Flood Risk Assessment

Argyll Estate, Coffs Harbour

NW30163

Prepared for
Land and Housing Corporation

20 July 2021

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Executive Summary

As described on the LAHC website:

> *The NSW Government will be exploring opportunities for new housing in the local area south of Bray Street to Argyll Street (including Deborah Close, Maple Street and Argyll Place) and from Frederick Street to Elm Street, Coffs Harbour, referred to as the 'Argyll Estate'.*

The purpose of this report is to provide a high-level understanding of the opportunities and constraints of the sites due to flooding and to inform the development strategy for Argyll Estate based on an assessment of flooding under Existing Conditions.

In a number of Figures, LAHC property boundaries are also highlighted to facilitate a visual assessment of the degree to which individual properties are impacted by flooding.

Flood Levels and Depths

The estimated 5% AEP, 1% AEP, 0.2% AEP and PMF flood levels and extent and depths are plotted in **Figures 3, 4, 5** and **6** respectively.

Floodways, Flood Storage and Flood Fringe

The mapping of hydraulic categories of Floodway, Flood Storage and Flood Fringe in a 1% AEP flood is given in **Figure 7.**

Flood Risk Precincts

The mapping of true hazard and flood risk precincts is given in **Figure 8**. The precincts include: High Flood Risk Flow Corridor, High Flood Risk, Medium Flood Risk and Low Flood Risk.

Climate Change

It was concluded from the BMT WBM (2018) study that 1% AEP flood levels in the Argyll Estate are estimated to increase up to 0.1 m only under a range of climate change scenarios which is well within Council's adopted freeboard of 0.5 m.

Planning Controls

As advised on the DPIE website:

> *The finalised flood-prone land package commenced on 14 July 2021.*
>
> *The package provides advice to councils on considering flooding in land-use planning and includes:*
>
> - *a revised 9.1 local planning direction on flooding*
> - *a new planning circular on flooding PS21-006 - considering flooding in land use planning: guidance and statutory requirements, which replaces planning circular PS 07-003*
> - *a new guideline - Considering Flooding in Land Use Planning, which replaces the Guideline on Development Controls on Low Flood Risk Areas*

- *Standard Instrument (Local Environmental Plans) Amendment (Flood Planning) Order 2021, which includes a mandatory 'flood planning' clause and an optional 'special flood consideration' clause*
- *Environmental Planning and Assessment Amendment (Flood Planning) Regulation 2021 which amends the 7A clauses under Schedule 4, and*
- *State Environmental Planning Policy Amendment (Flood Planning) 2021 which revokes councils existing flood planning LEP clause and replaces it with the mandatory Standard Instrument flood planning clause.*

Coffs Harbour LEP 2013

In relation to flood planning the relevant clause in the Coffs Harbour LEP 2013, it has been amended in accordance with the State Environmental Planning Policy Amendment (Flood Planning) 2021 which revoked Council's previous flood planning LEP clause and replaced it with the mandatory Standard Instrument flood planning clause.

Coffs Harbour Development Control Plan (DCP) 2015

Chapter E4 Flooding of the Coffs Harbour Development Control Plan (DCP) 2015 details the flooding planning requirements. Section E4.1 Flood Planning Requirements - General sets out general requirements while Section E4.2 sets out Flood Planning Requirements - Residential and Tourist Development.

Flood Planning Area

The Flood Planning Area (FPA) identified by Council is mapped in **Figure 10**.

It was found that the FPA either partially or completely covers all LAHC properties. Consequently, Council's DCP flood planning requirements apply to all LAHC properties.

LAHC Properties

For each LAHC property the following was estimated:

(i) The fraction of the lot classified as Floodway or Flood Storage or Flood Fringe (from **Figure 7**), and

(ii) The fraction of the lot classified as Low, Medium or High Flood Risk and/or High Flood Risk Flow Corridor (from **Figure 8**)

This information is summarised in the table attached in **Appendix D**.

It is noted from **Figure 7** that a number of roads are mapped as floodways in the 1% AEP flood. These include sections of Argyll Street, Kurrajong Street, Bray Street and Elm Street. Depending on the time it takes for these conditions to be reached in a 1% AEP flood on these streets these conditions have the potential to constrain evacuation of residents from properties during major floods.

This summary table in Appendix D identifies a number of properties which have significant constraints due the mapped 1% AEP floodway either completely covering the lot (51 Argyll Street and 53 Argyll Street and 10 Maple Street) or covering a significant proportion of the lot (47 Argyll Street, 59 Argyll Street, 61 Argyll Street, 12 Deborah Close and 3 Frederick Street).

The floodway which crosses through 10 Maple Street and across the head of Maple Street also poses a significant challenge to any evacuation of residents from 12 Maple Street and 13 Maple Street.

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1 Introduction

1.1 Purpose of this Report

As described on the LAHC website[1]:

> *The NSW Government will be exploring opportunities for new housing in the local area south of Bray Street to Argyll Street (including Deborah Close, Maple Street and Argyll Place) and from Frederick Street to Elm Street, Coffs Harbour, referred to as the 'Argyll Estate'.*
>
> *This area includes 127 properties and two vacant land lots owned by the NSW Land and Housing Corporation (LAHC) and the Aboriginal Housing Office (AHO).*

The purpose of this report is to provide a high-level understanding of the opportunities and constraints of the sites due to flooding and to inform the development strategy for Argyll Estate based on an assessment of flooding under Existing Conditions.

1.2 Location

The location of the LAHC properties is indicated in **Figure 1**.

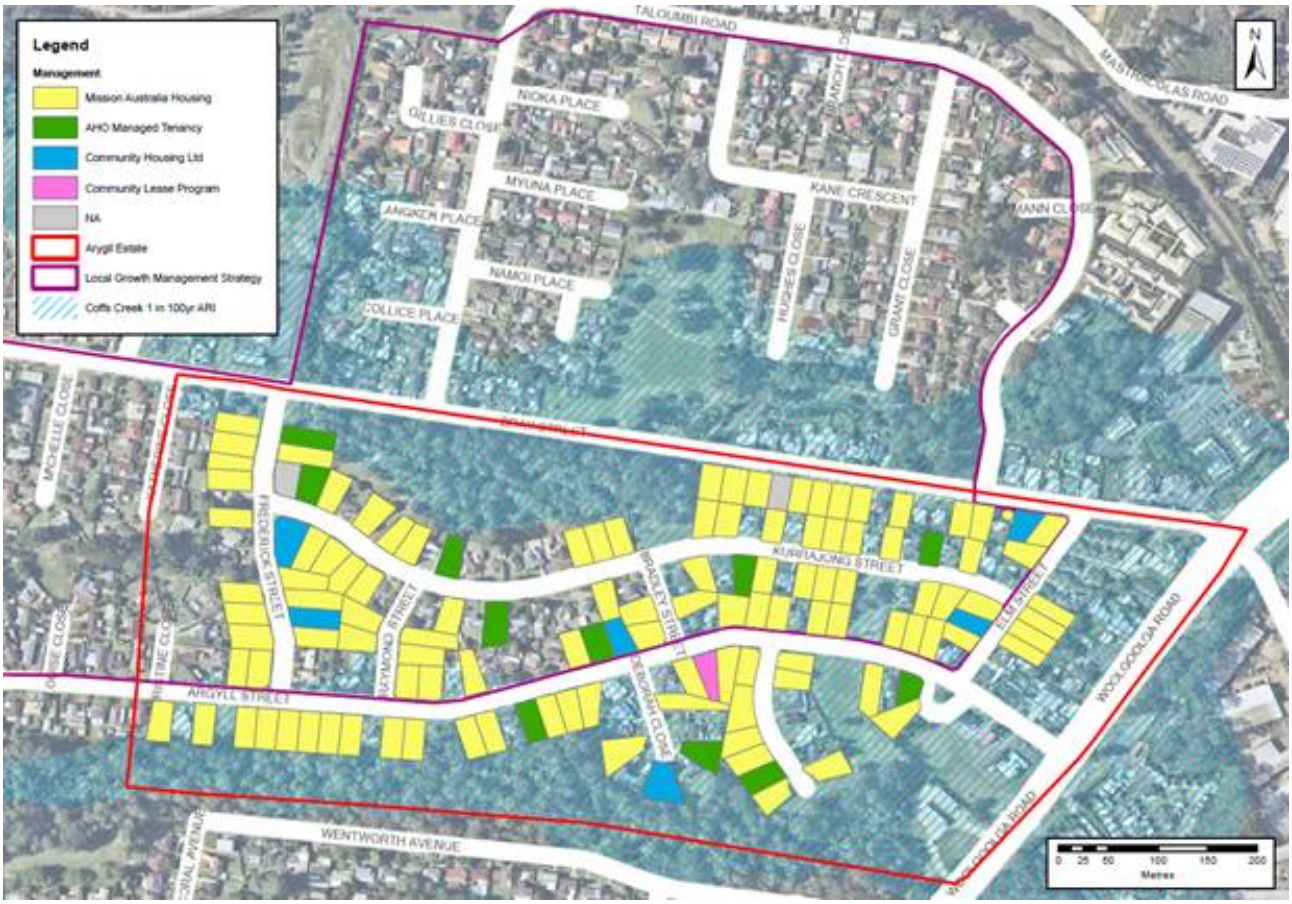


Figure 1 Location of Argyll Estate, Coffs Harbour

[1] https://www.dpie.nsw.gov.au/land-and-housing-corporation/regional/argyll-estate-coffs-harbour

1.3 Terminology

Book 1, Chapter 2, Section 2.2.5. Adopted Terminology in Australian Rainfall & Runoff, 2016 describes the adopted terminology as follows:

To achieve the desired clarity of meaning, technical correctness, practicality and acceptability, the National Committee on Water Engineering has decided to adopt the terms shown in Figure 1.2.1 and the suggested frequency indicators.

Frequency Descriptor	EY	AEP (%)	AEP (1 in x)	ARI
Very Frequent	12			
	6	99.75	1.002	0.17
	4	98.17	1.02	0.25
	3	95.02	1.05	0.33
	2	86.47	1.16	0.5
	1	63.21	1.58	1
Frequent	0.69	50	2	1.44
	0.5	39.35	2.54	2
	0.22	20	5	4.48
	0.2	18.13	5.52	5
	0.11	10	10	9.49
Rare	0.05	5	20	20
	0.02	2	50	50
	0.01	1	100	100
Very Rare	0.005	0.5	200	200
	0.002	0.2	500	500
	0.001	0.1	1000	1000
	0.0005	0.05	2000	2000
Extreme	0.0002	0.02	5000	5000
			↓	
			PMP/ PMPDF	

Figure 1.2.1. Australian Rainfall and Runoff Preferred Terminology

Navy outline indicates preferred terminology. Shading indicates acceptable terminology which is depends on the typical use. For example, in floodplain management 0.5% AEP might be used while in dam design this event would be described as a 1 in 200 AEP.

As shown in the third column of Figure 1.2.1, the term Annual Exceedance Probability (AEP) expresses the probability of an event being equalled or exceeded in any year in percentage terms, for example, the 1% AEP design flood discharge.

There will be situations where the use of percentage probability is not practicable; extreme flood probabilities associated with dam spillways are one example of a situation where percentage probability is not appropriate. In these cases, it is recommended that the probability be expressed as 1 in X AEP where 100/X would be the equivalent percentage probability.

For events more frequent than 50% AEP, expressing frequency in terms of annual exceedance probability is not meaningful and misleading, as probability is constrained to a maximum value of 1.0 or 100%. Furthermore, where strong seasonality is experienced, a recurrence interval approach would also be misleading. An example of strong seasonality is where the rainfall occurs predominately during the Summer or Winter period and as a consequence flood flows are more likely to occur during that period.

Accordingly, when strong seasonality exists, calculating a design flood flow with a 3 month recurrence interval is of limited value as the expectation of the time period between occurrences will not be consistent throughout the year. For example, a flow with the magnitude of a 3 month recurrence interval would be expected to occur or be exceeded 4 times a year; however, in situations where there is strong seasonality in the rainfall, all of the occurrences are likely to occur in the dominant season.

Consequently, events more frequent than 50% AEP should be expressed as X Exceedances per Year (EY). For example, 2 EY is equivalent to a design event with a 6 month recurrence interval when there is no seasonality in flood occurrence

The terminology adopted herein depends on the edition of Australian Rainfall and Runoff provide the IFD data. In the case of assessments based on ARR1987 the ARI terminology was adopted design floods. In the case of assessments based on ARR2019 the AEP terminology was adopted design floods.

2 Previous Studies

As described on Council's website

The Coffs Creek and Park Beach Flood Study for the Coffs Creek (and tributaries) catchment completed in 2018, updates older flood estimates using more accurate terrain data, an improved understanding of local rainfall patterns, and more sophisticated modelling techniques. It also considers the impact of the detention basins and other recent flood mitigation improvements.

Council has also used this information to review drainage strategies for the Park Beach area. Park Beach Management Options Assessment - May 2018 uses the new flood model to assess drainage modifications in the residential and commercial areas of the Park Beach area. The study assesses the reduction in flood damage costs for the various modifications and provides a benefit cost ratio for each option.

A Floodplain Risk Management Study and Plan for Coffs Creek catchment was completed in 2005, of which all recommended mitigation have now been investigated or completed.

Current Works and Projects

There are currently no works or projects in this catchment.

Past Work

As recommended in the 2005 Floodplain Risk Management Plan for Coffs Creek catchment, 4 detention basins have been built to reduce flood risk the last of which was completed in December 2018.

2.1 2018 Coffs Creek and Park Beach Flood Study

As described in part by BMT WBM (2018)

The Coffs Creek and Park Beach Flood Study has been prepared for Coffs Harbour City Council (Council) to define the existing flood behaviour in the catchment and establish the basis for subsequent floodplain management activities. Review of previously defined flood behaviour was required due construction of recent flood mitigation works, including multiple detention basins, across the catchment.

The primary objective of the Flood Study is to define the flood behaviour within the Coffs Creek catchment through the establishment of appropriate numerical models. The study has produced information on flood flows, velocities, levels and extents for a range of flood event magnitudes under existing catchment and floodplain conditions. Specifically, the study incorporates:

- *Compilation and review of existing information pertinent to the study and acquisition of additional data including survey as required;*
- *Development and calibration of appropriate hydrologic and hydraulic models;*
- *Determination of design flood conditions for a range of design event including the 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and PMF event; and*
- *Presentation of study methodology, results and findings in a comprehensive report incorporating appropriate flood mapping.*

Catchment Description

The Coffs Creek catchment has a relatively small area of around 25km2 and is located on the eastern Australian coast. The flat coastal floodplain rises steeply to an escarpment in the west. Elevations rapidly increase from below 10m AHD to more than 400m AHD over just a few kilometres. The Coffs Creek estuary forms the downstream limit of the catchment.

The catchment is bound to the north by densely vegetated ranges of state forest and national parkland. Much of the low lying floodplain area is urban development, consisting of residential, commercial and industrial properties. The upper catchment is primarily used for agriculture and horticulture purposes.

Coffs Creek consists of many branching streamlines and can be divided into three sections; Coffs Creek, including the main arm and minor tributaries to the north west; the Northern Tributaries of Coffs Creek, running adjacent to Bray Street and Argyll Street; and the area located east of the railway line, draining the low-lying areas of Park Beach.

The topography of the Coffs Creek catchment is conducive to extreme weather events. During the formation of a low pressure system off the coast known as an east coast low (ECL), the steep terrain located very close to the coastline is exposed. In the presence of strong onshore wind, moisture filled air masses are pushed towards the hills, where they rapidly rise facilitating intense rainfall over the upper catchment. The phenomenon of increased rainfall across the upper catchment was found to be consistent across a number of historic rainfall events.

The Coffs Creek catchment is prone to severe flash flooding as it is a relatively small catchment with steep upper slopes, a high level of urban development on the floodplain and the tendency for high rainfall.

Following from recommendations in the Floodplain Risk Management Study and Plan (Bewsher Consulting, 2005), multiple detention basins have been constructed in the catchment in recent years. These include the Bakers Road basin located upstream of William Sharp Drive (constructed 2010), the Bennetts Road basin (constructed 2012-2013) and the Spagnolos Road (constructed 2015).

Historical Flooding

A number of floods are known to have occurred in Coffs Harbour since the late 1800s. However, detailed information surrounding events prior to the 1970s is scarce. Newspaper clippings indicate that significant flood events were experienced in November 1917 and February 1938. Since rainfall records commenced, floods are known to have occurred in June 1950, April 1962 and April 1963. The April 1963 event was the largest of these.

More information is available for floods experienced in the latter part of the 20th century. This includes photographs, flood levels and other evidence relating to the number of properties inundated by floodwaters. Large flood events occurred in March 1974 and May 1977 and a smaller flood occurred in April 1989.

In recent years, extreme floods occurred in 1991, 1996 and 2009. The floods of November 1996 and March 2009 are the largest on record in Coffs Harbour were of similar magnitude. The rainfall gradient phenomenon ("orographic rainfall") was observed across the catchment for both the 1996 and 2009 events, with rainfall recorded over the upper catchment equivalent to design rainfall estimates rarer than the 0.2% AEP. During the 1996 event, recorded flood levels were up to 1.0m higher than previously defined 1% AEP design flood levels.

Serious flooding has also occurred within Park Beach in recent years, resulting from heavy, intense rainfall over the lower catchment in November 2009 and February 2015. ……..

Conclusions

The objective of the study was to undertake a detailed flood study of the Coffs Creek catchment and establish models as necessary for design flood level prediction.

In completing the flood study, the following activities were undertaken:

- *Compilation and review of existing information pertinent to the study and acquisition of additional data including survey;*
- *Development and calibration of appropriate hydrologic and hydraulic models;*
- *Calibration of the developed models using the available flood data, including the recent events of 1996, 2009 and 2015; and*
- *Prediction of design flood conditions in the catchment and production of design flood mapping series.*

The main departure of this study from the previous work is the different design flood conditions within the catchment, particularly peak flood levels and inundation extents. This is largely due to construction of detention basins within the catchment, but also due to:

- *Changing from a 1D to almost entirely 2D model representation; and*
- *Revising the design rainfall scaling factors and lowering the sea level boundary in accordance with OEH guidelines (2015).*

The Floodplain model development, calibration and design flood estimation are overviewed in **Section 3**.

Council's Mapping Compendium plots flood depths, velocities and water levels for the 5%, 2%, 1%, 0.5% and 0.2% AEP floods as well as the PMF. The compendium also maps 1% AEP Hydraulic Categories and provisional Flood Hazards as well as True Hazards.

2.2 Coffs Creek Floodplain Risk Management Study and Plan Review

In 2020 Coffs Harbour City Council received grant funding from the NSW State Floodplain Risk Management Program (DPIE) to review the Coffs Creek Floodplain Risk Management Study and Plan. Coffs Creek comprises many branching stream lines, and flow eastwards to the Coffs Creek Estuary in Coffs Harbour. The catchment can be divided into the following three sections:

- Coffs Creek, including the main arm and minor tributaries to the north west;
- The Northern Tributaries of Coffs Creek, running adjacent to Bray Street and Argyll Street, and
- The area located east of the railway line, draining the low lying areas of Park Beach.

The 2020 study area includes Argyll Estate.

This study appears to be ongoing.

3 Flooding under Existing Conditions

As described in part by BMT WBM (2018):

> ***Model Development***
>
> *Development of hydrologic and hydraulic models has been undertaken to simulate flood conditions in the catchment. The hydrological model developed using XP-RAFTS software provides for simulation of the rainfall-runoff process using the catchment characteristics of the Coffs Creek catchment and historical and design rainfall data. The hydraulic model, simulating flood depths, extents and velocities utilises the TUFLOW two-dimensional (2D) software developed by BMT WBM. The 2D modelling approach is suited to model the complex interaction between channels and floodplains and converging and diverging of flows through structures and urban environments.*
>
> *The floodplain topography is defined using a digital elevation model (DEM) derived from topographic, hydrographic and topographic survey data provided by Council. To supplement the available data, additional channel cross section survey of the Argyll Street branch of the Northern Tributaries of Coffs Creek was acquired during the course of the study.*

As described in part in Section 4.2.1 Topography by BMT WBM (2018):

> *In addition to the 2007 LiDAR survey provided by Council, BMT WBM had previously purchased LiDAR data covering the study area collected in 2013. Of particular benefit to this study is that in the years between each data set, numerous detention basins and other local works (levees and channel modifications) have been constructed across the catchment. For the Coffs Creek catchment, a 2m resolution gridded DEM was principally derived from the 2013 LiDAR data set, with components of the 2007 LiDAR utilised for calibration events.*
>
> *As discussed in Section 3, cross section survey of the watercourses was required to supplement the LiDAR data and provide the necessary detail on channel shape and dimensions for representation in the hydraulic model. The channel topography has been incorporated into the 2D model representation and is discussed further in Section 4.2.4.*

As described in part in Section 4.2.4 Channel Network by BMT WBM (2018):

> *… The approach adopted in this study involved embedding the channel topography within the 2D model domain.*
>
> *…. Due to the different nature of the creek channel upstream and downstream of the Pacific Highway, two different methods were adopted to define the width of the channel bed. Upstream of the Pacific Highway, the channel was lowered by one cell width (4m) to allow for a continuous flow path along the creek alignment.*
>
> *A sample cross sections of the modelled topography, derived from LiDAR data is provided in Figure 4-2.*

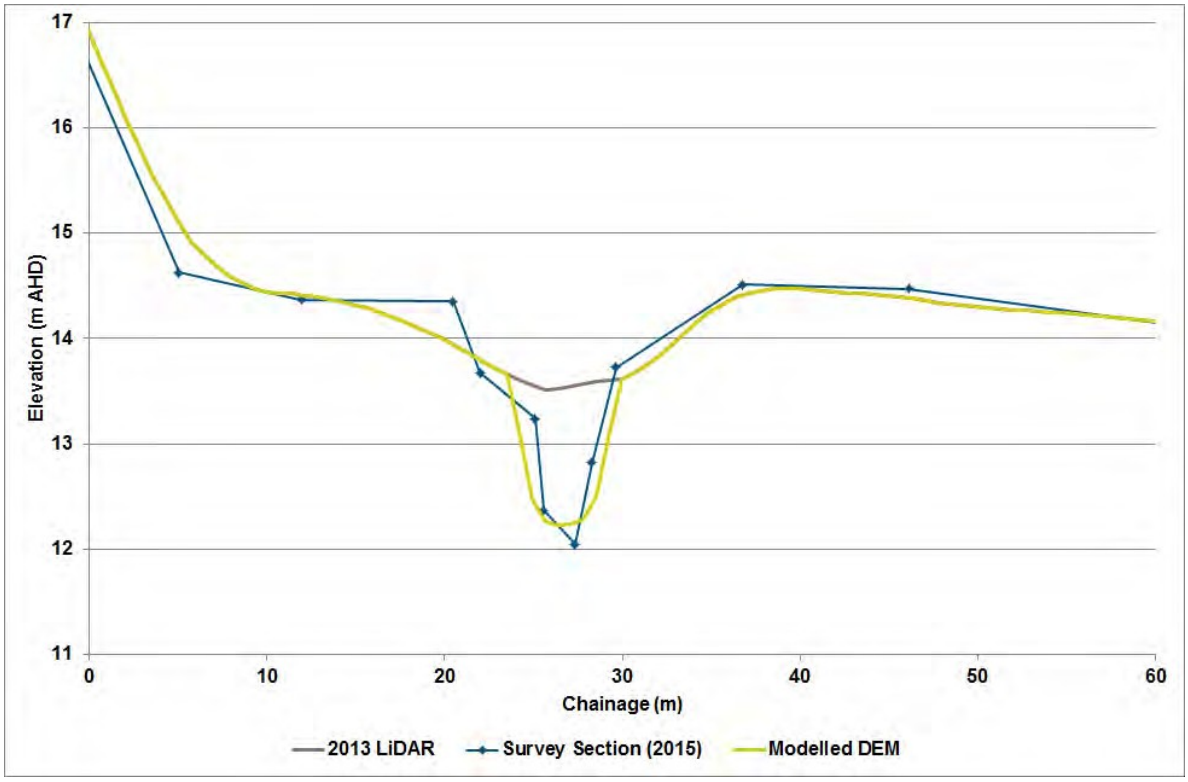


Figure 4-2 Sample Model Channel Section Derived from LiDAR Data Assessment (Upstream of Pacific Highway)

Downstream of the Highway, bed width is generally wider and more varied. Channel cross section survey information extracted from the RUBICON model developed for the Coffs Creek Flood Study (WMA, 2001) was used to define key elevation points (e.g. 0m AHD and -1m AHD) at each location. Interpolating between the points provided a smooth, continuous transition of channel width along the reach.

To inform the current assessment both ALS data and a DEM covering the subject properties were supplied by LAHC. It was interest to compare the ground levels contained in the supplied ALS data and DEM with the DEM adopted for the 2018 study. The following comparison were undertaken:

(i) Supplied ALS – Supplied DEM

(ii) Supplied ALS – Model DEM

(iii) Supplied DEM – Model DEM

and are plotted in **Figures A.1, A.2** and **A.3** respectively.

Figure A.1 discloses that the supplied ALS and supplied DEM are in close agreement with some minor differences along watercourses. Figures A.2 and A.3 disclose:

(i) Gutter levels appear to have been included in the supplied ALS and supplied DEM and not in the model DEM;

(ii) The lowering of the channel beds described in Section 4.2.4 Channel Network by BMT WBM (2018) contrasts with channel levels in the supplied ALS and supplied DEM;

(iii) The channel levels incorporated into the model DEM are considered to be a more realistic representation of true channel levels than the channel levels in the in the supplied ALS and supplied DEM

As described, in part, in Section 4.2.3 Hydraulic Roughness by BMT WBM (2018):

> *The development of the TUFLOW model requires the assignment of different hydraulic roughness zones. These zones are delineated from aerial photography and cadastral data identifying different land-uses (e.g. forest, cleared land, roads, urban areas, etc.) for modelling the variation in flow resistance. The hydraulic roughness is one of the principal calibration parameters within the hydraulic model and has a major influence on flow routing and flood levels. The roughness values adopted from the calibration process is discussed in Section 5.*

The spatial extent of the zones of adopted hydraulic roughness are plotted in **Figure 2**.

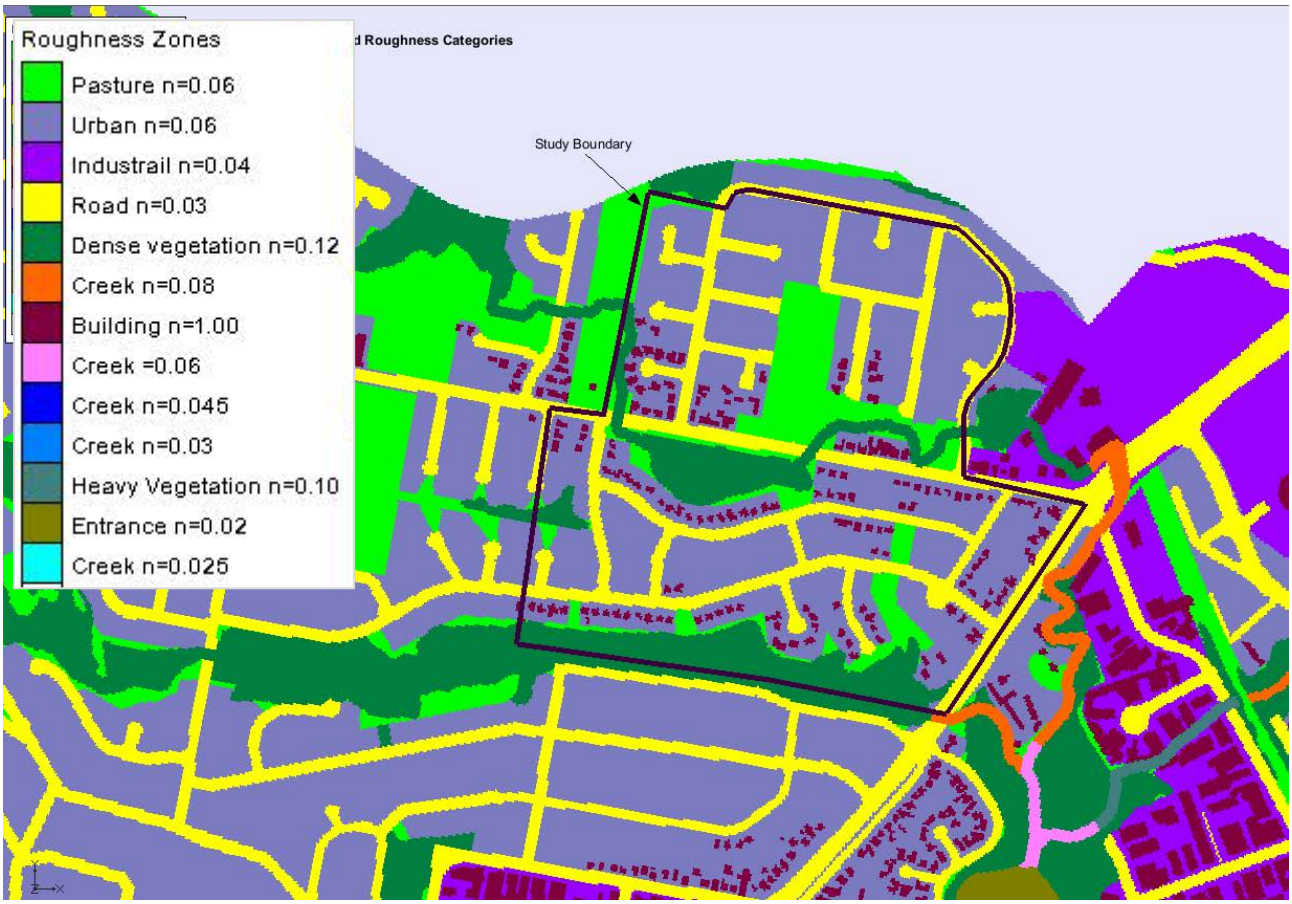


Figure 2 Roughness Zones (Source: 2018 Coffs Creek and Park Beach Flood Study)

As also described in part by BMT WBM (2018)

> ***Model Calibration and Validation***
>
> *The selection of suitable historical events for calibration of computer models is largely dependent on available historical flood information. Ideally the calibration and validation process should cover a range of flood magnitudes to demonstrate the suitability of a model for the range of design event magnitudes to be considered.*
>
> *In recent years, both the March 2009 and November 1996 events were major flood events in the Coffs Creek catchment. The 2009 event has been selected as the principle calibration event for the model for the following reasons:*

- *More comprehensive coverage of rainfall records during the event;*
- *Catchment topography during 2009 will be closer to 2013 LiDAR data given that extensive development within the catchment has occurred since 1996;*
- *Better coverage of surveyed flood marks within Park Beach; and*
- *Official MHL stream gauge recorded the entire event.*

Due to the uncertainty surrounding catchment topography as a result of development between the 1996 and 2009 events, the November 1996 event will be used to validate the model.

In March 2015, Park Beach and areas along the Northern Tributaries of Coffs Creek were flood affected due to localised heavy rainfall. This event was therefore used to validate the models performance in Park Beach.

Design Event Modelling and Output

The developed models have been applied to derive design flood conditions within the Coffs Creek catchment. In order to account for the rainfall gradient observed across the catchment in extreme flood events, scaling factors have been applied to design rainfall estimates which were calculated in accordance with the procedures Australian Rainfall and Runoff (IEAust, 2001). A range of storm durations using standard AR&R (2001) temporal patterns, were modelled in order to identify the critical storm duration for design event flooding in the catchment.

The impact of the recently constructed detention basins on design flood levels and the potential benefit of construction of a fourth detention basin at Upper Shephards Lane were assessed. The performance of the existing levees within the catchment was also reviewed.

A range of design flood conditions were modelled. The simulated design events included the 5% AEP, 2% AEP, 1% AEP, 0.5% AEP, 0.2% AEP and PMF event. The model results for the design events considered have been presented in a detailed flood mapping series for the catchment (see Mapping Compendium). The flood data presented includes design flood inundation, peak flood water levels and depths and peak flood velocities.

Hydraulic categories (floodway, flood fringe and flood storage) and provisional flood hazard categories (in accordance with Figure L2 of the NSW Floodplain Development Manual (2005)) have been mapped for flood affected areas within the catchment. True hazard categories, as defined in the Coffs Creek Floodplain Risk Management Study (Bewsher Consulting, 2005), have also been mapped.

Sensitivity Testing

A number of sensitivity tests have been undertaken to identify the impacts of the adopted model conditions on the design flood levels. Sensitivity tests included:

- *The impact of potential future climate change, including projected sea level rises and increased rainfall intensities;*
- *Structure and stormwater pipe blockages;*
- *Changes in the adopted roughness parameters; and*
- *Alternate design rainfall gradient scaling factors.*

3.1 Flood Levels and Depths

The estimated 5% AEP, 1% AEP, 0.2% AEP and PMF flood levels and extent and depths are plotted in **Figures 3, 4, 5** and **6** respectively. The LAHC property boundaries are also highlighted to facilitate a visual assessment of the degree of inundation of individual properties in each flood.

3.2 Hydraulic Categories

As described, in part, in Section 4.2.3 Hydraulic Roughness by BMT WBM (2018):

> *There are no prescriptive methods for determining what parts of the floodplain constitute flood ways, flood storages and flood fringes. Descriptions of these terms within the NSW Floodplain Development Manual (DIPNR, 2005) are essentially qualitative in nature. ……..*
>
> *The hydraulic categories as defined in the Floodplain Development Manual are:*
>
> - ***Floodway** – Areas that convey a significant portion of the flow. These are areas that, even if partially blocked, would cause a significant increase in flood levels or a significant redistribution of flood flows, which may adversely affect other areas.*
> - ***Flood Storage** – Areas that are important in the temporary storage of the floodwater during the passage of the flood. If the area is substantially removed by levees or fill it will result in elevated water levels and/or elevated discharges. Flood Storage areas, if completely blocked would cause peak flood levels to increase by 0.1m and/or would cause the peak discharge to increase by more than 10%.*
> - ***Flood Fringe** – Remaining area of flood prone land, after Floodway and Flood Storage areas have been defined. Blockage or filling of this area will not have any significant effect on the flood pattern or flood levels.*
>
> *A number of approaches were considered when attempting to define flood impact categories across the study catchment. The approach that was adopted derived a preliminary floodway extent from the velocity * depth product (sometimes referred to as unit discharge). The peak flood depth was used to define flood storage areas. The adopted hydraulic categorisation is defined in Table 7-4.*

Table 7-4 Hydraulic Categories

Floodway	*Velocity * Depth > 0.3m^2/sat the 1% AEP event*	*Areas and flow paths where a significant proportionof floodwaters are conveyed (including all bank-to- bank creek sections).*
Flood Storage	*Velocity * Depth < 0.3m^2/sand Depth > 0.5m at the 1% AEP event*	*Areas where floodwaters accumulate before being conveyed downstream. These areas are importantfor detention and attenuation of flood peaks.*
Flood Fringe	*Flood extent of the PMFevent*	*Areas that are low-velocity backwaters within the floodplain. Filling of these areas generally has little consequence to overall flood behaviour.*

The mapping of hydraulic categories in a 1% AEP flood is given in **Figure 7.** The LAHC property boundaries are also highlighted to facilitate a visual assessment of the degree to which individual properties are mapped in the hydraulic categories.

3.3 True Hazard and Flood Risk Precincts

As described, in part, in Section 7.6 true Hazard by BMT WBM (2018):

> *….. The Coffs Creek Floodplain Risk Management Study (Bewsher Consulting, 2005) specifically defined four categories of true hazard or flood risk, with guidance to the appropriate level of planning control applicable to each category.*
>
> *The true hazard categories, as defined by Bewsher (2005), are as follows:*
>
> - ***High Flood Risk** – Area within the 1% AEP event flood extent that is classified as high hydraulic hazard (see Section 7.4) and/or where there are significant evacuation difficulties. The high flood risk area is where high flood damages, potential risk to life, or evacuation problems are anticipated. Most development should be restricted with stringent development controls within this area.*
> - ***High Flood Risk Flow Corrido**r – A high flow corridor exists within the high flood risk area. It is defined as the area between the main creek banks and/or where the velocity * depth product exceeds 1.0* m^2/s*.*
> - ***Medium Flood Risk** – Area within the 1% AEP event flood extent that is not classified as high hydraulic hazard and where there are no significant evacuation difficulties. The potential for damages can be minimised by the application of appropriate development controls.*
> - ***Low Flood Risk** – Area within the PMF flood extent that is not classified as high or medium flood risk. The risk of damage is low and most land uses would be permitted within this area.*

The mapping of true hazard and flood risk precincts is given in **Figure 8**. The LAHC property boundaries are also highlighted to facilitate a visual assessment of the degree to which individual properties are mapped in the risk precincts.

3.4 Climate Change

As described, in part, in Section 7.6 true Hazard by BMT WBM (2018):

> *The potential impacts of future climate change were considered for the 1% AEP design event. There are potential impacts associated with both an increase in rainfall intensities and an increase in sea level rise. Table 7-5 summarises the climate change scenarios modelled. The impact of potential sea level rise extends as far upstream along the Coffs Creek Main Arm as the Pacific Highway bridge.*

BMT WBM (2018) tabulates estimated 1% AEP flood levels at selected locations under a range of climate change scenarios. The locations relevant to the LAHC properties are:

Table 7-5 Climate Change Scenarios

Modelled Simulation	Boundary Conditions
Adopted 1% AEP Design Event	*1% AEP rainfall 5% AEP ocean event*
1% AEP + 2050 SLR	*1% AEP rainfall 5% AEP ocean event + 0.4m*
1% AEP + 2100 SLR	*1% AEP rainfall 5% AEP ocean event + 0.9m*
1% AEP + 10% rainfall	*0.5% AEP rainfall 1% AEP ocean event (i.e. Adopted 0.5% AEP Design Event)*
1% AEP + 10% rainfall + 2050 SLR	*0.5% AEP rainfall 1% AEP ocean event + 0.4m*
1% AEP + 10% rainfall + 2100 SLR	*0.5% AEP rainfall 1% AEP ocean event + 0.9m*
1% AEP + 30% rainfall	*0.2% AEP rainfall 1% AEP ocean event (i.e. Adopted 0.2% AEP Design Event)*
1% AEP + 30% rainfall + 2050 SLR	*0.2% AEP rainfall 1% AEP ocean event + 0.4m*
1% AEP + 30% rainfall + 2100 SLR	*0.2% AEP rainfall 1% AEP ocean event + 0.9m*

Table 1 Summary of Model Sensitivity Results (Source: Table 7-7, BMT WBM (2018))

		Modelled Peak Flood Level (m AHD)								
ID	Location	1% AEP	1% AEP w 0.4mSLR	1% AEP w 0.9mSLR	1% AEP +10%RF (0.5%AEP)	0.5% AEP w0.4m SLR	0.5% AEP w0.9m SLR	1% AEP +30%RF (0.2%AEP)	0.2% AEP w0.4m SLR	0.2% AEP w0.9m SLR
H	Bray Street	7.1	7.1	7.1	7.1	7.1	7.1	7.2	7.2	7.2
I	Pacific Hwy, NT's	4.4	4.4	4.4	4.4	4.4	4.4	4.5	4.5	4.5
J	Orlando St, NT's	4.5	4.5	4.5	4.6	4.6	4.6	4.7	4.7	4.7

The estimated 1% AEP flood levels at locations H, I and J under a range of climate change scenarios are given in **Table 1**.

It is concluded that 1% AEP flood levels in the Argyll Estate are estimated to increase up to 0.1 m only under a range of climate change scenarios which is well within Council's adopted freeboard of 0.5 m.

4 Planning Controls

4.1 2021 Flood Prone Land Package

As advised on the DPIE website (https://www.planning.nsw.gov.au/Policy-and-Legislation/Managing-risk-in-land-use-planning/Flooding):

> *The finalised flood-prone land package commenced on 14 July 2021.*
>
> *The package provides advice to councils on considering flooding in land-use planning and includes:*
>
> - *a revised 9.1 local planning direction on flooding*
> - *a new planning circular on flooding PS21-006 - considering flooding in land use planning: guidance and statutory requirements, which replaces planning circular PS 07-003*
> - *a new guideline - Considering Flooding in Land Use Planning, which replaces the Guideline on Development Controls on Low Flood Risk Areas*
> - *Standard Instrument (Local Environmental Plans) Amendment (Flood Planning) Order 2021, which includes a mandatory 'flood planning' clause and an optional 'special flood consideration' clause*
> - *Environmental Planning and Assessment Amendment (Flood Planning) Regulation 2021 which amends the 7A clauses under Schedule 4, and*
> - *State Environmental Planning Policy Amendment (Flood Planning) 2021 which revokes councils existing flood planning LEP clause and replaces it with the mandatory Standard Instrument flood planning clause.*
>
> ***The updated guidance:***
>
> - *supports better management of flood risk beyond the 1% annual exceedance probability,*
> - *ensures best management practices in managing and mitigating severe to extreme flood events, and*
> - *builds greater resilience into communities in floodplains and reduce potential property damage and loss of life in recognition of increasing extreme flood events throughout NSW.*

The new planning circular on flooding PS21-006 is attached in **Appendix B**. PS21-006 states, in part, that the 2021 Considering Flooding in Land Use Planning Guideline:

> *.. supports the principles of the manual and provides advice to councils on land use planning on flood-prone land. It provides councils with greater flexibility in defining the areas to which flood-related development controls apply, with consideration of defined flood events, freeboards, low-probability/high- consequence flooding and emergency management considerations.*
>
> *The manual states that a defined flood event (DFE) of 1% AEP, or a historic flood of similar scale, plus a freeboard should generally be used as the minimum level for setting residential flood planning levels (FPL). Choosing different DFEs and freeboards requires justification based on a merit assessment that is consistent with the FRM process and principles of the Floodplain Development Manual.*
>
> *Special Flood Considerations apply to sensitive and hazardous development in areas between the FPA and the PMF and to land that may cause a particular risk to life and other safety considerations that require additional controls. These controls relate to the management of risk to life and the risk of hazardous industry/hazardous storage establishments to the community and the environment in the event of a flood.*

A copy of the 2021 Considering Flooding in Land Use Planning Guideline is attached in **Appendix C**. The guideline states, in part, defines flood planning areas as follows:

> ***Flood Planning Areas***
>
> *Flood Planning Areas will be introduced through a mandatory 'flood planning' clause in the Standard Instrument.*
>
> *FPA is the area of land at or below the flood planning level (FPL).*
>
> *The FPL is a combination of the flood level from the defined flood event (DFE) and freeboard selected for flood risk management purposes.*
>
> *Councils should define their FPAs and FPLs in their development control plans (DCPs) and outline if there are multiple FPAs/FPLs and where they apply. For example, a council may have a different FPAs for different catchments based on the flood risk identified through the FRM process. Council may also have different FPLs based on the land use type (for example, residential, industrial, commercial developments) these should be documented in their DCP. Council may have a range of development controls to suit the flood constraints and different types of development.*

4.2 Coffs Harbour Local Environmental Plan 2013

In relation to flood planning the relevant clause in the Coffs Harbour LEP 2013 are as follows:

> **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 onthe 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 authorityconsiders to be within the flood planning area unless the consent authority is satisfied thedevelopment—*
>
> (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 thepotential flood affectation of other development or properties, and*
>
> (c) *will not adversely affect the safe occupation and efficient evacuation of people or exceed thecapacity 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 ofriparian 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, theconsent authority must consider the following matters—*

(a) *the impact of the development on projected changes to flood behaviour as a result of climatechange,*

(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 thesafe 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 ConsideringFlooding 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* (refer **Appendix C**)

***flood planning area** has the same meaning as it has in the Floodplain Development Manual.*

***Floodplain Development Manual** means the Floodplain Development Manual (ISBN 0 7347 5476 0) published by the NSW Government in April 2005.*

5.22 *Special flood considerations*

[Not adopted]

4.3 Coffs Harbour Development Control Plan 2015

Chapter E4 Flooding of the Coffs Harbour Development Control Plan (DCP) 2015 details the flooding planning requirements. Section E4.1 Flood Planning Requirements - General states:

Objectives

To provide clear guidelines for development and subdivision proposals on land with a flood hazard to ensure that the provisions of Clause 7.3 Flood Planning, of Coffs Harbour LEP 2013 are satisfied. To minimise the flood risk to life and property associated with the use of land.

Requirements

(1) Development is to be designed and located so that it is free from any land that is at or below the 100- year Average Recurrence Interval flood level.
(2) Development is to be designed and located so that it is free from any floodways.
(3) Development is not to comprise the external storage of any materials below the 100-year Average Recurrence Interval flood level that are potentially hazardous or that may cause pollution.
(4) Development is not to result in an increase in flood levels on adjoining or surround land.
(5) Operational access to the development is to provide a level of service commensurate with the zoning and proposed use with consideration to both on site and off site access.

Exceptions

- *Development (including fill) may be supported below the 100-year Average Recurrence Interval flood level provided that:*
  - *the measures specified in this Chapter for specific development types are satisfied; and*
  - *no net filling is undertaken with the Coffs Creek Catchment west of the highway excluding balanced earthworks which may be supported subject to a merit assessment; and*
  - *basement car parks (where relevant) have weir protection from the 100-year Average Recurrence Interval flood level plus 100mm freeboard.*
- *Development proposals resulting in an increase in flood levels on adjoining land may be supported where consent is obtained from affected land owners agreeing to such increases. In this regard, written confirmation of acceptance of changed flood conditions from all adversely affected land owners is required to accompany the relevant development application. Proposals of this nature will be assessed on merit taking into account existing land uses, zoning and predicted impacts on adjoining land. Low intensity land uses including land zoned for rural, recreational and environmental purposes under Coffs Harbour LEP 2013 have additional merit.*
- *Open parking areas are to be assessed on merit, taking into account adjoining land uses and flood levels, access constraints and fill requirements.*

Notes:

- *Flood controls are also contained within the National Construction Code, Volumes 1 & 2 – Building Code of Australia and Australian/New Zealand Standard AS/NZS 3500.2:2003 – Sanitary Plumbing and Drainage.*
- *Safe and reliable access for pedestrians may be required from development to an area of refuge above the Probable Maximum Flood Level, either on or off the site.*

Section E4.2 Flood Planning Requirements - Residential and Tourist Development states, in part:

Requirements

(1) Buildings are to be designed and located so that they are free from any high hazard flood area.

(2) Development is to be designed and located with consideration to impacts from any high hazard flood area on access to the development and the operation of the development.

(3) Development applications for development at or below the 100-year Average Recurrence Interval flood level are to be accompanied by a flood study prepared by a suitably experienced and qualified engineer to substantiate that the development will not increase upstream or downstream flood levels or change flood behaviour to the detriment to any other property.

(4) The minimum finished floor level of all habitable room(s) is to be at the height of the 100-year Average Recurrence Interval flood level plus 0.5 metre freeboard.

(5) The minimum finished floor level of all non-habitable room(s) is to be at the height of the 100-year Average Recurrence Interval flood level.

Exceptions

- *Infill development and/or changes of use are to be assessed on merit, taking into account adjoining land uses and flood levels, access constraints and fill requirements. A flood study may be required in certain situations.*

- *The minimum floor level for alterations and additions to existing residential accommodation shall be as close to the flood planning level as practical and no lower than the existing floor level; and*
  - *where the existing floor level is < the 100-year Average Recurrence Interval flood level, alterations and additions are not to exceed 50m2; or*
  - *where the existing floor level is > the 100-year Average Recurrence Interval flood level but below the 0.5 metre freeboard level, alterations and additions are not to exceed 100m2.*
- *Alterations and additions to existing tourist and visitor accommodation is to be assessed on merit, taking into account adjoining land uses and flood levels, access constraints and fill requirements.*
- *A reduction in the 0.5 metre freeboard requirement may be supported for habitable rooms on land above the 100-year flood level but still affected by the Flood Planning Level (FPL) where adequate flood information is available. Flood behaviour and other points of considerations for a freeboard reduction include low flood flow volumes and velocities, flat flood gradient, compatibility with adjoining development and access issues.*
- *A reduction in the minimum finished floor level of all non-habitable room(s) buildings may be supported on merit taking into consideration compatibility with adjoining land use, access issues for the site and associated filling required.*
- *Land affected by the Middle Creek Floodway Limit Line (FLL) may be developed, provided that development only occurs up to the FLL, including fencing, landscaping and fill so as not to impede the passage of floodwaters or cause an afflux in flood levels.*
- *Alterations and additions to existing development beyond the Middle Creek Floodway Limit Line may be supported subject to a merit assessment.*

Notes:

- *Approval may be conditional upon the lodgement of a registered surveyor's certificate certifying the floor level prior to the development proceeding above finished floor level.*
- *Approval may be conditional upon a Flood Safe Plan being prepared in accordance with SES guidelines and implemented during the operational phase of the development.*

4.4 LAHC Properties

The LAHC properties are identified in **Figure 9**.

The Flood Planning Area (FPA) identified by Council is mapped in **Figure 10**.

It will be noted that the FPA either partially or completely covers all LAHC properties. Consequently, Council's DCP flood planning requirements outlined in Section 4.3 apply to all LAHC properties.

For each property the following was estimated:

(iii) The fraction of the lot classified as Floodway or Flood Storage or Flood Fringe (from **Figure 7**), and

(iv) The fraction of the lot classified as Low, Medium or High Flood Risk and/or High Flood Risk Flow Corridor (from **Figure 8**)

This information is summarised in the table attached in **Appendix D**.

It is noted from **Figure 7** that a number of roads are mapped as floodways in the 1% AEP flood. These include sections of Argyll Street, Kurrajong Street, Bray Street and Elm Street. Depending on the time it takes for these conditions to be reached in a 1% AEP flood on these streets these conditions have the potential to constrain evacuation of residents from properties during major floods.

This summary table in Appendix D identifies a number of properties which have significant constraints due the mapped 1% AEP floodway either completely covering the lot (51 Argyll Street and 53 Argyll Street and 10 Maple Street) or covering a significant proportion of the lot (47 Argyll Street, 59 Argyll Street, 61 Argyll Street, 12 Deborah Close and 3 Frederick Street).

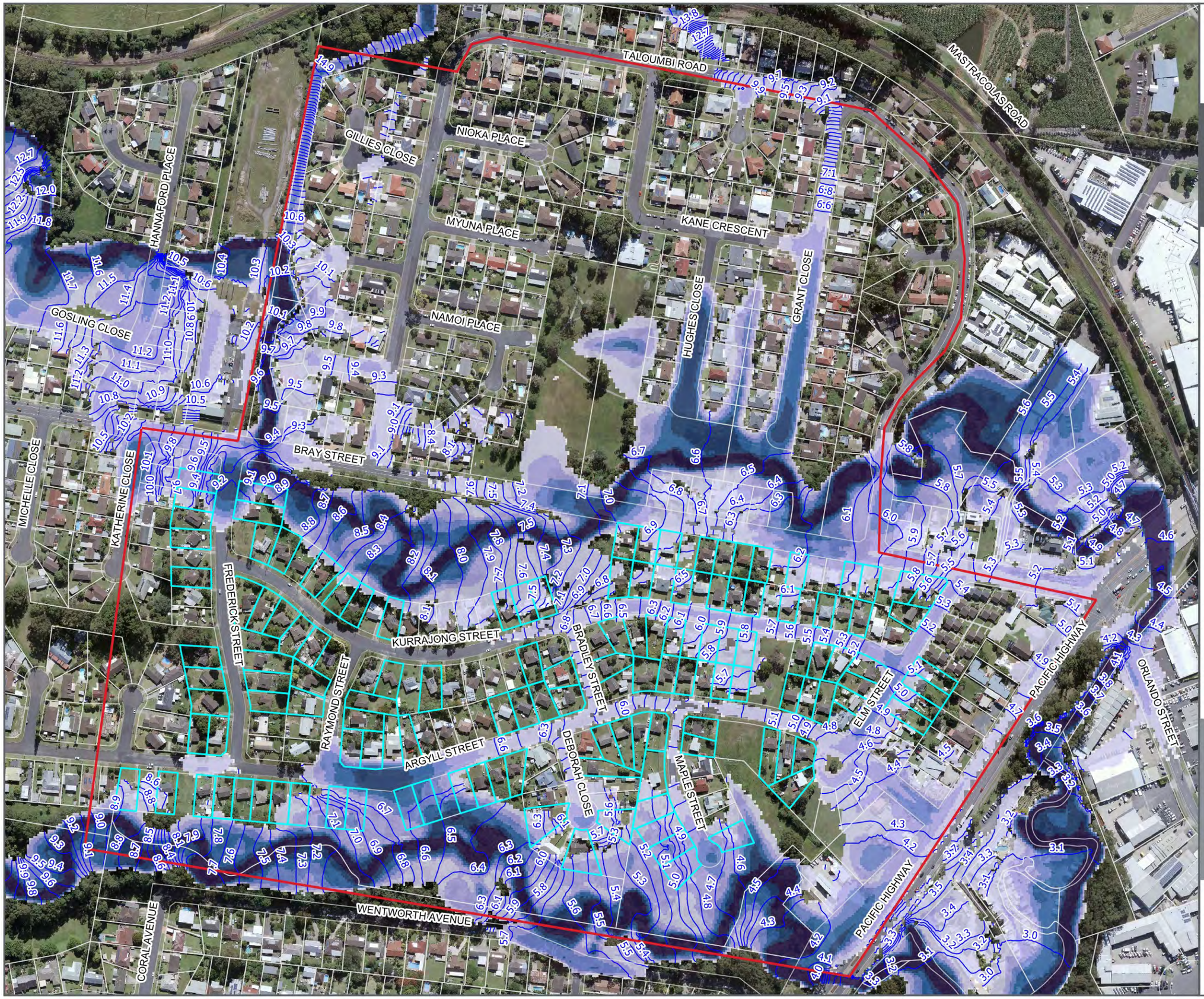
The floodway which crosses through 10 Maple Street and across the head of Maple Street also poses a significant challenge to any evacuation of residents from 12 Maple Street and 13 Maple Street.

5 References

BMT WBM (2018) “Coffs Creek and Park Beach Flood Study”, *Final Report*, Rev 5, 2 Vols, prepared for Coffs Harbour City Council, May

Argyll Estate, Coffs Harbour
Flood Risk Assessment

Benchmark Condition
Flood Levels and Flood Depths
5% AEP



Legend

- Cadastre
- LAHC Lot Boundary
- Site Boundary
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE 3

1:3,500 Scale at A3

0 40 80 120 160 200 m

N

Cardno

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Coordinate System: MGA Zone 56
Map: NW30163_Figures.qgz

Argyll Estate, Coffs Harbour
Flood Risk Assessment

Benchmark Condition
Flood Levels and Flood Depths
1% AEP

Legend

- Cadastre
- LAHC Lot Boundary
- Site Boundary
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE 4

1:3,500 Scale at A3

0 40 80 120 160 200 m

N

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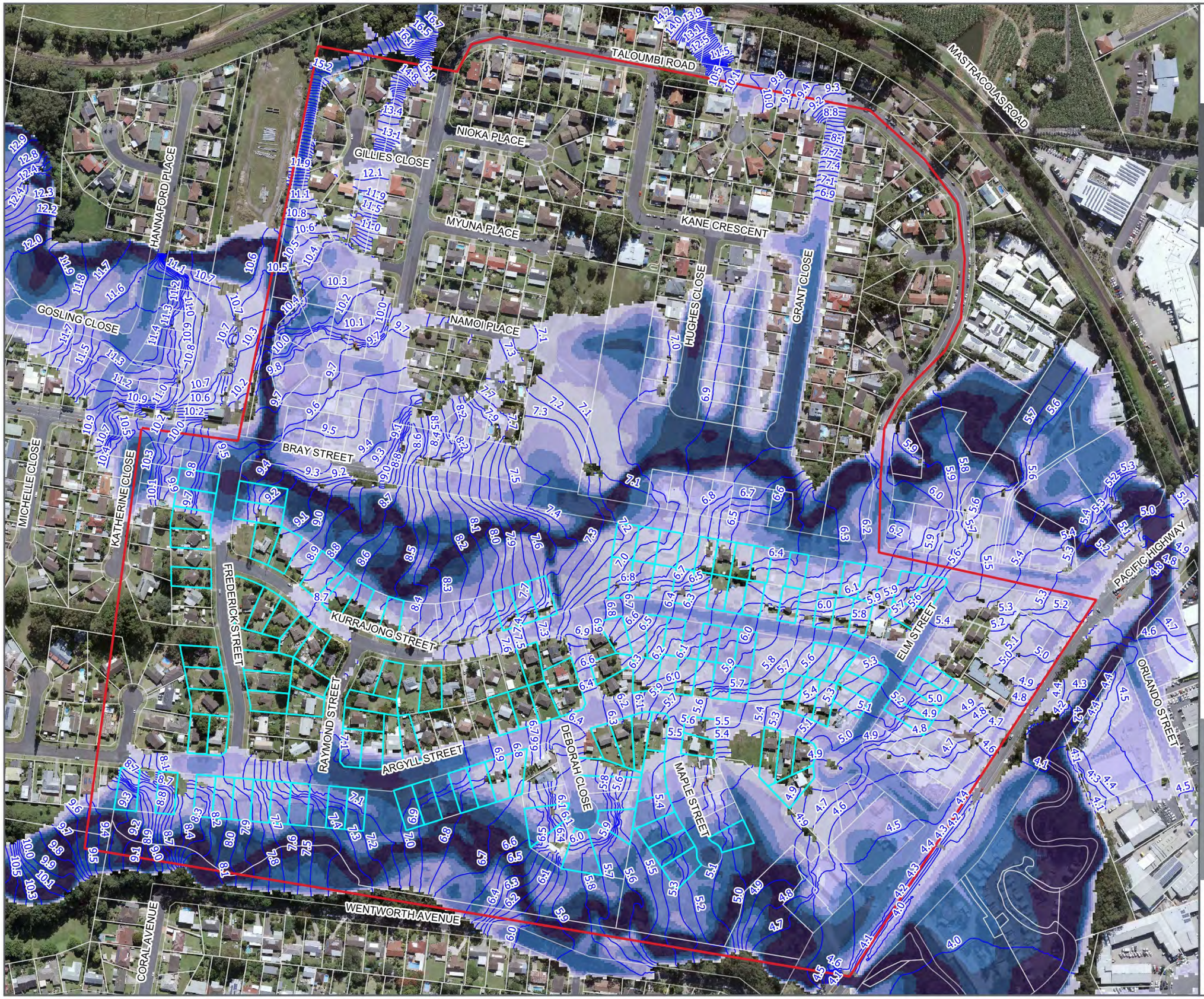
Argyll Estate, Coffs Harbour
Flood Risk Assessment

Benchmark Condition
Flood Levels and Flood Depths
0.2% AEP



Legend

- Cadastre
- LAHC Lot Boundary
- Site Boundary
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE 5

1:3,500 Scale at A3

0 40 80 120 160 200 m

N

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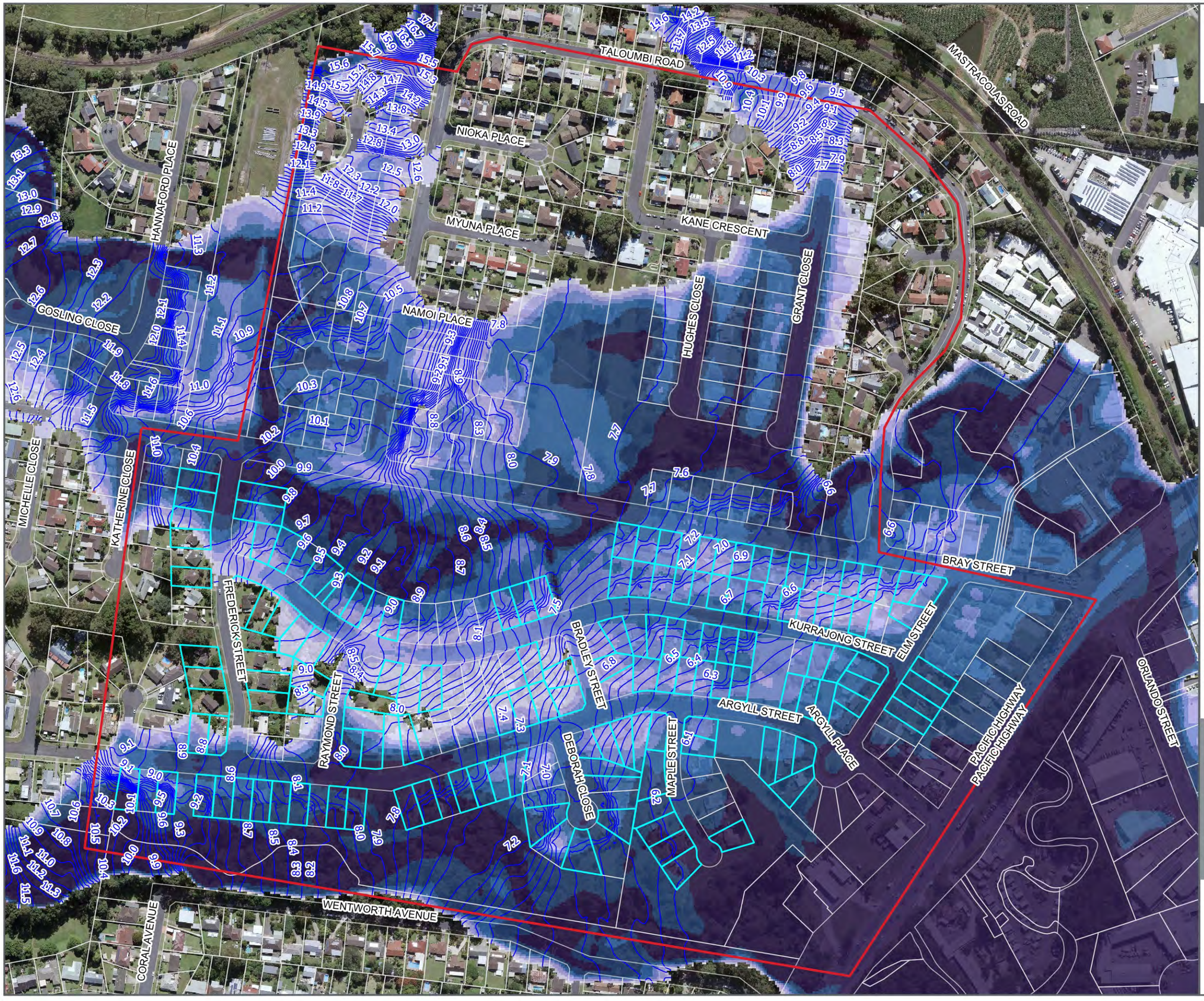
Argyll Estate, Coffs Harbour
Flood Risk Assessment

Benchmark Condition
Flood Levels and Flood Depths
PMF



Legend

- Cadastre
- LAHC Lot Boundary
- Site Boundary
- 0.1m Water Level Contour (mAHD)

Flood Depth (m)

- 0.00 to 0.10
- 0.10 to 0.30
- 0.30 to 0.50
- 0.50 to 0.70
- 0.70 to 1.00
- 1.00 to 1.50
- > 1.50

FIGURE 6

1:3,500 Scale at A3

0 40 80 120 160 200 m

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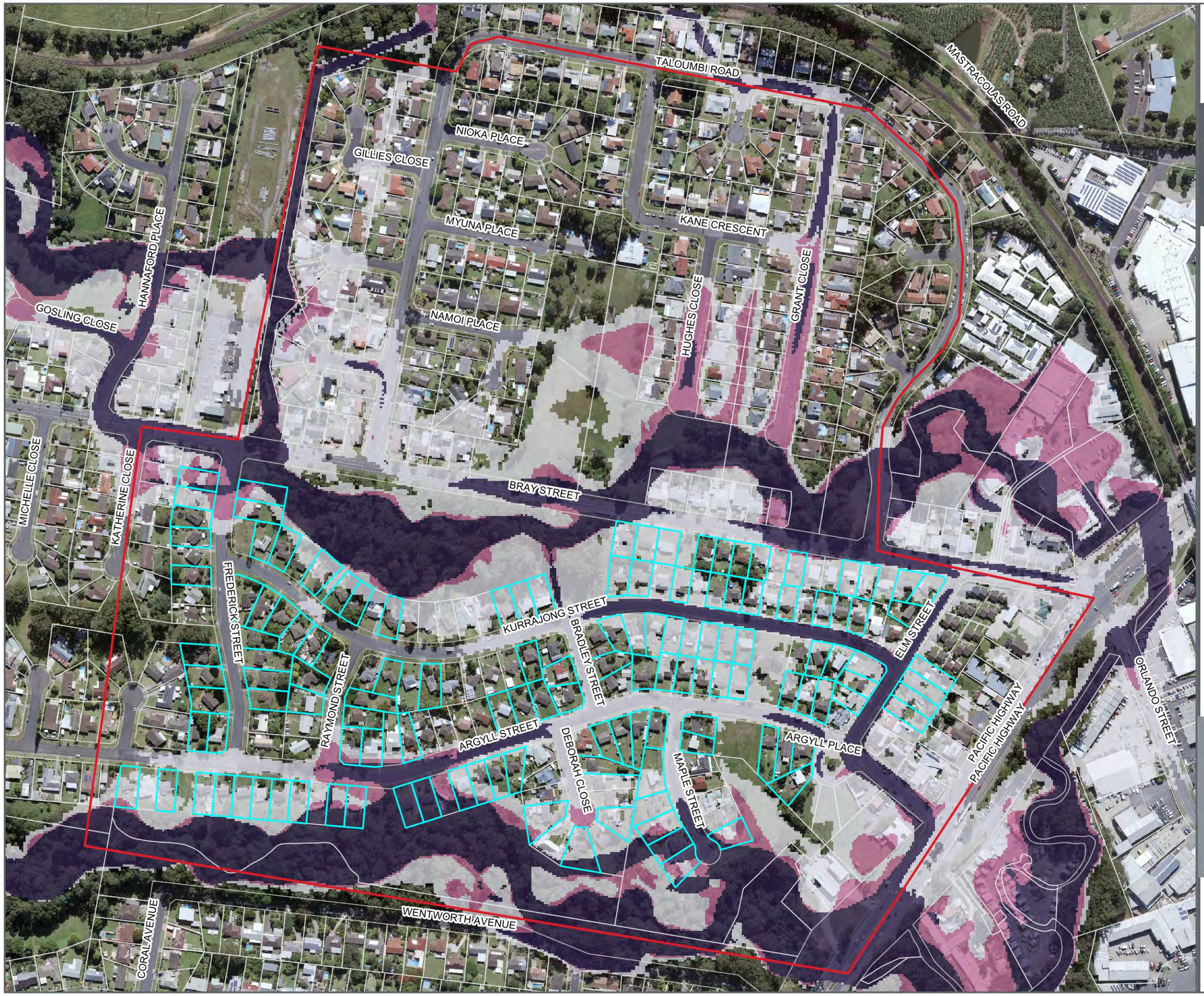
Argyll Estate, Coffs Harbour
Flood Risk Assessment

Benchmark Condition
Hydraulic Category
1% AEP



Legend

- CADASTRE NSW
- LAHC Lot Property
- Site Boundary

Hydraulic Category

- Flood Fringe
- Flood Storage
- Floodway

FIGURE 7

1:3,500 Scale at A3

0 40 80 120 160 200 m

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Argyll Estate, Coffs Harbour Flood Risk Assessment

Benchmark Condition
True Flood Hazard
1% AEP

Legend

- Cadastre
- LAHC Lot Boundary
- Site Boundary

True Flood Hazard Category

- Low Flood Risk
- Medium Flood Risk
- High Flood Risk
- High Flood Risk Flow Corridor

FIGURE 8

1:3,500 Scale at A3

0 40 80 120 160 200 m

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Argyll Estate, Coffs Harbour
Flood Risk Assessment

Benchmark Condition
LAHC Property Addresses

Legend

- Cadastre
- LAHC Lot Boundary
- Site Boundary

FIGURE 9

1:3,500 Scale at A3

0 40 80 120 160 200 m

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Argyll Estate, Coffs Harbour Flood Risk Assessment

Flood Planning Area

Legend

- Cadastre
- LAHC Lot Boundary
- Site Boundary
- Flood Planning Area

FIGURE 10

1:3,500 Scale at A3

0 40 80 120 160 200 m

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APPENDIX A
GROUND LEVEL DIFFERENCES

Cardno
Shaping the Future

Argyll Estate, Coffs Harbour Flood Risk Assessment

Ground Level Difference (Supplied ALS less Supplied DEM)

Legend

- Cadastre
- Site Boundary

Terrain Difference

- <= -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.50

FIGURE A.1

1:3,500 Scale at A3

0 40 80 120 160 200 m

N

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Coordinate System: MGA Zone 56
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Argyll Estate, Coffs Harbour Flood Risk Assessment

Ground Level Difference (Supplied ALS less Model DEM)

TALOUMBI ROAD
MASTRACOLAS ROAD
NIOKA PLACE
GILLIES CLOSE
MYUNA PLACE
KANE CRESCENT
HANNAFORD PLACE
GOSLING CLOSE
NAMOI PLACE
HUGHES CLOSE
GRANT CLOSE
MICHELLE CLOSE
KATHERINE CLOSE
BRAY STREET
FREDERICK STREET
KURRAJONG STREET
RAYMOND STREET
BRADLEY STREET
ELM STREET
ARGYLL STREET
DEBORAH CLOSE
MAPLE STREET
ARGYLL PLACE
PACIFIC HIGHWAY
PACIFIC HIGHWAY
ORLANDO STREET
CORAL AVENUE
WENTWORTH AVENUE

Legend

- Cadastre
- Site Boundary

Terrain Difference

- <= -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.50

FIGURE A.2

1:3,500 Scale at A3

0 40 80 120 160 200 m

N

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Coordinate System: MGA Zone 56
Map: NW30163_Figures.qgz

Argyll Estate, Coffs Harbour Flood Risk Assessment

Ground Level Difference
(Supplied DEM less Model DEM)

TALOUMBI ROAD
MASTRACOLAS ROAD
NIOKA PLACE
GILLIES CLOSE
MYUNA PLACE
KANE CRESCENT
HANNAFORD PLACE
GOSLING CLOSE
NAMOI PLACE
HUGHES CLOSE
GRANT CLOSE
MICHELLE CLOSE
KATHERINE CLOSE
BRAY STREET
FREDERICK STREET
KURRAJONG STREET
BRADLEY STREET
ELM STREET
RAYMOND STREET
ARGYLL STREET
DEBORAH CLOSE
MAPLE STREET
ARGYLL PLACE
PACIFIC HIGHWAY
PACIFIC HIGHWAY
ORLANDO STREET
CORAL AVENUE
WENTWORTH AVENUE

Legend

- Cadastre
- Site Boundary

Terrain Difference

- <= -0.50
- -0.50 - -0.20
- -0.20 - -0.10
- -0.10 - -0.05
- -0.05 - -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.10
- 0.10 - 0.20
- 0.20 - 0.50
- > 0.50

FIGURE A.3

1:3,500 Scale at A3

0 40 80 120 160 200 m

N

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Coordinate System: MGA Zone 56
Map: NW30163_Figures.qgz

APPENDIX B
PLANNING-CIRCULAR-21-006

Cardno
Shaping the Future

Planning circular

PLANNING SYSTEM

Circular	PS 21-006
Issued	14 July 2021
Related	Replaces PS07-003

Considering flooding in land use planning: guidance and statutory requirements

This circular replaces Planning Circular PS07-003 and provides information on how to consider flooding in land use planning. This circular also discusses changes to requirements for planning certificates issued under section 10.7 of the *Environmental Planning and Assessment Act 1979* and local planning direction 4.3 on flooding, which affects planning proposals.

Introduction

The NSW Government's Flood Prone Land Policy (the policy) is set out in the *Floodplain Development Manual: the management of flood liable land*, April 2005 (the manual).

The policy provides that councils are primarily responsible for managing flood risk to reduce the risk to life, property damage and other impacts in their local government areas. It also recognises that flood-prone land may be able to support some types of development.

The manual helps councils make informed decisions about managing flood risk through the development and implementation of floodplain risk management (FRM) plans through the FRM process.

Section 733 of the *Local Government Act 1993* protects councils from liability if they have followed the principles of the manual. This circular is consistent with the principles of the manual.

The manual sets out key issues relating to protecting existing and future occupants of flood-prone land that need to be considered in land use planning. These include the:

- safety of people including evacuation considerations
- management of flood risk, to reduce flood damage to public and private property and infrastructure
- management of the impacts of development, including cumulative impacts of development
- application of development controls
- management of the impacts of development on emergency services.

This circular provides advice on a package of changes regarding how land use planning considers flooding and flood-related constraints.

The package includes:

- an amendment to clause 7A of Schedule 4 to the *Environmental Planning and Assessment Regulation 2000* (the Regulation)
- a revised local planning direction regarding flooding issued under section 9.1 of the *Environmental Planning and Assessment Act 1979 (*the Act)
- two local environmental plan (LEP) clauses which introduces flood related development controls
- a new guideline: *Considering Flooding in Land Use Planning (2021)*
- revoking the *Guideline on Development Controls on Low Flood Risk Areas (2007)*.

The manual and its supporting guides, the *National Best Practice Guidance Australian Institute of Disaster Resilience (AIDR) Handbook 7* and its supporting documents, the AIDR *Guideline 7.5 and AIDR Practice Note 7.7,* all encourage the full range of flood risk to be considered in land use planning.

Understanding the constraints that flooding places on development of land can assist in identifying areas suitable for different types of development, as well as risk-appropriate controls that should apply to different types of development in LEPs. Development control plans (DCPs) may provide details of more specific controls relating to the varying constraints in different areas of the floodplain.

Effective consideration of flood risk in land use planning involves developing an understanding of the full range of flood behaviour up to the Probable Maximum Flood (PMF) and considering this in management of flood risk.

Section 10.7 planning certificates—Amendment to the EP&A Regulation

The *Environmental Planning and Assessment Amendment (Flood Planning) Regulation 2021* amends Schedule 4 to the Regulation to revise the matters to be specified in a planning certificate issued under section 10.7 for land subject to flood-related development controls.

Councils will continue to be required to distinguish between land where different categories of flood-related development controls apply.

Flood-related development controls are not defined but would include any development controls relating to flooding that apply to land, that are a matter for consideration under section 4.15 of the Act.

Clause 7A(1) of Schedule 4 to the Regulation will require councils to include a notation on section 10.7 planning certificates if the land or part of the land to which the certificate relates is within the flood planning area (FPA) and subject to flood related development controls.

Clause 7A(2) of Schedule 4 to the Regulation will require councils to include a notation on section 10.7 planning certificates
if the land or part of the land to which the certificate relates is between the FPA and the probable maximum flood (PMF) and subject to flood related development controls.
The FPA and the PMF have the same meaning as they have in the manual.

The amendment to the Regulation will commence on **14 July 2021** to allow councils time to prepare for the new requirements when issuing section 10.7 planning certificates.

If councils do not have this information, then an 'unknown' response should be provided in the planning certificate until such time as the information is made available to councils and councils have updated its flood-related development controls.

Unmapped locations may also be subject to flood related development controls and these areas should be noted in the planning certificate.

Where known, councils should include any additional information on flooding and flood risk in the planning certificate, under section 10.7(part 5) of the Act, outlining if the land is located within the floodplain.

Local planning direction 4.3—Flooding

Planning proposals are required to be consistent with directions issued under section 9.1 of the EP&A Act. Local Planning Direction 4.3—Flooding requires, among other matters, a planning proposal to be consistent with the principles of the manual.

The direction has been revised to remove the need to obtain exceptional circumstances to apply flood-related residential development controls above the 1% Annual Exceedance Probability (AEP) flood event. It also ensures planning proposals consider the flood risks and do not permit residential accommodation in high hazard areas and other land uses on flood prone land where the development cannot effectively evacuate.

The direction also makes provision for special flood considerations where councils have chosen to adopt the optional Special flood considerations clause in an LEP.

The revised direction will apply to planning proposals that have not been issued with a gateway determination under section 3.34(2) of EP&A Act.

Considering Flooding in Land Use Planning Guideline

The guideline supports the principles of the manual and provides advice to councils on land use planning on flood-prone land. It provides councils with greater flexibility in defining the areas to which flood-related development controls apply, with consideration of defined flood events, freeboards, low-probability/high-consequence flooding and emergency management considerations.

The manual states that a defined flood event (DFE) of 1% AEP, or a historic flood of similar scale, plus a freeboard should generally be used as the minimum level for setting residential flood planning levels (FPL). Choosing different DFEs and freeboards requires justification based on a merit assessment that is consistent with the FRM process and principles of the Floodplain Development Manual.

Special Flood Considerations apply to sensitive and hazardous development in areas between the FPA and the PMF and to land that may cause a particular risk to life and other safety considerations that require additional controls. These controls relate to the management of risk to life and the risk of hazardous industry/hazardous storage establishments to the community and the environment in the event of a flood.

Revised LEP clauses

To reflect the changes to the Regulation for flood-related development, two LEP clauses have been developed to apply to local government areas with flood prone land.

The LEP clauses relate to:

- Flood Planning
- Special Flood Considerations.

Further information

The revised local planning direction is available on the department's website at www.planning.nsw.gov.au/flooding

The Regulation is available from the NSW Legislation website at www.legislation.nsw.gov.au in the 'As Made' section.

The NSW Government's Floodplain Development Manual (2005) and supporting documents are available online at

environment.nsw.gov.au/topics/water/floodplains/floodplain-manual

and

environment.nsw.gov.au/topics/water/floodplains/floodplain-guidelines

Australian Institute of Disaster Resilience (AIDR) 2017 Managing the Floodplain Handbook and supporting documents are available online at

knowledge.aidr.org.au/resources/handbook-7-managing-the-floodplain/

For more information, please contact the relevant Department of Planning, Industry and Environment regional planning team.

Office contact details are available at www.planning.nsw.gov.au/Contact-Us

Department of Planning, Industry and Environment circulars are available at:

planning.nsw.gov.au/circulars

Authorised by:

Alex O'Mara

Group Deputy Secretary

Place, Design and Public Spaces

APPENDIX C

2021 CONSIDERING FLOODING IN LAND USE PLANNING GUIDELINE

Cardno®
Shaping the Future

NSW GOVERNMENT

Considering flooding in land use planning

Guideline

July 2021

dpie.nsw.gov.au

Acknowledgement of country

The Department of Planning, Industry and Environment acknowledges the traditional custodians of the land and pays respect to Elders past, present and future.

We recognise Australian Aboriginal and Torres Strait Islander peoples' unique cultural and spiritual relationships to place and their rich contribution to society.

Contents

Find out more:
www.dpie.nsw.gov.au

Considering flooding in land use planning – Guideline

This edition published: July 2021

Pathways artwork by Nikita Ridgeway

Cover image: River Road, Emu Plains flooding, March 2021.
— Infrastructure NSW | Adam Hollingworth

Windsor, looking east March 2021.— Infrastructure NSW | Top Notch Video

Introduction

This guideline provides advice to councils on flood-related land use planning and the areas where flood-related development controls should apply.

This guideline helps NSW communities to be more resilient to flooding beyond the 1% Annual Exceedance Probability[1] (AEP). This involves considering the management of flood risk for the full range of flooding up to the Probable Maximum Flood (PMF) in land use planning. The guideline applies to both mainstream and overland flow flooding.

This guideline is consistent with the NSW Government's Flood Prone Land Policy (the policy), set out in the NSW Floodplain Development Manual (the manual) published in 2005, which supports the resilient development of flood-prone land. Flood-prone land, or the floodplain, is defined in the manual as the land susceptible to flooding by the PMF event. The policy recognises that flood-prone land may be able to support some types of development. It outlines that each local council is responsible for managing the flood risk to reduce the risk to life, property damage and other impacts in their local government area.

The manual outlines the flood risk management (FRM) process to help councils make informed decisions on managing flood risk to both existing and future development. The FRM process involves studies to understand flood behaviour and examine management options, and the development and implementation of FRM plans.

The manual sets out key issues relating to managing risk to existing and future occupants of flood-prone land that need consideration in land use planning. These include the:

- safety of people including evacuation considerations
- management of flood risk, to reduce flood damage to public and private property and infrastructure
- management of the impacts of development, including cumulative impacts of development
- application of development controls
- management of the impacts of development on emergency services.

All terms referenced in this guideline have the same meaning as those in the standard instrument prescribed by the Standard Instrument (Local Environmental Plans) Order 2006 (Standard Instrument) or the manual, unless otherwise defined at the end of this guideline.

1 The 1% AEP flood is equivalent to the 100-year Annual Recurrence Interval (ARI) and has a 1% chance of happening every year.

Applying the guideline

Section 733 of the *Local Government Act 1993* provides councils with a limited protection from liability if they have followed the principles of the Floodplain Development Manual. As councils undertake or update studies under the FRM process or obtain additional flood information, this information could support councils with the implementation of this guideline.

Councils do not need to apply both flood planning categories outlined in this guideline in their land use planning documents. Councils are required to use the 'Flood Planning Area' (FPA) category and associated standard instrument clause but have discretion in the use of the 'Special Flood Considerations' (SFC) category in their land use planning documents.

Considering flooding in land use planning

The full range of flooding up to and including the PMF must be considered when undertaking strategic land use planning. This includes the preparation of:

- regional, metropolitan and district plans,
- local strategic planning statements,
- environmental planning instruments, and
- planning proposals.

Understanding how key flood constraints vary

The key constraints that result from flooding on land are:

- Flood function. Determining flood function involves identifying the location of floodways, flood storage areas, and flood fringe areas. Floodways and flood storage areas are sensitive to changes in flood behaviour due to activities such as filling or more intense development.
- Flood hazard. Floods are hazardous to people, and public and private infrastructure. The degree of flood hazard varies between locations in the floodplain and flood events of different scales.
- Extent and flooding behaviour. Understanding the extent of the full range of flood events and how flood function and flood hazard may change between events can enable the associated constraints on land to be considered in decision-making.
- Risk to life, such as in areas identified by council or state agencies under the FRM process or through emergency management planning processes.

Hunter Valley Flood Mitigation Scheme – John Spencer | DPIE

The Floodplain Development Manual and its guides provide guidance to assist councils in determining these flood constraints and how they vary on land within the floodplain.

Understanding these constraints allows DCP controls to be developed for the two categories outlined below, that are used in land use planning decision-making. The controls applied in these areas will vary with location, constraints and type of development.

Where flood-related development controls may be applied

There are two different categories where flood-related development controls may be applied/ considered. These are:

- Flood Planning Areas (FPAs), and
- Special Flood Considerations (SFCs).

Councils will be required to include the mandatory standard instrument 'flood planning' provision without variation in their LEPs, and if they choose to adopt the optional standard instrument SFC provision, it must be adopted without variation but subject to any relevant direction in the standard instrument (cl 4(2), SI order).

Flood Planning Areas

Flood Planning Areas will be introduced through a mandatory 'flood planning' clause in the Standard Instrument.

FPA is the area of land at or below the flood planning level (FPL).

The **FPL** is a combination of the flood level from the defined flood event (DFE) and freeboard selected for flood risk management purposes.

Councils should define their FPAs and FPLs in their development control plans (DCPs) and outline if there are multiple FPAs/FPLs and where they apply. For example, a council may have a different FPAs for different catchments based on the flood risk identified through the FRM process. Council may also have different FPLs based on the land use type (for example, residential, industrial, commercial developments) these should be documented in their DCP. Council may have a range of development controls to suit the flood constraints and different types of development.

Councils can attach their adopted flood policies, flood studies and floodplain risk management studies and plans to their DCPs to ensure they are considered by the consent authority when determining a development application under section 4.15 of the *Environmental Planning and Assessment Act 1979.*

The **DFE** is selected by council for floodplain risk management purposes for an area/catchment, generally through the FRM process outlined in the manual. DFEs form the basis for determining the level of exposure to flooding and associated risks to life and property damage. The manual identifies the 1% AEP flood event, or an equivalent historic flood, as an appropriate starting point for determining the DFE for development controls, including for residential development. The manual allows the selection of a rarer DFE to address broad scale flood impacts in consideration of the social, economic, environmental and cultural consequences associated with floods of different probabilities.

The typical freeboard for residential development due to flooding from waterways, such as rivers or creeks, is 0.5m. A lower freeboard or an alternative approach to freeboard may be used where the consequences to people and property of low probability flood events are assessed as minor through the FRM process.

Where councils propose alternative FPLs, they are required to demonstrate and document – in a flood study and/or floodplain risk management study – the merits of this approach, based on a risk management approach that is consistent with the FRM process and the principles of the manual.

Governor Phillip Park in flood, March 2021 — Infrastructure NSW | Top Notch Video

Special Flood Considerations

Special flood considerations (SFC) are particular flood risk considerations that a consent authority must be satisfied with before granting consent to certain types of development that have been identified by councils and the state government as having a higher risk to life and warranting the consideration of the impacts of rarer flood events on land located outside the FPA. These types of development require special flood considerations relating to the management of risk to life and the risk of hazardous industry/hazardous storage establishments to the community and the environment in the event of a flood.

SFCs also apply to land that, in the event of a flood, may cause a particular risk to life and require the evacuation of people or other safety considerations.

These special flood considerations include that the development:

1. will not affect the safe occupation of and efficient evacuation of people in the event of a flood, and
2. incorporates appropriate measures to manage risk to life from flood, and
3. will not adversely affect the environment in the event of a flood.

SFCs will be introduced through an optional clause in the Standard Instrument. This is an optional provision of the Standard Instrument and councils will have the discretion whether to adopt the clause in a LEP that adopts the Standard Instrument and apply the SFCs in their LGA, provided they have appropriate information and justification to support the flood related development controls. Studies under the FRM process, as well as emergency management planning processes and relevant strategies and plans developed by NSW Government may provide information and support justification for the adoption of the clause.

If councils choose to adopt the optional SFC clause in their LEPs, it is suggested that councils also include the relevant SFCs in its DCP.

These controls generally relate to:

- Sensitive uses that require ongoing functionality during and after a flood event such as hospitals with emergency facilities and emergency services facilities.
- Sensitive uses that require high levels of assistance with evacuation, such as seniors housing, group homes, boarding houses, hostels, caravan parks, educational establishments, centre-based childcare facilities and hospitals.
- Hazardous industries or hazardous storage establishments that require containment of materials in the event of a flood.

- Development that is not identified as sensitive and hazardous development (refer to definitions) that requires risk to life or other safety consideration such as:
  - areas of low probability flood events that have the potential for high consequences. (for example, where new floodways develop in low probability floods)
  - areas covered by an adopted council policy or plan
  - where development controls are needed to address risk to life or other safety considerations identified in studies under the FRM process or through the emergency management planning process.
- Areas that warrant development controls to address risk to life considerations such as:
  - areas with evacuation limitations
  - where increases in dwelling densities would have a significant impact on the ability of the existing community to evacuate using existing evacuation routes within the available warning time
  - where vertical evacuation for short duration flooding is required such as where the rate of rise of floodwater prohibits safe evacuation from the land
  - behind flood levees which may have warning and/or evacuation limitations.
  - impacted by either high hazard or/and H4 to H6 hazard vulnerability thresholds in the PMF as defined in the manual or its supporting guides, and unable to safely evacuate
  - where subdivision layouts and connections to local or regional evacuation routes need to be consistent with the Hawkesbury Nepean Designing Safer Subdivisions Guide
  - areas indirectly affected by flooding where development may have for example outages of utility services
  - areas isolated by floodwaters and/or terrain (such as high flood island or trapped perimeter).

Maps

All areas where flood-related development controls apply should be mapped, with maps made publicly available. This could entail being published in development control plans, other relevant environmental planning instruments or on a council website.

However, in areas where mapping is not available, risk-based flood controls can still apply to other flood-prone land, in accordance with the manual.

Isolated rural property in the Hawkesbury, March 2021 — Infrastructure NSW | Adam Hollingworth

Further Information

Please contact the relevant regional offices of the Department of Planning, Industry and Environment.
www.planning.nsw.gov.au

Definitions

Defined flood event (DFE)
is the flood event selected as a general standard for the management of flooding to development.

Flood Behaviour
refers to the characteristics of flood waters interacting with the landscape. These characteristics include the location, depth, velocity, timing, volume, and period of inundation related to flood water.

Flood planning level (FPL)
is the combination of the flood level from the defined flood event and freeboard selected for flood risk management purposes.

Sensitive and Hazardous development may include:

- boarding houses,
- caravan parks,
- correctional centres,
- early education and care facilities,
- eco-tourist facilities,
- educational establishments,
- emergency services facilities,
- information and education facilities,
- group homes,
- hazardous industries,
- hazardous storage establishments,
- hospitals,
- hostels,
- respite day care centres,
- seniors housing,
- sewerage system,
- tourist and visitor accommodation,
- water supply system.

Warrego flooding between Fords Bridge and Engonnia – Melissa Hams | DPIE

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APPENDIX D
LAHC PROPERTY FLOOD RISKS

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NW30163 Argyll Estate, Coffs Harbour

Property ID	Address No.	Address Street	1% AEP Hydraulic Category: Floodway 3	Flood Storage 2	Flood Fringe 1	Flood Risk Precinct: High Flow Corridor 4	High 3	Medium 2	Low 1
11	11	Argyll Pl			3			3	98
13	13	Argyll St			4			4	96
14	14	Argyll St			35			35	65
16	16	Argyll St			29			29	71
17	17	Argyll St							100
18	18	Argyll St			43			43	57
22	22	Argyll St			95			95	5
24	24	Argyll St			88			88	12
25	25	Argyll St			5			5	95
28	28	Argyll St			30			30	70
30	30	Argyll St			40			40	60
31	31	Argyll St			1			1	99
32	32	Argyll St			5			5	95
33	33	Argyll St			1			1	99
35	35	Argyll St			0			0	100
38	38	Argyll St			1			1	100
40	40	Argyll St			4			4	96
41	41	Argyll St			13			13	87
42	42	Argyll St			3			3	97
43	43	Argyll St			28			28	72
45	45	Argyll St	5	6	58		5	64	32
47	47	Argyll St	32	10	58	0	32	68	
51	51	Argyll St	99	1		2	97	1	
52	52	Argyll St	1	7	13		1	19	68
53	53	Argyll St	100				100		
56	56	Argyll St	10	11	22		10	33	57
58	58	Argyll St	4	16	26		4	42	53
59	59	Argyll St	45	36	19		45	55	
61	61	Argyll St	56	22	23		56	44	
65	65	Argyll St	11	1	75		11	76	14
67	67	Argyll St			80			80	20
69	69	Argyll St			72			72	28
71	71	Argyll St			71			71	29
73	73	Argyll St			69			69	31
75	75	Argyll St	0		78		0	78	22
76	76	Argyll St			3			3	87
79	79	Argyll St			65			65	35
83	83	Argyll St	0	15	63		0	78	22
3	3	Bradley St			1			1	92
4	4	Bradley St			3			3	97
5	5	Bradley St			3			3	97
17	17	Bray St			79			79	21
21	21	Bray St			73			73	27
23	23	Bray St	1		96		1	96	4
29	29	Bray St	4	7	90		4	96	
33	33	Bray St			46			46	54
35	35	Bray St			15			15	85
37	37	Bray St			7			7	93
39	39	Bray St			1			1	100
43	43	Bray St			100			100	
45	45	Bray St			98			98	2
47	47	Bray St	4		94		4	94	2
3	3	Deborah Cl			14			14	86
8	8	Deborah Cl	4	11	78		4	89	7
9	9	Deborah Cl		0	88			88	12
12	12	Deborah Cl	34	0	63		34	63	3
3	3	Elm St	2		44		2	44	54
5	5	Elm St	1		52		1	52	47
6	6	Elm St	8		70		8	70	22
7	7	Elm St	7		88		7	88	5
8	8	Elm St	7		82		7	82	11
9	9	Elm St			18			18	82
10	10	Elm St	3		91		3	91	6
12	12	Elm St	0		94		0	94	6
15	15	Elm St			76			76	24
3	3	Frederick St	47	21	31	11	35	52	2
4	4	Frederick St	26	45	29		26	74	
5	5	Frederick St	1	15	38		1	53	45
6	6	Frederick St	9	13	75		9	88	3
8	8	Frederick St		0	13			13	84
10	10	Frederick St			0			0	34
14	14	Frederick St							
17	17	Frederick St							11
19	19	Frederick St							9

Property ID	Address No.	Address Street	1% AEP Hydraulic Category: Floodway 3	Flood Storage 2	Flood Fringe 1	Flood Risk Precinct: High Flow Corridor 4	High 3	Medium 2	Low 1
21	21	Frederick St							22
22	22	Frederick St							
23	23	Frederick St							3
24	24	Frederick St							
25	25	Frederick St							
26	26	Frederick St							0
28	28	Frederick St			2			2	54
6	6	Kurrajong St	0		27		0	27	73
7	7	Kurrajong St	1		29		1	29	69
9	9	Kurrajong St	0		37		0	37	63
10	10	Kurrajong St	0		29		0	29	71
14	14	Kurrajong St	0		69		0	69	31
17	17	Kurrajong St			100			100	
18	18	Kurrajong St	0		44		0	44	56
19	19	Kurrajong St			100			100	
20	20	Kurrajong St	0		20		0	20	80
21	21	Kurrajong St	0		100		0	100	
22	22	Kurrajong St			32			32	68
25	25	Kurrajong St	5		95		5	95	1
26	26	Kurrajong St			78			78	22
27	27	Kurrajong St	1		83		1	83	15
30	30	Kurrajong St			92			92	8
31	31	Kurrajong St	0		35		0	35	65
32	32	Kurrajong St			88			88	13
38	38	Kurrajong St			74			74	26
40	40	Kurrajong St			85			85	15
41	41	Kurrajong St							100
42	42	Kurrajong St			77			77	23
51	51	Kurrajong St							98
54	54	Kurrajong St		2	38			40	60
55	55	Kurrajong St							85
58	58	Kurrajong St			31			31	69
60	60	Kurrajong St			35			35	65
61	61	Kurrajong St							99
63	63	Kurrajong St							100
65	65	Kurrajong St							65
66	66	Kurrajong St	0		63		0	63	37
67	67	Kurrajong St							8
68	68	Kurrajong St			18			18	82
70	70	Kurrajong St							100
2	2	Maple St			3			3	97
3	3	Maple St			1			1	99
4	4	Maple St			57			57	43
6	6	Maple St			100			100	
8	8	Maple St	21	20	59		21	79	
10	10	Maple St	91	5	4		91	9	
12	12	Maple St	43	31	25		43	57	
13	13	Maple St	17	52	32		17	83	
5	5	Raymond St							45
6	6	Raymond St							96
7	7	Raymond St							57
8	8	Raymond St							27