PP-2023-1505 (Council Ref: REZ-0001-2324) – Preliminary Flood Impact and Risk Assessment – Planning Proposal to Rezone 44 Middle Arm Road, Goulburn

Prepared by Goulburn Mulwaree Council

1. Introduction

This Flood Impact and Risk Assessment (FIRA) has been prepared in accordance with the NSW Planning and Environment's *Flood Impact and Risk Assessment – Flood Risk Management Guideline LU01*, 2023. This FIRA should be read in conjunction with the Planning Proposal PP-2023-2324 for 44 Middle Arm Road and supporting documentation.

This FIRA is a "simple" assessment in accordance with Section 2.8 of the Guidelines as it is being prepared at a preliminary stage of a larger development to assist in informing future planning noting that a development application will also need to be prepared and submitted.

The preparation of this preliminary FIRA has also considered the following guidelines from the *Flood Risk Management Toolkit*:

- *EM01- Support for Emergency Management Planning*
- *FB01- Understanding and Managing Flood Risk*
- *MM01- Flood Risk Management Measures*

2. Need for a flood impact risk assessment.

This planning proposal seeks to rezone an area of 11.7 hectares of rural land situated to the north of Goulburn, within the Middle Arm precinct of the *Urban and Fringe Housing Strategy*, which is currently zoned RU6 Transition. A site location plan is illustrated in **Figure 1.**

***Figure 1**: Site location plan*

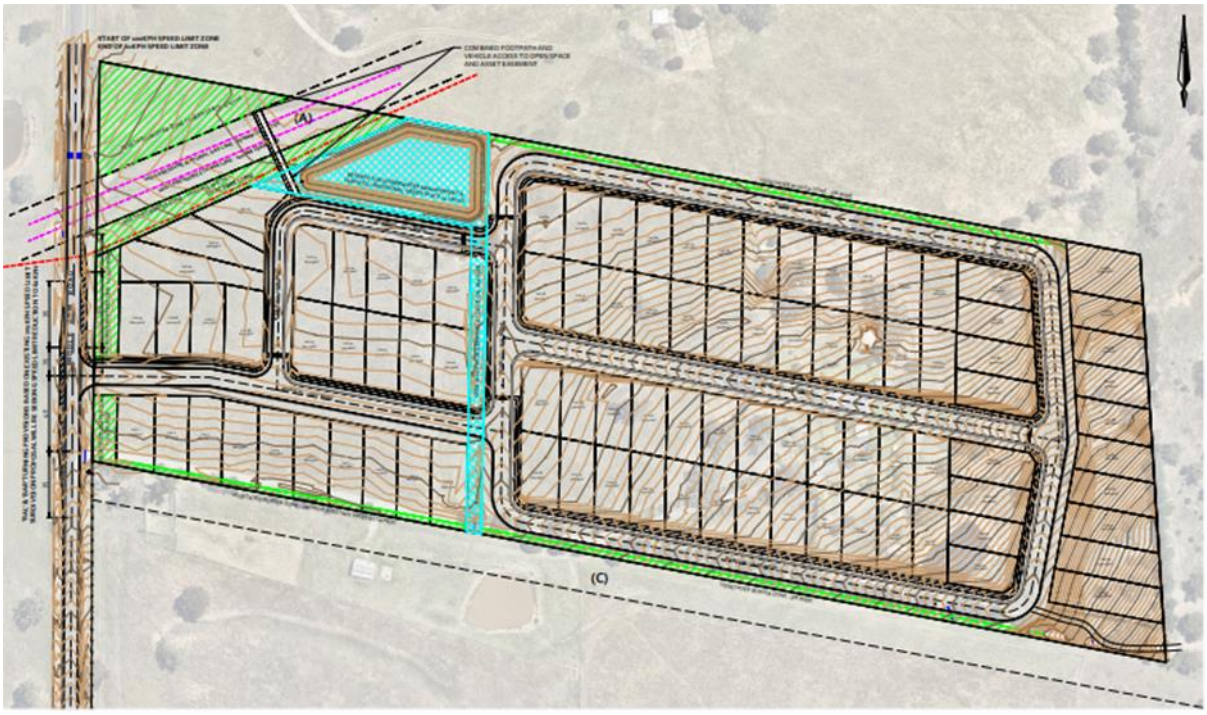
The subject site comprises one existing lot (Lot 2 DP 569505) accessed via Middle Arm Road. The site is mostly cleared grazing land and contains a dwelling, outbuildings and two dams.

The planning proposal is proponent led and seeks to rezone the site to R2 Low Density Residential, as identified within Council's *Urban and Fringe Housing Strategy*. Council has amended the proposal, with portions of the site affected by water courses or other easements now proposed to be zoned RE1 Public Recreation. The rezoning is to facilitate future urban residential subdivision, the site having the capacity for approximately 93 residential lots.

The site is constrained by drainage channels which have overland flow flooding impacts with generally all flood prone land proposed to be zoned RE1 Public Recreation. There is some land currently identified within the PMF which subject to earthworks and formalisation of drainage/roads has the capacity to be be fully contained within the RE1 zoned area and associated drainage infrastructure. The proposal also seeks to amend the minimum lot size from 20 hectares to 700m^2 for the R2 Low Density Residential area proposed. A copy of the submitted planning proposal document is available to view in **Appendix 1**.

The proponents concept subdivision plan identifies a ninety-three-lot subdivision, with an open space area located in the northwestern portion of the site and an area for drainage easements and a stormwater basin on the northern boundary. The site will be accessed via Middle Arm Road with a proposed BAL/BAR intersection treatment. The proponents concept subdivision plan is presented in **Figure 2** and **Appendix 2**.

***Figure 2**: Proponents Concept Subdivision Plan*



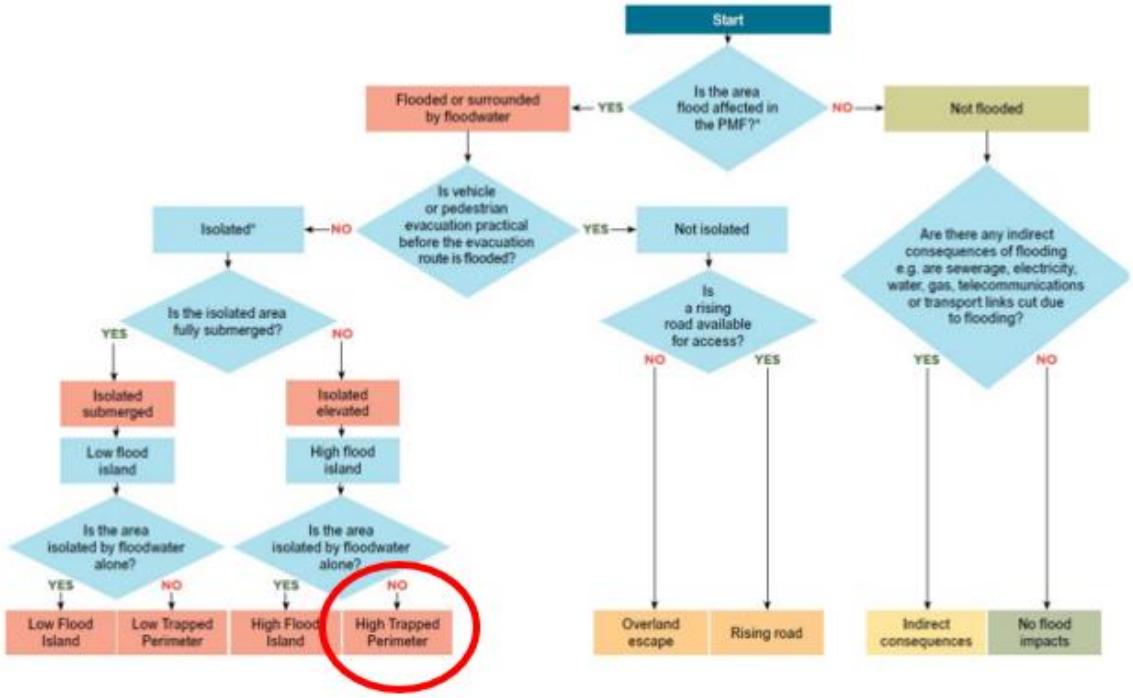
The northwestern corner of the site contains various easements including a section of the APA high pressure gas pipelines, an electrical and optical fibre easement as well as being affected by a non-perennial watercourse. This portion of the site is proposed to be zoned RE1 Public Recreation, as well as a section of land crossing the site north-south which is identified on the concept plan as being a drainage easement and an internal road. This area covers another section of non-perennial water course which crosses the site.

The site is located immediately to the north of the Goulburn Urban Area as currently zoned and approximately 2km north of the Wollondilly River. A non -perennial drainage channel runs vertically across the centre of the site (south – north) with another non-perennial channel which runs diagonally across the northwest corner of the site **Figure 3**.

***Figure 3**: Location of Drainage Channels*

Prior to any mitigations identified in this FIRA it is considered that the site would be classified as a high trapped perimeter using the flood emergency response classifications in EM01 as per the **Figure** 4 below. Portions of the site are currently flood affected; however, the site is on the border of existing residentially zoned land which forms an extension to the Marys Mount or North Goulburn urban release area (URA). As such, the site is not considered isolated and rising road access is available for evacuation to some extent.

Figure 4 *– Flood Emergency Response Classifications – Prior to Mitigations*



3. Consultation

Council has undertaken consultation in general terms in relation to flood impact and risk in Goulburn and the approach required when considering planning proposals for rezoning rural land on the town's periphery to residential. Council held two Goulburn Flooding Technical Working Group meetings between Council, SES and NSW DPE staff in October – November 2023 with representatives from NSW SES, NSW DPE (Planning) and NSW DPE (Biodiversity Conservation Division- Flooding). These meetings focused on planning proposals south of the Hume Highway and on the Goulburn central business district (CBD). It should be noted that the overall approach of all agencies towards rezoning land which may be directly or indirectly affected by flooding has informed this FIRA.

This FIRA is a preliminary assessment and further consultation is to be undertaken with the SES during the State agency consultation process associated with the planning proposal.

A copy of the presentation slides from the Goulburn Technical Working Group meetings are provided in **Attachment 1** to this FIRA.

4. Available Flood Studies and Existing Assessment Requirements

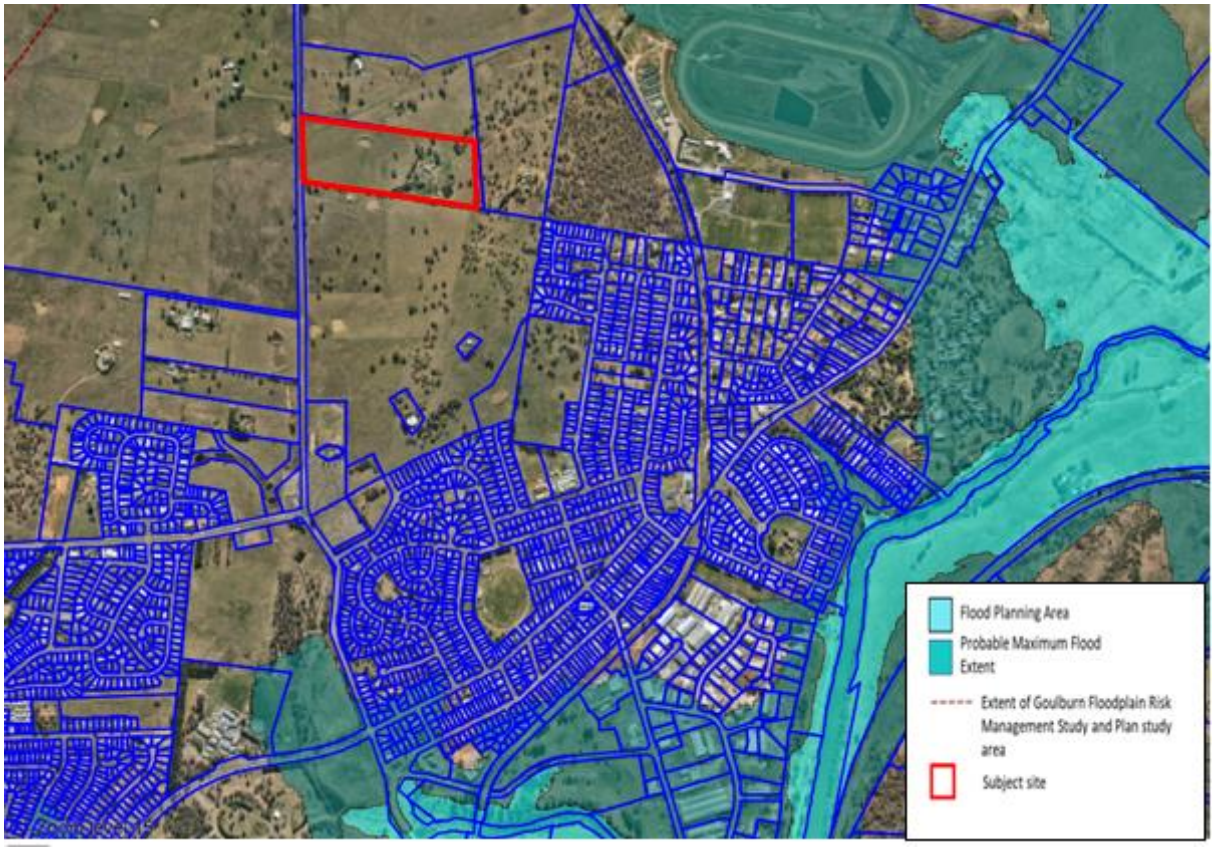
The Goulburn Floodplain Risk Management Study and Plan (The Flood Study) was adopted by Council on 16 August 2022 and was developed in collaboration with the former Department of Planning and Environment- Environment, Energy and Science. The Flood Study was prepared by GRC Hydro in accordance with and consistent with:

- The NSW Flood Prone Land Policy;
- The principles of the Floodplain Development Manual 2005, and
- Considering flooding in land use planning guideline 2021.

The study area includes the subject site but only models the extent of riverine and major tributary flooding. This site is not identified as being subject to riverine flooding for any design event (refer **Figure 5**). However, riverine flooding from the Wollondilly River does restrict access to central Goulburn from this precinct from a 0.2% AEP Event (1 in 500 event).

The Flood Study also included a Development Control Policy which applies controls to both flood prone land within the Flood Study boundaries and areas outside the scope of the Study.

***Figure 5**: FPA and PMF Wollondilly River in Relation to Subject Site*



The Flood Study and DCP flood policy implements Flood Planning Constraint Categories (FPCC) which groups similar types and scales of flood related constraints. Four FPCC's have been established to separate areas of the floodplain from the most constrained and least suitable areas for intensification of land use. The FPCC's are presented in Error! Reference source not found. **and Figure 7** below:

***Figure 6**: Extent of Flood Prone Land – Overland Flooding Modelling Using FPCC*

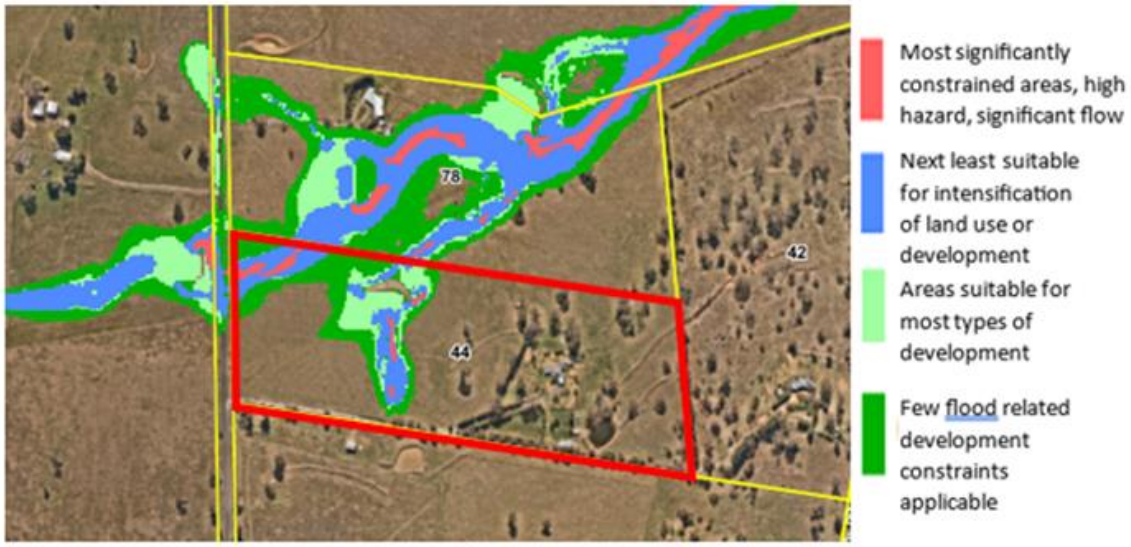


***Figure 7**: Flood Planning Constraint Categories*

Category	Summary
FPCC1	FPCC1 identifies the most significantly constrained areas, with high hazard or significant flood flows present. Intensification of use in FPCC1 is generally very limited except where uses are compatible with flood function and hazard.
FPCC2	FPCC2 areas are the next least suitable for intensification of land use or development because of the effects of flooding on the land, and the consequences to any development and its users.
FPCC3	FPCC3 areas are suitable for most types of development. This is the area of the floodplain where more traditional flood-related development constraints, based on minimum floor and minimum fill levels, will apply.
FPCC4	FPCC4 is the area inundated by the PMF (extent of flood prone land) but outside FPCC1-3. Few flood-related development constraints would be applicable in this area for most development types. Constraints may apply to key community facilities and developments where there are significant consequences to the community if failed evacuations occur.

The DCP flood policy applies different flood planning controls depending on the proposed land use category to ensure that new development does not increase flood risk.

Council has initiated the preparation of the overland flooding study for Goulburn following a successful funding application through the NSW Department of Planning and Environment Floodplain Management Grants program. This project is expected to be finalised in December 2025. However, as an interim measure, Council commissioned overland flood modelling. This modelling utilised the same data and methodology as the riverine flood modelling and mapping within the mainstream Flood Study. This has resulted in a mapping layer which illustrates the location and likely extent of overland flooding and the relative risk to life and property. The overland flood mapping also includes Flood Planning Constraint Categories which have been identified by the same consultant who prepared the Flood Study (GRC Hydro). This modelling is currently used to inform Council as to the potential for flooding and flood risk beyond riverine areas.

The overland flood model maps are available to view on the Council's website at: https://www.goulburn.nsw.gov.au/Development/Plans-Strategies#section-10

Both the Flood Study and the overland flow modelling have accounted for climate change utilising the ARR2019 methodology to determine the projected increase in precipitation intensity. These details have been utilised to determine increased rainfall for the 1%, 0.5% and 0.2% flood events up to 2090 and incorporated into the riverine and overland flow modelling.

The adopted *Goulburn Floodplain Risk Management Study and Plan* (The Flood Study) has assessed riverine flooding and associated risk in Goulburn. The extent of this study area includes the subject site which is not directly impacted by riverine flooding (due to its elevation). The site is included in the area where overland flow modelling has been undertaken as a separate project outside of the Goulburn Flood Study. It illustrates that portions of the site are inundated by overland flooding but this inundation aligns with the locations of the non-perennial water courses. Council's overland flow modelling would suggest that access within the site can be achieved to all lots where a proposed access road follows the southern boundary during each design event through to the probable maximum flood (PMF).

The overland flow modelling, illustrated in **Figure 6**, indicates that the identified drainage channels experience flood inundation.

A *Local Flood and Overland Flow Study* was submitted in support of the proposal which also models pre and post development overland flows.

Council's Overland Flood Modelling and the submitted Local Flood and Overland Flow Study's identification of the presence of overland flow inundation on site, suggests the subject site is flood prone and as such Ministerial Direction 4.1 applies.

The *NSW Flood Prone Land Policy's* (The Flood Policy) primary objective is to reduce the impacts of flooding and improve community resilience. The policy recognises that flood prone land is a valuable resource and proposals for rezoning should be the subject of careful assessment which incorporates consideration of local circumstances.

The policy requires:

- a merit-based approach to be adopted for all development decisions in the floodplain;
- a reduction in flooding impacts and liability on existing developed areas
- limiting the potential for flood losses in all areas proposed for development by the application of ecologically sensitive planning and development controls.

The *Flood Risk Management Manual* (the Manual) requires planning proposal authorities to consider the principles of the Manual and advice provided in the supporting Toolkit. The Manual establishes the following Vision:

> *"Floodplains are strategically managed for the sustainable long-term benefit of the community and the environment, and to improve community resilience to floods".*

and the following 10 principles for flood risk management:

1. Establish sustainable governance arrangements;
2. Think and plan strategically;
3. Be consultative;

4. Make flood information available;
5. Understand flood behaviour and constraints (for the full range of floods);
6. Understand flood risk and how it may change (for the full range of floods);
7. Consider variability and uncertainty;
8. Maintain natural flood functions;
9. Maintain flood risk effectively, and
10. Continually improve the management of flood risk.

The Manual highlights the requirement for a robust understanding and analysis of risk which can then be deployed to determine whether the risk is acceptable and determine if additional action is required to further reduce identified residual risk.

The *Flood Risk Management Toolkit* (the Toolkit) provides more detailed guidance on how to meet the objectives of the Flood Policy and Manual and these documents have been considered in the development of this planning proposal. The following documents in the Toolkit are especially pertinent to this planning proposal:

- *EM01- Support for Emergency Management Planning*
- *LU01- Flood Impact and Risk Assessment*
- *FB01- Understanding and Managing Flood Risk*
- *MM01- Flood Risk Management Measures*

The proposal's consistency with the Flood Policy, The Manual and Toolkit are largely addressed separately in the sections responding to Ministerial Direction 4.1 in the accompanying planning proposal.

In relation to this site, the main issues identified for consideration in this Flood Impact Risk Assessment are **site access/evacuation** and the **safe occupation** of proposed residential lots.

5. Warning Times, Evacuation, Isolation, Duration

In accordance with *EM01 Support for emergency management planning*, evacuation is considered in the context of this site, with emergency management responses tested.

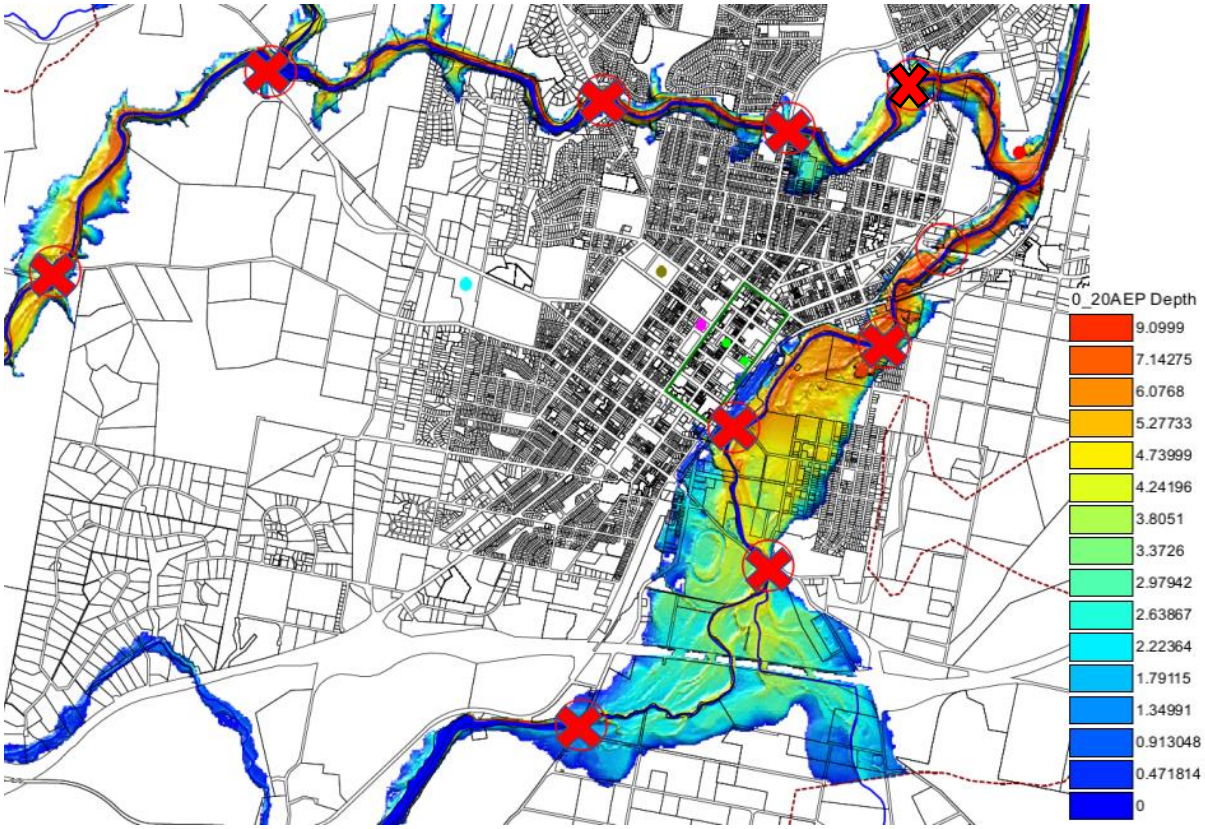
As stated in the NSW SES' *Goulburn Mulwaree LGA Local Flood Plan*, consultation with NSW SES is required as a part of the strategic planning for flood affected land to avoid additional risk. As stated at the beginning of this preliminary FIRA Council will undertake further consultation with the NSW SES in relation to the planning proposal and this FIRA.

This FIRA considers:

- The potential for this community to be isolated (noting it has already been established that this community will not be inundated – **refer to Section 10** of this FIRA).
- the availability for warning in this location/warning times
- evacuation capability
- compatibility with the existing EM response strategy
- whether occupants are safe and self sufficient in the event of a flood.
- Ability to self-evacuate to a place of safety.

The main consideration then is the potential for this community to be isolated and an evacuation route from the site to a suitable destination. It should be noted that the entirety Goulburn (north of the Wollondilly River) is cut off from the central portion of Goulburn once flooding reaches a 0.20%AEP Event (1 in 500) as identified in **Figure 8** below which details when each of the bridge crossings become blocked crossing the Wollondilly River to the north.

Figure 8: *Wollondilly and Mulwaree River Bridges Goulburn – Closures 0.2% AEP*



North of Marys Mount Road (and the road itself) is outside of the extent of riverine PMF flood level. Flooding to the north of the river (outside of the major tributaries) is overland flooding and is likely to be characterised as flash flooding (as there will be little to no warning). However, given the relative elevation of the area it is also considered that isolation times outside of riverine crossing points will be of relatively short duration.

6. Evacuation Point

The most direct route from the site to a potential evacuation location is from Middle Arm Road via Marys Mount Road to the developing commercial precinct near the intersection of Crookwell Road and Marys Mount Road (3.8 kms) centred on Box Avenue. This commercial area contains an existing childcare centre, gym/commercial building, car wash and café. Furthermore, a supermarket with medical centre is currently under construction and a site has been approved for a future service station. This commercial area is intended to service the North Goulburn/Marys Mount precinct. Therefore, it is likely that if access to the main section of Goulburn south of the Wollondilly (due to a 0.20% AEP Event – PMF event) is blocked, this commercial precinct would be the most likely source of food or other services during a period of isolation. The following **Figure 9** identifies the evacuation route and destination point, with various locations marked A – G where overland drainage results in potential flooding of the road.

Figure 9*: Evacuation Route- Subject Area to Commercial Area (Box Ave)*

The following tables identify the worst depths and velocities in the vicinity of each flood crossing point marked A – G between the site and the new commercial precinct centred on Box Avenue. The hazard categories used are from the Australian Emergency Handbook 7, with the vulnerability thresholds as specified in **Figure 10 and 11** below.

Figure 10: *Flood Hazard Vulnerability Thresholds*

Hazard Classification	Description
H1	Generally safe for vehicles, people and buildings.
H2	Unsafe for small vehicles.
H3	Unsafe for vehicles, children and the elderly.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

Figure 11: *Flood Hazard Curves (Australian Emergency Handbook 7)*

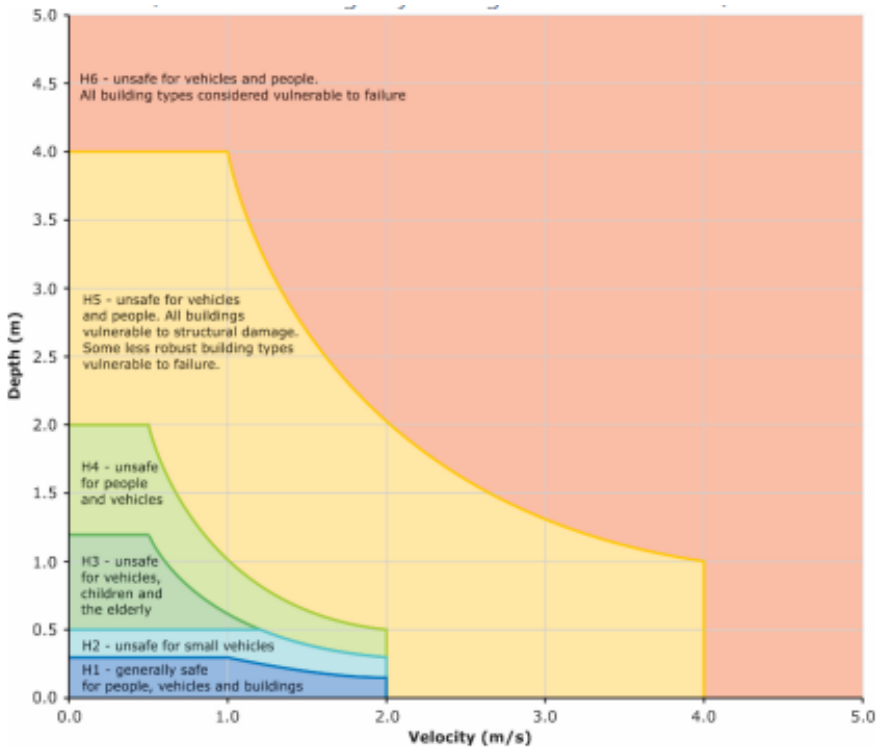


Table 1 :Overland Flooding Points 1% AEP and Hazard Ratings – Site to New Commercial Precinct

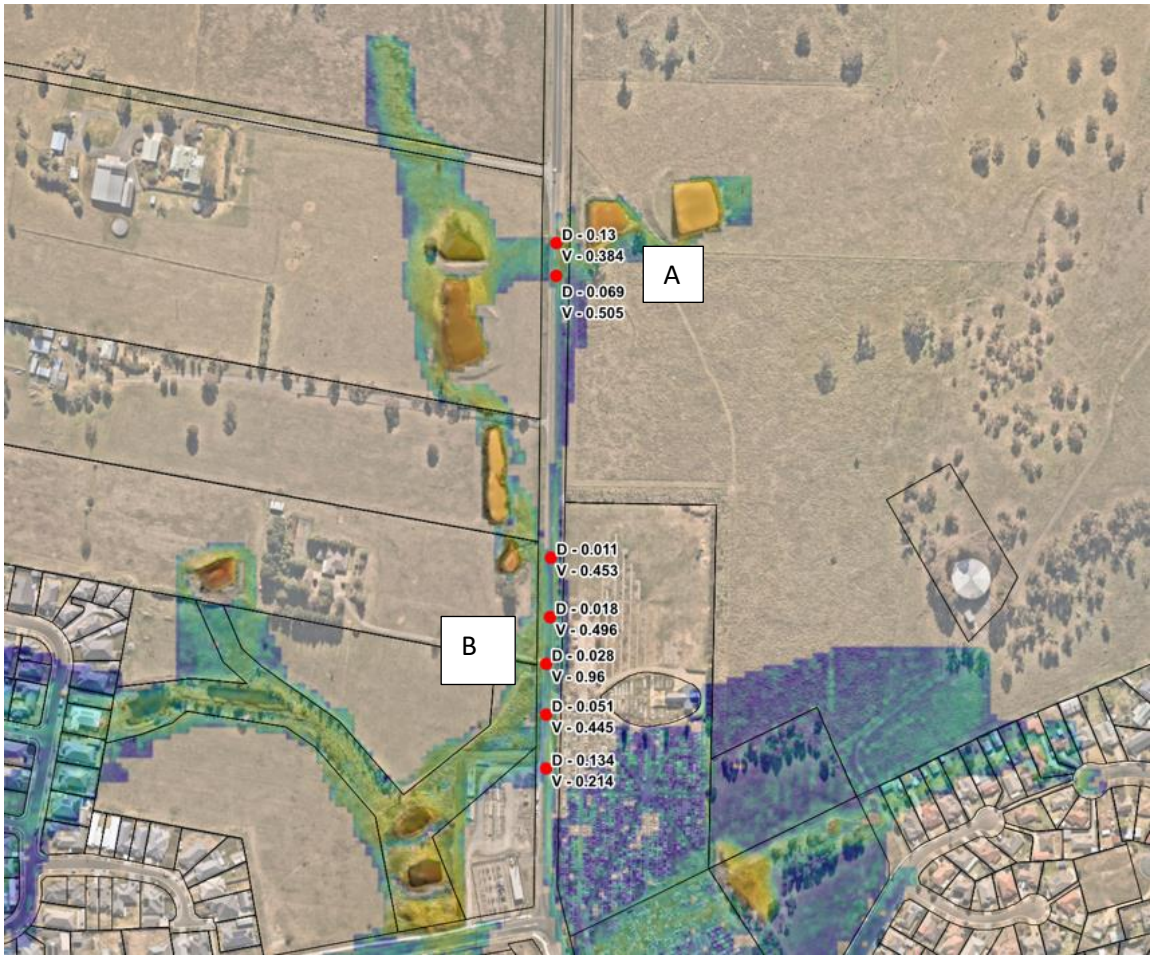
	A	B	C	D	E	F	G
Depth (m)	0.13	0.134	0.239	0.054	0.437	0.272	0.128
Velocity (m/s)	0.384	0.214	0.588	0.953	0.516	0.236	0.212
Hazard Category	H1	H1	H1	H1	H2	H1	H1

Table 2: Overland Flooding Points PMF and Hazard Ratings – Site to New Commercial Precinct

	A	B	C	D	E	F	G
Depth (m)	0.236	0.352	0.626	0.11	0.916	0.719	0.301
Velocity (m/s)	1.055	2.045	2.3	1.637	1.227	1.228	0.719
Hazard Category	H1	H5	H5	H1	H3 – H4	H3 – H4	H1

The following Council modelling has been applied to Middle Arm Road where it links the site to the existing North Goulburn (Marys Mount) urban area.

***Figure 4**: 1% AEP Event – Middle Arm Road, South of the Subject Site and the intersection of Middle Arm Road and Marys Mount Road in metres*



The modelling shows for the 1% AEP that depths of flood water over Middle Arm Road do not exceed 14cm at any one point. Therefore, the flood risk for evacuation through this area is low risk. Additionally, Council's *Development Control Plan (DCP) 2009*, identifies existing drainage to be controlled through this section of Middle Arm Road consistent with the drainage corridors identified in the overland flood modelling.

Figure 5: *Flood Evacuation Route via Middle Arm Road, PMF Event Depths and Velocities (m)*

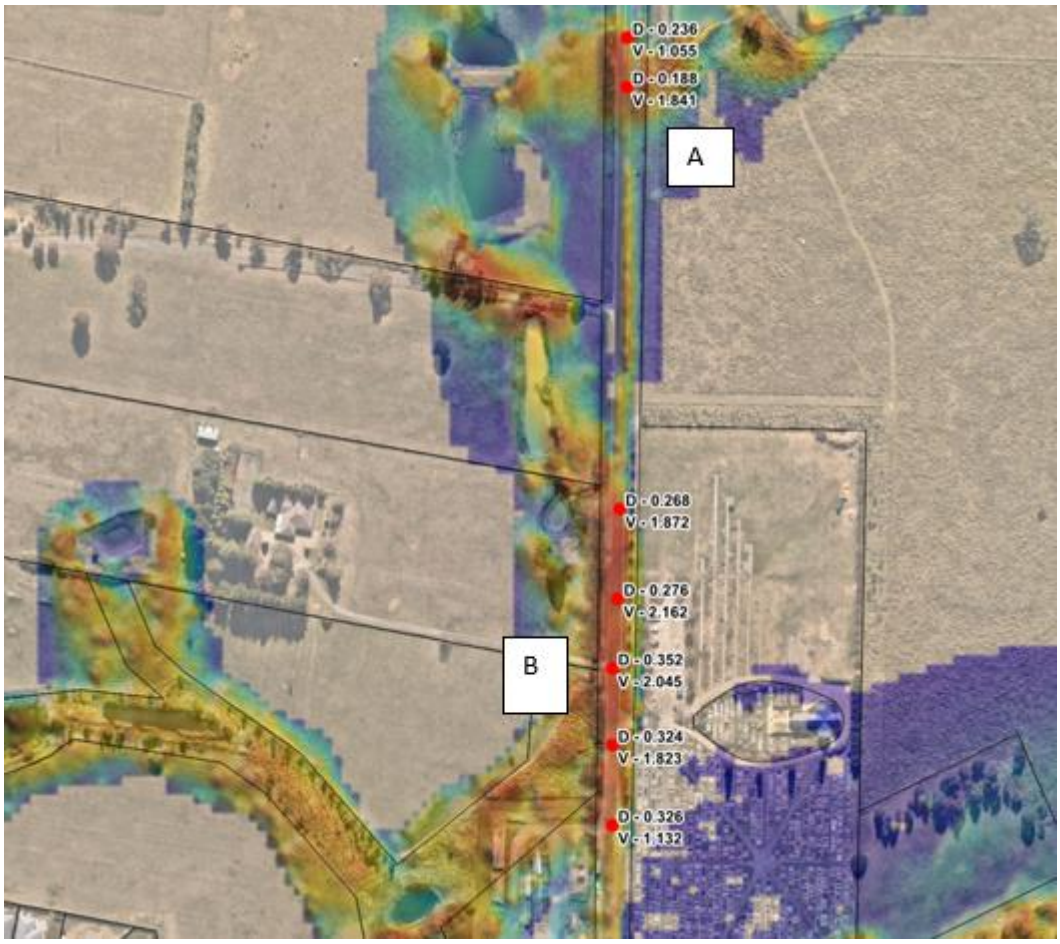


Figure 14*– Evacuation Route 1% AEP via Marys Mount Road – Points C- D*

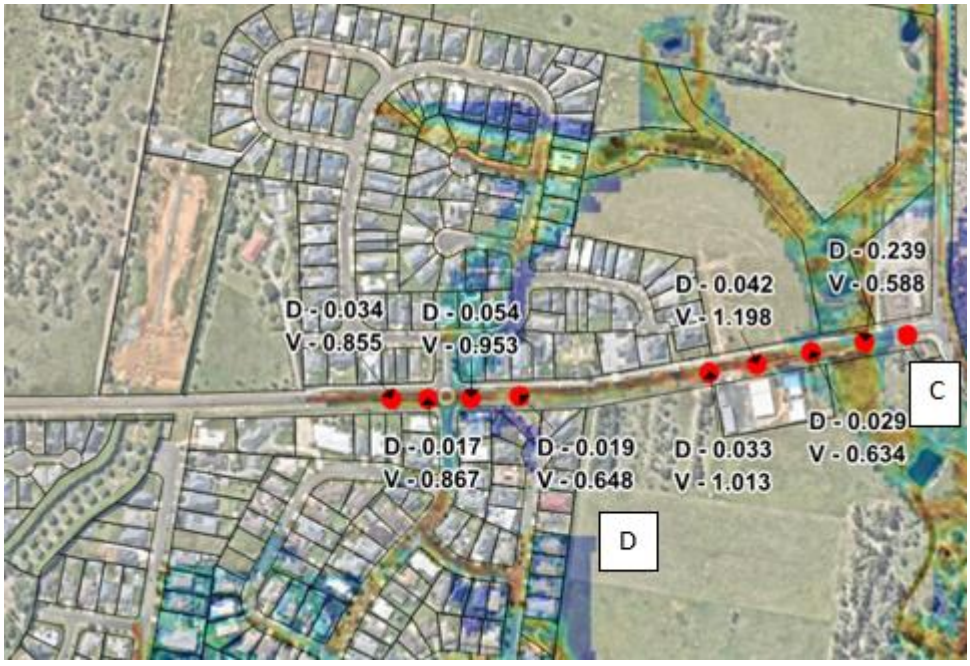


Figure 15 *– Evacuation Route 1% AEP via Marys Mount Road Points E - G*

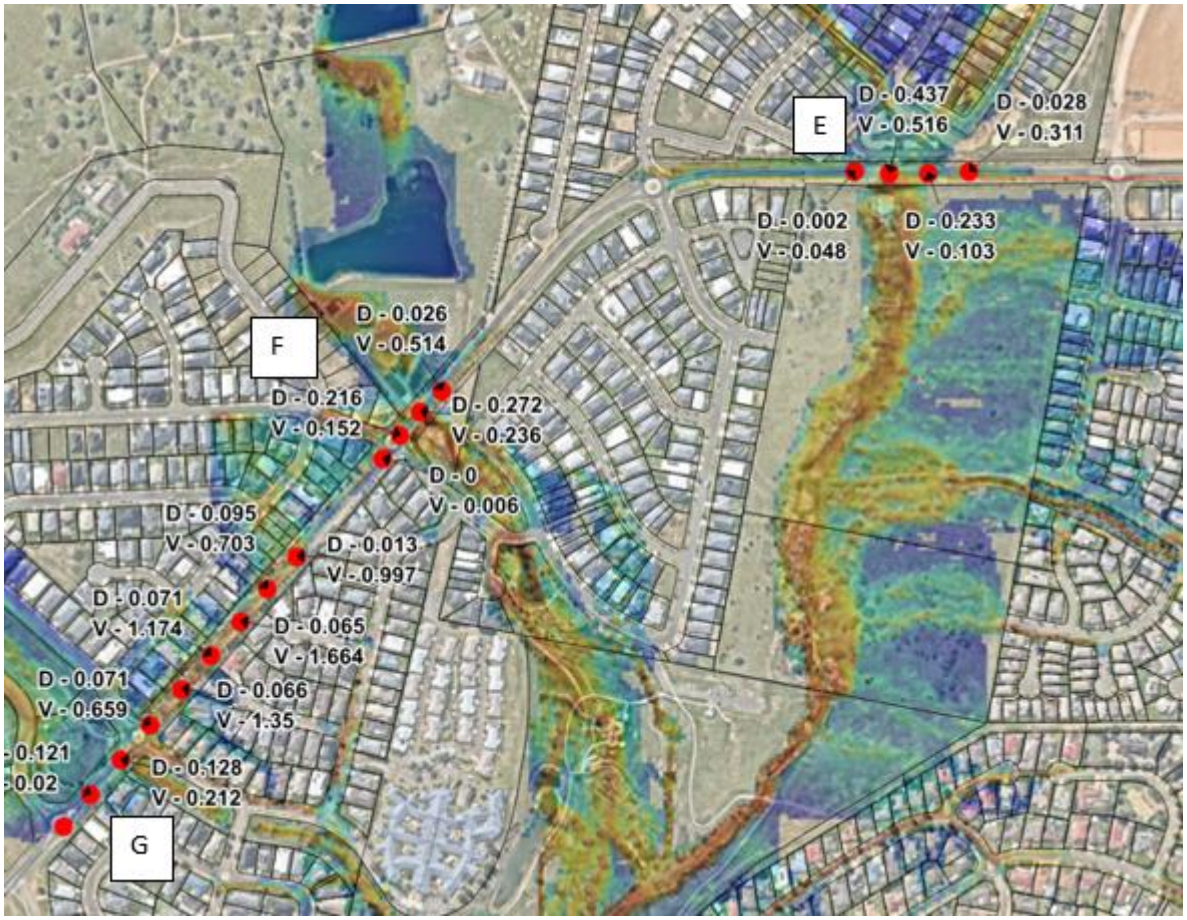


Figure 16 *– Evacuation Route PMF via Marys Mount Road Points C - D*

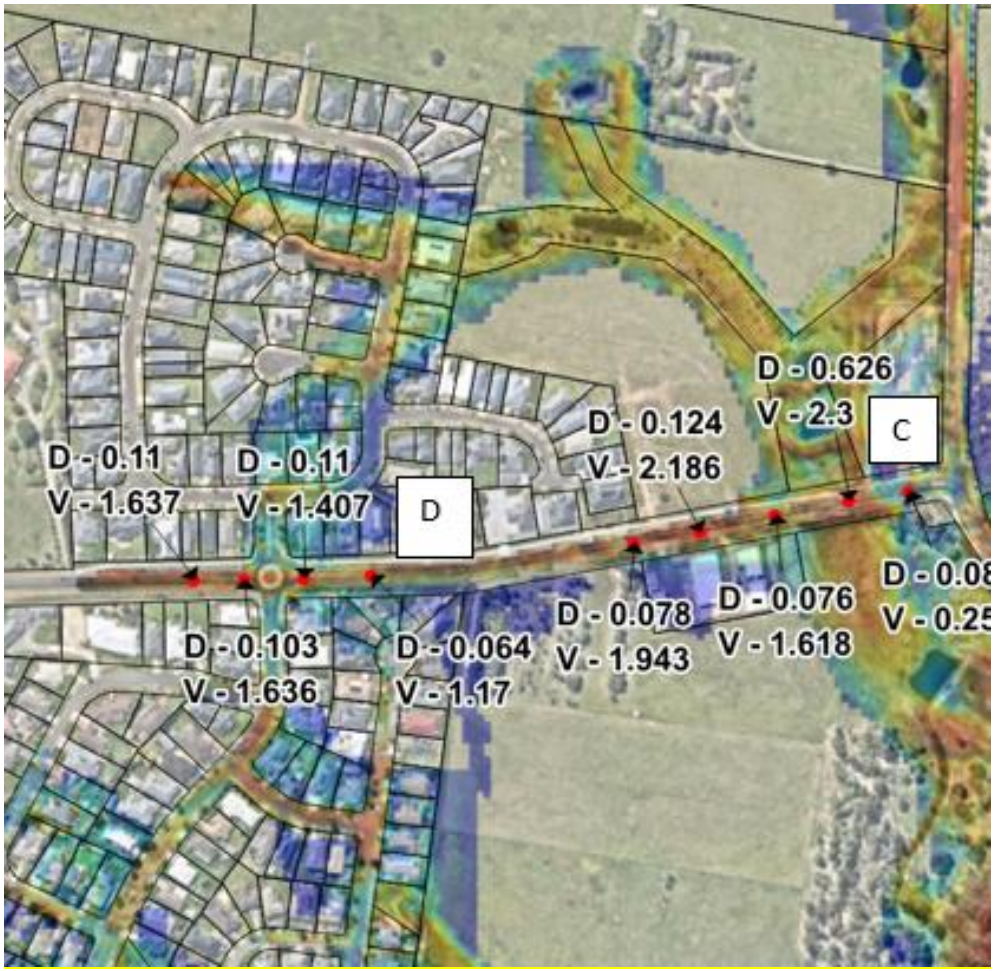
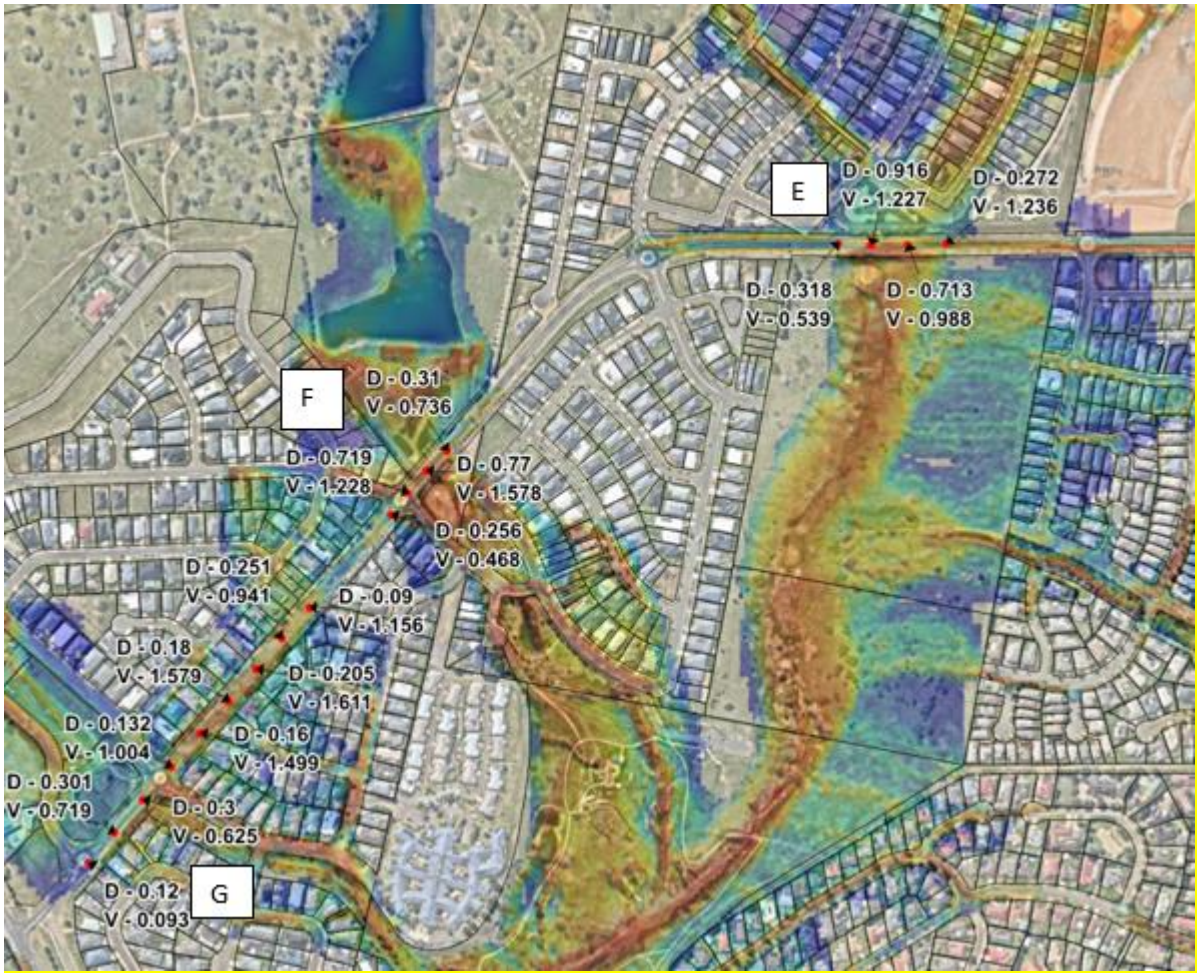


Figure 17– *Evacuation Route PMF via Marys Mount Road Points E - G*



The hazard categorisations for the various intersections vary greatly in a PMF event (refer Table 2) for each crossing on the main evacuation route.

This site can achieve evacuation to the North Goulburn (Marys Mount) urban area for a range of flood events up to and including the 1%AEP. As development occurs along Middle Arm Road further improvements to drainage, culverts etc are identified in Council's DCP 2009. However, the route from the site to the identified destination (new commercial area Box Avenue) is affected by more hazardous levels of flooding beyond the 1%AEP.

7. Evacuation - Alternative Routes

Two alternative routes are identified and are assesses as follows:

Alternate Route 1- Middle Arm Road (to north)- Norwood Road – Marble Hill Road- New Commercial Area (Box Avenue). This is a very indirect route to the new commercial area from the site and passes through a large rural catchment. This route is approximately 12km from the subject site through to the commercial area. Council is aware that Crookwell Road at Bumana Creek becomes blocked earlier than a 1% AEP, accordingly this route has not been considered further as a suitable alternative option.

Alternate Route 2 – Middle Arm Road (south)– Queen Street (to IGA supermarket Cnr Queen Street and Ross Street) 2.7kms. This route has an alternative destination which is

the existing IGA supermarket on the corner of Queen and Ross Streets in Bradfordville. Unlike the new commercial area this is a standalone supermarket with no other medical or other services planned for or provided. The following Figure… details the alternate route.

Figure 18: *Alternate Evacuation Route – Subject Site to Supermarket Cnr Queen/Ross Streets*

Figure 19: *Alternative Evacuation Route – 1% AEP - Points C1 – G1*

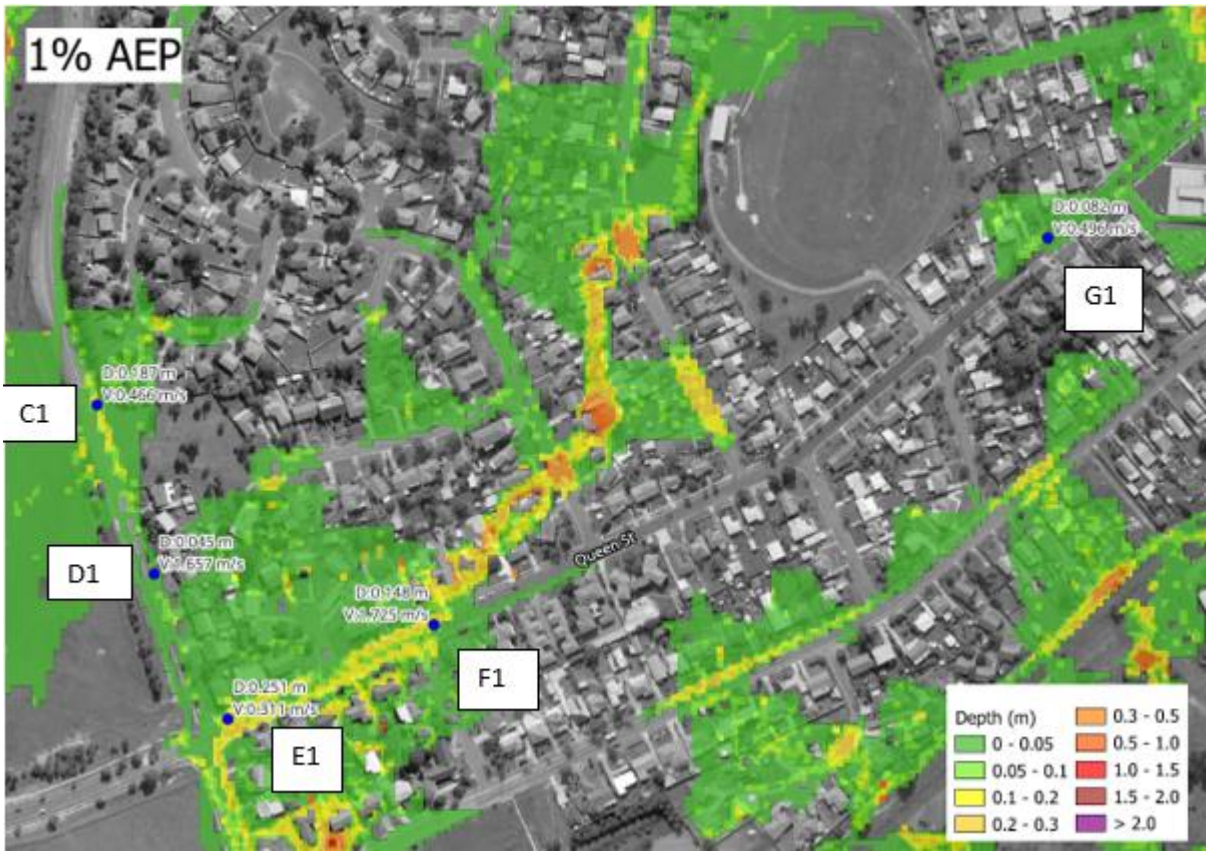


Table 3: Overland Flooding Points 1% AEP and Hazard Ratings – Alternate Route to Supermarket

	A	B	C1	D1	E1	F1	G1
Depth (m)	0.13	0.134	0.187	0.045	0.251	0.148	0.082
Velocity (m/s)	0.384	0.214	0.466	1.657	0.311	1.725	0.496
Hazard Category	H1	H1	H1	H1	H1	H1	H1

Figure 20: *Alternative Evacuation Route – PMF - Points C1 – G1*

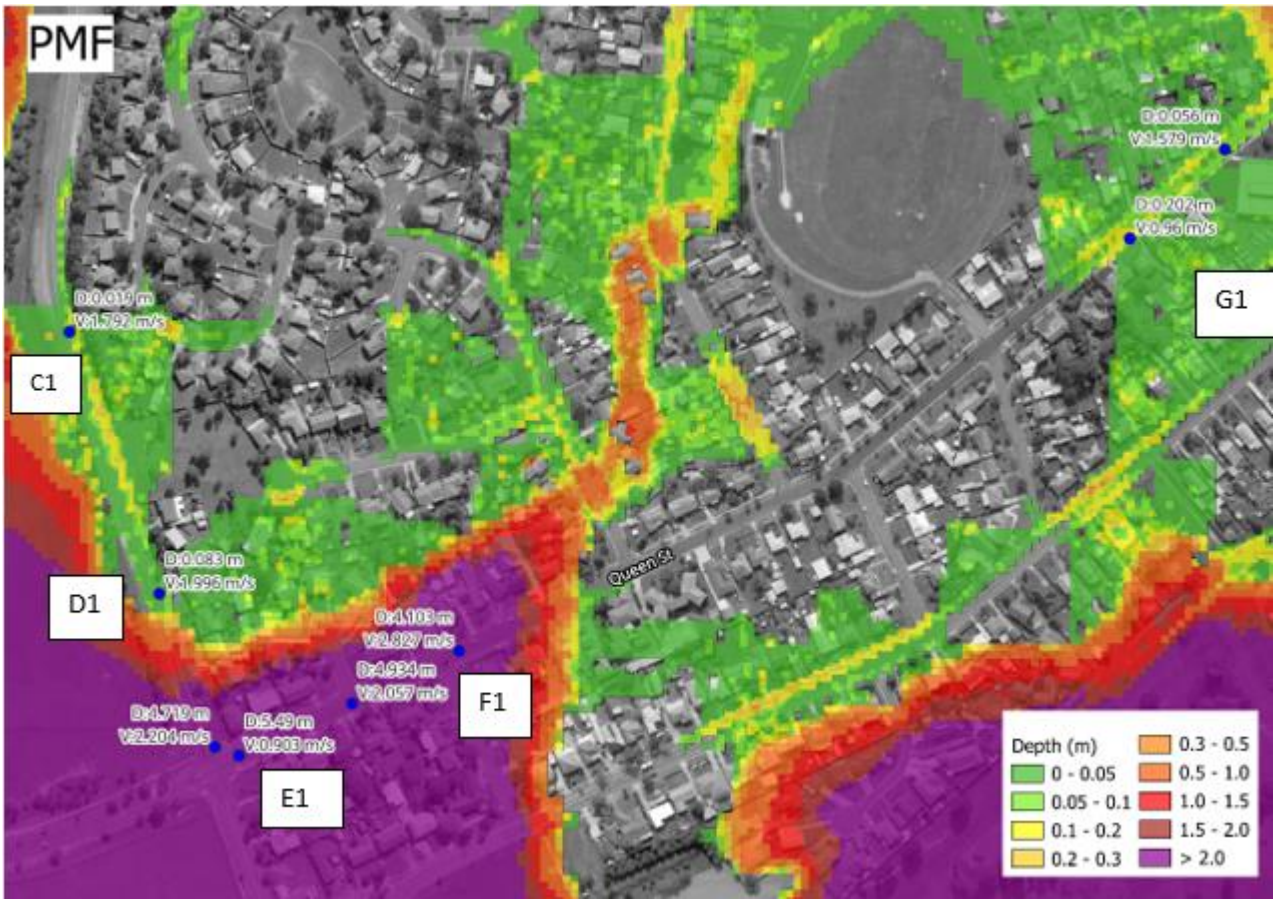


Table 4: Overland Flooding Points PMF and Hazard Ratings – Alternate Route to Supermarket

	A	B	C1	D1	E1	F1	G1
Depth (m)	0.236	0.352	0.019	0.083	5.49	4.934	0.202
Velocity (m/s)	1.055	2.045	1.792	1.996	0.903	2.057	0.96
Hazard Category	H1	H5	H1	H1	H6	H6	H1

As identified in Table 4 above, the route experiences high depths and velocities near the intersection of Middle Arm Road and Queen Street. This is due to the overland flooding interacting at this elevation with the riverine PMF. This route becomes too dangerous and is blocked at this point. However, it is possible to avoid this area of deeper riverine flooding by taking another more indirect alternate route via Amaroo Place, Woodward Street and Yarrowlow Street to Queen Street.

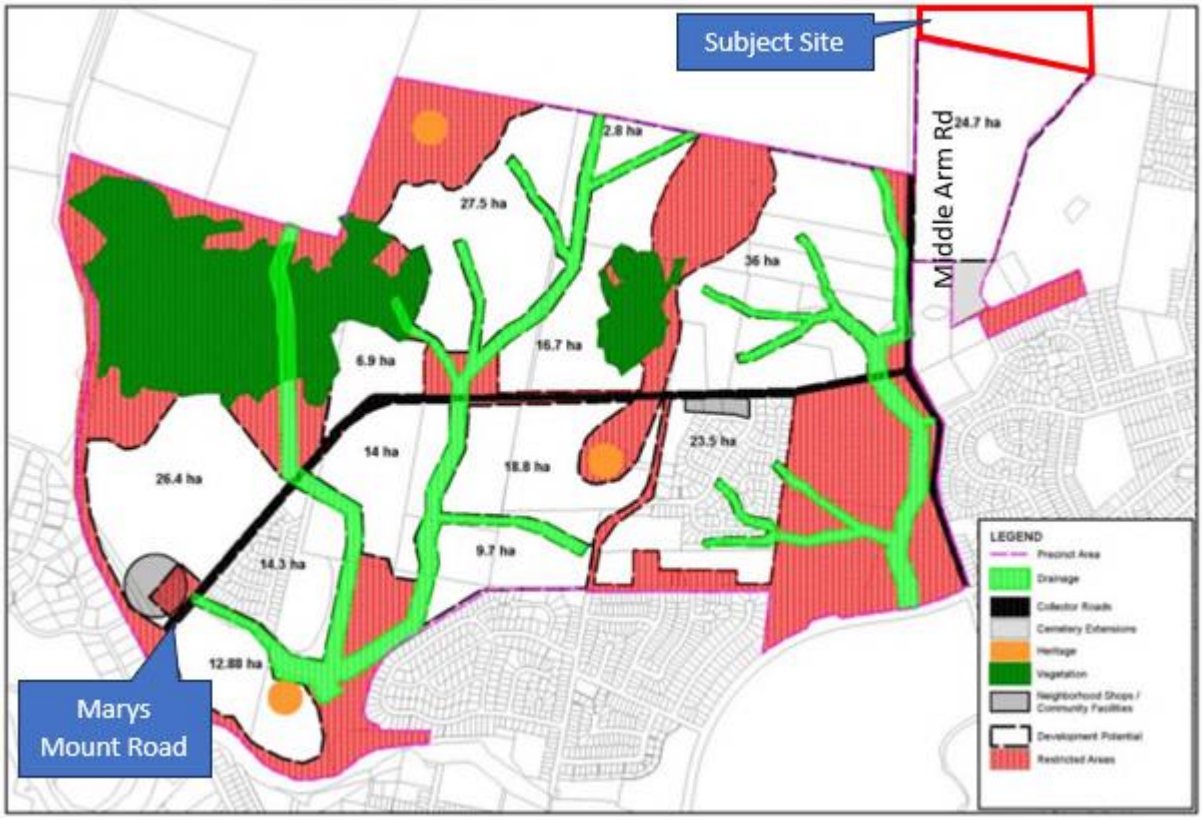
It is anticipated that overland flooding points A – B for both routes could be mitigated by future road drainage upgrades as the area develops (as identified in the Goulburn Mulwaree DCP structure plan for this precinct which identifies these drainage corridors). Should this occur the indirect route via Amaroo Place may be a viable option for horizontal evacuation across the precinct above the riverine PMF.

8. Potential Mitigations for Evacuation– Planning Provisions

It should be noted that the LiDAR data which the overland flood modelling is based on is from 2011. Many of the road improvements and stormwater detention work undertaken with newer subdivisions within the urban release area would have been constructed after this date.

The North Goulburn/Marys Mount Urban Release area has been identified since 2009. The planning for this release area identified the same drainage corridors that the subsequent overland flow modelling has identified. These corridors are shown in the following extract from the Goulburn Mulwaree DCP 2009 detailing their location.

Figure 21: *GM DCP 2009 identifying drainage channels in light green in the Marys Mount including alongside Middle Arm Road*



Each subdivision approved within the precinct has necessitated some formalisation of these drainage corridors with associated works such as on-site detention basins, roads and pit/pipework installation or upgrades. However, it should be noted that as is typically standard engineering practice that the piped drainage system is only designed "*for a 1 in 5 year storm event. Higher order storm events to be based on an overland flow systems along natural drainage lines*". **This is an important point for general consideration as all drainage systems (including those associated with local roads) outside natural drainage corridors are likely to be affected by any more than a 20%AEP event**.

Essentially the trigger for ongoing road upgrades at drainage points is the progression of new development within the area as a catalyst for improvements.

9. Warning Times

The concept plan in association with the Council modelling would suggest that all sections of the site can achieve access to Middle Arm Road in all design events and that flooding within internal roadways up to the PMF will be in the lowest hazard category.

The precinct is relatively elevated and sits above the flood plain for the Wollondilly River. Drainage corridors on site and along access roads are mostly non – perennial water courses. Whilst some warning may be available for crossing points at the Wollondilly River (where riverine flooding occurs) warning times associated with non-perennial water courses where crossing roads is likely to be short (flash flooding). It is also noted due to the relative elevation of this precinct that durations would be relatively short for isolation within the precinct itself.

In summary, the following points are made in relation to evacuation, warning times, isolation and duration:

- The context of flooding on the site as discussed later in Section 10 would suggest that evacuation as per the NSW SES *Goulburn Mulwaree LGA Local Flood Plan* (Refer Section 5.8) would not be required.
- The Marys Mount Precinct has been identified as an urban release area since 2009 with several large subdivisions under construction.
- This site is contiguous with the existing urban release area under development.
- Evacuation would largely be horizontal – moving across an elevated area above the Wollondilly floodplain.
- The main evacuation points prior to a 1 in 500 event would be to within central Goulburn but after this more realistically it would be either to the new commercial area centred on Box Avenue or the supermarket at Bradfordville (i.e. within areas north of the Wollondilly River).
- Currently access to both evacuation points (or for food/other services) involves several crossing points which are at H1 – H2 hazard levels in a 1% AEP event.
- Drainage corridors subject to flooding are identified in the DCP 2009 and road drainage is being incrementally upgraded as the subdivisions progress as per the structure plan.
- Currently the hazard categories for crossing points A – B are too hazardous for a PMF event however once upgrades to Middle Arm Road occur with the development of residentially zoned land, there may be some capacity to evacuate in the rarer events also (but only within the precinct).

10. Safe Occupation

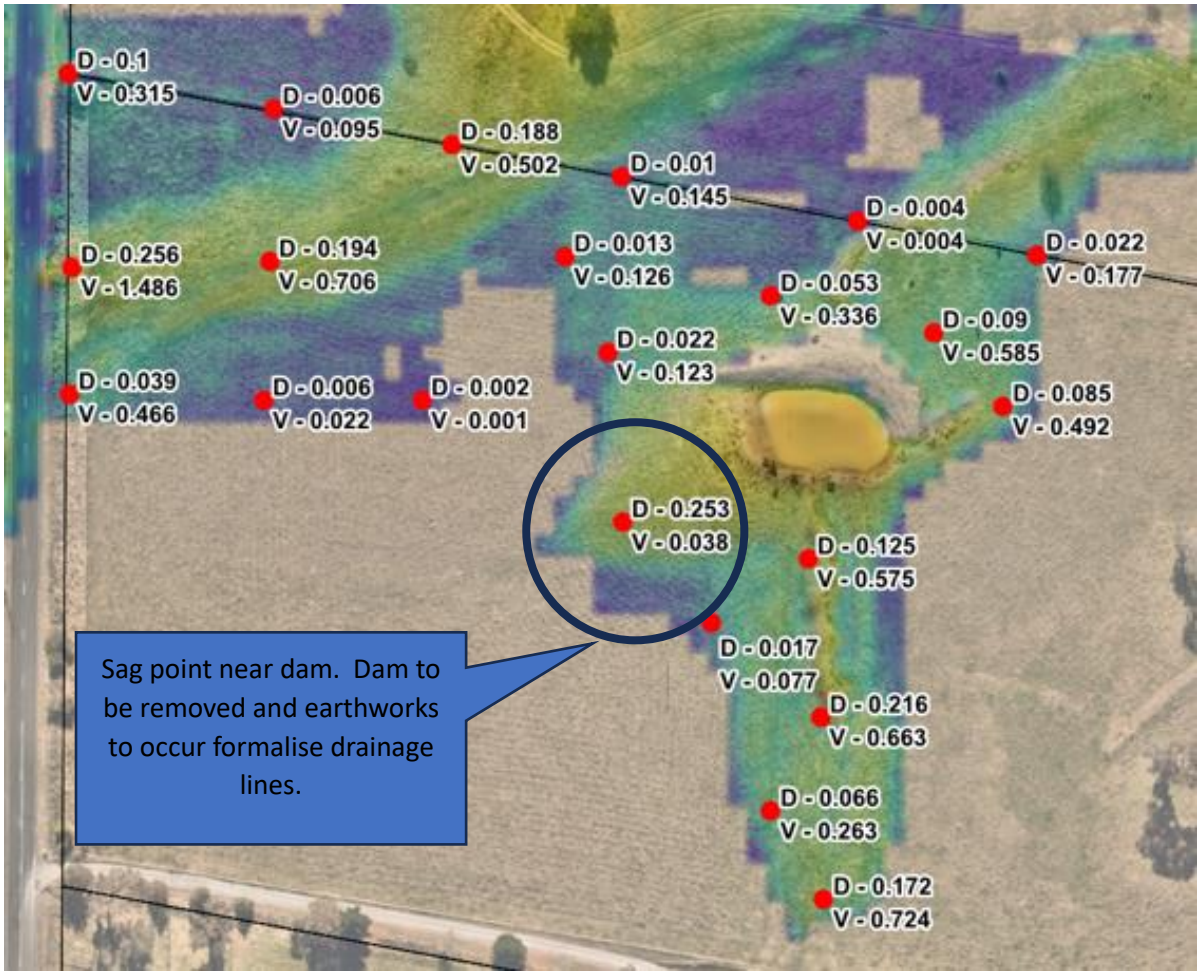
This planning proposal is seeking the rezoning of part of the existing RU6 Transition zoned site to a residential use. To ensure Ministerial Direction 4.1(2) is satisfactorily addressed and flood prone land is not rezoned from rural to residential, generally the full extent of overland flow inundation is proposed to be rezoned to RE1 Public Recreation based on a post development scenario, as illustrated in **Figure 22.** **The only exception is a sag point/depression area located between the drainage lines and in feeding into the existing dam.**

Figure 22: *Proposed RE1 zoning and Flood Prone Land (FPCC Categories)*

A more detailed understanding of depths and velocities is provided from the overland flood modelling for the 1%AEP are provided below.

Figure 23: *Subject Area -1%AEP extent, depths and velocities (identifying insert area)*

Figure 24*: 1%AEP extent, depths and velocities (insert area)*



The depths and velocities are also provided by the overland flood model for the PMF event as depicted in the figure below.

Figure 25: *Subject Area- PMF event, extent, depths and velocities (showing insert area)*

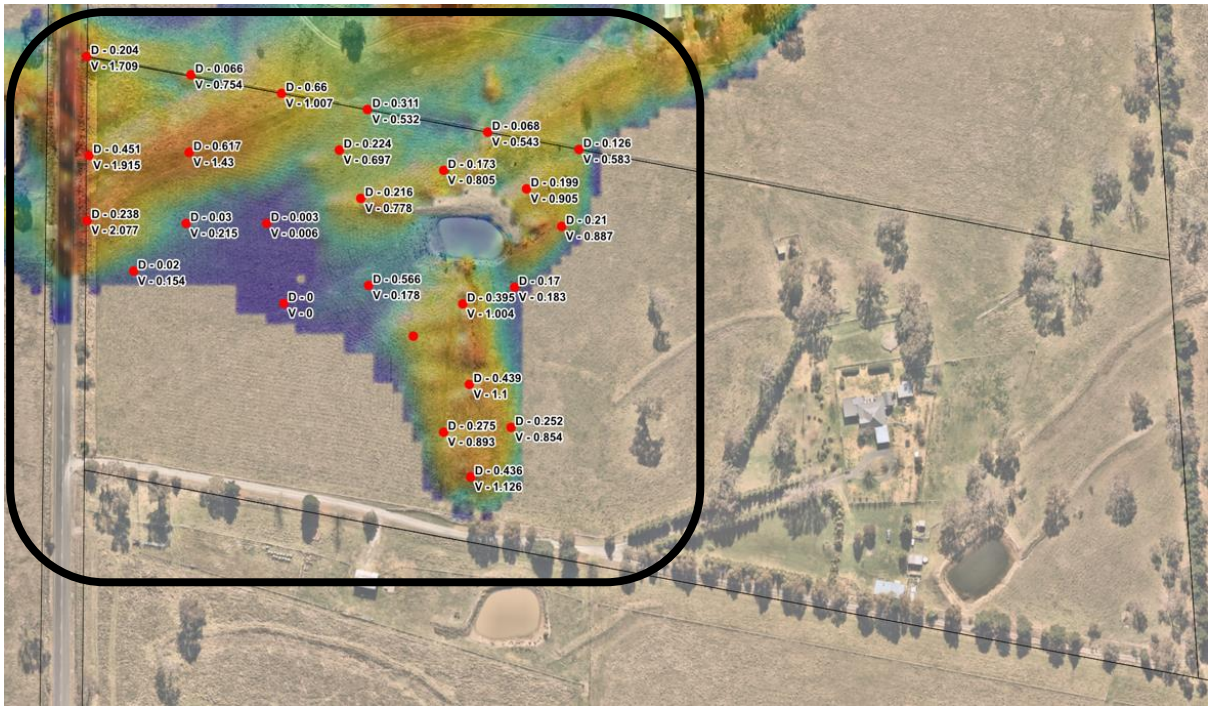
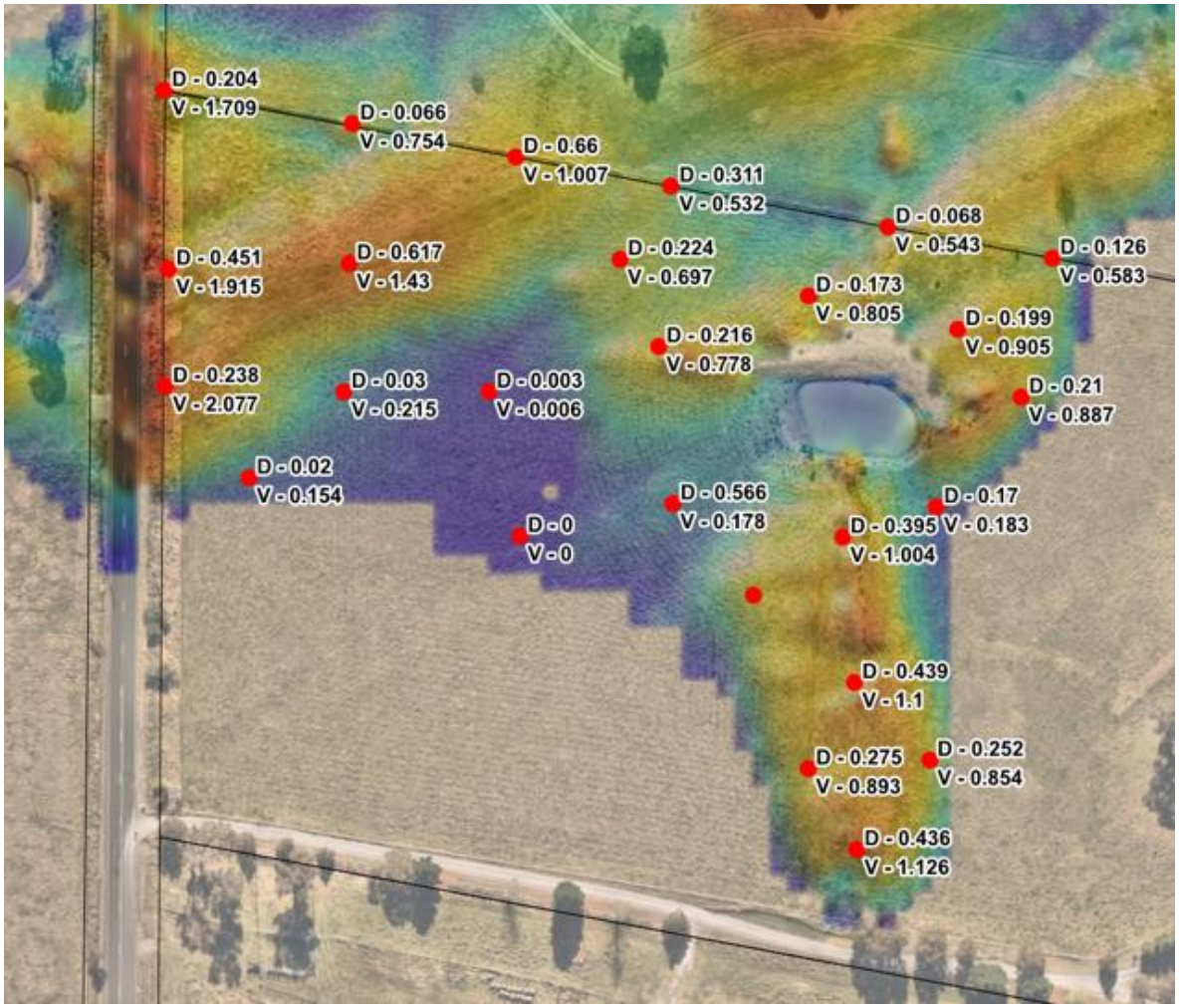


Figure 26: *PMF event, extent, depths and velocities (insert area)*



The submitted *Local Flood and Overland Flow Study* also modelled pre-development and post development flows for a range of events. The following pre and post development outcomes were modelled for the 1%AEP and PMF

Figure 27: *1% AEP Pre-development Depth and Extent*

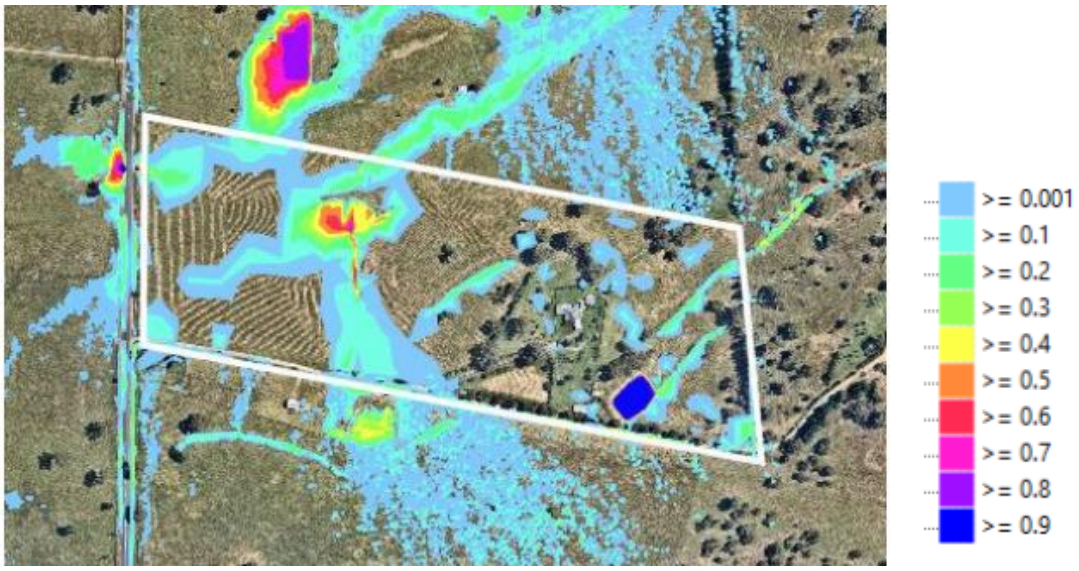
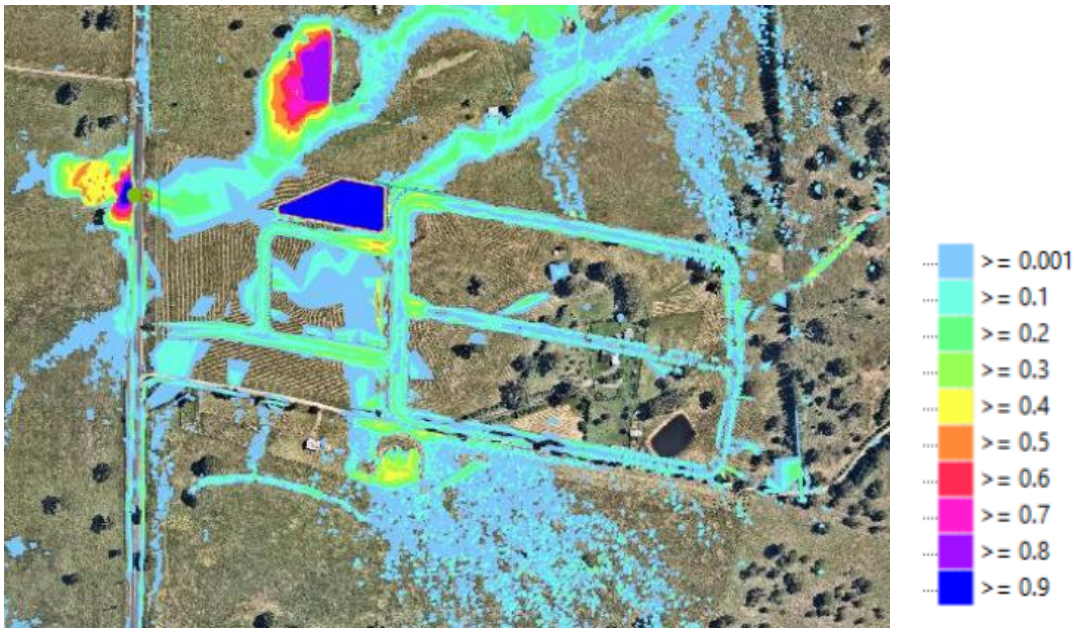


Figure 28*: 1% AEP Post Development Depth and Extent*



The depths identified for the 1% AEP event are shallow and within generally safe and within the low risk H1 hazard category.

***Figure 6**: PMF Pre-development Depth and Extent*

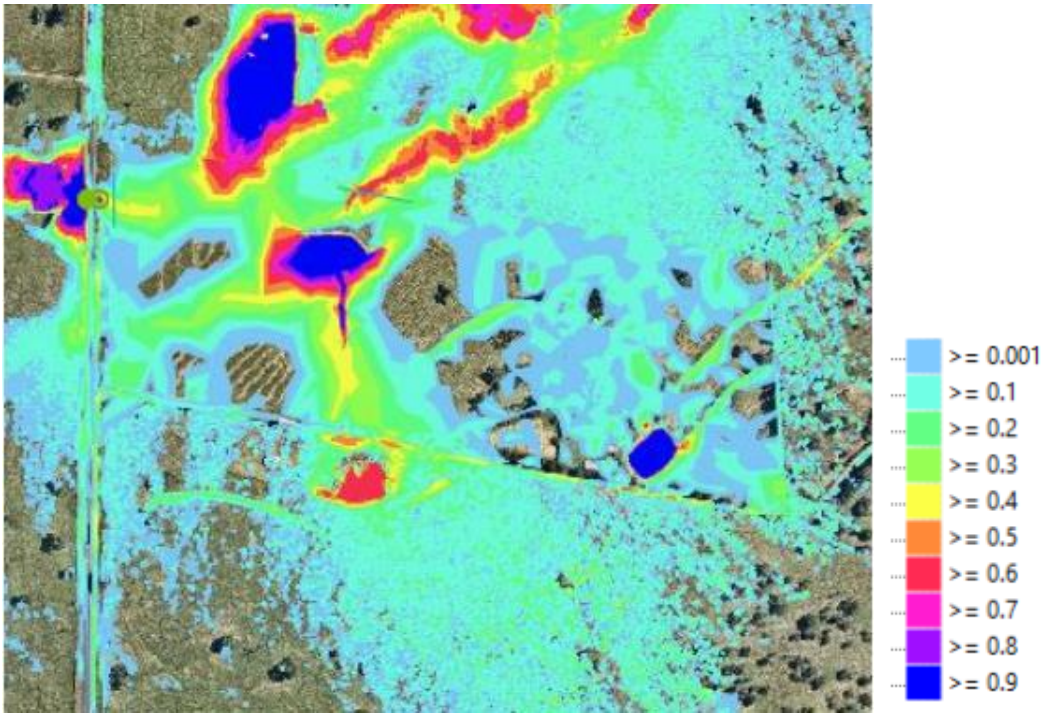
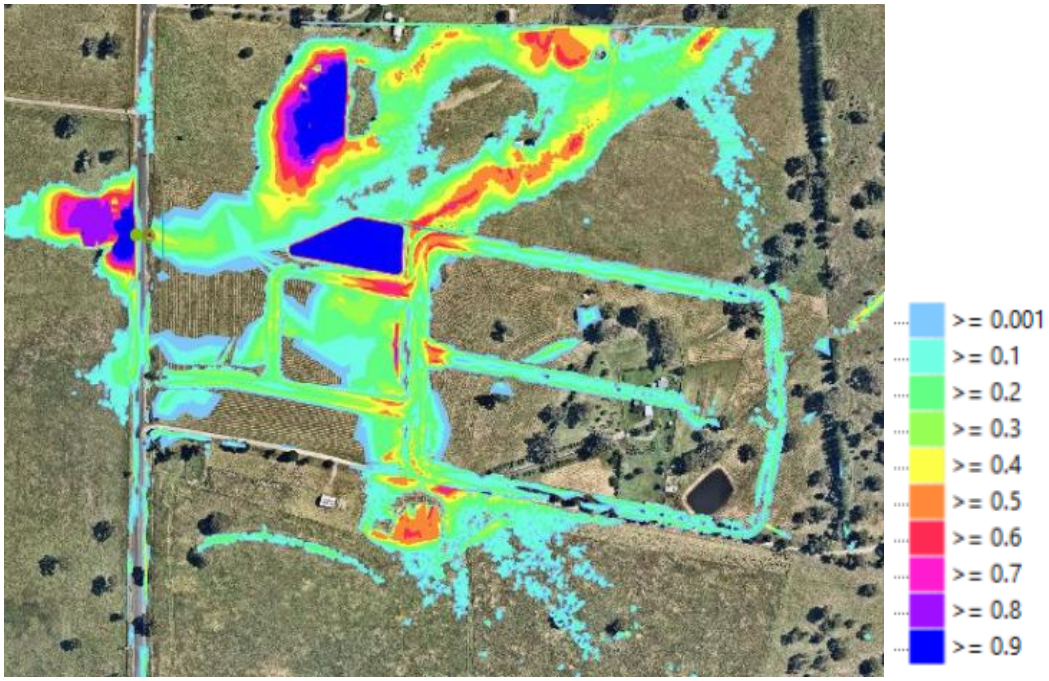


***Figure 7:** PMF Post Development Depth and Extent*



Depths of overland flow are generally very shallow outside of the channelised areas falling into the lowest hazard category except for the sag area near the farm dam. **The modelling demonstrates access is available to the proposed residential portions of the site and would suggest capacity for earthworks and formalisation of drainage associated with the subdivision phase being able to achieve the**

flooding being contained fully within the drainage reserves and RE1 Public Recreation Zoning.

The submitted Local Flood and Overland Flow Study found:

At the peak of the modelled rain event the depth of stormwater within these areas is generally less than 100mm however some sections of the site have slightly deeper bodies of water – particularly on the upstream side of the dam in the lower northwestern portion of the site. The pre-development model demonstrates that the main source of external overland flow is from the southern aspect of the site, however there is also a secondary flow of surface water that burdens the eastern portion of the site which is generally very limited in migration and depths, and tends to be confined to the shallow berms that have been formed. The pre-development model also confirms the restricted impact of the overland flows entering the northwestern corner of the site from the culverts under Middle Arm Road.

To gauge the potential impact of the external sources of overland flow on a future subdivision of the land a second 'post-development' model was prepared that incorporated the existing external terrain data with the proposed site regrading which includes decommissioning of the existing dams and the formation of the new internal road system. Also within the regraded site details was the conceptual design for the wetland treatment system in the lower northern portion of the property. The primary objective of the post-development model was to determine if the areas identified for the residential allotments and the access roads would be adversely impacted by overland flows in the same 1% AEP – 1-hour design rain event, and if so to what extent.

The post-development model was undertaken at a 'high-level' approach and did not include detailed designs for the proposed swales along the southern boundary, the configuration of the central drainage corridor, or the inclusion of 'pits and pipes' associated with the stormwater drainage system for the internal road network or the inter-allotment drainage system. The model also did not include the proposed 375mm diameter pipe to be installed within the central drainage corridor that will convey external sources of water through the site.

Based on the proposed site regrading and using the internal road corridors for the conveyance of surface water without any specific pit and pipe drainage information the post-development model demonstrated that essentially all surface water could be managed within the road reserves. There was a small area around the proposed residential Lots bounded by Roads 01, 02 and 03 where there was indication of overland flow, however the depths are less than 100m and would be easily removed by the proposed road and inter-allotment stormwater drainage systems. ***The depth of water within the roadways was generally less than 100mm except for where there was a sag in the formation, and it is anticipated that with a purpose designed pit and pipe drainage system included in the model the depth of water in the road reserves would be significantly less, and in many cases removed altogether. Additional information such as the shape and alignment of the swales along the southern boundary and the formation of the central drainage corridor would improve the results, but at this preliminary land rezoning stage it is considered that this level of detail is not required.***

11. Planning Risk Management Measures – Future Subdivision

As identified in Section 4 of *MM01 – Flood risk management measures*. There are a number of planning measures which can be undertaken to reduce risk, in this case the use of land use zoning and Development Control Plan (DCP) controls are considered to be an effective means of reducing risk.

As previous outlined the proposed use of the RE1 Public Recreation Zone will remove most of the land that is flood affected. This zone prohibits residential uses but allows roads (and as outlined in the accompanying planning proposal, drainage). Furthermore, the *Goulburn*

Mulwaree Local Environmental Plan (LEP) 2009 contains the following provisions that relate specifically to flooding:

5.21 Flood planning

(1) The objectives of this clause are as follows—
(a) to minimise the flood risk to life and property associated with the use of land,

(b) to allow development on land that is compatible with the flood function and behaviour on the land, taking into account projected changes as a result of climate change,

(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,

(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.

(2) Development consent must not be granted to development on land the consent authority considers to be within the flood planning area unless the consent authority is satisfied the development—
(a) is compatible with the flood function and behaviour on the land, and

(b) will not adversely affect flood behaviour in a way that results in detrimental increases in the potential flood affectation of other development or properties, and

(c) will not adversely affect the safe occupation and efficient evacuation of people or exceed the capacity of existing evacuation routes for the surrounding area in the event of a flood, and

(d) incorporates appropriate measures to manage risk to life in the event of a flood, and

(e) will not adversely affect the environment or cause avoidable erosion, siltation, destruction of riparian vegetation or a reduction in the stability of river banks or watercourses.

(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters—
(a) the impact of the development on projected changes to flood behaviour as a result of climate change,

(b) the intended design and scale of buildings resulting from the development,

(c) whether the development incorporates measures to minimise the risk to life and ensure the safe evacuation of people in the event of a flood,

(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

Considering Flooding in Land Use Planning Guideline means the *Considering Flooding in Land Use Planning Guideline* published on the Department's website on 14 July 2021.

flood planning area has the same meaning as it has in the Flood Risk Management Manual.

Flood Risk Management Manual means the *Flood Risk Management Manual,* ISBN 978-1-923076-17-4, published by the NSW Government in June 2023.

And

5.22 Special flood considerations

(1) The objectives of this clause are as follows—
(a) to enable the safe occupation and evacuation of people subject to flooding,

(b) to ensure development on land is compatible with the land's flood behaviour in the event of a flood,

(c) to avoid adverse or cumulative impacts on flood behaviour,

(d) to protect the operational capacity of emergency response facilities and critical infrastructure during flood events,

(e) to avoid adverse effects of hazardous development on the environment during flood events.

(2) This clause applies to—

(a) for sensitive and hazardous development—land between the flood planning area and the probable maximum flood, and

(b) for development that is not sensitive and hazardous development—land the consent authority considers to be land that, in the event of a flood, may—

(i) cause a particular risk to life, and

(ii) require the evacuation of people or other safety considerations.

(3) Development consent must not be granted to development on land to which this clause applies unless the consent authority has considered whether the development—

(a) will affect the safe occupation and efficient evacuation of people in the event of a flood, and

(b) incorporates appropriate measures to manage risk to life in the event of a flood, and

(c) will adversely affect the environment in the event of a flood.

(4) A word or expression used in this clause has the same meaning as it has in the Considering Flooding in Land Use Planning Guideline unless it is otherwise defined in this clause.

(5) In this clause—

Considering Flooding in Land Use Planning Guideline—see clause 5.21(5).

flood planning area—see clause 5.21(5).

Flood Risk Management Manual—see clause 5.21(5).

probable maximum flood has the same meaning as in the Flood Risk Management Manual.

sensitive and hazardous development means development for the following purposes—

(a) caravan parks,

(b) correctional centres,

(c) educational establishments,

(d) emergency services facilities,

(e) hazardous industries,

(f) hazardous storage establishments,

(g) hospitals.

There is no adopted flood planning area for this site. In situations such as this the 1%AEP Event plus a freeboard of .5m is applied as per Chapter 3 of the *Goulburn Mulwaree Development Control Plan* (DCP) 2009 (and Appendix J – Flood Policy). However, the nature of the depth of the PMF on the periphery of the drainage channels would suggest that there is little chance of scaling occurring outside of the PMF extent.

Additionally, it should be noted that the *Building Code of Australia* also specifies minimum floor levels for dwellings being:

- 150mm for slab on ground (although it can be reduced depending on drainage arrangements around the building but these would need to be demonstrated).
- 400mm for suspended floor (bearers and joists) this is more to do with ventilation and termite control.

In summary the main points identified in relation to safe occupation are:

- The Marys Mount Precinct is an existing urban release area at various stages of construction. This site is contiguous to this precinct and is identified as an urban growth area in Council's UFHS.
- The site is elevated and not affected by riverine flooding.
- The majority of flood affected land will in all events be zoned RE1 Public Recreation. A zone which prohibits residential development.
- Flooding is generally confined to defined overland flow paths. Flood affected areas outside the proposed RE1 Public Recreation Zone extents are small. Models undertaken to date have not factored in actual earthworks associated with the subdivision which could further limit extents of small break out areas on the periphery to formalise drainage channels.
- Clauses 5.21 and 5.22 of Goulburn Mulwaree LEP 2009 may be applied.
- Council's DCP and Flood Policy will apply to any further subdivision.
- The DCP requires a FPA of 0.5m (above 1% AEP) for areas not affected by riverine flooding as per current requirements.
- The Building Code of Australia also specifies minimum floor levels for dwellings (regardless of other planning provisions).
- It is considered that the site has the capacity to be developed with all lots having access and dwellings located above flood affected land.

12. Ability of Residents to Be Self Sufficient During Events

Residents would be able to self-evacuate and travel within the precinct subject to some crossing of roads at low hazard categories (H1- H2) in a 1% AEP. Crossing of the Wollondilly River will not be possible from a 0.20 % AEP event and upwards. During a 1% AEP event, residents would have access to either the new commercial precinct on Box Avenue or the supermarket on the corner of Queen Street and Ross Street.

Some mobility within the northern precinct beyond the Wollondilly Floodplain would be possible within a short duration of a PMF event. Beyond the floodplain to the north the precinct is relatively elevated and more likely to be prone to flash flooding with road closures being of a briefer duration. Lower sections of the precinct falling within the riverine PMF area are likely to experience significant durations for flooding. Evacuation points to two separate supermarkets for supplies have been identified in this FIRA.

In relation to self-sufficiency, the proposed sites are intended to be served by Council's reticulated water and sewer network. Water provision is gravity fed and given the elevation of the site and proximity to Council's reservoirs; water provision is unlikely to be affected in most events. Furthermore, being located within the Sydney drinking water catchment typically requires the provision of roof water tanks to new dwellings.

Given the relative elevation of the site to Council's sewer system the provision of sewer is likely to still be available, although there is likely to be no capacity at the Goulburn wastewater treatment plant to treat sewer should it become inundated in a PMF.

13. Compatibility with Emergency Response Plans

The context of flooding on the site as already discussed would suggest that evacuation generally as per the NSW SES *Goulburn Mulwaree LGA Local Flood Plan* (Refer Section 5.8) would not be required. Dwellings will not be subject to any level of flood event; therefore, evacuation would not be desirable as per the Local Flood Plan, unless due to a medical event.

14. Additional Impact on Emergency Services

The site is contiguous to an urban release area which is under construction and has been identified by Council since 2009.

The site is within an elevated precinct well above the riverine flood plain of the Wollondilly River. Safe occupation of dwellings should be achievable during all flood events including the PMF. Therefore, no evacuation should be required **except during a medical emergency**.

It is noted that emergency services are located either in central Goulburn (south of the Wollondilly River) including NSW Police, Goulburn Base Hospital, NSW Ambulance.

The new SES Operations Centre under construction is located on the northern side of the Mulwaree (Hetherington Street) and is further separated from the central section of Goulburn, noting Sydney Road is cut of during a PMF event.

Some NSW Police support may be available in association with the Police Academy which is located on the northern side of the Wollondilly River.

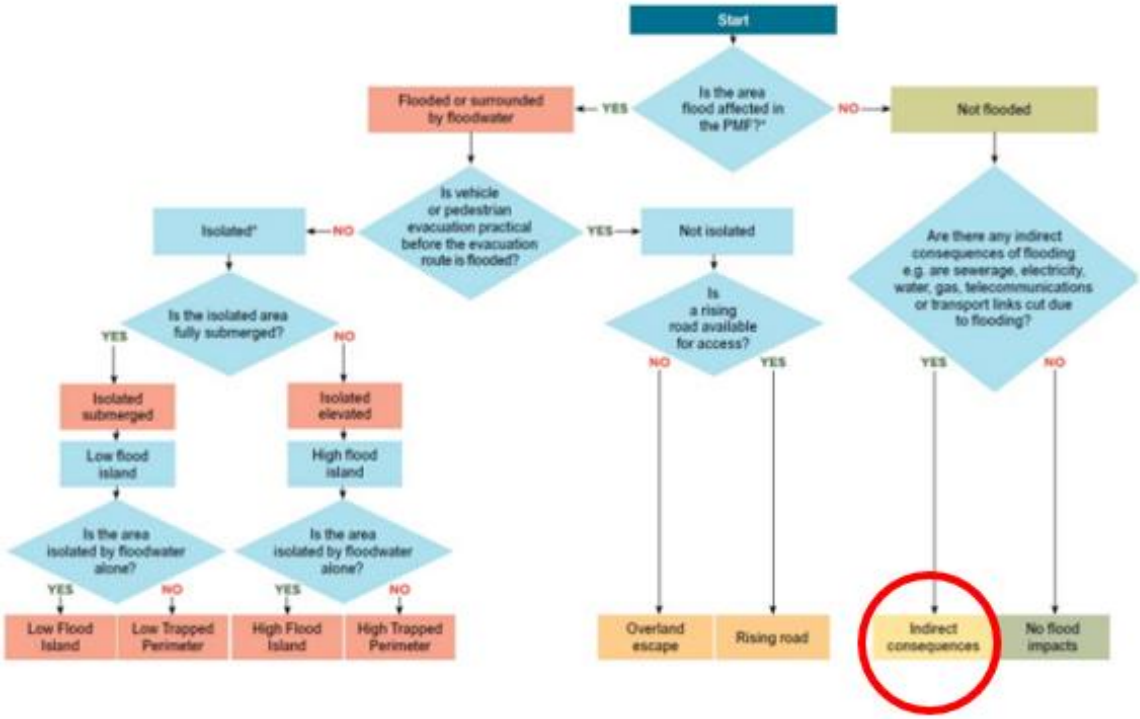
15. Conclusion

In conclusion, the site is contiguous to other areas currently being developed in the Marys Mount precinct urban release area. Subject to mitigations on site, such as the application of the RE1 Public Recreation Zone, the potential for additional earthworks to formalise drainage corridors to within the RE1 zone extents, the application of clauses 5.21 and 5.22 of the GM LEP and of a 0.5m FPA as per the DCP and Flood Policy. The development of flood free areas above the PMF for dwellings and most of the road network on this site is considered achievable.

The precinct to the north of Marys Mount Road is located above the Wollondilly floodplain and is therefore not subject to riverine flooding. The area would be cut off from central Goulburn in a 0.20%AEP Event. Horizontal evacuation can currently be achieved across the precinct up to at least a 1%AEP Event based on available information. Data is not available for other events up between the 1%AEP and PMF. However, Council is incrementally improving road drainage across the precinct with each new subdivision. These drainage corridors have been identified from the earliest planning of this urban release area in 2009.

The mitigations identified in this FIRA, if implemented, would result in indirect consequences only applying to this site due to flooding. Once the mitigations are in place, the hazard classification following the development process (refer **Figure 31**) would result in an improved outcome i.e., the site being not flooded with indirect consequences.

Figure 31: *Flood Emergency Response Classifications – Post Mitigations Identified in this FIRA*



Council considers the flood risk associated with the development of this site to be low and acceptable. Improvements to road drainage can only occur incrementally as development of the precinct continues.

The urban release area has been identified for some time and is progressively extending. This site is not considered to be isolated in relation to this precinct.