this report meets your requirements. For further information or clarification please contact the undersigned.

Yours faithfully

Torrent Consulting

Darren Lyons
Principal Water Resources Engineer
CPEng MIEAust RPEQ

References

BMT WBM (2017) *Williamtown – Salt Ash Floodplain Risk Management Study & Plan*. Port Stephens Council.

Bureau of Meteorology (2013) *Service Level Specification for Flood Forecasting and Warning Services for New South Wales and the Australian Capital Territory – Version 3.13*.

Punchline Planning (2024) *Scoping Proposal Amendment to Port Stephens LEP 2013‘Gracemere’ Function Centre.*

WMAWater (2010) *Hunter River: Branxton to Green Rocks Flood Study*. Maitland City Council.

WMAWater (2017) *Paterson River Flood Study Vacy to Hinton*. Dungog Shire Council, Maitland City Council, and Port Stephens Council.

APPENDIX A – Flood Certificate

PORT STEPHENS COUNCIL

FLOOD CERTIFICATE

File No: PSC2013-05401
Issue date: 24-Jan-24
Property ID: 36477

MR STEPHEN PUNCH
6 OXLEY CLOSE
EAST MAITLAND NSW 2323

Certificate number: 83-2024-1379-1

Property details: 893 Paterson Road WOODVILLE NSW 2321 (LOT: 10 DP: 1035397)

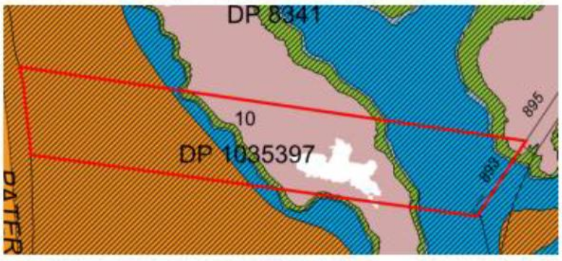
Thank you for your recent flood enquiry regarding the above property. This certificate confirms that this property **is** located in a **flood prone** area. This **is** a "flood control lot" for the purposes of the *State Environmental Planning Policy (Exempt and Complying Development Codes) 2008*. This lot **has** a levee or other structure on or adjacent to it, as part of the Hunter Valley Flood Mitigation Scheme, conditions and restrictions may apply see *Water Management Act 2000*.

Flood Planning Level	**7.7 metres AHD** (velocity = 2.8 m/s)	(This level defines the minimum floor level for habitable rooms and land that is subject to flood-related development controls (refer to Port Stephens DCP Section B5).
Highest Hazard Category	**High Hazard Floodway area**	

Flood levels that may be useful are:

Probable maximum flood level	9.0 metres AHD (velocity = 3.2 m/s)	(The highest flood level that could conceivably occur at this location. If required, onsite flood refuges are built at or above this level, refer to the Port Stephens Development Control Plan B5.2)
Current day 1% AEP flood level	6.6 metres AHD	(This level is useful for insurance purposes, refer to your insurance policy and the Insurance Contracts Regulation 1985 (Cwealth).)
Adaptable minimum floor level	7.5 metres AHD	(The 1% AEP flood level plus freeboard, 50 years from now, refer to the Port Stephens Development Control Plan B5.2.)
Minimum onsite wastewater level	4.6 metres AHD	(The 5% AEP level 50 years from now, refer to the Port Stephens On-site Sewage Management Development Assessment Framework and AS/NZS 1547:2012 5.5 land application system design.)

Flooding extent on subject lot, categorised by hazard



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Flood Hazard Hydraulic Categories

- Minimal Risk Flood Prone land
- Flood Planning Level
- Low Hazard Flood Fringe area
- Low Hazard Flood Storage area
- Low Hazard Overland Flow Path area
- Low Hazard Floodway area
- High Hazard Flood Fringe area
- High Hazard Flood Storage area
- High Hazard Overland Flow Path area
- High Hazard Floodway area

Information derived from Port Stephens Council, Maitland City Council & Dungog Shire Council 2017, *Paterson River Study Vacy to Hinton* WMA Water, Sydney.

PORT STEPHENS COUNCIL
116 Adelaide Street Raymond Terrace NSW 2324 | PO Box 42 Raymond Terrace NSW 2324 | **Phone:** 02 4980 0255 **Email:** council@portstephens.nsw.gov.au | www.portstephens.nsw.gov.au **ABN** 16 744 377 876

APPENDIX B – TUFLOW Model Development

Torrent Consulting has developed a TUFLOW hydraulic model covering the entire floodplain of the Lower Hunter River downstream to the river mouth at the Tasman Sea, including upstream to: Luskintyre on the Hunter River, Vacy on the Paterson River and Glen Martin on the Williams River, as presented in Figure A1

The catchment area of the Hunter River covers some 22 000 km^2, with the Paterson and Williams Rivers contributing around 1200 km^2 and 1300 km^2 respectively. The modelled area encompasses some 750 km^2.

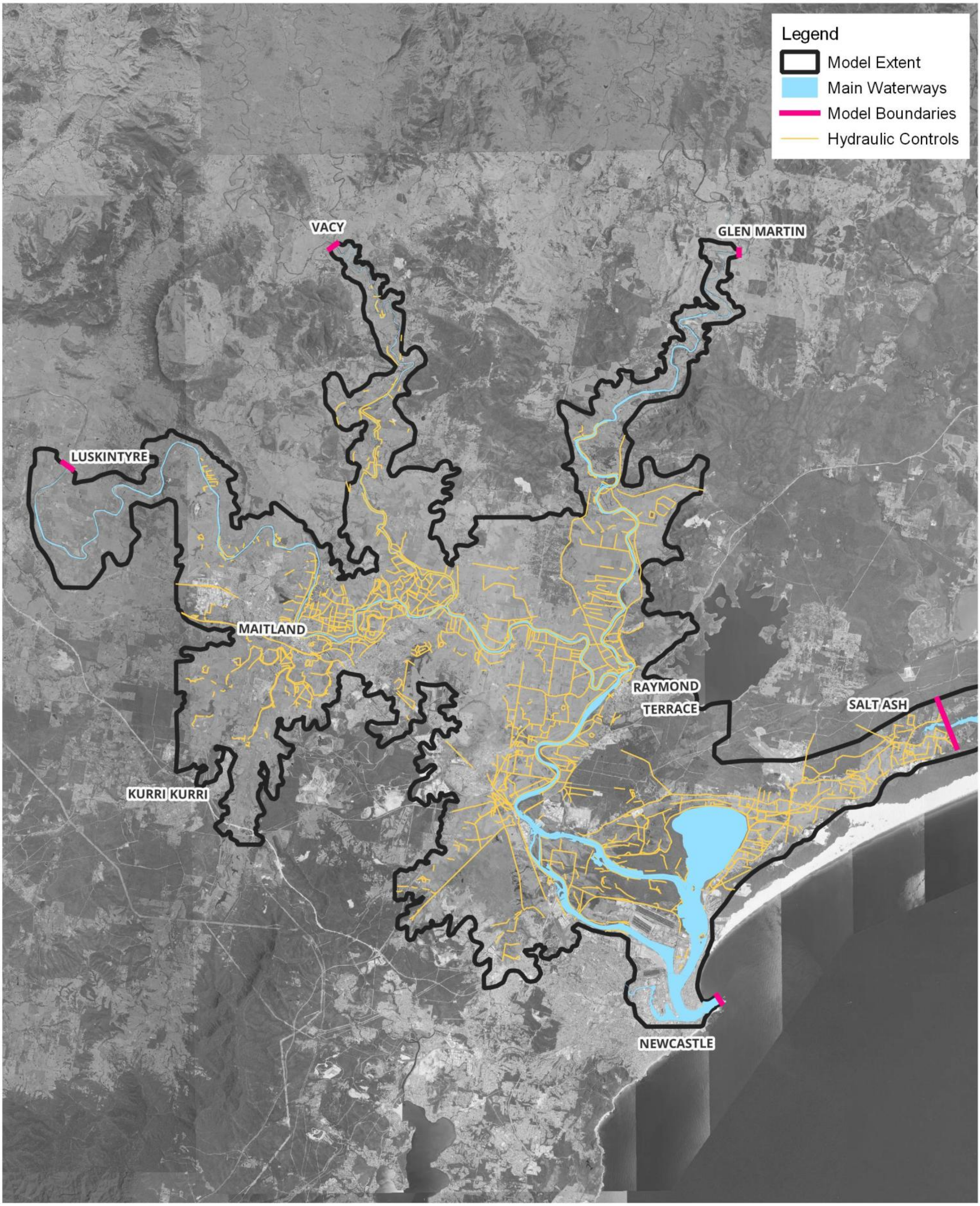
The model utilised the NSW Spatial Services LiDAR data product, downloaded via the ELVIS Foundation Spatial Data portal to define the floodplain topography. The model was constructed using a 20 m grid cell resolution, sampling elevations from the LiDAR data. The modelled floodplain contains numerous embankments that function as hydraulic controls and are of too small a scale to be adequately captured by the 20 m grid cell model resolution. Therefore, a network of breaklines was digitised along some 820 km of embankments and the underlying LiDAR data interrogated to populate the breaklines with the elevations of the embankment crests. These were then incorporated into the TUFLOW model using the Z Shape representation, which modifies model cell elevations to match those of the breaklines.

A total of 26 floodplain mound constructions were identified as having been constructed since the LiDAR data was captured in 2012-13, using available aerial imagery in Google Earth. The approximate extent of these mounds was identified from the imagery and incorporated into the TUFLOW model with assumed mound heights being adopted to raise them above the 1% AEP flood level.

The Hunter River Hydrographic Survey (May 2005) was used to provide representative channel cross-section information of the lower Hunter, Paterson and Williams Rivers. An appropriate channel topography was incorporated into the model, with a full 2D representation of both channel and floodplain. Aerial imagery was used to define separate surface materials for areas of cleared floodplain, river channel and remnant vegetation. Modelling of key hydraulic structures within the study area is also included for the Fullerton Cove and Salt Ash floodgates and culverts under Nelson Bay Road.

Many estuarine vegetation communities are not well penetrated, and are subsequently poorly filtered in, the LiDAR data product. These include areas of mangroves, saltmarsh, phragmites, rank grassland, wet heath, and other swampy habitats. The modelled floodplain elevations in these areas have therefore had an elevation correction adjustment applied to the LiDAR data. Site survey for this study identified the grasslands of the western study Lots to be around 0.2 m lower than the LiDAR representation. The swampier habitat of the eastern Lots is around 0.35 m lower than the LiDAR. Vegetation across the Hunter Estuary has been treated in this way in the TUFLOW model, with LiDAR elevations being lowered between 0.2 m and 0.6 m, depending on vegetation cover. The extent of the modified LiDAR elevations is presented in Figure A1.

The upstream model inflow boundaries on the Hunter, Paterson and Williams Rivers were developed using information contained in the Hunter River Branxton to Green Rocks Flood Study (WMA Water, 2010), the Paterson River Flood Study Vacy to Hinton (WMA Water, 2017) and the Williams River Flood Study (BMT WBM, 2009) respectively. Local hydrological inputs for the 750 km^2 of model area were also accounted for, although they are not overly important for the derivation of the design flood conditions. The downstream boundary of the model was configured as a tidal cycle with a peak water level of 1.1 m AHD, which is approximately an annual peak condition.



Legend

TUFLOW Model Configuration

0 7 14 km

approx. scale

Figure:	A-1	*Information shown on this figure is compiled from numerous sources and may not be complete or accurate. Torrent Consulting cannot be held responsible for the misuse or misinterpretation of any information and offers no warranty guarentees or representations of any kind in connection to its accuracy or completeness. Torrent Consulting accepts no liability for any loss, damage or inconvenience caused as a result of reliance on the information.*
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The model was calibrated to provide consistency with the Hunter River Branxton to Green Rocks Flood Study and the Williamtown – Salt Ash Floodplain Risk Management Study through iterative adjustment of the Manning's 'n' roughness parameters for the digitised land use materials. The adopted Manning's 'n' values are provided in Table A1.

The TUFLOW model produced results at Maitland that closely match those of the Hunter River Branxton to Green Rocks Flood Study. Consistent results at Raymond Terrace were harder to achieve and were found to be significantly influenced by total inflow volumes more-so than peak flow rates alone.

Design flood levels at Oakhampton are driven principally by peak flows (with variations in volume effectively negligible). Flood Frequency Analysis (FFA) undertaken for the Hunter River Branxton to Green Rocks Flood Study and the Singleton Floodplain Risk Management Study (BMT, 2020) provide similar estimates of design flood flows for the Hunter River, which provides a good level of confidence in those estimates. The derivation of design flood flow estimates through FFA at Raymond Terrace is less certain, due to a shorter period of continuous record and a lack of a site rating curve. Using FLIKE to derive probabilistic estimates of design peak flows, the results for the rarer events were found to vary significantly depending on the assumptions made for data entry of historic flood thresholds. This is because there is less than 40 years of continuous record and the largest flood events all occurred before this period.

Table A1 – Adopted Manning's 'n' Values

Surface Material	Manning's 'n'
Cleared floodplain	0.040
Hunter River channel u/s Morpeth	0.030
Hunter River channel Morpeth to Raymond Terrace	0.025
Hunter River channel d/s Raymond Terrace	0.020
Paterson River channel	0.045
Williams River channel	0.025
Remnant vegetation	0.120
Mangroves	0.150

Rainfall-runoff modelling was undertaken for the entire Hunter River catchment using methods outlined in ARR 2019 to assist in establishing suitable design flow conditions at Raymond Terrace, specifically the relationship between modelled peak flow conditions at Oakhampton and Raymond Terrace. With flows on the Hunter River dominating volumes at Raymond Terrace, establishing a relationship between design flows at Oakhampton and expected design flows at Raymond Terrace provides a useful tool for validating design flood levels at Raymond Terrace. The Hunter River catchment rainfall-runoff modelling found the critical duration at Oakhampton to be 48 hours, whereas it was the 72-hour duration at Raymond Terrace – indicative of the additional reliance on overall flood volume to maintain peak flows and levels. Table A2 presents the design flows at Oakhampton and the estimated equivalent design flow condition at Raymond Terrace.

Table A2 – Hunter River Design Peak Flows (m^3/s)

Design Event	Oakhampton	Raymond Terrace
20% AEP	1700	1400
10% AEP	2600	2300
5% AEP	3800	3200
2% AEP	5800	4700
1% AEP	8000	6300
0.5% AEP	10 300	7900
0.2% AEP	13 500	10 200

Ultimately, design flow estimates were adopted from the FLIKE FFA for the 20% AEP and 10% AEP events and from the rainfall-runoff modelling analysis for the rarer flood events. Table 2 presents the design flows at Oakhampton and the estimated equivalent design flow condition at Raymond Terrace. A comparison of the adopted design flows at Raymond Terrace with the 90% confidence interval determined using FLIKE is presented in Chart A1.

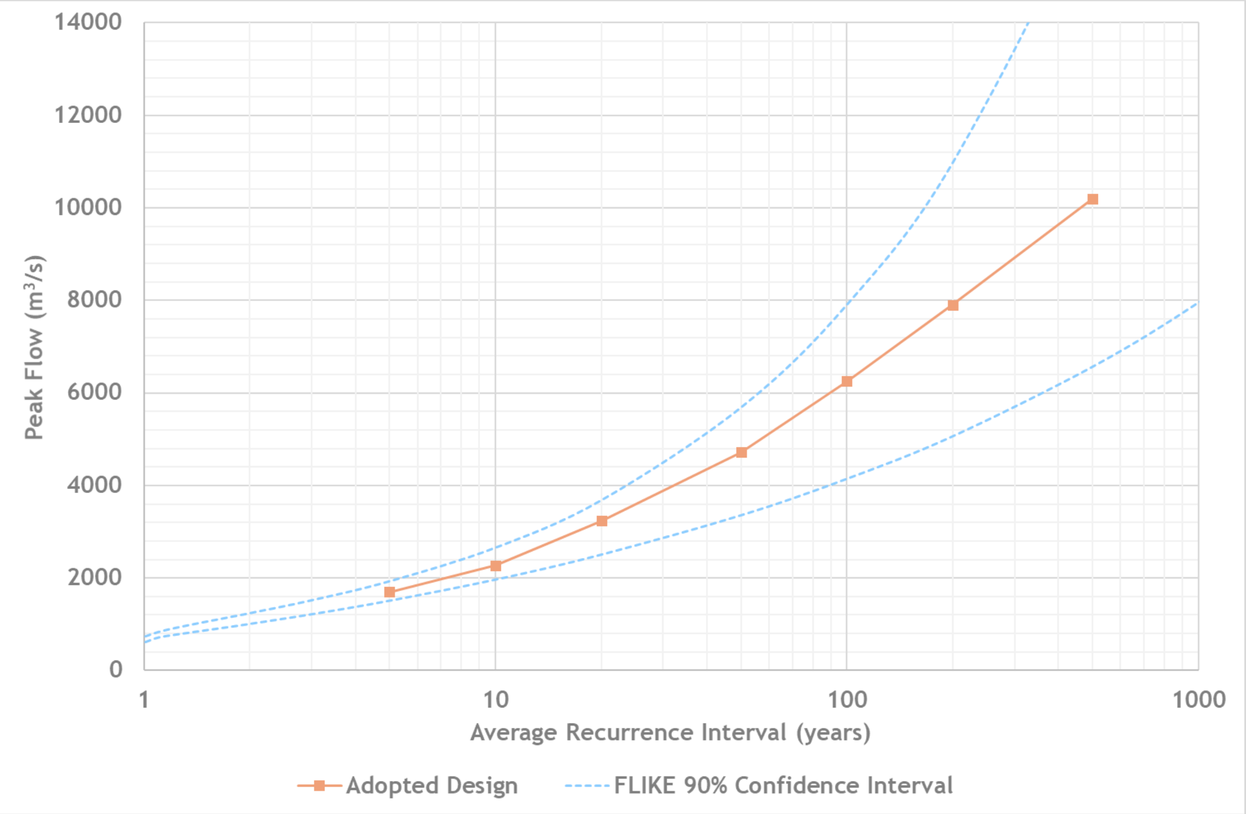

Chart A1 – Adopted Design Flood Flows at Raymond Terrace

Design flood flow hydrographs for the Hunter, Williams and Paterson Rivers were simulated in the TUFLOW model and the volumes of the flood recession were adjusted until the required peak flow conditions at Raymond Terrace were matched. The resultant peak flood levels at the Raymond Terrace gauge are presented in Table A3, together with those established for the Williamtown – Salt Ash Floodplain Risk Management Study. The overall consistency between the two is good and is well within the bounds of uncertainty of the FFA at Raymond Terrace.

Table A3 – Design Flood Levels at Raymond Terrace

Design Event	This Assessment	BMT WBM (2017)
20% AEP	2.6	2.2
10% AEP	2.9	3.0
5% AEP	3.3	3.3
2% AEP	4.0	4.1
1% AEP	4.7	4.8
0.5% AEP	5.3	5.2
0.2% AEP	6.1	N/A