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119073/L220620\_FloodImpactAssessment

11 July 2022

**Attention: Philip Drew**

**Re: Bunnings Mudgee – Assessment of Flooding**

## **1. INTRODUCTION**

WMAwater has been engaged by Bunnings Group Ltd. to provide an assessment of the impacts of flooding for a proposed Bunnings development at 134 Lions Dr, Burrundulla (Lot 2 DP1079362), herein referred to as the site. The site is located at the corner of Castlereagh Highway and Lions Drive, approximately 3 km southeast of the Mudgee town centre and sits directly opposite the existing Bunnings Mudgee Store. The site sits at the edge of a warehouse style commercial area and currently comprises a single dwelling and garage structure fronting Lions Drive. A reasonably sized farm dam is located in the south eastern corner of the site. A residential dwelling exists on the property to the east, adjacent to the shared boundary, known as No.18 Castlereagh Highway, Burrundulla. The location of the site is presented in Figure 1.

The proposed Bunnings development comprises, a main warehouse building, an outdoor timber trades and building materials yard, an outdoor nursery, delivery driveway, carparking and associated landscaping, including civil works featuring 12m wide channel along the southern and eastern boundaries of the site.

Council's flood planning area is currently defined by Mid-Western Regional Council Local Environmental Plan 2012 map 5270\_COM\_CL1\_006H\_010\_20120621. The site is not within the flood planning area defined by this map. Flow behaviour at the site and surrounding area is defined by the Mudgee Flood Study (Flood Study, WMAwater, 2021). The site sits within the broader Sawpit Gully catchment which moves in northerly direction towards the Cudgegong River. The site itself is subject to shallow inundation from a small flowpath resulting from changes to the historical Sawpit Gully flowpath. The information derived from the Flood Study is the most up to date representation of flood behaviour available in the locality.

An assessment of potential flood impacts as a result of the proposed development on the surrounding lots has been undertaken. The assessment considers the impact occurring as the result of changes to the site topography as a result of the development. Additionally, this assessment considers the development in the context of relevant planning controls.

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FIGURE 1  
SITE AREA





## 2. EXISTING FLOOD ENVIRONMENT

The site is subject to broad shallow inundation as defined by the Mudgee Flood Study (WMAwater, 2021). A review of the hydrologic and hydraulic models established as part of the Flood Study, identified some aspects of the catchment wide Flood Study required refinement for the purposes of a local assessment, such as the catchment delineation, culverts under Castlereagh Highway and creek and bank definition in the formed channel downstream of the highway. These aspects have been refined in the models used for the purposes of assessing impacts of the proposed Bunnings development. In comparison the refinements result in minimal changes to overall flood behaviour, with the most significant change occurring in the downstream channel. All other aspects and parameters have remained the same as those defined in the Flood Study. Further details of the model development are provided in the Flood Study.

The site and surrounding area sit within the broader Sawpit Gully catchment. The broad shallow inundation moves in the north easterly direction across the site, crossing the Castlereagh Highway via cross-drainage culverts (5 x 750 mm RCPs). Downstream of the highway a formed channel diverts flow adjacent to the existing Bunnings Warehouse and Council's treatment plant back easterly towards the natural creek system. The cross-drainage culverts are aligned to the formed channel as opposed to the catchment low point which is further to the south along the highway. In larger flood events the flow from upstream through and surrounding the site is primarily broad overland sheet flow. Historically Sawpit Gully ran north of the site through what is now development (north of Lions Road). Due to the presence of this development and a farm dam, the gully is now undefined, resulting in broad diverted overland flow through the site.

Under conditions presented in the Flood Study (Figure 2), a maximum flood depth of 0.48m occurs in the 1% AEP event at the south west corner of the site, with depths across other areas typically less than 0.2m. The deepest sections of the flow path occur in the south west corner and fronting Castlereagh Highway. During events where the capacity of the cross-drainage system is exceeded, flow spills onto the Castlereagh Highway to a depth of approximately 50mm (in the 1% AEP event) at the location of the cross drainage culverts, as well as at the catchment low point along the highway to the east. The dwelling on the property to the east is not shown to be impacted by flooding under existing conditions in the 1% AEP event.

Similar flow behaviour is observed in the 5% and PMF events, with depths typically less than 0.1m in the 5% AEP event and less than 0.4m in the PMF event. There is not a significant change in the overall flood extent with an increase of approximately 0.3m between the 5% AEP and PMF events.

The relatively shallow depths across the site means that the hydraulic hazard as defined by the Flood Study utilising the method described in Managing the floodplain: a guide to best practice in flood risk management in Australia (AIDR) for the 1% AEP (Figure 3) event is consistently H1 – generally safe for people, vehicles and buildings, with small pockets of H2 – unsafe for small vehicles, through the slightly deeper portions of the flow path and H3 – unsafe for vehicles, children and the elderly within the existing farm dam. These categorisations indicate that the flood behaviour is generally safe for vehicles, people and buildings and is not likely to impose risk to life or property damage in the 1% AEP event.

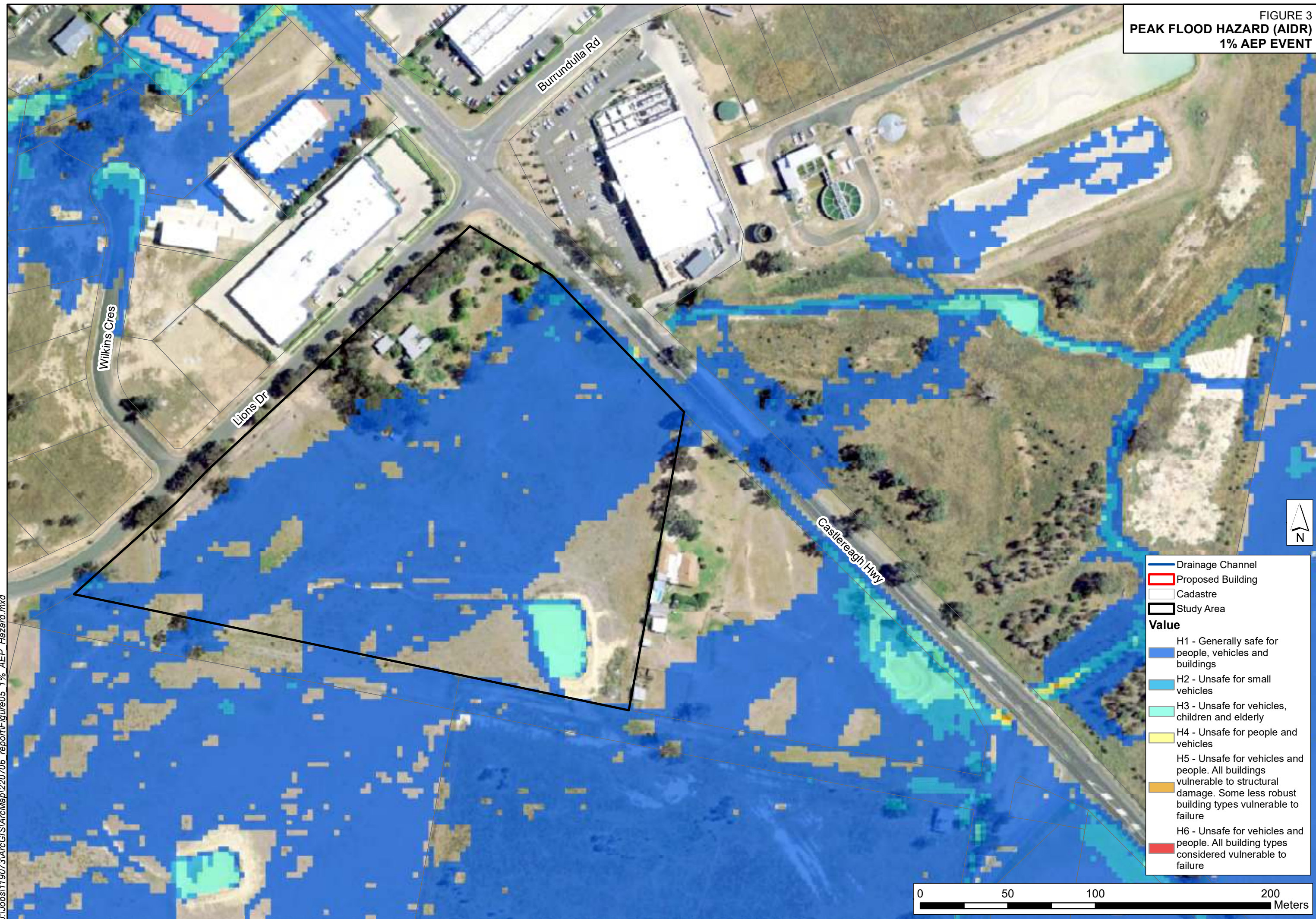


FIGURE 2  
PEAK FLOOD DEPTH  
1% AEP EVENT  
BASE CASE





FIGURE 3  
PEAK FLOOD HAZARD (AIDR)  
1% AEP EVENT





Hazard defined by the NSW Government Floodplain Development Manual (FDM) is no longer considered best practice as it provides a less granular and less descriptive definition of hydraulic hazard. Many Council's, including Mid-Western Regional Council, utilise the FDM hazard categories within their planning policies due to the hazard mapping available when the policy was developed. FDM hazard mapping is not available for the site. AIDR provides guidance for grouping hazard categories H1 to H6, into different scales of risk H1, H2 – H4, H5 and H6. This allows AIDR hazard categories to be aligned with planning controls using the FDM hazard categories.

### 3. FLOOD IMPACT ASSESSMENT

#### 3.1. Methodology

The proposed Bunnings development will alter the site from its current condition, with the removal of existing buildings and farm dam and construction of a warehouse, associated infrastructure, and creation of a drainage channel. Modelling has been carried out to establish the potential flood impacts that may occur from the proposed development.

This has been an iterative process with the initial channel concepts resulting in negative impacts on surrounding properties. Concept iterations have focussed on the design of the drainage channel, in order to minimise offsite impacts resulting from the development. The results presented below represent the assessment of the adopted concept (Diagram 1). The adopted concept includes a drainage channel with overall width of 12m and minimum depth of 1m. The channel shape is defined by a central 4m wide channel with 4 m side batters of 1:4 grade. The assessment has assumed that the central channel would be grassed and clear of tress, with scattered trees surrounding the central channel.

Diagram 1 Proposed Bunnings Development



The following steps were undertaken:

1. The existing conditions presented in the Mudgee Flood Study were reviewed to ensure that at a local scale the model was representative. This refined model establishes the base case against which the impacts of the development can be determined (Figure 2).
2. The proposed development (shown in Diagram 1) was represented into the revised base case model. The drainage channel was represented as a 1D channel within the hydraulic model, other features were built into the 2D topographic DEM;
3. The proposed development model was run for the 1% AEP event, and the results of the pre-development (revised base case) and post-development case (Figure 4) were compared to determine the changes in flood level (flood impacts); and
4. Impact maps were produced (Figure 5), indicating changes in flood level for the 1% AEP event due to the proposed Bunnings development.

### **3.2. Results**

The resulting peak flood depths as a result of the proposed Bunnings development for the 1% AEP event are shown on Figure 4 and the peak flood level impacts for the 1% AEP event are shown on Figure 5.

Generally, upstream catchment flow is contained within the proposed drainage channel and therefore there is a reduction in flood levels across the site and upstream of the Castlereagh Highway. The majority of the proposed development site, including location of proposed access and carparking, becomes flood free, as the flow moves around the site within the drainage channel. The portion of drainage channel running along the southern property boundary captures additional overland flow, reducing flow across the adjacent property to the east and reducing flood levels by up to 0.1m. The channel increases the efficiency of flow moving towards the cross drainage culverts (5 x 750 mm RCPs) under the Castlereagh Highway, resulting in a reduction in flood levels of up to 0.1m to the west of the culvert entrance and removal of the shallow inundation across the Castlereagh Highway, that was shown to occur in existing conditions.

This increased efficiency through the cross drainage culverts, slightly increases flood levels (by a maximum of 0.05m) in the channel immediately downstream of the Castlereagh Highway. The existing model was refined in this downstream area to ensure the top of bank levels were appropriately represented. Available topographic information shows there to be gap in the bank running along the channel. The flood mapping under existing conditions shows that flow escapes the channel at this location and moves towards the existing treatment ponds. Under the proposed scenario existing inundation at this location is increased, showing a maximum change in flood level of 0.21m within the treatment pond.

Impacts less than 0.01m are considered within the accuracy limits of the model and are not shown on the mapping.

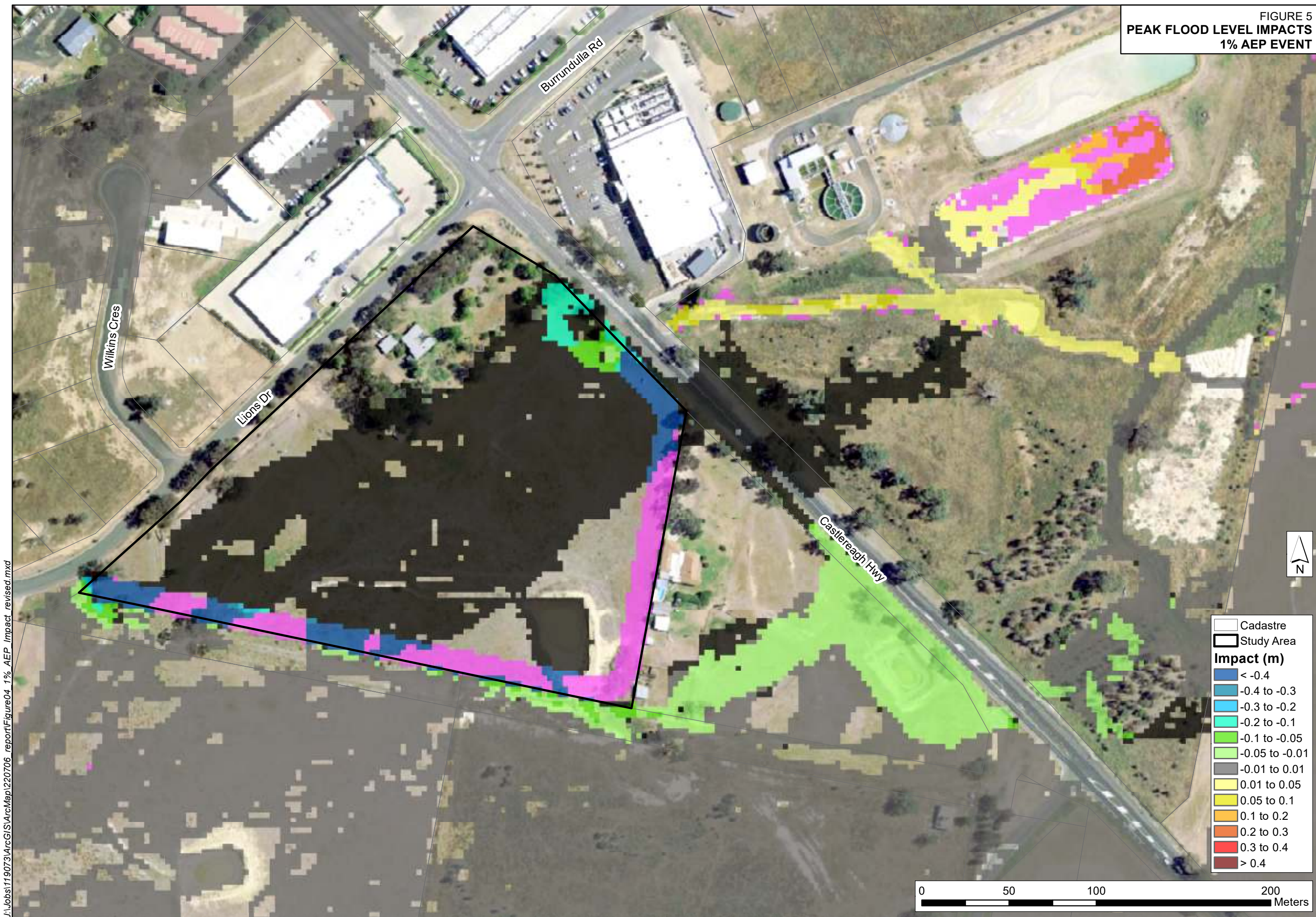


FIGURE 4  
PEAK FLOOD DEPTH  
1% AEP EVENT  
DEVELOPED CASE





FIGURE 5  
PEAK FLOOD LEVEL IMPACTS  
1% AEP EVENT





## 4. FLOOD RELATED DEVELOPMENT CONTROLS

Appropriate planning restrictions ensure that development is compatible with flood risk and can significantly reduce flood damages. Planning instruments can be used as tools to guide new development away from high flood risk locations and ensure that new development does not adversely affect flood behaviour. Councils use Local Environment Plans (LEPs) and Development Control Plans (DCPs) to appropriately control development with regards to flooding.

LEPs guide land use and development by zoning all land and identifying appropriate land uses allowed in each zone. DCPs support the implementation of the objectives of the LEP, providing specific guidance for design and assessment of proposed developments.

Mid-Western Regional Council apply planning controls through the Mid-Western Regional Local Environmental Plan 2012 (LEP 2012) and Development Control Plan 2013 (DCP 2013). Table 1 outlines how the proposed development meets the LEP objectives.

Table 1 Mid-Western LEP 2012

Mid-Western LEP 2012	
Provision 5.21 – Flood Planning	Response
<p>(1) Objectives:</p> <p>(a) to minimise the flood risk to life and property associated with the use of land,</p> <p>(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,</p> <p>(c) to avoid adverse or cumulative impacts on flood behaviour and the environment,</p> <p>(d) to enable the safe occupation and efficient evacuation of people in the event of a flood.</p>	<p>These objectives are addressed through an assessment of the flood hazard and function across the site under existing and developed conditions. They are addressed specifically in reference to Clause 2 and 3 below.</p>
<p>(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—</p> <p>(a) is compatible with the flood function and behaviour on the land, and</p> <p>(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</p> <p>(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</p> <p>(d) incorporates appropriate measures to manage risk to life in the event of a flood, and</p>	<p>The flood function classification for the site is defined in the Mudgee Flood Study, where the classification of “flood fringe” applies to the majority of the site. As defined in the Floodplain Development Manual, development in flood fringe areas would not have any significant effect on the pattern of flood flows and/or flood levels.</p> <p>An assessment of the impacts of the development on flood behaviour has been undertaken and the results presented in Section 3. The assessment showed that the development results in positive changes to flood behaviour including the removal of inundation across the majority of the site and on the Castlereagh Highway with only minor negative impacts on the immediate downstream channel in the 1% AEP event.</p>



<p>(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.</p>	<p>The development is therefore considered to be compatible with the flood function on the land.</p> <p>Under proposed conditions the site of the proposed building is no longer inundated in the 1% AEP event and therefore no flood hazard exists at the building, or car parking areas. In addition, a number of surrounding roads remain flood free allowing for efficient evacuation during a flood event.</p> <p>The proposed drainage channel appropriately manages the flow entering the site. The channel contains gently sloped vegetated banks, which will minimise any potential erosion. There is a very minor increase in flood levels (&lt;0.05m) and velocity (&lt;0.1m/s) in the downstream channel which are unlikely to result in reduced bank stability.</p>
<p>(3) In deciding whether to grant development consent on land to which this clause applies, the consent authority must consider the following matters—</p> <p>(a) the impact of the development on projected changes to flood behaviour as a result of climate change,</p> <p>(b) the intended design and scale of buildings resulting from the development,</p> <p>(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,</p> <p>(d) the potential to modify, relocate or remove buildings resulting from development if the surrounding area is impacted by flooding or coastal erosion.</p>	<p>The scale of existing flood behaviour across the site is relatively small, with only 0.3m between a 5% AEP and the PMF events. This coupled with the very minor change in flood levels beyond the development site in the 1% AEP event, indicate that the impacts of the development are unlikely to be greater under a future climate scenario.</p> <p>The size of the development relative to the site allows sufficient space for flow entering the site in the 1% AEP event to be appropriately managed within the proposed drainage channel.</p> <p>Under proposed conditions the site of the proposed building is no longer inundated in the 1% AEP event and therefore no flood hazard exists at the building, or car parking areas. In addition, a number of surrounding roads remain flood free allowing for efficient evacuation.</p> <p>Under proposed conditions the site of the proposed building is no longer inundated in the 1% AEP event. The flood impacts assessment showed that the development results in positive changes to flood behaviour in the 1% AEP event including the removal of inundation across the majority of the site and on the Castlereagh Highway with only minor negative impacts on the immediate downstream channel.</p>



The DCP supports the LEP through a range of controls including general controls and controls defined by a matrix which outlines specific controls for different land use types and flood risk classifications across floor level requirements, building components, structural soundness, flood affectation, evacuation and management and design.

Table 3 below outlines how the proposed development design meets the relevant general DCP planning controls.

Table 2 DCP 2013

<b>Mid-Western DCP 2013</b>	
<b>Provision 5.2 Flooding</b>	<b>Response</b>
<p><b>Development controls</b></p> <p>The development controls apply to all known potentially flooded areas (that is up to the largest estimated flood including the PMF when known). The type and stringency of controls have been graded relative to the severity and frequency of potential floods, having regard to categories determined by the relevant Floodplain Management Study and Plan. The categories applicable to each floodplain are depicted on the planning matrices in Appendix A as follows:</p> <ul style="list-style-type: none"> <li>• Matrix 1 – Urban Floodplains</li> <li>• Matrix 2 – All other floodplains.</li> </ul> <p><u>Performance Criteria</u></p> <p>(a) The proposed development should not result in any increased risk to human life.</p> <p>(b) The additional economic and social costs which may arise from damage to property from flooding should not be greater than that which can reasonably be managed by the property owner and general community.</p> <p>(c) The proposal should only be permitted where effective warning time and reliable access is available for the evacuation of an area potentially affected by floods, where likely to be required.</p> <p>(d) Development should not detrimentally increase the potential flood affectation on other development or properties.</p>	<p>Refer to Table 3 below.</p>
<p><b>Fill</b></p> <p>Earthworks that change the nature of a watercourse and have the potential to affect upstream or downstream properties is not permitted.</p> <p>This standard applies to watercourses in the high hazard flood risk precinct.</p>	<p>The site is within the Medium Flood Risk Precinct and therefore this control does not specifically apply. An assessment of the potential changes to flood behaviour has however been undertaken and the results are documented in Section 3. The assessment showed that the development results in positive changes to flood behaviour including the removal of inundation across the majority of the site and on the</p>



	Castlereagh Highway with only minor negative impacts on the immediate downstream channel in the 1% AEP event.
<b>Development Application</b> Applications must include information which addresses all relevant controls listed above, and the following matters as applicable.	This report and specifically Table 1, 2 and 3 indicate how relevant controls have been addressed.
<b>Survey Plan Required</b> Development applications for Flood Prone Land shall be accompanied by a survey plan showing: <ul style="list-style-type: none"> <li>(a) The position of the existing building/s or proposed building/s;</li> <li>(b) The existing ground levels to Australian height datum around the perimeter of the building and contours of the site;</li> <li>(b) The existing or proposed floor levels to Australian height datum; and</li> <li>(c) A reliable access route, with regular levels to Australian Height Datum along the centreline of this route, wherever development is within a high or medium flood risk precinct.</li> </ul> Applications for earthworks, filling of land and subdivision shall be accompanied by a survey plan (with a contour interval of 0.25m) showing relative levels to Australian height datum.	Relevant plans are attached to the application.
<b>Flood Study</b> For large scale developments, or developments in critical situations, particularly where an existing catchment based flood study is not available, a flood study using a fully dynamic one or two dimensional computer model may be required. For smaller developments the existing flood study may be used if available and suitable (e.g. it contains sufficient local detail), or otherwise a one dimensional steady state flood model would normally suffice. A flood study must demonstrate that the cumulative impact of a development on flood levels for up and downstream properties is negligible.	This report (Section 3) includes an assessment of the potential impacts of the development on flooding. The assessment has been undertaken using a fully dynamic two dimensional computer model.  The assessment showed that the development results in positive changes to flood behaviour including the removal of inundation across the majority of the site and on the Castlereagh Highway with only minor negative impacts on the immediate downstream channel in the 1% AEP event.

The site is inundated in the 100 year ARI (1% AEP), is not subject to significant evacuation difficulties and a maximum of H3 AIDR hydraulic hazard occurs on the site. This AIDR hydraulic hazard classification would generally equate to low hazard as defined by the FDM. These constraints place the development site in the Medium Flood Risk category. As per Matrix 2 Non Urban Floodplains (DCP 2013), the following controls apply to Commercial and Industrial development:

- **Floor Level:** Habitable floor levels to be equal to or greater than the 100 year ARI (1% AEP) flood (plus freeboard),
- **Building Components:** All structures to have flood compatible building components below or at the 100 Year ARI (1% AEP) flood level (plus freeboard),



- **Structural Soundness:** Applicant to demonstrate that any structure can withstand the forces of floodwater, debris & buoyancy up to and including the 100 year AR (1% AEP) flood (plus freeboard),
- **Flood Affectation:** The impact of the development on flooding elsewhere to be considered,
- **Evacuation:** Reliable access for pedestrians or vehicles required during a 100 year ARI (1% AEP) flood,
- **Management and Design:**
  - Flood plan required where floor levels are below the design floor level,
  - Applicant to demonstrate that area is available to store goods above the 100 year ARI (1% AEP) flood (plus freeboard),
  - No external storage of materials below the design floor level which may cause pollution or be potentially hazardous during any flood.

Table 3 below outlines how the proposed development design meets the relevant DCP planning controls.

Table 3 DCP 2013 – Matrix 2 Non Urban Floodplains

Planning Consideration	
<b>Floor Level</b>	Under existing conditions, the 1% AEP flood level varies from 472.89m AHD, at the south west corner of the proposed building, to 470.75m AHD, at the north east corner. The DCP 2013 defines the freeboard as 0.5m. The proposed finished floor level of 472.5m AHD is appropriate as an average of these levels. In addition, under proposed conditions the site of the proposed building is no longer inundated in the 1% AEP event.
<b>Building Components</b>	There are no proposed building components below the 100 Year ARI (1% AEP) flood level (plus freeboard). In addition, under proposed conditions the site of the proposed building is no longer inundated in the 1% AEP event.
<b>Structural Soundness</b>	There are no proposed structures below the 100 Year ARI (1% AEP) flood level (plus freeboard). In addition, under proposed conditions the site of the proposed building is no longer inundated in the 1% AEP event.
<b>Flood Affectation</b>	An assessment of the impacts of the development on flood behaviour has been undertaken and the results presented in Section 3. The assessment showed that the development results in positive changes to flood behaviour including the removal of inundation across the majority of the site and on the Castlereagh Highway with only minor negative impacts.
<b>Evacuation</b>	Under proposed conditions the site of the proposed building is no longer inundated. In addition, a number of surrounding roads remain flood free.
<b>Management and Design</b>	There are no proposed building components below the 100 Year ARI (1% AEP) flood level (plus freeboard), design floor level and therefore a flood plan is not required. Under proposed conditions large parts of the site are no longer inundated in the 1% AEP event and areas are available for goods and materials storage.



## 5. SUMMARY

WMAwater has undertaken a flood impact assessment for the proposed Bunnings development at 134 Lions Dr, Burrundulla. The proposed Bunnings development comprises, a main warehouse building, an outdoor timber trades and building material yard, an outdoor nursery, delivery driveway, carparking and associated landscaping, including a 12m wide channel along the southern and eastern boundaries of the site.

The site and surrounding area sit within the broader Sawpit Gully catchment. The broad shallow inundation moves in the north easterly direction across the site, crossing the Castlereagh Highway via cross-drainage culverts (5 x 750 mm RCPs). A revised base case was developed to ensure that the model was representative at a local scale.

Generally, upstream catchment flow is contained within the proposed drainage channel and therefore there is a reduction in flood levels across the site and upstream of the Castlereagh Highway. The majority of the proposed development site, including location of proposed access and carparking, becomes flood free, as the flow moves around the site within the drainage channel. Increased efficiency at the cross drainage structure results in removal of the shallow inundation across the Castlereagh Highway.

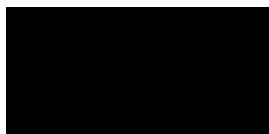
This increased efficiency through the cross drainage culverts, slightly increases flood levels (by a maximum of 0.05m) in the channel immediately downstream of the Castlereagh Highway. The maximum change in flood level is an increase of 0.21 m within the downstream treatment pond.

Mid-Western Regional Council apply planning controls through Clause 5.21 of the Mid-Western Regional Local Environmental Plan 2012 (LEP 2012) and Development Control Plan 2013 (DCP 2013). The proposed development appropriately meets the planning controls defined by the Non Urban Floodplain matrix for the Commercial and Industrial development within the Medium Flood Risk category.

Should you require any clarification on the above, please do not hesitate to contact the undersigned.

Yours Sincerely,

**WMAwater**



**Erin Askew**

Director

Figure 1: Study Area

Figure 2: 1% AEP Peak Flood Depth – Revised Base Case

Figure 3: 1% AEP Peak Flood Depth – Developed Case

Figure 4: 1% AEP Peak Flood Level Impact

Figure 5: 1% AEP Peak Flood Hazard (AIDR)