FLOOD PLANNING CONCEPTS

Our Plan, Our Future, Our Cessnock

Fact Sheet 1

What is this fact sheet for?

This fact sheet explains the flood planning concepts that are used in the flood management plans and documents Council produces. Flood related terminology is defined in the Cessnock Local Environmental Plan, Development Control Plan, the NSW Floodplain Development Manual 2005 and the Department of Planning, Industry and Environment (DPIE) guideline, 'Considering Flooding in Land Use Planning'. This Fact Sheet provides additional guidance on the key flood planning concepts.

Annual exceedance probability

An **'Annual Exceedance Probability'** (AEP) is the probability that a flood of a given (or larger) magnitude will occur within a period of one year. For example, a 1% Annual Exceedance Probability (AEP) Flood means you have a 1-in-100 chance that a flood of that size (or larger) could occur in any one year. The 1% AEP, also known as the 1-in-100 year flood, doesn't mean that if it floods one year, it will not flood for the next 99 years. Neither does it mean that if no flooding has occurred for 99 years that it will result in a flood the following year. For example, some parts of Australia have received two 1-in-100 year floods in one year.

Table 1 shows the probability of experiencing a given sized flood one or more times in a typical lifetime. For example, there is a 19% chance that a 1-in-100 year flood could occur twice in your lifetime.

Table 1: Probability of Flood Event

Probability of experiencing a given sized flood one or more times in an 80 year period			
Annual exceedance probability (AEP) %	Approximate Average recurrence interval (ARI) (years)	At least once (%)	At least twice (%)
5	20	98.4	91.4
1	100	55.3	19.1
Source: Managing the Floodplain: a guide to best practice in flood risk management in Australia - Handbook 7 - Australian Emergency Management Handbook series			

Defined flood event

The **defined flood event** (DFE) is selected by Council for floodplain risk management (FRM) purposes for an area or catchment, generally through the FRM process outlined in the Floodplain Development Manual 2005. The DFE forms the basis for determining the level of exposure to flooding and associated risks to life and property damage. For Cessnock City Council the DFE is the adopted 1% AEP flood level.

Severity of a flood

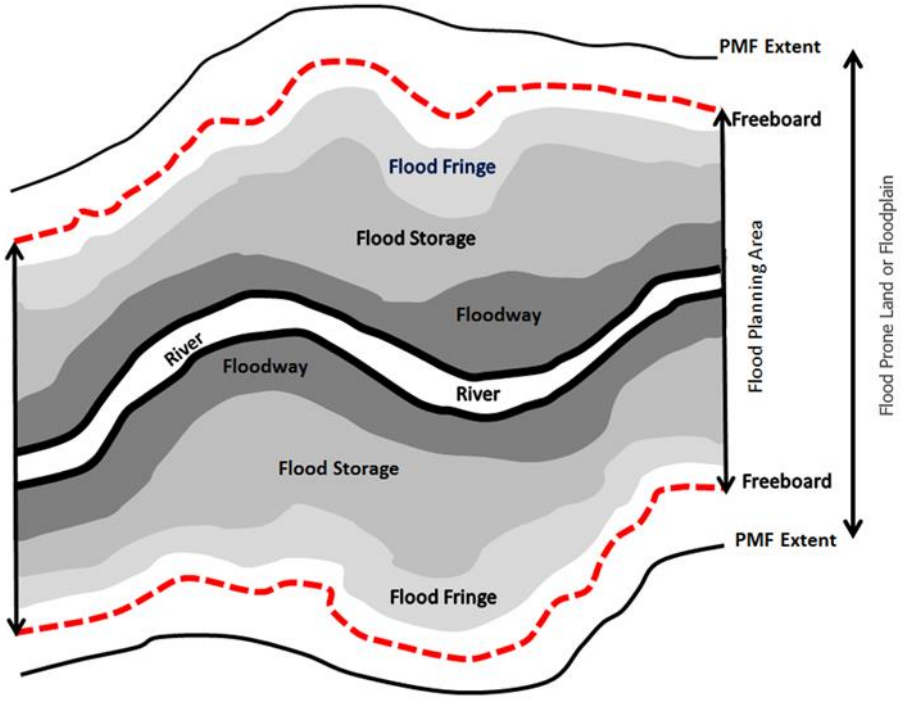
The severity of a flood event varies for different sized floods. Floods that occur more frequently often have lower water levels than less frequent floods. For example, the 1-in-100 year flood will have higher water

levels than a 1-in-20 year flood. The probability of a flood occurring and the severity of the flood are two different factors.

Probable maximum flood

The ***Probable Maximum Flood*** (PMF) is the largest flood that could conceivably occur at a particular location. It is usually based on a theoretical amount of rainfall (probable maximum precipitation) and is much greater than a 1% AEP flood. The land covered by a PMF is referred to as *Flood Prone Land*, or the *Floodplain* (see **Figure 1** and **Figure 2)**. The PMF is used by councils and the NSW SES in disaster planning and emergencies and to manage sensitive and hazardous development.

Figure 1: Floodplain Aerial View



Flood planning levels and freeboard

For the majority of the LGA, the **flood planning level** (FPL) is defined as the DFE event plus a 0.5m freeboard. The **flood planning area** (FPA) means land at or below the FPL. The only areas where a different freeboard applies is land at Branxton, land impacted by low risk overland flooding and land to which the Cessnock City Wide Flood Study applies.

The purpose of a freeboard is to cater for uncertainties in the estimation of flood levels across the floodplain due to wave action, localised hydraulic behaviour such as eddies and embankment or levee settlement. Freeboard also allows for some of the uncertainties associated with flood modeling including estimating climate change impacts. The FPL, showing a 1% AEP plus the freeboard is illustrated at **Figure 2**.

Hydraulic categories

Hydraulic categories identify the potential impact of development activity on flood behavior. The Floodplain Development Manual 2005 identifies three hydraulic categories of flood prone land, being floodway, flood storage and flood fringe. These hydraulic categories are identified in **Figure 1** and **Figure 2**.

The following hydraulic categories apply (based on the NSW Floodplain Development Manual 2005):

- Flood fringe
- Flood storage
- Floodway

Hydraulic categories are used to consider the impact of development on the behaviour of the flood.

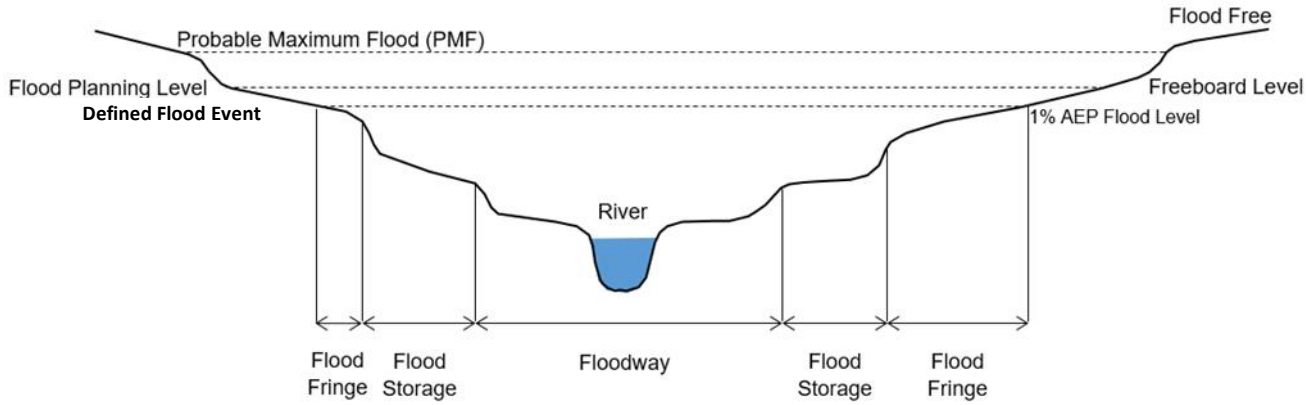
The **Floodway** is an area where a significant volume of water flows during floods and is often aligned with a natural water course. It relates to areas that, even if only partially blocked, would cause a significant increase in flood levels and/or significant redistribution of flood flow, which may in turn have a detrimental impact on neighbouring properties.

The **Flood Storage** area is a part of the floodplain and is important for the temporary storage of floodwaters. Development which substantially reduces the flood storage area through filling or levees can have an adverse impact on nearby areas increasing peak flood levels or peak flow rates.

The **Flood Fringe** is the remaining area affected by flooding after the floodway and flood storage areas are taken up. Development in the flood fringe area would not normally have any significant effect on flood levels or the pattern of flood flows.

The maps provided on Council's webpage and a Flood Information Certificate (purchased from Council) can be used to determine which hazard classification and which hydraulic category applies to your property and development.

Figure 2: Cross Section through Flood Plain



Hazard categories

Hazard categories identify the potential impact of flooding on development and people. The Australian Rainfall and Runoff Guidelines 2016 identify six hazard classifications. Hazard Classifications range from H1 to H6 and can be used to determine the types of development that are suitable in each hazard classification see **Figure 3.**

Hazard classifications provide guidance on the impact a flood event may have on people, vehicles and buildings. The classifications are based on thresholds that compare the velocity and depth of a flood peak. Additional flood hazards may include, but are not limited to, poor visibility, uneven surfaces, slippery surfaces, debris and contaminated water. These types of hazards are not included in the hazard classifications. Hazards may still be unacceptable in the H1 Classification for development targeting usage by vulnerable individuals such as the elderly and young children or sensitive uses and facilities

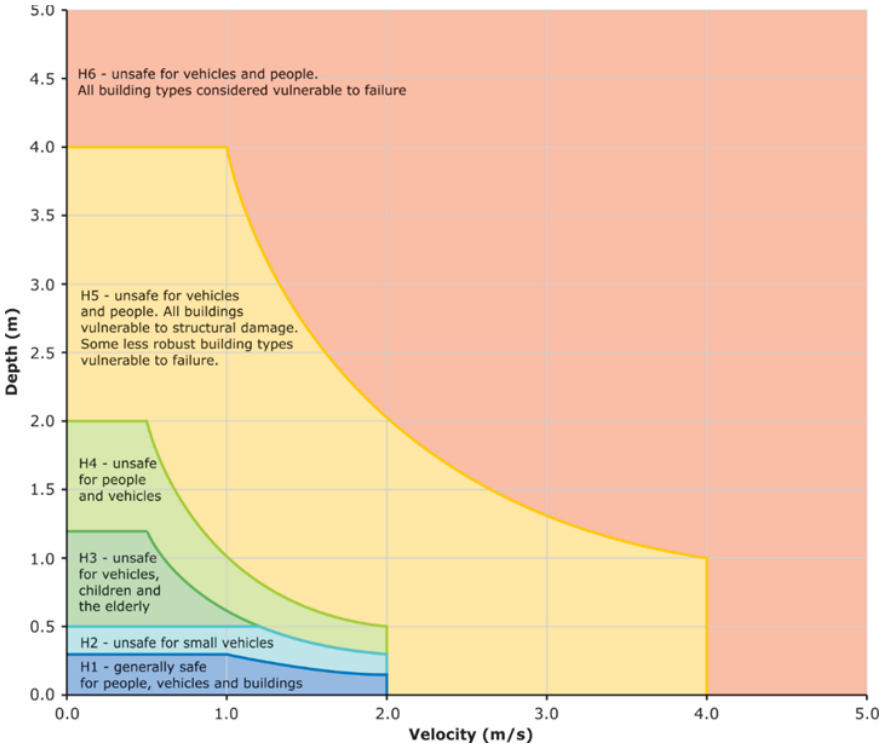
The hazard classifications relate to the 1% AEP event except for critical infrastructure which is related to the PMF. Hazard classifications are a general classification and other factors should be taken into consideration when locating and designing development including:

- Isolation – are there safe evacuation routes to flood free land?
- Effective warning time – lack of effective warning times can increase the exposure of people to hazardous flood situations
- Rate of rise – a rapid rise in flood waters can lead to people evacuating being cut off from safe refugee or being overwhelmed.

Time of day – flood peaks can occur at any time of the day or night. The consequence of a night flood peak might be the inability to receive or response to a flood warning increasing the potential risk of people being exposed to hazardous flood situations. Time of day hazard is particularly important for residential

development. For example commercial uses are often vacant at night however the occupants of a residential development are likely to be on site at night time, when there may be a reduced ability to receive or respond to flood warnings.

Figure 3: Combined Flood Hazard curves (Smith et al 2014) in AAR 2016



Flood refuges

On site flood refuges are not supported by Council or the State Emergency Service. On site flood refuges do not eliminate the risk from a flood event. On site flood refuges do not take into account the unpredictable nature of human behaviour in flood events, for example, there is no guarantee that people will remain in the flood refugee or that other family members will not try to access the site to be reunited. Additionally, buildings isolated in a flood event are also subject to fires and medical emergencies, with reduced capacity for emergency services to respond.

Land to which the Cessnock City Wide Flood Study applies

For land to which the Cessnock Citywide Flood Study applies, the flood planning level is taken to be the defined flood event plus 1 metre freeboard. Any applications that seek to vary the 1 metre freeboard must be accompanied by a FAR.

Locations impacted by overland flooding

Overland flooding occurs when stormwater sheets across the landscape at a shallow depth. It differs from riverine flooding, which occurs when stormwater spills from a natural or modified watercourse. In locations impacted by low risk overland flooding, the flood planning level is taken to be the defined flood event plus 0.3m freeboard.

Branxton flood planning area

The Branxton flood planning level is taken to be the defined flood event plus 0.7m freeboard to allow for uncertainty and variation in levels produced by studies completed in the Branxton planning area. Branxton may be impacted by flooding of the Hunter River. The freeboard of 0.7m is also in line with calibrated Historic 1955 Flood level.

The Branxton commercial area is located on flood prone land, a large portion of which is Hazard Category H5 or H6. Typically some types of commercial development are not supported on land with this hazard category; however Branxton has a number of unique factors that mean that flooding needs to be considered on a case by case basis in the Branxton commercial area. Factors specific to Branxton include:

- The flooding that affects Maitland Street in Branxton is typically river flooding that is of a low velocity and has sufficient warning time for occupants to leave or shops to close. The nature of flooding in Branxton is distinctively different to flooding in most other areas of the Cessnock LGA that are subject to flash flooding with little warning time for occupants. The low velocity of flood water in Branxton and the longer warning times for significant flood events mean that some forms of development that are normally not supported in the higher flood hazard categories may be suitable in the higher flood hazard in Branxton if suitably justified by the applicant.

- Maitland Street in Branxton contains a number of Heritage Items and is a significant heritage precinct. It is recognised that where suitable, some variances to flooding controls may be necessary to preserve the heritage character of Maitland Street Branxton e.g. it may not always be suitable to raise the floor level above the flood planning level in Branxton without compromising the heritage character of the area.

- The Branxton Subregional Land Use Strategy outlines that the Branxton town centre is to be focused around Maitland Street, between Cessnock Road and Bowen Street. For this to occur commercial developments need to be located along Maitland Road, while still ensuring that the risk to life from flood events has been considered. The Strategy outlines that variations to flood planning levels may be needed in Branxton to preserve the Heritage character of the town and allows commercial development to remain focused along Maitland Street.

Applications for development on flood prone land

Council's assessment of development is based on the level of flood risk, which is calculated by hydraulic categories and hazard categories. In preparing a development application to Council, the following steps should be taken. Council's flood mapping is available through Council's online mapping portal at www.cessnock.nsw.gov.au

Step 1
Determine what flood information is available for the site. This may include obtaining a Flood Information Certificate from Council and reviewing the adopted Flood Plain Risk Management Study for the area.

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Step 2
Determine what hazard classification (H1-H6) and which hydraulic category (Floodway, Flood Storage and Flood Fringe) applies to the site. You can obtain this information from the Flood Information Certificate.

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Step 4
Review the Land Use and Hazard Control Matrix in the Development on Flood Prone Land Chapter of the DCP to determine if your development is class A, B, C or x.

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Step 5
Address the relevant development controls in the Development on Flood Prone Land Chapter of the DCP.

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Step 6
Lodge a development application for Council's assessment.

It is recommended you seek a pre-DA meeting with relevant Council officers to discuss Council's requirements for your application.

Compliance Assessment
The Compliance Assessment is a detailed assessment on how the proposed development will achieve all relevant objectives and development controls of the Flood Prone Land DCP. It is expected that all relevant controls in the DCP are listed and an explanation is given on how each control has been met.

Development plans
Plans for the proposed development or works that indicate compliance with all relevant development controls must be submitted. These plans should contain characteristics as required by Council's DA Submission Matrix and Checklist.

Survey Plan details
In addition to the requirement to lodge general survey details with the development application (as specified in Development Plans above), a survey plan prepared by a registered surveyor must also indicate the following:

1. Existing ground levels at each corner of the proposed building envelope;

2. The floor levels of all existing buildings or structures to be retained as well as proposed floor levels for all new buildings and structures; and

3. The location of any existing buildings or structures.

All levels must be relative to *Australian Height Datum (AHD*). Levels relating to an arbitrary assumed datum are not acceptable.

Note: that some applications for ancillary development may not require survey details if a suitable structural engineering certificate is provided.

Flood assessment reports

Minor FAR

It is recommended that a Minor (FAR) is prepared by a suitably qualified and experienced Engineer. The full name of the person who prepared the report and relevant qualifications are to be provided on the front page of the report.

A **MINOR FAR** is to include:

1. A site plan and description of the watercourse, creek or drainage system that is relevant to the flood characteristics of the site, whether located on, adjacent to or remote from the development site;

2. Survey co-ordinates of the location of the FAR;

3. A plan showing cross-sections through site. As a guide, the following cross-section information should be provided:

    - A minimum of 3 cross-sections, at a maximum distance of 20m apart, should be taken through the site, perpendicular to the likely flow path (i.e. the direction of the cross-section may not necessarily be in a single straight line);
    - Cross-sections should extend at least as high as the highest flood level available at the site and if possible be wide enough to cover the full width of the floodplain at that location; and
    - The cross-sections should be plotted at a suitable exaggerated scale (i.e. the vertical scale is not necessarily the same as the horizontal scale);

4. Flood levels for the 1% Annual Exceedance Probability (AEP) events for the pre development scenario (all assumptions, calculations and modelling output tables must be provided);

5. Flood velocities for the 1% AEP event for the pre-development scenario (all assumptions, calculations and modelling output tables must be provided);

    Note: the roughness coefficients used shall allow for fully vegetated stream conditions in order to account for potential revegetation of degraded areas without impact on flood levels;

Major FAR

A major (FAR) must be prepared by a suitable qualified and experienced Engineer recognised under the National Professional Engineers Register or Chartered Professional Engineer in this field. The full name of the person who prepared the report, relevant qualifications and registration number are to be provided on the front page of the report.

A **MAJOR FAR** is to include:

1. A description of the watercourse, creek or drainage system that is relevant to the flood characteristics of the site, whether located on, adjacent to or remote from the development site;

    Note: The modelling shall include climate change considerations as per current Government Guidelines predicted changes in rainfall

2. A plan showing cross-sections through the site. As a guide, the following cross-section information should be provided:

   - A minimum of 8 cross-sections, at a maximum distance of 20m apart, should be taken through the site, perpendicular to the likely flow path (i.e. the direction of the cross-section may not necessarily be in a single straight line);
   - One cross-section should be at the upstream end and one cross-section at the downstream end of the proposed development site;
   - Cross-sections should extend at least as high as the highest flood level available at the site and if possible be wide enough to cover the full width of the floodplain at that location; and
   - The cross-sections should be plotted at a suitable exaggerated scale (i.e. the vertical scale is not necessarily the same as the horizontal scale);
   - Note: The modelling shall include a 50% and 100% blockage analysis of all existing drainage structures that may affect the development site;

2. Flood levels for the PMF, 1%, 5%, 10% and 20% Annual Exceedance Probability (AEP) events for the climate change pre development scenario (all assumptions, calculations and modelling output tables must be provided);

   Note: Localised flow effects shall be investigated and reported on where relevant;

3. Flood velocities and vectors for the 1% AEP event for the climate change pre-development scenario (all assumptions, calculations and modelling output tables must be provided);

   Note: the roughness coefficients used shall allow for fully vegetated stream conditions in order to account for potential revegetation of degraded areas without impact on flood levels;

5. Provisional Hazard categories based on depth and velocity as well as obvious other hazards such as evacuation difficulties as per the requirements of the NSW Floodplain Development Manual 2005;

   Note: In areas where local sub-catchment flooding, such as flows from drains, overland flow paths or similar, interact with overall catchment flooding from waterways, a joint probability analysis of flood behaviour shall be undertaken.

7. Provisional Hydraulic categories based on depth and velocity as per the requirements of the NSW Floodplain Development Manual 2005;

8. A determination of the hazard classification/s that apply to the development; and

9. Plans showing the results of (3) to (6) as well as the location of the proposed development.

Useful Links

NSW Floodplain Development Manual 2005

NSW SES information on how to be safe during a flood
Real time local rainfall & water levels
Council's local flood information