NSW STATE EMERGENCY SERVICE

# Illawarra

## (Wollongong City, Shellharbour City and Kiama Local Government Areas)

# Local Flood Plan

FloodSafe

# ILLAWARRA
# FLOOD EMERGENCY
# SUB PLAN

**A Sub Plan of the Local Emergency Management Plan (EMPLAN)**

**Volume 1 of the Illawarra Local Flood Plan for Wollongong City, Shellharbour City and Kiama Local Government Areas**

**Endorsed by the Local Emergency Management Committee**

**1 June 2022**

# AUTHORISATION

The Illawarra Flood Emergency Sub Plan is a sub plan of the Illawarra Local Emergency Management Plan (EMPLAN). It has been prepared in accordance with the provisions of the ***State Emergency Service Act 1989*** **(NSW)** and is endorsed by the Local Emergency Management Committee in accordance with the provisions of the ***State Emergency and Rescue Management Act 1989*** **(NSW)**.

**Authorised**

*NSW SES Wollongong Local/Unit Commander*

Date: 19.12.2022

Chris WARREN

*NSW SES Kiama Local/Unit Commander*

Date: 16/12/2022

*NSW SES Shellharbour Local/Unit Commander*

Date: 17/10/2022

**Endorsed**

*Chair, Local Emergency Management Committee*

Date: 7 October 2022

# VERSION HISTORY

| Version Number | Description | Date |
|---|---|---|
| | | |
| | | |

# PREVIOUSLY ENDORSED VERSION PRIOR TO LGA AMALGAMATION

The below table lists all previously endorsed versions of this plan.

| Description | Date |
|---|---|
| **Illawarra – Wollongong LFP** | **Jul 2017** |
| **Wollongong City Local Flood Plan** | **June 2010** |
| **Wollongong City Local Flood Plan** | **March 2004** |
| **Kiama/Shellharbour City Local Flood Plan** | **June 2009** |

# AMENDMENT LIST

Suggestions for amendments to this plan should be forwarded to:

Manager, Emergency Planning
NSW State Emergency Service
PO Box 6126, Wollongong NSW 2500
nswses.communityplanning@ses.nsw.gov.au

Amendments in the list below have been entered in this plan.

| Amendment Number | Description | Updated by | Date |
|---|---|---|---|
| | **Illawarra – Wollongong LFP** | | **Updated Aug 2017** |
| | | | |

*Document issue: 12102021*

# DISTRIBUTION LIST

Available for general use and distribution on the NSW State Emergency Service website www.ses.nsw.gov.au

# CONTENTS

# 1 OUTLINE AND SCOPE

## 1.1 PURPOSE

1.1.1 The purpose of this plan is to set out the multi-agency arrangements for the emergency management of flooding in the Wollongong City, Shellharbour City and Kiama Local Government Area (LGA).

## 1.2 AUTHORITY

1.2.1 This plan is written and issued under the authority of the *State Emergency and Rescue Management Act 1989* (NSW) ('SERM Act'), the *State Emergency Service Act 1989* (NSW) ('SES Act') and the NSW State Emergency Management Plan (EMPLAN).

1.2.2 This plan is a sub plan to the Illawarra Local Emergency Management Plan (EMPLAN) and is endorsed by the Emergency Management Committee (LEMC).

## 1.3 ACTIVATION

1.3.1 This plan does not require activation. The arrangements set out in this plan are always active.

1.3.2 The Illawarra Local Emergency Management Plan (EMPLAN) is active at all times in anticipation of the need to coordinate support and resources requested by combat agencies, including the NSW State Emergency Service (NSW SES).

## 1.4 SCOPE

1.4.1 The area covered by this plan is the Wollongong City, Shellharbour City and Kiama Council Local Government Areas (LGAs). The Wollongong City, Shellharbour City and Kiama Council LGAs and their principal towns, villages, rivers and creeks are shown in Appendix A.

1.4.2 The Wollongong City, Shellharbour City and Kiama Council areas are in the NSW SES South Eastern Zone and for emergency management purposes, are part of the Illawarra South Coast Emergency Management Region.

1.4.3 The plan sets out the Wollongong City, Shellharbour City and Kiama Councils level of emergency management arrangements for prevention, preparation, response and initial recovery for flooding in the Wollongong City, Shellharbour City and Kiama LGAs. Hazard and Risk information can be found in Volume 2 of this document, and NSW SES Response Arrangements can be found in Volume 3, where these documents exist.

1.4.4 In this plan a flood is defined as a relatively high water level 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 drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves (including tsunami) overtopping coastline defences.

1.4.5 The arrangements for dealing with episodes of coastal erosion by severe weather, are described in the NSW State Storm Plan.

1.4.6 The arrangements for the emergency management of tsunami are dealt with in the NSW State Tsunami Emergency Sub Plan.

1.4.7 This plan outlines the local level arrangements for the management of downstream consequences of flooding due to dam failure, however it does not cover the management of flooding of an underground mine by inrush or other cause, which should be covered by the Mine Emergency Sub Plan for the respective mine.

## 1.5 GOALS

1.5.1 The primary goals for flood emergency management in NSW are:

a. Protection and preservation of life.

b. Establishment and operation of flood warning systems.

c. Issuing of community information and community warnings.

d. Coordination of evacuation and welfare of affected communities.

e. Protection of critical infrastructure and community assets essential to community survival during an emergency incident.

f. Protection of residential property.

g. Protection of assets and infrastructure that support individual and community financial sustainability and aid assisting a community to recover from an incident; and

h. Protection of the environment and conservation values considering the cultural, biodiversity and social values of the environment.

## 1.6 KEY PRINCIPLES

1.6.1 The protection and preservation of human life (including the lives of responders and the community) is the highest priority.

1.6.2 Evacuation is the primary response strategy for people impacted by flooding.

## 1.7 ROLES AND RESPONSIBILITIES

1.7.1 General responsibilities of emergency service organisations and functional areas are set out in the NSW State EMPLAN and NSW State Flood Sub Plan.

1.7.2 Specific roles and responsibilities for agencies, functional areas and organisations in relation to flooding within Wollongong City, Shellharbour City and Kiama Councils are detailed within this plan, Appendix B and Appendix C.

1.7.1 Any agency with agreed responsibilities in this plan that are temporarily unable or no longer able to fulfil their responsibilities in response operations must as soon as possible notify the:

a. NSW SES Incident Controller (for local or zone level responsibilities during response operations).

b. NSW SES Zone Duty Commander (for regional level responsibilities outside of response operations).

## 1.8 PLAN MAINTENANCE AND REVIEW

1.8.1 The NSW SES will maintain the currency of this plan by:

a. Ensuring that all supporting emergency services and functional areas, organisations and officers mentioned in it are aware of their roles and responsibilities.

b. Conducting exercises to test arrangements.

c. Reviewing the contents of the plan:

- When there are changes which alter agreed plan arrangements.
- When changes to land use strategic plans and policies increase the population at risk.
- After a flood including reccomendations from after action reviews, reports, or inquiries; and
- As determined by the NSW SES Commissioner.

d. The plan is to be reviewed no less frequently than every five years or after a significant flood event.

## 1.9 SUPPLEMENTARY DOCUMENTS

1.9.1 Supplementary material published in previous versions of the Local Flood Emergency Sub Plan is now maintained on the NSW SES website at: NSW SES Flood Storm and Tsunami Plans including:

a. Flood Plan Glossary.

b. NSW SES Dam Failure Notification Flowchart.

c. NSW SES Resupply Flowchart.

# 2 OVERVIEW OF NSW FLOOD HAZARD AND RISK

## 2.1 THE FLOOD THREAT

2.1.1 The NSW SES maintains information on the nature of flooding and effects of flooding on the community in the Wollongong City, Shellharbour City and Kiama LGAs. This is outlined in Volume 2 – Hazard and Risk in Wollongong City, where this document exists.

2.1.2 Declared dams in or upstream of Wollongong City, Shellharbour City and Kiama Local Government Areas.

| Dam Name | Owner |
|---|---|
| **Barina Park Detention Basin** | Wollongong City Council |
| **Blackbutt Reserve** | Shellharbour City Council |
| **Brokers Road Retarding Basin** | Wollongong City Council |
| **Bucklands Retarding Basin** | Matt Crossingham |
| **Coalcliff** | Illawarra Coke Company |
| **Cordeaux** | WaterNSW |
| **Dobinsons Retarding Basin** | Roads and Maritime Services |

| | |
|---|---|
| **Foothills Estate Retention Basin 1** | Wollongong City Council |
| **Foothills Estate Retention Basin 3** | Wollongong City Council |
| **Foothills Road Basin** | Wollongong City Council |
| **Fountaindale** | Kiama Municipal Council |
| **Gannet Place Retarding Basin** | Wollongong City Council |
| **Greenmedows Retarding Basin** | Shellharbour City Council |
| **Gunyah Park Basin** | Wollongong City Council |
| **Kanahooka Retention Basin** | Forest Grove Community Association |
| **Nyrang Park Retention Basin** | Wollongong City Council |
| **Oak Flats Reservoir** | Sydney Water Corporation |
| **St Josephs School Retarding Basin** | Shellharbour City Council |
| **St Josephs School Retarding Basin** | Shellharbour City Council |
| **Shellcove Estate Detention Basin** | Shellharbour City Council |
| **Shellharbour City Centre Basin** | Shellharbour City Council |
| **South Bulli Basin 1** | Allied Coal Pty Ltd |
| **South Bulli Stormwater** | Wollongong Coal Ltd |
| **Upper Cordeaux 2** | WaterNSW |
| **Wollongong High School Retarding Basin** | Wollongong City Council |

# 3 PREVENTION/ MITIGATION

## 3.1 INTRODUCTION

3.1.1 The Floodplain Development Manual outlines the NSW Government's Flood Prone Lands Policy which details the framework for managing flood prone land in New South Wales. Incorporation of floodplain risk management into land use planning is one of the key means to limit the exposure to flood risks to our communities and help build long term resilience to future flood events.

## 3.2 LAND USE PLANNING

3.2.1 **Strategy:** Effective land use planning is a key focus for minimising the impacts of flooding. NSW SES will work with land use planning and consent authorities to inform and influence the consideration of the risks arising from flood, storm and tsunami, to prevent the creation of intolerable impacts of these hazards on the community.

**Actions:**

a. NSW SES will provide strategic input about land use planning matters which have or will create significant flood risk to life and/or property due to flooding.

b. NSW SES will provide responses to land use planning proposal referrals that have or will create significant flood risk to life and/or property due to flooding.

## 3.3 FLOODPLAIN RISK MANAGEMENT

3.3.1 **Strategy**: Advocate for consideration of emergency management in decision making to reduce risks to the existing community and minimise the growth in future, continuing and residual risk due to development through input to the floodplain management program.

**Actions**:

a. NSW SES will provide coordinated and consistent emergency management advice to councils and other agencies in relation to the management of land that is subject to flooding or coastal inundation; and

b. NSW SES will provide advice, support, technical resources and training for NSW SES representatives to contribute effectively on local Floodplain Management Committees.

# 4 PREPARATION

## 4.1 INTRODUCTION

4.1.1 Preparation includes arrangements or plans to deal with an emergency or the effects of an emergency.

## 4.2 FLOOD EMERGENCY PLANNING

4.2.1 **Strategy**: NSW SES develop, review and maintain Flood Emergency Sub Plans

**Actions**:

a. Develop and review this NSW SES Local Flood Emergency Sub Plan as required. Local Flood Emergency Sub Plans outline the specific arrangements for management of flood events within an LGA, and may include cross boundary arrangements; and

b. Review plans as per Section 1.8.

4.2.2 Local EMPLAN Consequence Management Guides (CMG's) for flood are not required for communities covered by NSW SES Local Flood Emergency Sub Plans however may be utilised in place of Local Flood Emergency Sub Plan if agreed to by NSW SES.

## 4.3 FLOOD INTELLIGENCE SYSTEMS

4.3.1 **Strategy**: NSW SES develop and maintain a flood intelligence system to identify flood behaviour, its impact on the community and required response actions.

**Actions**:

a. Gather and assess flood information for the full range of flood types and severities.

b. Collect, collate, and assess information on the characteristics of communities at risk and the potential effects of flooding on communities at risk; and

c. Share flood intelligence information with supporting agencies.

## 4.4 DEVELOPMENT OF WARNING SYSTEMS

4.4.1 **Strategy**: Develop, maintain and prepare systems for the provision of flood warnings and associated warning services.

**Actions**:

a. All levels of government work in partnership to develop and maintain flood warning infrastructure.

b. NSW SES maintains a list of the requirements for flood warnings for flood gauges in NSW (including flood classifications, warning times required and key statistics) and can be found in the supplementary document to the NSW State Flood Plan (see Section 1.9). Gauges of relevance within the Wollongong City, Shellharbour City and Kiama LGAs are also listed in Volume 3 of this plan, where this document exists.

c. The NSW SES will recommend new warning services and changes to warning alert levels for gauges to the NSW and ACT Flood Warning Consultative Committee.

d. The State Government, in partnership with Local Government, is responsible for developing and maintaining flash flood warning systems for local catchments where required.

e. Dam Owners will provide Dam Emergency Plans (where required) and consult with NSW SES on alert levels and messaging. Alert level definitions are listed in Dam Emergency Plans.

f. NSW SES maintains a dedicated dam failure hotline and procedures to ensure priority dissemination of dam failure warnings.

g. NSW SES develops and maintains warning and flood information products by:

- Utilising flood intelligence data.
- Developing warning and flood information products.
- Continuously reviewing warning and flood information products.
- Consulting with affected communities, key stakeholders, Dam Safety NSW and the NSW and ACT Flood Warning Consultative Committee; and maintain Operational Readiness; and
- Participating in the development of public information and warning systems.

h. Gauge owners adequately maintain flood warning gauges and systems, including those identified in the 'Service Level Specification' maintained by the Bureau of Meteorology (Bureau) and those identified in the 'Provision and Requirements for Flood Warning in New South Wales' maintained by NSW SES.

## 4.5 BRIEFING, TRAINING AND EXERCISING

4.5.1 **Strategy**: Ensure NSW SES, supporting agencies, functional areas and the community are prepared and familiar with the strategies and arrangements within the Flood Emergency Sub Plan and supporting documents.

**Actions**:

a. NSW SES will consult stakeholders throughout the development of plans.

b. NSW SES will inform stakeholders of content changes after revisions.

c. NSW SES will ensure their facilities and resources are maintained and operationally ready.

d. NSW SES will train personnel for their expected flood operation roles; and

e. NSW SES will regularly brief stakeholders on the exercise arrangements contained in the NSW Flood Emergency Sub Plan.

## 4.6 COMMUNITY RESILIENCE TO FLOODING

4.6.1 **Strategy**: NSW SES provides and maintains a flexible volunteer workforce to support community resilience.

**Actions**:

a. Ensure ongoing recruitment and training of a diverse range of volunteers.

b. Ensure pre-planning to facilitate the management of spontaneous volunteers and community members during a flood.

4.6.2 **Strategy**: NSW SES works with individuals, communities, businesses and government agencies to build flood resilience.

**Actions**:

a. Partners with and engage communities to understand and manage the risks associated with floods, including providing business continuity guidance (NSW SES Business FloodSafe), family preparedness (NSW SES Home FloodSafe) and other engagement strategies.

b. NSW SES will collate, assess and disseminate flood information to the community.

c. Collaborate with individuals, businesses, government agencies and communities when developing flood intelligence, preparedness and response information.

d. Plan for floods collaboratively with communities through community and stakeholder participation and engagement.

e. Collaborate with community sector and recognise the needs of individuals within communities who have an increased susceptibility during floods.

# 5 RESPONSE

## 5.1 INTRODUCTION

5.1.1 Flood response operations will begin:

a. On receipt of a Bureau Severe Weather Warning or Thunderstorm Warning that includes heavy rain or storm surge; or

b. On the receipt of a Bureau Flood Watch or Flood Warning; or

c. On receipt warnings for flash flood; or

d. On receipt of a dam failure alert; or

e. When other evidence leads to an expectation of flooding.

## 5.2 INCIDENT MANAGEMENT ARRANGEMENTS

5.2.1 **Strategy**: Maintain effective control of flood operations across New South Wales.

**Actions**:

a. The NSW SES uses the Australasian Inter-service Incident Management System (AIIMS) to manage the flood response.

b. Control of flood response will be at the lowest effective level and may be scaled to suit the incident.

c. The NSW SES State Controller (or delegate) will appoint Incident Controllers and establish Incident Control Centres (see NSW SES facilities on map in Appendix A).

d. The NSW SES Incident Controller, in consultation with participating supporting emergency services and Functional Areas will determine the appropriate breakdown of an Area of Operations into Divisions and/or Sectors in accordance with the principles of AIIMS.

5.2.2 **Strategy**: Maintain Incident Control Centre(s).

**Actions**:

a. NSW SES will operate Incident Control Centre(s) as required.

b. The NSW SES Incident Control Centre(s) will:

- Control resources from NSW SES and coordinate resources of supporting emergency services and functional areas.
- Manage Request for Assistance (RFA) tasking and ensure they are actioned in a timely manner.
- Undertake response planning and determine future resourcing requirements; and
- Coordinate information flow, including warnings, public information and social media.

5.2.3 **Strategy**: Provide effective liaison between the NSW SES and supporting agencies or functional areas in accordance with Local EMPLAN.

**Actions**:

a. Supporting emergency services and Functional Areas should provide Liaison Officers to NSW SES Incident Control Centres and/or Emergency Operation Centres as required

b. NSW SES will provide Liaison Officer(s) to Emergency Operations Centres as required; and

c. Where possible Emergency Operation Centres to be co-located with NSW SES Incident Control Centres for Flood Emergency Response.

5.2.4 **Strategy**: Coordinate resources and logistics support to ensure operational effectiveness.

**Actions**:

a. The NSW SES Incident Controller will notify agencies of potential access issues between locations, for the consideration of pre-deploying of resources.

b. The NSW SES may request resources and logistics support directly from a supporting emergency service or Functional Area.

c. Wherever possible, supporting organisations are to provide their own logistic support in consultation with NSW SES where appropriate.

d. The NSW SES Incident Controller will control air support operations and may utilise supporting agencies in the management of aircraft.

## 5.3 USE OF INFORMATION AND COLLECTION OF INTELLIGENCE

5.3.1 **Strategy**: Ensure flood information is effectively utilised communicated and collected during and post a flood.

**Actions**:

a. Information relating to the consequences of flooding, response strategies, situational awareness and operational updates will be distributed by NSW SES to supporting emergency services and Functional Areas listed under this Plan.

b. All supporting emergency services and Functional Areas and Council will accurately record and report information relevant to their activities and any real time flood information (including road closure information) to the NSW SES Incident Controller. This may be in the form of a combined Emergency Operations Centre (EOC) report, or direct from agencies where an EOC has not been established.

c. The NSW SES may establish and operate a Joint Intelligence Unit to coordinate the collection, collation, interpretation, mapping, actioning and dissemination of information; and

d. Reconnaissance, mapping, damage assessments, intelligence validation and post flood evaluation will be coordinated by NSW SES. This may occur post impact and continue into the recovery phase.

e. NSW SES may request Engineering to assist with the gathering of flood intelligence including (not limited to) maximum flood extents, peak flood heights, recording major flood damage at key high velocity locations and preparation of After-Flood Report.

5.3.2 **Strategy**: Ensure flood intelligence is incorporated into operational decision-making.

**Action**: The NSW SES will use flood intelligence, official forecasts, warnings, and flood scenario products to undertake an assessment of the predicted impact of a flood and to inform operational decision-making.

## 5.4 PROVISION OF INFORMATION AND WARNINGS TO THE COMMUNITY

5.4.1 **Strategy**: Timely and effective warnings are distributed to the community.

**Actions**:

a. The Bureau issues public weather and flood warning products before and during a flood. These may include:

- Severe Thunderstorm Warnings – Detailed - issued for all capital cities and surrounding areas when individual severe thunderstorms are within range of the capital city radars,
- Severe Thunderstorm Warnings - Broad-based - issued for the entire Australian State or territories affected highlighting broad areas where severe storms may occur within the next 3 hours,
- Severe Weather Warnings with reference to heavy rainfall and/or storm surge,
- Flood Watches, and
- Flood Warnings.

b. Dam Owners will utilise the Dam Emergency Plan to provide warnings and information to NSW SES and communities (where appropriate).

c. NSW SES Incident Controllers will issue the following NSW SES flood information products incorporating warnings from the above, expected consequences and safety messages:

- Livestock and Equipment Warnings
- Local Flood Advices
- Flood Bulletins
- NSW SES Evacuation Warning
- NSW SES Evacuation Order
- NSW SES All Clear

d. NSW SES liaises with the Bureau of Meteorology to discuss the development of flood warnings as required.

e. NSW SES provides alerts and deliver flood information to affected communities using a combination of public information.

f. NSW SES may request supporting agencies redistribute NSW SES alerts and information, including through the provision of doorknocking teams.

g. Road closure information will be provided to the community through the following agencies/methods:

- Local Government Council websites; and
- Transport for NSW 'Live Traffic' website: www.livetraffic.com or 'Transport InfoLine': 131 500. VMS messaging on roadways may also be used to advise motorists.

h. The Public Information and Inquiry Centre will be established by the NSW Police Force where required to provide information regarding evacuees and emergency information. Contact details will be broadcast once the centre is established.

i. The Disaster Welfare Assistance Line will be established by Disaster Welfare Services where required to provide information on welfare services and

assistance. Assistance line contact details will be broadcast once Disaster Welfare Services commence.

## 5.5 PROTECTION OF PROPERTY

5.5.1 **Strategy**: Coordinate the protection of property including critical infrastructure from destruction or damage arising from floods.

**Action**: NSW SES, supporting agencies, and community volunteers will assist the community (where resources are available, feasible and safe to do so) in:

a. The protection of properties through flood protection systems (e.g. sandbagging) to minimise entry of water into buildings; and

b. The raising or moving of household furniture and commercial stock/equipment.

## 5.6 ROAD AND TRAFFIC CONTROL

5.6.1 **Strategy**: Coordinate the closing and re-opening of flood affected roads.

**Actions**:

a. Wollongong City, Shellharbour City and Kiama Councils will coordinate the closure and reopening of council managed roads once inspections have been carried out by the relevant authority.

b. Transport for NSW will coordinate the closure and reopening of the state road network.

c. The NSW Police Force may close and re-open roads but will normally only do so (if the Wollongong City, Shellharbour City and Kiama Councils or Transport for NSW have not already acted and if public safety requires such action;

d. NSW SES will assist with erecting road closure signs and barriers when time and resources permit.

5.6.2 **Strategy**: Coordinate traffic control measures in flood affected areas.

a. The NSW SES Incident Controller may direct the imposition of traffic control measures into flood affected areas in accordance with the provisions of the *State Emergency Service Act, 1989* and the *State Emergency Rescue Management Act, 1989.*

b. The NSW SES Incident Controller may request the Local Emergency Operations Controller provide suitable personnel to assist with traffic coordination.

## 5.7 PROTECTION OF ESSENTIAL SERVICES

5.7.1 Arrangements for the protection of local assets are outlined in Volume 3, where this document exists, of the NSW SES Local Flood Emergency Sub Plan. In addition, Local and Region EMPLAN's contain infrastructure inventories.

5.7.2 **Strategy**: Minimise disruption to the community by ensuring protection of infrastructure and supply of essential energy, utility services and lifelines.

**Actions**:

a. The Transport Services Functional Area is to coordinate the provision of information about the assessment and restoration of transport network infrastructure.

b. The Energy and Utility Services Functional Area is to coordinate the assessment and restoration of essential energy and utility services (not including telecommunications).

c. The Telecommunications Services Functional Area is to coordinate the assessment and restoration of telecommunications and the Public Safety Network.

d. The Engineering Services Functional Area is to

- Coordinate the assessment and restoration of critical public buildings for example hospitals;
- Assessment and operation of flood protection levees
- Protection of property
- Construction and repair of levees
- Dam safety assessment and dam stability
- Water supply and sewerage operations
- Other critical infrastructure

e. Functional Areas and Council will keep the NSW SES informed of the status of utilities and infrastructure.

## 5.8 EVACUATION

5.8.1 Evacuation is the NSW SES's primary response strategy for managing the population at risk of flooding.

5.8.2 Community specific evacuation arrangements are located in Volume 3 of this Plan, where this document exists.

5.8.3 **Strategy**: Conduct planning to ensure all evacuation constraints are considered.

**Actions**:

a. Evacuations will take place when there is a risk to public safety. Circumstances may include:

- Evacuation of people when their homes or businesses are likely to flood.
- Evacuation of people who are unsuited to living in isolated circumstances, due to flood water closing access; and
- Evacuation of people where essential energy and/or utility services are likely to fail or where buildings have been or may be made uninhabitable; and

b. The NSW SES will consider the following in evacuation decisions:

- Duration of evacuation.
- Characteristics of the community.
- Numbers requiring evacuation.
- Availability of evacuation routes and transport.

- The ability for existing levees or other flood protection works to fulfil their intended function.
- Time available for evacuation.
- Evacuee management requirements.
- Resources and delivery of evacuation information
- Length of isolation.

c. NSW SES Incident Controllers, planning and intelligence officers will carefully consider the risks involved in conducting evacuations.

d. All evacuation decisions will be made as per the current NSW SES policies and procedures, and consistent with the NSW Evacuation Management Guidelines.

e. Potential Evacuation Centres are located in Volume 3, where this document exists / Local EMPLAN; and

f. The NSW Police Force will coordinate the provision of overall security for evacuated areas.

5.8.4 **Strategy**: Evacuate people pre-emptively from dangerous or potentially dangerous places and or locations created by the flood hazard to safe locations away from the hazard.

a. NSW SES will control and coordinate the evacuation of affected communities.

b. The NSW SES Comissioner (or delegate) will warn communities to prepare for a possible evacuation, where circumstances allow such lead time.

c. The NSW SES Comissioner (or delegate) will order any necessary evacuations and provide information to the community about when and how to evacuate.

d. Support to evacuation operations may be requested from other emergency services and supporting agencies using arrangements in the local EMPLAN and supporting plans.

e. Health Services Functional Area will coordinate the evacuation of hospitals, health centres and aged care facilities (including nursing homes) in consultation with the NSW SES and Welfare Services.

f. School administration offices (Government and Private) will coordinate the evacuation of schools in consultation with the NSW SES and Welfare Services, if not already closed.

g. Caravan Park proprietors will inform the NSW SES Incident Controller when caravan park evacuations have been completed.

h. People who are reluctant or refuse to comply with any Evacuation Order will be referred to the NSW Police Force.

## 5.9 EVACUEE MANAGEMENT AND WELFARE

5.9.1 Research and experience in flood operations shows that most evacuees go to family, friends and commercial accommodation outside the impact area.

5.9.2 **Strategy**: Maintain the welfare of communities and individuals affected by the impact of a flood.

**Actions**:

a. NSW SES will provide initial welfare for evacuees where required but will hand the responsibility over to the Welfare Services Functional Area as soon as possible. The NSW SES will brief the Welfare Services Functional Area at the earliest opportunity regarding the level of assistance required.

b. Welfare Services Functional Area will manage evacuation centres for affected residents and travellers in accordance with the Welfare Services Functional Area Supporting Plan.

c. Schools Administration (Government and Private) will manage the safety of students directly affected by flooding and will work with the NSW SES in the temporary closure of schools and will coordinate with NSW SES Transport and Welfare Services in the management of school evacuees.

d. Disaster Victim Registration will be controlled and coordinated by the NSW Police Force with the assistance of NSW SES and Welfare Services Functional Area.

e. NSW SES will provide details of all residents assisted in evacuations to the Welfare Services Functional Area as early as possible.

f. Where the expected remaining number of evacuees and the duration of evacuation is assessed to be beyond the capability and capacity of the established evacuation centre arrangements the SEOCON may establish Major Evacuation Centres or Mass Care facilities; and

g. The decision to establish Major Evacuation Centres or Mass Care Facilities will be made by the NSW SES and SEOCON in consultation with members of the State Emergency Management Committee.

5.9.3 **Strategy**: Coordinate available and accessible health services for flood affected communities.

**Action**: The provision of environmental health advice, assessment of public health risks and coordination of immediate mental health support will be provided by Health Services Functional Area.

5.9.4 **Strategy**: Maintain the welfare of animals impacted by a flood.

**Actions**:

a. Agriculture and Animal Services Functional Area will coordinate the welfare of livestock, pets, companion animals and wildlife including support to primary producers, animal holding establishments and community members; and

b. Agriculture and Animal Services Functional Area role will coordinate the evacuation, emergency care of animals and assessment, humane destruction and disposal of affected animals, and supply of emergency fodder, water and aerial support where necessary.

## 5.10 FLOOD RESCUE

5.10.1 **Strategy**: Control and coordinate flood rescue of people and domestic animals.

**Actions**:

a. NSW SES will perform flood rescue, where training and equipment is suitable and where a risk assessment has indicated that the risk to rescuers is acceptable.

b. Flood rescue operations will be conducted in accordance with the State Rescue Board Land Rescue Policy and the NSW State Rescue Board Flood Rescue Policy which sets out the framework, governance, responsibilities and requirements for the management and conduct of flood rescue in NSW.

c. NSW SES may request other supporting emergency services to undertake flood rescues on behalf of the NSW SES. Agencies must be authorised/accredited to undertake flood rescue operations in accordance with State Rescue Board requirements, as prescribed by NSW SES. Supporting emergency services must supply information regarding rescues performed to the NSW SES. Notification arrangements with NSW Police Force are outlined in the NSW State Rescue Board Flood Rescue Policy; and

d. Rescue agencies will conduct rescue of domestic small and large animals as per the State Rescue Board Land Rescue Policy (and may include Large Animal Rescue of family horses and cows at a residence or property). The rescue of livestock (which includes commercial animals found on farming and breeding enterprises) will be coordinated through Animal and Agriculture Services Functional Area.

## 5.11 RESUPPLY

5.11.1 **Strategy**: Coordinate resupply to towns and villages isolated by flooding to minimise disruption to the community.

**Actions**:

a. NSW SES will advise communities and businesses if flood predictions indicate that areas are likely to become isolated, and indicative timeframes where possible.

b. Retailers should be advised to ensure sufficient stock is available for the duration of the flood.

c. When isolation occurs, NSW SES will establish loading points where retailers can instruct suppliers to deliver goods.

d. NSW SES will endeavour to support the delivery of mail to isolated communities but may not be able to do so according to normal Australia Post timetables.

e. NSW SES will assist hospitals with resupply of linen and other consumables where able.

f. NSW SES may request resupply assistance from supporting agencies.

g. NSW SES may conduct resupply operations as per the designated resupply plan for the event.

h. Where additional supplies are required Engineering be requested to coordinate the supply of goods and services in response to and recovery from the emergency.

5.11.2 **Strategy**: Coordinate resupply to rural properties isolated by flooding.

**Actions**:

a. When requested, NSW SES will establish a resupply schedule and coordinate the resupply for isolated rural properties.

b. NSW SES will provide local suppliers with designated loading points. Resupply items are to be packaged by the supplier; and

c. Isolated households unable to afford resupply items will be referred to Welfare Services Functional Area for assistance.

## 5.12 ALL CLEAR AND RETURN

5.12.1 **Strategy**: Coordinate the safe return of communities to flood affected areas when the immediate danger to life and property has passed.

**Actions**:

a. NSW SES Incident Controller will determine when it is safe to progressively return in consultation with the relevant Emergency Operations Controller and supporting agencies considering the ongoing risk to public safety.

b. NSW SES Incident Controller will specify the level of access to affected communities as the following:

- Not suitable for access.
- Limited access by emergency services and response agencies.
- Limited access by residents and/or business operators; or
- Full access

c. NSW SES Incident Controller will issue an 'All Clear' message when the immediate danger to life and property has passed for areas assessed as safe; and

d. The NSW SES will facilitate the return of evacuees to their homes.

## 5.13 END OF RESPONSE OPERATIONS

5.13.1 **Strategy**: Conclude response operations.

**Actions**:

a. Response operations will conclude when:

- There is a reduced likelihood of additional flooding within the Area of Operation and flood waters have receded.
- All requests for assistance related to the flood have been completed;
- The need for warning and evacuation no longer exist.
- There is no further likelihood of rescuing people.
- Resupply is no longer required (resupply operations may occur concurrently with the recovery phase).
- Response to fire and hazardous material incidents have concluded (not including subsequent clean-up of contaminated sites); and

- All affected areas have had an 'All Clear' issued.

## 5.14 POST IMPACT ACTIONS

5.14.1 **Strategy**: Learnings from the event are used to inform recovery and future events.

**Actions**:

a. NSW SES will continue to engage with communities after significant floods through convening one or more community forums, workshops or other opportunities to provide communities a chance to provide feedback, address any concerns and provide input into the recovery process. These will typically include other agencies such as the Bureau of Meteorology, Welfare Services and Wollongong City Council representatives.

b. NSW SES will conduct After Action Reviews, at the conclusion of response operations, which will involve all stakeholders. Findings will be shared and incorporated into improved disaster resilience planning.

c. NSW SES will provide information and data throughout the emergency response to inform community recovery. A report will be developed at the request of the SERCON at the conclusion of the response within an area. Should a response summary report be required it will include the following:

- The emergency action plan in place at conclusion of the response emphasising any continuing activities including community meetings/ engagement activities.
- Resources allocated to the emergency response and associated exit strategies.
- Details of any areas or situations with potential to re-escalate the emergency;
- A recommendation for the conclusion of the NSW SES as lead agency to transition to Resilience NSW as the lead agency for Recovery.
- Any actions that are incomplete or outstanding.
- Damage Assessment Data and Information obtained throughout the response phase which will further support the long-term recovery of communities.

d. NSW SES will undertake/coordinate a comprehensive review of intelligence and plans following significant flood events.

5.14.2 **Strategy:** Participate in post flood data collection analysis.

**Actions:** NSW SES works with relevant stakeholders and Wollongong City, Shellharbour City and Kiama Councils on post flood data collection analysis including review of flood intelligence where necessary.

# 6 RECOVERY OPERATIONS

## 6.1 INTRODUCTION

6.1.1 Recovery is the process of returning an affected community to its proper level of functioning after an emergency. It will generally commence simultaneously with the Response phase.

6.1.2 Recovery operations will be initiated and conducted as outlined in the NSW State EMPLAN and as further detailed in the NSW Recovery Supporting Plan.

### 6.2 NSW SES RECOVERY ROLE

6.2.1 **Strategy**: NSW SES will support recovery operations and established Recovery Committees.

6.2.2 **Actions**:

a. NSW SES will provide representation to Recovery Committees as required and may have an ongoing role in the Recovery phase.

b. NSW SES roles on Recovery Committees may include providing information about any continuing response, guidance on mitigation strategies and general advice and assistance to the committee as a subject matter specialist and or expert.

c. NSW SES will provide information to Resilience NSW to support applications to Treasury for Natural Disaster Relief and Recovery Arrangements.

d. The NSW SES, in conjunction with a Recovery Committee, will provide a service to support the information needs of a community immediately following a flood; and

e. NSW SES and where required supporting agencies will assist with clean-up operations after floods, where possible when resources and personnel permit.

f. NSW SES may coordinate immediate relief in collaboration with Resilience NSW.

# 7 ABBREVIATIONS

For a full list of abbreviations refer to the NSW State Flood Plan - Abbreviations

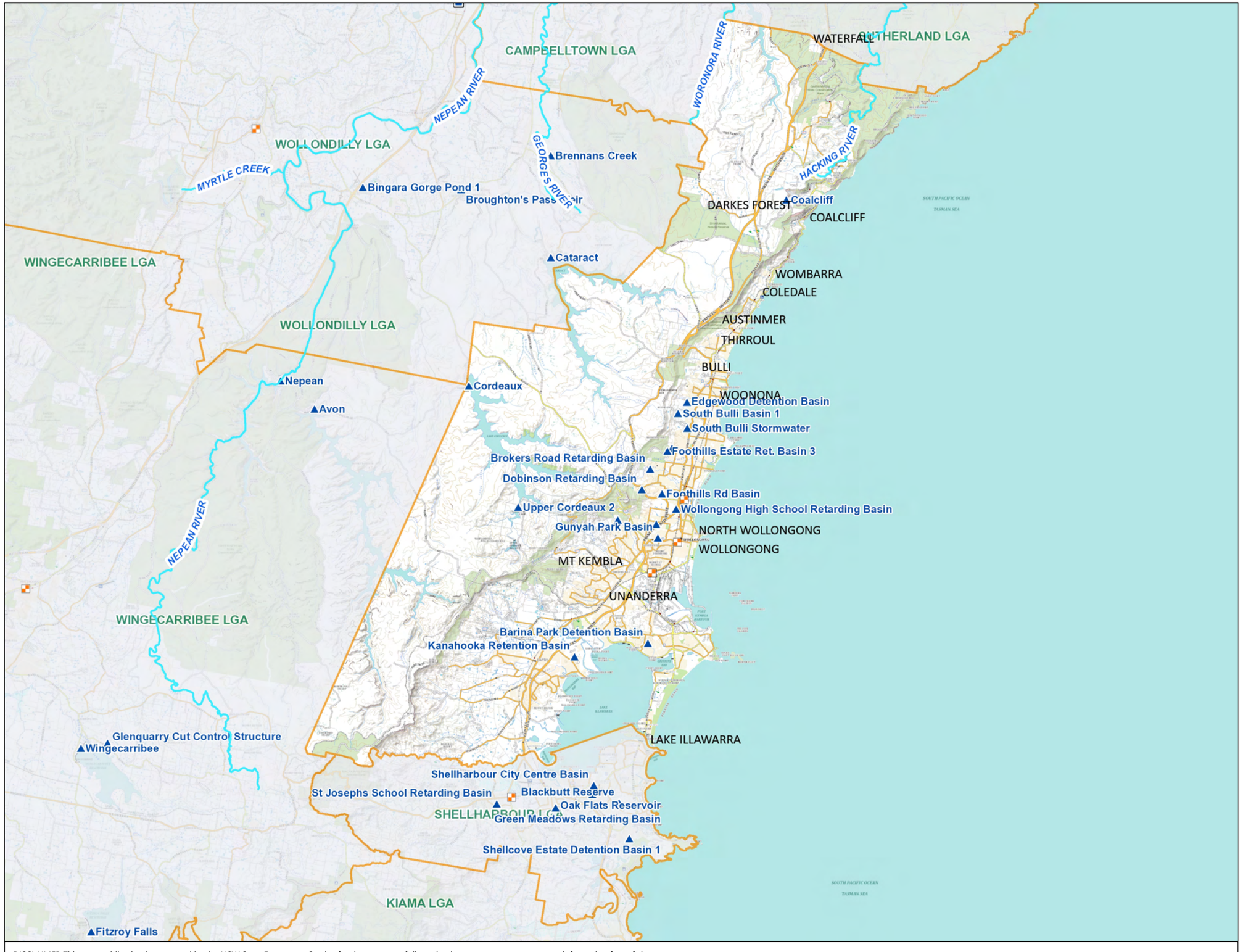
# 8 GLOSSARY

Common emergency service terminology can be found within the Australian Disaster Resilience Glossary.

Readers should refer to EMPLAN Annex 9 – Definitions.

Refer to the NSW State Flood Plan for a complete glossary of terminology used throughout this plan and within NSW SES Flood Plans.

**For a full list of definitions refer to the Supporting Document - State Flood Plan Glossary** https://www.ses.nsw.gov.au/media/2650/glossary.pdf




# Appendix A - Map of Wollongong City Council Area

Local Flood Plan LGA Map

## Legend

- NSW SES Headquarters
- Gauges BOM Forecast Locations
- Major Rivers
- Levees
- Declared Dams (Prescribed)
- Local Government Areas
- States Australia



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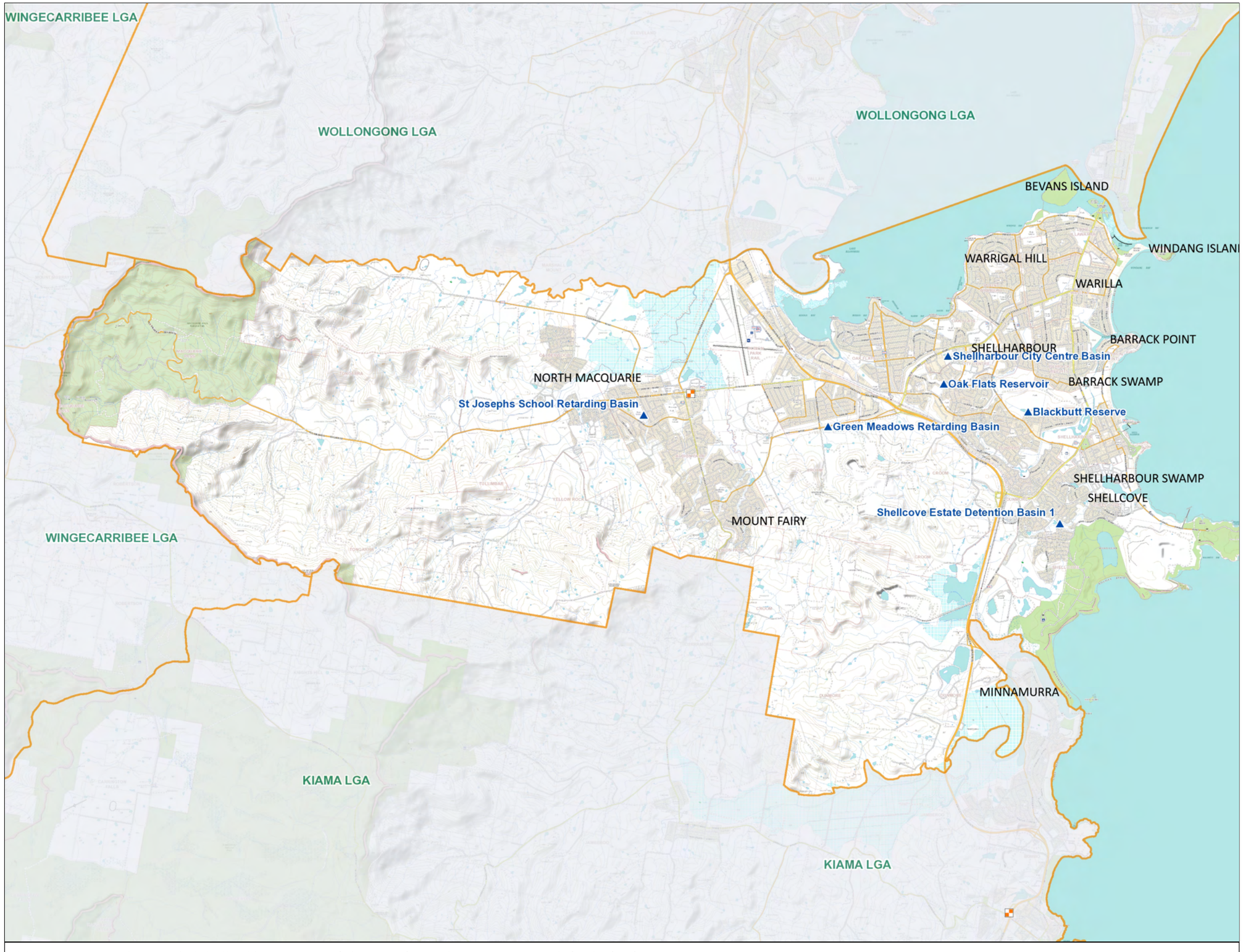


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NSW STATE EMERGENCY SERVICE

# Appendix A - Map of Shellharbour City Council Area

Local Flood Plan LGA Map

Legend

- NSW SES Headquarters
- Gauges BOM Forecast Locations
- Major Rivers
- Levees
- Declared Dams (Prescribed)
- Major Towns NSW
- Local Government Areas
- States Australia



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NSW STATE EMERGENCY SERVICE

# Appendix A - Kiama Shire Council Area

Legend

- NSW SES Headquarters
- Gauges BOM Forecast Locations
- Major Rivers
- Levees
- Prescribed Dams
- Major Towns NSW
- Local Government Areas



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# 1 Appendix B – Roles and Responsibilities

| AGENCY | RESPONSIBILITIES |
|---|---|
| **NSW State Emergency Service** | NSW SES is the designated Combat Agency for floods, storms and tsunami and controls response operations. NSW SES roles and responsibilities in relation to floods are outlined in the NSW State Flood Plan. |

| AGENCY | RESPONSIBILITIES |
|---|---|
| **Agriculture and Animal Services Functional Area** | The roles and responsibilities for Agriculture and Animal Services are outlined in the Agriculture and Animal Services Supporting Plan and NSW State Flood Plan. |
| **Australian Government Bureau of Meteorology** | The roles and responsibilities for the Australian Government Bureau of Meteorology are outlined in the NSW State Flood Plan. |
| **«LGA_Name»** | **Preparedness**<br>• Establish and maintain floodplain and coastal risk management committees and ensure that key agencies are represented.<br>• Develop and implement floodplain risk management plans in accordance with the NSW Government's Flood Prone Land Policy and the Floodplain Development Manual.<br>• Provide levee studies, flood studies and floodplain management studies to NSW SES.<br>• Maintain Dam Emergency Plans for the Council owned dams and provide copies to NSW SES.<br>• Provide information on the consequences of dam failure to NSW SES for incorporation into planning and flood intelligence.<br>• Coordinate the development of warning services for catchments prone to flash flooding (small catchments), where appropriate.<br>• Maintain council-owned flood warning networks and flood mitigation works.<br>• Participate in NSW SES-led flood emergency planning meetings, to assist in the preparation of Flood Sub Plans.<br>• Maintain a plant and equipment resource list for the council area.<br>• Contribute to community engagement activities.<br>**Response**<br>• Subject to the availability of council resources, assist NSW SES with flood operations including:<br>– Traffic management on council managed roads. |

| AGENCY | RESPONSIBILITIES |
|---|---|
| | – Provision of assistance to NSW SES (plant, equipment and personnel where able and requested).<br>– Property protection tasks including sandbagging.<br>– Assist with the removal of caravans from caravan parks.<br>– Warning and/or evacuation of residents and other people in flood liable areas.<br>– Provision of back-up radio communications.<br>– Resupply of isolated properties.<br>– Technical advice on the impacts of flooding.<br>– Close and reopen council roads (and other roads nominated by agreement with Transport for NSW) and advise NSW SES, NSW Police Force and people who contact the council for road information.<br>– Assist NSW SES to provide filled sandbags and filling facilities to residents and business in areas which flooding is expected.<br>• Assist with making facilities available for domestic pets and companion animals of evacuees during evacuations.<br>• Operate flood mitigation works including critical structures such as detention basins and levees and advise NSW SES regarding their operation.<br>• Manage and protect council-owned infrastructure facilities during floods.<br>• Provide advice to NSW SES and the Health Services Functional Area during floods about key council managed infrastructure such as sewerage treatment and water supply.<br>• Advise the Environmental Protection Authority of any sewerage overflow caused by flooding.<br>• Work with NSW SES and NSW Department of Planning and Environment to collect flood related data during and after flood events.<br>**Recovery**<br>• Provide for the management of health hazards associated with flooding including removing debris and waste.<br>• Ensure premises are fit and safe for reoccupation and assess any need for demolition.<br>• Provide services, assistance and advice to State Government in accordance with the State Recovery Plan. |
| **Caravan Park Proprietor(s)** | • Prepare a flood emergency plan for the Caravan Park.<br>• Ensure that owners and occupiers of movable dwellings are aware that the caravan park is flood liable by providing a written notice to |

| AGENCY | RESPONSIBILITIES |
|---|---|
| | occupiers taking up residence and displaying this notice and emergency management arrangement within the park.<br>• Ensure that owners and occupiers of movable dwellings are aware that if they are expecting to be absent for extended periods, they should:<br>– Provide the manager of the caravan park with a contact address and telephone number in case of an emergency.<br>– Leave any movable dwelling in a condition allowing it to be relocated in an emergency (i.e.: should ensure that the wheels, axles and draw bar of the caravans are not removed and are maintained in proper working order).<br>• Ensure that occupiers are informed of Flood Information. At this time, occupiers should be advised to:<br>– Ensure that they have spare batteries for their radios.<br>– Listen to a local radio station for updated flood information.<br>– Prepare for evacuation and movable dwelling (cabins) relocation.<br>• Ensure that owners and occupiers of caravans are aware of what they must do to facilitate evacuation and movable dwelling relocation when flooding occurs.<br>• Coordinate the evacuation of people and the relocation of movable dwellings when floods are rising and their return when flood waters have subsided. Movable dwellings will be relocated back to the caravan park(s) by owners or by vehicles and drivers arranged by the park managers.<br>• Secure any movable dwellings that are not able to be relocated to prevent floatation.<br>• Inform NSW SES of the progress of evacuation and/or movable dwellings relocation operations and of any need for assistance in the conduct of these tasks. |
| **Childcare Centres and Preschools** | • When notified of possible flooding or isolation, childcare centres and preschools should.<br>– Liaise with NSW SES and arrange for the early release of children whose travel arrangements are likely to be disrupted by flooding and/or road closures.<br>– Assist with coordinating the evacuation of preschools and childcare centres. |
| **Dams Safety NSW** | The roles and responsibilities for Dams Safety NSW (formerly NSW Dam Safety Committee) are outlined in the NSW State Flood Plan. |
| **Department of Defence** | Arrangements for Defence Assistance to the Civil Community are detailed within the State EMPLAN (section 448). |

| AGENCY | RESPONSIBILITIES |
|---|---|
| **Energy and Utilities Services Functional Area** | The roles and responsibilities for Energy and Utilities Services are outlined in the Energy and Utility Services Supporting Plan (EUSPLAN).<br><br>Roles and responsibilities in addition to the Supporting Plan are:<br><br>• Assist NSW SES with identification of infrastructure at risk of flood damage where resources are available.<br><br>• Facilitate local utility service distribution providers (electricity, gas, water, wastewater) to:<br><br>– Provide advice to NSW SES of any need to disconnect power/gas/water/wastewater supplies or of any timetable for reconnection.<br>– Advise NSW SES of any hazards from utility services during flooding and coastal erosion/inundation.<br>– Advise the public with regard to electrical hazards during flooding and coastal erosion/inundation, and to the availability or otherwise of the electricity supply.<br>– Clear or make safe any hazard caused by power lines or electricity distribution equipment.<br>– Reconnect customers' electrical/ gas/ water/wastewater installations, when certified safe to do so and as conditions allow.<br>– Assist NSW SES to identify infrastructure at risk of flooding for incorporation into planning and intelligence. |
| **Engineering Services Functional Area** | The roles and responsibilities for Engineering Services are outlined in the Engineering Services Supporting Plan and NSW State Flood Plan. |
| **Environmental Services Functional Area** | The roles and responsibilities for Environmental Services are outlined in the Environmental Services (ENVIROPLAN) Supporting Plan. |
| **Floodplain Management Australia** | The roles and responsibilities for Floodplain Management Australia are outlined in the NSW State Flood Plan. |
| **Fire and Rescue NSW** | The roles and responsibilities for Fire and Rescue NSW are outlined in the NSW State Flood Plan. |
| **Forestry Corporation of NSW** | The roles and responsibilities for Forestry Corporation of NSW are outlined in the NSW State Flood Plan. |
| **Health Services Functional Area** | The roles and responsibilities for Health Services are outlined in the Health Services (HEALTHPLAN) Supporting Plan and NSW State Flood Plan. |
| **Local Emergency Operations Controller (LEOCON)** | • Monitor flood operations.<br><br>• If requested, coordinate support for the NSW SES Incident Controller. |
| **Local Emergency Management Officer (LEMO)** | • If requested by the NSW SES Incident Controller, advise appropriate agencies and officers of the start of response operations. |

| AGENCY | RESPONSIBILITIES |
|---|---|
| **Manly Hydraulics Laboratory (MHL)** | The roles and responsibilities for Manly Hydraulic Laboratory are outlined in the NSW State Flood Plan. |
| **Marine Rescue NSW** | The roles and responsibilities for Marine Rescue NSW are outlined in the NSW State Flood Plan. |
| **NSW Ambulance** | The roles and responsibilities for NSW Ambulance are outlined in the Health Services (HEALTHPLAN) Supporting Plan and NSW State Flood Plan. |
| **NSW Department of Education, Association of Independent Schools of NSW, and National Catholic Education Commission** | The roles and responsibilities for NSW Department of Education, Association of Independent Schools of NSW, and National Catholic Education Commission are outlined in the NSW State Flood Plan. |
| **NSW Department of Planning and Environment (Environment and Heritage Group)** | The roles and responsibilities for NSW Department of Planning and Environment (Environment and Heritage Group) are outlined in the NSW State Flood Plan (referred to as DPIE EES). |
| **NSW Department of Planning and Environment (Water)** | The roles and responsibilities for NSW Department of Planning and Environment (Water) are outlined in the NSW State Flood Plan. |
| **NSW Food Authority** | The roles and responsibilities for NSW Food Authority are outlined in the Food Safety Emergency Sub Plan. |
| **NSW National Parks and Wildlife Services** | The roles and responsibilities for NSW National Parks and Wildlife Services are outlined in the NSW State Flood Plan. |
| **NSW Police Force** | The roles and responsibilities for NSW Police Force are outlined in the NSW State Flood Plan. |
| **NSW Rural Fire Service** | The roles and responsibilities for NSW Rural Fire Service are outlined in the NSW State Flood Plan. |
| **Owners of Declared Dams within or upstream of the LGA** | The roles and responsibilities for Owners of Declared Dams are outlined in the NSW State Flood Plan. |
| **Public Information Services Functional Area** | The roles and responsibilities for Public Information Services are outlined in the Public Information Services Supporting Plan and NSW State Flood. Plan**.** |
| **Resilience NSW** | The roles and responsibilities for Resilience NSW are outlined in the NSW State Flood Plan. |
| **SEOCON/SEOC** | The roles and responsibilities for the SEOCON/SEOC are outlined in the NSW State Flood Plan**.** |
| **Surf Life Saving NSW** | The roles and responsibilities for Surf Life Saving NSW are outlined in the NSW State Flood Plan. |

| AGENCY | RESPONSIBILITIES |
|---|---|
| **Telecommunications Services Functional Area** | The roles and responsibilities for Telecommunications Services are outlined in the Telecommunications Services (TELCOPLAN) Supporting Plan. |
| **Transport for NSW** | • Transport for NSW coordinates information on road conditions for emergency services access.<br>• Transport for NSW coordinates the management of the road network across all modes of transport.<br>• Transport for NSW in conjunction will assist NSW SES with the evacuation of at-risk communities by maintaining access and egress routes.<br>• Assist NSW SES with the communication of flood warnings and information provision to the public through Live Traffic and Social Media according to the VMS protocols and procedures.<br>• Assist NSW SES with identification of road infrastructure at risk of flooding. |
| **Transport Services Functional Area** | The roles and responsibilities for Transport Services are outlined in the Transport Services Functional Area Supporting Plan and NSW State Flood Plan. |
| **VRA Rescue NSW** | The roles and responsibilities for VRA Rescue NSW are outlined in the NSW State Flood Plan. |
| **Water NSW** | The roles and responsibilities for Water NSW are outlined in the NSW State Flood Plan. |
| **Welfare Services Functional Area** | The roles and responsibilities for Welfare Services are outlined in the Welfare Services Functional Area Supporting Plan and NSW State Flood Plan. |

# 2 Appendix C – Community Specific Roles and Responsibilities

| | |
|---|---|
| **Community Members** | **Preparedness**<br>• Understand the potential risk and impact of flooding.<br>• Prepare homes and property to reduce the impact of flooding.<br>• Understand warnings and other triggers for action and the safest actions to take in a flood.<br>• Households, institutions and businesses develop plans to manage flood risks, sharing and practicing this with family, friends, employees and neighbours.<br>• Have an emergency kit; and<br>• Be involved in local emergency planning processes.<br>**Recovery**<br>• Assist with community clean-up if required and able to do so. Participate in After Action Reviews if required. |

NSW STATE EMERGENCY SERVICE

# HAZARD AND RISK IN WOLLONGONG CITY

**Volume 2 of the Illawarra Local Flood Plan**

**Last Update: August 2017**

FloodSafe

# AUTHORISATION

The Hazard and Risk in Wollongong City has been prepared by the NSW State Emergency Service (NSW SES) as part of a comprehensive planning process. The information contained herein has been compiled from the latest available technical studies.

**Approved**

*Manager Emergency Risk Management*

Date: 2/8/17

**Approved**

Alexandra McFadden a/R.C.

*NSW SES Illawarra-South Coast Region Controller*

Date: 7th July 2017

**Tabled at LEMC** Date:

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# LIST OF TABLES

# VERSION LIST

The following table lists all previously approved versions of this Volume.

| Description | Date |
|---|---|
| Wollongong City Local Flood Plan – Annexes A, B C and H | June 2010 |
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# AMENDMENT LIST

Suggestions for amendments to this Volume should be forwarded to:

The Wollongong City Local Controller

NSW State Emergency Service

PO Box 322

FAIRY MEADOW NSW 2519

Email: wol.ops@ses.nsw.gov.au

Amendments promulgated in the amendments list below have been entered in this Volume.

| Amendment Number | Description | Updated by | Date |
|---|---|---|---|
| | | | |
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*Document Issue: Version 3-02052016*

# 1 THE FLOOD AND COASTAL EROSION THREAT

## 1.1 OVERVIEW

a. The Wollongong City Local Government Area (LGA) is located approximately 80km South of Sydney on the NSW coast. It extends from Helensburgh in the north to Lake Illawarra in the south and inland to the Illawarra Escarpment in the west. The major business centre is located in the Wollongong CBD, with smaller business centres located in surrounding suburbs.

b. Major roads located within the LGA include the Princes Highway, M1, Illawarra Highway and Picton Road. The South Coast Rail line also runs parallel to the coast through the Council area. Port Kembla Harbour is located in the Wollongong LGA and is a major commercial location in the Illawarra Region with a high percentage of heavy vehicles accessing the port.

c. The Wollongong Council area falls within the Wollongong Coast River Basin which contains numerous streams running off the Illawarra escarpment in an easterly direction towards the coast.

d. The Wollongong City LGA boundary is shown on Map 1 – Wollongong Coast Basin.

## 1.2 LANDFORMS AND RIVER SYSTEMS

### Wollongong Coast Basin

a. The Wollongong Coast River Basin begins in the Illawarra Escarpment. The escarpment is 250 m in elevation in Wollongong's northern suburbs and 670 m to the west of Dapto, at which point it is about 20 km from the sea. East of the escarpment is a series of low ridges that divide small, steep stream catchments. The coast proper is lined with sand dunes, which impound small lagoons and swampy areas into which these creeks discharge. To the south of the city is the 35 square kilometre Lake Illawarra, a shallow tidal lake that occupies the area between plain and coastal dunes (1). The Wollongong Coast Basin is shown on Map 1 – Wollongong Coast Basin.

b. The headwaters of the creeks are generally steep and heavily forested, with middle and lower sections grading from moderately steep down to relatively flat (2). The middle to lower reaches of the streams flow through the developed parts of the catchment.

c. All creeks are interrupted by the major road and rail links and have a limited flow capacity at the bridges and culvert crossings (1).

d. The Wollongong Coast Basin incorporates nine creek catchments and multiple smaller creeks and coastal lakes including (listed from north to south):

i. Northern Suburbs Catchment

ii. Hewitts Creek Catchment

iii. Collins Creek Catchment

iv. Towradgi Creek Catchment

v. Fairy and Cabbage Creek Catchment

vi. Wollongong City Catchment

vii. Allens Creek Catchment

viii. Mullet Creek Catchment

ix. Minnegang Creek Catchment

x. Minor watercourses

xi. Lake Illawarra Catchment

e. These are further described in Annex 1 – Illawarra River Basin Schematics and below.

### Northern Suburbs Catchment

f. The Northern Suburbs Catchment encompasses locations north of Austinmer. These include Coledale, Wombarra, Clifton, Coalcliff, Wombarra and Scarborough. The watercourses located in the northern suburbs include; Horse, Reeces, Stockyard, Denmark, Daly, Carricks, Wards, Hyde, Falces, Jacky Jones, Gladsenbury, Pinecourt, Hicks, Flanigans and L.B Kelly Creeks as well as Barton Gully. Creek systems located in the Northern Suburbs catchment run through culverts or under bridges (1). The Northern Suburbs Catchment is shown on Maps 2 & 3.

g. The Hacking River flows through Otford and has historically caused flooding issues.

h. Stanwell Creek flows through Stanwell Park and has historically caused flash flooding issues.

### Hewitts Creek Catchment

i. The Hewitts creek catchment encompasses the suburbs of Thirroul and Bulli and consists of Slacky, Tramway, Woodlands, Hewitts and Thomas Gibson Creeks. The catchment drains an area of approximately 8.1km$^2$ (3). Hewitts Creek Catchment is shown on Maps 2 & 4.

#### Hewitts Creek

j. Hewitts Creek has a catchment of 380ha and is drained by two creeks which convey runoff from the escarpment. These creeks (Hewitts and Woodlands) join approximately 400m above McCauley's Beach via an artificial diversion structure. Woodlands Creek has a length of 3km to its confluence with Hewitts creek with a total fall of 400m. Hewitts Creek has a length of 3.3km with a total fall of 350m. Hewitts

Creek discharges into the rear dune area of McCauley's Beach in Thirroul before entering the ocean (2).

**Slacky Creek**

k. Slacky Creek has a catchment of 280ha and consists of a mix of residential, recreational and forested land, discharging to the sea south of Sandon Point, across Bulli Beach. The stream length is 5.5km and the catchment has a fall of 350m (2).

**Tramway Creek**

l. Tramway Creek has a catchment area of 53ha and flows through a mixture of residential, retail and light industrial land in Bulli for 1.5km. The creek discharges into the low lying rear dune area of McCauley's Beach, 200m south of the outlet of Hewitts Creek. Flow from Slacky Creek may be diverted into Tramway Creek in larger flooding events (2).

**Thomas Gibson Creek**

m. Thomas Gibson Creek has a catchment of 86ha and is located north of Hewitts Creek. The system is 1.6km long and comprises of three creeks that merge at the foot of the catchment before discharging into the sea at two locations across Thirroul Beach (2).

### Collins Creek Catchment

n. The Collins Creek catchment encompasses the combined catchments of Whartons, Collins, Farrahars Creeks, Bellambi Gully and Bellambi Lake and drains through the suburbs of Bulli, Woonona, Woonona East, Russell Vale, Bellambi, Corrimal and Corrimal East (4). The Collins Creek catchment is shown on Maps 2 & 5.

o. The upper reaches of the catchment are fed by runoff which originates in the heavily wooded escarpment where gradients in excess of 50 percent are common (4).

p. The middle to lower reaches of the streams flow through the developed parts of the catchment. The gradient of the streams in these parts flattens from around 20 percent where they drain developed areas west of the Princes Highway, to less than 1 percent where they discharge into a coastal estuary environment (4).

q. This coastal estuary environment is subject to entrance filling and berm building as a result of wave action (4).

### Towradgi Creek Catchment

r. The Towradgi Creek catchment contains multiple watercourses. They are Towradgi Creek, South and North Angels Creeks, Carr Creek, South and North Corrimal Creeks, Parker Creek and Towradgi Lagoon. The catchment drains an area of about 7.2km$^2$ through the northern Wollongong suburbs of Tarrawanna, Corrimal, Towradgi and Fernhill. The Towradgi Creek catchment is shown on Maps 2 & 6.

s. About 50% of the catchment is steep and forested and forms part of the Illawarra Escarpment. The lower half of the catchment is much flatter and mostly urbanised. Towradgi Creek flows into the Tasman Sea at Corrimal Beach (1).

**Towradgi Creek**

t. The main channel of Towradgi Creek extends from the foothills of the Illawarra Escarpment in Balgownie and discharges to the Tasman Sea. The creek is joined by the tributaries at various locations along its length (5).

**North and South Corrimal Creeks**

u. North Corrimal and South Corrimal Creeks run from the Illawarra Escarpment and drain the suburb of Corrimal. The main reach of North Corrimal Creek extends from Coxs Avenue in Corrimal to its confluence with Towradgi Creek immediately upstream of the Illawarra Railway. The main reach of South Corrimal Creek extends from Justine Avenue in Corrimal to its confluence with Towradgi Creek upstream of Memorial Drive in Tarrawanna (5).

**North and South Angels Creeks**

v. North Angels and South Angels Creeks run from the Illawarra Escarpment and drain the suburb of Tarrawanna. The main reach of North Angels Creek extends from Bellambi Street in Tarrawanna to its confluence with South Angels Creek near Meads Avenue in Tarrawanna. The main reach of South Angels Creek extends from Corrimal Street in Tarrawanna to the Princes Highway where the creek joins Towradgi Creek (5).

**Carr and Parker Creeks**

w. Carr Creek and Parker Creek are two shorter creeks which drain the lower urbanised area of the catchment. Carr Creek extends from Dalton Street in Towradgi to its confluence with Towradgi Creek approximately 160m upstream of Pioneer Road Bridge. Parker Creek runs from Carroll Road in Towradgi to its confluence with Towradgi Creek at Lake Parade in Towradgi (5).

**Towradgi Lagoon**

x. Towradgi Lagoon is located at the downstream end of Towradgi Creek, next to Corrimal Beach (5).

### Fairy and Cabbage Creek Catchment

y. The catchment consists of both the Fairy and Cabbage Tree Creek Catchments. It also includes the Towradgi Arm and Fairy Lagoon. It includes the suburbs of Fernhill, Towradgi, Balgownie, Fairy Meadow, Mount Pleasant, Mount Ousley, Keiraville, North Wollongong, Gwynneville, Wollongong and West Wollongong. Fairy and Cabbage Creek catchment is shown on Maps 2 & 7.

z. Fairy Creek is located immediately north of Wollongong. The four main branches of the creek rise high upon the slopes of the Illawarra escarpment east of Mount Keira. The Fairy Creek catchment occupies an area of approximately 7.6 square kilometres to the confluence with Cabbage Tree Creek. The catchment area is subject to rainfalls of high intensity and is characterised by steep slopes and a high degree of urbanisation. The confluence of Fairy and Cabbage Tree Creeks (catchment area 10.5 square kilometres) occurs at a tidal lagoon just upstream of the Squires Way Bridge (1).

aa. Minor watercourses that make up the catchment include; Bootie Street branch, Cabbage Tree Creek, Wellington Drive branch, Hopewood Crescent branch, Dobinson Street branch, Alvan Parade branch, Parkview Grove branch, Dumfries Avenue branch, Dallas Street branch, Industrial branch, University branch, Botanic Gardens branch, Nyrang Park branch, Akuna Street branch, Gilmore Park branch, Gunyah Park branch and Gipps Street branch (6).

### Wollongong City Catchment

bb. The Wollongong City catchment is also known as Gurungaty Waterway Catchment and includes the suburbs of Wollongong, Coniston and Mangerton. Wollongong City catchment is shown on Maps 2 & 8.

cc. The Wollongong City catchment is 730 ha and discharges into Port Kembla Inner Harbour via the Gurungaty Waterway. A high dune systems separates the Pacific Ocean from the catchment along the eastern side and rises very steeply to the west reaching elevations of 100mAHD in the suburbs of Coniston, Mangerton and Mount St Thomas (7). The northern boundary of the catchment is traced by Crown Street.

dd. The catchment is extremely urbanised with a mixture of medium density housing, commercial and industrial development. The section of the catchment upstream of the South Coast railway line is predominantly low to medium density housing, the area to the north and north-east of the upper catchment is comprised of higher density commercial and residential development and the southern portion of the catchment in the vicinity of Port Kembla Inner Harbour is largely occupied by the BlueScope steel works site (7).

### Allans Creek Catchment

ee. Allans Creek catchment adjoins the Wollongong City catchment and includes Byarong Creek, Branch Creek, Brandy and Water Creek, American Creek, Ghost Creek, Nudjia Creek, Charcoal Creek, Jenkins Creek, Running Brook and Allans Creek. It includes the suburbs of West Wollongong, part of Mangerton, Figtree, Mount Saint Thomas, Mount Kembla, Kembla Heights, Cordeaux Heights, Unanderra, Spring Hill, Port Kembla and Farmborough Heights (1). Allans Creek catchment is shown on Maps 2 & 9.

ff. The Allans Creek catchment is characterised by a low flat floodplain west of Port Kembla, which is dominated by the backdrop of the Illawarra Escarpment. The steep western areas of the catchment, near the Illawarra Escarpment are mainly forested or in rural nature, while closer to the coast the catchment floodplain is relatively flat with a blend of industrial, residential and commercial development (8).

gg. Allans Creek drains to Tom Thumb Lagoon and Port Kembla Harbour through the Bluescope Street industrial area. Allans Creek is tidal as far upstream as the F6 Freeway (8).

hh. Allans Creek and its tributaries are highly modified systems with both piped and open channel sections. The result is a hydrologically complex system in the lower reaches, with varied flood peaks providing several flooding mechanisms (8).

## Mullet Creek Catchment

ii. The catchment comprises of Mullet Creek and Brooks Creek, which drain areas of 74.48 $km^2$ and 5 $km^2$, respectively. Both watercourses discharge separately to Lake Illawarra (1). The Mullet Creek catchment is shown on Maps 2, 10 & 11.

### Mullet Creek

jj. The headwaters of Mullet Creek are located in the Illawarra Escarpment and the creek flows for 22km before reaching Lake Illawarra. The headwaters of Mullet Creek are mainly forested and much of the catchment is used for rural activities however the areas of Dapto, Horsley, Brownsville, Kembla Grange and Farmborough Heights within the Mullet Creek catchment are urban areas and the catchment is expected to see further urban and residential growth in the future in the West Dapto area (9).

### Brooks Creek

kk. The Brooks Creek catchment is almost completely urban development. Brooks Creek flows for 5km before reaching Lake Illawarra (9).

## Minnegang Creek Catchment

ll. The Minnegang Creek catchment is located 8.5km south of Wollongong and includes the suburbs of Lake Heights and Warrawong. Approximately 80% of the catchment is developed, mostly with low density residential housing, with the remaining 20% being recreational area or cleared open space (1). The Minnegang Creek catchment is shown on Maps 2 & 12.

mm. The steep catchment rises from the northern shore of Lake Illawarra to the intersection of Lake Heights Road and Flagstaff Road (1).

nn. Minnegang Creek has two main tributaries. The first follows Melinda Grove and passes under Gilgandra Street and meets Minnegang Creek just upstream of Mirrabooka Road. The second tributary flows from south west of Gordon Crescent, under Ranchby

Avenue and confluences with Minnegang Creek just upstream of Lake Heights Road. The system is comprised of a combination of open watercourses and pipe drains and discharges into Lake Illawarra (10).

### Minor Watercourses

oo. Several minor creeks located in the Wollongong City LGA flow westward from the escarpment through unpopulated country to a series of water storage reservoirs. The more important of these, and the storage's to which they feed, are:

i. Avon River and Gallahers Creek: to Lake Avon.

ii. Cordeaux River and Kembla Creek: to Lake Cordeaux.

iii. Rocky, Cataract, Bellambi and Allen Creeks: to Lake Cataract.

iv. Waratah Rivulet: to Lake Woronora (1).

pp. O'Hares Creek, a tributary of the Georges River, also flows west from the escarpment (1).

### Lake Illawarra Catchment

qq. Lake Illawarra is a shallow coastal lagoon located on the undulating coastal plain between the ocean and the cliffs of the Illawarra Escarpment. The lake shares its shores with the Shellharbour City LGA. Lake Illawarra is shown on Map 1, 2 & 13.

rr. The Lake Illawarra Catchment has an area of 270 $km^2$, including the 35 $km^2$ lake, rising from sea level to an elevation of 760m at Mount Murray. The Lake is generally open to the sea through an entrance channel that is affected by ocean storms, wave action, floods and tides (11).

ss. Several surrounding water courses feed in to the Lake from both the Shellharbour City and Wollongong City LGAs including Minnegang Creek, Budjong Creek, Yallah Creek, Wollingurry Creek, Marshall Creek, Frazer Creek, Albion Creek, Oakey Gully, Macquarie Rivulet, Mullet Creek, Brooks Creek, Hooka Creek, Duck Creek and, Horsley Creek (11).

## 1.3 STORAGE DAMS

a. Three dams (Cordeaux Dam, Upper Cordeaux 2 Dam and Cataract Dam) are located on the Illawarra Escarpment and flow out of the LGA towards the west. The Wollongong City LGA would not be affected by any dam break or spillage from any of these dams.

b. Coalcliff Dam is located between Coalcliff and Stanwell Park in the northern suburbs catchment on a tributary of Stanwell Creek. This creek discharges to the ocean at Stanwell Park Beach. There is no dam failure information available for this dam.

c. There are also 14 prescribed detention/retarding basins in the Wollongong LGA that could contribute to flood affects downstream were they to fail or overtop. These are further described in Section 1.7 and under Section 2 – Specific Risk Areas.

d. These dam, detention and retarding basins locations are shown on Map 1 - Wollongong Coast Basin Map.

## 1.4 WEATHER SYSTEMS AND FLOODING

a. Flooding in the Wollongong City LGA is dominated by 'flash' flooding. The streams respond quickly to high-intensity rainfall and flooding can begin very soon after the beginning of heavy rains.

b. Average annual rainfall in the council area varies from less than 1,100 mm in the Dapto, Windang and Kemblawarra area to more than 1,600 mm along the escarpment southwards from Mt Keira. About 60-70 per cent of this falls in the summer and autumn quarters, most of it in February, March and April. Rainfall of more than 50mm in a day is recorded, on average, about eight times a year somewhere in the council area. Such rainfall frequently produces flooding, particularly when catchments are already wet. Very high daily falls (200 mm or more) almost always produce flooding, much of it severe (1).

c. Flooding can occur at any time of the year, but in different seasons it is triggered by different rain-producing mechanisms. There is a slight bias towards the February-March period as well as August as far as flood occurrence is concerned. Within this period the concentration is in the late summer and early autumn months (1).

d. Floods may result from any of the five weather patterns summarised below:

   i. **Ex Tropical Cyclones**: Rainfall and flooding that results from a cyclone moving south and downgraded to a rain depression. Such weather systems can produce prolonged heavily rainfall. Heavy rainfall originating from these cyclones in the Illawarra can occur anytime between January and May and have historically resulted in widespread and localised flooding affecting dwellings.

   ii. **Zonal Synoptic Patterns**: This pattern occurs when the centre of a high or low-pressure system is located south of New South Wales directing a moist onshore flow onto the coast. These pressure systems often combine with a low-pressure trough and/or upper air disturbances to create a state of prolonged instability. In February 1984, moist air behind a front and a high-pressure system centred southeast of Tasmania, along with small surface low-pressure systems, resulting in extreme instability and intense rainfall. Zonal synoptic patterns together with easterly lows account for 50% of the flooding in the Illawarra.

iii. **Inland Depressions**: These inland depressions or low-pressure systems originating from continental northern Australia that can dip down into New South Wales and intensify over coastal areas. These often occur in autumn, just after the northern monsoon season.

iv. **Easterly Lows:** Defined as low-pressure troughs moving south from Queensland, generally just off the NSW coastline, before heading in a south-easterly direction. They occur predominately in the winter months.

v. **Continental Lows:** Low-pressure systems, which move across the continent towards the central NSW coastline. There is two types;

- Lows originating from central and southern Queensland moving south towards Sydney, intensifying as they near or cross the coastline. Unlike inland depressions no trough structure is evident.
- Where a low-pressure system moves eastwards across the southern continental areas, before intensifying near the coastline, thereby producing intense rainfall. East coast cyclones or lows would also fit into this category (these are easterly moving pressure systems, which develop into intense cyclonic depressions when they pass over mountainous coastal terrain and a warm poleward flowing current. Predominately occur in winter and autumn (1).

vi. **Thunderstorms**: Localised thunderstorms have caused localised flooding in various areas, usually to only sections of a suburb at any one occasion (1).

## 1.5 CHARACTERISTICS OF FLOODING

a. Flooding in the Wollongong City LGA is dominated by flash flooding from overbank flooding of its numerous streams (1). Due to the nature of the topography, rainfall can be concentrated within one catchment area without effecting other or neighbouring catchments (1).

b. Overland flooding also occurs across the LGA due to the shape of catchments and drainage system overloads (1).

c. Except for their headwaters, most of the catchments are heavily urbanised which increases the speed of rises in creek levels. Floodplain areas are of relatively limited size, and during periods of flooding only small proportions of total flow are carried within creek channels. The result is substantial floodplain inundation, often to considerable depths.

d. Velocities of flow are usually high (often more than 2 metres per second) and flooding is characterised by very rapid rises and falls in water level. As it is common in urban catchments, flood peaks usually occur at night time. Overbank flows occur frequently,

even in the less severe events of approximately 20-50% AEP (that is, floods that occur on average every 2 to 5 years).

e. Filling of land in the lower reaches of some of the catchments has also significantly reduced the pre-existing storage capacity of the floodplain leading to more flooding than would have naturally been the case (1).

f. In previous flood events large quantities of flood debris washed down from the upper forested and urban catchments appeared to exacerbate upstream flooding by blocking culvert and bridge waterways (1). The design capacity of the urban stormwater drainage system in these areas is understood to be based on a 10 year or smaller Average Recurrence Interval (ARI) storm event. Hence, some properties have been flooded by surcharging of the stormwater drainage system and/or the inability of local runoff to enter the stormwater drainage system independent of, or in combination with mainstream flooding (1).

g. Most of the creeks discharge into small coastal lakes, lagoons or swamps before reaching the sea. The mouths are prone to closure through build-up of sand at their outlets. This causes flood levels in the lakes and in the lower stream reaches to rise in the early stage of a flood before the flood waters scour the outlet. High velocities are often experienced at the outlets as the sand bars collapse (1).

h. The north-south orientation of the road and rail links means that all the creeks are interrupted by culverts and bridges which have limited flow capacity that are prone to blockage by debris, worsening these effects. Few road culverts are capable of passing events more severe than those of about 10% AEP without overtopping. Inadequate waterway capacity or blockages are a frequent cause of flooding (1).

i. Because of the short catchment response times, it is extremely difficult to accurately determine the timing and contribution of local flooding to overall flooding at a given built-up location in the study area. Thus, the determination of the likelihood and contribution of stormwater flooding requires some subjective assessment (1).

## 1.6 FLOOD HISTORY

a. Severe floods are more common in the February-March period and in August than in other months (1). Significant flood events in Wollongong have occurred in 1950-52, 1958-61, 1973-78, 1983-84, 1991-92 and 1998-99, 2012, 2014 and most recently in 2016. Of these, the most severe was the 1998 flood event.

**August 1998 Event**

b. A major storm occurred in 17 August 1998, during which about 1000 properties in Wollongong suffered above floor inundation. At least 144 of these properties were considered unfit for occupation immediately following the event, with 24 of these

properties voluntary purchased in the Fairy/Cabbage Creek catchment. In addition to damage to private homes, motor vehicles were also swept off roads (12).

c. The main areas affected were the more populated central and northern suburbs of Wollongong, mainly within the Hewitts, Bellambi, Towradgi, Cabbage Tree and Fairy Creek catchments, and partially in the Allans Creek catchment to the south of the city centre (2). Additionally coal wash was washed into Keiraville from the Kemira Colliery, creating an additional hazard for emergency services.

d. During this event the Wollongong Unit Headquarters located on Montague Street in North Wollongong experienced inundation (1m depth in Montague Street), became isolated and lost power, communications, and telephone connection.

e. The total tangible damage for the flood event was estimated at $75 million, and insurance companies paid out around $42 million in claims. Apart from the tangible loss, the event also brought intangible losses, with one human life lost during the event. Services were also disrupted which caused major inconvenience to local residents. Train services were limited as a result of damage to the railway line, The University of Wollongong, schools and shops were closed for several days (12).

f. The heavy rainfall was a result of the interaction between a localised low pressure system and a much more extensive upper level trough. The storm was further enhanced and intensified by convergence into the localised low and uplift over the Illawarra Escarpment (12). The most significant rainfall intensities occurred over a 3 to 6 hour period with some rainfall stations recording 1% AEP (100 year ARI) intensities. The highest 24 hour total of 445mm was recorded at Mt Ousley. Other factors such as flood debris, blockages and flow diversions increased flood levels at particular locations (2).

g. Detailed mapping of the 1998 event can be found in the flood studies located on Wollongong City Council's website.

**February 1984 Event**

h. This event was the largest flooding event in the Mullet Creek catchment and saw widespread flooding in the Wollongong area. Rainfall fell over the area from the 17$^{th}$ to 18$^{th}$ of February lasting approximately 48 hours and was non-stationary in nature (9).

i. Anecdotal evidence from residents in the area suggest that this was a flash flood with reports of floodwaters rising 2m in an hour and 1.5m in 15 minutes at Darkes Road, Dapto. The event saw main roads in low lying areas inundated, including the Princes Motorway (M1) and Princes Highway (9).

**March 1975 Flood**

j. The March 1975 flood event is considered the second largest storm in the Mullet Creek catchment and the Brooks Creek catchment; however, there are no recorded flood levels available for the event in Brooks Creek, only recordings of debris marks (9).

**20 October 1987 Flood**

k. The event saw heavy rainfall over a 12 hour period with flooding reported in the commercial precinct at Woonona. Shops within the Main Street of Woonona were flooded and residents reported fences and outhouses being washed away by the event. Within the rainfall event, there were bursts of rain equivalent to 50% AEP (2 year ARI) events or 1 year ARI events (4).

l. The event was attributed to the intense depression off the coast of NSW, which was registered at 1005 hectopascals (4).

**April 1988 Event**

m. Heavy continuous rain was recorded throughout the City of Wollongong from the 3rd to 10th of April, 1988 (total approximately 250mm) leaving the area in a highly saturated state. 14 days later, after some light intermittent rain, heavy rain again developed with approximately 300 mm of rain being recorded over the three days from 28th to 30th April. The heaviest rain occurred at the end of this prolonged wet period, during the early hours of 30th April (2).

n. Aside from widespread flooding, particularly in the northern suburbs of Wollongong, this storm lead to the collapse of a section of the Illawarra Rail embankment at Coledale in which a house was engulfed and lives lost (2).

**9th February 2012 Event**

o. The event was caused by two separate storm cells originating north-west of Wollongong. The first storm cell propagated towards the coast and peaked in intensity between Wollongong and Ulladulla. The second storm cell followed a similar direction as the first storm cell but had less intensity (7).

p. The storm event lasted for 5 hours, with the peak coinciding with high tide, exacerbating flooding in the low lying areas of Swan Street, Kembla Street, Corrimal Street and Evans Street. 11 residents in the Wollongong City Catchment reported above floor level flooding (7). Observed flood levels at Swan Street were 2.76m AHD (7).

**24th March 2014 Event**

q. The 2014 event was a 12 hour event however, the peak coincided with the local low tide and as such didn't induce as much flooding in the Wollongong City Catchment area, with only 1 resident reporting above floor flooding (7).

### 5th June 2016 Event

r. The June 2016 rainfall event occurred in conjunction with abnormally high tides and resulted in the flooding of properties in lower Wollongong (Kembla/Swan Streets) and Windang. Lower Wollongong flooding resulted in road closures in conjunction with the morning high tide 5 June 2016. Properties in this area reported experiencing over floor flooding.

s. The MHL Cudgeree Bay gauge (214416) in Lake Illawarra near Windang recorded a peak lake height of 1.57m which persisted for approximately 4 hours from 22.00hrs 5 June 16 (evacuations occur at heights above 1.2m). In conjunction with the recorded height, accounts from NSW SES members on scene noted that flooding was exacerbated by strong winds causing a storm surge (13). The abnormally high tide occurred at 20:28hrs 5 June 2016 with a height of 1.99m at the lake entrance gauge (214417). A maximum of 327mm of rain was recorded in a 36hour period during the event over the Lake Illawarra catchment.

t. The Jetty's by the Lake, South Pacific, and Oasis caravan parks in Windang were partially evacuated with 44 persons registered at the evacuation centre (13). Oaklands Village internally evacuated low-lying areas but no homes experienced over-floor inundation. Jetty's by the Lake had 5 vans left uninhabitable with 27 vehicles written off. South Pacific experienced over floor flooding while Oasis had no reports of over floor flooding. All parks experienced internal road flooding, with sections of Jetty's by the lake isolated.

### Lake Illawarra

u. Historical flood events within Lake Illawarra are summarised in Table 1. Note that Lake Illawarra was permanently opened in 2007.

**Table 1: Historical Flood Levels at Lake Illawarra Entrance Gauge (214417)**

| Year | Height at Gauge (m AHD) | Estimated Average Recurrence Interval (ARI) (years) |
|---|---|---|
| 1984 (14) | 1.9 | 83 |
| 1975 (14) | 1.8 | 62.5 |
| 1977 (14) | 1.8 | 62.5 |
| 1991 (14) | 1.8 | 62.5 |
| 1978 (14) | 1.6 | 28 |
| 2011 (15) | 1.6 (at Cudgeree Bay gauge 214416) | 16 |
| 2016 | 1.58 (1.5 at Cudgeree Bay gauge 214416) | > 17 |
| 1974 (14) | >1.5 | > 17.5 |

| Year | Height at Gauge (m AHD) | Estimated Average Recurrence Interval (ARI) (years) |
|---|---|---|
| 1919 (14) | >1.5 | > 17.5 |
| 1930 (14) | >1.5 | > 17.5 |
| 1959 (14) | >1.5 | > 17.5 |
| 1943 (14) | >1.5 | > 17.5 |
| 1988 (14) | 1.5 | 17.5 |
| 1990 (14) | 1.4 | 12.5 |
| 1998 (11) | 1.2 | 5 |

## 1.7 FLOOD MITIGATION SYSTEMS

### Levees

a. A levee is located at the northern end of Austin Street, Woonona in the Collins Creek catchment. The levee comprises sections of earth bund and reinforced block wall. The levee is overtopped in a 1% AEP flood (100 year ARI) (12).

### Prescribed Detention/Retarding Basins

b. There are 25 detention or retarding basins located within the Wollongong LGA as outlined in Table 2. Further details regarding these basins can be found within Section 2 – Specific Risk Areas.

**Table 2: Detention and Retarding Basins within the Wollongong LGA**

| Name | Owner / Catchment | Catchment | Location |
|---|---|---|---|
| **Barina Park Detention Basin** | Wollongong City Council | Minnegang Creek Catchment | Barina Ave, Lake Heights |
| **Brokers Road Retarding Basin** | Wollongong City Council | Cabbage Tree Creek Catchment | Brokers Road, Balgownie (Northern and Southern basins) |
| **Bucklands Retarding Basin** | Matt Crossingham | Allans Creek Catchment | Koloona Ave, Figtree |
| Corrimal High School Retarding Basin | Unknown | Collins Creek Catchment | Murray Road, Corrimal |
| **Dapto Heights Retarding Basin** | Wollongong City Council | Mullet Creek Catchment | Colvin Place, Dapto |
| **Edgewood Detention Basin** | Wollongong City Council | Collins Creek Catchment | Edgewood Estate, Woonona |
| **Fisher Park Detention Basin** | Unknown | Fairy Creek Catchment | Fisher Park, West Wollongong |

| Name | Owner / Catchment | Catchment | Location |
|---|---|---|---|
| **Foothills Estate Retarding Basin 1** | Wollongong City Council | Towradgi Creek Catchment | Tarrawanna |
| **Foothills Estate Retarding Basin 3** | Wollongong City Council | Towradgi Creek Catchment | Tarrawanna |
| **Foothills Rd** | Wollongong City Council | Cabbage Tree Creek Catchment | Foothills Rd, Mount Ousley |
| **Gannet Place Retarding Basin** | Wollongong City Council | unnamed catchment | Gannet Avenue, Berkeley |
| **Gilmore Creek** | Unknown | Fairy Creek Catchment | Gilmore Park, West Wollongong |
| **Gunyah Park Basin** | Wollongong City Council | Fairy Creek Catchment | Dempster St, West Wollongong |
| **Kanahooka Detention Basin** | Forest Grove Community Association | Mullet Creek Catchment | Stanthorpe Dr, Kanahooka |
| **Nyrang Park Retarding Basin** | Wollongong City Council | Fairy Creek Catchment | Nyrang St, Keiraville |
| **South Bulli Basin 1** | Allied Coal Pty Ltd | unknown | Russell Vale |
| **South Bulli Stormwater** | Gujarat NRE Minerals Limited | unknown | Russell Vale |
| **Wollongong High School Retarding Basin** | Wollongong City Council | Fairy Creek Catchment | Foleys Ln, North Wollongong |
| **Gordon Hutton Park flood retarding basin** | Unknown | Collins Creek Catchment | Bulli |
| **Flood retarding basin Nos. 1, 2 & 3** | Unknown | Bellambi Gully catchment | |
| Slacky Flat detention basin | Unknown | Hewitts Creek Catchment | Black Diamond Place, Bulli (eastern end) (15). |
| South Angels Creek detention basin | Unknown | Towradgi Creek Catchment | Located west of Corrimal Street, at the start of South Angels Creek (6). |
| North Angels Creek detention basin | Unknown | Towradgi Creek Catchment | Directly west of Bellambi Street in Tarrawanna at the start of North Angels Creek (6). |
| Corrimal Creek detention basin | Unknown | Towradgi Creek Catchment | Immediately west of South Corrimal Creek (6). |
| Wisemans Park | Unknown | Fairy Creek Catchment | Wisemans Park, Gwynneville |

## Other Flood Mitigation

c. There is a voluntary purchase scheme run by Wollongong City Council. Many properties located in high risk locations have been purchased and demolished.

d. Flood proof walls have been installed on the boundaries of properties located in Lemrac Avenue, Corrimal to divert floodwaters into North Corrimal Creek (16).

e. Wollongong City Council has constructed a low earth mound at Cheryl Place, Corrimal to deflect floodwaters away from nearby houses (16).

f. There is a weir located on North Corrimal Creek at the Coke Works in East Corrimal (5).

## 1.8 EXTREME FLOODING

a. The effects of an extreme flooding (or the Probably Maximum Flood [PMF]) varies across the Wollongong catchment. In some areas, there is little difference between the 1% AEP and the PMF event, in others flood flows more than triple and peak levels can be more than five times higher.

b. The effects of extreme flooding in the 1% AEP and PMF events within each catchment are outlined in Section 2 – Specific Risk Areas.

## 1.9 COASTAL EROSION AND COASTAL INUNDATION

a. The Wollongong City Council area is bordered by the Pacific Ocean to the east.

b. The coastal areas are subject to natural coastal processes and resultant coastline hazards that include coastal erosion, oceanic inundation, and shoreline recession (1).

c. The coastal erosion/oceanic inundation problem in the Wollongong City LGA takes two forms:

   i. Undercutting of dunes on their seaward sides, threatening the collapse of dwellings and other infrastructure.

   ii. The potential breaking through of the dunes by sea water, causing flooding and isolation of property on the landward side of the dunes (1).

d. The most severe problems of coastal erosion/inundation occur as a result of oceanic storm conditions associated with the passage of ex-tropical cyclones and temperate-zone low-pressure systems. These storms may cause temporary sea level rises with large associated waves. The worst erosion/inundation is likely when severe weather conditions occur in conjunction with high tides (1).

e. There is an increasing risk to low lying areas in the Illawarra with the onset of sea level rise. Properties located in Wollongong around Swan Street and properties along Lake Illawarra are at the greatest risk of increased flooding.

f. Refer to Specific Risk Areas – Coastal Erosion and Inundation 2.14 for detail on those locations within the Wollongong LGA that have been identified as being at risk of coastal erosion or inundation.

# 2 EFFECTS ON THE COMMUNITY

## 2.1 COMMUNITY PROFILE

**Table 3: Census of Housing and Population data (2011)**

| Census Description | Wollongong LGA |
|---|---|
| **Total Persons** | **192,418** |
| Aged 0-4 yrs | 12,077 |
| Aged 5-14 yrs | 23,592 |
| Aged 65 + yrs | 31,474 |
| Of Indigenous Origin | 4,228 |
| Who do not speak English well | 5,047 |
| Have a need for assistance (profound/severe disability) | 11,199 |
| Living alone (Total) | 18,583 |
| Living alone (Aged 65+) | 7,745 |
| Residing in caravans, cabins or houseboats or improvised dwellings | 771 |
| **Occupied Private Dwellings (Households)** | **71,764** |
| No Motor Vehicle | 8,201 |
| Caravan, cabin, houseboat or improvised dwell | 518 |
| Rented via State or Housing Authority | 5,796 |
| Rented via Housing Co-Op or Community Church Group | 362 |
| No Internet Connection | 16,650 |
| **Unoccupied Private Dwellings** | **5,874** |
| **Average persons per occup dwelling** | **2.5** |
| **Average vehicles per occup dwelling** | **1.6** |

# SPECIFIC RISK AREAS - FLOOD

## Wollongong Coast Basin

## 2.2 NORTHERN SUBURBS

### 2.2.1 Community Overview

a. The northern suburbs of Wollongong consist of locations north of Austinmer. These include Coledale, Wombarra, Clifton, Coalcliff, Wombarra and Scarborough. The population in this area is 4,338 (1).

b. The northern suburbs are shown on Map 3.

**Table 4: Population and Dwellings in Northern Suburbs (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Stanwell Park | 1,380 | 582 |
| Wombarra / Scarborough / Clifton | 864 | 403 |
| Coledale | 1,168 | 519 |
| Coalcliff | 196 | 84 |

### 2.2.2 Characteristics of flooding

a. Historically the northern suburbs have been affected by flash flooding.

b. Parts of this area have also been identified as being at risk of coastal erosion and coastal inundation (18).

### 2.2.3 Flood Behaviour

a. Watercourses located in this area include Hicks Creek, Horse Creek, Stockyard Creek and Flanigans Creek (1).

b. Floodplain behaviour from catchment flooding is unknown. There are no Flood Studies or Floodplain Risk Management Studies available for this area.

### 2.2.4 Classification of Floodplain

a. No information available.

### 2.2.5 Inundation

a. Flooding from rainfall, creek and overland flood is not well understood for this area. However Monash Street in Wombarra is a known flooding problem area (1).

b. Properties and public infrastructure have been identified as being at potential risk from coastal inundation during a 1% AEP storm event at: Stanwell Park Beach, Coalcliff Beach, in Stanwell Park, Scarborough/Wombarra Beach, Coledale Beach, Sharkies Beach, Austinmer and Austinmer North Beaches. These are detailed **Error!**

**eference source not found.** (Refer to Specific Risk Area- Coastal Erosion and Inundation Section **Error! Reference source not found.**4).

### 2.2.6 Isolation

a. Isolations can occur throughout this area, with debris and landslips caused by heavy rainfall commonly occurring on Lawrence Hargrave Drive (1).

b. Coledale Hospital can be isolated for short periods of time (1).

c. No other information is available.

### 2.2.7 Flood Mitigation Systems

a. No information available.

### 2.2.8 Dams

a. There is no dam failure information regarding Coalcliff Dam, however discharge from this dam would flow into Stanwell Creek which flows through residential areas between Lawrence Hargrave Drive, Beach Road and Lower Coast Road prior to discharging to the ocean on Stanwell Beach (19).

### 2.2.9 At Risk Facilities

a. **Coledale Hospital** is located on Lawrence Hargrave Drive in Wombarra and can be isolated for short periods of time. Major landslips or road inundation north and south of its location may affect the hospitals ability to obtain supplies or maintain functional operations in the short term. (1).

b. **Surf Life Saving Clubs** at Helensburgh, Coalcliff and Scarborough/Wombarra have all been identified as being at potential risk of coastal erosion (18).

### 2.2.10 Other Considerations

a. No information available.

## 2.3 HEWITTS CREEK CATCHMENT

### 2.3.1 Community Overview

a. The Hewitts Creek catchment is located 10 km north of the Wollongong CBD, between the Illawarra Escarpment and the coastline to the east (2). The Hewitts Creek catchment incorporates the suburbs of Thirroul and Bulli. The population of Thirroul in 2011 was 5,620 and Bulli was 5,671 (17).

**Table 5: Population and Dwellings in Hewitts Creek Catchment (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Thirroul | 5,620 | 2,307 |
| Bulli | 5,671 | 2,215 |

b. The Hewitts Creek catchment is shown on Map 4.

### 2.3.2 Characteristics of flooding

a. Significant sections of the area are prone to flash flooding, particularly upstream of the railway and low lying areas behind the coastal dune. Floodwaters rise very quickly, resulting in too short a flood warning time to allow safe evacuation (20).

b. Downstream portions of the catchment are also subject to oceanic conditions can be flooded due to coastal inundation (18).

### 2.3.3 Flood Behaviour

a. Watercourses located within the Hewitts Creek catchment include; Hewitts Creek, Slacky Creek, Thomas Gibson Creek, Tramway Creek and Woodlands Creek (3).

b. The presence of structures has a significant influence on flood behaviour within these areas which can be further exacerbated by blockages of culverts.

c. Key areas where these structures exacerbate flooding include:

   i. The coal haulage embankment in the Slacky Creek catchment diverts flows eastwards along Hobart Street to the Tramway Creek catchments when the capacity of culverts are exceeded (3).

   ii. Once the capacity of the culvert beneath Lachlan Street, Thirroul in Hewitts Creek is exceeded, water flows east along Lachlan Street and into Thomas Gibson Creek (3).

   iii. Once the capacity of the culverts beneath Cliff Parade, Thirroul in Thomas Gibson Creek are exceeded, water flows northwards along Cliff Parade and into Flanagans Creek at the esplanade (3).

iv. When the capacity of the culverts beneath the Illawarra Railway on Tramway Creek are exceeded upstream properties, particularly in Allenby Parade, Bulli are subject to flooding (3).

d. Tidal surges in excess of 1.4m will directly affect flood outflows (1).

e. The areas which are shown to have high hydraulic hazard, that is areas with fast and/or deep flowing waters, is generally limited to the within the stream channels, and land upstream of the railway line where significant flood depths occur (20).

### 2.3.4 Classification of Floodplain

a. The majority of the study area is classified as High Trapped Perimeter, indirectly affected areas or those areas in between that are not flood affected (3). However there are a number of locations that can become Low Flood islands whereby they can be first isolated and then eventually flooded.

b. Numerous areas throughout the catchment may become isolated, but not inundated in High Flood Islands, High Trapped Perimeters or indirectly affected areas.

#### Low Flood Islands

c. These are all located on the western side of the railway line and include:

i. Properties on Hewitts Avenue, Thirroul;

ii. Properties at the base of Bulli Pass on the Princes Highway, and Sturdee Avenue (on the border of Bulli and Thirroul);

iii. Lawrence Hargrave Drive, Thirroul south of Lachlan Street;

iv. Lachlan Street (east of Pass Avenue), Thirroul;

v. Bulli Showground and Racing Complex, Bulli.

#### High Flood Islands

d. High Flood Islands in particular have been identified in:

i. McCauleys Beach Estate, Thirroul (southern half)

ii. Properties located between George and Lachlan Streets, Thirroul (upstream of laneway);

iii. On either side of the railway line around the Thirroul CBD.

### 2.3.5 Inundation

a. 80% of the estimated flood damages to property comes from within Hewitts Creek and Tramway Creek catchments.

b. There are two flood level gauges, owned by MHL, on Hewitts Creek: Hewitts Creek Entrance Gauge (214408) and Hewitts Creek Upstream Gauge (214410). There are currently no warnings linked to these gauges.

### Slacky Creek

c. Properties in the Slacky Creek catchment that may experience inundation are located in Beacon Avenue, George Avenue, Beach Street and National Avenue (3) (20).

### Tramway Creek

d. Properties in the Tramway Creek catchment that may experience inundation are located upstream of the rail line, in Allenby Parade, Point Street, the Princes Highway Haig Street and Hobart Street (3) (20).

### Woodlands Creek

e. Properties in Bulli in the Woodlands Creek catchment that may experience inundation are located directly upstream of the rail embankment and include Sturdee Avenue and Hewitts Avenue. The Princes Highway may also be impacted. Areas downstream of the rail embankment including the McCauleys Beach Estate can become isolated (3) (20).

### Hewitts Creek

f. Properties in Thirroul located in the Hewitts Creek catchment that may experience inundation are located directly upstream of the rail embankment and adjacent to Hewitt Creek. Streets where properties may experience inundation include Lawrence Hargrave Drive, High Street, Lachlan Street, George Street, Pass Avenue, Hewitts Avenue, Corbett Avenue and Hamilton Road. Parts of McCauleys Beach estate downstream of the railway embankment may become isolated due to road and bridge closures (3) (20).

### Thomas Gibson Creek

g. Properties located in the Thomas Gibson Creek catchment that may experience inundation are located immediately upstream of the rail line on Lawrence Hargrave Drive, downstream of the rail embankment in Spray Street, Bath Street, Cliff Parade and The Esplanade. (3) (20).

h. There is no flood warning system located in this catchment as the rate of rise of floodwaters is too quick to allow for a system to be implemented.

**Table 6: Estimated No. Properties with Over Floor Flooding in the Hewitts Creek Catchment (20)**

| Design Flood Event (% AEP) | No. Properties with Over floor Flooding in Slacky Creek | No. Properties with Over floor Flooding in Tramway Creek | No. Properties with Over floor Flooding in Woodlands Creek | No. Properties with Over floor Flooding in Hewitts Creek | No Properties with Over floor Flooding in Thomas Gibson Creek | Total Properties with Over floor Flooding |
|---|---|---|---|---|---|---|
| **PMF** | 6 | 15 | 5 | 70 | 29 | 125 |
| **1% AEP** | 1 | 11 | 5 | 58 | 22 | 97 |
| **2% AEP** | 1 | 10 | 5 | 57 | 18 | 91 |
| **5% AEP** | 1 | 10 | 4 | 47 | 13 | 75 |
| **20% AEP** | 0 | 0 | 0 | 6 | 5 | 11 |

**Table 7: Estimated No. Properties with Over Ground Flooding in the Hewitts Creek Catchment (20)**

| Design Flood Event (% AEP) | No. Properties with Over ground Flooding in Slacky Creek | No. Properties with Over ground Flooding in Tramway Creek | No. Properties with Over ground Flooding in Woodlands Creek | No. Properties with Over ground Flooding in Hewitts Creek | No Properties with Over ground Flooding in Thomas Gibson Creek | Total Properties with Over ground Flooding |
|---|---|---|---|---|---|---|
| **PMF** | 35 | 20 | 6 | 89 | 38 | 188 |
| **1% AEP** | 28 | 11 | 5 | 74 | 30 | 148 |
| **2% AEP** | 27 | 11 | 5 | 74 | 27 | 144 |
| **5% AEP** | 27 | 10 | 5 | 35 | 25 | 132 |
| **20% AEP** | 0 | 0 | 0 | 10 | 5 | 15 |

### 2.3.6 Isolation

a. Isolation to single properties may occur due to road /access closures in the catchment. Access would be regained within 1-2 hours of cessation of rainfall (1).

b. A number of areas can become isolated due to flooding of creeks and roads cutting off access to areas including:

- Sandon Point residential area;
- McCauleys Beach Estate

### 2.3.7 Flood Mitigation Systems

a. Black Diamond Place Detention Basin is located adjacent to Slacky Creek in Bulli. There is no further information on this detention basin (20).

b. There are no other known flood mitigation systems in the Hewitts Creek catchment.

### 2.3.8 Dams

a. Old Bulli Mine Dam is located in Bulli. There is no further information on this dam (20).

### 2.3.9 At Risk Facilities

a. **Bulli Public School** is located on Haig Road in Bulli. This area can become a high hazard floodway due to flooding in Tramway/Slacky Creek.

b. **St Michael's Catholic Primary School** is located on Station Street in Thirroul and may become locally isolated due to road closures (3).

c. **Thirroul Public School** is located on Roxburgh Avenue in Thirroul. It is located on a High Flood island and may become isolated from other parts of Thirroul (3).

d. **Thirroul Early Childhood Centre** is located on Lawrence Hargrave Drive in Thirroul.

e. **Thirroul Pre-School Centre** is located on Lawrence Hargrave Drive in Thirroul.

f. **Bulli Community Preschool** is located on Quilkey Place in Bulli. This area can become a high hazard floodway due to flooding from Slacky Creek (3).

g. **Sandon Point Children's Centre** is located on Point Street in Bulli and may become locally isolated due to road closures (3).

h. **Southern Cross Court Retirement Village** is located on Raymond Road in Thirroul.

i. **Tasman Court Retirement Village** is located on Tasman Parade in Thirroul.

j. **McCauley Lodge Residential Care Service** is located on Tasman Parade in Thirroul.

### 2.3.10 Other Considerations

a. The Thirroul Seaside Festival is held in the first weekend of April. The festival draws a large number of tourists to the area.

b. Known trouble spots exist in George and Lachlan Streets and Hewitts Ave, Thirroul. The Princes Hwy and Lawrence Hargrave Drive at the bottom of Bulli Pass and the highway near Bulli Trotting Track have suffered damage in previous events.

## 2.4 COLLINS CREEK CATCHMENT

### 2.4.1 Community Overview

a. The Collins Creek Catchment covers the suburbs of Bellambi, Bulli, Corrimal, Corrimal East, Russell Vale and Woonona. The total population of these suburbs was 32,191 in 2011 (17).

b. The Collins Creek catchment is located to the north of the Wollongong CBD and is situated between the Illawarra Escarpment in the west and the Tasman Sea in the east.

c. The catchment is made up of four smaller catchments. They are the Whartons Creek catchment, Collins Creek Catchment, Bellambi Gully/ Farrahars Creek catchment and Bellambi Lake catchment (12).

d. The Collins Creek catchment is shown on Map 5.

**Table 8: Population and Dwellings in Collins Creek Catchment**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Bellambi | 4,011 | 1,790 |
| Bulli | 5,671 | 2,215 |
| Corrimal | 6,325 | 2,776 |
| Corrimal East | 3,159 | 1,500 |
| Russel Vale | 1,518 | 585 |
| Woonona | 11,442 | 4,751 |

### 2.4.2 Characteristics of Flooding

a. Because of the small size of the catchments and comparatively steep gradient of the creeks, flooding is of a “flash flooding” nature and is usually short duration (12).

b. The catchment is subject to riverine and overland flooding and particularly in the middle and lower reaches flooding can occur as a result of blockages in culverts and bridges and the drainage network reaching capacity (4).

### 2.4.3 Characteristics of flooding

a. Because of the small size of the catchments and comparatively steep gradient of the creeks, flooding is of a “flash flooding” nature and is usually short duration (12).

b. The catchment is subject to riverine and overland flooding and particularly in the middle and lower reaches flooding can occur as a result of blockages in culverts and bridges and the drainage network reaching capacity.

### 2.4.4 Flood Behaviour

a. The Collins Creek catchment is made up of Whartons, Collins, Farrahars and Bellambi Gully Creeks, and Bellambi Lake (1).

b. The creeks have a capacity general less than a 20% AEP (5 year ARI). Depths are shallow up to the 10% AEP (12).

#### Whartons Creek Catchment

c. In the 1% AEP event the floodway is generally contained to the creek, with additional floodways existing on Dumbrell Road, the Princes Highway between Station Street and Hopetoun Street and Ursula Road between Franklin Avenue and Benelong Street (12).

d. Water can also break out of these floodways and inundate areas including Gordon Hutton Park, the Princes Highway and Illawarra Railway Line and the area between Ursula Road and Whartons Creek downstream of the Railway Line (12).

#### Collins Creek Catchment

e. In the 1% AEP event the floodway is generally contained to the creek in the upper sections of the catchment. In the lower sections of the catchment the floodway crosses properties between High Street and the Princes Highway before crossing the Highway and flowing down Nicholson Road, Lang Street, Woonona Street and Bell Street. It then crosses over the Princes Highway and flows down Campbell Street and through properties to join the floodway in Nicholson Road. The floodway follows the creek before opening up into to Collins Park where a third of the park becomes a floodway. Another floodway also flows down Lawrence Street and Carrington Street before entering Collins Park (12).

f. In the 1% AEP event floodwaters can accumulate in the Edgewood detention basin, on the western side of the Railway embankment, on the western side of Memorial Drive and on Lawrence and Carrington Streets adjacent to the floodway (12).

g. In the 1% AEP event some shallower flooding (flood fringe areas) can be found adjacent to the floodways, in the area between the Princes Highway and Memorial Drive bounded but Russell Street and Gray Street and the area bounded by Memorial Drive, Collins Park, Kialoa Road and Campbell Street (12).

#### Farrahars Creek/Bellambi Gully Creek Catchment

h. In the 1% AEP event floodways are generally located within the creeks. Sections of floodway can be found flowing through properties between Bellambi Lane and Albert Street, on York Road between Terania Street and Collaery Road, between Memorial Drive and the Illawarra Railway Line near Lode Lane and Brompton Road and following the creek, along Ellen Street, through the grounds of Holy Spirit College, along Railway Parade between Charlotte Harrison Drive and Lighthouse Drive, along Lighthouse Drive and Pendlebury Parade (12).

i. In the 1% AEP event flood storage areas can be found adjacent to floodways, in Kathleen Crescent, on Stanhope Street, on the western side of Memorial Drive near the Albert Street intersection (12).

j. In the 1% AEP event flood fringe areas can be found adjacent to floodways and creeks, in Hollymount Park, in Cawley Park and along Kerrong Avenue, between Bellambi Lane and Albert Street, between Memorial Drive and the Illawarra Railway Line and the entire area east of the Railway Line from Lighthorse Drive to Holy Spirit College (12).

### Bellambi Lake Catchment

k. In the 1% AEP event floodways can be found following the creek, along Robson Street and Rothery Street, between the Princes Highway and Wilga Street, along Eager Street, on Mountbatten Street and in Mountbatten Park, on the western side of the Illawarra Railway line neat Louis Street, on Sellers Crescent and Turner Esplanade and in Bellambi Lagoon (12).

l. In the 1% AEP event flood storage areas can be found between Rothery Street and Mountbatten Street, in the Corrimal High detention basin and in Bellambi Lagoon (12).

m. In the 1% AEP event flood fringe areas can found between Wilford Street and the Princes Highway near the creek, between Eager Street and Rothery Street, the entire area between Memorial Drive and the Illawarra Railway Line, between Railway Street and McConnell Street, between Rothery Street and Turner Esplanade and Bellambi Lagoon (12).

## 2.4.5 Classification of Floodplain

a. Note: Flood classifications are only available for the 1% AEP event. These may vary during other events.

### Low Flood Islands:

b. In the 1% AEP event Low Flood Islands in the Whartons Creek catchment can be found comprising of some residential properties located on Tulip Way and Gardenia Terrace, Woonona; Benelong Street, Bulli; Farrell Road, Bulli; and Colemans Lane, Bulli (12).

### High Flood Islands:

c. In the 1% AEP event a High Flood Island is located in the Collins Creek catchment and is comprised of some residential properties located on Campbell Street, Robert Street, Nicholson Road and Woonona High School, Woonona; Popes Road and Woonona Parade, Woonona; Cedar Terrace, Forestview Way, Woonona; Cooper Avenue, Collins Avenue and Parranweena Way, Woonona (12).

d. In the 1% AEP High Flood Islands can also be found in the Bellambi Gully and Farrahars Creek catchments. They comprise of large areas of residential properties located on Lassiter Avenue and Pendlebury Parade, Woonona; properties bounded by Cornelius O'Brien Way and Grand Pacific Drive, Charlotte Harrison Drive, Harriet Spearing Drive,

and the coast, Woonona; Chester Street, Bellambi Lane, Kirton Road and Watts Lane, Bellambi; Brompton Road, Hardie Street, Daphne Street, Jones Place and Rothery Road, Corrimal (12).

e. In the 1% AEP the Bellambi Lake Catchment is a High Flood Island comprising residential properties located on Rothery Road, Edwina Street and Mountbatten Street, Corrimal (12).

### 2.4.6 Inundation

a. Damaging flooding will occur in the study area even at the 20% AEP (5 year ARI) level with shallow depths of inundation, and progressively increase with increasing AEP (12).

b. There is one flood level gauge, owned by MHL, located on Bellambi Lake: Bellambi Gauge (214488). There are currently no warnings provided to this gauge.

c. The Princes Highway is impacted upon in events as frequent as a 20% AEP (5 year ARI) and will reach depths of 1m at several locations during a major flood event (4).

**Table 9: Estimated No. Properties with Over Floor Flooding in the Whole Collins Creek Catchment (12).**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | No. Public Properties with Over floor Flooding | Total Properties with Over floor Flooding |
|---|---|---|---|---|
| **PMF** | 1394 | 73 | 24 | 1491 |
| **0.2% AEP** | 689 | 52 | 9 | 750 |
| **0.5% AEP** | 578 | 48 | 8 | 634 |
| **1% AEP** | 511 | 47 | 6 | 564 |
| **2% AEP** | 428 | 47 | 6 | 481 |
| **5% AEP** | 356 | 46 | 5 | 407 |
| **10% AEP** | 62 | 11 | 2 | 75 |
| **20% AEP** | 38 | 8 | 1 | 47 |

#### Whartons Creek Catchment

d. In the 20% AEP (5yr ARI) event inundation of land occurs in Gordon Hutton Park, upstream of Organs Road, in properties on Organs Road, Hospital Road, the Princes Highway, Dumbrell Road, Farrell Road, downstream of the Illawarra Rail Line adjacent to the creek, in the grounds of Bulli High School and Waniora Public School, Bulli Park and properties on Ursula Road, Benelong Street, Alroy Street, Jardine Street and Godolphin Street. Over floor flooding in the 20% AEP (5yr ARI) event occurs to properties located on the Princes Highway, Dumbrell Road, Alroy Street and Ursula Road (12).

e. In the 10% AEP (10yr ARI) event inundation in addition to the 20% AEP (5yr ARI) occurs on land on Corrie Road, Railway Street, Colemans Lane and Trinity Row. Over floor flooding occurs in properties located in Alroy Street and Trinity Row (12).

f. In the 5% (20yr ARI) and 2% (50yr ARI) events in addition to the 10% (10yr ARI) inundation of grounds occurs on Hopetoun Street, Agapantha Terrace, Tulip Way and Park Road. Over floor flooding occurs in properties located Godolphin Street, Jardine Street, Ursula Road, Benelong Street, Franklin Avenue, Colemans Lane, Princes Highway, Railway Street and Organs Road (12).

g. In the 1% AEP (100yr ARI) event in addition to 2% (50yr ARI) event inundations, over floor flooding occurs on properties located on Hospital Road (12).

h. In the 0.5% AEP (200yr ARI) and 0.2% AEP (500yr ARI) inundation occurs on Athol Street and McKinnon Street. Over floor flooding affects properties on Corrie Road and Hopetoun Street (12).

i. In the PMF event over floor flooding occurs on Agapantha Terrace and Tulip Way (12).

**Table 10: Estimated No. Properties with Over Floor Flooding in the Whartons Creek Catchment (12)**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | No. Public Properties with Over floor Flooding | Total Properties with Over floor Flooding |
|---|---|---|---|---|
| **PMF** | 170 | 22 | 10 | 202 |
| **0.2% AEP** | 59 | 12 | 5 | 76 |
| **0.5% AEP** | 49 | 11 | 5 | 65 |
| **1% AEP** | 40 | 11 | 3 | 54 |
| **2% AEP** | 29 | 11 | 3 | 43 |
| **5% AEP** | 21 | 11 | 3 | 35 |
| **10% AEP** | 5 | 2 | 1 | 8 |
| **20% AEP** | 3 | 2 | 0 | 5 |

## Collins Creek Catchment

j. In the 20% AEP (5yr ARI) event over ground flooding occurs in areas adjacent to the creeks. Properties impacted are located in Hollymount View, Peppermint Circuit, Popes Road, Mountain Avenue, Stephan Drive, Joseph Street, Lang Street, Woonona Parade, Bell Street, Princes Highway, Franklin Avenue, Fretus Avenue, High Street, Nicholson Road, Austin Street, Campbell Street, Haddon Lane, Russell Street, Thompson Street, Waterloo Street, Lawrence Street, Kialoa Road, Cooper Avenue, Kulgoa Road, and Ocean and Collins Parks. Over floor flooding occurs in properties located on Kialoa Road, Franklin Avenue, Thompson Street, Cotterill Avenue Princes Highway, Woonona Avenue and Lang Street (12).

k. In the 10% AEP (10yr ARI) event over ground flooding occurs in Lilly Pilly Circuit and Carrington Street. Over floor flooding occurs to properties located on the Princes Highway (12).

l. In the 5% AEP (20yr ARI) over ground flooding affects properties located in Adams Parade, Collins Avenue, Lighthorse Drive, Dorrigo Avenue, Royal Crescent, Robertson Road and Kareela Road. Over floor flooding occurs in properties located on Carrington Street, Lawrence Street, Cotterill Avenue, Royal Crescent, Waterloo Street, Adams Parade, Campbell Street, Nicholson Road, High Street, Fretus Avenue, Mountain Avenue and Popes Road (12).

m. In the 2% AEP (50yr ARI) event over ground flooding affects properties located in Forestview Way, Park Road and Wynn Street. Over floor flooding occurs in the same locations as in the 5% AEP (20yr ARI).

n. In the 1% AEP over ground flooding affects properties located in Muir Street. Over floor flooding occurs in Dorrigo Avenue and the same locations as the 5% and 2% AEP (12).

o. In the 2% and 5% AEP over ground flooding affects properties located in Sussex Street, Park Street, Beach Drive and Ocean Avenue. Over floor flooding occurs in Robertson Street (12).

p. Over ground flooding in the PMF occurs on Cedar Terrace, Hillcrest Avenue, Liamina Avenue, Corinda Road and Owen Street. Over floor flooding occurs in the same locations as the 5% and 2% AEP (12).

**Table 11: Estimated No. Properties with Over Floor Flooding in the Collins Creek Catchment (12)**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | No. Public Properties with Over floor Flooding | Total Properties with Over floor Flooding |
|---|---|---|---|---|
| **PMF** | 318 | 21 | 2 | 341 |
| **0.2% AEP** | 144 | 17 | 2 | 163 |
| **0.5% AEP** | 125 | 15 | 2 | 142 |
| **1% AEP** | 112 | 15 | 2 | 129 |
| **2% AEP** | 97 | 15 | 2 | 114 |
| **5% AEP** | 79 | 14 | 1 | 94 |
| **10% AEP** | 12 | 3 | 1 | 16 |
| **20% AEP** | 9 | 1 | 1 | 11 |

## Farrahars Creek/Bellambi Gully Creek Catchment

q. In the 20% AEP (5yr ARI) event over ground flooding occurs in areas adjacent to the creek channels. Properties that may be affected include those located between the

Illawarra Railway Line and Memorial Drive, the Russell Vale Golf Course, Duke Street, Marlen Place, Watergum Way, Princes Highway, Albert Street (Woonona), Hale Street, Chenhalls Street, Monie Street, Stanhope Street, Greta Street, Rose Street, Alice Street, Mitchell Road, Kathleen Crescent, Pendlebury Parade, George Cheadle Place, Harriet Spearing Drive, John Cawley Crescent, Elizabeth Underwood Close, Doris Avenue, Collaery Road, Neville Avenue, Leslie Street, Williams Crescent, West Street, Moreton Street, Hicks Street, East Street, Terania Street, York Road, Nimbin Street, Keerrong Avenue, Bellambi Lane, Albert Street (Bellambi), Kirton Road, Hardie Street, Brompton Road, Lavender Street, Ellen Street, Pioneer Road, Gladstone Street and Lismore Street. Over floor flooding affects properties located on Monie Street, Stanhope Street, Princes Highway, Doris Avenue, Collaery Road, West Street, Ellen Street and Pioneer Road (12).

r. In the 10% AEP (10yr ARI) event over ground flooding occurs in Halley Crescent, Ivor Street and Jones Place, in addition to those affected in the 20% AEP (5yr ARI). Over floor flooding occurs in Gladstone Street in addition to properties affected in the 20% AEP (5yr ARI) event (12).

s. In the 5% AEP (20yr ARI) event overground flooding affects properties located on Gayantay Way, Linda Place, Channon Street, Eager Street, Chester Street, Frances Street and Hollebon Road in addition to those affected in smaller events. Over floor flooding affects properties located in Marlen Place, Albert Street (Woonona), Greta Street, Mitchell Road, Linda Place, Kathleen Crescent, Pendlebury Parade, Elizabeth Underwood Close, Neville Avenue, Williams Crescent, East Street, York Road, Keerrong Avenue, Bellambi Lane, Albert Street (Bellambi), Brompton Road and Frances Street in addition to those impacted in smaller events (12).

t. In the 2% AEP (50yr ARI) event overground flooding affects properties located on Alfred Street and Noosa Avenue in addition to those impacted in smaller events. Over floor flooding occurs in properties located in George Cheadle Place in addition to properties impacted in smaller events (12).

u. In the 1% AEP (100yr ARI) event overground flooding occurs in Pallier Place, George Tate Close and Narelle Crescent in addition to those affected in smaller events. Over floor flooding impacts properties located in Chenhalls Street, Jones Place and Lismore Street in addition to properties affected in smaller events (12).

v. In the 0.5% AEP (200yr ARI) event overground flooding occurs in Thomas Collaery Place in addition to locations affected in smaller events. Over floor flooding occurs on properties in Alice Street in addition to properties affected in smaller events (12).

w. In the 0.2 % AEP (500yr ARI) event overground flooding impacts properties located on John Street and Henry Fry Place in addition to those affected in smaller events. Over floor flooding affects properties located in Duke Street, Halley Crescent, Eager Street, Kirton Road and Lavender Street in addition to those affected in smaller events (12).

x. In the PMF event overground flooding impacts properties located in Pat Geraghty Place, Cornelius O'Brien Way, Henry Fry Place, Edward Corrigan Close, Elizabeth Reynolds Circuit, Charlotte Harrison Drive, Broker Street and Daphne Street in addition to those impacted in smaller events. Over floor flooding affects properties located on John Cawley Crescent, Cornelius O'Brien Way, Edward Corrigan Close, Elizabeth Reynolds Circuit, Charlotte Harrison Drive, Thomas Collaery Place, Moreton Street, Hicks Street, Terrania Street and Chester Street in addition to those impacted in smaller events (12).

**Table 12: Estimated No. Properties with Over Floor Flooding in the Farrahars/Bellambi Gully Creek Catchment (12)**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | No. Public Properties with Over floor Flooding | Total Properties with Over floor Flooding |
|---|---|---|---|---|
| **PMF** | 408 | 27 | 12 | 447 |
| **0.2% AEP** | 240 | 20 | 2 | 262 |
| **0.5% AEP** | 210 | 19 | 1 | 230 |
| **1% AEP** | 186 | 18 | 1 | 105 |
| **2% AEP** | 145 | 18 | 1 | 164 |
| **5% AEP** | 127 | 18 | 1 | 146 |
| **10% AEP** | 26 | 6 | 0 | 32 |
| **20% AEP** | 19 | 5 | 0 | 24 |

## Bellambi Lake Catchment

y. In the 20% AEP (5yr ARI) event over ground flooding occurs in areas adjacent to the creek and also affects properties located on Robson Street, Lyndon Street, Bloomfield Avenue, Annie Street, Midgley Street, Princes Highway, Wilga Street, Eager Street, Rothery Street, Edwina Street, Mountbatten Street, Louis Street, Collins Street, Park Road, Dalby Street, Coolgardie Street, Pioneer Road, Edyth Street, Thalassa Avenue, Cawley Street, Turner Esplanade, Birch Crescent, Sellers Crescent, Gleeson Crescent, Kells Crescent, Tressider Place, Hapgood Place and Sangstar Place. Over floor flooding affects properties located on Rothery Street and Mountbatten Street (12).

z. In the 10% AEP (10yr ARI) event over ground flooding affects properties located in the same locations as the 20% AEP (5yr ARI). Over floor flooding affects properties located on Midgley Street, Park Road, Pioneer Road, Gleeson Crescent and Kells Crescent in addition to areas affected in the 20% AEP (5yr ARI) event (12).

aa. In the 5% AEP (20yr ARI) event over ground flooding affects properties located on Hansen Street, Carroll Road and Connaghan Avenue in addition to locations impacted in smaller events. Over floor flooding affects properties located on Robson Street,

Princes Highway, Wilga Street, Eager Street, Louis Street, Collins Street, Coolgardie Street, Thalassa Avenue, Cawley Street and Connaghan Avenue in addition to those affected in smaller events (12).

bb. In the 2% AEP (50yr ARI) event over ground flooding affects properties located in the same locations as those affected in smaller events. Over floor flooding affects properties located on Turner Esplanade in addition to properties affected in smaller events (12).

cc. In the 1% AEP (100yr ARI) event over ground flooding affects properties located in the same locations as those affected in smaller events. Over floor flooding affects properties located on Carroll Street and Birch Crescent in addition to properties affected in smaller events (12).

dd. In the 0.5% AEP (200yr ARI) event over ground flooding affects properties located in the same locations as those impacted in smaller events. Over floor flooding affects properties located on Bloomfield Avenue in addition to those impacted in smaller events (12).

ee. In the 0.2% AEP (500yr ARI) event over ground flooding affects properties located on Ramela Street in addition to areas affected in smaller events. Over floor flooding affects properties located on Edwina Street in addition to those impacted in smaller events (12).

ff. In the PMF event over ground flooding affects properties located in the same areas as those impacted in smaller events. Over floor flooding affects properties located on Edyth Street and Sellers Crescent in addition to those affected in smaller events (12).

**Table 13: Estimated No. Properties with Over Floor Flooding in the Bellambi Lake Catchment (12)**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | Total Properties with Over floor Flooding |
|---|---|---|---|
| **PMF** | 498 | 3 | 501 |
| **0.2% AEP** | 246 | 3 | 249 |
| **0.5% AEP** | 194 | 3 | 197 |
| **1% AEP** | 173 | 3 | 173 |
| **2% AEP** | 157 | 3 | 160 |
| **5% AEP** | 129 | 3 | 132 |
| **10% AEP** | 19 | 0 | 19 |
| **20% AEP** | 7 | 0 | 7 |

### 2.4.7 Isolation

a. Isolation in the catchment consist of the areas defined as High and Low Flood Islands above.

### 2.4.8 Flood Mitigation Systems

a. **Gordon Hutton Park flood retarding basin** is located within the Whartons Creek catchment. The basin has been designed to surcharge during a 5% AEP (20 year ARI) event. Partial blockages of the spillway by fences can result in exacerbated flooding to properties which lie to the east of the Princes Highway near Hopetoun Street and Farrell Road (12).

b. **Edgewood Estate flood retarding basin** is located in the Collins Creek catchment. The volume of flood storage in the basin in 11,900$m^3$. This volume is equivalent to 17mm of rainfall excess falling in the catchment. The spillway operates during a 1% AEP (100 year ARI) event. The water from the basin discharges in a north-easterly direction across Hollymount View and discharges into a water quality pond to the east of Cedar Terrace (12).

c. **Flood retarding basin Nos. 1, 2 & 3** are located in the Farrahars Creek/Bellambi Gully catchment. The spillway in basin 1 begins to spill during a 20% AEP (5yr ARI) event. The spillway and basin 2 surcharges in a 1% AEP (100 year ARI) event. During the PMF event flood water from basin 2 discharges into basin 3 via a 6 x 0.9m culvert which runs through the embankment. Basin 3 discharges through a 1500mm diameter pipe. This is overtopped during a 50 year ARI event. During a 100 year ARI event the Princes Highway is inundated to depths exceeding 500mm for up to 140m north of the basin outlet pipe (12).

d. **Corrimal High School flood retarding basin** is located in the Bellambi Lake catchment. The spillway of the basin operates for a 15 AEP (100 year ARI) event. A number of properties located downstream of the basin in Edyth Street, Thalassa Avenue and Cawley Street may experience inundation in the 5% AEP (20 year ARI) (12).

e. **Bulli Upper Railway Basin** previously existed at the top of Slacky Creek in Bulli however this dam has now been decommissioned.

f. **Austin Street Levee**: A levee is located at the northern end of Austin Street, Woonona in the Collins Creek catchment. The levee comprises sections of earth bund and reinforced block wall. The levee is overtopped in a 1% AEP event (12).

### 2.4.9 Dams

a. There are no dams located within the Collins Creek catchment.

### 2.4.10 At Risk Facilities

a. **Schools:** There are nine schools and three childcare centres affected by flooding in the catchment. Details are shown in Annex 2 (12).

b. **Aged Care/retirement:** There are four aged care /retirement facilities affected by flooding in the catchment. Details are shown in Annex 2 (12).

c. **Hospitals:** The main access to Bulli hospital can be lost at the Princes Highway intersection road closure in a 5% AEP (1).

### 2.4.11 Other Considerations

a. **Illawarra Railway line** may become compromised due to scouring, culvert blockage and inundation.

## 2.6 TOWRADGI CREEK CATCHMENT

### 2.6.1 Community Overview

a. The Towradgi Creek catchment covers the suburbs of Corrimal, Tarrawanna, East Corrimal, Towradgi and Fernhill. The population of these suburbs was 15,680 with 6,711 dwellings in 2011 (17).

b. The catchment is located north of the Wollongong CBD and is situated between the Illawarra Escarpment to the west and the Tasman Sea to the east.

c. The Towradgi Creek catchment is shown on Map 6.

**Table 14: Population and Dwellings in Towradgi Creek Catchment**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Corrimal | 6,325 | 2,776 |
| Tarrawanna | 1,996 | 832 |
| Corrimal East | 3,159 | 1,500 |
| Towradgi | 3,123 | 1,372 |
| Fernhill | 1,024 | 507 |

### 2.6.2 Characteristics of flooding

a. The Towradgi Creek catchment is affected by flash flooding with the community having less than 1 hour warning time.

### 2.6.3 Flood Behaviour

a. The Towragdi Creek Catchment incorporates Towradgi Creek, South and North Angels Creeks, Carr Creek, South and North Corrimal Creeks, Parker Creek and Towradgi Lagoon (5).

b. Towradgi Lagoon is mechanically opened by Wollongong City Council when the lagoon reaches the trigger level of 1.6m AHD and rainfalls is expected to cause the lagoon to rise further (5).

c. The only information currently available for the Towradgi Creek Catchment is for a 1% AEP flood event.

#### North Corrimal Creek

d. In the 1% AEP event the floodway generally follows the creek channel and its immediate banks. It may impact properties that back onto the creek including those located on Lemrac Avenue, Frances Street, Collins Street, Underwood Street and Railway Street. The floodway also flows down Coxs Avenue, Lemrac Avenue, Willow Grove, Collins Street, Underwood Street, the Princes Highway, Russell Street, Wilga Street, Memorial Drive and Railway Street (5).

e. In the 1% AEP event flood storage areas can be found on the north side of the floodway between Collins Street and Francis Street, in the commercial properties located on the southern side of Russell Street, around the floodway at the Memorial Drive and Railway Street intersection and to the west of the Illawarra Railway (5).

f. In the 1% AEP event flood fringe areas can be found adjacent to the floodway, in the Corrimal Memorial Park and Ziems Park (5).

### South Corrimal Creek

g. In the 1% AEP event the floodway flows down Foothills Road before entering the creek system where it remains in its banks until it reaches The Avenue where it crosses the road and flows through properties located near The Avenue and Underwood Street intersection. The floodway flows down Tarrawanna Road and crosses the Princes Highway before flowing through the Corrimal Library carpark. The floodway then follows the creek channel until joining Towradgi Creek (5).

h. In the 1% AEP event flood storage areas can be found mainly where South Corrimal Creek joins Towradgi Creek (5).

i. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and on the western side of Underwood Street between The Avenue and Collins Street (5).

### North Angels Creek

j. In the 1% AEP event the floodway flows across properties located between Crowther Place and Bellambi Street, crosses Bellambi Street and flows through properties located between Bellambi Street and Meadow Street. It then flows down Tarrawanna Road, impacting properties located between Karen Place and Tarrawanna Road and follows the creek channel, potentially affecting properties adjacent to the creek before joining South Angels Creek (5).

k. In the 1% AEP event flood storage can be found in the detention basin at the start of the creek (5).

l. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and impacts properties located on Tarrawanna Road and between Meadow Street and Crowther Place (5).

### South Angels Creek

m. In the 1% AEP event the floodway follows the creek channel until it crosses Corrimal Street where it affects properties located adjacent to the creek between Corrimal Street and Meadow Street. The floodway crosses Meadow Street and flows into the field on Henry Street before crossing Williamson Street and following the creek channel until it joins with Towradgi Creek. Properties located on Meads Avenue and the Princes Highway may form part of the floodway (5).

n. In the 1% AEP event flood storage areas can be found in the detention basin at the start of the creek and in areas adjacent to the floodway on the west and east side of Corrimal Street (5).

o. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and affects properties located on Corrimal Street, Brooker Street, Meadow Street and Henry Street (5).

### Towradgi Creek

p. In the 1% AEP event the floodway of the upper section of Towradgi Creek is contained to the creek channel until it reaches Meadow Street where it crosses the road and impacts the Keira Street intersection and affects properties located on Meadow Street. The floodway then follows the creek channel and crosses Charles Road before reaching the Princes Highway where South Angels Creek joins. Properties adjacent to the creek may also form part of the floodway. The floodway then flows east towards the Illawarra Railway Line where it joins with North and South Corrimal Creeks. Downstream of the Illawarra Railway the floodway follows the creek channel and spreads out into the floodplain areas adjacent to the creek. Properties on Colgong Crescent form part of the floodways and properties located on Pioneer Road, Lake Parade, Cassell Avenue and Augusta Street may be affected by the floodway (5).

q. In the 1% AEP event flood storage areas can be found to the west and south of Prosser Close, at the Keira Street and Meadow Street intersection, to the west of the Illawarra Railway, near Augusta Street and Pioneer Drive and to the north of Juanita Avenue (5).

r. In the 1% AEP event flood fringe areas can be found adjacent to the floodway, affecting properties on Caldwell Avenue, Wallace Road, Devenish Street, Gregory Avenue, Pioneer Road, Lake Parade, Payne Road and Spinks Road (5).

### Carr Creek

s. In the 1% AEP event the floodway is contained to the creek channel beginning at Carr Street before meeting Towradgi Creek near Colgong Crescent (5).

t. In the 1% AEP event flood storage can be found on the western side of Memorial Drive and impacts properties located on Dalton Street (5).

u. In the 1% AEP event flood fringe areas can be found adjacent to the floodway, in the area bounded by Ziems Avenue, Towradgi Road and Memorial Drive and between Memorial Drive and the Illawarra Railway affecting properties located on Carr Street and Waugh Avenue (5).

### Parker Creek

v. In the 1% AEP event the floodway is contained to the creek channel (5).

w. In the 1% AEP event the flood storage areas can be found adjacent to the floodway, on Parker Road and on the western side of Corrimal Beach Tourist Park (5).

x. In the 1% AEP event flood fringe areas can be found in the area bounded by Corrimal Beach Tourist Park, Murray Road, Towradgi Creek and Spinks Road (5).

### 2.6.4 Classification of Floodplain

a. The majority of the study area is classified as High Trapped Perimeter (whereby the area can become isolated by road closures and the surrounding terrain / topography) or else is Not Flood Affected (5). There are also a number of areas that are Low or High Flood Islands. Mapping can be seen in the Towradgi Creek Flood Study 2015 available on Wollongong City Council's website.

#### Low Flood Islands

b. A low flood island can develop in the 1% AEP event in the area bounded by Memorial Drive, Towradgi Road and the Illawarra Railway and includes all properties located in Carr Street and Waugh Avenue, Towradgi.

c. In the PMF Low Flood Islands can also be found in Towradgi:

   i. between Henrietta Street and Memorial Drive,

   ii. in the block between Cassell Avenue, Juanita Avenue and Towradgi Creek and

   iii. between Lake Parade and Towradgi Creek (6).

#### High Flood Islands

d. In the 1% AEP event there is a High Flood Island that is expected to develop in the area bounded by the Illawarra Railway, Towradgi Creek, Sturdee Street and Glossop Street. It includes all properties located in Cologong Crescent and Raymond Parade, and properties located on the northern side of Sturdee and Glossop Street. It remains a High Flood Island up to the PMF (6).

e. In the PMF event High Flood Islands can also be found:

   i. north of Julius Street, in the block bounded by the Princes Highway, Towradgi Road and Ziems Avenue,

   ii. in the block bounded by Memorial Drive, the Illawarra Railway and south of Railway Street,

   iii. in the block bounded by The Avenue, Underwood Street, Tarrawanna Road, Meadow Street and Karen Place,

   iv. the block bounded by Willow Grove, Lemrac Avenue, Francis Street and Collins Street,

   v. the block bounded by Russell Street, the Princes Highway, Railway Street and Underwood Street and the area bounded by the Princes Highway, Railway Street, Wilga Street and Collins Street.

f. These areas are all classified as High Trapped Perimeter Areas in the 5% and 1% AEP events (5).

### Rising Road Access

g. Areas with Rising Road Access away from floodwaters can be found north of Coxs Avenue, surrounding Caldwell Avenue and in the area bounded by the Illawarra Railway, Murray Road and Sturdee Street in all events (5).

## 2.6.5 Inundation

a. There is one flood level gauge, owned by MHL, located on Towradgi Creek: Towradgi Creek Upstream Gauge (214475). There are currently no warnings issued to this gauge.

b. In a 1% AEP flood, the majority of residential properties flooded above floor level are located in Towradgi Creek, Parker Creek, North Corrimal Creek and Carr Creek proximity (1).

c. Properties affected by flooding are located on Angel Street, Bellambi Street, Betram Close, Brooker Street, Caldwell Avenue, Carr Street, Carroll Road, Cassell Avenue, Cawley Street, Colgong Crescent, Collins Street, Coxs Avenue, Dalton Street, Francis Street, Gregory Avenue, Henrietta Street, Juanita Avenue, Karen Place, Lake Parade, Lemrac Avenue, Meadow Street, Parker Road, Pioneer Road, Princes Highway, Railway Street, Raymond Parade, Spinks Road, St Andrews Place, Tarrawanna Road, The Avenue, Towradgi Road, Underwood Street, Waugh Avenue, Williamson Street, Willow Grove and Ziem Avenue.

d. They begin to become affected at the 20% AEP event up to the PMF event with depths and extents of inundation in the streets increasing (5).

e. Gauges are located at Towradgi Creek upstream and downstream (MHL), Corrimal (Sydney Water) and Towradgi (BoM) (1).

**Table 15: Estimated No. Properties with Over Floor and Ground Flooding in the Towradgi Creek Catchment (21).**

| Design Flood Event (% AEP) | Average Over Floor Depths (m) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | No. Residential Properties with Over ground Flooding | No. Commercial Properties with Over ground Flooding |
|---|---|---|---|---|---|
| **PMF** | 1.0m<br>Max: 3.2m | 451 | 23 | 626 | 22 |
| **1%** | 0.42m<br>Max: 3.0m | 115 | 16 | 339 | 14 |
| **2%** | 0.42m<br>Max: 1.8m | 86 | 15 | 285 | 14 |
| **5%** | 0.35m<br>Max: 1.7m | 67 | 15 | 238 | 13 |
| **20%** | 0.33m<br>Max: 1.4m | 34 | 12 | 171 | 11 |

### 2.6.6 Isolation

a. Isolation in the catchment consist of the areas defined as High and Low Flood Islands and Trapped Perimeter areas above.

### 2.6.7 Flood Mitigation Systems

a. Detentions Basins within the catchment are located downstream of Meadow Street, the confluence of Princes Highway, Pioneer Road and the outlet near South and North Angels Creek (21).

   i. **Foothills Estate Retarding Basin 1** is owned by Wollongong City Council and is located on Towradgi Creek in Tarrawanna. The basin has a capacity of 21ML and in the event of failure would affect up to 100 properties (22).

   ii. **Foothills Estate Retarding Basin 3** is owned by Wollongong City Council and is located in Tarrawanna (5).

   iii. **South Angels Creek**: A detention basin is located west of Corrimal Street, at the start of South Angels Creek. No other information on this basin is known (5).

   iv. **North Angels Creek:** A detention basin is located directly west of Bellambi Street in Tarrawanna at the start of North Angels Creek. No other information on this detention basin is known (5).

   v. **South Corrimal Creek**: A formalised detention basin is located immediately west of South Corrimal Creek (5).

b. Other flood mitigation measures within this catchment include:

i. Flood proof walls have been installed on the boundaries of properties located in Lemrac Avenue to divert floodwaters into North Corrimal Creek (16).

ii. Wollongong City Council has constructed a low earth mound at Cheryl Place to deflect floodwaters away from nearby houses (16).

iii. There is a weir located on North Corrimal Creek at the Coke Works in East Corrimal (5).

iv. The potential consequences to properties of these flood mitigation works has not been not documented.

### 2.6.8 Dams

a. There are no dams located within or upstream of the Towradgi Creek catchment.

### 2.6.9 At Risk Facilities

a. **Schools:** There is one school, two childcare centres and two aged care facilities located in the catchment. Details are shown in Annex 2.

b. **Illawarra Railway**: In the PMF event floodwater depths of 0.6m can be reached on the Illawarra Railway at the Towradgi Creek crossing (21).

### 2.6.10 Other Considerations

a. No other considerations

## 2.8 FAIRY AND CABBAGE TREE CATCHMENT

### 2.8.1 Community Overview

a. The community area comprises the catchments of Fairy Creek, Cabbage Tree Creek and Towradgi Arm (6). The Fairy and Cabbage Creek catchments are shown on Map 7.

b. The catchment includes the suburbs of Balgownie, Fairy Meadow, Mount Pleasant, Mount Ousley, Gwynneville, Keiraville, Wollongong, North Wollongong and West Wollongong. Sections of Fernhill and Towradgi are also included in this catchment (1).

c. Mount Ousley and Towradgi have a high proportion of residents aged 65 and over. They also have high proportion of owned properties and a low turnover rate (6).

d. Suburbs closer to the university have a lower median age, a higher rate of rentals (up to 60%), a high turnover rate, low median incomes and a high proportion over people born overseas that speak a language other than English (up to 27%). This is likely due to students studying at the University of Wollongong with many international students attending (6).

**Table 16: Population and Dwellings in Fairy and Cabbage Tree Catchments (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Fairy Meadow | 6,777 | 3,077 |
| Mount Pleasant and Mount Ousley | 2,743 | 1,056 |
| Gwynneville | 2,514 | 1,096 |
| Keiraville | 4,862 | 1,950 |
| Wollongong | 16,388 | 8,794 |
| North Wollongong | 2,115 | 1,071 |
| West Wollongong | 4,706 | 2,029 |
| Balgownie, Fernhill and Towradgi | 8,194 | 3,409 |

### 2.8.2 Characteristics of flooding

a. The Fairy and Cabbage Tree catchment is affected primarily by flash flooding with rapid rises and falls. The catchment responds quickly to intense rainfall, often within less than an hour (23).

### 2.8.3 Flood Behaviour

a. This catchment includes Fairy Creek, Cabbage Tree Creek, the Towradgi Arm and Fairy Lagoon (1).

b. Fairy Lagoon is located in North Wollongong and is fed by Fairy Creek, Towradgi Arm and Cabbage Tree Creek. The Lagoon is opened by Wollongong City Council when heavy rain is predicted and the lagoon levels are likely to exceed 1.6m AHD (6).

### 2.8.4 Classification of Floodplain

#### Low Flood Islands

a. Low Flood Islands from the 20% AEP event to the PMF event are located on Anama Street, Hay Street, College Place and Graham Avenue, the area bounded by Memorial Drive, Foleys Lane, Helen Street, Aristo Crescent, Mount Ousley Road, Princes Highway and Soudan Street, and the area between Braeside Avenue, Michael Street, John Street and south of Gipps Road (23).

b. There is a Low Flood Island in the 20% AEP event located on Jardine Street and Kingsford Street east of the Princes Highway. In the 1% AEP event the island grows to include Hurley Street and Smith Street and in the PMF event includes Norman Street and Chapman Street (23).

c. In the 20% AEP event to the 1% AEP event Low Flood Islands can be found in the area between Elliotts Road, Carters Lane, the Illawarra Railway and Dixon Street, and the area including Montague Street, Ajax Avenue, Exeter Avenue and Achilles Avenue. In the PMF event these join with the larger Low Flood Island east of the Illawarra Railway (23).

d. There is a Low Flood Island located on Hillview Circuit from the 5% AEP event to the PMF event (23).

e. There is a Low Flood Island located in the area between Elliotts Road, Princes Highway, Illawarra Railway and Soudan Street from the 1% AEP event to the PMF event (23).

f. In the PMF event Low Flood Islands can be found on Lila Avenue, Waitangi Street, and Crawford Avenue (23).

g. In the PMF event there is a large Low Flood Island located in the area bounded by the Illawarra Railway, Cannell Crescent, Edgar Street, Tasman Sea, Bourke Street, Noel Street, Virginia Street and Pleasant Avenue. This flood island incorporates some of the High and Low Flood Islands described above (23).

#### High Flood Islands

h. There are three locations that remain High Flood Islands from the 20% AEP event to the PMF event. They are located in Helen Brae Avenue, the University of Wollongong campus and on Cabbage Tree Lane between Dawson Street and McLean Avenue (23).

i. There is a High Flood Island located on Dixon Street and Carters Lane from Pioneer Road to Edgar Street in the 20% AEP event to the 1% AEP event. In the PMF event this changes to a Low Flood Island (23).

j. There are High Flood Islands located on the TAFE NSW Wollongong Campus and Porter Street, Hindmarsh Street and Railway Crescent from the 20% AEP event to the 1% AEP event. In the PMF these areas change to Low Flood Islands (23).

k. There are High Flood Islands located on Cowper Street, Stafford Street and Station Street in the 5% AEP event. These then change to Low Flood Islands in the 1% AEP. They then form part of the larger flood island in the PMF event described below (23).

l. In the PMF event High Flood Islands can be found in Guest Avenue, Hopewood Crescent and Dymock Street, and the area bounded by Norman Street, Princes Highway, Daisy Street and Lila Avenue (23).

#### High Trapped Perimeter

m. High Trapped Perimeter areas are located in Gore Street and Orton Street, west of Brokers Road between Wellington Drive and Lang Street, and west of Foothills Road between Greenslopes Avenue and Cabbage Tree Lane. These locations remain high trapped perimeters from the 20% AEP event to the PMF event (23).

#### Overland Access

n. Overland access areas can be found in the area north of the University of Wollongong, Akuna Street and Nyrang Street, and west of Harkness Avenue. These location have overland access from the 20% AEP event to the PMF event (23).

#### Rising Road Access

o. All other locations have Rising Road Access in all events (23).

### 2.8.5 Inundation

a. There are three flood level gauges, owned by MHL, located in the Fairy and Cabbage Creek catchment: Balgownie Road Gauge (214409), Cabbage Tree Creek Upstream Gauge (214405) and Fairy Creek Downstream Gauge (214404). Currently there are no warnings provided to these gauges.

b. Common flood affected areas include the Chalmers St culvert, Campus East, Brandon Park, west of the Illawarra Railway at Porter Street and east of the Illawarra Railway in Ajax and Exeter Streets (1).

c. Major damage has occurred during past flood events in Anama Street and Montague Street (1).

d. In the 20% AEP event in the highest risk area, 17 dwellings in Archilles Avenue, Ajax Avenue, Exeter Avenue, Montague Street, Rose Street, William Street, Ira Avenue, Weekes Street, Balmoral Street and Chalmers Street are affected by over floor flooding. Over floor flooding can also occur in Grey Street, Chapman Street, Jardine Street, Princes Highway, Carters Lane, Rann Street and Alvan Parade. Properties located in Ralph Black Drive, Akuna Street, Helen Brae Avenue, Hopewood Crescent,

Anama Street, Lang Street and Maroota Avenue have been identified as experiencing over floor flooding, however may have been included in Wollongong City Council's voluntary acquisition program and are no longer flood affected (6).

e. In the 5 % AEP event an additional 480 dwellings will experience over floor flooding. Properties at the highest risk are located in Wellington Drive, Blanchard Crescent, Sherwood Drive, Church Street, Rae Crescent, Foothills Road, Kingsford Street, Smith Street, Norman Street, Daisy Street, Aristo Crescent, Jobson Avenue, Lysaght Street, Woodhill Street, Rosedale Avenue, Braeside Avenue, Anne Street, Gipps Street, College Place, Graham Avenue, Hillview Avenue, Porter Street, Crawford Avenue, Gipps Road, Robsons Road, Murranar Road, Storey Street, Donald Street and Elliotts Road in addition to those affected in the 20% AEP (6). Additional properties that may experience over floor flooding are located in Greenacre Road, Poulter Street, Rosemont Street, Akuna Street, Spearing Parade, Northfields Avenue, Ralph Black Drive, Anama Street, Dallas Street, Parkview Grove, McGrath Street, Helen Brae Avenue, Hopewood Crescent, Clifford Street, Hurley Avenue, Dobinson Street, Lang Street, Maroota Avenue, John Street, Foothills Road, Marlo Road and Edgar Street (23).

f. In the 1% AEP event additional properties that experience overground flooding are located in Eastern Street, Foley Street, Stafford Street, Mount Ousley Road, Townsend Street, Hamilton Street, Dawson Street, Cabbage Tree Lane, Dixon Street, Brokers Road, Bootie Street and Robin Place (23).

g. 20% AEP event over ground flooding occurs in Achilles Avenue, Akuna Street, Ajax Avenue, Anama Street, Anne Street, Aristo Crescent, Armstrong Street, Balgownie Road, Balmoral Street, Bootie Street, Braeside Avenue, Brynymor Place, Buckle Crescent, Cabbage Tree Lane, Camphora Avenue, Cannell Crescent, Carters Lane, Cassian Street, Chalmers Street, Chapman Street, Clifford Street, College Place, Cosgrove Avenue, Cowper Street, Crawford Avenue, Daisy Street, Dawson Street, Dobinson Street, Donald Street, Eastern Street, Edgar Street, Elliotts Road, Exeter Avenue, Fisher Street, Florence Street, Foley Street, Foothills Road, Georgina Avenue, Gilmore Street, Gipps Road, Gipps Street, Graham Avenue, Grafton Street, Greenacre Street, Grey Street, Guest Avenue, Gwynne Street, Hamilton Street, Harkness Avenue, Hay Street, Helen Brae Avenue, Hillcrest Street, Hindmarsh Avenue, Hopewood Crescent, Hurley Avenue, Ira Avenue, Irvine Street, Jardine Street, Jobson Avenue, Lang Street, Lila Avenue, Lysaght Street Madeline Street, Marlo Road, Maroota Avenue, Matthews Street, McGrath Street, McLean Avenue, Mercury Street, Montague Street, Mount Ousley Road, Murphys Avenue, Murranar Road, Norman Street, Northcote Street, Northfields Avenue, Nyrang Street, Parkview Grove, Pioneer Road, Porter Street, Poulter Street, Princes Highway, Puckey Avenue, Rae Crescent, Railway Crescent, Ralph Black Drive, Rann Street, Robsons Road, Rose Street, Rosedale Avenue, Rosemont Street, Sherwood Drive, Smith Street, Spearing Parade, Stafford

Street, Storey Street, Squires Way, Townsend Street, Virginia Street, Watangi Street, Weekes Street, Wellington Drive, William Street, and Woodhill Street (23).

h. In the 5% and 1% AEP events properties affected by over ground flooding are located in Andrew Avenue, Bourke Street, Brokers Road, Blanchard Crescent, Church Street, Cochrane Street, Collaery Avenue, Dallas Street, Dixon Street, Dumfries Avenue, Dymock Street, Fairy Avenue, Fairy Street, Flinders Street, Foleys Lane, George Bailey Drive, Gowan Brae Avenue, Helen Street, Hillview Avenue, Holder Street, Hoskins Street, John Street, Kingsford Street, Lonbard Avenue, Mt Keira Road, Mountview Avenue, Noel Street, Robin Place, Soudan Street, Strone Avenue and University Avenue, in addition to the locations affected in the 20% AEP (23).

i. In the PMF event over ground flooding occurs in Gore Street, Hunter Street, Gownie Place, Sproule Crescent, Winton Place, Alvan Parade, Ryan Street, Russell Street, Sunninghill Circuit, Bellebrae Avenue, Winton Place, Cambridge Avenue, Michael Street, Moore Street, Sheppard Street, Dempster Street, Macquarie Street, Throsby Drive, Kiernan Street, Lucinda Street, Frances Street, Gaynor Avenue, Station Street, and all streets east of the Princes Highway, between Murranar Road/ Florence Street and Bourke Street/ Bode Avenue, in addition to the locations affected in smaller events (23).

j. The Bureau of Meteorology provides Severe Thunderstorm Warnings, and detailed Severe Thunderstorm Warnings for the heavily populated Wollongong Region. These warnings are relatively good flash flood warnings for the catchment (7).

**Table 17: Estimated No. Properties with Over Floor and Ground Flooding in the Fairy and Cabbage Tree Catchments (6)**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No Residential Properties with Over ground Flooding | No. Commercial Properties with Over floor Flooding | No. Commercial Properties with Over ground Flooding |
|---|---|---|---|---|
| **PMF** | 1,546 | 2,855 | 370 | 473 |
| **1% AEP** | 599 | 1,949 | 206 | 329 |
| **2% AEP** | 518 | 1,844 | 180 | 297 |
| **5% AEP** | 431 | 1,684 | 143 | 250 |
| **20% AEP** | 14 | 403 | 15 | 41 |

### 2.8.6 Isolation

a. Isolations in the catchment consist of the High Trapped Perimeter Areas, Overland Access Areas and High and Low Flood Islands described above.

### 2.8.7 Flood Mitigation Systems

a. There are a number of detention basins located in the Wollongong and Fairy Creek catchments as listed in **Error! Reference source not found.**. The consequences to roperty from these detention basins are unknown.

**Table 18: Detention basins located within the Fairy Creek and Wollongong Catchments**

| Location Details | Suburb | Catchment |
|---|---|---|
| **Wollongong High School** | Fairy Meadow | Fairy Creek Catchment |
| **Gilmore Park** | West Wollongong | Fairy Creek Catchment |
| **Nyrang Park** | West Wollongong | Fairy Creek catchment |
| **Gunyah Park on Dempster St** | West Wollongong | Fairy Creek Catchment |
| **Fisher Park** | West Wollongong | Fairy Creek Catchment |
| **Wisemans Park** | Gwynneville | Fairy Creek Catchment |
| **Foothills Road** | Mount Ousley | Cabbage Tree Creek catchment |
| **Brokers Road northern basin near Duncan St intersection** | Balgownie | Cabbage Tree Creek catchment |
| **Brokers Road southern basin at southern end of Brokers Road** | Balgownie | Cabbage Tree Creek catchment |

### 2.8.8 Dams

a. There are no dams located upstream of the Fairy and Cabbage Creek Catchment.

### 2.8.9 At Risk Facilities

a. There are eleven schools, three child care facilities and one aged care centre affected by flooding in the catchment. Details are shown in Annex 2.

### 2.8.10 Other Considerations

a. The University of Wollongong has increases in traffic at the morning and afternoon peaks during session.

b. Areas that have experienced flooding and damage in previous events include:

   i. Chalmers St culvert is a regular flood area.

   ii. Major damage has occurred in Anama St, Fairy Meadow, Montague St, Nth Wollongong with Campus East and Brandon Park also subject to flooding.

   iii. Porter St, North Wollongong west of the railway line has suffered flooding and then downstream water inundation occurs in Ajax and Exeter St's.

## 2.9 WOLLONGONG CITY CATCHMENT

### 2.9.1 Community Overview

a. The catchment includes the suburbs of Wollongong, Coniston and Mangerton (7). The Wollongong City Catchment is shown on Map 8.

b. The population of Wollongong in 2011 was 16,388 with 8,794 dwellings. Coniston (combined with Mt St Thomas) had a population of 3,741 with 1,597 dwellings and Mangerton had a population of 2,717 with 1,191 dwellings (17) (7).

c. The Wollongong City Catchment is comprised of a higher percentage than the broader Wollongong Local Government Area of non-English speakers with 30% of the residents speaking a language other than English at home (7).

d. The Wollongong City Catchment region has a lower car ownership percentage than the Wollongong LGA (7).

e. 53% of residents in the Wollongong City Catchment rent compared to 30% across the LGA (7).

f. Additionally, there is a high percentage of new residents in the area and are most likely residing in the new high density development around the golf course, train station and the Council building (7).

**Table 19: Population and Dwellings in Wollongong City Catchment (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Wollongong | 16,718 | 8,937 |
| Coniston | | |
| Mangerton | 2,821 | 1,247 |

### 2.9.2 Characteristics of flooding

a. The Wollongong City catchment is affected by overland flooding. During intense storm events runoff can exceed the capacity of the local subsurface drainage resulting in overland flow throughout the entire catchment. Additionally open channels in the lower catchment near JJ Kelly Park and the Golf Course are at a low elevation and have a low gradient causing flooding to occur via backwaters from tidal action within Port Kembla Inner Harbour. This can be exacerbated by coincident high tides (24).

### 2.9.3 Flood Behaviour

a. In the 1% AEP event floodways can be found along Gurungaty Waterway, in the creek on the south side of Springhill Road adjacent to the train line in Port Kembla Harbour, along the defined creek channels in JJ Kelly Park, along Swan Street, Kembla Street, Evans Street, Church Street, Keira Street, Kenny Street, Auburn Street, West Street, Finlayson Street, Beach Street, Glebe Street, Bank Street, Ellen Street, Corrimal Street,

Osbourne Street and Gladstone Avenue, in MacCabe Park, along the gully running from the western end of Myuna Way through property boundaries between Staff Street and Rowland Avenue meeting with Osbourne Street, at the Illawarra Railway crossing points at Osbourne Street, South Street, Union Street and Robertson Street, through the council reserve located on South Street and behind properties located on Wonson Avenue and Robertson Street (7).

b. In the PMF event the floodway can be found in the same locations as in the 1% AEP with the width of the floodway increasing and in many locations affecting properties located on the listed streets. Additional floodways can be found along Springhill Road, Grasmere Street, Gregory Street, Union Street, Atchinson Street, George Street, Stewart Street, Burelli Street and Crown Street. The Illawarra Railway at Wollongong Train Station and northern section on the Wollongong Cemetery also forms part of the floodway (7).

c. In the 1% AEP event flood storage areas can be found on the eastern side of Corrimal Street in Wollongong Golf Course, in JJ Kelly Park, on and to the east of Springhill Road south of the Swan Street intersection, on the western side of the Illawarra at the Osbourne Street, South Street, Union Street and Robertson Street crossings, on the eastern side of the Springhill Road and Masters Road intersection including over the rail line, on Gladstone Avenue between Grasmere Street and John Street and along Beach Street. Small sections of flood storage can also be found on the low lying parts of properties located on Swan Street and Kembla Street and in locations throughout the Steelworks and Port Kembla Harbour complex (7).

d. In the PMF event flood storage areas can be found in the same locations as in the 1% AEP with additional areas being found on Springhill Road and in the area surrounding Tate Street. Small sections of flood storage can also be found on low lying parts of properties located in the block bounded by Stewart Street, Kembla Street, Ocean Street, Church Street, Swan Street, Corrimal Street, bank Street ad Harbour Street (7).

e. In the 1% AEP event flood fringe areas can be found adjacent to the floodway and in the block bounded by Corrimal Street, Bank Street, Harbour Street, Burelli Street, Church Street, Ellen Street, Kenny Street, West Street, Auburn Street and Swan Street. Flood fringe areas can also be found on the Illawarra Railway at the Wollongong Train Station and in locations throughout the Steelworks and Port Kembla Harbour complex.

f. In the PMF event flood fringe areas can be found in the same locations as in the 1% AEP with additional areas being located on Robertson Street, north of Ellen Street in properties on Auburn Street, Atchison Street, Kenny Street and Keira Street, in properties on Union Street and Heaslip Street and south of Swan Street between Kenny Street and Keira Street (7).

### 2.9.4 Classification of Floodplain

#### Low Flood Islands

a. Low Flood Islands which initially become isolated and then inundated can develop in the following parts of the Wollongong City Catchment:

   i. Gladstone Avenue between Grasmere Street and John Street from the 5% AEP up to the PMF (7).

   ii. Gladstone Avenue between South Street, Heaslip Street and the Illawarra Railway from the 5% AEP up to the PMF event (7).

   iii. The block bounded by Frederick Street, Rowland Avenue, Ellen Street, Atchison Street and Dean Street from the 5% AEP to the PMF event (7).

   iv. Auburn Street between Swan Street and Miller Street in the 5% to the PMF event (7).

   v. The area bounded by Springhill Drive, Keira Street, Fox Avenue and Old Springhill Road in the PMF event. In events below the PMF the area has Rising Road Access (7).

   vi. The block bounded by Swan Street, Corrimal Street, Beach Street and Kenny Street in the 5% AEP event (7).

   vii. In the 1% AEP event the Low Flood Island at Swan Street is extended to the north to include the area bounded by Beach Street, Corrimal Street, Bank Street, Harbour Street, Stewart Street and Beatson Street. It also incorporates the area east of Corrimal Street including properties located on Ross Street and Swan Street. These areas change from High Flood Island to Low Flood Island between the 5% AEP and 1% AEP events (7).

   viii. In the PMF event the Low Flood Island at Swan Street is extended to include the area bounded by the Illawarra Railways, Swan Street, Kenny Street and West Street, the area bounded by Corrimal Street, Bank Street, Kembla Street and Glebe Street and the eastern side of JJ Kelly Park. These areas were previously High Flood Islands (7).

#### High Flood Islands

b. High Flood Islands which become isolated by surrounding floodwaters but still have some high ground flood free can develop in the following parts of the Wollongong City Catchment:

   i. In the 5% AEP event there are High Flood Islands located in the industrial areas south of Springhill Road, in the area east of Corrimal Street including properties located on Ross Street and Swan Street and the area bounded by the Illawarra Railway, Swan Street, Kenny Street, Beach Street, Corrimal Street, Bank Street,

Harbour Street, Stewart Street, Beatson Street, Glebe Street, Kembla Street and Ellen Street (7).

ii. In the 1% AEP event the High Flood Island located to the east of the Illawarra Railway is extended north to include properties located between Atchison Street and Keira Street. The area also has its eastern portion converted to a Low Flood Island (7).

iii. In the PMF event the High Flood Island located to the east of the Illawarra Railway in extended to the north up to Stewart Street. Part of the south and east of the flood island are converted to Low Flood Islands (7).

iv. In the PMF event there is a High Flood Island located to the north of Springhill Drive in the industrial area surrounding John Cleary Place (7).

**Rising Road Access**

c. All other areas have Rising Road Access in all events (7).

### 2.9.5 Inundation

a. In all events inundation occurs in industrial areas south of Springhill Road and Masters Road, in the area bounded by the Illawarra Railway, Bridge Street, Springhill Road, the Wollongong Golf Course, Harbour Street and Keira Street and to the west of the Illawarra Railway affecting all roadways and properties located in the valleys. The depths of water varies across the area however the areas at greatest risk of high depths are in the south eastern portion of the catchment and are listed as high and low flood islands above (7).

b. Some high risk areas, in terms of property and risk to life, include:

i. Swan Street, and the southern parts of Kembla, Evans and Church Streets;

ii. Springhill Road, particularly between Swan Street and Keira Street;

iii. Springhill Road, 200m to 300m south of Masters Road;

iv. Springhill Road near Tom Thumb Road and Bridge Street;

v. Trapped depressions along Gladstone Avenue upstream of the railway line, particularly near Osborne Street, Union Street, Robertson Street, and Vale/Grasmere Streets;

vi. Auburn Street, just south of Swan Street;

vii. Allan Street behind Rowland Avenue and the retirement village on Staff Street;

viii. Vacant land at the northern end of Gregory Street; and

ix. Wollongong Golf Club.

c. The Bureau of Meteorology provides Severe Thunderstorm Warnings, and detailed Severe Thunderstorm Warnings for the heavily populated Wollongong Region. These warnings are relatively good flash flood warnings for the catchment (7).

**Table 20: Estimated No. Properties with Over Floor and Ground in the total Wollongong City Catchment (7)**

| Design Flood Event (% AEP) | No. Properties with Over floor Flooding | No. Properties with Over ground Flooding |
|---|---|---|
| **PMF** | 940 | 2352 |
| **1% AEP** | 361 | 1539 |
| **2% AEP** | 337 | 1512 |
| **5% AEP** | 201 | 1410 |
| **10% AEP** | 172 | 1377 |
| **20% AEP** | 149 | 1339 |

**Table 21: Estimated No. Properties with Over Floor and Ground Flooding in Wollongong City Catchment – upstream (west) of the Illawarra Railway (7)**

| Design Flood Event (% AEP) | No. Properties with Over floor Flooding | No. Properties with Over ground Flooding |
|---|---|---|
| **PMF** | 358 | 1,220 |
| **1% AEP** | 118 | 538 |
| **2% AEP** | 113 | 538 |
| **5% AEP** | 47 | 537 |
| **10% AEP** | 43 | 536 |
| **20% AEP** | 40 | 534 |

**Table 22: Estimated No. Properties with Over Floor and Ground Flooding in Wollongong City Catchment – downstream (east) of the Illawarra Railway (7)**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Residential Properties with Over ground Flooding | No. Commercial Properties with Over floor Flooding | No. Commercial Properties with Over ground Flooding |
|---|---|---|---|---|
| **PMF** | 321 | 690 | 261 | 442 |
| **1% AEP** | 107 | 608 | 136 | 393 |
| **2% AEP** | 95 | 590 | 129 | 384 |
| **5% AEP** | 64 | 533 | 90 | 355 |
| **10% AEP** | 55 | 501 | 74 | 340 |
| **20% AEP** | 47 | 478 | 62 | 327 |

### 2.9.6 Isolation

a. Isolations in the catchment consist of the areas defined as High and Low Flood Islands above.

### 2.9.7 Flood Mitigation Systems

a. There are no known detention basins in the Wollongong City Catchment (7).

### 2.9.8 Dams

a. There are no dams located upstream of the Wollongong City Catchment.

### 2.9.9 At Risk Facilities

a. There are nine child care centres, four aged care facilities and two schools that are affected by flooding. Details are shown in Annex 2 (7).

### 2.9.10 Other Considerations

a. Win Stadium and the Entertainment Centre are located on Harbour Street in Wollongong. Additional traffic will be located around this precinct when events are scheduled. Access is affected by flooding on Corrimal Street and Masters Road prior to the 5% AEP event (7).

## 2.10 ALLANS CREEK CATCHMENT

### 2.10.1 Community Overview

a. The Allans Creek catchment is located directly to the west and south west of the Wollongong CBD.

b. The Allans Creek catchment includes the suburbs of Mount Keira, West Wollongong, Mangerton, Figtree, Mount Kembla, Cordeaux Heights, Farmborough Heights and Unanderra. Allans Creek Catchment is shown on Map 9.

**Table 23: Population and Dwellings in Allans Creek Catchment (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| West Wollongong | 4,706 | 2,029 |
| Mount Keira | 1,522 | |
| Mount Kembla & Cordeaux Heights | 5,792 | 1,837 |
| Mangerton | 2,717 | 1,191 |
| Unanderra | 5,924 | 2,501 |
| Figtree | 10,625 | 4,038 |
| Farmborough Heights | 4,181 | 1,452 |

### 2.10.2 Characteristics of flooding

a. Allans Creek catchment is affected by flash and overland flooding with short warning times (1).

### 2.10.3 Flood Behaviour

a. The Allans Creek catchment includes Byarong, Branch, American, Ghost, Nudjia, Allans, Charcoal, Jenkins, Running, Brandy and Water Creeks. Allans Creek drains to Tom Thumb Lagoon and Port Kembla Harbour and is influenced by tidal conditions as far upstream as the M1 Motorway (8).

b. A series of urbanised drainage systems also feed into these main tributaries along with a series of road areas and parks that act as floodways during rare and extreme event. These include: Arrow Avenue, Bellevue Road, Berkeley Road, Blackman Parade, Cleverdon Crescent, Cordeaux Road, Cummins Creek, Figtree Park, Five Islands Road, F6 Freeway, Govett Crescent, Grace Street, Hargraves Street, Princes Highway, O'Briens Road, Illawarra Railway, Resolution Drive, Rickard Road, Sheringa Grove, Springhill Road, Tresnan Road, Wallawa Street, Figtree Grove (shopping centre) and various drains in the Unanderra area (8).

### 2.10.4 Classification of Floodplain

#### Low Flood Islands

a. In the 5% AEP event there are Low Flood Islands located in:

i. the area between the Princes Highway, Illawarra Railway, Old Five Islands Road and Central Road,

ii. the area between Five Islands Road, Princes Motorway and the Illawarra Railway and

iii. The areas listed as High Flood Islands (see below) all become low flood islands in the 5% AEP (8).

### High Flood Islands

b. In the 20% AEP event High Flood Islands can be found in:

i. Figtree Grove, Princes Highway between Byarong Creek crossing and Bellevue Road,

ii. The Avenue between Cleverdon Crescent and Preston Street,

iii. the area bounded by Avalon Terrace, Grafton Avenue and Cleverdon Crescent and

iv. the area surrounding the Figtree Gardens Caravan Park.

c. In the 5% AEP these all become Low Flood Islands (8).

### Rising Road Access

d. All other locations have Rising Road Access in all events (8).

## 2.10.5 Inundation

a. There are three flood level gauges, owned by MHL, located in the Allans Creek catchment: Koloona Avenue Upstream Gauge (214425), Blackmans Parade Upstream Gauge (214430) and Byarong Creek Gauge (214420). There are currently no warnings issued to these gauges.

b. Hazard mapping of the Allans Creek Catchment shows that some residential properties in Unanderra, Cordeaux Heights and Figtree are located in High Hazard Areas (8).

c. Key risk areas identified as:

i. Koloona Avenue (Byarong Creek)

ii. Harry Graham Park (Byarong Creek)

iii. Govett Crescent / Suttor Place (American Creek)

iv. Old Five Islands Road (Unanderra)

v. Arrow Avenue (Byarong Creek)

vi. Rickard Road (Charcoal Creek)

vii. Preston & Seddon Streets (Byarong Creek)

d. The Avenue to Lysaght Oval (Byarong Creek / American Creek)

e. Major flooding in this area is in Wallawa St and Arrow Ave, Figtree then crossing through Figtree Shopping Centre. O'Brien's Rd, Unanderra flooding regularly with traffic disruptions to Springhill Rd at times.

f. Most significant rain events results in reports of persons stuck in vehicles in flood waters at the junction of Five Islands Road and the F6 off ramp.

g. In the 20% AEP event flooding affects properties located in Koloona Avenue, Valley Drive, Casurina Place, Coronata Drive, Eugena Place, Euroka Street, Whelan Avenue, Langson Avenue, Uralba Street, Risley Road, Darragh Drive, Jacaranda Avenue, Cypress Avenue, Thames Street, The Mall, Wallawa Street, Arrow Avenue, The Princes Highway, Seddon Street, Preston Street, Cleverdon Crescent, Grafton Avenue, O'Briens Road, Baker Crescent, Foy Avenue, Govett Crescent, Gibsons Road, Sheringa Grove, Chapman Street, Hutt Parade, Albert Street Carr Parade, Richards Street, Fraser Street, Grace Street, Nudjia Road, Hargraves Street, Marley Place, Cummins Street, Tresnan Street, Beatus Street, Coachwood Drive, Hibiscus Place, Rickard Road, Blackman Parade, Waples Road, River Oak Road, Normandie Place, Resolution Drive, Five Islands Road and Prince of Wales Avenue (8).

h. In the 5% AEP event flooding affects properties located in Avalon Terrace, Arkell Drive, Northview Terrace, Platypus Close, Alandale Avenue, O'Donnell Drive, Edmund Avenue, Musgrave Place, Central Road, Leigh Crescent Alukea Road, Derribong Drive, Old Five Islands Road, First Avenue, O'Neil Street, Short Street, Second Avenue, Third Avenue, Fourth Avenue, Tannery Street and Gladstonbury Avenue in addition to the locations affected in smaller events (8).

i. In the 1% AEP event flooding affects properties located in Springhill Road in addition to the locations affected in smaller events (8).

j. In the PMF event flood affects properties located in Waynote Place in addition to the locations affected in smaller events (8).

**Table 24: Estimated No. Properties with Over Ground Flooding in the Allans Creek Catchment (8)**

| Design Flood Event (% AEP) | No. Residential Properties with Over ground Flooding | No. Commercial Properties with Over ground Flooding | No. Industrial Properties with Over ground Flooding | Total Properties with Over ground Flooding |
|---|---|---|---|---|
| **PMF** | 785 | 76 | 72 | 933 |
| **1%** | 590 | 37 | 37 | 664 |
| **2%** | 555 | 36 | 36 | 627 |
| **5%** | 498 | 31 | 32 | 561 |
| **10%** | 265 | 22 | 14 | 301 |
| **20%** | 217 | 21 | 11 | 249 |

**Table 25: Estimated No. Properties with Over Floor Flooding in the Allans Creek Catchment (8)**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | No. Industrial Properties with Over floor Flooding | Total Properties with Over floor Flooding |
|---|---|---|---|---|
| **PMF** | 507 | 64 | 64 | 635 |
| **1%** | 317 | 25 | 34 | 376 |
| **2%** | 276 | 21 | 33 | 330 |
| **5%** | 230 | 18 | 29 | 277 |
| **10%** | 65 | 13 | 7 | 85 |
| **20%** | 44 | 12 | 4 | 60 |

### 2.10.6 Isolation

a. Isolations in the Allans Creek catchment are listed above as High and Low Flood Islands.

### 2.10.7 Flood Mitigation Systems

a. There are no known detention basins or flood mitigation systems located in the Allans Creek catchment (8).

### 2.10.8 Dams

a. There are no known dams located upstream of the Allans Creek catchment (8).

### 2.10.9 At Risk Facilities

a. **Figtree Gardens Caravan Park** is a particularly high hazard area. It is a large scale caravan park located in the lower parts of the American Creek floodplain and is classified as a low flood island in events above a 5% AEP. A number of the caravans are likely to be immovable in the time of flood, there is insufficient warning time to prepare for evacuation, and the access to and from the park is through a high hazard area (8).

b. There are six schools, three aged care facilities, a hospital and a caravan park that are affected by floodwaters in the Allans Creek catchment. Details are shown in Annex 2 (8).

### 2.10.10 Other Considerations

a. High density of population located within the Westfield Figtree shopping complex.

## 2.11 MULLET/BROOKS CREEK CATCHMENTS

### 2.11.1 Community Overview

a. The Mullet Creek catchment is located 12 km south of Wollongong and sits between the Illawarra Escarpment to the west and Lake Illawarra to the east. The Mullet Creek and Brooks Creek Catchments are shown in Maps 10 & 11.

b. The Mullet/Brooks Creek catchment includes the suburbs of Farmborough Heights, Dombarton, Kembla Grange, Wongawilli, Huntley, Avondale, Brownsville, Kanahooka, Horsley, Cleveland, Dapto, Penrose, Koonawarra and West Dapto. The population of these suburbs is shown below.

c. A large proportion of the Mullet/Brooks Creek catchment is earmarked for urban development over the next 40 years. The West Dapto Masterplan has identified a developable area of 1.328 hectares, which is expected to provide space for 19.000 dwellings, housing 55.000 people potentially trebling the existing population. The development of the West Dapto Release Area could affect flood behaviour in a number of ways (9).

**Table 26: Population and Dwellings in Mullet Creek Catchment (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Kembla Grange | 5,924 | 2,501 |
| Wongawilli | 184 | 66 |
| Huntley | 307 | |
| Avondale / Cleveland / Marshall Mount / Penrose | 352 | 134 |
| Kanahooka | 5,167 | 2,062 |
| Koonawarra | 3,633 | 1,355 |
| Horsley | 7,056 | 2,322 |
| Dapto, Penrose, Brownsville | 12,725 | 5,128 |
| West Dapto | 10,735 (Dapto) | 4,234 (Dapto) |

### 2.11.2 Characteristics of flooding

a. The Mullet Creek catchment and Brooks Creek catchment is subject to a combination of riverine flooding and overland flooding. The catchment is extremely steep, sloping from 600mAHD to 50mAHD and has been progressively urbanised in areas, resulting in very dynamic flash flooding with rapid rises and falls (9).

b. Flooding occurring from Lake Illawarra is primarily a combination of overland and riverine flooding and is slow to rise and fall. The flooding is influenced by the tidal nature of the lake (9).

### 2.11.3 Flood Behaviour

a. The Mullet Creek catchment includes Mullet Creek, its tributaries and Brooks Creek. The flow from these catchments discharge to Lake Illawarra at separate locations. (9)

b. The Mullet Creek floodplain covers the entire golf course and racecourse area between the F6 Freeway and the Princes Highway with flood depths predicted to be greater than 1.5m in the 1% AEP (9).

c. Flow discharges to Lake Illawarra by either the southern or northern outlet and the main flow path is via Mullet Creek and exits the catchment through the southern outlet. The remaining flow follows either Tank Trap Channel, Hooka Creek or becomes overland flow through the park before discharging into Lake Illawarra the northern outlet (9).

d. The Brooks Creek floodplain is significantly narrower than the Mullet Creek floodplain and is mainly confined to the channel until reaching Fowlers Road and Byamee Street (9).

e. Flow from the Brooks Creek catchment discharges to Lake Illawarra via three flow paths; the main creek channel, underneath Lakeside Drive and down Edgeworth Avenue (9).

f. High velocities are predicted in the 1% AEP event in the area on the northern side of Horsley near Huxley Drive, near Sunnybank Crescent, the flow path parallel to Hamilton Street and near Ena Avenue (9).

### 2.11.4 Classification of Floodplain

a. A High Flood Island is created in Bambil Crescent in the PMF event (9).

b. Rural properties located to the west of Dapto become Overland Access Areas in all events from the 20% AEP event (9).

c. Horsley becomes an Overland Access Area from the 20% AEP event (9).

d. All other locations have Rising Road Access (9).

### 2.11.5 Inundation

a. There is one flood level gauge, owned by MHL, located on Mullet Creek: Mullet Creek Gauge (214400). There are currently no warnings issued to this gauge.

b. Properties affected by over-ground and over flood flooding within the Mullet and Brooks Creek catchments are shown in Tables 26 and 27.

**Table 27: Estimated No. Properties with Over Ground Flooding in the Mullet and Brooks Creek Catchments (25).**

| Design Flood Event (% AEP) | No. Residential Properties with Over ground Flooding | No. Commercial Properties with Over ground Flooding | Total Properties with Over ground Flooding |
|---|---|---|---|
| **PMF** | 1,061 | 97 | 1,158 |
| **1%** | 214 | 25 | 239 |
| **2%** | 183 | 21 | 204 |
| **5%** | 154 | 20 | 174 |
| **10%** | 39 | 16 | 55 |
| **20%** | 22 | 14 | 36 |

**Table 28: Estimated No. Properties with Over Floor Flooding in the Mullet and Brooks Creek Catchments (25).**

| Design Flood Event (% AEP) | No. Residential Properties with Over floor Flooding | No. Commercial Properties with Over floor Flooding | Total Properties with Over floor Flooding |
|---|---|---|---|
| **PMF** | 509 | 79 | 588 |
| **1%** | 77 | 21 | 98 |
| **2%** | 58 | 19 | 77 |
| **5%** | 44 | 18 | 62 |
| **10%** | 4 | 11 | 15 |
| **20%** | 1 | 5 | 6 |

### 20% AEP event

c. In the 20% AEP event properties affected by flooding are located in Wongawilli Road, Homestead Drive, Shone Avenue, Horsley Drive, Greenbrook Place, Cleveland Road, Avondale Road, Ena Avenue, West Dapto Road, Princes Highway, Hooka Creek Road, Essex Street, Sussex Street, Darkes Road, Hamilton Street, Burringbar Street, Kembla Grange Pl, Marshall Street, Beltana Avenue, Lakelands Drive, Trackside Drive, Cambridge Road, Bambil Crescent, Edgeworth Avenue, Oaks Avenue and Valley Way (9).

d. The Grange Golf Club and Kembla Grange Racecourse are inundated by floodwaters in the 20% AEP event (23).

### 10% AEP event

e. In the 10% AEP event properties affected by flooding are located in Parkdale Avenue, Oakhurst Close, London Street, Rogers Avenue, William Beach Road, Culgoa Crescent, Byamee Street, Toronto Avenue, Julianne Street, Brown Avenue, St James Crescent and Bong Bong Road in addition to those affected in smaller events (9).

f. Over floor flooding affects properties located on Cleveland Road, Bong Bong Road, West Dapto Road, Kembla Grange Place, Darkes Road, Trackside Drive, St James Crescent and Oaks Avenue (25).

#### 5% AEP event

g. In the 5% AEP event properties affected by flooding are located in Prince Edward Drive, Lakeside Drive, Palmer Avenue, Howell Avenue, Wallabah Way, Eleebana Crescent and Aldinga Avenue in addition to those affected in smaller events (9).

#### 1% AEP event

h. In the 1% AEP event properties affected by flooding are located in Dale Street, Pharlap Avenue, Hore Street, Windsor Crescent, Regal Place, Melrose Way Rondanella Drive, Hertford Street, Murra Murra Road and McCabe Street in addition to those affected in smaller events (9).

i. In the 1% AEP event over floor flooding affects properties located on Avondale Road, Burringbar Street, Hamilton Street, Hore Street, Prince Edward Drive, Essex Street, Melrose Way, Shone Avenue, Horsley Drive, Brown Avenue, Beltana Avenue, Lakelands Drive, Cambridge Road, Culgoa Crescent and Edgeworth Avenue (25).

#### PMF event

j. In the PMF event properties affected by flooding are located in Glen Ayre Avenue, Glenwood Grove, Winnilong Way, Dombarton Place, Ritchie Crescent, Huxley Drive, Sunnybank Crescent, Barlyn Circuit, Eastwood Place, Woodridge Road, Goodman Place, Reed Park Place, Sierra Drive, Trifecta Place, Manikato Place, Kingston Town Drive, Sailsbury Street, Oxford Street, Bedford Street, Kent Street, Brownsville Avenue, Kundle Street, St Lukes Avenue, Barham Place, Station Street, North Terrace, Unara Road, Elizabeth Street, Shell Place, Craig Crescent, Rink Road, Cirrus Street, Robert Street, Bangaroo Avenue, Bingara Avenue, Alcoomie Crescent, Caloola Crescent, Erang Place, Bundella Place, Lakeline Drive, Casurina Crescent, Callistemon Crescent, Willow Tree Avenue and Angophora Crescent in addition to those affected in smaller events (9).

#### Other

k. Floodwaters also inundate rural lands located in the floodplains of each creek system (25).

### 2.11.6 Isolation

a. Horsley becomes isolated in the 20% AEP event. The community is isolated for a short period (up to 6 hours) (9).

b. Rural properties located in Cleveland, Avondale and Marshall Mount may experience isolations (1).

c. West Dapto will become inaccessible if there is overtopping at West Dapto Road, Darkes Road and Bong Bong Road. These road closures will also cause the isolation of rural properties located to the west of Dapto in the 20% AEP event (9).

### 2.11.7 Flood Mitigation Systems

a. The Kanahooka Detention Basin is located on Stanthorpe Dr in Kanahooka. Properties located in the areas adjacent to the basin and its culvert outlet on Stanthorpe Dr, Rondanella Dr and Olivia Pl are at risk of flooding in the event of the basin wall overtopping or failing (26).

### 2.11.8 Dams

a. There are no dams located upstream of the Mullet and Brooks Creek catchments.

### 2.11.9 At Risk Facilities

a. There is one school and one retirement village that are impacted by flooding. Details are listed in Annex 2.

b. The Illawarra Railway line at Kembla Grange, near Darkes Road and near McCabe Street is affected by floodwaters (1).

c. Possible loss of sewerage services to approx 2000 properties for up to 5 days and approx 4000 properties for up to 2 weeks.

d. Possible loss of water supply to approx. 15,000 people for up to 5 days including Dapto High School.

e. Flooding may cause pipe failure to Sydney water assets in area. This could impact on water supply to BlueScope Steel resulting in a loss of steel production.

### 2.11.10 Other Considerations

a. Rural properties with livestock are located at the base of the escarpment. Illawarra Racecourse and numerous stable facilities and properties located at Kembla Grange.

b. Existing coal operations may be interrupted or impacted due to flood events resulting in some economic loss due to delayed rail and truck movements. Coal wash stockpiles and runoff dams located at Wongawilli and Kembla Grange may require monitoring by owner.

## 2.12 MINNEGANG CREEK CATCHMENT

### 2.12.1 Community Overview

a. Minnegang Creek flows through the suburb of Lake Heights, extending from the northern shore of Lake Illawarra to the intersection of Lake Heights Road and Flagstaff Road. The catchment is located to south of the Wollongong CBD, on the northern shore of Lake Illawarra. Minnegang Creek Catchment is shown in Map 12.

b. The catchment is almost entirely developed with 80% of the catchment comprising low density residential housing and the remaining 20% recreational and cleared land (10).Lake Heights had a population of 3,404 with 1,477 dwellings in 2011 (17).

**Table 29: Population and Dwellings in Minnegang Creek Catchment (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Lake Heights | 3,259 | 1,405 |

### 2.12.2 Characteristics of flooding

a. The Minnegang Creek catchment is affected by a combination of flash and overland flooding (27).

### 2.12.3 Flood Behaviour

a. The Minnegang Creek catchment is steep and flows are normally contained within the creek system. Overland flooding can occur when the drainage systems capacity has been met. This flooding can be widespread and has shallow water depths. There is little difference between the flood extents of different sized events (27).

b. High velocity flows can be found within the creek system, and through some drainage structures. High risk locations include Minnegang Creek's intersection with; Lake Heights Road, Barina Road, Gilgandra Street, Mirrabooka Road, Weringa Avenue and the exit of Barina Park detention basin (27) (10).

c. Significant water depths can be found within Minnegang Creek, upstream of the Lake Heights Road culvert, upstream of the start of the drainage system and within the Barina Park detention basin where depths of up to 3m may occur (27).

### 2.12.4 Classification of Floodplain

a. Lake Heights has Rising Road Access in all flooding events (28).

### 2.12.5 Inundation

a. There is little difference between the flood extents of different sized events (27).

b. The highest concentration of affected properties lies directly downstream of Barina Park (8).

c. Properties upstream of the Barina Park detention basin that may be affected by flooding in the 1% AEP and PMF events are located adjacent to Minnegang Creek and the Melinda Grove flowpath on Ranchby Avenue, Lake Heights Road, Barina Avenue, Karrabah Crescent and Gilgandra Street (28).

d. Properties downstream of the Barina Park detention basin that may be affected by flooding in the 1% AEP and PMF events are located adjacent to Minnegang Creek on Mirrabooka Road, Weringa Avenue, Denise Street, Trevor Avenue and Northcliffe Drive (28).

**Table 30: Estimated No. Properties with Over Floor and Ground Flooding in Lake Heights (27).**

| Design Flood Event (% AEP) | No. Properties with Over floor Flooding | No. Properties with Over-ground Flooding |
|---|---|---|
| **PMF** | 20 | 59 |
| **1% AEP** | 17 | 48 |
| **2% AEP** | 17 | 44 |
| **5% AEP** | 13 | 43 |
| **20% AEP** | 5 | 35 |

### 2.12.6 Isolation

a. There are no known isolations within the Minnegang Creek catchment (28).

### 2.12.7 Flood Mitigation Systems

a. There is one detention basin in the Minnegang Creek catchment, located at Barina Park. The Barina Park detention basin has sufficient capacity to prevent spilling in a flood event slightly smaller the 20% AEP event. Water depths of 3m can be found within the detention basin (27).

b. The consequences of the failure of the embankment are unknown.

c. There are no other flood mitigation systems located in the Minnegang Creek catchment (27).

### 2.12.8 Dams

a. There are no dams located upstream of the Minnegang Creek catchment.

### 2.12.9 At Risk Facilities

a. There are no at risk facilities identified in the catchment.

### 2.12.10 Other Considerations

a. The Illawarra Yacht Club is located on Northcliffe Drive in Lake Heights at the base of Minnegang Creek, where it discharges into Lake Illawarra. The Club and its grounds may be impacted by floodwaters in the 1% AEP and PMF events (28).

## 2.13 LAKE ILLAWARRA

### 2.13.1 Community Overview

a. Lake Illawarra is located to the south of the Wollongong CBD and lies within the Wollongong City Council and Shellharbour City Council local government areas. Suburbs located in the Wollongong City LGA within the Lake Illawarra catchment are Kemblawarra, Koonawarra, Warrawong, Lake Heights, Yallah, Windang, Berkeley, Primbee and Kanahooka (1). The Lake Illawarra catchment is shown on Map 13.

**Table 31: Population and Dwellings in Lake Illawarra (17)**

| Suburb | Population | Private Dwellings |
|---|---|---|
| Kemblawarra | unknown | unknown |
| Warrawong | 4,770 | 2,156 |
| Lake Heights | 3,404 | 1,477 |
| Haywards Bay / Yallah | 693 | 222 |
| Kanahooka | 5,255 | 2,109 |
| Koonawarra | 3,490 | 1,305 |
| Windang / Primbee | 4,177 | 1,964 |
| Berkeley | 7,235 | 2,907 |

### 2.13.2 Characteristics of flooding

a. The Lake Illawarra catchment is affected by a combination of flash, riverine and overland flooding. Flood heights are dependent on the ocean tides however can rise quickly with inflows from Mullet Creek and Macquarie Rivulet (11).

b. Flooding can occur as a result of runoff from the creek systems entering the lake, or wind set-up, tides, wind-wave action and wave set-up from the lake and entrance (11).

c. Lake Illawarra is also at risk of coastal inundation with up to 179 land parcels considered to be at risk under 2010 sea level conditions (18).

### 2.13.3 Flood Behaviour

a. Floodwaters within the lake body usually have slow velocities. Floodwaters accelerate into the entrance channel out to the Tasman Sea. The rate and depth of flooding of the lake and its foreshores are controlled not only by the rate of catchment runoff but also to a large extent by the size and degree of shoaling of the lake entrance channel and the ocean level (11).

b. Hazard mapping for the PMF and 1% AEP event is provided in the Lake Illawarra FRMS (11). In the 1% AEP event some of the properties on the lake foreshore are in High or Low hazard areas, particularly surrounding Griffins Bay, Primbee and Windang. The Tallawarra Power is also located in the high hazard area, as is Windang Bridge. A similar

pattern is shown in the PMF event, although a more extensive area is High Hazard, particularly at Primbee and Windang (11).

**Table 32: Flood Heights on Lake Illawarra at the Cudgeree Bay Gauge (214416) (11)**

| Event | Level (AHD) |
|---|---|
| **PMF** | 3.19m |
| **1%** | 2.24m |
| **2%** | 1.99m |
| **5%** | 1.81m |
| **10%** | 1.54m |
| **20%** | 1.40m |
| **50%** | 1.08m |

### 2.13.4 Classification of Floodplain

a. Windang is a low flood island in the 1% AEP event (2.24m at Cudgeree Bay Gauge). It is not known at what height this begins (11).

b. Primbee can become a high flood island in the PMF (3.19m at the Cudgeree Bay Gauge (214416)) (11).

c. All other locations have Rising Road Access in events from the 1% AEP event (2.24m at Cudgeree Bay Gauge (11).

### 2.13.5 Inundation

a. There are three gauges, owned by MHL, located in Lake Illawarra: Koonawarra Point Gauge (214440), Lake Illawarra Entrance Gauge (214417) and Cudgeree Bay Gauge (214416). An alert system, sends notifications to Wollongong City Unit for the Cudgeree Bay Gauge (214416) when the water level reaches particular thresholds.

b. Flooding primarily occurs around the lake foreshore, and in particular at Primbee, Albion Park Rail, Yallah, Oak Flats and Kanahooka (11).

#### 1% AEP Event

c. In the 1% AEP (2.24m at Cudgeree Gauge) event, all of the urban areas of Windang Peninsula are inundated (excluding a few properties on Ocean Street) including major and minor access roads. In the PMF event the entire urban area experiences inundation. Inundation can occur for long periods of time (18 -24 hours) (11).

d. In the 1% AEP event properties affected by floodwaters are located on Windang Road, Lakeview Parade, Bundah Place, Purry Burry Avenue, Fairymeadow Parkway, Kiara Place, Nicolle Road, Werrang Road, Government Road, Golf Place, King Street, Shellharbour Road, Kemblawarra Road, Carlotta Crescent and Northcliffe Drive (11).

### PMF event

e. In the PMF event (3.19m at the Cudgeree Bay Gauge) properties affected by floodwaters are located on Hoskins Avenue, Cowper Street, First Avenue, Margaret Street, Stuart Road, Kully Way, Minnegang Street, Venn Street, Wilkinson Street, Yawang Street, Narrawan Street, Bourke Way, Winnima Way and Holborn Street in addition to those impacted in the 1% AEP event (11).

**Table 33: Estimated No. Properties with Over Floor Flooding in the Lake Illawarra Catchment Related to the Cudgeree Bay Gauge (214416) (11)**

| Design Flood Event (% AEP) | No. Properties with Over floor Flooding | No. Caravans Flooded |
|---|---|---|
| **PMF (3.19m)** | 620-627 | 644-645 |
| **1% AEP (2.24m)** | 139-157 | 458-459 |
| **2% AEP (1.99m)** | 37-45 | 200 |
| **5% AEP (1.81m)** | 10 | - |
| **10% AEP (1.54m)** | 1 | 20 |
| **20% AEP (1.4m)** | 0 | 0 |
| **50% AEP (1.08m)** | 0 | 0 |

### 2.13.6 Isolation

a. The suburb of Windang is isolated in the 1% AEP event (2.24m at Cudgeree Bay Gauge). The exact height isolation occurs is unknown but will occur prior to the 1% AEP event. In the 1% AEP event isolation can occur for up to 18 hours and during the PMF event can occur for up to 24 hours (11).

### 2.13.7 Flood Mitigation Systems

a. There are no existing levees in the Lake Illawarra catchment and no information regarding detention basins was documented.

### 2.13.8 Dams

a. There are no dams located upstream that affect flooding in Lake Illawarra.

### 2.13.9 At Risk Facilities

a. There are five caravan parks, one school and one preschool affected by flooding in the Lake Illawarra catchment. They are described in Annex 2.

b. The Tallawarra Power Station, located on the western foreshore of Lake Illawarra is at risk of flooding in the 1% AEP event (2.24m at Cudgeree Bay gauge) (11).

### 2.13.10 Other Considerations

a. No other considerations.

# SPECIFIC RISK AREAS – COASTAL EROSION AND INUNDATION

## 2.14 COASTAL EROSION AND INUNDATION

a. The locations outlined in Table 34 have been identified as being at risk of coastal erosion and/or coastal inundation within the Wollongong LGA based on 2010 sea levels. These are also shown on Map 1.

b. Of these locations, the largest number of properties at risk of coastal inundation are those located near Lake Illawarra and Thirroul Beach.

c. Coastal erosion is currently mainly a risk to public facilities rather than residential dwellings along the Wollongong coast including Surf Life Saving Clubs, rock pools and parking and road infrastructure.

d. Additional facilities and properties have been identified as being at risk in the future with sea level rises (18).

**Table 34: Coastal Erosion and Inundation Risk during a 1% AEP storm event along the Wollongong LGA Coastline based on 2010 sea level modelling (18)**

| Beach Name | Coastal Erosion Risk | Coastal Inundation Risk |
|---|---|---|
| **Stanwell Park Beach** | Helensburgh-Stanwell Park SLSC & car park | 24 land parcels<br>Roads |
| **Coalcliff Beach** | SLSC & car park Coalcliff<br>Coalcliff Tidal Rock Pool | 16 land parcels |
| **Scarborough/Wombarra Beach** | SLSC Illawarra Park (off Monash<br>Street, Wombarra) | 1 land parcel<br>Roads |
| **Coledale Beach** | No impacts expected | 2 land parcels<br>Roads |
| **Sharkies Beach, Austinmer** | Austinmer boat harbour car park | 3 land parcels |
| **Austinmer and Austinmer North Beaches** | Tuckerman Park car park<br>Austinmer Rock Baths | 10 land parcels |
| **Thirroul Beach** | SLSC & car park Thirroul<br>Thirroul Saltwater Pool | 173 land parcels<br>Roads |
| **McCauleys Beach, Bulli** | Cycleway<br>Sandon Point Tent Embassy | 29 land parcels<br>Roads |
| **Sandon Point Beach, Bulli** | SLSC Sandon Point | 24 land parcels<br>Roads |
| **Bulli Beach** | Bulli Rock Baths<br>Cycleway | 24 land parcels |

| Beach Name | Coastal Erosion Risk | Coastal Inundation Risk |
|---|---|---|
| **Woonona/Bellambi Beach** | No impacts expected | 66 land parcels<br>Roads |
| **Bellambi Harbour, Bellambi Point and Corrimal Beach** | Bellambi Tidal Rock Pool | 58 land parcels<br>Roads |
| **Towradgi/Fairy Meadow and North Wollongong Beaches** | SLSC North Wollongong<br>Towradgi Tidal Rock Pool<br>Cycleway | 13 land parcels<br>Roads |
| **Wollongong City / Coniston Beach** | Wollongong Golf Course | 12 land parcels |
| **Perkins Beach, Primbee** | No impacts expected | 7 land parcels |
| **Lake Illawarra** | No impacts expected | 176 land parcels<br>Roads |

# ROAD CLOSURES AND ISOLATED COMMUNITIES

## 2.15 ROAD CLOSURES

a. Tables 35-45 list roads liable to flooding in the Wollongong City LGA.

**Table 35: Main roads liable to flooding in Wollongong City LGA.**

| **State Highways and Major Roads** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Princes Hwy | Bulli | Bulli Pass | Can be closed for periods exceeding 24 hours due to rain related mudslides and road undermining. Not unusual for closure of over 1 week | | |
| Princes Hwy | Bulli | Junction of Lawrence Hargrave Drive | Depths may exceed 1.5m | | |
| Princes Hwy | Bulli | Cnr of Hobart St | | | |
| Princes Hwy | Bulli | Between Point St and Black Diamond Place. Slacky Creek crossing | Depths may exceed 1.5m | | |
| Princes Hwy (1) | Bulli | Between Hopetoun & Organs Road | Can reach approx. 0.7m depth. | | |
| Princes Hwy (1) | Corrimal | North of Rothery Road | Can reach depths of approx. 0.9m | | |
| Princes Hwy (21) | Corrimal | At Towradgi Creek crossing | Depths of 0.1m in 1% AEP & 1.7m in PMF | | |
| Princes Hwy (21) | Corrimal | Cnr Tarrawanna Rd | Depths range from 1.0m in 20% AEP to 1.8m in PMF. | | |
| Princes Hwy (21) | Corrimal | Between Railway St & Russell St | Depths range from 0.9m in 20% AEP to 1.8m in PMF. | | |

| **State Highways and Major Roads** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Princes Hwy (1) | Fairy Meadow | Various locations | | | |
| Princes Hwy (1) | Figtree | Junctions of Bellevue Rd, The Avenue, O'Briens Road and Gibsons Road – between London Drive and the Avenue | High velocity with depths recorded at over 0.8m in some locations | | |
| Princes Hwy (1) | Kembla Grange | Near racecourse entrance | Water stays for up to a week if lake levels are high. In major flooding only suitable for high clearance vehicles. | | |
| Princes Hwy (1) | Russell Vale | Outside Golf Course | Can reach depths exceeding 0.6m. | | |
| Princes Hwy (1) | Russell Vale | Between Albert St & Bellambi Lane | Bellambi Creek crossing. Can reach depths of approx. 0.6m with high velocity. | | |
| Princes Hwy | Russell Vale | Between Broker & Moreton Sts | Nuisance flooding. Remains passable. | | |
| Princes Hwy | Tallawarra | Duck Creek Culvert/Bridge | | | |
| Princes Hwy (1) | Unanderra | Between of Cordeaux Road and Farmborough Road | | | |
| Princes Hwy | Woonona (1) | Between Gray St & Hillcrest Ave | Can exceed depths of 1.0m at Woonona shopping precinct. | | |

| **State Highways and Major Roads** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Princes Hwy | Woonona (1) | Between Alfred St & Hale St | Can exceed depths of 1.0m | | |
| Princes Hwy | | Allans Creek crossing | Overtopped for 2 hrs in PMF with ~0.7m depth (8) | | |
| Princes Hwy | | American Creek crossing | Overtopped for 8 hrs in 1% AEP with ~1.7m depth (8) | | |
| Princes Hwy | | Byarong Creek | Overtopped for 4 hrs in 1% AEP with ~0.9m depth (8) | | |
| Princes Hwy | | Charcoal Creek | Overtopped for 8 hrs in 1% AEP with ~1.0m depth (8) | | |
| Princes Hwy | | Jenkins Creek | Overtopped for 4 hrs in 1% AEP with ~0.9m depth (8) | | |
| Princes Hwy | | Unanderra Drain | Overtopped for 8 hrs in 1% AEP with ~0.4m depth (8) | | |
| Princes Hwy (6) | North Wollongong | Ajax Avenue to Bourke Street | Impacts 22,000 vehicles per day when closed | | |
| Princes Motorway (M1) | | At Cataract Creek crossing | | | |
| Princes Motorway (M1) (1) | Figtree | Between Masters Road on and off ramp both directions | Recorded depths of over 1m | | |

| **State Highways and Major Roads** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Princes Motorway (M1) | Unanderra | Approx 200m south of Masters Rd off ramp | Depths reported at 300-500mm | | |
| Princes Motorway (M1) (6) | Mount Ousley | | water flows across near the University and Nyrang Park in the 1% AEP.<br>60,000 vehicles affected. | | |
| Princes Motorway (M1) | | American / Byarong Creek crossing | Overtopped for 8 hrs in 1% AEP with ~2.2m depth (8) | | |
| Princes Motorway (M1) | | Allans Creek / Unanderra Drain | Overtopped for 5 hrs in PMF with ~1.2m depth (8) | | |
| Princes Motorway (M1) | | Freeway Trib Branch | Overtopped for 3 hrs in 1% AEP with ~0.4m depth (8) | | |
| Memorial Drive (21) | Corrimal | Junction of Railway Street | Depths range from 0.8m in 20% AEP to 1.3m in PMF. | | |
| Memorial Drive (1) | Corrimal | Between Rothery St & Bellambi Lane | Can reach depths of approx. 0.5m south of Rothery St. | | |
| Memorial Drive | Corrimal | At the Carr Creek crossing north of Towradgi Road | Depths range between 0.1m in 20% AEP to 1.1m in PMF (21). | | |
| Memorial Drive (6) | Fairy Meadow | Between Chapman Street and Elliots Road, and between the Botanic | In conjunction with Princes Highway closure impacts 40,000 | | |

| State Highways and Major Roads (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| | | Gardens and Woodhill Street in the 1% AEP. | vehicles per day | | |

**Table 36: Roads liable to flooding in the Northern Suburbs**

| Local Roads Northern Suburbs (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Lady Carrington Dr | Otford | Hacking River | | | nil |
| Lawrence Hargrave Drive | | Various locations where creeks cross roadways | May close for a number of days post rain event due to landslips or road undermining | | nil |
| | Thirroul | Between Hewitts Ave & Phillip St, ***and*** Cnr Railway Parade | | | |
| Otford Road | Otford | Hacking River | | | nil |

**Table 37: Roads liable to flooding in the Hewitts Creek Catchment**

| Local Roads Hewitts Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Hobart Street | | From Princes Hwy to approx 200m west of Haig Road | Reports of depths exceeding 2m | | |
| | | | | | |
| | | | | | |

**Table 38: Roads liable to flooding in the Collins Creek Catchment**

| **Local Roads Collins Creek Catchment** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Birch Cres (1) | Bellambi | Northern end at Sellers Cres intersection | | | nil |
| Blackall St | Bulli | At Slacky Creek | | | nil |
| Brompton Rd | Bellambi | Between Daphne St and Bellambi Ln | | | nil |
| Campbell Street (1) | Woonona | Between Northern Distributor & Robert St | | | nil |
| Carrington Street (1) | Woonona | Cnr Lawrence St | | | nil |
| Cawley Street (1) | Bellambi | Between Connaghan Ave & Rothery St | | | nil |
| Culgoa Road (1) | Woonona | Between Kareela Rd & Campbell St | | | nil |
| Farrell Road (1) | Bulli | Cnr Trinity Road | New drainage has been installed and may alleviate past flooding problems | | nil |
| Gahans Lane (1) | Woonona | Intersection with High Street | | | nil |
| Hollymount View (1) | Woonona | At both intersections | | | nil |
| Liddle Street | Woonona | Between Nicholson Road and Gray Street | | | nil |
| Pioneer Road (1) | East Corrimal | Between Railway St & Owen Park Rd | | | nil |
| Pioneer Road (1) | Bellambi | Between Union St & Lismore St | | | nil |
| Railway Parade (1) | Woonona East | Southern End | | | nil |
| Rothery Street (1) | Corrimal | Between Hardie St and Bloomfield Ave | | | nil |
| Stanhope St (1) | Woonona | At both intersections | | | nil |

| Local Roads Collins Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Thompson Street | Woonona | At Collins creek bridge | | | nil |

**Table 39: Roads liable to flooding in the Towradgi Creek Catchment**

| Local Roads Towradgi Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Angel Street/ Meads Avenue footbridge (21) | Corrimal | footbridge | Flood depths range from 0.1m in the 5% AEP to 2.8m in the PMF | | nil |
| Colgong Crescent footbridge (21) | East Corrimal | footbridge | Flood depths range from 1.3m in the 20% AEP event to 4.1m in the PMF. | | nil |
| Lake Parade/ Towradgi Park footbridge (21) | East Corrimal | footbridge | Flood depths range from 0.2m in the 20% AEP to 1.8m in the PMF | | nil |
| Meads Avenue/ Princes Highway footbridge (21) | Corrimal | footbridge | Flood depths range from 0.9m in the 20% AEP to 4.0m in the PMF. | | nil |
| 49 Tarrawanna Road access bridge (21) | Tarrawanna | footbridge | Flood depths range from 0.3m in the 20% AEP to 1.3m in the PMF. | | nil |
| Bellambi St (21) | Tarrawanna | At North Angels Creek crossing | Depths range from 1.1m in 20% AEP to 1.6m in PMF | | nil |
| Brooker Street (21) | Tarrawanna | At South Angels Creek crossing | Depths range from 0.7m in | | nil |

| Local Roads Towradgi Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| | | | 5% AEP to 1.0m in PMF | | |
| Carr Street | Towradgi | Northern end | Depths range between 0.9m in 20% AEP & 2.3m in PMF (21). | | nil |
| Carroll Road | East Corrimal | Parker Creek crossing | Depths range from 0.2m in 20% AEP to 2.2m in PMF (21). | | nil |
| Charles Road | Corrimal | At the Towradgi creek crossing | Depths range from 1.1m in the 20% AEP to 3.0m in the PMF event (21). | | nil |
| Colgong Crescent | Towradgi | Carr Creek crossing | Depths range from 0.4m in 20% AEP to 1.4m in PMF (21). | | nil |
| Collins Street (1) | Corrimal | At both intersections at North Corrimal Creek crossing | Depths range from 0.7m in 20% AEP to 1.7m in PMF (21). | | nil |
| Cross Street (21) | Corrimal | Near intersection with Rothery Street | Depths range from 1.3m in 20% AEP to 2.3m in PMF. | | nil |
| Lake Parade | East Corrimal | Parker Creek crossing | Depth range from 0.1m in 20% AEP to 2.1m in PMF (21). | | nil |
| Lake Parade (1) | East Corrimal | Total closure to whole road | One of two egress routes from Corrimal beach Tourist Park | | nil |
| Lemrac Avenue | Corrimal | North Corrimal Creek crossing | Depths range from 0.9m in 20% AEP to 2.9m in PMF (21). | | nil |

| **Local Roads Towradgi Creek Catchment** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Meadow Street (1) | Tarrawanna | Between Caldwell Ave & Keira St at the Towradgi Creek crossing | Depths range from 0.7m in the 20% AEP to 2.2m in PMF (21). | | nil |
| Meadow Street (21) | Tarrawanna | North of Kendall St | Depths range from 0.3m in 20% AEP to 0.9m in PMF. | | nil |
| Meadow Street (21) | Tarrawanna | Between Tarrawanna Rd & Karen Pl | Depths range from 0.7m in 20% AEP to 0.6m in PMF. | | nil |
| Parker Road | East Corrimal | Parker Creek crossing | Depths range from 0.5m in 20% AEP to 2.5m in PMF (21). | | nil |
| Pioneer Road | East Corrimal | Between Sturdee St & Lake Parade at the Towradgi Creek crossing | Depths range from 0.2m in 20% AEP & 3.5m in PMF (21). | | nil |
| Railway Street (21) | Corrimal | Between Harbinger St & Gilbert St | Depths range from 1.4m in the 20% AEP to 2.5m in the PMF. | | nil |
| Tarrawanna Road (21) | Corrimal | Near Underwood Street | Depths range from 0.1m in 2% AEP to 0.3m in PMF. | | nil |
| Tarrawanna Road (21) | Tarrawanna | Between Meadow Street and Angel Street | Depths range from 0.7m in 20% AEP to 1.3m in PMF. | | nil |
| The Avenue (21) | Corrimal | South Corrimal Creek crossing | Depths range from 1.3m in 20% AEP to 3.1m in PMF. | | nil |
| Underwood St (1) | Corrimal | At The Avenue & Francis St intersection up to Russell St | Depths range from 0.7m in 20% AEP to 2.2m in PMF at North Corrimal | | nil |

| Local Roads Towradgi Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| | | | Creek Crossing (21). | | |
| Ursula Road (1) | Bulli | At both intersections | | | nil |

**Table 40: Roads liable to flooding in the Fairy and Cabbage Creek Catchments**

| Local Roads Fairy and Cabbage Creek Catchments (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Achilles Avenue (6) | North Wollongong | Whole length | Affected by floodwaters in the 1% AEP. | nil | nil |
| Ajax Ave (6) | North Wollongong | Junction of Montague Street | Flooded in 1% AEP | Yes access via Flinders St | nil |
| Balgownie Road (1) | Balgownie | Between Weekes St and Sproule Cres | nil | Yes via local roads | nil |
| Cabbage Tree Lane (1) | Fairy Meadow | At 3 locations; Brynymor Pl, Dawson St and Mclean Ave intersections | | | nil |
| Carters Lane | Fairy Meadow | Pioneer Road Junction | | | nil |
| Exeter Avenue (6) | North Wollongong | Whole length | Is affected by flooding in the 1% AEP | no | nil |
| Flinders Street | North Wollongong | Between Bourke and Ajax Streets | No access to properties in Stafford St, or those on Flinders St | no | nil |
| Foleys Lane (1) | North Wollongong | At the TAFE entrance | Loss of vehicle access to the TAFE | May be able to use pedestrian footbridge | nil |
| Gipps Road (1) | Keiraville | Between William Street and Eastern Street | | | nil |

| **Local Roads Fairy and Cabbage Creek Catchments** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Graham Ave (23) | Gwynneville | Closes first at the College Pl intersection before closing at the University Ave intersection | Causes isolation of College Pl and Graham Ave area (area becomes a low flood island) | no | nil |
| Mt Ousley Rd (1) | Fairy Meadow | Junction with Princes Highway in the 1% AEP | Impacts 15,000 vehicles per day | | nil |
| Montague Street | North Wollongong | From Ajax Ave to road rise at Para Ck bridge | SES HQ flooded, access to SES HQ lost | no | nil |
| Murphys Avenue (1) | Keiraville | Between John St and Eastern St, and at the Irvine Street intersection | nil | Yes via local roads | nil |
| Northfields Avenue | Gwynneville | Outside the University of Wollongong campus | Loss of access to the university | no | nil |
| Squires Way (1) | Fairy Meadow | Overflowing Sewer | | | nil |

**Table 41: Roads liable to flooding in the Wollongong City Catchment**

| **Local Roads Wollongong City Catchment** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Corrimal Street (7) | Wollongong | Swan Street Intersection | Depths range from 0.1m in 20% AEP to 0.65m in 1% AEP. | Yes via local roads | nil |
| Gladstone Avenue (7) | Coniston | Near Union Street | Depths range from 1.15m in 20% AEP to | Yes via local roads | nil |

| Local Roads Wollongong City Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| | | | 1.3m in 1% AEP. | | |
| Gladstone Avenue (7) | Wollongong | Near Osboure Street | Depths range from 0.9m in 20% AEP to 1.1m in 1% AEP. | Yes via local roads | nil |
| Kembla Street (7) | Wollongong | Swan Street intersection | Frequently closed<br>Depths range from 0.6m in 20% AEP to 1.18m in 1% AEP. | Yes via local roads | nil |
| Springhill Road (7) | Wollongong | Near John Cleary Place | Depths range from 0.4m in 20% AEP to 0.35m in 1% AEP. | | nil |
| Springhill Road (7) | Wollongong | Near Bridge Street | Depths range from 0.35m in 20% AEP to 0.62m in 1% AEP. | | nil |
| Springhill Road (7) | Spring Hill | Just south of Masters Road intersection | Depths range from 0.7m in 20% AEP to 1.1m in 1% AEP | | nil |
| Springhill Road (7) | Wollongong | Port Kembla Road intersection | Depths range from 1.6m in 20% AEP to 2.6m in 1% AEP. | | nil |

**Table 42: Roads liable to flooding in the Allans Creek Catchment**

| Local Roads Allans Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Cordeaux Road (1) | Figtree | Various locations from Gibsons Road to Mount Kembla | Depths may reach 300-500mm but includes high velocity | | nil |

| **Local Roads Allans Creek Catchment** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Five Islands Road (1) | Unanderra/Coniston | Junction of Princes Hwy and Five Islands Rd,<br>***and***<br>On and Off ramps from F6<br>***and***<br>Roundabout at junction of Glastonbury Avenue<br>And<br>Between the F6 and Springhill Road | Regular reports of vehicles trapped in flood waters at this location | | nil |
| Gladstone Avenue (7) | Mount Saint Thomas | Near Vale Street | Depth range from 1.6m in 20% AEP to 2.6m in 1% AEP. | | nil |
| Gibsons Road (1) | Figtree | Where road crosses American Creek. | | | nil |
| O'Briens Road (1) | Figtree | Between Princes Hwy and Murray Park Road,<br>***and***<br>East of Church of Christ | Depths of over 600mm recorded<br>Affected by flooding in the 20% AEP event | | nil |
| Old Port Road | Port Kembla | Near railway over-bridge | | | nil |
| Springhill Road (1) | Springhill | Various locations at and between Masters Road and Five Islands Road. | Have recorded depths of 2.0m | | nil |
| Uralba Street (1) | Figtree | At Byarong Creek | Depths of over 1.2m recorded. | | nil |

**Table 43: Roads liable to flooding in the Mullet Creek Catchment**

| **Local Roads Mullet Creek Catchment** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Avondale Road (1) | Avondale | East and west of South Avondale Road<br>Low point between Oakhurst Cres and Dale St | Depths >1m can be reached. | | nil |
| | | Mullet Creek bridge | Can reach depths of over 1.5m | | nil |
| Byamee Street (1) | Dapto | At the Brooks Creek crossing between Aldinga Ave and Bambil Cres | | | nil |
| Bong Bong Road (1) | Dapto | Near Hamilton and Burringbar Sts<br>From Princes Highway to Parkdale Avenue | Can reach depths of >1.5m. May be impassable for over 24hours | | nil |
| Burringbar Street | Dapto | Whole length | No access to properties on Burringbar St | no | nil |
| Cambridge Road (1) | Dapto | Whole length | Loss of access to properties on Cambridge Rd | yes | nil |
| Cleveland Road (1) | Dapto | For 1km west from railway line and at Mullet Creek crossing near junction of Avondale Road. | May exceed 1m | | nil |
| Darkes Road (1) | Dapto | Rail line and creek crossings | Depths calculated to exceed 2m | | nil |
| Emerson Road (1) | Dapto | At the Beltana Ave intersection | | yes | nil |
| Fowlers Road (1) | Dapto | Junctions of Rink Rd and Julianne St | Can reach depths of over 1.5m | | nil |

| Local Roads Mullet Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Lakelands Drive (1) | Dapto | At the Oxford Rd intersection | | Yes via local road | nil |
| Lakeside Drive | Kanahooka | Between Edgeworth Ave & Wallabah Way | Affect known to remain for over 48 period or until lake able to release to ocean. | | nil |
| West Dapto Road (1) | Dapto | All creek crossings and low lying areas.<br>Junction of Sheaffes Road | Can reach depths of >0.6m | | nil |

**Table 44: Roads liable to flooding in the Minnegang Creek Catchment**

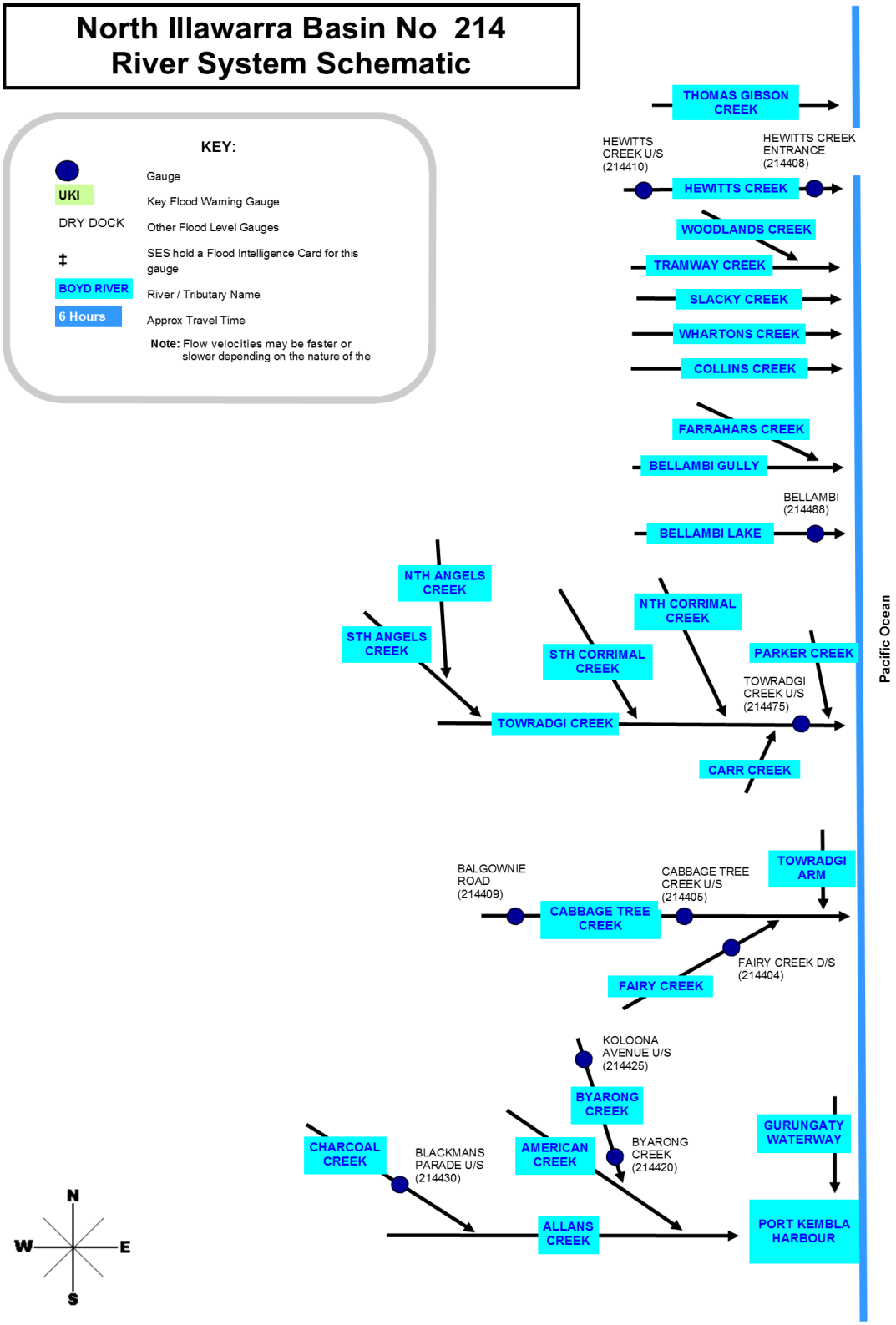
| Local Roads Minnegang Creek Catchment (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Barina Avenue (1) | Lake Heights | Between Culburra St and Derowie Cres | nil | Yes via local roads | nil |
| Denise Street (1) | Lake Heights | Between Weringa Ave and Canberra Rd, and | nil | Yes via local roads | nil |
| | | Between Canberra Rd and Northcliffe Dr | nil | Yes via local roads | nil |
| Karrabah Street (1) | Lake Heights | At the intersection with Melinda Grove | nil | Yes via local roads | nil |
| Lake Heights Road (1) | Lake Heights | Between Buena Vista Ave and Culburra St | nil | Yes via local roads | nil |
| Mirrabooka Road (1) | Lake Heights | Just east of the Derowie Cres intersection | nil | Yes via local roads | nil |
| Ranchby Avenue (1) | Lake Heights | At 6 locations along the entire length of the Avenue | nil | Yes via local roads | nil |

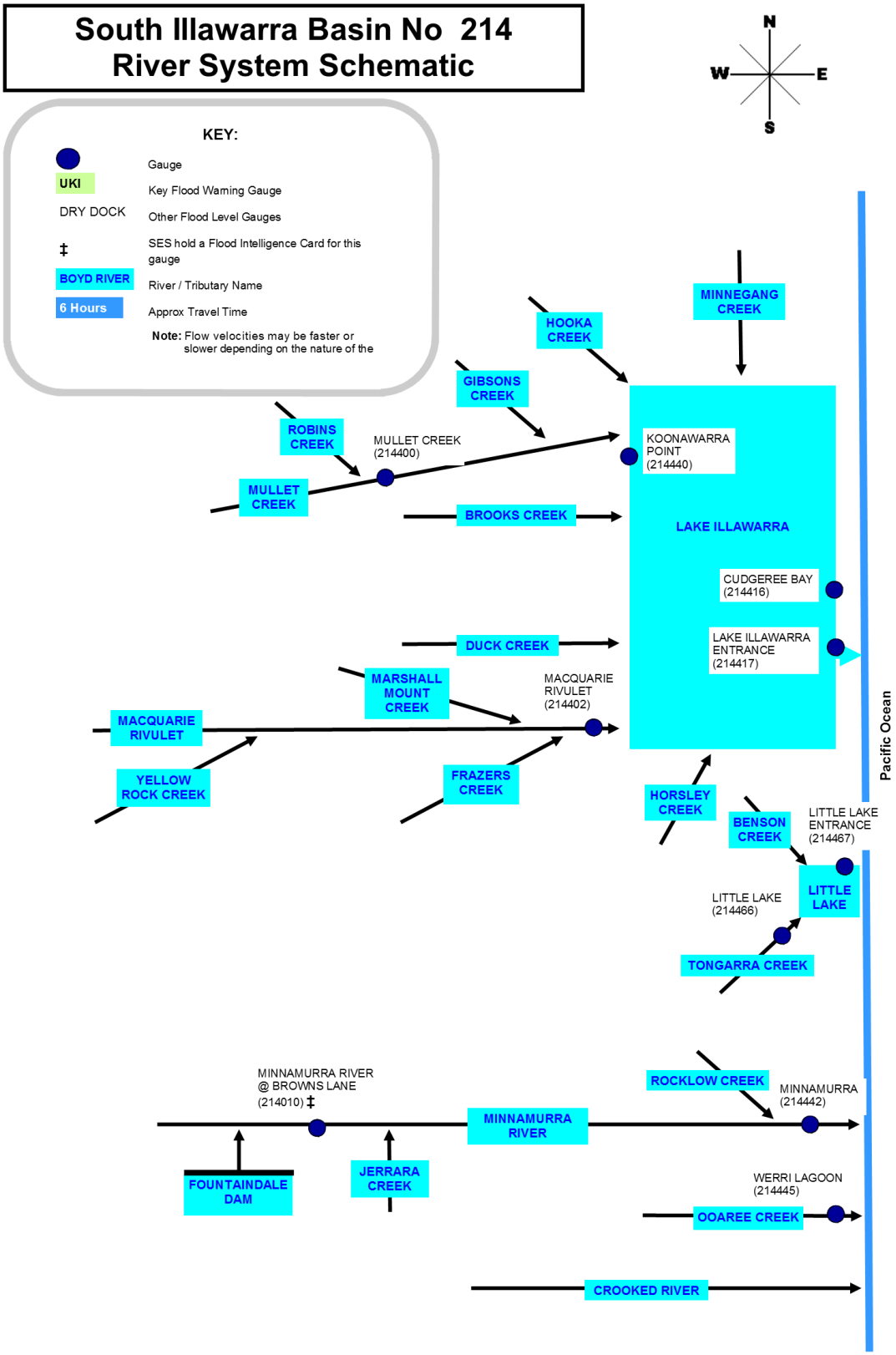
| **Local Roads Minnegang Creek Catchment** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Trevor Avenue (1) | Lake Heights | Near the St Cloud Cres intersection | nil | Yes via local roads | nil |
| Weringa Avenue (1) | Lake Heights | Between Denise St and Katrina St | nil | Yes via local roads | nil |

**Table 45: Roads liable to flooding in the Lake Illawarra Catchment**

| **Local Roads Lake Illawarra Catchment** (1) | | | | | |
|---|---|---|---|---|---|
| **Road** | **Nearest Suburb** | **Closure location** | **Consequence of closure** | **Alternate Route** | **Indicative gauge height** |
| Boundary Road | Windang | Near Windang Road | | | nil |
| King Street | Warrawong | Intersection of Hoskins Ave | | | nil |
| Northcliffe Drive (1) | Warrawong/ Lake Heights | Between First Ave & Denise St<br>***and***<br>The intersection of Wilkinson St (eastern end) | | | nil |
| Windang Road | Windang | Between the suburbs of Primbee & Lake Illawarra | | | nil |

# ANNEX 1: ILLAWARRA RIVER BASIN SCHEMATICS




South Illawarra Basin No 214
River System Schematic
N
W
E
S
KEY:
Gauge
UKI
Key Flood Warning Gauge
DRY DOCK
Other Flood Level Gauges
‡
SES hold a Flood Intelligence Card for this gauge
BOYD RIVER
River / Tributary Name
6 Hours
Approx Travel Time
Note: Flow velocities may be faster or slower depending on the nature of the
MINNEGANG CREEK
HOOKA CREEK
GIBSONS CREEK
ROBINS CREEK
MULLET CREEK (214400)
MULLET CREEK
KOONAWARRA POINT (214440)
BROOKS CREEK
LAKE ILLAWARRA
CUDGEREE BAY (214416)
LAKE ILLAWARRA ENTRANCE (214417)
DUCK CREEK
MARSHALL MOUNT CREEK
MACQUARIE RIVULET (214402)
MACQUARIE RIVULET
YELLOW ROCK CREEK
FRAZERS CREEK
HORSLEY CREEK
BENSON CREEK
LITTLE LAKE ENTRANCE (214467)
LITTLE LAKE
LITTLE LAKE (214466)
TONGARRA CREEK
Pacific Ocean
MINNAMURRA RIVER @ BROWNS LANE (214010) ‡
ROCKLOW CREEK
MINNAMURRA (214442)
MINNAMURRA RIVER
FOUNTAINDALE DAM
JERRARA CREEK
WERRI LAGOON (214445)
OOAREE CREEK
CROOKED RIVER

# ANNEX 2: FACILITIES AT RISK OF FLOODING AND/OR ISOLATION

**Table 46: Facilities at risk of flooding in the Collins Creek Catchment**

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Schools** | | | |
| Waniora Public School | Ursula Road | Bulli | Grounds experience inundation in 20% AEP and buildings in 5% AEP (12) |
| Bulli High School | Ursula Road | Bulli | Grounds experience inundation in the 20% AEP and buildings in the 0.5% AEP (12) |
| Woonona High School | Nicholson Lane | Woonona | Grounds experience inundation in the 20% AEP. The buildings begin to experience over floor flooding in the 2% AEP (12). |
| Woonona East Public School | Royal Crescent | Woonona | Grounds experience inundation in the 5% AEP. The buildings do not experience over floor flooding (12). |
| Russell Vale Public School | Terania Street | Russell Vale | Grounds experience inundation in the 20% AEP. Buildings do not experience over floor flooding (12). |
| Holy Spirit Collage | Cawley Street | Bellambi | Grounds experience inundation in the 20% AEP. Buildings experience over floor flooding in the PMF event (12). |
| Corrimal Public School | Princes Highway | Corrimal | Grounds experience inundation in the 5% AEP. Buildings do not experience over floor flooding (12). |
| Bellambi Public School | Owen Park Road | Bellambi | Grounds experience inundation in the 5% AEP. Buildings do not experience over floor flooding (12). |
| Corrimal High School | Murray Road | Corrimal | Northern ovals experience inundation in the 20% AEP. Southern grounds experience inundation in the PMF. Buildings are not affected by over floor flooding (12). |
| **Child Care Centres** | | | |
| Bulli Childrens Centre | | Bulli | |
| Bulli Pre School | Hospital Road | Bulli | Grounds experience inundation in the 20% AEP. Buildings do not experience over floor flooding (12) |

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| Balls Paddock Children's Centre | Luxor Street | Woonona | Grounds experience inundation in the 20% AEP. Building experiences over floor flooding in the 5% AEP (12) |
| Coolgardie Children's Centre | Coolgardie Street | Corrimal | Grounds experience inundation in the 5% AEP. Building does not experience over floor flooding (12). |
| **Facilities for the aged and/or infirm** | | | |
| Tasman Court Retirement Village | 23 Tasman Parade | Thirroul | 40 low-care hostel units |
| IRT Sid Wearne Court Retirement Facility | Farrell Road | Bulli | The grounds are impacted in the 5% AEP. The buildings do not experience over floor flooding (12). |
| Northern Family Care Cottage | Ball Street | Woonona | The grounds are affected by flooding in the 0.2% AEP. The building does not experience over floor flooding (12). |
| IRT Woonona Aged Care | Popes Road | Woonona | The grounds are affected by flooding in the 20% AEP. The buildings experience over floor flooding in the 0.2% AEP (12). |
| Chesalon Care Woonona | Alice Street | Woonona | Grounds experience inundation in the 20% AEP. Buildings do not experience over floor flooding (12). |
| **Utilities and infrastructure** | | | |
| - | - | - | - |
| **Camping Ground / Caravan Parks** | | | |
| Bulli Beach Tourist Park | Farrell Road | Bulli | Park is impacted by floodwaters in the PMF event (12) |
| **Hospitals** | | | |
| Bulli Hospital | Hospital Road | Bulli | Main access at Hospital Road/Princes Highway intersection closed in the 5% AEP event (1). |
| Coledale Hospital | Lawrence Hargrave Drive | Wombarra | Not affected by floodwaters but may become isolated for short periods of time (1). |

**Table 47: Facilities at risk of flooding in the Towradgi Creek Catchment**

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Schools** | | | |
| Corrimal East Public School | Duff Parade | Corrimal | South eastern corner of grounds is affected by flooding in the PMF event (5). |
| Tarrawanna Public School | Kendall Street | Tarrawanna | Is affected by flooding in the PMF event (5). |
| **Child Care Centres** | | | |
| Gumnut Village Preschool | Dalton Street | Towradgi | Is affected by flooding before the 20% AEP event (5). |
| Corrimal Community Preschool | Short Street | Corrimal | Access to the Preschool is lost in the 20% AEP event (5). |
| **Facilities for the aged and/or infirm** | | | |
| Bishop McCabe Retirement Village | Ziems Avenue | Towradgi | Is affected by flooding in the 20% AEP event (5). |
| IRT Birch Villa | Underwood Street | Corrimal | Is affected by flooding in the PMF event. Access is lost in the 1% AEP event (5). |
| **Utilities and infrastructure** | | | |
| Illawarra Railway | Towradgi Creek crossing | Corrimal | In the PMF event a floodwater depth of 0.6m can be reached (21). |
| **Camping Ground / Caravan Parks** | | | |
| Corrimal Beach Tourist Park | Lake Parade | East Corrimal | The park becomes isolated in the 20% AEP event (5). |
| **Hospitals** | | | |
| - | - | - | - |

**Table 48: Facilities at risk of flooding in the Fairy and Cabbage Creek Catchments**

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Schools** | | | |
| TAFE Illawarra – Wollongong Campus | Foleys Road | Wollongong | Is affected by over floor flooding in the 5% AEP event. Over ground flooding occurs in the 20% AEP event (23). |
| University of Wollongong | Northfields Avenue | Keiraville | Is affected by over ground flooding in the 20% AEP event. No over floor flooding is experienced (23). |
| Keiraville Public School | Gipps Road | Keiraville | Over ground flooding occurs in 20% AEP event, no over floor flooding (23). |
| Keira High School | Lysaght Street | Fairy Meadow | Over floor flooding occurs in the 1% AEP event, over ground flooding occurs in the 20% AEP event (23). |
| Elonera Montessori School | Mount Ousley Road | Mount Ousley | Is affected by overground flooding in the 20% AEP event. No over floor flooding (23) |
| Good Samaritan Catholic Primary School | McGrath Street | Fairy Meadow | Is affected by over ground flooding in the 5% AEP event (23). |
| Fairy Meadow Public School | Princes Highway | Fairy Meadow | Is affected by over ground flooding in the 1% AEP event (23). |
| Pleasant Heights Public School | Alvan Parade | Mount Pleasant | Is affected by over ground flooding in the 5% AEP event (23). |
| Towradgi Public School | Carters Lane | Fairy Meadow | Is affected by over ground flooding in the 2% AEP event (23). |
| Edmund Rice College | Mount Keira Road | West Wollongong | Is affected by over ground flooding in the 20% AEP event. Not affected by over floor flooding (23). |
| **Child Care Centres** | | | |
| Willy Wagtail's Garden Childcare Centre | Florence Street | Fairy Meadow | Is affected by overground flooding in the 20% AEP event. No over floor flooding (23). |
| Shining Starts Early Learning | Greenacre Road | Wollongong | Is affected by over ground flooding in the 20% AEP event. No over floor flooding (23). |
| Tinkerbell Pre-school and Day Care Centre | Gwynne Street | Gwynneville | Is affected by over ground flooding in the 20% AEP event. No over floor flooding (23). |

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Facilities for the aged and/or infirm** | | | |
| IRT Towradgi Park | Murranar Rd | Towradgi, 2518 | 68 units. Is affected by over floor flooding in the 5% AEP event and over ground flooding in the 20% AEP event (23). |
| IRT Braeside Close | 155 Gipps Road | Gwynneville, 2500 | 50 self care units. Affected by overfloor flooding in the 5% AEP event. Affected by over ground flooding in the 20% AEP event (23). |
| **Utilities and infrastructure** | | | |
| NSW SES Wollongong City Unit | Montague Street | North Wollongong | Access is impacted in the 20% AEP. Grounds are impacted in the 20% AEP event (23). |
| Illawarra Railway (6) | Dixon Street to Elliots Road | Fairy Meadow | Railway would be overtopped in the 1% AEP. |
| Illawarra Railway (6) | Soudan Street to North Wollongong Station | North Wollongong | 1.1km on line would be flooded in the 1% AEP. |
| Beaton Park Sporting Complex | Foleys Road | Gwynneville | The facility is affected by flooding in the 20% AEP event (23). |
| **Camping Ground / Caravan Parks** | | | |
| - | - | - | - |
| **Hospitals** | | | |
| - | - | - | - |
| **Hotels / Motels** | | | |
| Quality Suites Pioneer Sands | Carters Lane | Fairy Meadow | Is affected by over floor and over ground flooding in the 20% AEP event (23). |
| Wollongong Surf Leisure Resort | Pioneer Road | Fairy Meadow | Is affected by over ground flooding in the 1% AEP event (23). |
| UOW Campus East | Cowper Street | Fairy Meadow | Is affected by over ground flooding in the 20% AEP. No over floor flooding (23). |
| UOW International House | Porter Street | North Wollongong | Is affected by overground flooding in the 20% AEP event (23). |

**Table 49: Facilities at risk of flooding in the Wollongong City Catchment**

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Schools** | | | |
| TAFE Illawarra – West Wollongong Campus | Gladstone Avenue | Wollongong | Is affected by flooding prior to the 5% AEP event (7). |
| Coniston Public School | Auburn Street | Coniston | The oval is affected by flooding in the 20% AEP event (24). |
| **Child Care Centres** | | | |
| Kenny Street Community Preschool | Kenny Street | Wollongong | Is affected by flooding in the20%, access to the facility is affected in the 20% AEP event (24). |
| Ocean View Preschool | Harold Street | Coniston | Access to the facility is affected in the 1% AEP event (7). |
| Wollongong Preschool Kindergarten | Atchison Street | Wollongong | Is affected before the 20% AEP event (24). |
| Grandma Rosie's Childcare | Kenny Street | Wollongong | Is affected by flooding in the 20% AEP event (24). |
| Wollongong City Community Preschool | Keira Street | Wollongong | Is affected by flooding in the 20% AEP event (24). |
| South Workers Child Care Centre | Ellen Street | Wollongong | Is affected by flooding in the 20% AEP (24). |
| Stewart Street Community Preschool | Stewart Street | Wollongong | Is affected by flooding in the 20% AEP (24). |
| Boombalee Kidz | Church Street | Wollongong | Is affected by flooding prior to the 20% AEP event (24). |
| Wollongong Lollipop Kidz | Keira Street | Wollongong | Is affected by flooding in the 20% AEP event (24). |
| **Facilities for the aged and/or infirm** | | | |
| Warrigal Care | Bridge Street | Coniston | Access to the facility is impacted in the 1% AEP event (7). |
| IRT Diment Towers | Staff Street | Wollongong | Is affected by flooding in the 1% AEP event (7). |
| IRT Howard Court – Retirement Village | Stewart Street | Wollongong | Is affected by flooding in the 5% AEP event (24). |
| IRT Links Seaside | Ross Street | Wollongong | Is affected by flooding prior to the 20% AEP event (24). |
| **Utilities and infrastructure** | | | |
| Illawarra Railway | Wollongong Station and south | Wollongong/Coniston | The Railway is affected by flooding prior to the 20% AEP event (24). |

**Table 50: Facilities at risk of flooding in the Allans Creek Catchment**

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Schools** | | | |
| Farmborough Road Public School | Farmborough Road | Unanderra | Northern fields are affected by flooding in the 5% AEP event (8). |
| St Pius X Catholic Primary School | Cnr Cummins St & Hargraves St | Unanderra | Is affected by floodwaters in the 20% AEP event (8). |
| Figtree Public School | Gibsons Road | Figtree | Is affected by floodwater in the 5% AEP event (8). |
| Figtree High School | Gibsons Road | Figtree | Is affected by floodwaters in the 20% AEP event (8). |
| Lindsay Park Public School | Thames Street | West Wollongong | Is affected by flooding in the PMF event (8). |
| Cedars Christian College | Waples Road | Farmborough Heights | Is affected by floodwaters in the 20% AEP event (8). |
| **Child Care Centres** | | | |
| The Ants Pants Pre School | Northview Terrace | Figtree | Is affected by floodwaters in the 5% AEP event (8). |
| Little People's Early Learning Centre | Gibsons Road | Figtree | Is affected by floodwaters in the 5% AEP event (8). |
| Figtree Early Childhood Centre | Princes Highway | Figtree | Is affected by floodwaters in the 5% AEP event (8). |
| **Facilities for the aged and/or infirm** | | | |
| Farmborough Aged Care Centre | Waples Road | Farmborough Heights | Is affected by flooding in the 20% AEP event (8). |
| Marco Polo Aged Care Services | Waples Road | Farmborough Heights | Is affected by floodwaters in the 20% AEP event (8). |
| Kennedy Health Care Group | Suttor Place | Figtree | Is affected by floodwaters in the 1% AEP event (8). |
| **Utilities and infrastructure** | | | |

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| Illawarra Railway (8) | Jenkins Creek Crossing | | In the 1% AEP event the railway is overtopped by 0.97m for 4.5hrs. In the PMF event the railway is overtopped by 1.2m for 7.5hrs. |
| Illawarra Railway (8) | Charcoal Creek crossing | Unanderra | In the 1% AEP event the railway is overtopped by 1.76m for 4.5hrs. In the PMF event the railway is overtopped by 3.04m for 7.5hrs. |
| Illawarra Railway (8) | Allans Creek crossing | Unanderra | In the PMF event the railway is overtopped by 0.81m for 3hrs. |
| Illawarra Railway (8) | Unanderra drain crossing | Unanderra | In the 1% AEP event the railway is overtopped by 0.55m for 4.5hrs. In the PMF event the railway is overtopped by 2.27m for 7hrs. |
| Illawarra Railway (8) | American Creek crossing | Figtree | In the PMF event the railway is overtopped by 0.38m for 2hrs. |
| **Camping Ground / Caravan Parks** | | | |
| Figtree Gardens Caravan Park | Woodrow Place | Figtree | Is affected by floodwaters in the 5% AEP event. The park becomes isolated in the 20% AEP event (8). |
| **Hospitals** | | | |
| Illawarra / Figtree Private Hospital | Suttor Place | Figtree | Is affected by floodwaters in the 1% AEP event (8). |
| **Hotels / Motels** | | | |
| Sovereign Inn | Princes Highway | Figtree | Is affected by floodwaters in the 20% AEP event (8). |
| Figtree Hotel | Princes Highway | Figtree | Is affected by floodwaters in the 5% AEP event (8). |
| Unanderra Hotel | Central Road | Unanderra | Is affected by floodwaters in the PMF event (8). |

**Table 51: Facilities at risk of flooding in the Mullet Creek Catchment**

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Schools** | | | |
| Dapto High School | Cleveland Road | Dapto | Grounds are affected by flooding in the 20% AEP event. Over floor flooding occurs in the 10% AEP event (25). |
| **Child Care Centres** | | | |
| - | - | - | - |
| **Facilities for the aged and/or infirm** | | | |
| Lakeline Estate | Kanahooka Road | Kanahooka | Is affected by flooding in the PMF event (25). |
| **Utilities and infrastructure** | | | |
| - | - | - | - |
| **Camping Ground / Caravan Parks** | | | |
| - | - | - | - |
| **Hospitals** | | | |
| - | - | - | - |

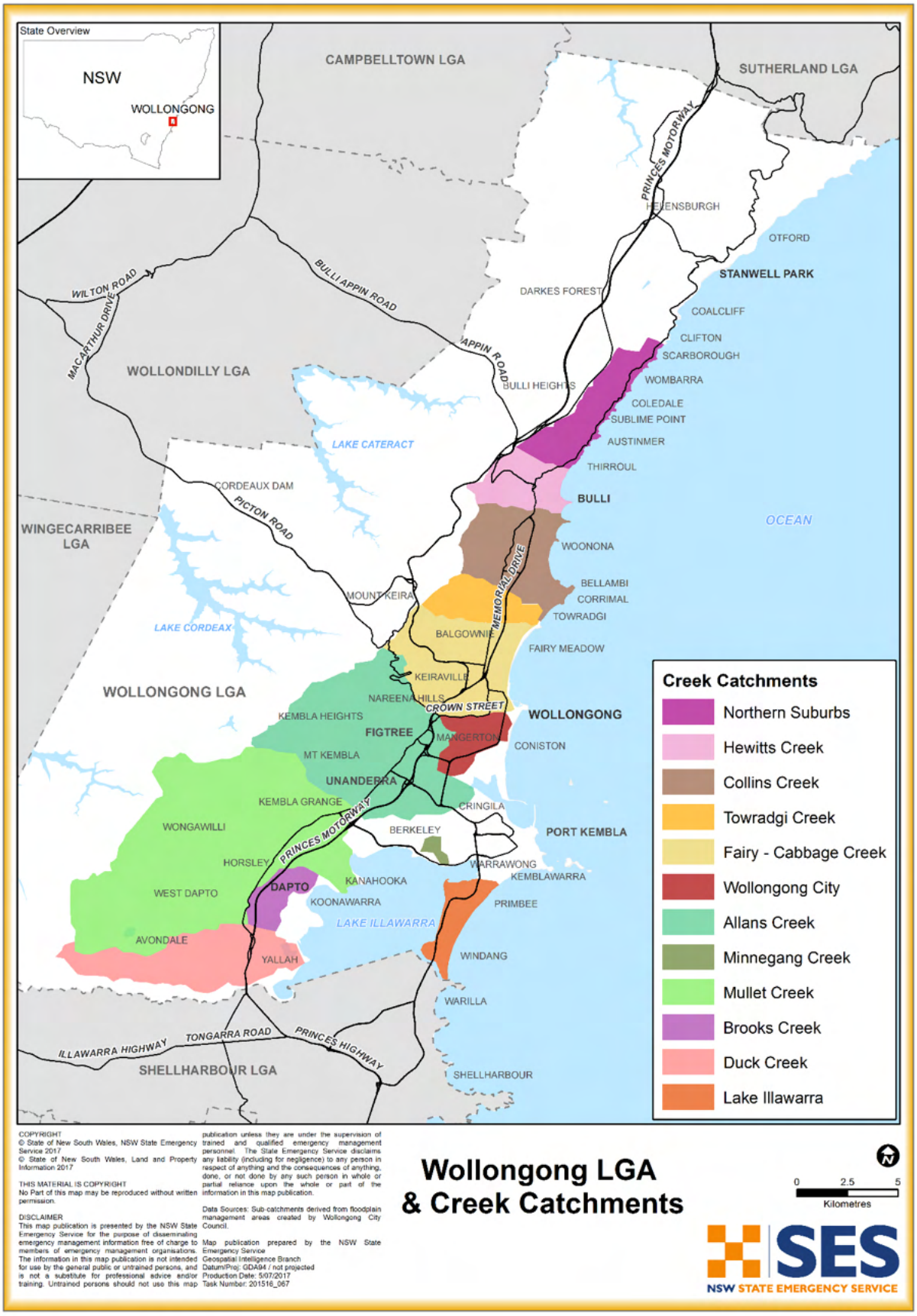
**Table 52: Facilities at risk of flooding in the Lake Illawarra Catchment**

| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| **Schools** | | | |
| Windang Public School | Oakland Avenue | Windang | Is affected by flooding prior to the 1% AEP (2.24m at Cudgeree Bay Gauge) (11). |
| **Child Care Centres** | | | |
| Lakeview Pre-School | Windang Road | Primbee | Is affected by floodwaters prior to the 1% AEP event (2.24m at Cudgeree Bay Gauge) (11). |
| **Facilities for the aged and/or infirm** | | | |
| - | - | - | - |
| **Utilities and infrastructure** | | | |
| - | - | - | - |
| **Camping Ground / Caravan Parks** | | | |
| Oasis Resort | Windang Road | Windang | Is affected by floodwaters prior to the 1% AEP event (11). No overfloor flooding in 2016 (1.57m at Cudgeree Bay Gauge (214416)). |
| South Pacific Park Village | Windang Road | Windang | Is affected by floodwaters prior to the 1% AEP event (11). Over floor flooding was reported in 2016 (1.57m at Cudgeree Bay Gauge (214416)). |
| Jetty's by the Lake | Windang Road | Windang | In 2016 (1.57m at Cudgeree Bay Gauge (214416)) the island section became isolated, 5 vans were left uninhabitable and most internal roads inundated. |
| Windang Beach Tourist Park | Fern Street | Windang | Affected by floodwaters prior to the 1% AEP event (11). |

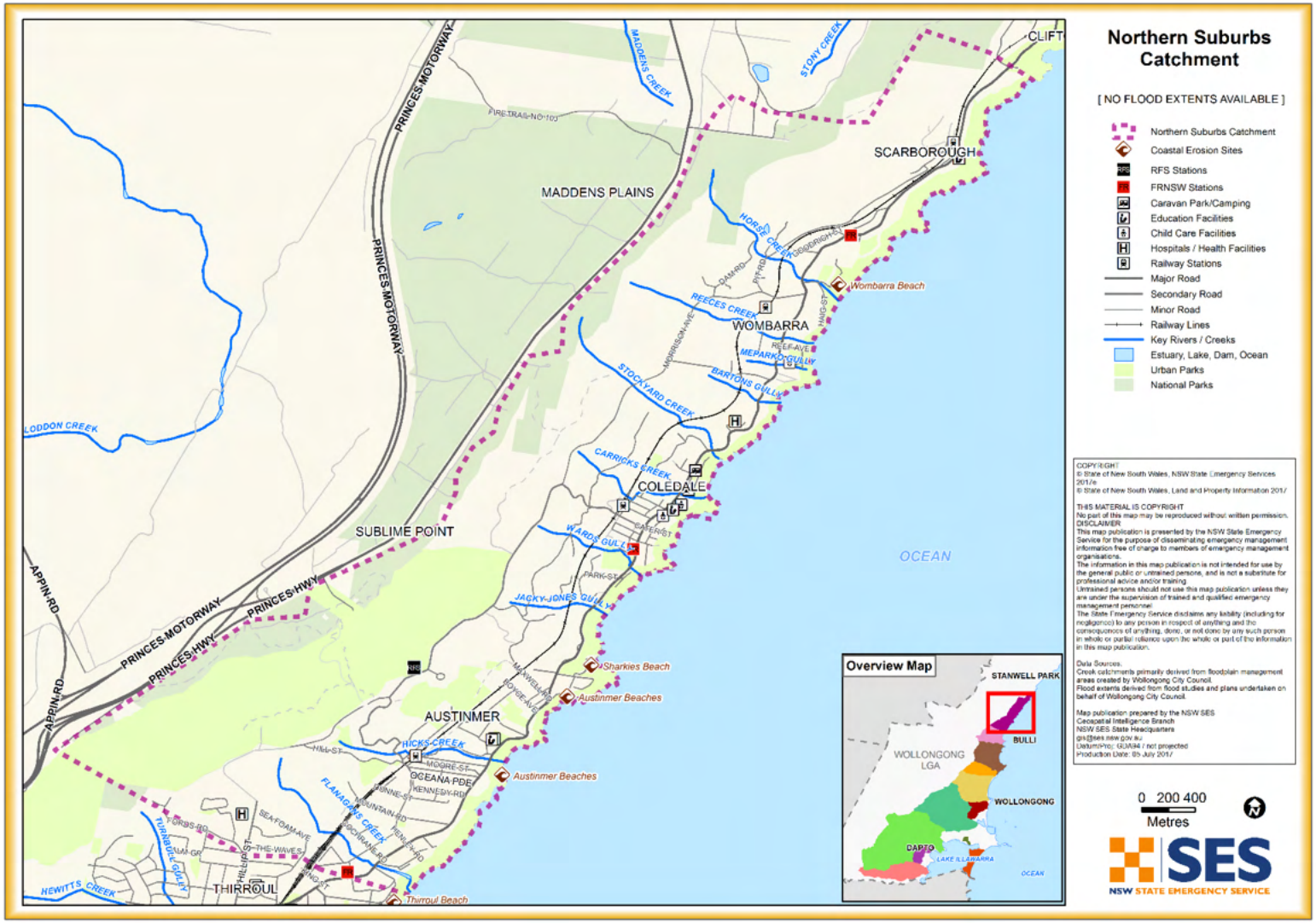
| Facility Name | Street | Suburb | Comment |
|---|---|---|---|
| Oaklands Village | Judbooley Parade | Windang | In 2016 (1.57m at Cudgeree Bay Gauge (214416)) internal road were flooded – some waist deep with no over floor flooding. Is evacuated at 1.5m at the Cudgeree Bay Gauge (1). |
| Lake Illawarra Village | Windang Road | Windang | Affected by floodwaters prior to the 1% AEP event. |
| **Hospitals** | | | |
| | | | |

# MAP 1: WOLLONGONG COAST BASIN

# MAP 2: WOLLONGONG LGA AND CATCHMENT OVERVIEW MAP



# MAP 3: NORTHERN SUBURBS CATCHMENT MAP



# MAP 4: HEWITTS CREEK CATCHMENT MAP

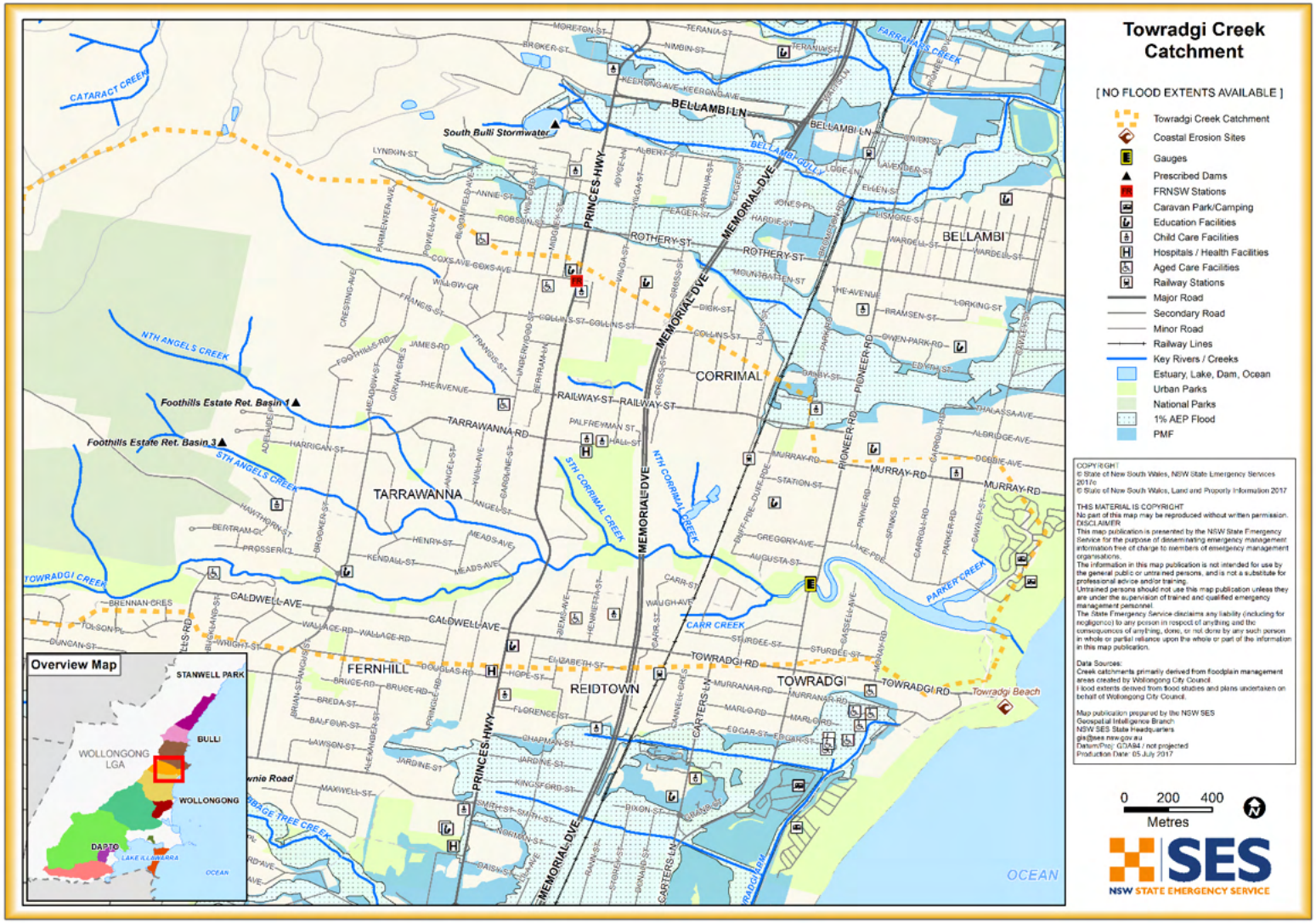
# MAP 5: COLLINS CREEK CATCHMENT MAP



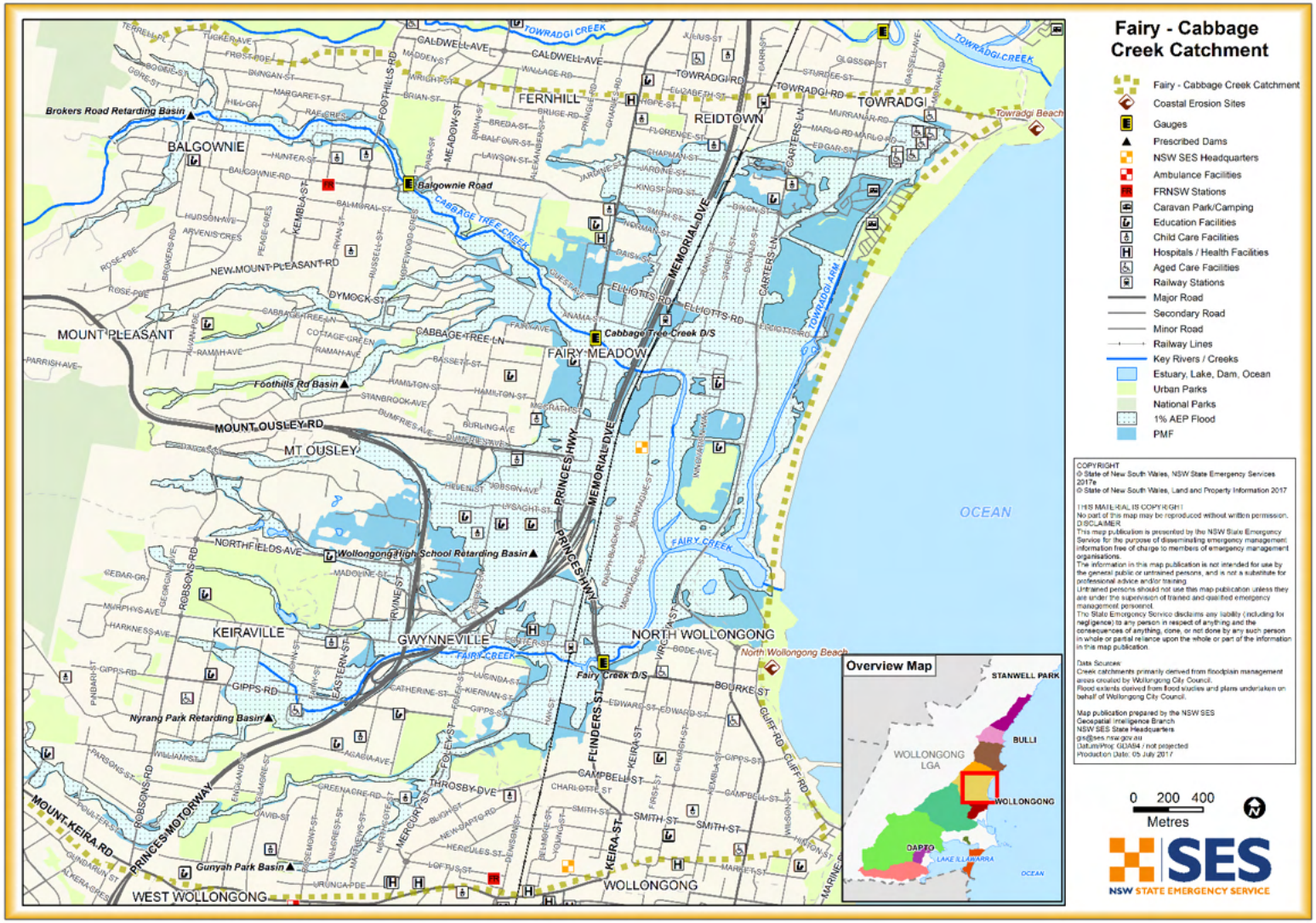

Data Sources:
Creek catchments primarily derived from floodplain management areas created by Wollongong City Council.
Flood extents derived from flood studies and plans undertaken on behalf of Wollongong City Council

Map publication prepared by the NSW SES
Geospatial Intelligence Branch
NSW SES State Headquarters
gis@ses.nsw.gov.au
Datum/Proj: GDA94 / not projected
Production Date: 06 July 2017

# MAP 6: TOWRADGI CREEK CATCHMENT MAP



# MAP 7: FAIRY AND CABBAGE TREE CATCHMENT MAP

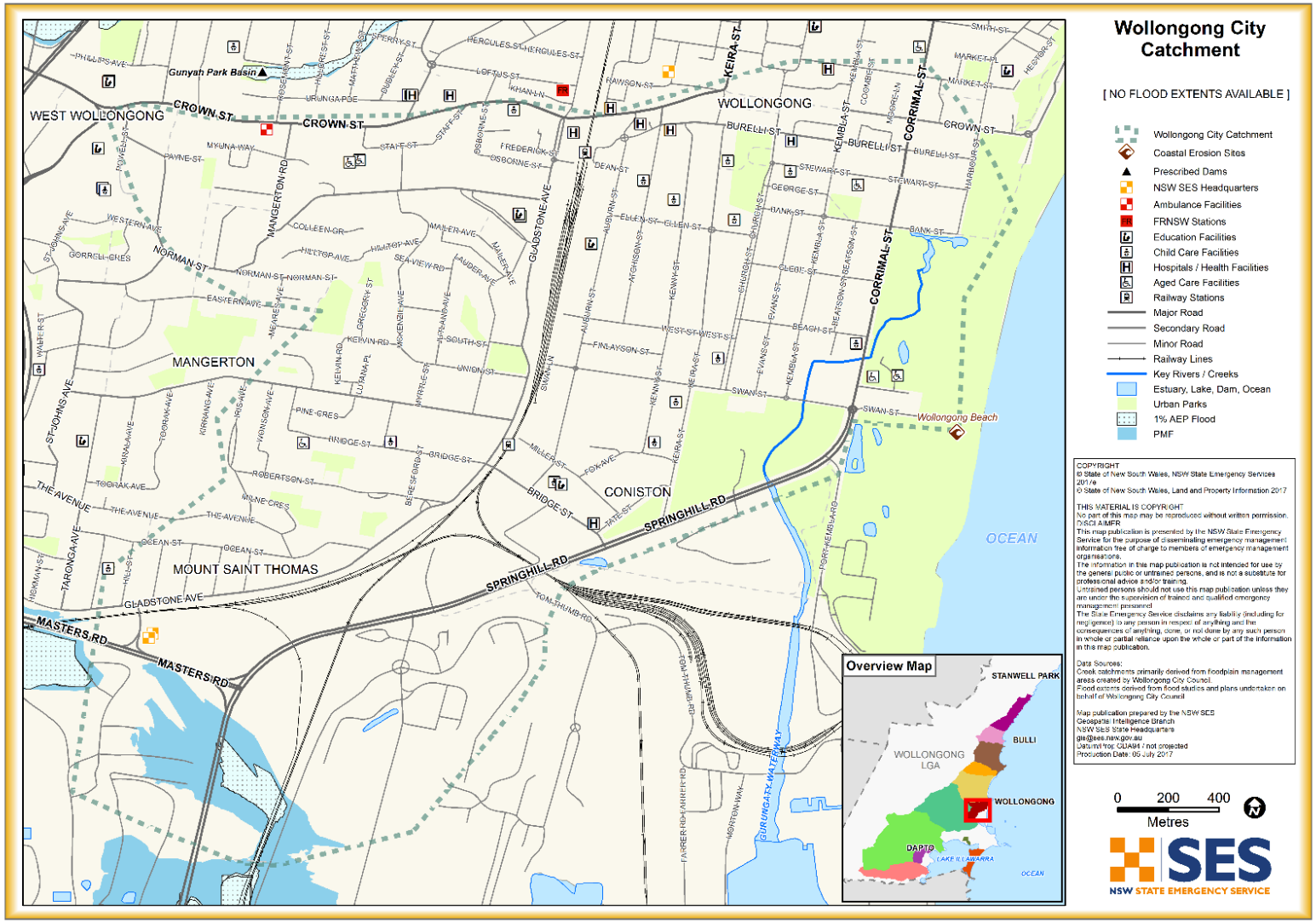




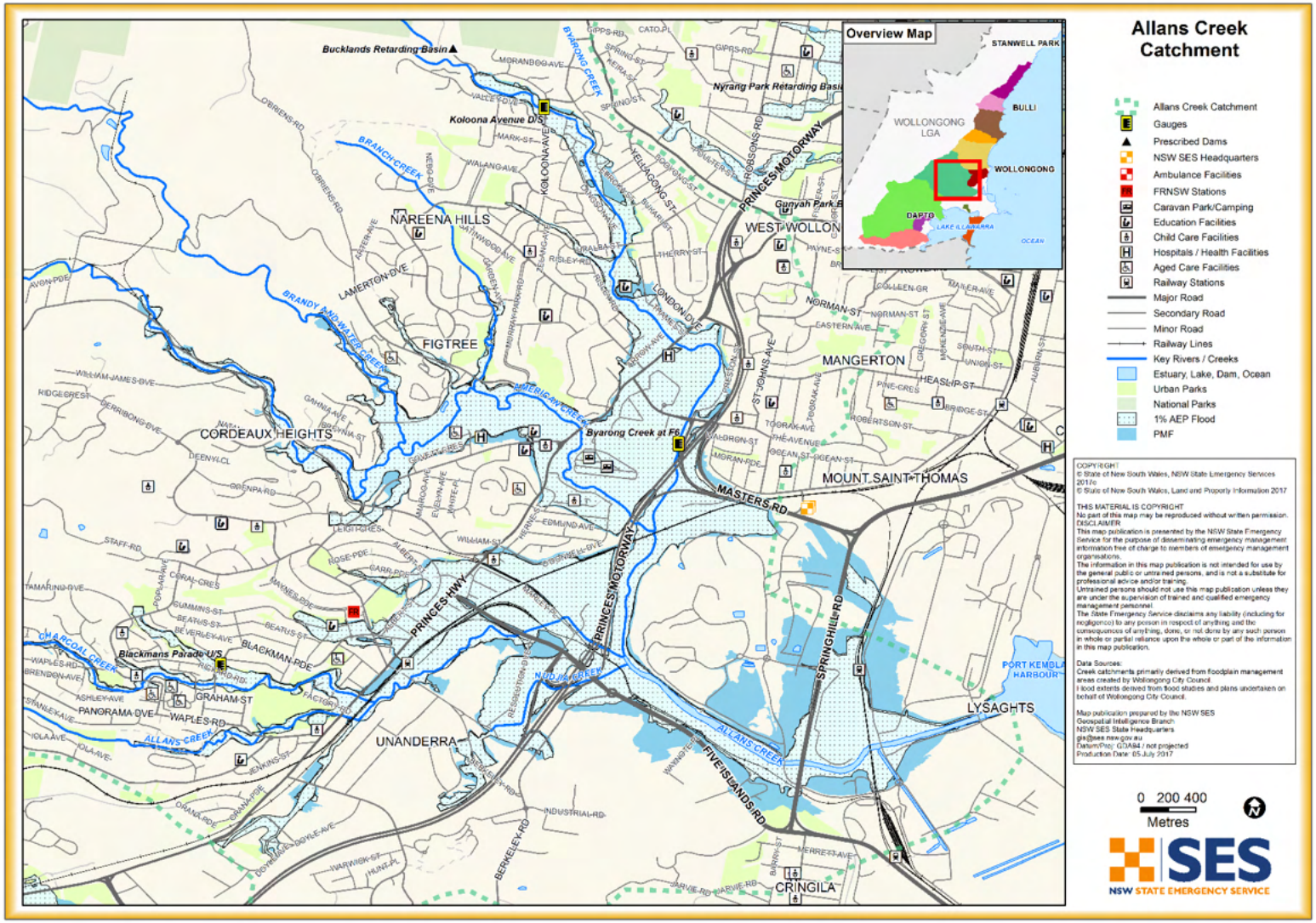

Data Sources
Creek catchments primarily derived from floodplain management areas created by Wollongong City Council.
Flood extents derived from flood studies and plans undertaken on behalf of Wollongong City Council.

Map publication prepared by the NSW SES
Geospatial Intelligence Branch
NSW SES State Headquarters
gis@ses.nsw.gov.au
Datum/Proj: GDA94 / not projected
Production Date: 05 July 2017

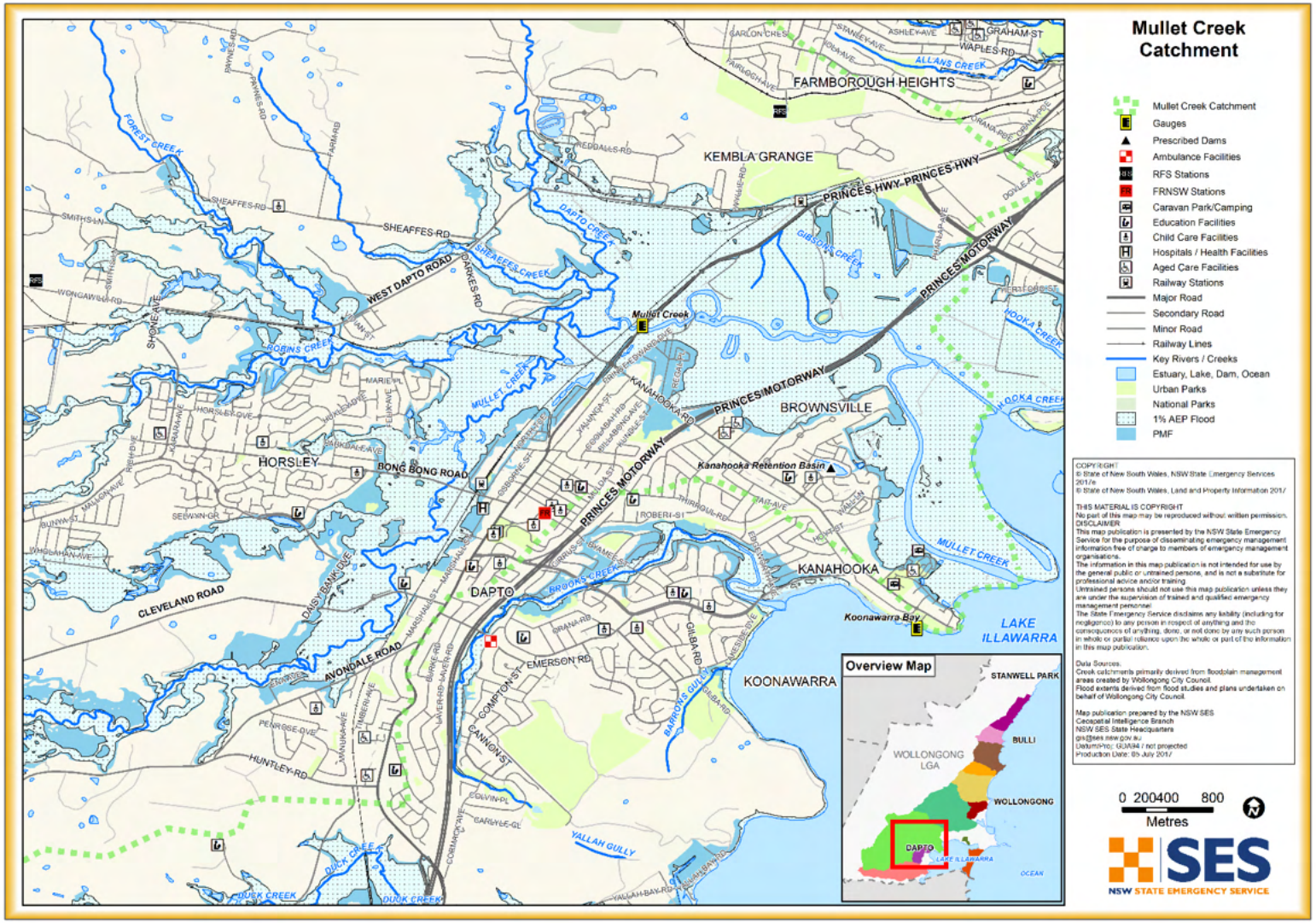
# MAP 8: WOLLONGONG CITY CATCHMENT MAP



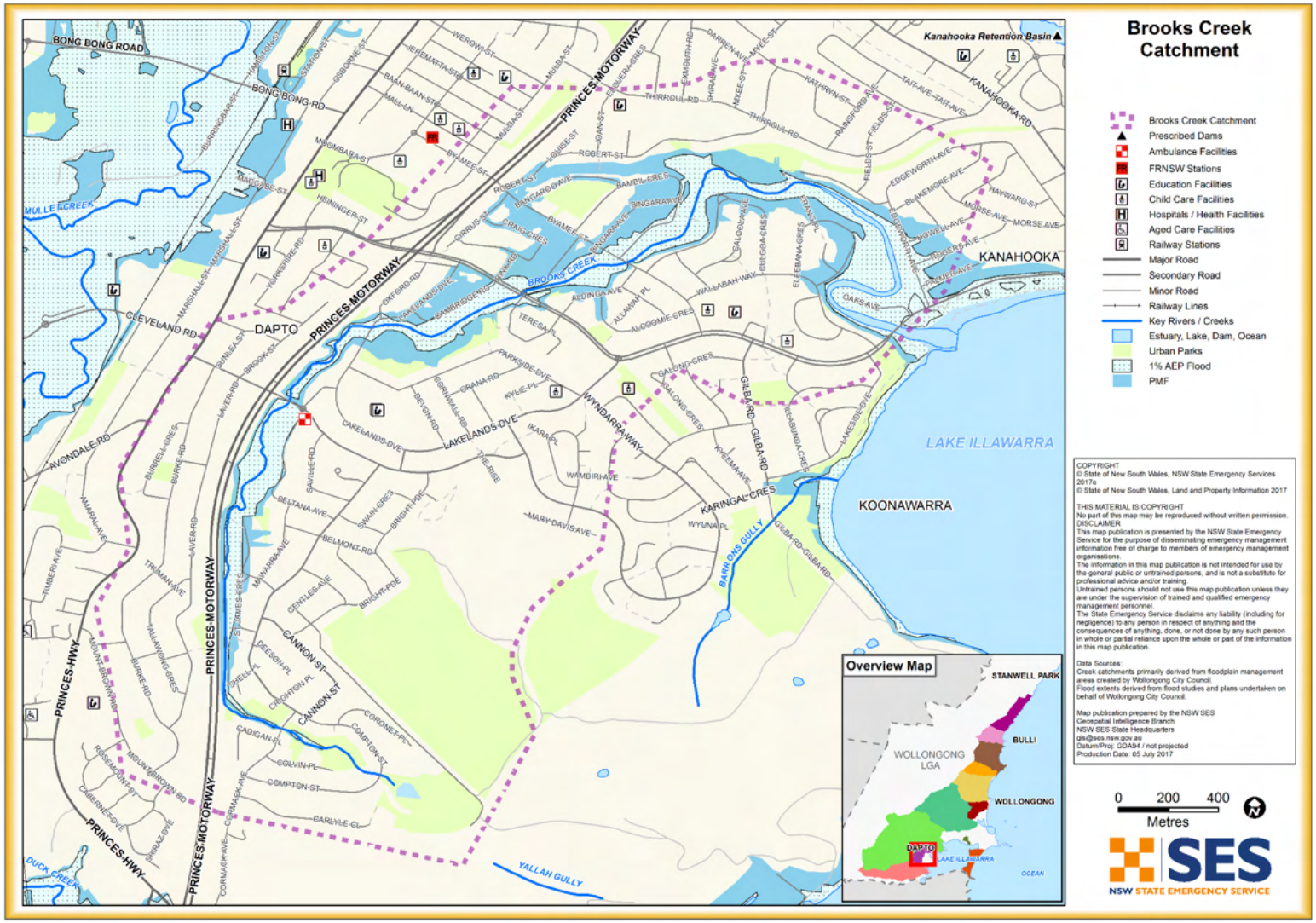
# MAP 9: ALLANS CREEK CATCHMENT MAP



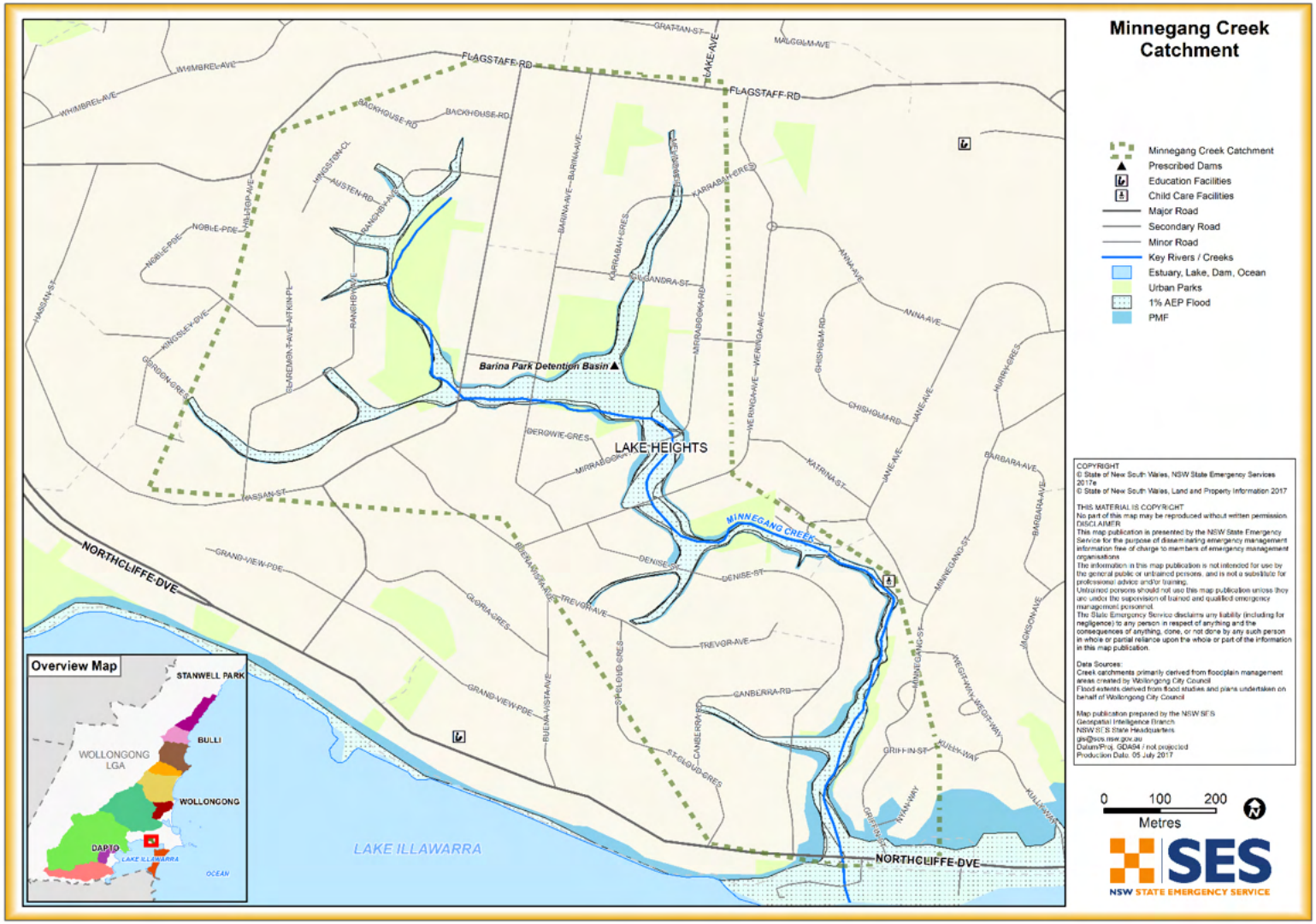
# MAP 10: MULLET CREEK CATCHMENT MAP



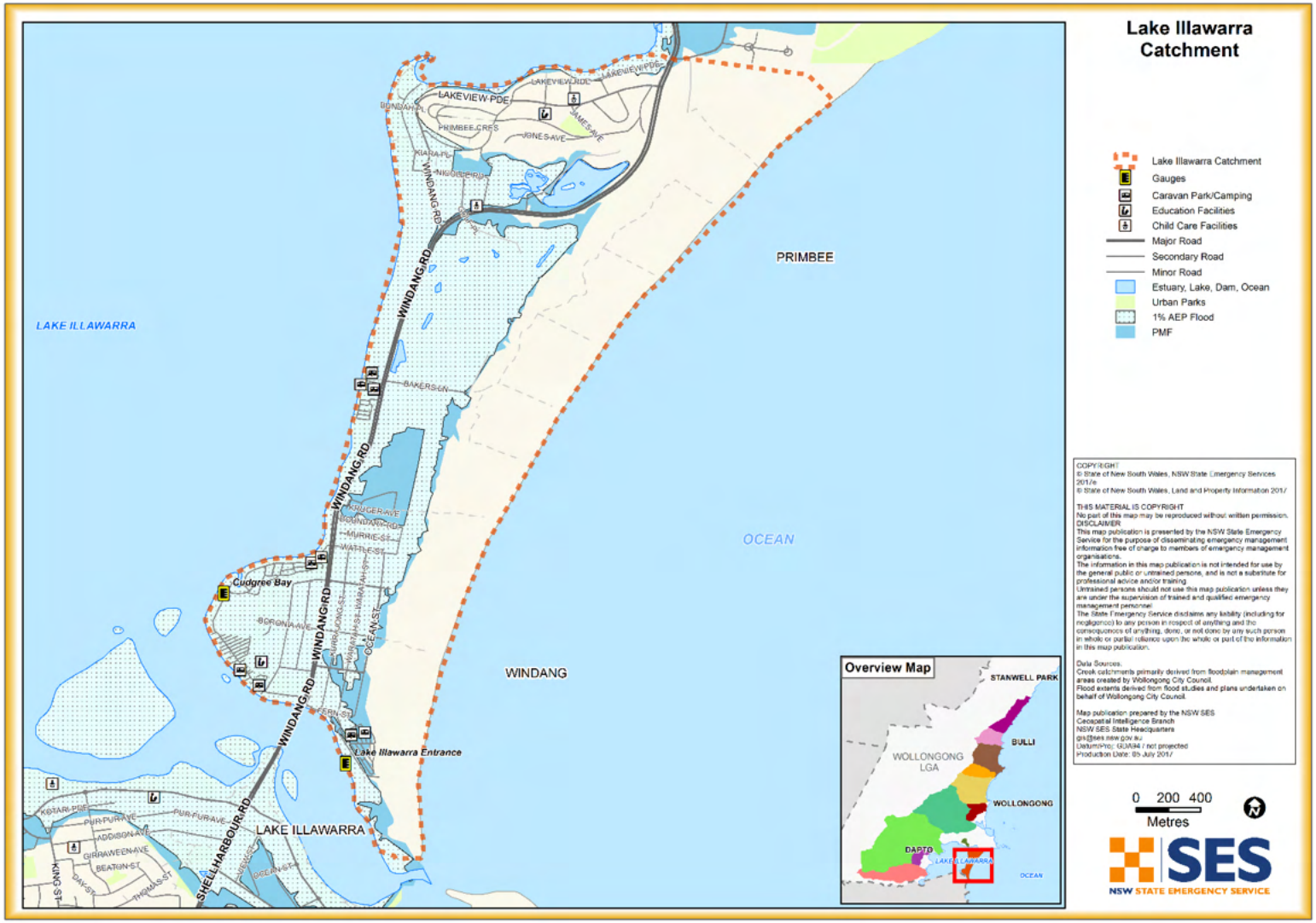
# MAP 11: BROOKS CREEK CATCHMENT MAP



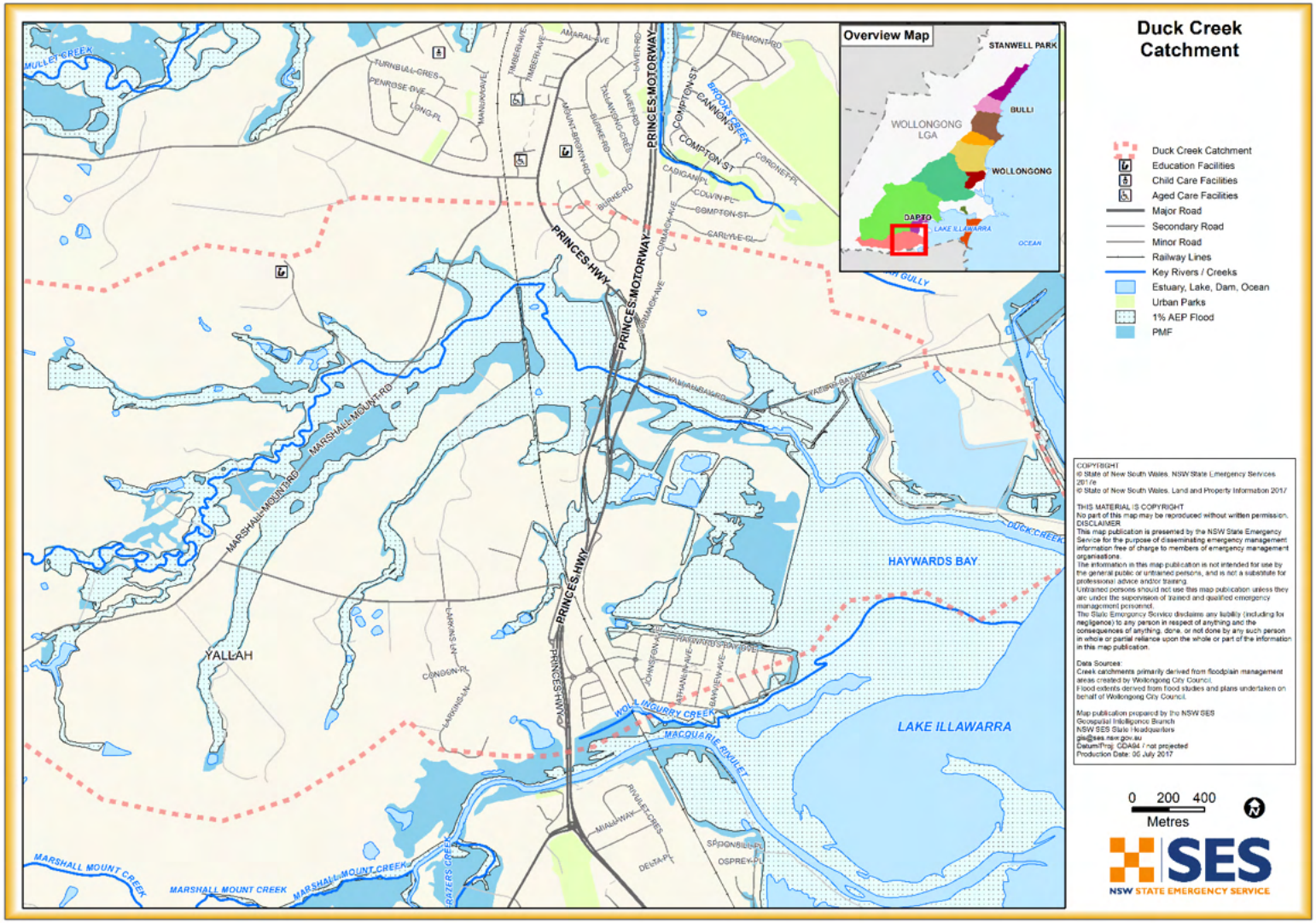
# MAP 12: MINNEGANG CREEK CATCHMENT MAP



# MAP 13: LAKE ILLAWARRA CATCHMENT MAP



# MAP 14: DUCK CREEK CATCHMENT MAP



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NSW STATE EMERGENCY SERVICE

# SES RESPONSE ARRANGEMENTS FOR WOLLONGONG CITY

**Volume 3 of the Illawarra Local Flood Plan**

Last Update: June 2010

FloodSafe

# ANNEX C - **ROAD CLOSURES**

| **STATE HIGHWAYS AND MAJOR ROADS** | | | |
|---|---|---|---|
| **ROAD** | **NEAREST SUBURB** | **USUAL POINT OF CLOSURE** | **COMMENTS/ IMPLICATIONS** |
| Princes Hwy | Bulli | Bulli Pass | Can be closed for periods exceeding 24 hours due to rain related mudslides and road undermining. Not unusual for closure of over 1 week |
| | | Junction of Lawrence Hargrave Drive | Depths may exceed 1.5m |
| | | Cnr of Hobart St | |
| | | Between Point St and Black Diamond Place. Slacky Creek crossing | Depths may exceed 1.5m |
| | | Between Hopetoun & Organs Road | Can reach approx. 0.7m depth. |
| | Corrimal | North of Rothery Road | Can reach depths of approx. 0.9m |
| | | Between Towradgi Rd & Thurston Cres | |
| | | Cnr Tarrawanna Rd | |
| | | Between Railway St & Russell St | |
| | Fairy Meadow | | |
| | Figtree | Junctions of Bellevue Rd, The Avenue, O'Briens Road and Gibsons Road | High velocity with depths recorded at over 0.8m in some locations |
| | Kembla Grange | Near racecourse entrance | Water stays for up to a week if lake levels are high. In major flooding only suitable for high clearance vehicles. |
| | North Wollongong | | |
| | Russel Vale | Outside Golf Course | Can reach depths exceeding 0.6m. |
| | | Between Albert St & Bellambi Lane | Bellambi Creek crossing. Can reach depths of approx. 0.6m with high velocity. |
| | | Between Broker & Moreton Sts | Nuisance flooding. Remains passable. |
| | Tallawarra | Duck Creek Culvert/Bridge | |
| | Unanderra | Between of Cordeaux Road and Farmborough Road | |

| STATE HIGHWAYS AND MAJOR ROADS | | | |
|---|---|---|---|
| **ROAD** | **NEAREST SUBURB** | **USUAL POINT OF CLOSURE** | **COMMENTS/ IMPLICATIONS** |
| Princes Hwy | Woonona | Between Gray St & Hillcrest Ave | Can exceed depths of 1.0m at Woonona shopping precinct. |
| | | Between Alfred St & Hale St | Can exceed depths of 1.0m |
| F6 | | At Cataract Creek crossing | |
| | Figtree | Between Masters Road on and off ramp both directions | Recorded depths of over 1m |
| | Unanderra | Approx 200m south of Masters Rd off ramp | Depths reported at 300-500mm |
| | Mount Ousley | | Water velocity travelling down roadway makes it unusable |
| Northern Distributor | Corrimal | Junction of Railway Street and to the south | |
| | | Between Rothery St & Bellambi Lane | Can reach depths of approx. 0.5m south of Rothery St. |

| LOCAL ROADS | | | |
|---|---|---|---|
| **ROAD** | **NEAREST SUBURB** | **USUAL POINT OF CLOSURE** | **COMMENTS/ IMPLICATIONS** |
| Ajax Ave | North Wollongong | Junction of Montague Street | |
| Avondale Road | | East and west of South Avondale Road<br>Low point between Oakhurst Cres and dale Street | Depths >1m can be reached. |
| | | Mullet Creek bridge | Can reach depths of over 1.5m |
| Bellambi St | Tarrawanna | Southern End | |
| Birch Cres | Bellambi | Northern end | |
| Blackall Street | Bulli | At Slacky Creek | |
| Bong Bong Road | Dapto | Near Hamilton and Burringbar Sts | Can reach depths of >1.5m. May be impassable for over 24hours |
| Boundary Road | Windang | Near Windang Road | |
| Brompton Road | Bellambi | | |
| Campbell Street | Woonona | Between Northern Distributor & Robert St | |
| Carrington Street | Woonona | Cnr Lawrence St | |
| Carters Lane | | Pioneer Road Junction | |
| Cawley Street | Bellambi | Between Connaghan Ave & Rothery St | |
| Cleveland Road | Dapto | For 1km west from railway line and at Mullet Creek crossing near junction of Avondale Road. | May exceed 1m |
| Collins Street | Corrimal | At both intersections | |
| Cordeaux Road | | Various locations from Gibsons Road to Mount Kembla | Depths may reach 300-500mm but includes high velocity |

| LOCAL ROADS | | | |
|---|---|---|---|
| **ROAD** | **NEAREST SUBURB** | **USUAL POINT OF CLOSURE** | **COMMENTS/ IMPLICATIONS** |
| Culgoa Road | Woonona | Between Kareela Rd & Campbell St | |
| Darkes Road | | Rail line and creek crossings | Depths calculated to exceed 2m |
| Farrell Road | Bulli | Cnr Trinity Road | New drainage has been installed and may alleviate past flooding problems |
| Five Islands Road | Unanderra | Junction of Princes Hwy and Five Islands Rd,<br>***and***<br>On and Off ramps from F6<br>***and***<br>Roundabout at junction of Glastonbury Avenue | Regular reports of vehicles trapped in flood waters at this location |
| Fowlers Road | | Junctions of Rink Rd and Julianne St | Can reach depths of over 1.5m |
| Gahans Lane | Woonona | Eastern end | |
| Gibsons Road | Figtree | Where road crosses American Creek. | |
| Hobart Street | | From Princes Hwy to approx 200m west of Haig Road | Reports of depths exceeding 2m |
| Hollymount View | Woonona | At both intersections | |
| King Street | Warrawong | Intersection of Hoskins Ave | |
| Lady Carrington Dr | | Hacking River | |
| Lake Parade | East Corrimal | Total closure to whole road | One of two egress routes from Corrimal beach Tourist Park |
| Lakeside Drive | | Between Edgeworth Ave & Wallabah Way | Affect known to remain for over 48 period or until lake able to release to ocean. |
| Lawrence Hargrave Drive | | Various locations where creeks cross roadways | May close for a number of days post rain event due to landslips or road undermining |
| | Thirroul | Between Hewitts Ave & Phillip St,<br>***and***<br>Cnr Railway Parade | |
| Liddle Street | Woonona | | |
| Meadow Street | Tarrawanna | Between Caldwell Ave & Keira St,<br>***and***<br>North of Kendall St,<br>***and***<br>Between Tarrawanna Rd & Karen Pl | |
| Montague Street | North Wollongong | From Ajax Ave to road rise at Para Ck bridge | SES HQ flooded |

| LOCAL ROADS | | | |
|---|---|---|---|
| **ROAD** | **NEAREST SUBURB** | **USUAL POINT OF CLOSURE** | **COMMENTS/ IMPLICATIONS** |
| Northcliffe Drive | Warrawong | Between First Ave & Denise St<br>***and***<br>The intersection of Wilkinson St (eastern end) | |
| Old Port Road | | Near railway over-bridge | |
| O'Briens Road | Figtree | Between Princes Hwy and Murray Park Road,<br>***and***<br>East of Church of Christ | Depths of over 600mm recorded |
| Otford Road | Otford | Hacking River | |
| Pioneer Road | Bellambi | Between Bellambi Lane & Lismore St | |
| | East Corrimal | Between Coolgardie St & Owen Park Rd,<br>And<br>Between Sturdee St & Lake Parade | |
| | | | |
| Railway Parade | Woonona East | Southern End | |
| Railway Street | Corrimal | Between Harbinger St & Gilbert St | |
| Rothery Street | Corrimal | | |
| Squires Way | | Overflowing Sewer | |
| Springhill Road | Springhill | Various locations at and between Masters road and Five Islands Road | Have recorded depths of 2.0m |
| Stanhope St | Woonona | At both intersections | |
| Thompson Street | | At Collins creek bridge | |
| Underwood St | Corrimal | At The Avenue & Francis St intersection up to Russell St | |
| Uralba Street | Figtree | At Byarong Creek | Depths of over 1.2m recorded. |
| Ursula Road | Bulli | At both intersections | |
| West Dapto Road | Dapto | All creek crossings and low lying areas.<br>Junction of Sheaffes Road | Can reach depths of >0.6m |
| Windang Road | Windang | Between the suburbs of Primbee & Lake Illawarra | |

# ANNEX D - **GAUGES MONITORED BY THE SES**

| AUTOMATIC RAINFALL RECORDERS | | |
|---|---|---|
| **Gauge Name** | **Owner** | **Catchment** |
| Balgownie Reservoir | WCC | Cabbage Tree Creek |
| Bellambi | | Bellambi Creek |
| Berkeley (Northcliffe Dr) | | Harbour Creek |
| Cleveland Road | | Mullet Creek |
| Dapto Bowling Club | | Mullet Creek |
| Darkes Road | | Mullet Creek, Robins Creek |
| Dombarton Loop | | Mullet Creek, Robins Creek, Forest Creek |
| Figtree Reservoir | WCC | Brandy and Water Creek/American Creek |
| Glennifer Brae | WCC | |
| Huntley Colliery | | Mullet Creek |
| Kembla Grange Golf Course | WCC | Mullet Creek |
| Mount Kembla | | American Creek |
| Mount Pleasant | | Cabbage Tree Creek |
| Port Kembla | | |
| Rixons Pass | | Collins Creek<br>Hewitts Creek |
| Russell Vale | MHL | Collins Creek<br>Towradgi Creek<br>Cabbage Tree Creek |
| Scarborough | WCC | |
| Wollongong (AWS) | | |
| Wollongong City Council | | J.J. Kelly |
| Wongawilli Colliery | WCC | Mullet Creek, Robins Creek |
| Wongawilli Reservoir | WCC | Mullet Creek |
| Woonona (Popes Rd) | | Collins Creek |

**Notes:**
In addition to these gauges active reconnaissance of known trouble spots is also carried out by Wollongong City SES members during operations involving flooding and heavy rainfall.

| AUTOMATIC RIVER HEIGHT RECORDERS | | | | |
|---|---|---|---|---|
| **Gauge Name** | **AWRC No** | **Stream** | **Owner** | **Response Trigger Levels** |
| Allans Creek | 10004 | Allans Creek | MHL | 0.7m |
| American Cree | 10005 | American Creek | MHL | |
| Bellambi Creek (DS) | 10112 | Bellambi Creek | | |
| Bellambi Creek (US) | 10350 | Bellmabi Creek | | |
| Berkeley | 10021 | Lake Illawarra | | |
| Byarong Creek (F6) | 10069 | Byarong Creek | MHL | |
| Cabbage Tree Creek | 214405 | Cabbage Tree Creek | MHL | 5.3m |
| Cudgeree Bay | 214416 | Lake Illawarra | | |
| Dapto High School | 10114 | Mullet Creek | | |
| F6 (Near Uni) | 10142 | Fairy Creek | MHL | |
| Foothills Road | 10147 | Cabbage Tree Creek | | |
| Hewitts Creek Entrance | | Hewitts Creek | MHL | |
| Hewitts Creek | | Hewitts Creek | MHL | 11.4m |
| Kaloona Ave | 10195 | Byarong Creek | | |
| Kanahooka Point | 214415 | Lake Illawarra | | |
| Koonawarra | 10206 | Mullet Creek | | |
| Lake Entrance | 214417 | Lake Illawarra | | |
| Lake Illawarra Village | 10211 | Lake Illawarra | | |
| Mullet Creek | 214200 | Mullet Creek | MHL | 3.0m |
| Pioneer Road | 10297 | Towradgi Creek | | |
| Princes Hwy No 3 | 214404 | Fairy Creek | | |
| Prince Hwy No 4 | 10454 | Mullet Creek | | |
| Robsons Road | 10331 | Fairy Creek | | |
| Tallawarra Power Station | 10362 | Lake Illawarra | | |
| Towradgi Creek DS | | Towradgi Creek | MHL | 1.3m |
| Towradgi Creek US | | Towradgi Creek | MHL | |

**Notes:**
Some of these, e.g. Cudgeree Bay, are configured to generate proactive warnings when pre-determined levels are reached. In addition to these gauges active reconnaissance of known trouble spots is also carried out by Wollongong City SES members during operations involving flooding and heavy rainfall.

# ANNEX E - **DISSEMINATION OF SES FLOOD BULLETINS**

The Illawarra South Coast SES Region Headquarters distributes SES Flood Bulletins and other flood related information (including Flood Warnings) to the following regional media outlets:

## Television Stations:

| Station | Location |
|---|---|
| Win TV | Wollongong |
| Prime TV | Wollongong |
| Southern Cross Ten | Wollongong |
| SBS | Crows Nest |
| ABC TV | Sydney |

## Radio Stations:

| Station | Location | Frequency |
|---|---|---|
| Wave FM | Warrawong | 96.5 |
| ABC Illawarra | Wollongong | 97.3 |
| i98 FM | Coniston | 98.1 |
| Power FM | Nowra | 94.9 |
| VOX FM | Wollongong | 106.9 |
| Living Sound FM | Coniston | 94.1 |

## Newspapers:

| Name | Location |
|---|---|
| Illawarra Mercury | Wollongong |
| Wollongong Advertiser | Wollongong |
| Northern Leader | Corrimal |
| Lake Times | Shellharbour |

# ANNEX F - **EVACUATIONS ARRANGEMENTS**

## Arrangements

1. **Control.** During floods evacuations will be controlled by the NSW SES. Small-scale evacuations will be controlled by the Wollongong City SES Operations Controller. Should the evacuations operations escalate beyond the capabilities of local resources control may be handed over to the Illawarra South Coast SES Region Operations Controller.
2. **Conduct.** Evacuations will be controlled by the SES Operations Controller and conducted with assistance from the NSW Rural Fire Service, NSW Police, NSW Fire Brigade, Ambulance of NSW and service club personnel.
3. Evacuations will be controlled by the SES and conducted in four phases:

   Phase 1 - Warning.

   Phase 2 – Withdrawal.

   Phase 3 – Shelter.

   Phase 4 – Return.

## Decision to Evacuate

4. The responsibility for issuing any general evacuation order during flooding rests with the Local SES Operations Controller who exercises his/her authority in accordance with section 22 (1) of The State Emergency Service Act 1989. During the possibility of large-scale evacuations the decision to evacuate will usually be made after consultation with the Wollongong City LEOCON and the Illawarra South Coast Region Operations Controller.
5. **When evacuations should occur.** As far as possible, evacuations will be carried out before inundation occurs. Due to the flash flood nature of flooding in the Wollongong LGA this may not be able to occur.

   The SES will retain intelligence that identifies “hot spots” that lie within high hazard areas. These areas are identified at the end of this section.
6. **What to consider.** When deciding to evacuate the following should be considered.

   a. Predicted flood level and rate of rise.

   b. Rainfall situation and rainfall predictions.

   c. Condition of evacuation routes.

   d. Characteristics of the at risk population.

   e. Time of day.

   f. Likely duration of evacuation operations and time available to conduct evacuations.

   g. Likely duration of any isolation and preparedness of the community to cope with isolation.

   h. Condition of essential services
7. **Voluntary Evacuations.** Some people will make their own decision to evacuate earlier and move to alternative accommodation using their own transport. These evacuees will be advised, via the media, to inform the Police or SES of their evacuation and their temporary address. Where possible, people

will be given the opportunity to evacuate voluntarily at an early stage of a potentially severe flood. Elderly people and mothers with young children will especially be encouraged to evacuate voluntarily under such circumstances.

8. Evacuation triggers.

   a. **Failure of Essential Services.** The failure of public utilities such as sewerage, power, telephones and water pose a significant health risk to residents on the floodplain or in flood affected areas. In the event of any or all of these systems failing or potentially failing, the need for evacuations will be discussed with the members of the LEMC.

   b. **Flooding affecting properties.** Evacuations are to occur, if it is likely properties will be flooded. (See Community cards for Trigger levels/rainfall)

   c. **Isolation of properties.** Persons who are not prepared for isolation or unsuited due to medical conditions etc, should be encouraged to evacuate

   d. **Dam Failure.** Evacuations are to occur when advised of Imminent Dam failure

## Groupings and Tasks

9. **Operational Sectors.** For the purpose of managing flood response operations and evacuations during severe floods the Wollongong Local Government Area will be divided into operational sectors based on the flood plain management areas.

10. **Tasks.** Tasking will align with the agreed responsibilities as outlined in Part 2 – Responsibilities.

## Phase 1 – Warning

11. **Evacuation Warnings.** On receipt of flash flood warnings or observations predicting rainfall that may result in flooding, public health concerns or prolonged isolation, the Local SES Operations Controller will consult as necessary to determine the level of the threat and the need to consider evacuations. As soon as possible after the decision to evacuate is made, the Local SES Operations Controller will issue evacuation warnings to the 'at risk' residents, indicating what people should do before evacuating and when actually doing so.

12. **Content of Evacuation Warnings/Orders** will include:

   a. The rainfall situation and the state of tributaries.

   b. The condition of transport routes.

   c. Location of evacuation shelters

13. Dissemination of Evacuation Warnings. These are disseminated via:

   a. The radio and TV stations listed in Annex E.

   b. Door-knocks by emergency service personnel.

   c. Public address systems from emergency service vehicles.

   d. Telephone.

   e. SES Flood Bulletins.

## Phase 2 – Withdrawal

14. **Introduction.** Withdrawal involves the actual removal of the community/individuals from dangerous or potentially dangerous areas to safer areas.

15. **Movement.** Evacuees are to be encouraged to move using their own transport where possible. The Local SES Operations Controller will arrange transport for those people without their own vehicles. This may include the provision of buses. Evacuees will be taken or advised to go to the nearest accessible Assembly Point or Evacuation Centre. Evacuees who cannot reach an evacuation centre unaided will be transported from their homes or from designated assembly points nearby.

16. **Phasing/Priority**. In evacuations priority will be given to assist in the movement and management of people. These priorities will be determined at the time of the operations and are dependent upon many circumstances.

17. **Traffic Control.** When large-scale evacuations are likely, evacuation routes are to be secured by the NSW Police and kept clear by the following means:

    a. Denying access to all traffic except for emergency vehicles (including buses and private vehicles being used for the purposes of evacuation).

    b. Keeping one lane clear at all times for use by emergency vehicles.

    c. Positioning a tow truck or similar vehicle at appropriate entry points, road blocks and exit points along the evacuation routes.

18. **Evacuation routes.** Most roads within the Illawarra become quickly inundated from creek overflows as well as storm water drain spill. Due to the possibility of storm water drain spill occurring in any area it is difficult to pre-define evacuation routes within this plan. Therefore evacuation route advice will be provided according to intelligence gathered at the time of the event.

19. **Special Needs Groups.** A large number of elderly persons and tourists reside in urban areas of the Wollongong Local Government Area. When evacuations are ordered Ambulance Service personnel will be deployed to assist with the safe evacuation of these people.

20. **Animals.** Evacuees with their own transport will be encouraged to take their pet such as cats, dogs and horses with them as they evacuate. These animals will therefore be transported by car, truck or horse float along the evacuation routes designated in this plan. Animals so shifted will be collected from their owners at evacuation centres and taken to pre-arranged facilities. Due to safety restrictions, it may not be possible to allow animals to accompany their owners when being transported via aircraft or flood rescue boats. In these cases, provision will be made for animals to be picked up as the people are evacuated. Arrangements will also be made to pick up animals that are left behind. Assistance animals (guide dogs, hearing assistance animals, etc), however, will remain in the care of their owners throughout the evacuation. This includes transport and access into evacuation centres.

21. **Doorknocking.** Field teams conducting doorknocks will record and report back the following information back to the Operations Centre:

    a. Addresses and locations of houses doorknocked and/or evacuated.

    b. The number of occupants.

c. Details of the location evacuees are intending to present at.

d. Details of how the evacuees will register.

e. Details of support required (such as transport, medical evacuation, assistance to secure house and/or property and raise or move belongings).

f. Details of residents who refuse to comply with the evacuation order.

22. Properties, which have been doorknocked, should be marked with survey tape. Written on the survey tape should be the name of the doorknocking unit and the time of doorknock.

23. **Refusal to Evacuate.** Field teams should not dedicate additional time dealing with people who are reluctant or refuse to comply with any evacuation order. These cases should be referred to the Local Emergency Management Operations Controller who will arrange for Police to ensure their evacuation.

24. **Security.** The NSW Police will provide security for evacuated premises. Details of evacuated premises are to be passed to the Wollongong and Lake Illawarra Police stations.

25. **Transport and storage**. Transport and storage of furniture from flood threatened properties will be arranged as time and resources permit.

## Phase 3 – Shelter

26. **Evacuation Centres.** The usual purpose of evacuation centres is to meet the immediate needs of victims, not to provide them with accommodation. Evacuees will be advised to go to or be taken to the nearest accessible evacuation centre, which may initially be established at the direction of the Local SES Operations Controller but managed as soon as possible by the Welfare Services. Any of the following sites may be suitable as evacuation centres:

27. **Action on arrival.** On arrival, evacuees will be:

a. Registered;

b. Medically checked, if necessary; and

c. Provided with their immediate welfare needs.

28. **Registration.** The NSW Police are responsible for the registration of evacuees.

## Phase 4 – Return

29. Once it is considered safe to do so, the Local SES Operations Controller will authorise the return of evacuees to their normal or alternative place of residence. This decision will be made in consultation with appropriate.

30. The return will be controlled by the Local SES Operations Controller and may be conducted, at his/her request, by Welfare Services

## Evacuation Areas ("Hot Spots")

The following locations will be monitored by SES as to determine if evacuations will be required. Only in extreme rainfall events will SES consider evacuations.

| **AREA 1** | **NORTH FROM THIRROUL TO CLIFTON** | |
|---|---|---|
| No data available at time of publication | | |
| **AREA 2** | **HEWITTS CREEK CATCHMENT** | |
| **Suburb** | **No of properties** | **Creek** |
| Thirroul | 50 | Hewitts Creek |
| Thirroul | 15 | Thomas Gibson |
| Thirroul | 5 | Woodlands |
| **AREA 3** | **COLLINS CREEK CATCHMENT** | |
| No data available at time of publication | | |
| **AREA 4** | **TOWRADGI CREEK CATCHMENT** | |
| **Suburb** | **No of properties** | **Creek** |
| Bellambi | 2 | Towradgi Creek |
| Bulli | 10 | Tramway Creek |
| Corrimal | 240 | Towradgi Creek |
| East Corrimal | 1 | Towradgi Creek |
| Fernhill | 5 | Towradgi Creek |
| Tarrawanna | 15 | Towradgi Creek |
| Towradgi | 125 | Towradgi Creek |

| **AREA 5** | **FAIRY & CABBAGE TREE CREEKS CATCHMENT** | |
|---|---|---|
| **Suburb** | **No of properties** | **Creek** |
| Fairy Meadow | TBC | |
| North Wollongong | TBC | |
| **AREA 6** | **ALLENS CREEK CATCHMENT** | |
| **Suburb** | **No of properties** | **Creek** |
| Cordeaux Heights | 7 | Allens Creek |
| Farmborough Heights | 2 | Allens Creek |
| Figtree | 299 | Allens Creek |
| Mangerton | 26 | Allens Creek |
| Mt Keira | 2 | Allens Creek |
| Port Kembla | 5 | Allens Creek |
| Unanderra | 104 | Allens Creek |
| West Wollongong | 37 | Allens Creek |
| **AREA 7** | **MULLET CREEK CATCHMENT** | |
| **Suburb** | **No of properties** | **Creek** |
| Berkeley | 5 | Mullet Creek |
| Brownsville | 1 | Mullet Creek |
| Dapto | 19 | Mullet Creek |
| Dapto | 27 | Brooks Creek |
| Horsley | 2 | Mullet Creek |
| Horsley | 1 | Robins Creek |
| Kanahooka | 9 | Brooks Creek |
| Koonawarra | 4 | Brooks Creek |
| **AREA 8** | **MINNEGANG CREEK CATCHMENT** | |
| **Suburb** | **No of properties** | **Creek** |
| Lake Heights | 8 | Minnegang Street |
| **LAKE ILLAWARRA** | | |
| No data available at time of publication | | |

# ANNEX G - **ARRANGEMENTS FOR THE EVACUATION OF CARAVAN PARKS AND THE RELOCATION OF CARAVANS**

## General

1. The following caravan parks are flood liable:
   a. Corrimal Beach Tourist Park
   b. Oasis Caravan Park
   c. Lake Illawarra Village
   d. Oaklands Village
   e. Figtree Gardens, Prince Hwy, Figtree

## Advising Procedures

2. Caravan Park proprietors will be encouraged to ensure that the owners and occupiers of caravans are:
   a. Made aware that the caravan park is flood liable by:
      - Handing a printed notice to occupiers taking up residence.
      - The notice should indicate that the caravan park is liable to flooding and outline the evacuation and van relocation arrangements as detailed in this Annex.
   b. Displaying this notice prominently in each van. Made aware that if they are expecting to be absent from their vans for extended periods, they can:
      - Provide the manager with a key; in a sealed envelope; to the van.
      - Provide a contact address and telephone number.
      - Inform the manager if a vehicle will be required to relocate the van during flood time.
      - Leave any mobile van in a condition allowing it to be towed in an emergency (ie: tyres inflated, jacks wound up, personal effects secured and annexes and lines for water, sewer, electricity and gas readily detachable).
   c. Informed when a flood is rising. At this time, occupiers will be advised to:
      - Ensure that they have spare batteries for their radios.
      - Listen to a local radio station for updated flood information.
      - Prepare for evacuation and van relocation.
3. The Local SES Operations Controller will ensure that the managers of caravan parks are advised of flood warnings and the details of any evacuation order.

## Evacuation of Occupants and Relocation of Vans

4. Caravan park proprietors will be encouraged to install flood depth indicators and road alignment markers within their caravan parks.
5. When an evacuation order is given:
    a. Occupiers of non-movable vans should:
        - Secure their vans by tying them down to prevent flotation.
        - Isolate power to their vans.
        - Collect personal papers, medicines, a change of clothing, toiletries and bedclothes.
        - Lift the other contents of their vans as high as possible within the van.
        - Move to a designated evacuation centre if they have their own transport, or move to the caravan office to await transport.
    b. Where possible, vans that can be moved will be relocated by their owners. Park managers will arrange for the relocation of mobile vans whose owners do not have a vehicle. Council and SES personnel may assist if required and may be able to provide additional vehicles.
6. Occupants of vans that are being relocated should go to a designated evacuation centre if they have their own transport. Those without their own transport are to report to the caravan park office.
7. Caravan park managers should:
    a. Ensure that their caravan park is capable of being evacuated within the following times.
        - Corrimal Beach Tourist Park – 3 hours
        - Oasis Caravan Park – 6 hours
        - Lake Illawarra Village – 6 hours
        - Oaklands Village – 6 hours
        - Figtree Gardens – 3 hours
    b. Advise the Local SES Operations Controller of:
        - The number of people requiring transport.
        - Details of any medical evacuations required.
        - Whether additional assistance is required to effect the evacuation.
    c. Check that no people remain in non-removable vans that are likely to be inundated.
    d. Inform the Local SES Operations Controller when the evacuation of the caravan park has been completed.
    e. Provide the Local SES Operations Controller with a register of people that have been evacuated.
8. Caravan parks south of the Wollongong Catchment, due to the short warning time available, should concentrate on the evacuation of persons rather than vans.

9. The Local SES Operations Controller, using Council resources as necessary, will advise when it is safe for the caravan parks to be re-occupied.

## Return of Occupants and Vans

10. Vans will be towed back to the caravan parks by van owners or by vehicles and drivers arranged by the park managers. Again, Council and SES personnel will assist if available.

# ANNEX H - **THE MANAGEMENT OF COASTAL EROSION**

## Background

1. The Wollongong City Council area is bordered by the Pacific Ocean to the east. There are three main types of beach units within the LGA's boundaries: compartmentalised, sheltered, and exposed. The coastal areas are subject to natural coastal processes and resultant coastline hazards that include coastal erosion, oceanic inundation, and shoreline recession.

2. The coastal erosion/oceanic inundation problem in the Wollongong City LGA takes two forms:
   a. Undercutting of dunes on their seaward sides, threatening the collapse of dwellings and other infrastructure
   b. The potential breaking through of the dunes by sea water, causing flooding and isolation of property on the landward side of the dunes

3. The most severe problems of coastal erosion/inundation occur as a result of oceanic storm conditions associated with the passage of ex-tropical cyclones and temperate-zone low-pressure systems. These storms may cause temporary sea level rises with large associated waves. The worst erosion/inundation is likely when severe weather conditions occur in conjunction with high tides

## At Risk Beaches

4. The following are classified as "Hot Spots" for coastal erosion within the Wollongong City LGA:

| Beach Name | Risk | Beach Name | Risk |
|---|---|---|---|
| Stanwell Park | Extreme | Cliffs between Stanwell Park & Coalcliff | Medium |
| Coalcliff | Extreme | Coledale Beach | Medium |
| Thirroul | Extreme | Sandon Point Beach | Medium |
| Bellambi Point | Extreme | Bellambi Point | Medium |
| Flagstaff Point | Extreme | North Wollongong Beach | Medium |
| Wollongong (South Beach) | Extreme | Belmore Beach | Medium |
| Wollongong | Extreme | Red Point | Medium |
| Sharkey Beach | High | | |
| Port Kembla Harbour | High | | |

**Table 7: Erosion risk levels of beaches**

## Concept of Operations

5. **Control**. The SES is the designated combat agency for damage control from storms, including coastal erosion from storm activity.

6. Evacuation arrangements for Wollongong City LGA are contained in Annex F.

7. Within this role and as specified under the State Storm Plan the SES is responsible for the following during and in the period immediately prior to a storm event occurring out at sea:

a. Advising the community at risk of the likely problem and actions they should take;
b. The protection of life through the warning and evacuation of residents at risk; and
c. The coordination of the lifting and/or relocation of readily movable household items and commercial stock and equipment.

8. The role of the SES as the combat agency for storms does not include coastal erosion and inundation caused by astronomical high tides when severe weather is not actually developing or occurring.

9. The SES is not responsible for controlling or conducting any physical mitigation works to protect properties or structures at risk from coastal erosion/inundation, either during or outside the period of storm activity. This includes, but is not limited to:
   a. The placement of rocks or other materials on beaches or foreshore areas
   b. The construction of temporary walls made of sandbags, geo-technical tubes, or other material

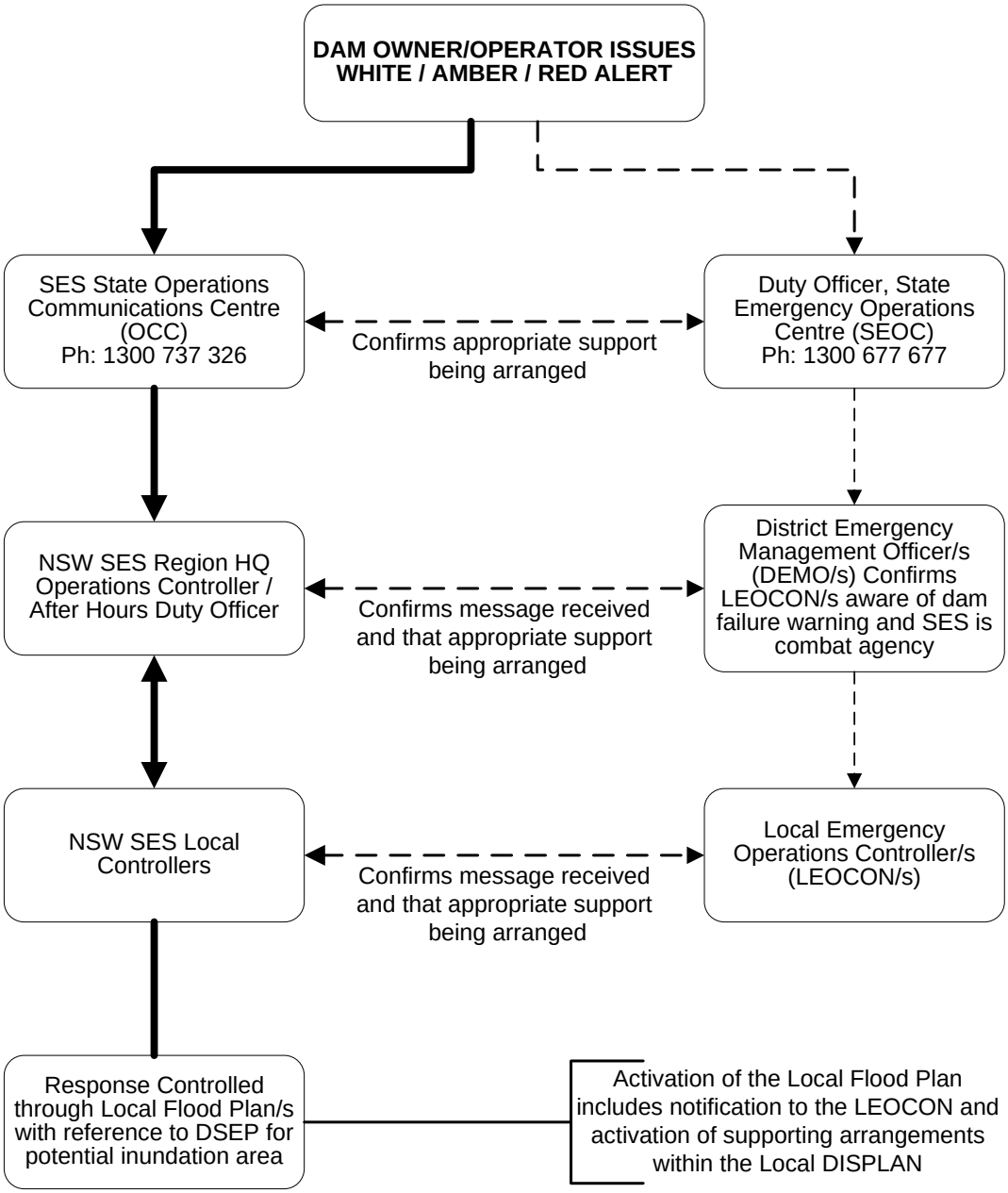
10. DECC will provide ongoing advice to local councils and coastal zone management committees on the formulation and implementation of coastal zone management plans including procedures for addressing coastal processes, coastline hazards and risks, management options and coastal policies.

11. BoM will issue Severe Weather Warnings.

# ANNEX I - **PRESCRIBED DAMS IN THE WOLLONGONG LGA**

1. Wollongong City Council has 10 Dams Prescribed under the NSW Dams Safety Committee:
    - Edgewood - Woonona
    - Foothills Estate 1&2 - Tarrawanna
    - Foothills Estate 3 – Tarrawanna
    - Brokers Road - Balgownie
    - Foothills Road - Mount Ousley
    - Wollongong High School – North Wollongong
    - Nyrang Park – Gwynneville
    - Gunyah Park – Keiraville
    - Gannet Avenue – Berkeley
    - Dapto Heights
2. The emergency Management Sub Committee of the NSW Dams Safety Committee has not rated these dams as having either a significant or a high risk ranking so no specific dam details are outlined in this plan. Current arrangements outlined in the relevant DSEP will be implemented should it be required.

# Notification Arrangements for Potential Dam Failure




**NOTE: dam owners should take every attempt to call SES State Operations in the first instance and only use the SEOC if the SES cannot be contacted**
**The '000' emergency contact number is not the preferred method of contacting the NSW Police in the context of dam failure. It is likely that the '000' operators will have difficulty dealing with the very unusual case of potential or actual dam failure. If '000' is used, the caller must give the details of the incident to the '000' operator before asking to be transferred to the duty Operations Inspector (DOI).**

# ANNEX J - **EVACUATION RECORDING SHEET**

| House No | Street | Suburb | Number of Occupants | Evacuating to: *(Tick as appropriate)* | | Registration by: *(Tick as appropriate)* | | Type of Support Required *(Tick as appropriate)* | | | | Notes |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Private address | Evac Ctr | Phone | Evac Ctr | Transport | Medical | Animal | Other | |
| | | | | | | | | | | | | |
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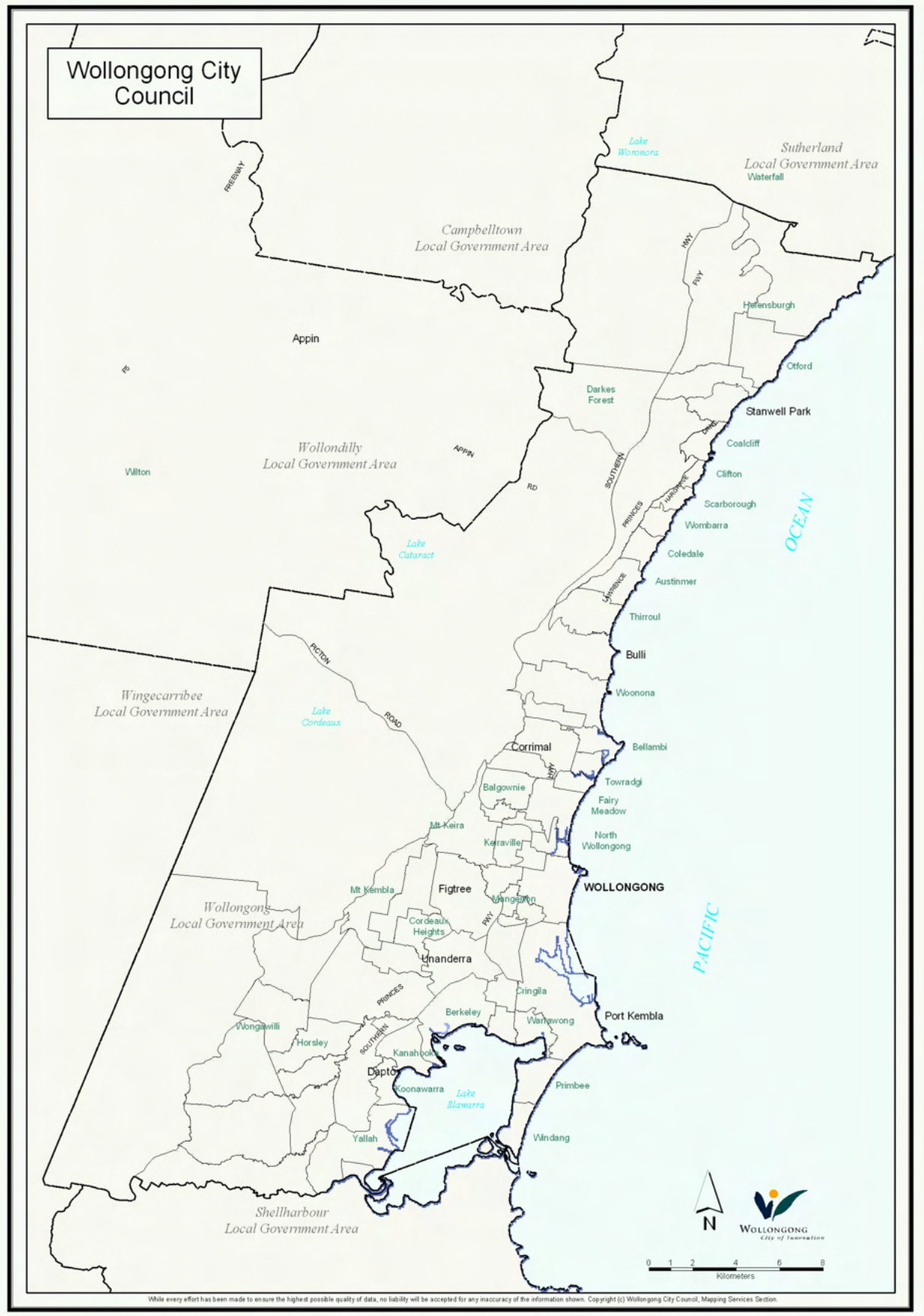
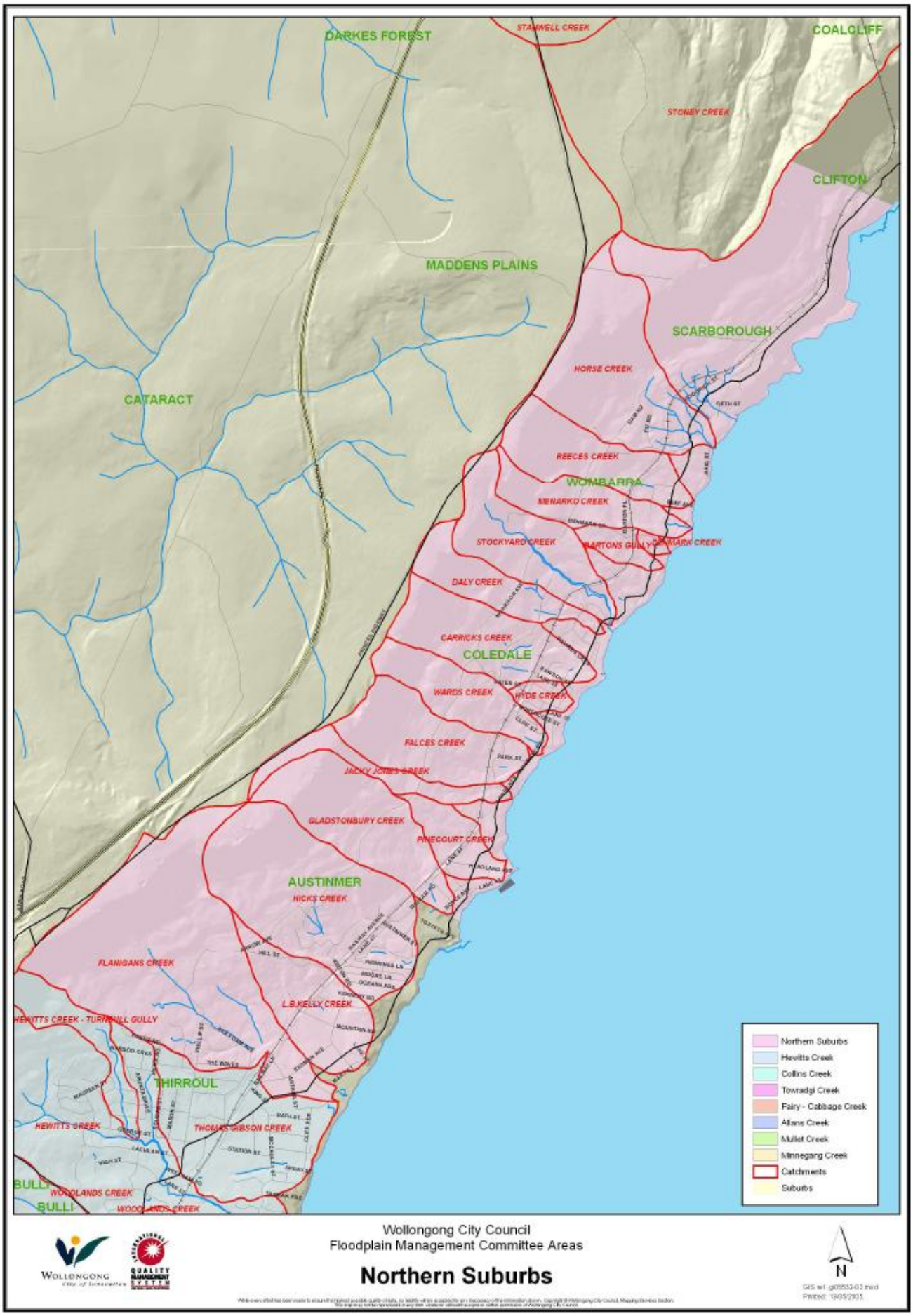
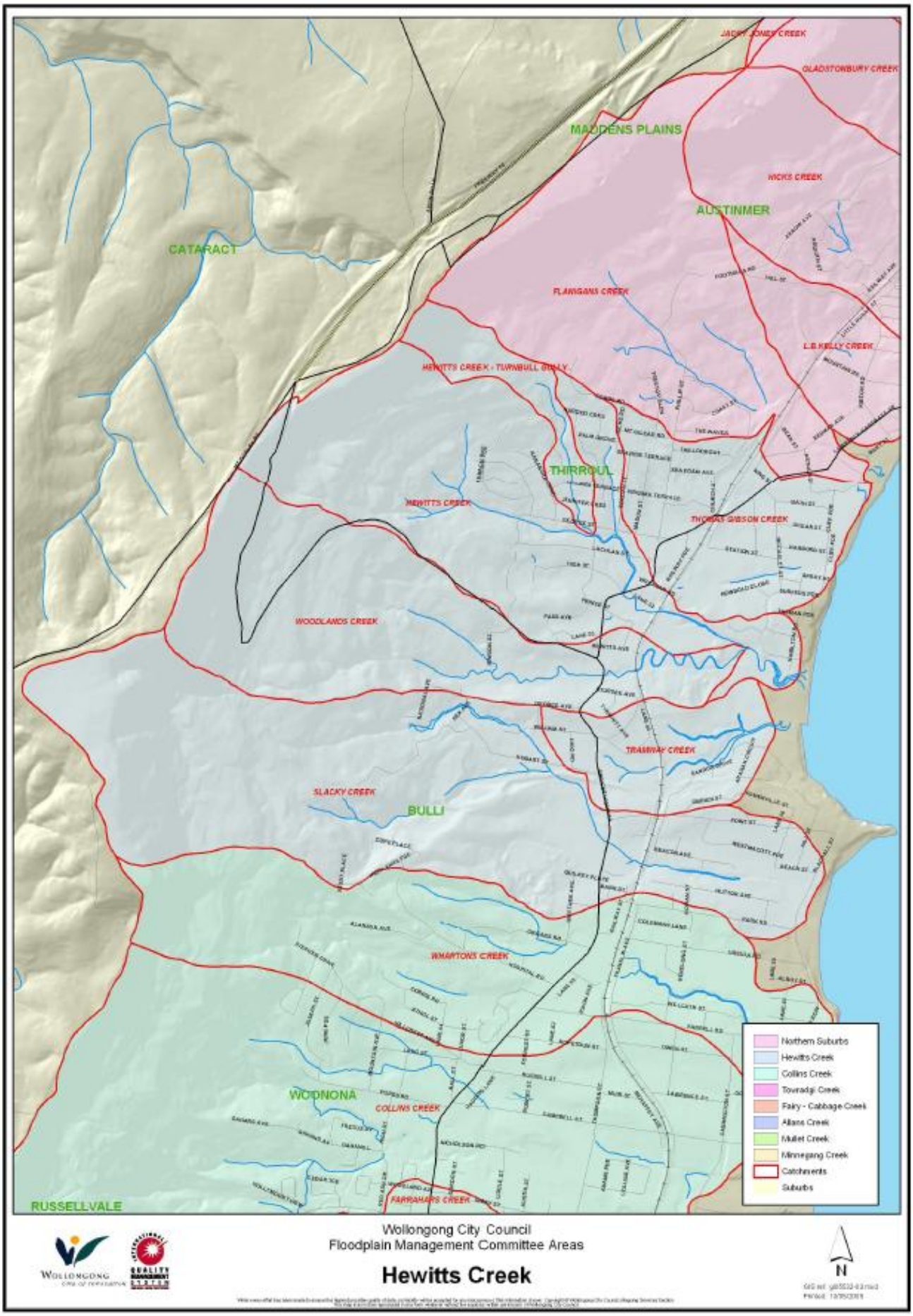
# MAP 1 - WOLLONGONG LOCAL GOVERNMENT AREA



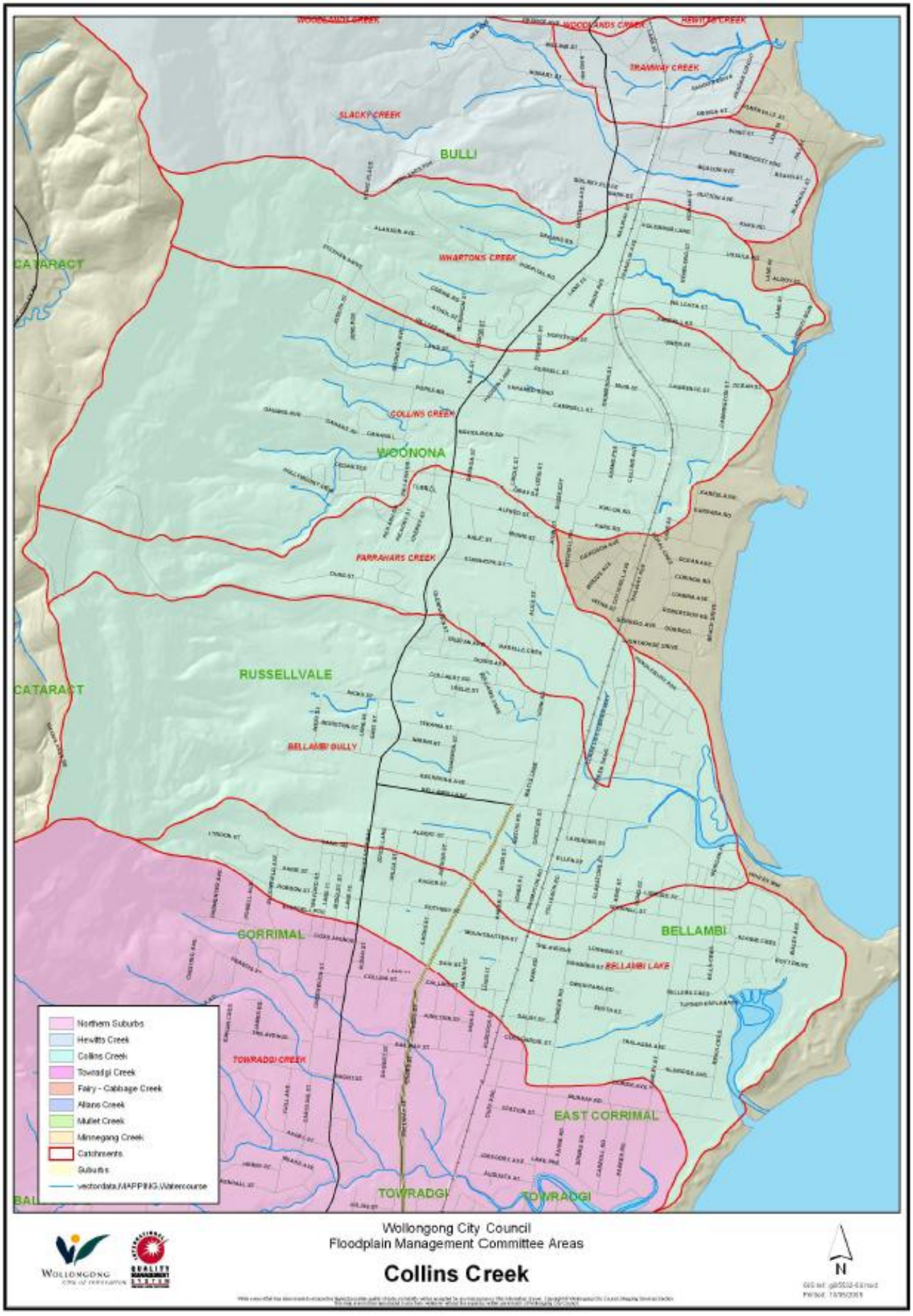
# MAP 2 - AREA 1: NORTHERN SUBURBS CATCHMENT



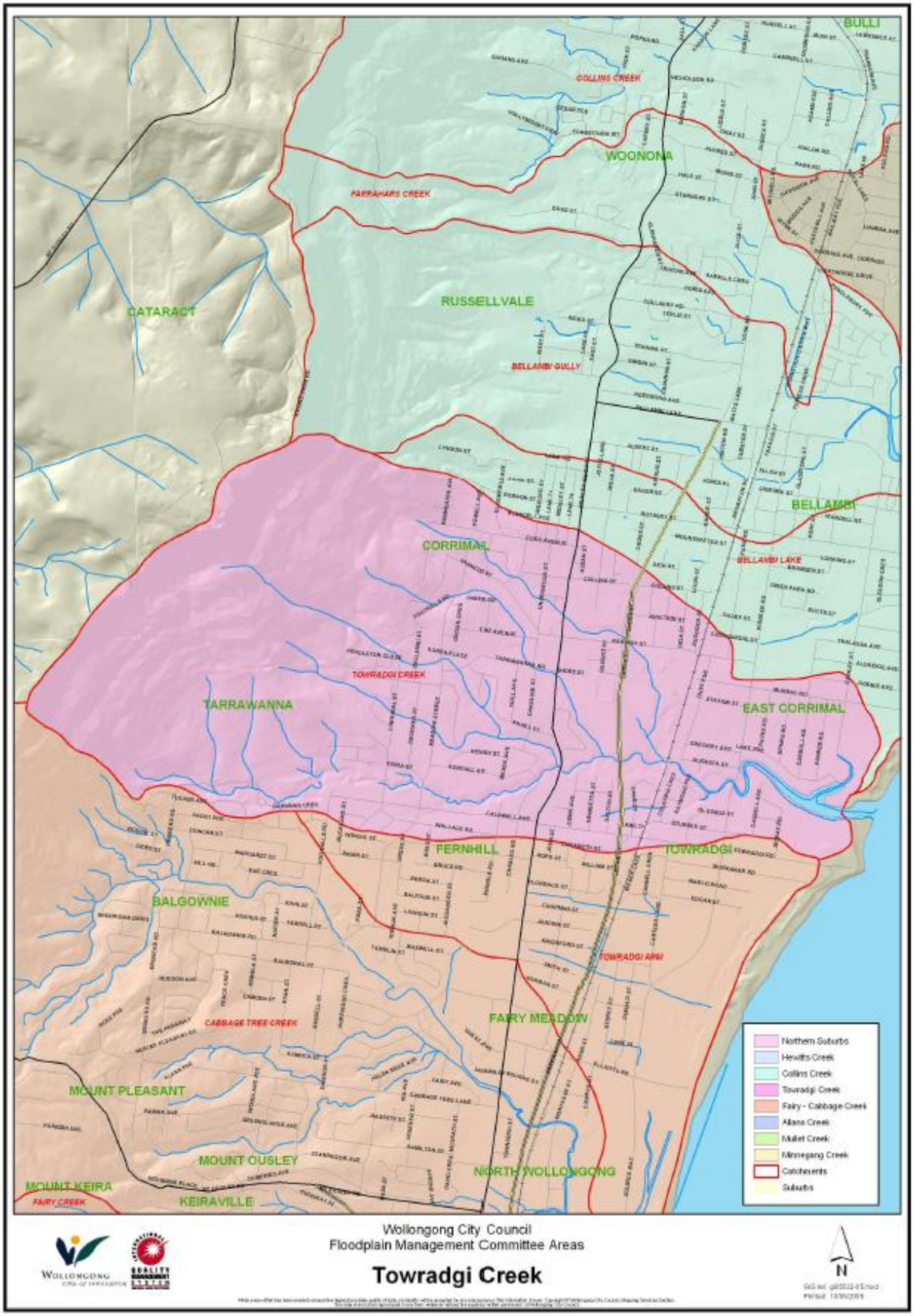
# MAP 3 - AREA 2: HEWITTS CREEK CATCHMENT



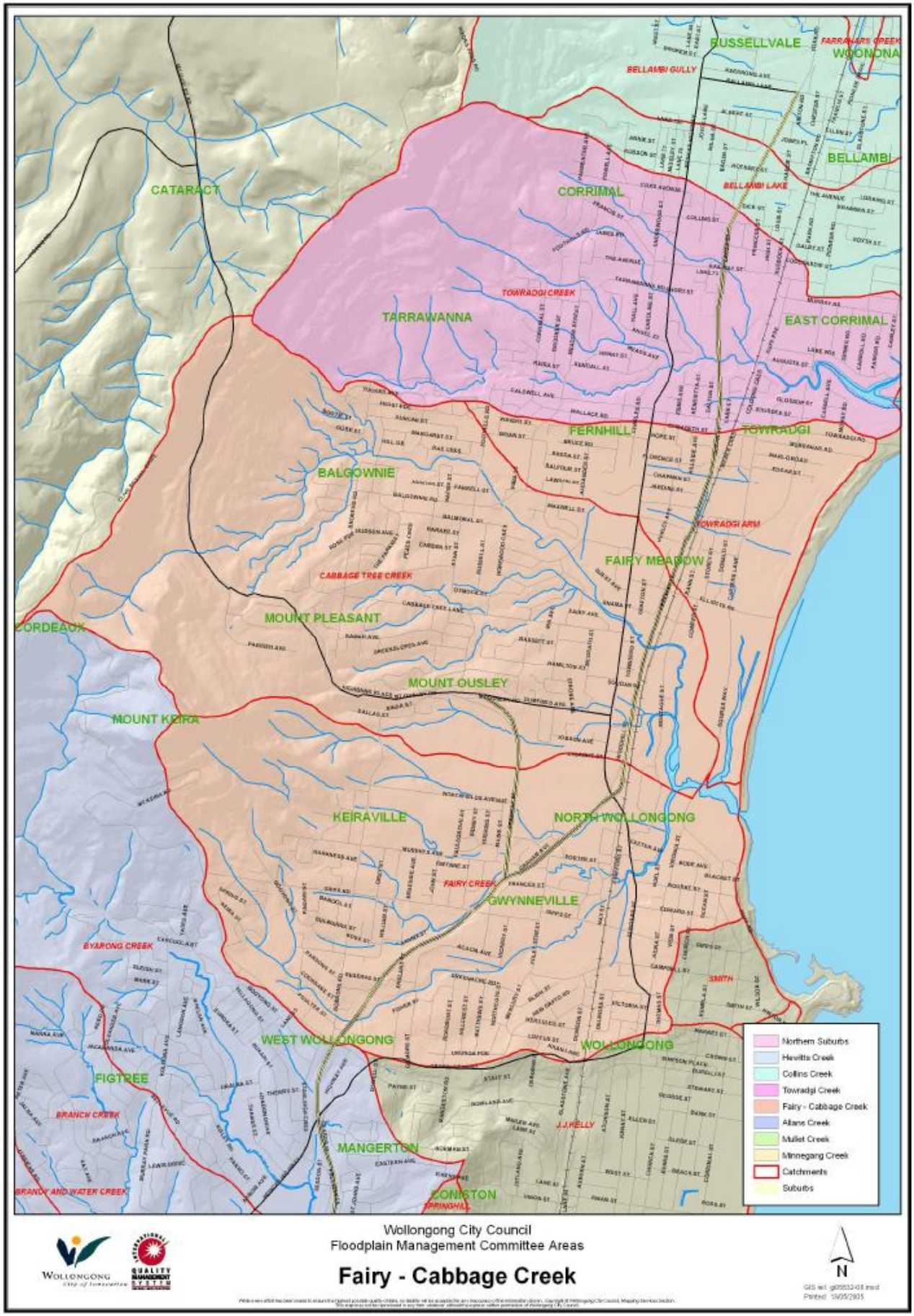
# MAP 4 - AREA 3: COLLINS CREEK CATCHMENT



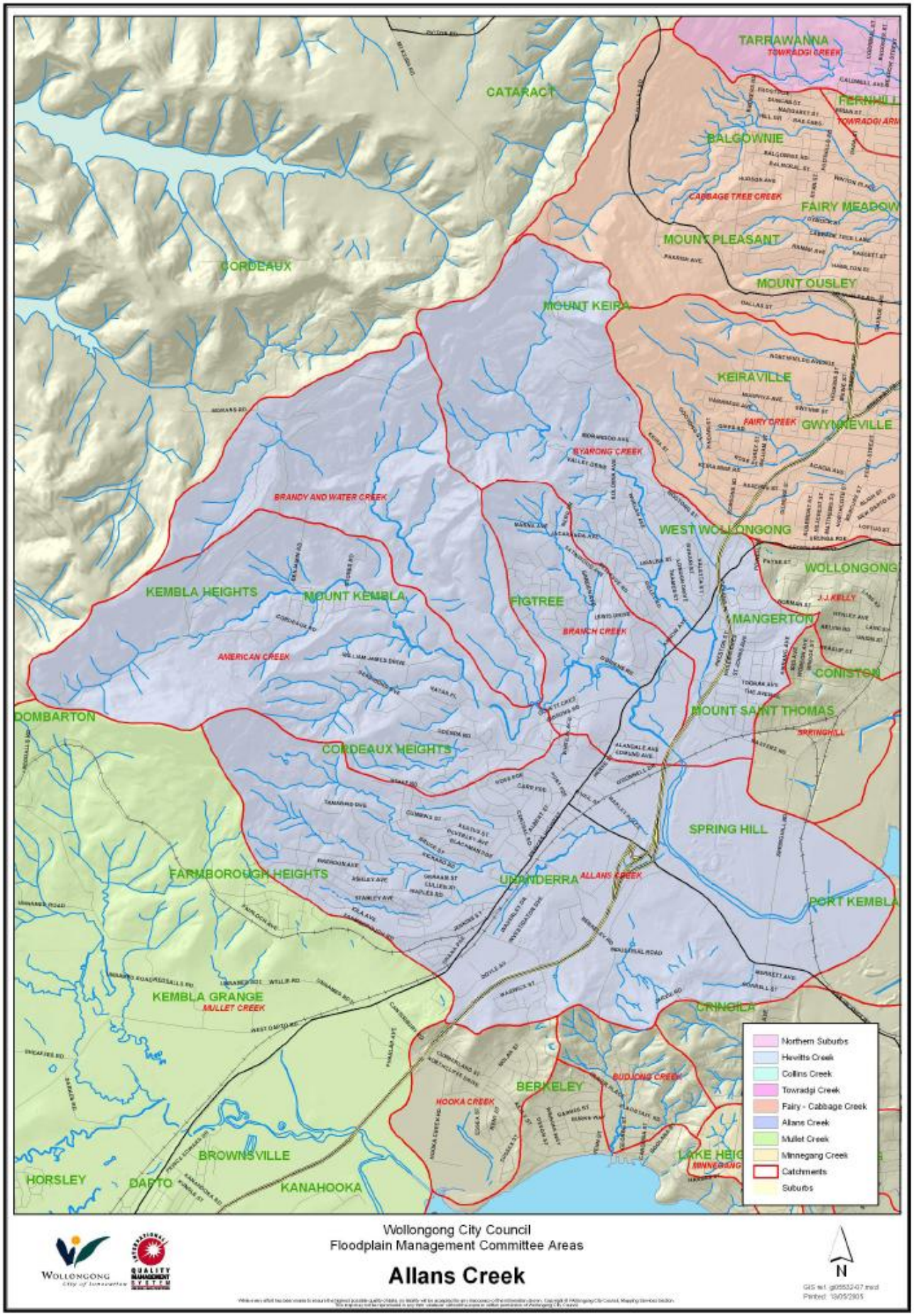
# MAP 5 - AREA 4: TOWRADGI CREEK CATCHMENT



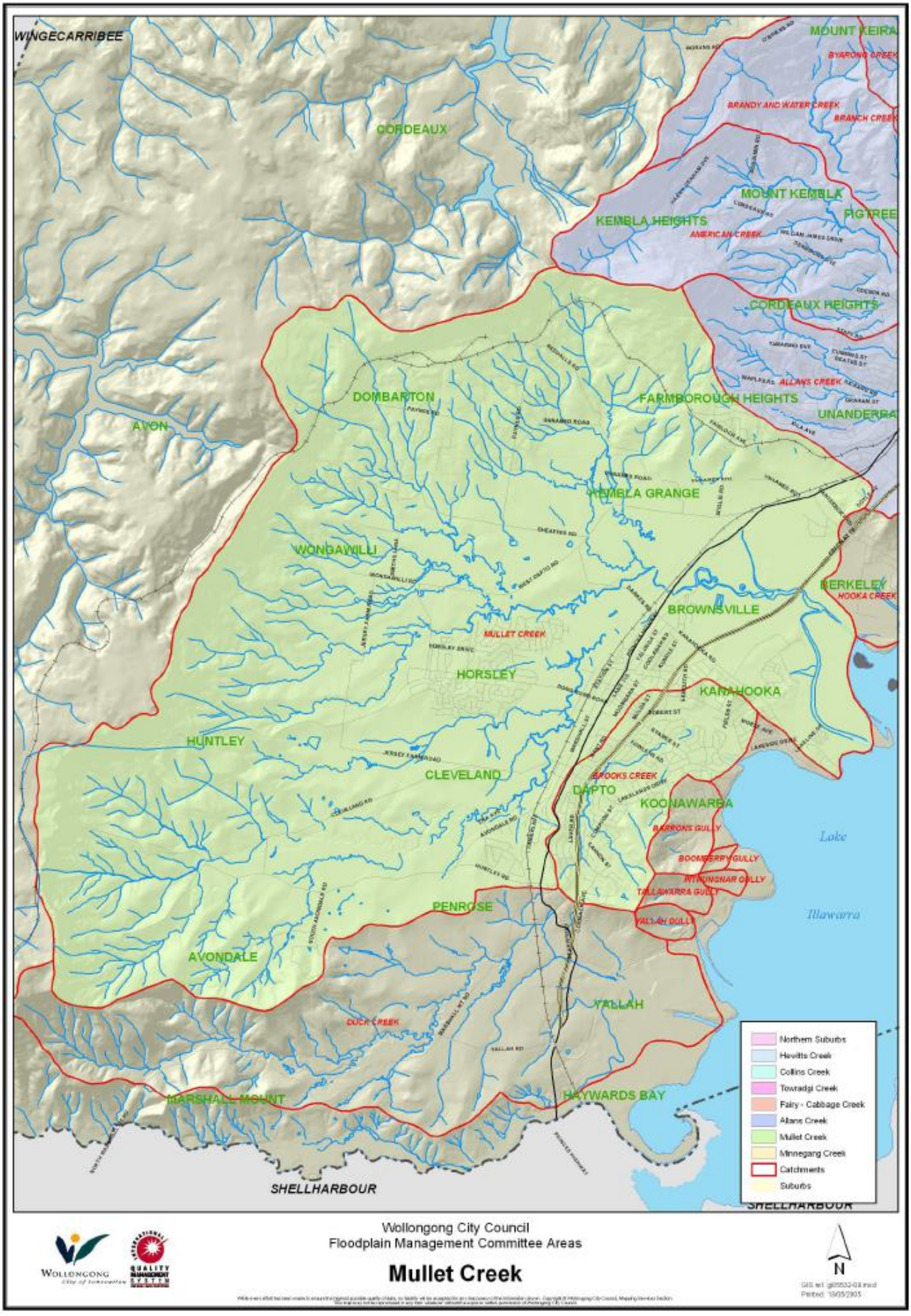
# MAP 6 - AREA 5: FAIRY & CABBAGE CREEK CATCHMENT



# MAP 7 - AREA 6: ALLANS CREEK CATCHMENT



# MAP 8 - AREA 7: MULLET CREEK CATCHMENT



# MAP 9 - AREA 8: MINNEGANG CREEK CATCHMENT