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# Flood Risk Management Development Control Plan

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# Contents

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1.0	Introduction	1
1.1	The Name of this DCP .....	1
1.2	Background .....	1
1.3	Related DCPs .....	1
1.4	Objectives of this Plan .....	2
1.5	Land and development to which this DCP applies.....	2
1.6	Relationship to other documents.....	3
1.7	Approval and Commencement of the DCP.....	3
2.0	Considering flood risk management in your DA	4
2.1	Is consideration of the flood risk management required for your DA? .....	4
2.2	What should you do if your property is affected by this DCP? .....	5
2.3	Pre-DA Comments .....	5
2.4	DA information.....	5
2.5	Information available from Council.....	6
3.0	Requirements for studies	7
3.1	Who can undertake further technical studies?.....	7
3.2	Study reports.....	7
4.0	References	11

## List of Appendices

- Appendix A:** Glossary of terms
- Appendix B:** List of categories of suitable practitioners
- Appendix C:** Flood planning levels
- Appendix D:** Design rainfall intensities
- Appendix E:** Management of flood risk - Checklist



## 1.0 Introduction

### 1.1 The Name of this DCP

This development control plan (DCP) is known as the “**Flood Risk Management Development Control Plan**”.

### 1.2 Background

The Flood Risk Management DCP is one of a series of four development control plans that have been introduced to control all aspects of stormwater management within the Woollahra Local Government Area (LGA). The need for these plans has arisen due to the increasing demands on an aging system that was designed in an era where little was understood about stormwater management and there was less intensive urban development.

Council has a responsibility to manage flood risk to ensure that any:

- new development will not experience undue flood risk, and
- existing development will not be adversely flood affected through increased damage or hazard as a result of any new development.

This DCP uses a “performance approach” to direct the design of new developments. This allows for some flexibility for innovation while at the same time ensuring that the proposed and surrounding existing developments will not experience increased and/or undue damage as a result of inundation.

This DCP provides controls to facilitate a consistent, technically sound, best practice approach for the management of flood risk within the Woollahra LGA.

A glossary of technical terms used in this DCP is provided in Appendix A.

### 1.3 Related DCPs

The four DCPs are:

1. **Stormwater Drainage Management DCP** – provides detailed control measures regarding stormwater drainage issues such as stormwater discharge from a site, on-site stormwater detention, easements and connection to a downstream stormwater drainage system.
2. **Flood Risk Management DCP** – provides detailed control measures regarding development of land subject to inundation from intense rainfall or from high water levels in Sydney Harbour.
3. **Stormwater Quality Management DCP** – provides detailed control measures regarding stormwater quality.
4. **Geotechnical and Hydrogeological Management DCP** – provides detailed control measures regarding proposed works below the level of the existing ground.

## 1.4 Objectives of this Plan

The objectives of this DCP are:

- to ensure that existing development is not adversely flood affected through increased flood damage and /or flood hazard,
- to provide a mechanism to control development on flood prone land for the safety of people and property,
- to reduce the impact of flooding on individual properties,
- to ensure stormwater management is appropriate to the site and its surrounds and that is integrated into the overall design of the development,
- to ensure that applications to Council are of a high standard, and
- to ensure development meets all environmental planning requirements of Council.

## 1.5 Land and development to which this DCP applies

This DCP applies to all land within Woollahra LGA. It applies to all development on private and public land that requires consent from Council.

Council will take this DCP into consideration when:

- assessing, conditioning and determining DAs on flood liable land,
- reviewing proposals to rezone flood liable land,
- revising other associated planning and development control policies that relate to flood liable lands.

From the past experience Council is aware that some parts of the LGA are flood liable as they are from time to time subject to inundation arising from:

- **mainstream flooding** resulting from relatively high stream flow which overtops the natural or artificial banks in any part of a natural or man-made stream, channel or river, and/or,
- **local overland flooding** associated with stormwater before entering a watercourse or trunk drainage system, and/or,
- **foreshore inundation** resulting from super-elevated sea levels and/or waves overtopping foreshore defences, excluding tsunamis.

To date Council does not have maps or plans identifying the entire extent of flood liable properties within the LGA. Studies will be undertaken by Council to increase our knowledge of flooding but it may be several years before a complete record is obtained. Even then minor amendments will need to be made as future flood events will more closely define the extents.

Section 2 of this DCP provides an approach for identifying whether a property is flood liable and therefore subject to the controls in this DCP.

## **1.6 Relationship to other documents**

### **1.6.1 The Act and the Regulation**

This DCP has been prepared under section 72 of the Environmental Planning and Assessment Act 1979 and the Environmental Planning and Assessment Regulation 2000.

### **1.6.2 State policies and regional plans**

State environmental planning policies and regional environmental plans may apply to the land to which this DCP applies. Where this occurs, the statutory provisions of these policies and plans prevail over this DCP.

### **1.6.3 Woollahra LEP 1995**

Woollahra Local Environmental Plan 1995 applies to the land to which this DCP applies. Woollahra LEP 1995 is a statutory instrument that sets out the land use zones and broad development controls for development within the Woollahra municipality. It also contains objectives for matter dealt with in this DCP such as stormwater management and environmentally sensitive development.

This DCP supplements the provisions of the Woollahra LEP 1995. The provisions of the Woollahra LEP prevail over this DCP.

### **1.6.4 Other Woollahra DCPs, policies and codes**

In the event of any inconsistency between this DCP and other development control plans, policies and codes, this DCP prevails unless otherwise specified in this plan or in other plans, policies and codes.

## **1.7 Approval and Commencement of the DCP**

This DCP was approved by Woollahra Council on..... and commenced on.....

## 2.0 Considering flood risk management in your DA

### 2.1 Is consideration of the flood risk management required for your DA?

In many locations, Council and Sydney Water's stormwater systems are old and constructed to standards applicable at the time. Consequently, in many places they are undersized and therefore subject to overflow in frequent rainfall events. Council will be undertaking technical studies that will identify all properties that are affected by either mainstream flooding, local overland flooding, or foreshore inundation. Following the completion of these studies and the respective Floodplain Risk Management Plans, maps will be produced identifying the affected properties. However, these studies will take several years to complete. In the interim the following approach for identifying those properties that must take the controls in this DCP into account when submitting a DA:

#### *Approach 1:*

Properties that are situated adjacent to an open or covered channel or watercourse must contact Council for further information regarding **mainstream flooding**. If ground levels of any part of the proposed development site is below one metre plus the level of nearby channel or creek bank level then the site may be affected by mainstream flooding. A mainstream flood study is required to assess the flooding effect and to establish flood levels.

#### *Approach 2:*

All properties containing a drainage reserve, drainage easement (private or public), open channel, drainage depression or underground pipe or culvert are automatically assumed to be affected by **local overland flooding**. In addition, properties inundated by 1 m<sup>3</sup>/s of discharge or 0.3 m depth of floodwater in a 1 % AEP event are deemed affected by local overland flooding. Further properties with low level driveways or footpaths or their boundary levels are below the level of Council's kerb are assumed to be affected. An overland flow study or assessment is required to assess the flooding effect and to determine the flood levels.

#### *Approach 3:*

All properties fronting Sydney Harbour with any part of their land below RL 2.3 m AHD are affected by **foreshore inundation**. A foreshore inundation study or assessment is required to assess the flooding effect and to determine the flood levels

Properties situated outside these categories may still be subject to inundation as a result of local drainage but they are not subject to the controls within this DCP.

A map showing areas where a mainstream flood study or overland flow study is required is available with Council and can be viewed at Council's Customer Service Counter. This map can also be viewed from Council's web site.

## 2.2 What should you do if your property is affected by this DCP?

A flood and/ or overland flow assessment will be required if your property is affected by this DCP. This assessment is to establish the 1% AEP flood level and/ or to assess any adverse flood impacts by the proposed development. The scope of investigation required to satisfy the controls in this DCP is dependent upon many factors including:

- the extent of the flood hazard,
- the nature of the proposed works,
- the nature of the local catchment,
- the potential impacts of the proposed works on other floodplain users.

To meet objectives of this DCP a suitable report must be prepared for works on flood liable land. The applicant must engage a suitably qualified practitioner (Appendix B) to demonstrate that the proposed works:

- will not adversely affect other floodplain users,
- comply with the required Flood Planning Levels indicated in Appendix C of this DCP,
- comply with the NSW Government's Floodplain Management Manual – January 2001,
- for properties fronting Sydney Harbour and subject to inundation the works must comply with the NSW Government's Coastal Policy.

If you require any clarification of the type of studies or any other flooding issues you should consult Council's staff (by pre-DA meeting, by telephone or at the Customer Services counter) to identify important issues at an early stage and avoid later problems in the assessment process.

## 2.3 Pre-DA Comments

You may use Council's pre-DA consultation service (for which a fee is charged) to discuss your development proposal with Council staff, including assessment officers, senior planners, landscape development officers, development engineers, heritage officers and health officers. The service provides useful comments on a proposal and identifies issues at an early stage. Minutes of the meeting are provided as part of the service. Refer to the pre-DA consultation service application for information that must be provided by applicants.

## 2.4 DA information

Material that must be provided with a DA is set out in the Council's DA Guide. DA and advertising fees can be confirmed with Council prior to lodgement.

## **2.5 Information available from Council**

Council will make available information on its drainage system where it is available, on the express understanding that Council is not liable for the accuracy of the information or the consequences of it being used. The developer and/or design consultants must confirm by inspection and/or survey any information affecting designs. This includes confirmation of pit locations, pipe locations and size, and utility authority service locations.

Results from drainage studies carried out for Council, which have been reported to the Council may also be made available. Information provided to Council by other parties may be released at the discretion of Council, subject to copyright and privacy restrictions.

## 3.0 Requirements for studies

### 3.1 Who can undertake further technical studies?

The analysis of flood risk is complex and requires particular expertise. Council has prepared a list of sources for suitably qualified practitioners (Appendix B) who must be used if further technical studies are required to satisfy this DCP.

### 3.2 Study reports

The level of detail included in any engineering studies will vary depending upon the local situation. Your practitioner may need to consult with Council to obtain further clarification in this regard. The following provides a broad outline of the necessary work.

#### 3.2.1 Mainstream flooding and local overland flooding reports

The following points must be addressed in the report:

##### **Obligations of the practitioner:**

- The report must be site specific and relate directly to the proposed development.
- Previous reports and data may be utilised or provided as supplementary information where certified as appropriate by the practitioner.
- The practitioner must certify that the information provided in the report details the consequences of undertaking the development in accordance with the objectives of this DCP.
- If appropriate, historical flood information must be included. In some cases it may be appropriate to undertake examination of historical events and obtain relevant rainfall and flood data.

##### **Nature of the report:**

- Design rainfall data for use in the study are provided in Appendix D.
- The approach for determining the design flood information must be in accordance with the principles of Australian Rainfall and Runoff – 1987 edition or subsequent supplements.
- Appropriate hydrologic and hydraulic models must be used. For a local overland flooding report this would typically be DRAINS and HEC-RAS. For a flood study a more sophisticated hydraulic model such as Mike-11 or a fully 2D model may be applicable. Your practitioner should liaise with Council in this regard.
- The key survey data must be obtained by field survey by a registered surveyor and not from 1:4000 maps or similar.
- In areas of local overland flooding, Council is looking to open up flow paths to reduce the extent of inundation and hazard. The report must address this issue.
- The extent of loss of temporary floodplain storage must be quantified and clearly identified.

- The hydraulic impacts of the proposed development must be quantified using appropriate hydrologic and hydraulic mathematical/computer models.
- Any adverse impact must be clearly identified and described in terms of economic, social, environmental and hydraulic consequences for other floodplain users.

**Nature of the proposed works:**

- All materials used in structures that are located below the relevant flood planning level must be from materials that will not adversely be affected by inundation.
- All electrical equipment, wiring, fuel lines or any other service pipes and connections must be waterproofed to 0.5 m above the relevant flood planning level.

**Conditions which must be met:**

- A plan at a suitable scale (no smaller than 1:500) must be provided showing the proposed works, design flood information, and corresponding flood extents for existing and design scenarios.
- The proposed works are in accordance with the flood planning levels in Appendix C.
- Properties that are affected by mainstream flooding will generally only be permitted to import fill to construct a building pad to a maximum of 1m above natural surface. Suspended floors must be used for depths greater than 1 m. For properties affected by local overland flooding the effect of filling is likely to be more significant and filling in the floodplain will generally not be permitted.
- The location of existing and proposed fences, retaining walls or any other barriers to flow must be clearly identified and their hydraulic impacts assessed. For properties affected by local overland flooding it may be necessary to modify these structures to permit the free passage of overland flow.
- Potential constraints on development must be assessed including (but not limited to): the degree of inundation of the land; flood hazard; waterborne debris; blockage of flow paths; buoyancy; effective warning time; flood education, awareness and readiness; flood proofing; evacuation and emergency management issues.

### 3.2.2 Foreshore inundation reporting

For properties fronting Sydney Harbour the 1% AEP water level resulting from a combination of astronomical tides and storm surge is generally taken as 1.5 mAHD. Local wind and wave setup together with wave runup may raise this level to 2.0 m AHD. For this reason the 1% AEP inundation level for properties fronting Sydney Harbour is taken as 2.0 m AHD. Thus the flood planning level for residential floor levels on these lands is 2.3 m AHD (1% AEP + 0.3 m freeboard).

Structures constructed on land below 2.3 m AHD and close to the foreshore (taken as within 10m of mean high water) may experience wave damage and/or cause waves to be deflected/reflected onto adjoining properties. No further assessment of foreshore inundation is required if the applicant's surveyor can provide a survey plan indicating that **one** of the following conditions is met:

- all works are on land that is 10 m or greater beyond mean high water and the building floor and car park entry comply with the relevant flood planning levels,
- all works are on land that is at 2.3 m AHD or greater and the building floor and car park entry comply with the relevant flood planning levels.

If none of the above conditions can be met, the applicant is to engage a suitably qualified practitioner to demonstrate that the proposal is compatible with the NSW Government's Coastal Policy and the specified flood planning levels in Appendix C.



## 4.0 References

1. Australian Rainfall and Runoff, 1987  
Institution of Engineers, Australia
2. Floodplain Management Manual, January 2001  
New South Wales Government



## APPENDIX A: Glossary of terms

The majority of the flood related terms were taken from the NSW Government's Floodplain Management Manual, January 2001 (the Manual).

<b>Annual Exceedance Probability (AEP)</b>	The chance of a flood of a given or larger size occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m <sup>3</sup> /s has an AEP of 5%, it means that there is a 5% chance (that is a one-in-20 chance) of a peak flood discharge of 500 m <sup>3</sup> /s or larger occurring in any one year (see Average Recurrence Interval).
<b>Australian Height Datum (AHD)</b>	A common national surface level datum approximately corresponding to mean sea level.
<b>Average Recurrence Interval (ARI)</b>	The long term average number of years between the occurrence of a flood as big as, or larger than, the selected event. For example, floods with a discharge as great as, or greater than, the 20 year ARI flood event will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event (see Annual Exceedance Probability).
<b>Biodiversity</b>	In broad terms, refers to “the variety of life forms, the different plants, animals and microorganisms, the genes they contain and the ecosystems they form” (NPWS 1997).
<b>Boat shed</b>	Means a building or any other structure used for the storage and routine maintenance of a boat or boats and which is associated with a private residence and includes any skid used in connection with the building or other structure.
<b>Catchment</b>	The land area draining through the main stream, as well as tributary streams, to a particular site. It always relates to an area above a specific location.
<b>Conservation</b>	Means the use, management and protection of resources so that they are not degraded, depleted or wasted and are available on a sustainable basis for present and future generations.
<b>Detention systems</b>	Detention systems are holding ponds that temporarily store stormwater to control and reduce downstream flow rates. They are designed to retard stormwater during intense rainfall and to empty once the peak of the storm has passed.
<b>Developer</b>	Means the person proposing the work or activity, for example the owner of the land or someone acting on behalf of the owner of the land.
<b>Development</b>	Is defined in Part 4 of the Environmental Planning and Assessment Act 1979.
<b>Development consent</b>	Means consent under Part 4 of the Environmental Planning and Assessment Act 1979 to carry out development.

<b>Development control plan (DCP)</b>	Means a plan made by either Council or under section 72 or section 51A of the Environmental Planning and Assessment Act 1979 respectively. DCPs are used to provide more detailed provisions than those included in a local environmental plan (in the case of a DCP made by a Council) or a regional environmental plan (in the case of a DCP made by the Department).
<b>Discharge</b>	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m <sup>3</sup> /s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
<b>Drainage easements</b>	Are the legal rights attached to land whereby another parcel of land has the right to use part or all of the land for the purpose of draining water.
<b>Drainage reserves</b>	Are the lands vested in Council for drainage purposes.
<b>Easement</b>	Means a right applying to land enabling a person to have the use of other land in different ownership for a specific purpose. Without the easement the use would constitute a trespass or nuisance.
<b>Ecologically sustainable development (ESD)</b>	Using, conserving and enhancing natural resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be maintained or increased. A more detailed definition is included in the Local Government Act 1993.
<b>Effective warning time</b>	The time available after receiving advice of an impending flood and before the floodwaters prevent appropriate flood response actions being undertaken. The effective warning time is typically used to move equipment, raise furniture, evacuate people and transport their possessions.
<b>Emergency management</b>	A range of measures to manage risks to communities and the environment. In the flood context it may include measures to prevent, prepare for, respond to and recover from flooding.
<b>Existing ground level</b>	Means the surveyed level of the ground surface immediately prior to the proposed development and prior to any associated excavation, development or site works.
<b>Flood</b>	Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with major drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves overtopping coastline defences excluding tsunami.
<b>Flood education, awareness and readiness</b>	<p><b>Flood education</b> seeks to provide information to raise awareness of the flood problem so as to enable individuals to understand how to manage themselves and their property in response to flood warnings and in a flood event. It invokes a state of flood readiness.</p> <p><b>Flood awareness</b> is an appreciation of the likely effects of flooding and a knowledge of the relevant flood warning, response and</p>

	evacuation procedures.
	<b>Flood readiness</b> is an ability to react within the effective warning time.
<b>Flood liable land</b>	Is synonymous with flood prone land (i.e. land susceptible to flooding by the probable maximum flood (PMF) event). Note that the term flood liable land now covers the whole of the floodplain, not just that part below the flood planning level, as indicated in the 1986 Floodplain Development Manual (see flood planning area).
<b>Floodplain</b>	Area of land which is subject to inundation by floods up to and including the probable maximum flood event, that is, flood prone land.
<b>Floodplain risk management plan</b>	A management plan developed in accordance with the principles and guidelines in the Floodplain Management Manual. Usually includes both written and diagrammatic information describing how particular areas of flood prone land are to be used and managed to achieve defined objectives.
<b>Flood planning area</b>	The area of land below the flood planning level and thus subject to flood related development controls. The concept of flood planning area generally supersedes the Aflood liable land≡ concept in the 1986 Floodplain Development Manual.
<b>Flood planning levels (FPLs)</b>	The combination of flood levels and freeboards selected for planning purposes, as determined in floodplain risk management studies and incorporated in floodplain risk management plans. The concept of flood planning levels supersedes the Astandard flood event≡ used for flood planning in the past.
<b>Flood proofing</b>	A combination of measures incorporated in the design, construction and alteration of individual buildings or structures subject to flooding, to reduce or eliminate flood damages.
<b>Flood prone land</b>	Land susceptible to flooding by the Probable Maximum Flood (PMF) event. Flood prone land is synonymous with flood liable land.
<b>Flood risk</b>	<p>Potential danger to personal safety and potential damage to property resulting from flooding. The degree of risk varies with circumstances across the full range of floods. Flood risk is divided into 3 types, existing, future and continuing risks. They are described below.</p> <p><b>Existing flood risk:</b> the risk a community is exposed to as a result of its location on the floodplain.</p> <p><b>Future flood risk:</b> the risk a community may be exposed to as a result of new development on the floodplain.</p> <p><b>Continuing flood risk:</b> the risk a community is exposed to after floodplain risk management measures have been implemented. For a town protected by levees, the continuing flood risk is the consequences of the levees being overtopped. For an area without any floodplain risk management measures, the continuing flood</p>

	risk is simply the existence of its flood exposure.
<b>Foreshore</b>	The section of land extending from the low water mark to the rear of the first line of properties as viewed from the waterway.
<b>Freeboard</b>	A factor of safety typically used in relation to the setting of floor levels, levee crest levels, etc. It is usually expressed as the difference in height between the adopted Flood Planning Level and the flood used to determine the Flood Planning Level. Freeboard provides a factor of safety to compensate for uncertainties in the estimation of flood levels across the floodplain, such as wave action, localised hydraulic behaviour and impacts that are specific event related, such as levee and embankment settlement, and other effects such as sea level rise and climate change. Freeboard is included in the Flood Planning Level.
<b>Front fences and walls</b>	Refers to fences and walls located or proposed to be located forward of the building façade.
<b>Habitable room/ area</b>	<p><b>In a residential situation:</b> a living or working area, such as a lounge room, dining room, rumpus room, kitchen, bedroom or workroom.</p> <p><b>In an industrial or commercial situation:</b> an area used for offices or to store valuable possessions susceptible to flood damage in the event of a flood.</p>
<b>Hazard</b>	A source of potential harm or a situation with a potential to cause loss. From a flood perspective, the hazard is flooding which has the potential to cause damage to the community. Definitions of high and low hazard categories are provided in the Floodplain Management Manual.
<b>Hydraulics</b>	Term given to the study of water flow in waterways; in particular, the evaluation of flow parameters such as water level and velocity.
<b>Hydrology</b>	Term given to the study of the rainfall and runoff process; in particular, the evaluation of peak flows, flow volumes and the derivation of hydrographs for a range of floods.
<b>Local environment plan (LEP)</b>	Means a plan made under section 70 of the Environmental Planning and Assessment Act 1979. An LEP is a legal document and generally provides the land use zones, Council objectives and development standards for different types of development.
<b>Local government area (LGA)</b>	The land area subject to control by the local authority (in this case Woollahra Municipal Council).
<b>Local overland flooding</b>	Inundation by local runoff or stormwater rather than overbank discharge from a stream, river, estuary, lake or dam. For the purposes of this DCP the local runoff must equal or exceed 1 m <sup>3</sup> /s through the property or a depth of 0.3 m in the 1% AEP. All properties containing a Council owned pipe and/or a drainage easement are subject to local overland flooding.

<b>Local drainage</b>	Are flooding and drainage issues in urban areas of a smaller scale than local overland flooding.
<b>Mainstream flooding</b>	Inundation of normally dry land occurring when water overflows the natural or artificial banks of a stream, river, estuary, lake or dam.
<b>Mathematical/computer models</b>	The mathematical representation of the physical processes involved in runoff generation and stream flow. These models are often run on computers due to the complexity of the mathematical relationships between runoff, stream flow and the distribution of flows across the floodplain.
<b>Mean high water (MHW)</b>	The mean of all high tides (including spring and neap tides) taken over a long time. For the purposes of this study it is assumed to be 0.5 mAHD and defines the boundary between Sydney Harbour and the land. On a well defined or steeply sloping foreshore (or seawall) it can be taken as the “top of the bank”. On a gently sloping foreshore a survey by a Registered Surveyor may be required.
<b>Merit approach</b>	<p>The merit approach weighs social, economic, ecological and cultural impacts of land use options for different flood prone areas together with flood damage, hazard and behaviour implications, and environmental protection and well being of the State=s rivers and floodplains.</p> <p>The merit approach operates at two levels. At the strategic level it allows for the consideration of social, economic, ecological, cultural and flooding issues to determine strategies for the management of future flood risk which are formulated into Council plans, policy and planning instruments. At a site specific level, it involves consideration of the best way of conditioning development allowable under the floodplain risk management plan, local floodplain risk management policy and planning instruments.</p>
<b>Objective</b>	Describes an outcome that development is required to achieve in relation to DCP. Objectives describe the intent of the related performance criteria.
<b>Performance criteria</b>	Represents specific ways in which a proposed development can meet the related objectives in this DCP. The relevance and intent of a specific performance criterion in relation to a proposed development must be interpreted in the context of the related objective.
<b>Probable maximum flood (PMF)</b>	The largest flood that could conceivably occur at a particular location, usually estimated from probable maximum precipitation. Generally, it is not physically or economically possible to provide complete protection against this event. The PMF defines the extent of flood prone land, that is, the floodplain. The extent, nature and potential consequences of flooding associated with the PMF event should be addressed in a Floodplain Risk Management study.

<b>Probable maximum precipitation (PMP)</b>	The greatest depth of precipitation for a given duration meteorologically possible over a given size storm area at a particular location at a particular time of the year, with no allowance made for long-term climatic trends (World Meteorological Organisation, 1986). It is the primary input to the estimation of the Probable Maximum Flood.
<b>Probability</b>	A statistical measure of the expected change of flooding (see Annual Exceedance Probability).
<b>Riparian zone</b>	Is the area of vegetation located on the bank of a natural watercourse, such as a river, where the flows from its site of origin by air, wind, water or gravity.
<b>Risk</b>	Chance of something happening that will have an impact. It is measured in terms of consequences and likelihood. From a flood perspective it is the likelihood of consequences arising from the interaction of floods, communities and the environment.
<b>Runoff</b>	The amount of rainfall which actually ends up as streamflow, also known as rainfall excess.
<b>Seawall</b>	Means a structure placed partially or wholly along the land/water interface to protect the land from the sea or to stop accelerated erosion of the shoreline, but does not include a breakwater.
<b>Site</b>	Means the allotment or group of allotments of land on which a building stands or is proposed to be erected.
<b>Stormwater</b>	Means untreated rain water that runs off the land onto which it falls.
<b>Survey plan</b>	A plan prepared by a registered surveyor.
<b>Swimming pool</b>	Means an impermeable structure capable of holding water to a depth greater than 300 mm for swimming or other recreation purposes, but does not include a spa pool.
<b>Trunk drainage</b>	Is the stormwater drainage system that links property, interallotment and street drainage with the receiving waters.
<b>Tsunami</b>	Long period ocean waves generated by geological and tectonic disturbances below the sea. Incorrectly referred to as “tidal waves”, Tsunami travels at speeds of up to 800 km/hr in the open ocean, where they are of low height. However, Tsunami can rise to a height of 10 m or more through the shoaling process as they approach land.

## APPENDIX B: List of categories of suitable practitioners

Task	Acceptable Practitioner	Industry Association
<b>Survey:</b> <ul style="list-style-type: none"> <li>▪ property boundaries,</li> <li>▪ title search,</li> <li>▪ easement plan,</li> <li>▪ cross-sections,</li> <li>▪ locating buildings,</li> <li>▪ certification.</li> </ul>	<ul style="list-style-type: none"> <li>▪ Registered surveyor</li> </ul>	Institution of Surveyors <a href="http://www.isaust.org.au">www.isaust.org.au</a>
<b>Flood and Stormwater Analysis:</b> <ul style="list-style-type: none"> <li>▪ investigation,</li> <li>▪ design,</li> <li>▪ flood study, local overland flooding study,</li> <li>▪ certification,</li> <li>▪ hydrologic/hydraulic modelling,</li> <li>▪ flood proofing,</li> <li>▪ flood evacuation.</li> </ul>	<ul style="list-style-type: none"> <li>▪ National Professional Engineers Registration as administered by the Institution of Engineers, Australia (NPER) with a minimum of 10 years practice in the water engineering field in the last 15 years. Also, at least 5 years practical experience in the flooding and drainage field in small coastal catchments in Australia.</li> </ul>	Institution of Engineers <a href="http://www.ieaust.org.au">www.ieaust.org.au</a>
<b>Foreshore Inundation:</b>	<ul style="list-style-type: none"> <li>▪ NPER with a minimum of 10 years practice in the coastal and estuarine fields in the last 15 years.</li> </ul>	Institution of Engineers <a href="http://www.ieaust.org.au">www.ieaust.org.au</a>
<b>Structural Analysis of Water Related Structures:</b> <ul style="list-style-type: none"> <li>▪ inspection,</li> <li>▪ investigation,</li> <li>▪ design,</li> <li>▪ certification.</li> </ul>	<ul style="list-style-type: none"> <li>▪ NPER with at least 5 years appropriate practical experience on similar structures.</li> </ul>	Institution of Engineers <a href="http://www.ieaust.org.au">www.ieaust.org.au</a>

Please note that Council officers cannot recommend specific practitioners to be engaged. After reviewing Appendix B it is recommended that you contact the relevant industry association for a list of members.



## APPENDIX C: Flood planning levels

Flood planning levels (FPL) are a combination of flood levels and freeboards selected for planning and development control purposes. They represent the minimum standard that will be approved by Woollahra Municipal Council but do not preclude the use of higher levels where appropriate. Definitions of flood related items are provided in the Glossary of Terms (refer Appendix A).

Type of development	Type of flooding	Flood planning level (FPL)
<b>Residential properties</b> Habitable room or area floor level <i>(Refer Appendix A for the definition habitable room/ area)</i>	Inundated by mainstream flooding, local overland flooding or foreshore inundation.	1% AEP flood level + 0.3 m
	Property not affected by mainstream or local overland flooding or foreshore inundation but has an OSD structure.	0.3 m above the maximum water level of the OSD storage
<b>Residential properties</b> Non-habitable room or area floor level such as a garage or laundry	Inundated by mainstream flooding, local overland flooding or foreshore inundation.	1% AEP flood level + 0.15 m
	Property not affected by mainstream or local overland flooding or foreshore inundation but has an OSD structure.	0.15 m above the maximum water level of the OSD storage
<b>Residential and non residential</b> Entrance to Underground Garage or Car Park	All type of flooding	1% AEP flood level + 0.15 m
<b>Residential threshold levels</b> <i>(Refer Note 1)</i>	Local overland flooding	1% AEP flood level + 0.3 m
<b>Residential threshold levels</b> <i>(Refer Note 2)</i>	Mainstream flooding	0.3 m above the FPL for the structure
<b>Commercial/ retail properties</b> Floor level	All type of flooding	1% AEP flood level + 0.3 m
<b>Commercial/ retail properties</b> Garage level or entrance to underground garage or car park	All type of flooding	1% AEP flood level + 0.15 m
<b>Flood access</b> <i>(Refer Note 3)</i>	Mainstream flooding	1% AEP flood level

### Note:

1. This would be applicable for the properties that are located below the road or footpath level. This is to prevent local overland floodwater entering buildings or houses those floor levels are well below the road or footpath level.
2. For this purpose a threshold level is defined as the height of a permanent bank, wall or similar on the subject property which affords protection to either a habitable floor or non-habitable floor. For threshold levels, a higher flood planning level has been adopted than for the structure it protects. This is to partially account for the consequences of failure.
3. Flood access must be available for pedestrians and vehicles to a suitable area of flood free land. This is to allow people to get out of the flooding area. This flood access could be a different from the normal low level access.
4. The 1% AEP flood level in Sydney Harbour is 2.0 m AHD



## APPENDIX D: Design rainfall intensities

The following design rainfall intensities are to be used throughout the Woollahra Municipal Council LGA.

### Woollahra Municipal Council Design Rainfall Intensities

Duration		Average Recurrence Interval						
		1 in 1	1 in 2	1 in 5	1 in 10	1 in 20	1 in 50	1 in 100
Minutes	Hours	Rainfall Intensities in mm/hour						
5	0.083	104	133	167	187	213	246	271
6	0.100	98	125	157	175	199	231	254
7	0.117	92	118	148	166	189	219	241
8	0.133	88	112	141	158	180	209	231
9	0.150	84	107	135	151	173	201	222
10	0.167	80	102	130	146	166	193	214
11	0.183	77	99	125	140	161	187	207
12	0.200	74	95	121	136	156	181	201
13	0.217	72	92	117	132	151	176	195
14	0.233	69	89	114	128	147	171	190
15	0.250	67	86	111	124	143	167	185
16	0.267	65	84	108	121	139	162	180
17	0.283	64	82	105	118	136	159	176
18	0.300	62	80	102	115	133	155	172
19	0.317	60	78	100	113	130	152	168
20	0.333	59	76	98	110	127	148	165
21	0.350	57	74	95	108	124	145	162
22	0.367	56	72	93	106	122	143	159
23	0.383	55	71	91	104	119	140	156
24	0.400	54	69	90	101	117	137	153
25	0.417	53	68	88	100	115	135	150
26	0.433	52	67	86	98	113	132	147
27	0.450	51	65	85	96	111	130	145
28	0.467	50	64	83	94	109	128	143
29	0.483	49	63	82	93	107	126	140
30	0.500	48	62	80	91	105	124	138
31	0.517	47	61	79	90	104	122	136
32	0.533	46	60	78	88	102	120	134
33	0.550	46	59	77	87	101	118	132
34	0.567	45	58	75	86	99	117	130
35	0.583	44	57	74	84	98	115	128
36	0.600	43	56	73	83	96	113	126
37	0.617	43	55	72	82	95	112	125
38	0.633	42	55	71	81	94	110	123
39	0.650	42	54	70	80	92	109	121
40	0.667	41	53	69	79	91	107	120
41	0.683	40	52	68	78	90	106	118
42	0.700	40	52	67	77	89	105	117

### Woollahra Municipal Council Design Rainfall Intensities

Duration		Average Recurrence Interval						
		1 in 1	1 in 2	1 in 5	1 in 10	1 in 20	1 in 50	1 in 100
Minutes	Hours	Rainfall Intensities in mm/hour						
43	0.717	39	51	67	76	88	103	115
44	0.733	39	50	66	75	87	102	114
45	0.750	38	50	65	74	86	101	113
46	0.767	38	49	64	73	85	100	111
47	0.783	37	48	63	72	84	99	110
48	0.800	37	48	63	71	83	97	109
49	0.817	37	47	62	70	82	96	108
50	0.833	36	47	61	70	81	95	106
51	0.850	36	46	60	69	80	94	105
52	0.867	35	46	60	68	79	93	104
53	0.883	35	45	59	67	78	92	103
54	0.900	35	45	59	67	77	91	102
55	0.917	34	44	58	66	77	90	101
56	0.933	34	44	57	65	76	89	100
57	0.950	33	43	57	65	75	89	99
58	0.967	33	43	56	64	74	88	98
59	0.983	33	42	56	63	74	87	97
60	1	32	42	55	63	73	86	96
90	1.5	25	33	43	49	57	67	75
120	2	21	27	36	41	47	56	63
180	3	16	21	27	31	36	43	48
240	4	13	17	22	26	30	35	39
300	5	11	15	19	22	26	30	34
360	6	10	13	17	19	23	27	30
720	12	6	8	11	12	14	17	19
1440	24	4	5	7	8	9	11	12
2880	48	3	3	4	5	6	7	8
4320	72	2	3	3	4	4	5	6

Probable Maximum Precipitation Depth in mm				
Duration		Catchment Area		
Minutes	Hours	1km <sup>2</sup>	2km <sup>2</sup>	3km <sup>2</sup>
15	0.25	170	160	160
30	0.5	250	240	230
60	1	360	350	340
90	1.5	460	450	440
120	2	540	530	520
180	3	660	640	630
360	6	870	850	830

Linear interpolation should be undertaken for durations and catchment sizes not shown.

## APPENDIX E: Management of flood risk – Checklist

1. Is the proposed development is within the area where a mainstream flood study, foreshore inundation study and/ or overland flood study would be required to establish the nature of flooding or flood levels? *(A copy of plan that shows the areas where a flood or overland flow study would be required is available at Council's Customer Service counter.)*

Yes  No

2. Have you attended a Pre-DA meeting at Council?

Yes  No

3. Have you been advised by a Council Officer regarding whether your property is affected by this DCP? Yes  No

If YES, what were the outcomes:

Affected by mainstream flooding Yes  No

Affected by local overland flooding Yes  No

Affected by foreshore inundation Yes  No

4. If YES to 1 above **OR** any of the 3 types of affectation under 3 above, have you engaged a suitably qualified practitioner to prepare a report?

Yes  No

If the response to the above questions is NO please provide some comment.

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Have you included a report signed by your practitioner with your DA?

Yes  No



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