

Shoalhaven City

# Local Flood Plan

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# SHOALHAVEN CITY FLOOD EMERGENCY SUB PLAN

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

**Volume 1 of the Shoalhaven City Flood Emergency Sub Plan**

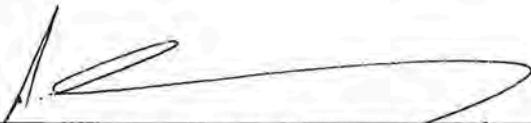
**Endorsed by the Local Emergency Management Committee**

**October 2022**

## AUTHORISATION

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

Recommended



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NSW SES Shoalhaven Local Commander  
Date: 25/10/2022

Approved



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Chair, Shoalhaven Local Emergency Management  
Committee  
Date: 27/10/2022.

## VERSION HISTORY

Version Number	Description	Date
1.0	Shoalhaven City Local Flood Plan	Feb 2004
2.0	Shoalhaven City Local Flood Plan	June 2014

## AMENDMENT LIST

Suggestions for amendments to this plan should be forwarded to:

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

Amendment Number	Description	Updated by	Date

## DISTRIBUTION LIST

Available for general use and distribution on the NSW State Emergency Service website [www.ses.nsw.gov.au](http://www.ses.nsw.gov.au)

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# 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 Shoalhaven City 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 Shoalhaven City Local Emergency Management Plan (EMPLAN) and is endorsed by the Local 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 Shoalhaven City 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 Shoalhaven City LGA. The Shoalhaven City LGA and its principal towns, villages, rivers, and creeks are shown in Appendix A.
- 1.4.2 The Council area is in the NSW SES South Eastern Zone and for emergency management purposes, is part of the Illawarra South Coast Emergency Management Region.
- 1.4.3 The plan sets out the Shoalhaven City Council level emergency management arrangements for prevention, preparation, response, and initial recovery for flooding in the Shoalhaven City LGA. Hazard and Risk information can be found in Volume 2 of this document, and NSW SES Response Arrangements can be found in Volume 3.
- 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 tsunamis) 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 Shoalhaven City are detailed within this plan, Appendix B and Appendix C.

1.7.3 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); and

- c. NSW SES Local Commander (for local 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 recommendations 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 and supporting material of the Local Flood Emergency Sub Plan is maintained on the NSW SES website at [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 Shoalhaven City LGA.

2.1.2 Declared dams in or upstream of the Shoalhaven City Local Government Area.

Dam Name	Owner
Bamarang	Shoalhaven Water
Bendeela Pondage	WaterNSW
Cambewarra	Shoalhaven Water
Comberton Grange Retention Basin	Shaolin Temple Foundation (Australia) Ltd
Danjera	Shoalhaven Water
Kangaroo Pipeline Control Structure	WaterNSW

Porters Creek	Shoalhaven Water
Tallowa	WaterNSW

## 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 the local Floodplain Risk Management Committee.

## 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 a LGA, and may include cross boundary arrangements; and
- b. Review plans as per Section 1.8 of the [NSW State Flood Sub Plan](#).

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 Shoalhaven City LGA are also listed in Volume 3 of this plan.
- 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 of 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:
    - [Shoalhaven City Council Local Live Traffic website](#) and
    - [Transport for NSW 'Live Traffic' website](#) or 'Transport InfoLine': 131 500.
    - VMS messaging on roadways may also be used to advise motorists.
  - h. The Public Information and Inquiry Centre (PIIC) 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. Shoalhaven City Council 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 Shoalhaven City Council 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.
- e. Shoalhaven City Council operates a vehicular ferry at Comerong Island. Comerong Island Ferry is withdrawn from service at 1.8m to 2.0m (Nowra Bridge Gauge) depending on the flow of water in the Shoalhaven River.

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 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.

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. 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 Commissioner (or delegate) will warn communities to prepare for a possible evacuation, where circumstances allow such lead time.
- c. The NSW SES Commissioner (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 exists.
  - 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 Shoalhaven 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 Shoalhaven City Council 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>



Legend

-  NSW SES Headquarters
-  Local Government Areas

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# 1 Appendix B – Roles and Responsibilities

AGENCY	RESPONSIBILITIES
NSW State Emergency Service	The 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 detailed within the <a href="#">NSW State Flood Plan</a> .

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.
Shoalhaven City Council	<p><b>Preparedness</b></p> <ul style="list-style-type: none"> <li>• Establish and maintain floodplain and coastal risk management committees and ensure that key agencies are represented.</li> <li>• Develop and implement floodplain risk management plans in accordance with the NSW Government’s Flood Prone Land Policy and the Floodplain Development Manual.</li> <li>• Provide levee studies, flood studies and floodplain management studies to NSW SES.</li> <li>• Maintain Dam Emergency Plans for the Shoalhaven City council dams and provide copies to NSW SES.</li> <li>• Provide information on the consequences of dam failure to NSW SES for incorporation into planning and flood intelligence.</li> <li>• Coordinate the development of warning services for catchments prone to flash flooding (small catchments), where appropriate.</li> <li>• Maintain council-owned flood warning networks and flood mitigation works.</li> <li>• Participate in NSW SES-led flood emergency planning meetings, to assist in the preparation of Flood Sub Plans.</li> <li>• Maintain a plant and equipment resource list for the council area.</li> <li>• Contribute to community engagement activities.</li> </ul> <p><b>Response</b></p> <ul style="list-style-type: none"> <li>• Subject to the availability of council resources, assist NSW SES with flood operations including: <ul style="list-style-type: none"> <li>– Traffic management on council managed roads.</li> </ul> </li> </ul>

AGENCY	RESPONSIBILITIES
	<ul style="list-style-type: none"> <li>– Provision of assistance to NSW SES (plant, equipment and personnel where able and requested).</li> <li>– Property protection tasks including sandbagging.</li> <li>– Assist with the removal of caravans from caravan parks.</li> <li>– Warning and/or evacuation of residents and other people in flood liable areas.</li> <li>– Provision of back-up radio communications.</li> <li>– Resupply of isolated properties.</li> <li>– Technical advice on the impacts of flooding.</li> <li>– 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.</li> <li>– Assist NSW SES to provide filled sandbags and filling facilities to residents and business in areas which flooding is expected.</li> </ul> <ul style="list-style-type: none"> <li>• Assist with making facilities available for domestic pets and companion animals of evacuees during evacuations.</li> <li>• Operate flood mitigation works including critical structures such as detention basins and levees and advise NSW SES regarding their operation.</li> <li>• Manage and protect council-owned infrastructure facilities during floods.</li> <li>• 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.</li> <li>• Advise the Environmental Protection Authority of any sewerage overflow caused by flooding.</li> <li>• Work with NSW SES and NSW Department of Planning and Environment to collect flood related data during and after flood events.</li> </ul> <p><b>Recovery</b></p> <ul style="list-style-type: none"> <li>• Provide for the management of health hazards associated with flooding including removing debris and waste.</li> <li>• Ensure premises are fit and safe for reoccupation and assess any need for demolition.</li> <li>• Provide services, assistance and advice to State Government in accordance with the State Recovery Plan.</li> </ul>
<b>Caravan Park Proprietor(s)</b>	<ul style="list-style-type: none"> <li>• Prepare a flood emergency plan for the Caravan Park.</li> <li>• Ensure that owners and occupiers of movable dwellings are aware that the caravan park is flood liable by providing a written notice to</li> </ul>

<b>AGENCY</b>	<b>RESPONSIBILITIES</b>
	<p>occupiers taking up residence and displaying this notice and emergency management arrangement within the park.</p> <ul style="list-style-type: none"> <li>• Ensure that owners and occupiers of movable dwellings are aware that if they are expecting to be absent for extended periods, they should: <ul style="list-style-type: none"> <li>– Provide the manager of the caravan park with a contact address and telephone number in case of an emergency.</li> <li>– 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).</li> </ul> </li> <li>• Ensure that occupiers are informed of Flood Information. At this time, occupiers should be advised to: <ul style="list-style-type: none"> <li>– Ensure that they have spare batteries for their radios.</li> <li>– Listen to a local radio station for updated flood information.</li> <li>– Prepare for evacuation and movable dwelling (cabins) relocation.</li> </ul> </li> <li>• Ensure that owners and occupiers of caravans are aware of what they must do to facilitate evacuation and movable dwelling relocation when flooding occurs.</li> <li>• 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.</li> <li>• Secure any movable dwellings that are not able to be relocated to prevent floatation.</li> <li>• 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.</li> </ul>
<b>Childcare Centres and Preschools</b>	<ul style="list-style-type: none"> <li>• When notified of possible flooding or isolation, childcare centres and preschools should. <ul style="list-style-type: none"> <li>– 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.</li> <li>– Assist with coordinating the evacuation of preschools and childcare centres.</li> </ul> </li> </ul>
<b>Dams Safety NSW</b>	The roles and responsibilities for Dams Safety NSW (formerly NSW Dam Safety Committee) are outlined in the NSW State Flood Plan.
<b>Department of Defence</b>	Arrangements for Defence Assistance to the Civil Community are detailed within the State EMPLAN (section 448).

AGENCY	RESPONSIBILITIES
<b>Energy and Utilities Services Functional Area</b>	<p>The roles and responsibilities for Energy and Utilities Services are outlined in the Energy and Utility Services Supporting Plan (EUSPLAN).</p> <p>Roles and responsibilities in addition to the Supporting Plan are:</p> <ul style="list-style-type: none"> <li>• Assist NSW SES with identification of infrastructure at risk of flood damage where resources are available.</li> <li>• Facilitate local utility service distribution providers (electricity, gas, water, wastewater) to: <ul style="list-style-type: none"> <li>– Provide advice to NSW SES of any need to disconnect power/gas/water/wastewater supplies or of any timetable for reconnection.</li> <li>– Advise NSW SES of any hazards from utility services during flooding and coastal erosion/inundation.</li> <li>– Advise the public with regard to electrical hazards during flooding and coastal erosion/inundation, and to the availability or otherwise of the electricity supply.</li> <li>– Clear or make safe any hazard caused by power lines or electricity distribution equipment.</li> <li>– Reconnect customers’ electrical/ gas/ water/wastewater installations, when certified safe to do so and as conditions allow.</li> <li>– Assist NSW SES to identify infrastructure at risk of flooding for incorporation into planning and intelligence.</li> </ul> </li> </ul>
<b>Engineering Services Functional Area</b>	<p>The roles and responsibilities for Engineering Services are outlined in the Engineering Services Supporting Plan and NSW State Flood Plan.</p>
<b>Environmental Services Functional Area</b>	<p>The roles and responsibilities for Environmental Services are outlined in the Environmental Services (ENVIROPLAN) Supporting Plan.</p>
<b>Floodplain Management Australia</b>	<p>The roles and responsibilities for Floodplain Management Australia are outlined in the NSW State Flood Plan.</p>
<b>Fire and Rescue NSW</b>	<p>The roles and responsibilities for Fire and Rescue NSW are outlined in the NSW State Flood Plan.</p>
<b>Forestry Corporation of NSW</b>	<p>The roles and responsibilities for Forestry Corporation of NSW are outlined in the NSW State Flood Plan.</p>
<b>Health Services Functional Area</b>	<p>The roles and responsibilities for Health Services are outlined in the Health Services (HEALTHPLAN) Supporting Plan and NSW State Flood Plan.</p>
<b>Local Emergency Operations Controller (LEOCON)</b>	<ul style="list-style-type: none"> <li>• Monitor flood operations.</li> <li>• If requested, coordinate support for the NSW SES Incident Controller.</li> </ul>
<b>Local Emergency Management Officer (LEMO)</b>	<ul style="list-style-type: none"> <li>• If requested by the NSW SES Incident Controller, advise appropriate agencies and officers of the start of response operations.</li> </ul>

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

<b>AGENCY</b>	<b>RESPONSIBILITIES</b>
<b>Telecommunications Services Functional Area</b>	The roles and responsibilities for Telecommunications Services are outlined in the Telecommunications Services (TELCOPLAN) Supporting Plan.
<b>Transport for NSW</b>	<ul style="list-style-type: none"> <li>• Transport for NSW coordinates information on road conditions for emergency services access.</li> <li>• Transport for NSW coordinates the management of the road network across all modes of transport.</li> <li>• Transport for NSW in conjunction will assist NSW SES with the evacuation of at-risk communities by maintaining access and egress routes.</li> <li>• 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.</li> <li>• Assist NSW SES with identification of road infrastructure at risk of flooding.</li> </ul>
<b>Transport Services Functional Area</b>	The roles and responsibilities for Transport Services are outlined in the Transport Services Functional Area Supporting Plan and NSW State Flood Plan.
<b>VRA Rescue NSW</b>	The roles and responsibilities for VRA Rescue NSW are outlined in the NSW State Flood Plan.
<b>Water NSW</b>	The roles and responsibilities for Water NSW are outlined in the NSW State Flood Plan.
<b>Welfare Services Functional Area</b>	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

<p><b>Community Members</b></p>	<p><b>Preparedness</b></p> <ul style="list-style-type: none"> <li>• Understand the potential risk and impact of flooding.</li> <li>• Prepare homes and property to reduce the impact of flooding.</li> <li>• Understand warnings and other triggers for action and the safest actions to take in a flood.</li> <li>• Households, institutions, and businesses develop plans to manage flood risks, sharing and practicing this with family, friends, employees, and neighbours.</li> <li>• Have an emergency kit; and</li> <li>• Be involved in local emergency planning processes.</li> </ul> <p><b>Recovery</b></p> <ul style="list-style-type: none"> <li>• Assist with community clean-up if required and able to do so.</li> <li>• Participate in After Action Reviews if required.</li> </ul>
<p><b>Sussex Inlet Community Action Group</b></p>	<p>A NSW SES Community Cache is located at the Thompson Street Sporting Complex adjacent to the Sussex Inlet Rural Fire Brigade, Thompson Street. The Sussex Inlet Community Action Group has access to the Cache to assist with preparing their community for floods and storms and to build local resilience.</p>



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# HAZARD AND RISK IN SHOALHAVEN CITY

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**Volume 2 of the Shoalhaven City LGA Local Flood Plan**

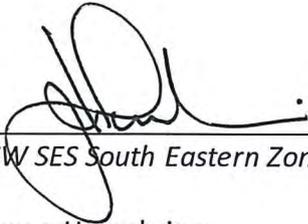
**Last Update: October 2022**



# AUTHORISATION

The Hazard and Risk in the Shoalhaven City LGA 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.

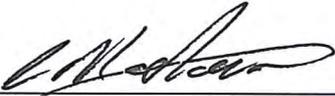
**Approved**

**Signature**  \_\_\_\_\_  
*NSW SES South Eastern Zone Coordinator Planning*

Print Name: Joanne Humphries

Date: 25 October 2022

**Approved**

**Signature:**  \_\_\_\_\_  
*NSW SES South Eastern Zone Commander*

Print Name: Colin Malone

Date: 25 October 2022

**Date Tabled at LEMC**      27 October 2022

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## VERSION LIST

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

Description	Date
Shoalhaven City Local Flood Plan (Annex A and B)	February 2004

## AMENDMENT LIST

Suggestions for amendments to this Volume should be forwarded to:

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

Amendment Number	Description	Updated by	Date

*Document Issue: Version 1-October 2022*

# 1 THE FLOOD AND COASTAL EROSION THREAT

## OVERVIEW

The City of Shoalhaven is a Local Government Area (LGA) in the south-eastern coastal region of New South Wales, Australia. The area is about 200kms south of Sydney. The Princes Highway passes through the area, and the South Coast railway line traverses the northern section, terminating at Bomaderry. It is a regional and growing residential and tourist area. It encompasses substantial areas of National Park, State Forest, bushland, beaches, and coastal lakes and lagoons as well as rural farming and agricultural areas (1).

Shoalhaven City LGA has a current population (2021 census) of 108,531 people with a projected population in 2036 of 119,467 people (2). Most of the population is concentrated on the coastal fringe with the major centres being Nowra, Ulladulla, Huskisson-Vincentia, St Georges Basin, and Sussex Inlet.

The Shoalhaven is a popular tourist destination, and during peak holiday seasons the transient population increases by a factor of (up to) four during holiday periods (3).

Shoalhaven's coastal zone extends 165kms along the NSW south coast, from Shoalhaven Heads to North Durras. It includes over 100 beaches, bays and headlands, creeks, lakes, and estuaries (4).

Shoalhaven City Council manages 11 Intermittently Closed and Open Lakes and Lagoons (ICOLL). When entrances close, rainfall, runoff, and wave overtopping increases water levels in the ICOLL and often causes inundation of low-lying foreshore areas. Depending upon the amount, intensity and location of rainfall and catchment size and morphology, water levels will either creep up slowly or rise rapidly until they overtop the level of the entrance berm (4).

## LANDFORMS AND RIVER SYSTEMS

Shoalhaven City LGA is located within the lower Shoalhaven River Basin and the upper Clyde River-Jervis Bay River Basin of the NSW South Coast. A number of smaller coastal basins sit within these two basins. These include St Georges Basin, Lake Conjola, Burrill Lake, and Lake Tabourie. The LGA stretches from Berry in the north, to North Durras in the south.

The natural opening and closing of ICOLL systems occur on an irregular basis. The main reason for artificially opening an ICOLL entrance is to mitigate and reduce the impacts of flooding. When water levels rise in a closed ICOLL following rainfall this can lead to flooding of urban and rural development adjacent to the lake or lagoon foreshore, including private properties, business premises, roads, parklands, sewerage systems and farmland. The trigger for artificially opening many ICOLL (rather than let nature take its course) is often a consequence of past developments being allowed to be located in low lying areas too close to the edge of the lake or lagoon (6).

The basins within Shoalhaven City LGA are shown on Maps 1 and 2 and are further described below.

### The Shoalhaven River Basin

**The Shoalhaven River** is 332kms long and has a catchment area of approximately 7,500km<sup>2</sup>. The river is subject to tidal influence until 50 kms upstream of the river mouth. The headwaters rise on the eastern slopes of the Great Dividing Range some 40kms inland of Moruya at an elevation of 1,350 metres. The river flows in a northerly direction, parallel to the Great Dividing Range through undulating terrain, being joined by the Jembaicumbene, Gillamatong, Reedy and Borough Creeks and the Mongarlowe River. These various tributaries drain the Great Dividing Range and the Minuma, Bendoura, Benmanang, Durran Durra and Budawang Ranges.

The floodplain for the Lower Shoalhaven River area was formed by the infilling of an old coastal lagoon and flood behaviour in the area has been extensively modified since European settlement. The southern part of the floodplain is drained by the Crookhaven River, which rises near Nowra, while the northern section is drained by Broughton Creek, which rises upstream of Berry. The present river channel is characterised by a number of flood mitigation works including drainage channels, floodgates, constructed levee embankments and bank stabilisation works (5).

Two hundred years ago the main entrance and the natural mouth of the river was at Shoalhaven Heads. In approximately 1822 Alexander Berry had a narrow channel excavated between the Shoalhaven River and the Crookhaven River to the west of what is now Comerong Island (5). It appears that historically the Shoalhaven River has had several different courses through the floodplain that have divided it into a number of basin areas separated by higher land which was once the natural levee beside old river courses. The present Shoalhaven River channel has extensive natural levees along its course. Various flood mitigation projects have been completed in this reach, including the establishment of major agricultural drainage channels, installation of floodgates on drains, construction of levee banks and bank stabilisation. These works were aimed at augmenting natural levees, reducing permanent swamp levels, draining floodwaters from low lying areas, and preventing back-up of floodwaters into low lying areas.

The Shoalhaven River below Welcome Reef enters a narrow gorge and travels eastward through mountainous terrain. On this reach it is joined by Nerrimunga and Bungonia Creeks which drain between Lake Bathurst and Goulburn, and the Corang and Endrick Rivers which flow from the Budawang Ranges.

The major tributary downstream of the Endrick River, Yalwal Creek, drains a large plateau area bounded by the Turpentine Range on the south-east and reaches the Shoalhaven River about 18kms upstream of Nowra. The remaining tributary, the Kangaroo River, originates in the Robertson-Moss Vale Plateau. The Kangaroo River flows through steep, mountainous

terrain for 48 kms, being joined by Tallowa Creek and Bundanoon Creek just before entering the Shoalhaven River into Tallowa Dam approximately 30 kms upstream of Nowra.

The river downstream of Burrier is an estuarine reach. Between Burrier and Nowra, the Shoalhaven is contained in a deep incised valley with narrow floodplain pockets. At Nowra, Nowra Creek enters the Shoalhaven River. Below Nowra, the Shoalhaven flows through a wide alluvial floodplain (approximately 120 square kms in size) extending northward up the valley of Broughton Creek, the river's final tributary, to the town of Berry and southward to the vicinity of Jervis Bay beyond the Crookhaven River.

The Lower Shoalhaven River system is tidal for a large extent upstream past Grady's Riverside Retreat caravan park. Riverine flood flows are dominant in determining water levels during floods within the Shoalhaven River upstream of Nowra, with entrance conditions, ocean conditions and sea level rise impacting areas up to approximately Pig Island. The Broughton Creek floodplain is not influenced by ocean conditions and is mainly controlled by the constrained outlet to the Shoalhaven River.

The Shoalhaven River discharges into the Pacific Ocean via two outlets, Shoalhaven Heads and Crookhaven Heads. Transfer of flow from the Shoalhaven River into the **Crookhaven River** is via an artificial canal, Berry's Canal, which was cut in the 1820's. Berry's Canal is gradually capturing Shoalhaven River flow. The river entrance at Shoalhaven Heads is intermittent, thus reducing tidal flushing flows, and this is aggravated by discharge via Berry's Canal involving erosion, which increases the canal's capacity. However, high river levels cause the Shoalhaven Heads outlet to open due to the overtopping of dunes. A notch is normally maintained to facilitate scouring of the entrance to keep flood levels down in the Shoalhaven Heads area.

**Bomaderry Creek** is a major tributary of the Shoalhaven River joining it between Nowra Bridge and Pig Island at the township of Bomaderry. It has a number of tributaries including Good Dog Creek, Browns Creek and Tapitallee Creek. Its upper catchment consists of steep heavily vegetated land northwest of the Shoalhaven River originating in Cambewarra and Browns Mountains. The central portion of the catchment comprises broad floodplain with predominantly rural land use. The lower catchment consists of mostly urbanised land use in the townships of North Nowra and Bomaderry (5).

It appears that historically the Shoalhaven River has had several different courses through the floodplain that have divided it into a number of basin areas separated by higher land which was once the natural levee beside old river courses. The present Shoalhaven River channel has extensive natural levees along its course. Various flood mitigation projects have been completed in this reach, including the establishment of major agricultural drainage channels, installation of floodgates on drains, construction of levee banks and bank stabilisation. These works were aimed at augmenting natural levees, reducing permanent swamp levels, draining floodwaters from low lying areas, and preventing back-up of floodwaters into low lying areas.

**Lake Wollumboola** is located on the NSW South Coast just north of Jervis Bay and has a catchment area of 41.4km<sup>2</sup>. The region lies within the Shoalhaven City LGA and the Jervis Bay National Park. The township of Culburra Beach is situated on the north-eastern shoreline with part of the town falling inside the catchment area. Lake Wollumboola is a largely unmodified and diverse lake and catchment.

Lake Wollumboola's ecosystem supports an abundance of plant and animal species with a number of those species being vulnerable, endangered, or critically endangered. The high biodiversity of the lake enables the ecosystem to support plant and animal species at critical stages of their life cycle. The Lake provides a key breeding site for the migratory Little Tern as well as breeding habitat for the Green and Golden Bell Frog and over 80 species of birds during each year. The lake provides significant social, educational, and economic value to the community.

Lake Wollumboola has many recreational uses including bush walking, bird watching and beach fishing. The surrounding ecosystem provides an important area for scientific study and school and university student excursions. Tourism comprises the major economic value of the lake as the town of Culburra Beach provides a relaxed holiday destination especially in the summer months.

The NSW National Parks and Wildlife Service are responsible for the management of the Lake Wollumboola entrance, with a trigger level of 2.75mAHD at which the lake can be opened manually for flood mitigation purposes if necessary (6). When the entrance is closed, the level is around mean level of approximately 1.5mAHD to 1.6mAHD. The Lake opening level is a mean level of approximately 0.4mAHD to 0.5mAHD.

Numerous swamps are also present near the coast, including Foys, Coomonderry, Worrigeer, Terara, Numbaa and Brundee swamps. These wetlands act as retention basins during flood times and can overflow during periods of heavy rain.

## The Clyde River Basin

**The Clyde River** has an area of 2,900 square kms and is located south of the Shoalhaven catchment. The main topographic feature of the valley is the Budawang Range, which extends along the western and north-western boundaries of the catchment. A plateau with an average elevation of 550 metres branches towards the south-east from the northern extremities of the Budawang Range, and the headwaters of the Clyde River rise on this plateau and in the mountainous terrain to the west.

From its source, the Clyde River flows in a southerly direction. After flowing through steep, heavily vegetated land and falling over 300 metres in elevation, it emerges from undulating hill country. Its major tributaries in the upper and middle reaches are Claydons, Pigeon House, Yadboro and Boyne Creeks and the Bimberamala River. Between Brooman and Currawan the river leaves the Shoalhaven City LGA. Floodplain development within the Council area is limited and flooding causes few problems.

**Currambene Creek** catchment starts 12kms south of Nowra. It is separated from the Shoalhaven River by the Turpentine Range which runs along its northern and western boundaries.

Currambene Creek rises in the plateau area occupied by the Royal Australian NAVY Air Station, HMAS Albatross at an elevation of 100 metres, falling 90 metres along a stream length of 7kms to the Princes Highway crossing. Just upstream of the highway, the Creek is joined by Parma Creek which rises to the south-west at an elevation of 300m and has a stream length of 20kms. The combined catchment area at the Princes Highway is 95km<sup>2</sup> of which Parma Creek, the major arm, contributes 75km<sup>2</sup>.

Currambene Creek is tidal below The Falls, which are just upstream of the Princes Highway. From The Falls to the Creeks outlet into Jervis Bay in Huskisson, travel 16kms

**Moona Moona Creek** discharges into Jervis Bay at the northern end of Collingwood Beach between Huskisson and Vincentia. Its catchment area encompasses rural areas east of the Pacific Highway as well as parts of the Huskisson, and Vincentia urban areas. A major tributary of Moona Moona Creek is Duck Creek which originates in the Tomerong area. The tidal limit is around 3kms upstream from the outlet into Jervis Bay. Above this tidal limit the creek is overgrown and ill defined (7).

**St Georges Basin** is located 15kms south of Nowra. The basin is a coastal lagoon with an estimated surface area of 37km<sup>2</sup>. The basin discharges through the Sussex Inlet channel to the Pacific Ocean at Bherwerre Beach. The channel is approximately 6kms long and ranges from 50 to 300m wide. If this channel becomes blocked or constricted flooding can intensify. The total catchment area to the Pacific Ocean is approximately 327km<sup>2</sup>.

The two main creeks flowing into the Basin are Wandandian and Tomerong, contributing 49% and 13% respectively to the total catchment area. Other watercourses include Cows Creek, Tullarwalla Creek, Pats Creek, Home Creek, Worrowing Waterway, Erowal Creek and Stony Creek.

The upper catchment is predominantly rural land, which has been cleared of natural vegetation. The lower slopes close to the Basin contain a number of urban centres, including Sussex Inlet, Wandandian, Bewong, Basin View, St Georges Basin, Sanctuary Point, Old Erowal Bay and Wrights Beach.

**Lake Conjola** is located approximately 50kms south of Nowra. Lake Conjola has a surface area of approximately 4.3km<sup>2</sup> and a catchment area of 145km<sup>2</sup>. There are 19 tributaries that flow into Lake Conjola with most joining at the upstream end of the Lake. The majority of the catchment is State Forest with the towns of Lake Conjola Village, Fishermans Paradise, Conjola Park and Cunjurong Point and Berringer located upon the shores of the lake.

Lake Conjola is an intermittently closed and open lake. The current planned entrance management trigger level (August 2013) at which the council may consider artificially opening Lake Conjola is at 1.0mAHD (10).

Significantly, the PMF flood extent at Lake Conjola does not increase substantially beyond the 1% AEP extent, given the steep nature of the topography at the edge of the floodplain.

**Burrill Lake** is located on the NSW South Coast approximately 180kms south of Sydney, and around 5kms south-south-west of Ulladulla. The major settlements in the catchment include Dolphin Point, Burrill Lake, Bungalow Park, and Kings Point. It has a catchment area of approximately 78km<sup>2</sup> with the main tributary being Stony Creek (9).

Burrill Lake is connected to the ocean through Burrill Inlet. The entrance channel is subject to periodic closure dependant on the level of sand build up at the ocean entrance (9). The current entrance management policy (May 2008) recommends opening at a lake level of 1.25mAHD (12).

**Lake Tabourie** is a small coastal lake located in the Shoalhaven City LGA. It is what is referred to as an ICOLL and has periods during which the entrance is closed off from the ocean by the formation of berm. The Lake Tabourie catchment is located approximately 12kms south of Ulladulla. It drains an area of approximately 47km<sup>2</sup>. The village of Tabourie Lake is low-lying with an elevation of around 2mAHD and as a result low level persistent flooding is common. The entrance is managed by Council and may be artificially open (if required) during a flood event to minimise the risk to property. Flooding has also occurred due to elevated ocean levels rather than catchment flooding. The current entrance management policy allows for the mechanical opening of the entrance when lake water levels are elevated, and heavy rain is predicted such that lake water levels are likely to exceed 1.3mAHD overnight. This provision is required because, even for more frequent events (such as the 20% AEP), the rate of rise of lake water levels can be as high as 0.3 m per hour (13) (10).

The major creeks feeding into Lake Tabourie are Lucy Kings Creek and Munno Creek. Tabourie Creek leads out of the lake discharging into the ocean near Lake Tabourie township and adjacent to the Lake Tabourie Holiday Park (11). Branderee and Lemon Tree Creeks feed into Tabourie Creek on the southern side of Lake Tabourie (11).

**Other Coastal Lakes** - There are numerous other coastal lakes and embayments along the coast, nearly all of them tidal. The major lakes are Swan Lake, Termeil Lake, Meroo Lake, Willinga Lake, and Durras Lake. Most of these water bodies are fed by creeks and by local runoff and their levels rise when the creeks are in flood (12).

## STORAGE DAMS

Declared dam locations are shown on Map 1 Shoalhaven River Basin and Map 2 Clyde River – Jervis Bay River Basin.

Larger declared dams, either in or upstream of the Shoalhaven City LGA with some potential for flood impacts, include:

- Fitzroy Falls Reservoir
- Danjera Dam

- Kangaroo Pipeline Control Structure
- Tallowa Dam

Other smaller declared dams within the Shoalhaven City LGA include:

- Bamarang Reservoir
- Bendeela Pondage
- Cambewarra
- Danjera Creek Dam
- Porters Creek Dam.

There is also a retarding basin located at Comberton Grange.

## Bamarang Dam

**Table 1: Bamarang Dam Summary Information**

<b>Bamarang Dam (13)</b>	
Owner / Operator	Shoalhaven Water
Description of Dam	Bamarang Dam is part of the Shoalhaven water supply system. The Dam consists of a main embankment and two saddle embankments. The main embankment is a 26m high, 320m long zoned earth fill embankment. It has an unlined spillway with a width of 4.8m. It has a capacity of 3,800ML at FSL (RL101.8mmAHD). Saddle Dam No. 1 is located around the left abutment from the main embankment and is a zoned earth fill embankment with a maximum height of 4.7m and a crest length of 460m. Saddle Dam No. 2 is located at the opposite end of the reservoir to the main embankment and is also a zoned earth fill embankment but does not have filters provided. It has a maximum height of 3.2m and a crest length of 205m. The majority of Saddle Dam No. 2 is above the Full Supply Level.
Location	Bamarang Dam is an off-river storage located approximately 10 kms west of Nowra within the Shoalhaven catchment. Overflows from the dam flow into Calymea Creek and from there into the Shoalhaven River. The dam lies within the Shoalhaven City LGA and the Shoalhaven River Basin.
Communities Downstream	There are no houses located downstream in the flood inundation area that are at risk from dam break, however there are several farm sheds and stables that could potentially be impacted. Farmers working within the floodplain or people travelling on Yalwal Road or Burrier Road may be at risk from dam break. In addition, bushwalkers, and cyclists (tracks along Shoalhaven Creek), campers (camping area adjacent to Canoe Calymea Creek business), temporary workers in the Men's shed and visitors to Historic Boyd Homestead may be at some risk.
Monitoring System	Water levels within Bamarang Dam are continuously monitored by Shoalhaven Water through a telemetered system. Visual inspections are undertaken, and other parameters are measured on a regular basis including Seepage monitoring, Piezometers, earth pressure cells.

Warning System	There is no warning system installed.
Other	Bamarang Dam is designed to be able to safely pass the PMF. If the dam were to fail it is expected that the time taken for the flood wave to reach the Shoalhaven River would be about 7 or 8 minutes.

## Bendeela Pondage

**Table 2: Bendeela Pondage Summary Information**

Bendeela Pondage (14)	
Owner / Operator	WaterNSW
Description of Dam	Bendeela Pondage is an earth and rock fill embankment dam with a storage capacity of 1,200mgl at FSL (182.83mAHD). The dam crest level is RL 184.35mAHD and has a length of 2118m. It is an off-river reservoir that forms part of the Shoalhaven water supply scheme. It is a balance reservoir, with no external catchment but incorporates a spillway to regulate the maximum storage level in the event of a malfunction of one or both of the connected power stations. The spillway has a crest level of RL 182.88mAHD and a length of 122m. Below the storage is the Bendeela Pipeline Control Structure with flows controlled by a fixed wheel gate.
Location	Bendeela Pondage is located approximately 21kms north-west of Nowra just to the north of the Kangaroo River. Upstream of Bendeela Pondage is Fitzroy Falls Reservoir and Fitzroy Canal. It lies within the Shoalhaven City LGA and the Shoalhaven River Basin.
Communities Downstream	There are no known deficiencies at this dam however were dam failure to occur people at the following locations may be at risk: <ul style="list-style-type: none"> <li>• Bendeela Power and Pumping Station</li> <li>• Bendeela picnic and camping areas adjacent to Kangaroo River and</li> <li>• Three nearby houses downstream of the eastern embankment.</li> </ul>
Monitoring System	The dam is regularly monitored for seepage, water table levels, reservoir levels, rainfall, and deformation / displacement. It is not currently linked to WaterNSW's dam alarm alert system.
Warning System	There are no warning systems at the dam to directly warn nearby or downstream people of an emergency at the dam.
Other	During a potential dam failure, the reservoir level at Bendeela Pondage will need to be lowered as rapidly as possible through the: <ul style="list-style-type: none"> <li>• Release of water through the Bendeela power and pumping station</li> <li>• Preventing water from entering from Fitzroy Canal.</li> </ul>

## Cambewarra Dam

**Table 3: Cambewarra Dam Summary Information**

Cambewarra Dam (15)	
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Owner / Operator	Shoalhaven Water, a Group of Shoalhaven City Council
Description of Dam	Cambewarra Dam is a disused storage that previously formed part of the main water supply for Nowra until 1980. The dam comprises a concrete gravity section, approximately 8.4m high and 40m long, and an embankment section, 2.3m high and 150m long. The catchment area of the dam is approximately 1.5km <sup>2</sup> . The dam has a storage capacity of 28 ML at FSL (RL 107.67mAHD). The nominal crest level of the concrete section of the dam is RL109.5mAHD, and the embankment sections RL 109.77mAHD. It has a 12m wide uncontrolled spillway consisting of a partially lined channel as well as a 6m wide emergency spillway.
Location	The Dam is located on Cambewarra Creek approximately 9kms north-west of Nowra and is accessed from Tannery Road. It lies within the Shoalhaven City LGA and the Shoalhaven River Basin.
Communities Downstream	Residents on eastern embankment of dam some residents close to creek line at Cambewarra Village.
Monitoring System	During an emergency personnel will be required to monitor the site 24 hours per day until the emergency has passed.
Warning System	None specifically installed.
Other	The critical Probable Maximum Precipitation for Cambewarra Dam is 430mm of rainfall in 1.5hrs. No dam break study has been undertaken and no dam break flood inundation mapping is available. However, the Dam Safety Emergency Plan (DSEP) lists around 9-17 properties and two road bridges that may experience flood impacts.

## Comberton Grange Retarding Basin

**Table 4: Comberton Grange Retarding Basin Summary Information**

Comberton Grange Retarding Basin (16)	
Owner / Operator	Currently owned by the Shaolin Temple Foundation. Previously owned by Shoalhaven City Council as part of a quarry.
Description of Dam	This was built as a sediment control dam for the quarry that previously operated on site. The dam wall is constructed of compacted clayey gravel fill and is approximately 175m long and up to 14m high. The basin has a storage capacity of 39ML; however, the storage level is kept at about 0.5m below FSL (RL 25.64mAHD) to maintain storage in the event of a storm. Water is able to discharge over a grassed line open spillway with a crest level of RL 28.4m and length of 85m, or else be released through a siphon pipe located on the dam wall.
Location	The Comberton Grange Retarding Basin is located within the old Comberton Grange Quarry site off Forest Road at Comberton Grange about 25kms south of Nowra.
Communities Downstream	There are currently no known downstream dwellings however plans are to develop a Shaolin Temple and tourist complex on the property in the future.
Monitoring System	Regular inspections and monitoring of parameters such as water levels. No electronic surveillance equipment has been installed.

Warning System	None known
Other	Since the change of ownership, the future of this Retarding Basin is unclear.

## Danjera Dam

**Table 5: Danjera Dam Summary Information**

Danjera Dam (17)	
Owner / Operator	Shoalhaven Water
Description of Dam	Danjera Dam is a concrete buttress and earth embankment dam with a maximum height of 29.5m and crest length of 147m. It has a lined spillway and has two gated and valved outlet pipes through which water can be released. The storage capacity of the dam at FSL (RL 73.76mAHD) is 7,800ML. When full Danjera Dam covers an area of around 0.9km <sup>2</sup> .
Location	Danjera Dam is located around 20 kms west of Nowra within the Shoalhaven River catchment. The dam is fed by Danjera Creek which joins with Yalwal Creek just downstream of the dam and eventually flows into the Shoalhaven River.
Communities Downstream	There are no houses located downstream between the dam and the Shoalhaven River. However, there is a camping area nearby that could potentially be impacted by dam failure. The only persons potentially at risk are campers in the Yalwal Campsite, located on the shore of the dam, who may not be able to leave the camp site if access roads are affected. Hikers and day walkers within the dam break flood zones would also potentially be at risk.
Monitoring System	The dam has a continuous telemetered system to monitor storage levels within the dam and has regular visual inspections.
Warning System	There is no specific warning system installed.
Other	During an emergency the storage levels in the dam can be lowered through the release of water through the outlet pipes.

## Fitzroy Falls Dam

**Table 6: Fitzroy Falls Reservoir Summary Information**

Fitzroy Falls Reservoir (18)	
Owner / Operator	WaterNSW
Description of Dam	Fitzroy Falls Reservoir is an earth and rock fill dam that forms part of the Shoalhaven Water Supply System. Constructed in 1974 the dam has a storage capacity of 23,500mgl. The dam's catchment area is about 31km <sup>2</sup> . The dam is able to safely discharge to the estimated PMF. Fitzroy Falls includes three Saddle Dams. Fitzroy Falls has a fixed crest side channel spillway located near the centre of the dam. Length of

	<p>spillway crest is 61m. Dam crest level is RL 666.24mAHD and FSL RL 663.50mAHD.</p> <p>The saddle dams have a maximum height of 6.4m a combined crest length of 1,524m and a total fill volume of 201,800m<sup>3</sup>.</p>
Location	Fitzroy Falls Dam is located on Yarrunga Creek, approximately 16kms south-east of Moss Vale within the Wingecarribee Shire LGA and the Shoalhaven River Basin.
Communities Downstream	Downstream of the Main Dam - Fitzroy Falls picnic areas, Visitors Centre, Pearsons Road Bridge, and the lookout. Downstream of Saddle Dams - Illawarra Farm, Grahams Rd, Upper River Rd, and Hampton Bridge.
Monitoring System	<p>Various parameters including water level and discharge are monitored via telemetry systems linked to alarm alerts. WaterNSW also continuously monitors for earthquakes.</p> <p>WaterNSW has in place a seismic monitoring network that continuously monitors the occurrence of earthquakes that could affect WaterNSW assets and determines their location and magnitude.</p>
Warning System	There is no automatic warning system installed to directly warn the Fitzroy Falls Visitors Centre or downstream residents.
Other	If the dam were to fail, warning times are expected to be as little as 10 minutes for the flood wave to reach Fitzroy Falls Visitors Centre. High velocities would also be expected for this area.

## Kangaroo Pipeline Control Structure

**Table 7: Kangaroo Pipeline Control Structure Summary Information**

Kangaroo Pipeline Control Structure (19)	
Owner / Operator	WaterNSW
Description of Dam	<p>Kangaroo Pipeline Control Structure was constructed in 1997. The structure is concrete, buttressed and flanked by earth/rock fill embankments. It was constructed to act mainly as an inlet and outlet structure for flow between Fitzroy Canal and Kangaroo Pipeline for power generation and water supply purposes and forms part of the Shoalhaven Water Scheme. It has a capacity of 24,000mgl (including Fitzroy Falls Reservoir and Fitzroy Falls Canal). There are no known deficiencies at this dam.</p> <p>The Dam crest level is RL 666.24mAHD and has a crest length of 980m. The spillway is located on Fitzroy Falls dam.</p>
Location	Located 18kms south-east of Moss Vale at the southern end of Fitzroy canal. It virtually shares the same reservoir with Fitzroy Falls Dam. It lies within the Shoalhaven City LGA and the Shoalhaven River Basin.
Communities Downstream	<p>There are no dwellings at risk downstream, however failure of the pipeline structure may cause damage to:</p> <p>Morton National Park The bridge over Trimbles Creek on Moss Vale-Nowra Road</p>
Monitoring System	<p>The pipeline structure has continuous monitoring systems in place for storage level and earthquakes. It is regularly inspected and monitored for rainfall and surface displacement.</p> <p>The performance of the dam is monitored by measurement of:</p>

	<ul style="list-style-type: none"> <li>• Storage level</li> <li>• Seismological</li> <li>• Rainfall</li> <li>• Surface displacement.</li> </ul> <p>WaterNSW has in place a seismic monitoring network that continuously monitors the occurrence of earthquakes. The Seismology Research Centre in Melbourne monitors the data and notifies WaterNSW.</p>
Warning System	There are no warning systems at the dam to directly warn nearby and downstream people of an emergency at the dam.
Other	During an emergency water can be prevented from flowing into the reservoir by controlling the Kangaroo pipeline. Water levels within the reservoir can also be lowered by opening the fixed wheel gates, opening the Fitzroy Canal Outlet, and pumping water through the Burrawang pumping station.

## Porters Creek Dam

**Table 8: Porters Creek Dam Summary Information**

Porters Creek Dam (20)	
Owner / Operator	Shoalhaven Water
Description of Dam	Porters Creek Dam is the main source of water supply in the Southern Shoalhaven Water Supply Scheme. It is a composite dam consisting of a concrete gravity section and adjacent earth fill embankment. The concrete gravity section has a crest length of 139m and a maximum height of 17m. The earth fill section is a 98m long embankment on the left side of the main concrete section. It has a maximum height of 4.7m and a crest width of 3.1m. It has a capacity of 1,900ML at FSL (RL 481.58mAHD) and has a spillway and scour valve through which water can be released. The spillway consists of a 74.7m long ogee-crested weir, with the central 10m wide section 50mm lower than the general overflow crest.
Location	Porters Creek Dam is located on Porters Creek within Morton National Park, 11kms northeast of Milton. Access is by way of a 14kms unsealed road off the Princes Highway near Yatte Yattah. It lies within the Shoalhaven City LGA and the Clyde River-Jervis Bay River Basin.
Communities Downstream	There are no dwellings at risk downstream, however approximately 250m below the dam, Porters Creek flows over the 40m high Ngadyoo Falls in Morton National Park. A small picnic area and several bushwalking trails are located at the base of the falls.
Monitoring System	The water level in Porters Creek Dam is automatically recorded and connected by telemetering to Shoalhaven City Council's water treatment plant in Milton.
Warning System	No specific warning system is installed.
Other	Dam access is not possible during a flood event. Due to a structural deficiency at the dam, the maximum level over the spillway that can be safely passed is 0.52m (RL 482.1m). During an emergency, water can be released from the dam through the scour valve however this valve

	cannot be operated during a flood event due to its location below the spillway crest.
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## Tallowa Dam

**Table 9: Tallowa Dam Summary Information**

Tallowa Dam (21)	
Owner / Operator	WaterNSW
Description of Dam	<p>Tallowa Dam is a concrete gravity dam with non-overflow abutments and a centrally located ungated overflow spillway. The total length of the dam is 518m long and has a maximum height of 43m at the abutment sections. The height of spillway crest is 32m and 350.5m long.</p> <p>Tallowa Dam forms an impoundment (Lake Yarrunga). Water from this lake can be pumped via Fitzroy Falls and Wingecarribee Dams and then transferred either to Warragamba or to the Nepean-Avon System. Lake Yarrunga also forms the lower storage for the Kangaroo Valley Power Station pumped-storage electricity generation scheme.</p>
Location	<p>Tallowa Dam is located at the junction of Shoalhaven and Kangaroo Rivers, approximately 20kms west of Nowra and approximately 8kms downstream of the Kangaroo Valley Township.</p> <p>It lies within the Goulburn-Mulwaree LGA and the Shoalhaven River Basin.</p>
Communities Downstream	<p>Properties within Nowra gorge (Grassy Gully), Nowra, Bomaderry, Terara, Berry, Shoalhaven Heads, Greenwell Point, Orient Point.</p> <p>Major developments downstream of Tallowa Dam include: five caravan parks, Shoalhaven Starches (Manildra) and Burrier Pumping station.</p>
Monitoring System	<p>The performance of the dam is monitored by measurement of seepage, foundation uplift pressures, and deformation/displacement, chemical analysis of leakage and stored water, reservoir level, rainfall and foundation drain inter-connectivity. WaterNSW has a seismic monitoring network that continuously monitors the occurrence of earthquakes.</p>
Warning System	<p>There are no warning systems at the dam to directly warn nearby and downstream people of an emergency at the dam.</p>
Other	<p>There are currently no known deficiencies at this dam which could lead to failure. It is built to withstand floods up to a PMF.</p> <p>Failure of Tallowa Dam during a Sunny Day or PMF dam failure has the potential to endanger between 10 to 1,000 lives in downstream areas and damage the Burrier Pumping Station, Nowra Bridge, properties in Nowra Gorge and Nowra. The loss of Tallowa Dam would mean that the Bendeela Pumping / Power Station would be inoperable.</p> <p>Travel times to reach Grassy Gully can be as little as 15 minutes with potentially high rates of rise and flow velocities.</p>

## WEATHER SYSTEMS AND FLOODING

There are pronounced differences in average rainfalls within the Shoalhaven City LGA. These are governed by physical conditions relating to the orographic triggering of rainfall by the escarpment and range country, and by the rain shadow effect of the Australian Alps, which shelter parts of the South Coast from south-westerly airstreams during winter. The areas with the highest annual rainfall levels are the Kangaroo Valley and the Budawang Range. These areas have annual rainfalls of greater than 1270mm. Some coastal and near coastal areas receive, on average, less than 900mm per year.

Rainfall tends to be highest in the summer and autumn months and lowest in late winter and spring. Historically, floods have been most frequent in the February-June period, though this does not mean that other periods are flood-free.

Summer rainfall can be caused by tropical air-mass incursions or occasionally by the passage of cold fronts, whereas the progression of low-pressure systems is responsible for much of the winter rainfall (such as East Coast Lows). The more severe flood-producing weather systems are those in which a high-pressure system over Tasmania or Victoria combined with a deep, slow moving low-pressure cell situated over the NSW coast produces vigorous on-shore flows of moist, warm air. This air is subjected to orographic uplift and can produce very heavy rainfall. Oceanic storm surges and large waves may also be associated with such events. These conditions may result in incursions of seawater onto land and the retarding of flood flows.

Short-term, high intensity convective thunderstorms can cause local 'flash' flooding, especially during summer months when thunderstorms are most frequent. Minor creeks may rise, but main river levels are not affected. When such thunderstorms occur over built-up areas stormwater flooding may occur.

Potential impacts of climate change include an increase in rainfall of around 10%. For the coastal lakes there are expected increases in berm heights in association with sea level rise. This may also include an increase in wave heights from ocean storms (11).

The 2019-2020 'Black Summer' bushfires that burned across the Shoalhaven, Eurobodalla and Bega Valley affected more than one million hectares and impacted approximately 47 estuaries and coastal catchments. A diverse range of landscapes and ecosystems were also affected including rainforests, wet sclerophyll forests, heathlands and sensitive waterways and aquatic ecosystems. The fires were immediately followed by large amounts of rainfall that generated large volumes of surface runoff and flooding, which triggered large-scale mobilisation of ash, soils, and sediment. Shoalhaven City Council, Eurobodalla Shire Council and Bega Valley Shire Council received joint grant funding from the NSW Government, under the NSW Bushfire Affected Coastal Waterways Program, to develop a South-East Catchment and Waterways Bushfire Recovery Plan. All three Councils also received funding from the NSW Government for on-ground works. For the Shoalhaven this includes funding to undertake the Shoalhaven Local Government Area (LGA) Catchment Stabilisation and Ecological Monitoring Works Project (24).

## CHARACTERISTICS OF FLOODING

### The Shoalhaven River Basin

Upstream of Burrier, the Shoalhaven River catchment is rugged, forested and virtually unpopulated, resulting in no significant flooding problems. The exception of this is within Kangaroo Valley on Kangaroo River. Kangaroo Valley township and surrounding floodplain can be impacted by floods greater than 20% AEP. The northern bank of Kangaroo River breaks first, followed by the southern bank at around 10% AEP. The entire floodplain can be inundated to significant depths. This flooding is largely contributed by Kangaroo River, however Barrengarry Creek can also contribute to flooding in the area (22).

Downstream of Burrier a floodplain of more than 12,000ha is subject to inundation when natural levees are overtopped. Most of this land is below Nowra and Berry. In significant events a very large area between Nowra and Greenwell Point south of the river is inundated and the Worrigea, Terara, Numbaa and Brundee Swamps are joined by floodwaters, which extend south to Crookhaven River.

Within the Shoalhaven River itself, the low-lying Pig, Numbaa, Old Man (Kurrajong), Nobles and Haven Islands can be completely inundated, and large parts of Comerong and Apple Orchard Islands flood.

Significant flooding also occurs on the north bank to Shoalhaven Heads, and on Broughton Creek upstream to Berry. The main sources of flooding in Berry township includes Broughton Mill Creek, Connollys Creek, Bundewallah Creek and the unnamed watercourse locally known as Town Creek (23).

Flooding on Broughton Creek, or on the small creeks which feed the swamps downstream of Nowra, is not sufficient by itself to create more than nuisance flooding on the Shoalhaven floodplain. However, such flooding can aggravate existing problems caused by floods on the main river. Flooding from Broughton Creek can generate flooding in Berry and Shoalhaven Heads. This can be independent of conditions within the Shoalhaven River.

Storm surge offshore of the river's entrances can also aggravate flooding effects within the Shoalhaven floodplain. The record flood of 1870 produced a very high peak at Greenwell Point because it occurred simultaneously with strong wave set-up and surge conditions in the ocean. In June 1975, wind and wave action caused the pushing up of water levels in Crookhaven Bight to the extent that water levels at Nowra were higher than those caused by greater up-river flows during previous floods. Consequently, significant backwater effects occurred in the lower reaches of the river. A minimum of six to nine hours warnings will be available of significant river rises at Nowra (Table 10).

**Table 10: Indicative Flow Travel Time for the Shoalhaven River**

Locations	Travel Time
Braidwood to Nowra	24 hours

Mountview to Nowra	17 to 24 hours
Mongarlowe to Nowra	14 to 21 hours
Hampton Bridge to Nowra	8 to 9 hours
Tallowa Dam to Nowra	4 hours
Grassy Gully to Nowra	2 to 3 hours
Nowra to Broughton Creek	30 minutes
Nowra to Crookhaven Heads	2 hours

### Lake Wollumboola

For Lake Wollumboola, the mean sea level has a significant influence on the lake levels across the full range of conditions, from minimum level to extreme flood levels. Lake Wollumboola alternates between being opened and closed to the ocean. It is therefore a member of the group of estuaries known as an ICOLL. The entrance depends on the movement of sand by waves, tides freshwater catchment runoff and wind (6).

### Currumbene and Moona Moona Creeks

The flood risk in both catchments is influenced by tides and the entrance conditions. Flooding in the lower portion of the two streams may be influenced by both elevated ocean levels and catchment runoff. Elevated ocean levels are caused by storms which generate strong onshore winds, large waves and have low atmospheric pressure (7).

### St Georges Basin and Sussex Inlet

Flooding within St Georges Basin can result from a combination of mechanisms including catchment runoff, high ocean conditions and/or wind waves. The worst affected areas are Sanctuary Point near Tomerong /Cockrow Creek and Sussex Inlet. Tomerong/ Cockrow Creek tends to experience flash flooding, whilst flooding at Sussex Inlet is of a longer duration (24). A minimum of six to nine hours warning time will be available for St Georges Basin (Table 11).

**Table 11: Indicative Flow Travel Time for St Georges Basin**

Locations	Travel Time
Wandandian Creek to St Georges Basin	6 to 9 hours
Tomerong Creek to St Georges Basin	4 to 9 hours
St Georges Basin to Sussex Inlet	0 to 1 hour

### Burrill Lake and Lake Conjola

Flooding within Burrill Lake and Lake Conjola can be the result of:

- Catchment flooding from local catchment rainfall
- Ocean inundation as a result of high ocean tides combined with storm surge
- Low-level persistent flooding due to elevated lake levels during periods of entrance closure

- Permanent inundation or tidal inundation due to increased ocean levels due to sea level rise (25).

Catchment flooding tends to result from major rainfall events of hundreds of millimetres over one to two day periods and longer. This is the dominant flooding mechanism in terms of peak flood levels and results in the most hazardous flood conditions (25).

Due to the steepness of the catchments, the flood response can be relatively fast. Peak flood conditions in Burrill Lake can be reached within around 12 hours and for Lake Conjola, 22 hours from the onset of rainfall. In Burrill Lake, it can be a matter of hours from the main Lake response to when properties may begin to be affected by inundation of water (25).

### Lake Tabourie

Flooding within the Lake Tabourie catchment area can be a result of catchment flooding and/or ocean derived flood events.

Flood levels within the lake are significantly influenced by whether or not the berm entrance is open or closed (11).

Within Lake Tabourie, downstream of the Princes Highway there are low lying areas where properties may be inundated.

## FLOOD HISTORY

### The Shoalhaven River

The worst period of flooding on record on the Shoalhaven River was between 1860 and 1873. There were several major floods during this period, the two largest occurring in April 1870 and February 1873. Both events devastated the then thriving settlement of Terara, which was subsequently relocated to the present site of Nowra. The flood of 1870 reached an estimated 6.55m at Nowra Bridge and 5.7m at Terara (26).

Since 1860 there appears to have been 21 floods, which have exceeded the 'major' flood level of 4.3mAHD at the Nowra Bridge.

The peak heights of the floods known to have reached or exceeded moderate flood level (3.3mAHD) at Nowra Bridge Gauge 215411 from 1925 (Table 12).

Table 12: Flood History for the Shoalhaven River at Nowra Bridge

Month	Year	Gauge Height (metres)	Classification Mod: 3.3m and Maj: 4.3m
19 August	1998	3.320	Moderate
11 March	1975	3.400	Moderate
June	2016	3.400	Moderate
06 September	1967	3.430	Moderate

24 October	1999	3.500	Major
08 August	1998	3.580	Major
02 June	1978	3.600	Major
February	2020	3.600	Major
12 June	1964	3.680	Major
June	2013	3.760	Major
12 June	1991	3.875	Major
August	2015	3.970	Major
August	2020	4.170	Major
17 April	1927	4.190	Major
17 October	1976	4.350	Major
11 June	1991	4.380	Major
30 April	1988	4.650	Major
30 October	1959	4.930	Major
02 August	1990	5.000	Major
21 June	1975	5.090	Major
28 August	1974	5.100	Major
21 March	1978	5.500	Major
05 May	1925	5.540	Major

### **Kangaroo River**

The largest recorded floods on the Kangaroo River occurred in 1975, 1978, 1990, 1991, 1999 and 2005. During these events, a number of local roads were closed by floodwaters. Flood duration varied from several hours to several days, with two residents reporting above floor flooding, one experienced a depth of 2.1m above floor level (29).

### **Broughton Creek**

Historically, significant flood events occurred on Broughton Creek in 1984, 1978, 1975 and 1971, with most of the water coming from Town Creek (23).

The majority of the flooding along this creek affects rural land, particularly downstream of the railway line, which can cause issues for safe refuge of livestock as well as materials and

equipment during storm events. Generally, flooding does not impact on a significant number of houses or buildings (30).

**Broughton Mill Creek** - overbank flooding affects the eastern side of Berry. Much of the floodplain is classed as high hazard in the 1% AEP, generally due to depth (30).

**Town Creek**, responsible for the majority of flood damages in the study area. Results in overground and over floor flooding of properties along its length (30).

### **Bomaderry Creek**

Much of the flood history data for the Bomaderry Creek catchment is associated with major flooding on the Shoalhaven River. There is little flood data for the upper parts of the catchment (31).

### **Nowra and Browns Creeks**

**Browns Creek** is a major tributary of Nowra Creek and flows in a northerly direction east of the Princes Highway. It joins Nowra Creek near the intersection of the Princes Highway and Hillcrest Avenue.

Significant flooding has occurred within this catchment in 1999, 1989, 1978 and 1974 (32).

### **Lake Wollumboola**

In March 2011 there was flooding of Lake Wollumboola which caused 10 properties to experience flooding above floor level (6).

### **The Clyde River**

The two highest recorded floods on the Clyde River at Brooman were in 1961 and 1963 when the river reached 13.18m and 12.62m respectively. Earlier (ungauged) floods were recorded in 1860 (when rainfall of 475 mm was experienced in a four-day period), 1914, 1916, 1925, 1934, 1941, 1942 and 1945. The 1934 event was apparently more severe on the Clyde River than the 1925 storm which created records on many of the other rivers of the South Coast.

### **St Georges Basin and Sussex Inlet**

In recent times the most significant events within the St Georges Basin Floodplain occurred in 1959, 1971, 1991 and August 2015. There were also several smaller events in the mid 1970's, as well as 1992, 1993, 1994 and 2016 (33) (24).

During the August 2015 event a major flood level of 1.8m AHD was reached on the Island Point Road Gauge near Sanctuary Point and a moderate flood level of 1.42m AHD was reached on the Sussex Inlet Gauge.

During this event Sussex Inlet was heavily impacted with the main over floor flooding experienced in Poole Avenue, River Road and Wunda Road.

The Park Drive at Sanctuary Point had over floor flooding of approximately 1m through some properties, with flooding primarily related to catchment flooding from Cockrow Creek rather than from St Georges Basin itself.

### **Currambene and Moona Moona Creeks**

Significant flooding occurred in 1971, 1974, 1975 and 1976 rainfall events which produced the first, second, third and fourth largest flows at the Currambene gauge in recorded history(7) (34).

### **Lake Conjola**

During the August 2015 event Lake Conjola peaked at 1.94m on the Lake Conjola gauge (216420). Lake Conjola received a total of 311.5mm of rainfall, within a three-day period (33). This resulted in the eastern side of Lake Conjola becoming isolated due to road closures and numerous properties and caravan parks experiencing flooding.

### **Burrill Lake**

The most significant recorded flood event occurred in 1971, which followed 630mm of rain over an eleven-day period and reached a maximum height of 2m AHD on the flats adjoining the channel.

The most recent flooding occurred in August 2015 when a height of 1.44m AHD was reached at the Burrill Lake gauge (216435). During this event 223mm of rainfall fell over a 5-day period, with 113mm of this rainfall falling in one day (33). This resulted in over floor flooding of a few houses in Lake View Drive, Commonwealth Avenue, Princes Avenue and Federal Avenue. There was also some flooding of the Big 4 Bungalow Caravan Park and Dolphin Caravan Parks.

### **Lake Tabourie**

Major historical food events have occurred in 1971, 1975, 1988 and 1991 (11).

The highest known lake flood level is reportedly 2.5m in February 1971 (11).

During the August 2015 flood event, the Lake Tabourie gauge (216440) reached 1.22m AHD. During this event 213mm of rainfall fell over a 5-day period, with 176mm of this rainfall falling within a 48-hour period (33).

Historically flooding has resulted in inundation, particularly of properties east of Centre Street and those located on the Princes Highway to the west of the bridge. An ocean driven event in 1974 also resulted in inundation around Tabourie Lake (3).

## **FLOOD MITIGATION SYSTEMS**

Shoalhaven City Council manages flood mitigation drainage structures, which include; 50 flood mitigation drains (total length of 48.5km), nine levee banks (total length of 23.5km), 60 flood gates, three weirs and 14 bridges.

## Levees

Shoalhaven City LGA has two Category 1 levee banks which are located along the Shoalhaven River at Riverview Road, Nowra, and Terara Village south of Nowra Bridge on the Princes Highway. Category 1 levees are identified as critical infrastructure as they provide protection from riverine flood inundation to residential properties. Levee locations are shown on Map 3 and Map 4. Refer to Section 2.2 and Section 2.5 for further information.

## Coastal Lakes and Lagoons

Artificial entrance management of ICOLL systems may be used to manage existing flood risk. Entrance constriction or closure contributes to the severity of flooding of urban areas and associated public infrastructure. Shoalhaven City Council in partnership with state agencies and its community has developed Entrance Management Plans (EMP) for;

- Burrill Lake,
- Currarong Creek,
- Lake Conjola,
- Shoalhaven River,
- Swan Lake, and
- Tabourie Lake.

An entrance management policy is an appropriate mechanism to set out the conditions for entrance management. These policies consider the need to adequately consider and address potential environmental and social impacts and the manner in which any impacts are to be managed. While entrance management is often considered amongst the suite of options within a floodplain risk management plan, it is generally not desirable to rely on entrance intervention to set flood planning levels for future development particularly where the risk can be otherwise avoided (4).

## Seawall structures

There is currently nearly 300m of varied seawalls on the southern corner of Mollymook Beach extending from the sewage pumping station south of the Mollymook Golf Club (MGC) building to the Surf Lifesaving Club (SLSC) boat ramp. This coastal protection infrastructure has been previously impacted by major storms and East Coast Low events such as those which occurred in 2015, 2016 and 2020, and is nearing the end of design life. Council has decided that the replacement of existing seawalls is the preferred option to mitigate the risks of coastal hazards on essential public infrastructure, as well as the MGC. This will improve amenity, safety and ensure protection from current and future coastal hazards (38).

## EXTREME FLOODING

### The Shoalhaven River

The community within the Lower Shoalhaven catchment is susceptible to extensive flooding, most notably;

- Low-lying foreshore areas of Shoalhaven Heads, Coolangatta, and Comerong Island, Greenwell point, Orient Point and Culburra Beach
- Throughout the Broughton Creek and Crookhaven River floodplains as well as properties around East Nowra, southern Bomaderry, and Berry.

Shoalhaven Heads, Coolangatta, and Comerong Island - Almost 85 properties will experience above floor flooding in the 1% AEP event with most properties on Hay Avenue and Jerry Bailey Road south of Davenport Road affected along with some properties on Shoalhaven Heads Road, including the three caravan parks (Mountain View Resort, Ingenia Holidays and Coastal Palms). In a 0.2% AEP event a significant number of properties along Jerry Bailey Rd south of Shoalhaven Heads Road will be impacted along with properties around the Hay Avenue to Jerry Bailey Road intersection. Approximately 240 properties in addition to the caravan parks would have flooding above floor level in a PMF event, including all properties along Jerry Bailey Road and adjacent cross streets, properties on Scott Street, Ablett Circuit and Discovery Place, as well as properties along Bolong Road. In the Coolangatta area properties would be isolated as Bolong Road becomes inundated in events more frequent than the 5% AEP event. Properties on Comerong Island closest to Shoalhaven Heads foreshore flood waters back up from the south from Berrys Canal/ Crookhaven River with floodwaters inundating most land. All properties will have above floor flooding in a 5% AEP event as the levee overtops and the Island experiences flooding from both the north and south (5).

Greenwell Point - Over floor flooding begins in a 5% AEP event with some 44 foreshore properties impacted as well as the Pine Park and Coral Tree caravan parks becoming inundated, however, this jumps significantly to 250 properties in a 2% AEP event. The number of impacted properties continues to climb with increasing flood depths with almost 310 properties impacted in a 1% AEP event and 420 in the PMF event. Greenwell Point is significantly affected by flooding and becomes isolated with Greenwell Point Road, the only egress, experiencing flooding over the road between a 20% AEP and 10% AEP event and becoming cut off in events rarer than the 10% AEP (5).

Orient Point and Culburra Beach - Over 94 properties would have above floor flooding in the 1% AEP event and more than 320 properties in the PMF event with significant flood depths. Properties along the river foreshore areas of Culburra Beach begin to experience flooding above floor in a 5% AEP event. The number of affected properties increases to almost 60 in a 2% AEP event with nine properties in Orient Point having over floor flooding. The low point on Prince Edward Avenue near The Strand becomes impassable to vehicles between

the 5% AEP event and 2% AEP event. Properties north of this low point would be isolated except for egress by foot via the beachfront (5).

Terara, Numbaa, Brundee, Worrigeer, Mayfield, and Pyree areas - Extensive flooding is experienced throughout the Crookhaven River floodplain with various swamp areas and floodwaters backing up from Crookhaven River/Crookhaven Creek as well as from the Shoalhaven River breaking its banks around Numbaa. Once the Terara levee is overtopped, there is extensive flooding throughout the floodplain with around 80 properties impacted in the 5% AEP event, 190 in a 2% AEP event including Shoalhaven Caravan Village, climbing to more than 250 in the 1% AEP event and around 330 properties in the PMF event.

### **Broughton Creek (Berry)**

In the township of Berry there is minimal time before the water levels rise to hazardous levels, with depths potentially rising to 1m in about half an hour (23). High velocities and relatively high depths can occur across roads and railway crossings. During a PMF all land between Broughton Creek in the north to Andersons Lane Creek in the south would be flooded. There may be up to 50 properties affected by flooding in the PMF flood event.

### **Kangaroo Valley**

In the PMF event (25.3m at the Hampden Bridge gauge (215220)) the entire Kangaroo Valley floodplain will be inundated taking in the northern parts of the township and extending into the rural areas along Barrengarry Creek to the north and Jarretts Lane Creek and Nugents Creek to the east (13). 115 properties would be affected by over floor flooding (38). Flood depths can be extreme within the Kangaroo Valley, with some properties potentially flooded above their roof level (22).

### **St Georges Basin and Sussex Inlet**

The developed areas most at risk of inundation within the St Georges River Basin include the low-lying properties around the foreshores of the Basin, at Sussex Inlet and around the Park Drive area adjacent to Cockrow Creek, Sanctuary Point.

Extreme events within St Georges Basin are expected to result in 1051 properties being flooded above floor level within Sussex Inlet (560), Basin Foreshore (212) and Sanctuary Point (279) (39).

### **Burrill Lake**

Extreme flood events within Burrill Lake are expected to reach 4.1m at the Burrill Lake gauge. In this instance, the northern peninsular of Burrill Lake township would be completely flooded, in addition to residential areas on the eastern side of Burrill Lake with 543 properties affected by over floor flooding. Tourist parks would also be flood affected (40).

### **Lake Conjola**

During extreme flood events the eastern half of the Lake Conjola township would initially be isolated, but eventually completely inundated by floodwaters. 335 properties would be

affected by over floor flooding and all three tourist park developments within the town would be flood affected (40).

### **Lake Tabourie**

During a PMF event water levels are expected to reach 4.2m at the Lake Tabourie gauge with 201 properties affected by over floor flooding. As the flood progresses low flood islands are expected to develop within residential areas which will eventually be inundated. There are a number of areas that will become trapped perimeters including the south-eastern part to of the Lake Tabourie township and the higher parts of the Lake Tabourie Tourist Park. The lower parts of the Lake Tabourie Tourist Park are expected to become part of a high hazard floodway (11) (41).

## **COASTAL EROSION**

Coastal (beach) erosion occurs due to one or more process drivers; wind, waves, tides, currents, ocean water level, and downslope movement of material due to gravity (47). The most damaging of these driving forces are large coastal storms, which in NSW are dominated by East Coast Low cyclonic events. These powerful low-pressure systems generate gale force winds, heavy rain leading to flash flooding, rough seas, and large coastal swell, all of which contribute to coastal erosion. There is also evidence that coastal erosion in NSW may be exacerbated by periods of La Nina climatic cycles, which are associated with a positive Southern Oscillation Index (SOI) and a negative Pacific Decadal Oscillation (PDO), both of which will likely be affected by climate change in the future.

Shoalhaven City Council LGA has no identified coastal 'erosion hotspots' (47) Shoalhaven City Council manages 40 of the 109 beaches and 11 of the 15 lakes and estuaries. All beaches managed by Council were risk assessed for the 1% event. Based on this criterion, 10 beaches were prioritised as being at greater risk of coastal erosion and requiring the preparation of coastal hazard studies (Map 25). Coastal hazard studies for erosion, recession and inundation have been completed for beaches, which are partially backed by urban development and are considered to have assets at risk (44). If dune levels are low or the foreshore not protected by dunes, the coincidence of elevated ocean water levels and wave run-up can result in flooding and damage to structures. In Shoalhaven this has happened at sections of Culburra, Warrain, Collingwood, Narrawallee and Collers Beaches (42).

The principal trigger for the known landslips is rainfall. Significant wet weather has triggered a number of hazardous landslides in parts of the Shoalhaven City LGA.

## 2 EFFECTS ON THE COMMUNITY

### COMMUNITY PROFILE

Shoalhaven City LGA has a current population (2021 census) of 108,531 people with a projected population in 2041 of 131,531 people (47). The Census only captures that population who were residing in the area on a permanent basis. The additional temporary population generated by tourism accommodation is approximately 12% annually and during peak holiday season can increase by a factor of three (3). In Shoalhaven on the NSW south coast, the permanent population of 108,531 is estimated to be closer to 300,000 during holiday periods.

Most of the population is concentrated on the coastal fringe with the major centres being Nowra, Ulladulla, Huskisson-Vincentia, St Georges Basin, and Sussex Inlet. The majority of flood affected towns in the Shoalhaven have people aged 65 years and over making up over 30% of the population, with some locations as high as 50% (4).

Fluctuations of population at weekends and in holiday periods can have profound implications for demand for water, energy, sewerage, parking, police, and health services. If these are not provided to accommodate peak populations, then stresses and strains are likely to occur when capacity is stretched. It is now quite normal to see day-visitors being turned away from Hyams Beach due to a lack of parking and to see Heavy Traffic alerts for Ulladulla and Milton (as well as further north) as holiday traffic may queue for kilometres along the Princes Highway.

Population increases at certain times, caused by holiday makers, festival participants and “schoolies” can affect the health and character of communities. Where a component of the temporary population is comprised of second homeowners it can contribute to house price increases and generate affordability issues for the incumbent population. Most critically, because the non-resident populations are not counted at the Census, councils with a substantial temporary population receive a smaller share of Financial Assistance Grants than are necessary to meet the infrastructure and services needs of peak holiday and weekend populations.

The Shoalhaven City LGA is also considered a southern sea change LGA locality. The main features are high usage between November and April. The rental usage has a distinctive pattern of flat rental use in the winter, and peaks in the summer holiday period. (5)

As well as tourism there are non-resident properties used by owners and their families. In the Shoalhaven City LGA, every 1,000 holiday homes generate a temporary population of more than 2,000 persons. High Christmas period use is noticeable in the Shoalhaven, and high usage levels in April, a school holiday period. A substantial temporal population comes to the LGA and uses its services on a regular basis throughout the year. Due to the proximity approximately 10% of its non-residential owners live permanently in the ACT (5).

Shoalhaven City LGAs' population increases by nearly 12,000 (approximately 11%) annually with the tourist and temporal population.

Caravan parks are a substantial form of tourist and equivalent full-time residents (EFTR) accommodation and therefore have a powerful influence in generating additional population in areas where they are located along the Shoalhaven City LGA coastline. In 2010 there were 51 caravan parks with a capacity of 9266 people. Regardless of location, caravan parks do add a significant number of EFTR to the prevailing population in sea change LGAs. Even on the lowest estimates of persons per site, caravan parks generate an EFTR addition to the population of close to 10,000 people (5).

Additional populations are generated by caravan parks, hotels, motels, and apartments. There are also day-trippers and people who stay with relatives and friends when in coastal communities (5).

Table 13: Census of Housing and Population data (2021)

Census Description	Shoalhaven City LGA	Bawley Point	Berry	Bomaderry	Burrill Lake	Culburra Beach	Currarong	Durras North	Greenwell Point	Huskisson	Kangaroo Valley
<b>Total Persons</b>	<b>108,531</b>	<b>844</b>	<b>3,098</b>	<b>6,738</b>	<b>1,782</b>	<b>2,946</b>	<b>479</b>	<b>50</b>	<b>1,245</b>	<b>840</b>	<b>856</b>
Aged 0-4 years	5,448	41	116	341	98	141	16	0	37	29	37
Aged 5-14 years	11,889	82	332	772	203	240	24	6	97	64	85
Aged 65 + years	30,418	247	1,203	1,802	500	962	191	8	487	263	224
Of Indigenous Origin	7,067	16	36	570	85	189	10	0	62	39	10
Who do not speak English well	402	0	0	26	8	12	0	0	0	11	0
Have a need for assistance (profound/severe disability)	8,783	30	269	622	118	284	34	5	102	58	39
Living alone (Total)	5,568	52	90	425	98	208	38	3	101	69	32
Living alone (Aged 65+)	2,632	21	46	176	46	110	7	0	64	29	13
Residing in caravans, cabins or houseboats or improvised dwellings	1,188	8	6	14	9	3	4	20	34	19	0
<b>Occupied Private Dwellings (Households)</b>	<b>42,667</b>	<b>330</b>	<b>1,232</b>	<b>2,818</b>	<b>730</b>	<b>1,278</b>	<b>214</b>	<b>16</b>	<b>557</b>	<b>370</b>	<b>338</b>
No Motor Vehicle	1,863	3	39	215	25	58	0	0	19	27	5
Caravan, cabin, houseboat, or improvised dwell	784	3	3	4	4	0	3	5	29	4	0
Rented via State or Housing Authority	791	0	3	111	0	0	0	0	0	15	0
Rented via Housing Co-Op or Community Church Group	772	0	7	132	4	0	0	0	0	7	0
<b>Unoccupied Private Dwellings</b>	<b>12,794</b>	<b>371</b>	<b>127</b>	<b>209</b>	<b>192</b>	<b>880</b>	<b>309</b>	<b>31</b>	<b>180</b>	<b>294</b>	<b>139</b>
<b>Average persons per occupied dwelling</b>	<b>2.3</b>	<b>2.2</b>	<b>2.3</b>	<b>2.2</b>	<b>2.3</b>	<b>2.2</b>	<b>2.0</b>	<b>2.1</b>	<b>2.1</b>	<b>1.9</b>	<b>2.3</b>
<b>Average vehicles per occupied dwelling</b>	<b>1.8</b>	<b>2</b>	<b>1.9</b>	<b>1.7</b>	<b>1.8</b>	<b>1.7</b>	<b>2.1</b>	<b>1.6</b>	<b>1.8</b>	<b>1.7</b>	<b>2.1</b>

## Shoalhaven City LGA Local Flood Plan

Census Description	Lake Conjola	Lake Tabourie	Milton	Nowra	Shoalhaven Heads	St Georges Basin	Sussex Inlet	Terara	Tomerong	Ulladulla	Vincentia
<b>Total Persons</b>	<b>687</b>	<b>689</b>	<b>1,801</b>	<b>9,956</b>	<b>3,248</b>	<b>3,215</b>	<b>295</b>	<b>305</b>	<b>1,194</b>	<b>7,262</b>	<b>3,870</b>
Aged 0-4 years	14	25	85	632	156	139	2.3	10	54	338	180
Aged 5-14 years	33	73	190	1,203	315	308	1.9	28	165	771	413
Aged 65 + years	386	192	645	2,296	1,190	1,111	295	121	227	2,274	1,116
Of Indigenous Origin	14	29	42	1,225	118	209	2.3	14	65	380	126
Who do not speak English well	0	0	0	80	9	22	1.9	0	4	32	16
Have a need for assistance (profound/severe disability)	64	39	197	1,214	220	320	295	27	46	595	199
Living alone (Total)	44	49	61	614	250	166	2.3	40	33	392	166
Living alone (Aged 65+)	27	20	39	220	163	84	1.9	22	14	207	73
Residing in caravans, cabins or houseboats or improvised dwellings	177	8	17	0	293	41	295	91	0	234	0
<b>Occupied Private Dwellings (Households)</b>	<b>318</b>	<b>282</b>	<b>666</b>	<b>3,843</b>	<b>1,454</b>	<b>1,293</b>	<b>1,739</b>	<b>148</b>	<b>381</b>	<b>3,040</b>	<b>1,592</b>
No Motor Vehicle	5	4	30	456	72	24	101	14	0	188	55
Caravan, cabin, houseboat, or improvised dwell	101	3	18	0	200	39	18	65	0	167	0
Rented via State or Housing Authority	0	0	5	385	14	6	6	0	0	84	0
Rented via Housing Co-Op or Community Church Group	0	0	5	281	0	6	11	0	0	123	0
<b>Unoccupied Private Dwellings</b>	<b>157</b>	<b>120</b>	<b>79</b>	<b>350</b>	<b>269</b>	<b>295</b>	<b>801</b>	<b>11</b>	<b>69</b>	<b>455</b>	<b>964</b>
<b>Average persons per occupied dwelling</b>	<b>1.9</b>	<b>2.2</b>	<b>2.4</b>	<b>2.2</b>	<b>2.1</b>	<b>2.3</b>	<b>2</b>	<b>1.8</b>	<b>2.8</b>	<b>2.2</b>	<b>2.2</b>
<b>Average vehicles per occupied dwelling</b>	<b>1.6</b>	<b>1.8</b>	<b>2.0</b>	<b>1.5</b>	<b>1.7</b>	<b>1.9</b>	<b>1.7</b>	<b>1.7</b>	<b>2.5</b>	<b>1.7</b>	<b>1.9</b>

## SPECIFIC RISK AREAS - FLOOD (North to South)

### The Shoalhaven River Basin

#### NOWRA-BOMADERRY

##### Community Overview

Nowra and Bomaderry are towns in the South Coast region of New South Wales and are located 125kms south of Sydney.

In the 2021 census the towns had an estimated population of 38,775 (North Nowra and Bomaderry 16,191 and Nowra 22,584) with Aboriginal and Torres Strait Islander people making up 6.9% of the population. There were approximately 13,163 private dwellings (52).

Nowra and Bomaderry are shown on Map 3 and Map 4.

##### Characteristics of flooding

Nowra and Bomaderry are affected by riverine flooding from the Shoalhaven River, along with flash flooding of Nowra, Browns, Abernathy's, and Bomaderry Creeks which may affect a number of properties for short periods. There is also potential for major flooding of the floodplain downstream of Nowra Bridge.

##### Flood Behaviour

Floodway areas are generally contained to the Shoalhaven River, with properties affected by flooding located within flood storage areas (3).

In Browns Creek, flow through the central channel is classed as high hazard in the 1% AEP which cuts across both Quinns Lane and Hillcrest Avenue (37).

In Nowra Creek, upstream of the gorge, the majority of the flow path is classed as high hazard while the industrial precinct is mostly classified as low hazard (37).

The majority of flood affected areas in Bomaderry Creek are classified as being floodways, with flood storage areas being located between Bomaderry Creek and Moss Vale Road (5).

##### Classification of Floodplain

Within the Riverview Road area, once the Riverview Road Levee is overtopped the entire area will become part of a high hazard floodway (3).

The low-lying areas of Nowra and Bomaderry become High Hazard Flood Storage areas as the Shoalhaven River breaks its banks and inundates the floodplain (3).

Properties affected by flooding in the Nowra and Browns Creek catchments have Rising Road Access (37).

Properties in flood affected areas of the Bomaderry Creek catchment have Rising Road Access (5).

## Inundation

The Bureau of Meteorology provides warnings to the Nowra Gauge (215411) for the Shoalhaven River. Nowra, Browns and Bomaderry Creeks are ungauged.

### The Shoalhaven River

During an extreme flood it is expected that around 104 buildings in Nowra would be inundated above floor level (8.9m at the Nowra bridge gauge), with 34 inundated during a 1% AEP flood event (6.3m at the Nowra Bridge gauge) (3).

During an extreme event in Bomaderry an estimated 77 buildings would be inundated above floor level, with 33 inundated during a 1% AEP flood event, and 11 during a 10% AEP event (3).

The Riverview Road area is largely protected by a levee up to 6.4m (around 1% AEP flood level). However, seven buildings are inundated above floor level in a 1% AEP (due to backwater flooding across Ferry Lane and not overtopping of the levee) (3). Once the levee is overtopped up to 177 properties are at risk of over floor flooding (35).

**Table 14: Properties inundated above floor level related to the Nowra Bridge Gauge**

Gauge Height (mAHD)	Nowra	Bomaderry	Riverview Road Area
10% AEP (4.8m)	3	11	0
5% AEP (5.3m)	5	24	0
2% AEP (5.8m)	12	27	2
1% AEP (6.3m)	34	33	7
PMF (8.9m)	104	77	177

### Nowra and Browns Creeks

The below descriptions indicate when areas where properties are first impacted by flooding. As the events increase the numbers of properties affected in the previously listed street increases.

In the 20% AEP, locations impacted by flooding include Berry Street, Central Avenue, Bellevue Street, Quinns Lane and Browns Road (37).

In the 10% AEP, additional locations affected in Albatross Road and Hillcrest Avenue (37).

In the 2% AEP, additional locations impacted include Jellicoe Street, St Anns Street, Albert Street, and the Princes Highway (37).

In the PMF, additional locations affected include Bice Road, Somerset Avenue, Kerwick Close, Dobbie Close, McDonald Avenue and Ernest Street (37).

**Table 15: Properties inundated above floor level and over ground in Nowra related to the Nowra and Browns Creek catchment**

Design Flood Event	No. Properties with above floor Flooding	No. Properties with over ground Flooding
20% AEP	1	18
10% AEP	3	22
5% AEP	6	29
2% AEP	9	46
1% AEP	14	62
0.2% AEP	37	92
PMF	154	221

### Bomaderry Creek

The below descriptions indicate when areas where properties are first impact by flooding. As the events increase the numbers of properties affected in the previously listed street increases. Bomaderry Creek also impacts areas of Cambewarra.

In the 20% AEP locations that are at risk of flooding include Cambewarra Road, Tannery Road, Main Road, Hockeys Lane, Illaroo Road, Worthington Way, Tarawara Street, Bolong Road, Maleen Street and Numrock Street (44).

In the 2% AEP, addition properties are affected in Kongoola Avenue and Coomea Street (44).

In the PMF, additional properties affected by flooding are located on Taylors Lane, Tartarian Crescent, Beinda Street, Brinawarr Street, Meroo Road, Tarawal Street, Bunberra Street and Birriley Street (44).

**Table 16: Properties inundated above floor level and over ground related to the Bomaderry Creek catchment**

Design Flood Event	No. Properties with above floor Flooding	No. Properties with over ground Flooding
20% AEP	7	23
10% AEP	11	25
5% AEP	13	29
2% AEP	17	34
1% AEP	21	37
0.2% AEP	23	43
PMF	71	94

### Isolation

No properties are expected to be isolated in the urban area, however, a number of rural properties within Nowra/Bomaderry and their surrounds may be isolated.

### Flood Mitigation Systems

The Riverview Road Levee is a grass covered earthen embankment located on the Shoalhaven River extending from Nowra Bridge 1km downstream to Ferry Lane. The levee currently protects 141 residences up to 2m above the natural surface (to the height of the levee bank)

from direct inundation from the Shoalhaven River. Water can still enter the area in smaller floods from backwater flooding occurring downstream across Ferry Lane (35).

Between 1986/1987 the Riverview Road Levee was raised to the existing estimated 1% AEP flood level of 6.4mAHD. No freeboard allowance was included, although the levee is up to 0.3 m higher than the 1% AEP level in parts.

The Terara Levee prevents flood flows in the Shoalhaven River from overtopping the levee in events in the range of 15 to 20 year ARI events. However, a significant area behind the levee is still subjected to inundation from backwater flooding. Terara village experiences flooding from both direct Shoalhaven River flow (the levee offers some protection) and backwater flooding from the floodplain.

### **Dams**

Whilst there are a number of dams within tributaries of the Shoalhaven River upstream of Nowra – Bomaderry, only failure of Tallowa Dam has the potential to have significant flooding impacts in this area (Table 9).

### **At Risk Facilities**

The facilities that are at risk of flooding in Nowra/Bomaderry are shown in Annex 2.

### **Other Considerations**

The population of Nowra – Bomaderry increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

There are key pinch-points on the road networks associated with peak holiday traffic as well as an increase of through-traffic in Nowra and Bomaderry along the Pacific Highway.

The increased summer population from tourism activity brings increased pressure on infrastructure. The additional temporary population generated by tourism accommodation is approximately 12% annually and during peak holiday season can increase by a factor of three (3).

Annual events and festivals are Shoalhaven Environmental Expo, Shoalhaven Pet Expo, Reconnection Sunday (June), Arty Farty Party (July), Shoalhaven Health and Wellbeing Expo (June), Thrive Together Fair (August), Shoalhaven River Festival (October), Shoalhaven Superheros Festival (November).

## KANGAROO VALLEY

### Community Overview

The town of Kangaroo Valley sits within a gently sloping wide valley along the Kangaroo River. It is located approximately 20kms west of Berry and 22kms north-west of Nowra.

In the 2021 Census, there were 856 people in Kangaroo Valley with 494 private dwellings (52). A stream gauge (215220) exists at Hampton Bridge; however, this is not a key warning gauge and therefore flood predictions from the Bureau are not available for this area.

Kangaroo Valley is shown on Map 5.

### Characteristics of Flooding

Kangaroo Valley is affected by flash flooding from the Kangaroo River and its tributaries. Waters can rise rapidly with limited warning times. Flooding duration can vary from several hours to several days.

### Flood Behaviour

The main flow arrives from Kangaroo River with several minor inclusions from tributaries between Glenmurray Road and Hampden Bridge.

Water depths can be extreme reaching a maximum depth of over 10m in a number of locations.

### Classification of Floodplain

During a 1% AEP flood event the majority of Kangaroo Valley is classified as having Overland Escape routes away from flooding. However, some rural properties are considered to be Low Flood Islands and some areas near town as being Low Trapped Perimeters that will be first isolated, then completely inundated (40).

At a PMF flood extent additional properties are considered to be Low Flood Islands and Low Trapped Perimeters.

### Inundation

Over floor flooding does not affect properties until the 2% AEP event (16.6m at the Hampden Bridge gauge (215220)) where some low-lying properties adjacent to the river in Upper Kangaroo Valley Road, Moss Vale Road and Cullen Crescent begin to experience over floor flooding (38).

In the 1% AEP event (17.5m at the Hampden Bridge gauge (215220)) additional properties on Moss Vale Road and Cullen Crescent become affected by over floor flooding with the RFS and Ambulance stations on Broughton Street also flooded above floor level (38).

By the PMF event (25.3m at the Hampden Bridge gauge (215220)) the entire Kangaroo Valley floodplain will be inundated during a PMF event taking in the northern parts of the

township and extending into the rural areas along Barrengarry Creek to the north and Jarretts Lane Creek and Nugents Creek to the east (13). Properties on Moss Vale Road, Upper Kangaroo Valley Road, Nugents Creek Road, Broughton Street, Cullen Crescent, and Rectory Park Way become affected by over floor flooding (38).

Average over-floor flooding depths during a PMF are estimated to be 5.24m in residential houses and 6.53m in caravan parks (16).

**Table 17: Properties inundated above floor level and over ground in the Kangaroo Valley**

AEP %	No. properties with above floor Flooding	No. properties with over ground Flooding
20% AEP	0	0
10% AEP	0	0
2% AEP	14	21
1% AEP	34	31
0.5% AEP	54	36
PMF	115	94

### Isolation

In the 20% AEP event (11.7m at the Hampden Bridge gauge (215220)) 90 properties in Upper Kangaroo River become isolated when Upper Kangaroo River closes immediately to the east of No. 262. An additional five properties become isolated in the 10% AEP event (13.3m at the Hampden Bridge gauge (215220)) when Upper Kangaroo River Road closes at the Barrengarry Creek crossing (38).

12 properties including the RFS, and Ambulance Stations become isolated when Moss Vale Road closes in two locations (outside No.126 and No. 110) in the 10% AEP event (13.3m at the Hampden Bridge gauge (215220)) (38).

22 properties between No. 100 and 130 Moss Vale Road become isolated when Moss Vale Road closes in the 2% AEP event (16.6m at the Hampden Bridge gauge (215220)) (38).

91 properties on Moss Vale Road and Jarretts Lane, including the Glenmack Caravan Park become isolated when Moss Vale Road closes at Nugents Creek crossing in the 2% AEP event (16.6m at the Hampden Bridge gauge (215220)) (38).

In the 1% AEP event (17.5m at the Hampden Bridge gauge (215220)) properties located on Jenanter Drive, Cullen Crescent and Moss Vale Road become isolated when Moss Vale Road closes at Hampden Bridge (38).

In the PMF event (25.3m at the Hampden Bridge gauge (215220)) Bendeela closes causing the isolation of properties on Bendeela Road and Jacks Corner Road (38).

### Flood Mitigation Systems

There are no flood mitigation systems within Kangaroo Valley.

## **Dams**

Tallowa Dam is located downstream of Kangaroo Valley township and is not expected to contribute to flooding in the area.

Bendeela Pondage is located to the north of the Kangaroo River. Whilst unlikely, failure of this dam has some potential to affect picnic and camping areas along the Kangaroo River.

Refer to Section 1. 2 for further information.

## **At Risk Facilities**

There are three caravan parks, one school, one pre-school and emergency services that are at risk of flooding and/or isolation in Kangaroo Valley and these are shown in Annex 2.

## **Other Considerations**

Kangaroo Valley attracts a large number of tourists who may visit the area for the day or stay in the numerous accommodation options available including campsites adjacent to the river. The population of Kangaroo Valley increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community (22).

## **BERRY**

### **Community Overview**

Berry is located 14kms north of Nowra on the Princes Highway. In the 2021 Census, there were 3,098 people in Berry (State Suburbs) with 39.8% of the population aged over 65 (52).

In 2017 the Berry bypass was opened, with a diversion of the Princes Highway around the northern side of the town.

Berry is shown on Map 6.

### **Characteristics of Flooding**

The eastern part of Berry (including and east of Prince Alfred Street) is affected by a combination of riverine and flash flooding from Broughton Mill Creek and Broughton Creek (30).

The majority of the Berry township is affected by flash flooding from the local Town Creek catchment (30).

### **Flood Behaviour**

In the PMF flood event, the majority of the floodplain is located within the floodway (45).

### **Classification of Floodplain**

Flood affected properties in Berry have Rising Road Access (45).

### **Inundation**

In the 1% AEP there are no properties in the Town Creek catchment that are affected by over floor flooding (due to the creek diversion for the bypass), and eight properties in the Broughton Creek catchment that are affected by over floor flooding. These at-risk properties are located Prince Alfred Street, Queen Street, North Street, Albany Street and Pulman Street, adjacent to Broughton Creek (46).

There may be up to 50 properties affected by flooding in the PMF flood event.

### **Isolation**

Roads to Kangaroo Valley, Shoalhaven Heads and Gerroa may also experience flooding.

The urban properties experience rapid rise and fall of flood waters. Many rural properties may experience longer periods of inundation.

David Berry hospital may be isolated for longer periods requiring resupply.

### **Flood Mitigation Systems**

There are no levees or other forms of flood mitigation within Berry.

### **Dams**

There are no dams that could impact on flooding in Berry.

### **At Risk Facilities**

The facilities that are at risk of flooding in Berry are shown in Annex 2.

### **Other Considerations**

The population of Berry increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## TERARA

### Community Overview

In the 2021 census the population of Terara was 305, with 191 private dwellings. (52).

Terara is shown on Map 7.

### Characteristics of Flooding

Terara is affected by riverine flooding from the Shoalhaven River.

### Flood Behaviour

Terara Village is located adjacent to the Shoalhaven River, which is becomes a floodway. It is assumed that after the levee overtops, flows in Terara will become higher in velocity.

### Classification of Floodplain

Terara is classified as a Low Flood Island, as it can be isolated from 2.87mAHD then flooded once the levee is overtopped and backwater flooding inundates the area behind the levee.

### Inundation

The river begins to overtop its banks at Terara at a height of 4.4mAHD (equivalent to 4.5mAHD at the Nowra Bridge gauge) (3).

Below 4.7mAHD the village may be inundated from the southern floodplain (Worrigea Swamp). Above 4.9mAHD the levee will be overtopped, and the village will be flooded from the Shoalhaven River (3).

**Table 18: Properties inundated above floor level in Terara**

Design Flood Event (mAHD)	No. properties with above floor Flooding
20% AEP (2.87m)	0
10% AEP (3.99m)	0
5% AEP (4.61m)	1
2% AEP (5.01m)	13
1% AEP (5.19m)	44
PMF (6.04m)	55

### Isolation

Local rain may cause flooding of the Terara Road evacuation route even before the Terara Levee begins to overtop. Jindy Andy Lane is overtopped at 1.88mAHD local level, Comerong Island Road at 2.1mAHD and Terara Road at 2.87mAHD (3).

The average ground level in Terara Village is approximately 3.4mAHD and the majority of ground in the village will be inundated and isolated by backwater from the floodplain prior to the overtopping of the levee.

Comerong Island Ferry is withdrawn from service at 1.8m to 2.0m (Nowra Bridge Gauge) depending on the flow of water in the Shoalhaven River. Comerong Island has 10 dwellings and a population of 19 people (ABS 2021 Census) and 10 dwellings.

Pig Island Ferry is withdrawn from service between 1.3m and 2.0m (Nowra Bridge Gauge) depending on the strength of the river flow. There is one dwelling on Pig Island and livestock.

## Flood Mitigation Systems

**Table 19: Terara Levee summary of information**

Terara Levee	
Location	Terara levee is adjacent to the Shoalhaven River and runs along the front of Terara (47).
Type of Levee	Raised earth embankment. The main purpose of the Terara levee is to provide protection from higher velocity floodwaters inundating the village first hence this is considered a deflective levee (48).
Owner	Shoalhaven City Council - originally constructed in the mid-1970s and upgraded in 2005.
Design Height and freeboard	4.6m AHD plus 300mm freeboard (26) from Bryant Street to Nobblers Lane.
Overtopping Height	4.9m AHD at Bryant Street to 5.0m AHD upstream (5% AEP event is 4.8m AHD, 2% AEP event is 5.1m AHD) (26).
No. of properties protected	Once the levee is overtopped, there is extensive flooding throughout the floodplain with around 80 properties impacted in the 5% AEP event, 190 in a 2% AEP event including Shoalhaven Caravan Village, climbing to more than 250 in the 1% AEP event and around 330 properties in the PMF event (5).
Known low points	A section of the original 1970 levee has never been upgraded and contains low points at 4.4m AHD – 4.7m AHD on the Terara gauge. There is a defect still present at number 2 Southern Road, Terara. Overtopping at this section could occur from 4.2m AHD on the Terara gauge (47).
Location and sequence of inundation	Majority of the ground in the village will be inundated by backwater flooding from the floodplain in a 5% AEP prior to the levee overtopping. Terara Levees are overtopped south of Pig Island for events larger than 5%.
Consequences of levee overtopping or failure	Flooding of properties and school
Deficiencies	A realistic scenario is for the levee to fail at either a point of overtopping or due to a piping failure through the embankment due to a defect such as a large crack due to tree roots or geotechnical reasons. The worst case for a levee breach is when the water level is high on one side of the levee and low or dry on the other. When a breach occurs in this situation, the levee is eroded, and it allows a

	large volume of water to be suddenly released. However, with a low height levee structure, the breach width is limited and the failure and associated impacts behind the levee are likely to be mainly localised (5).
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**Dams**

Failure of Tallowa Dam could potentially have some additional flooding impact at Terara during a Sunny Day Failure and a PMF failure.

**At Risk Facilities**

The facilities that are at risk of flooding in Terara are shown in Annex 2.

**Other Considerations**

No other considerations.

## SHOALHAVEN HEADS

### Community Overview

Shoalhaven Heads is located on both Seven Mile Beach and the intermittent mouth of the Shoalhaven River approximately 15km east of Nowra.

In the 2021 census the population of Shoalhaven Heads was 3,248 with 1,833 private dwellings. People aged 65 years and over made up 36.6% of the population (52).

Shoalhaven Heads is shown on Map 8.

### Characteristics of Flooding

Flooding of Shoalhaven Heads is influenced by the following:

- Flash flooding from local rain,
- King Tides,
- Flooding from Broughton Creek,
- Flooding from the Shoalhaven River,
- River entrance condition, whether the entrance is open or closed at Shoalhaven Heads (Peak will be higher if initially closed rather than open at the beginning of the flood) (3), and
- Large seas or storm surges.

### Flood Behaviour

Floodway areas in Shoalhaven Heads are limited to the southern end of Hay Avenue (3).

All other flood affected properties are located within flood storage areas (3).

### Classification of Floodplain

Shoalhaven Heads has not been classified according to Emergency Response Classifications, however the majority of the community is located on high ground above the PMF with access out of town available to the north via Gerroa Road (3).

### Inundation

Low lying properties, Holiday Resorts and Caravan Parks in Hay Avenue, Jerry Bailey Road, River Road, Scott Street, Ablett Court, Discovery Place, Bramall Road, Ravenscliffe Road, Renown Avenue and off Shoalhaven Heads Road are most at risk of flooding.

**Table 20: Properties inundated above floor level over ground flooding within Shoalhaven Heads during design flood events related to Shoalhaven Heads (Wharf Road) Gauge**

Shoalhaven Heads Gauge (mAHD)	No. properties with above floor flooding	No. properties with over ground flooding
20% AEP (1.73m)	2	68
10% AEP (1.93m)	9	84
5% AEP (2.22m)	20	134

2% AEP (2.34m)	34	145
1% AEP (2.7m)	84	192
0.2% AEP (2.34m)	188	259
PMF (4.12m)	241	263

### Isolation

Shoalhaven Heads is unlikely to become isolated, with access available to the north via Gerroa Road.

### Flood Mitigation Systems

Shoalhaven City Council has an entrance management policy for the Shoalhaven River which allows for mechanical entrance opening of the Shoalhaven River at Shoalhaven Heads, when identified trigger water levels are reached, however mechanically opening the entrance at Shoalhaven Heads does not prevent flooding. In most instances it reduces the duration of flooding only. For major floods a small reduction in peak flood height may occur.

With an open entrance Shoalhaven Heads is more likely to be inundated by oceanic flooding, caused by king high tides or large swell.

### Dams

The failure of Tallowa Dam is unlikely to have more than negligible flood effects within the Shoalhaven Heads area. Refer to Section 1.2 and the Tallowa Dam Safety Emergency Plan for further detail.

Other upstream dams are not expected to have any impacts at Shoalhaven Heads.

### At Risk Facilities

The facilities that are at risk of flooding in Shoalhaven Heads are shown in Annex 2.

### Other Considerations

The population of Shoalhaven Heads increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## GREENWELL POINT

### Community Overview

Greenwell Point is in the Shoalhaven region of New South Wales. It is about 13 km east of Nowra on the South Coast.

In the 2021 census the population of Greenwell Point was 1,245 with 557 private dwellings and people aged 65 years and over made up 39% of the population (52).

Greenwell Point is shown on Map 9.

### Characteristics of Flooding

Greenwell Point is affected by riverine flooding from the Shoalhaven and Crookwell Rivers.

The lower Shoalhaven River is connected to the Crookhaven River via Berry's Canal. The Shoalhaven River generally flows out to the ocean via the Crookhaven River entrance, however in floods it generally flows out through the Shoalhaven River entrance, as the entrance is opened (naturally or by Council). As a result, flooding in Greenwell Point can be influenced by the behaviour of the Crookhaven/Shoalhaven Rivers and by tides, large seas, and prevailing winds (3).

Greenwell Point can also be affected by flooding from local runoff.

### Flood Behaviour

Floodwaters impacting Greenwell Point south of South Street are classified as a floodway area, with other areas classified as flood storage (3).

### Classification of Floodplain

Greenwell Point is classified as a High Flood Island in the PMF, with inundated areas having Rising Road Access.

### Inundation

Floor survey level data suggests that properties being to experience flooding from 1.37m at the Greenwell Point Gauge (215417) with as many as 137 properties experiencing over floor flooding by the 10% AEP event (2.0m at the Greenwell Point Gauge (215417)). Streets with properties at risk of over floor flooding at this flood level include Adelaide Street, Church Street, Greenwell Point Road, Comerong Street, Haiser Road, Leonore Avenue, Keith Avenue, Green's Road, Bailey Avenue, Church Street, Pyree Street, Crookhaven Drive, Fraser Avenue, Morrissey Way, and West Street (3).

By an extreme event (5.2m at Greenwell Point gauge) as many as 372 properties would be flooded over floor, (Additional properties located on Bindaree Street, Berrellan Street, Albert Avenue, Wilkins Street, South Street and Bartlett Drive) with only two small High Flood Islands remaining flood free around Spies Avenue and Greenwell Point Road/ Church Street area (51).

**Table 21: Properties inundated above floor level and over ground related to the Greenwell Point Gauge**

<b>Greenwell Point Gauge (215417)(mAHD)</b>	<b>No. properties with above floor flooding</b>	<b>No. properties with over ground flooding</b>
50% AEP	0	41
20% AEP (1.2m)	0	46
10% AEP (1.24m)	0	55
5% AEP (1.6m)	44	303
2% AEP (2.32m)	249	404
1% AEP (2.71m)	307	428
0.2% AEP (3.66m)	399	442
PMF (4.76m)	420	446

**Isolation**

Greenwell Point Road is the only access route for Greenwell Point. This road gets cut in a number of places in floods of less than 10% AEP (1.46m at the Greenwell Point Gauge (215417)) resulting in the isolation of Greenwell Point (26).

The critical levels for evacuation access are between 1.46mAHD and 1.6mAHD (26) (Refer to section 2.24 Road Closures for further detail). The access road may be inundated for up to 24 hours.

**Flood Mitigation Systems**

There are no flood mitigation systems located in Greenwell Point.

**Dams**

There are no dams located upstream of Greenwell Point that impact flooding.

**At Risk Facilities**

The facilities that are at risk of flooding in Greenwell Point are shown in Annex 2.

**Other Considerations**

The population of Greenwell Point increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## **TOMERONG, WANDANDIAN AND BEWONG**

### **Community Overview**

Tomerong, Wandandian and Bewong are villages located approximately 180 km south of Sydney and 20 km south of Nowra. The villages are located approximately 8 km inland northern and western shores of Jervis Bay.

In the 2021 census the population of Tomerong was 1,194 with 381 private dwellings, the population of Wandandian was 359 with 141 private dwellings and the population of Bewong was 80 with 38 private dwellings (52).

Tomerong is shown on Map 10, Wandandian and Bewong are shown on Map 11.

### **Characteristics of Flooding**

Flash flooding from Tomerong Creek and Suffolk Creek can affect Tomerong, flash flooding from Wandandian Creek, Bollerang Creek and Condies Gully can affect Wandandian and flash flooding from Wandandian Creek and Bewong Creek can affected Bewong (24).

Riverine flooding can cause flooding in Tomerong and Wandandian. There is also a risk of overland flooding.

### **Flood Behaviour**

Flood modelling has not yet been undertaken in Tomerong and Wandandian.

### **Classification of Floodplain**

Classification of the floodplain in Tomerong and Wandandian has not yet been undertaken.

### **Inundation**

The Bureau of Meteorology does not provide flood warnings to gauges in Tomerong, Wandandian or Bewong however the NSW SES monitors rain and river gauges including Island Point Road 216415.

Historically, low-lying properties adjacent to Tomerong Creek have been subject to inundation and the Princes Highway has become inundated and impassable for short periods.

Modelling shows properties in Bewong located on Bottle Brush Ave and properties located between the Princes Highway and Wandandian Creek can be affected by flooding in the PMF event (39).

### **Isolation**

There are no known isolations in Tomerong, Wandandian or Bewong.

### **Flood Mitigation Systems**

There are no flood mitigation systems located in Tomerong or Wandandian.

**Dams**

There are no dams located upstream of Tomerong or Wandandian.

**At Risk Facilities**

The facilities that are at risk of flooding and/or isolation in Tomerong and Wandandian are shown in Annex 2.

**Other Considerations**

No other considerations

## ST GEORGES BASIN

### Community Overview

St Georges Basin is located 15km south of Nowra. The Basin is a coastal lagoon with an estimated surface area of 37km<sup>2</sup>. The Basin discharges through Sussex Inlet Channel to the Pacific Ocean at Bherwerre Beach. The lower slopes close to the Basin contain a number of urban centres, including Sussex Inlet (see section 2.11), Basin View, St Georges Basin, Sanctuary Point, Old Erowal Bay and Wrights Beach.

In the 2021 census the population of St Georges Basin (including Basin View, St Georges Basin, Sanctuary Point, Erowal Bay, Old Erowal Bay and Wrights Beach) was 15,259 with 8,269 private dwellings. People aged 65 years and over made up 30.8% of the population.

St Georges Basin is shown on Map 12.

### Characteristics of Flooding

Flooding is influenced by the height of St Georges Basin, wind, tide, ocean conditions, in addition to local run-off and the flood conditions of tributaries flowing into St Georges Basin. The community within the St Georges Basin catchment is susceptible to flooding, most notably in Sussex Inlet and Sanctuary Point near Tomerong Creek as well as properties around Worrowing Waterway and Old Erowal Bay. Properties around the Basin foreshore are typically only impacted in rare events larger than the 1% AEP event.

Wind generated wave setup within St Georges Basin is not considered in the flood modelling but can contribute significantly to flood events. St Georges Basin Flood Study (44) mentioned residents reported that up to 0.5m difference in basin flood levels were observed in the 1971 flood due to the wind stress across the open water body.

### Flood Behaviour

Generally, the Basin and the main channel area of the inlet and tributaries are classified as floodway, the adjacent areas are classified as flood storage and the reminder becomes flood fringe (24).

### Classification of Floodplain

Flood affected areas in St Georges Basin have Rising Road Access (39).

### Inundation

The Bureau of Meteorology provide flood warnings to the Island Point Road Gauge (216415).

Properties within the St Georges Basin area can be flood affected in as little as a 50% AEP flood event. The majority of properties are located around the Park Drive area adjacent to the

lower reaches of Cockrow Creek as well as houses and caravan parks scattered around the Basin foreshore areas or along the smaller tributaries.

**Table 22: Properties inundated above floor level in Sanctuary Point and St Georges Basin foreshore related to the Island Point Road gauge.**

<b>Island Point Gauge (mAHD)</b>	<b>No. properties with above floor flooding in Sanctuary Point</b>	<b>No. properties with above floor flooding for St Georges Basin</b>
20% AEP	13	2
10% AEP	19	3
5% AEP (1.8m)	52	4
2% AEP (2.1m)	92	5
1% AEP (2.4m)	110	9
PMF (5.1m)	627	149

### **Isolation**

There may be some short-term isolations in St Georges Basin due to road closures at various creek crossings.

Basin View may become isolated for short periods due to flooding of local creeks.

### **Flood Mitigation Systems**

There are no flood mitigation systems located in St Georges Basin, Sanctuary Point or Basin View.

### **Dams**

There are no dams located upstream of St Georges Basin, Sanctuary Point or Basin View.

### **At Risk Facilities**

The facilities at risk of flooding in St Georges Basin are shown in Annex 2.

### **Other Considerations**

The population of St Georges Basin increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## VINCENTIA

### Community Overview

Vincentia is located on the western shores of Jervis Bay. It is roughly 25km south-east of Nowra, and approximately 200 km south of Sydney.

In the 2021 census the population of Vincentia was 3,870 with 2,655 private dwellings with people aged 65 years and over making up 35.7% of the population (52).

Vincentia is shown on Map 13.

### Characteristics of Flooding

Vincentia is affected by flash flooding from Moona Moona Creek, along with coastal impacts and overland flows.

### Flood Behaviour

In the 1% AEP event, flood affected areas of Vincentia are in flood fringe areas while in the PMF these become high hazard storage areas (34).

### Classification of Floodplain

All areas in Vincentia that are flood affected are classified as having Rising Road Access (34).

### Inundation

Flood affected streets in Vincentia include McNamara Court, Berry Street, Woden Street, Albion Street and Bayswater Street (34).

**Table 23: Properties inundated above floor level and over ground in Vincentia**

Design Flood Event	No. properties with above floor Flooding	No. properties with over ground Flooding
5% AEP	0	0
2% AEP	9	17
1% AEP	10	25
0.5% AEP	21	29
PMF	49	63

### Isolation

Vincentia may become isolated in a 1% AEP flood event if The Wool Road, Jervis Bay Road, and Elizabeth Drive become flooded.

### Flood Mitigation Systems

There are no flood mitigation systems located in Vincentia.

### **Dams**

There are no dams located upstream of Vincentia.

### **At Risk Facilities**

The facilities that are at risk of flooding in Vincentia are shown in Annex 2.

### **Other Considerations**

The population of Vincentia increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## SUSSEX INLET

### Community Overview

Sussex Inlet is located within St Georges Basin on the west bank of the waterway called Sussex Inlet.

In 2021 the population of Sussex Inlet was 3,888 with 2,648 private dwellings. People aged 65 year and over made up 43% of the population. (52).

Sussex Inlet is shown on Map 14.

### Characteristics of Flooding

Flooding within Sussex Inlet can be a result of a combination of mechanisms including catchment runoff, high ocean conditions and/or wind waves and local overland flooding (24).

### Flood Behaviour

The Sussex Inlet channel links St Georges Basin to the ocean at Bherwerre Beach. It is approximately 6km long, and ranges between 50m and 300m wide. The tidal range varies by approximately 1.8m at the ocean entrance end of the channel and is then dampened or reduced to only 0.2m at the Basin.

The Basin level rises when the rate of inflow to the Basin is greater than the outflow to the ocean. The Sussex Inlet channel and external ocean conditions can act as constrictions to the rate of outflow, elevated water levels within the individual creeks as a result of intense rain over the local tributary catchments.

The levels in the creeks may also be affected by an elevated Basin level or by constrictions along their lengths, local runoff over a small area accumulating in low spots. Generally, this occurs in areas which are relatively flat with little ground slope to facilitate drainage. The problem may be compounded by inadequate local drainage provisions and elevated Basin levels at the downstream outlet of the urban pipe or road drainage system, elevated ocean levels (high seas). Generally elevated ocean levels occur as a result of storm surge (from a low-pressure system) in combination with increased wave activity.

The majority of flood affected areas within Sussex Inlet are considered to be High Hazard Flood Storage Areas. Water is temporarily stored in these areas with floodwaters tending to rise slowly, these areas can have low velocities but potentially very large depths which can be as much as 5mAHD, well above the roofline of first floor properties (39).

The water channels surrounding Sussex Inlet can potentially become High Hazard Floodway's with high velocities and large depths (24).

## Classification of Floodplain

### Low Flood Island

The majority of Sussex Inlet is classified as a Low Flood Island during an extreme flood event. This includes the area located to the east of the canal crossing on Jacobs Drive, the main town centre and canal estates. Both Jacobs Drive and River Roads are cut by floodwaters early during flood events isolating this area. Most of this area is flooded in a 1% AEP event (2.2mAHD on the Sussex inlet gauge which is the equivalent to 2.4mAHD in the village), with all of it flooded in an extreme event (24).

### High Flood Island

Parts of the Sussex Inlet canal estates remain flood free in a 1% AEP event on a High Flood Island, however these areas will be inundated during extreme flood events and become part of the Low Flood Island.

### High Trapped Perimeters / Overland Escape

Most of the remaining part of Sussex Inlet is flood free with access roads open to the west. However, this area may still become isolated from other major centres due to the closure of other roads including Sussex Inlet Road and the Princes Highway.

The northern settlement of Badgee, becomes cut off from Sussex Inlet when the River Road Bridge is flooded. Parts of Badgee, particularly Fairview Crescent may still experience inundation, however most of this area remains flood free and is classified as a High Trapped Perimeter. Overland escape from Badgee is available to the west along the flood free access road (FFAR).

The southern settlements of Cudmirrah and Berrara can also be isolated from Sussex Inlet.

### Inundation

Flood water may rise quickly and inundate Sussex Inlet, within 30 minutes to one hour, depending on tides, swell, and flood waters from St George's Basin.

The lower levels buildings within Sussex Inlet can be flood affected in as little as 50% AEP (1 in 2 year ARI) and 10% AEP (1 in 10 year ARI) events (Table 24) (39). Most of these properties are located in the lower areas of including Fairview Crescent (in Badgee), Wunda Avenue, Ellmoos Avenue, River Road, and the numerous Sussex Inlet Caravan Parks scattered around the Basin foreshore.

The majority of additional properties affected in a 1% AEP event are associated with the canal estates and other areas accessed off Jacobs Drive in Sussex Inlet (24).

**Table 24: Properties inundated above floor level in Sussex Inlet related to the Sussex Inlet gauge**

Sussex Inlet Gauge (mAHD)	No. properties with above floor flooding Sussex Inlet
20% AEP	2
1.5m to 1.6m (10% AEP)	6
1.7 to 1.8m (5% AEP)	28
2.0 to 2.1m (2% AEP)	200
2.2 to 2.3m (1% AEP)	336
4.5 to 5.0m (PMF)	1212

### Isolation

Sussex Inlet becomes isolated when Sussex Inlet Road is flooded, however an alternate access route may be available via Blackbutt Road/Bendalong Road.

The settlement of Badgee located immediately north of Sussex Inlet can become cut off from Sussex Inlet once River Road becomes inundated at 0.9m at the Sussex Inlet Gauge (216412). A new flood free access road (FFAR) was completed in June 2021 to the west of Badgee. The Sussex Inlet FFAR should be opened by the Shoalhaven City Council when the water level in St Georges Basin (measured at the Island Point Rd gauge) is 1.2mAHD. At this gauge level water is predicted to pond on River Rd between 100 – 150mm deep immediately to the east of the Badgee Bridge and near the Wunda Ave intersection. The FFAR for this existing residential area extends from Suncrest Avenue to Sussex Inlet Road. The FFAR has been constructed with part of the road sealed and part gravel. The main road into Sussex Inlet, Jacobs Drive, becomes inundated in small or frequent flood events at around 1.2m on the Sussex Inlet gauge (216412). Flooding of Jacobs Drive restricts access into and out of most of the township to the east of the canal crossing (24). The only alternative route along River Road (at Ellmoos Avenue) is also cut at around 1.0m at the Sussex Inlet gauge (216412). Once this area is isolated, it can potentially also become completely inundated and is classified as a Low Flood Island.

Access and evacuation difficulties are experienced in as little as the 10% AEP design event and greater. The whole developed area will be isolated from the Princes Highway in larger events such as the 1% AEP (1 in 100 ARI) event.

### Flood Mitigation Systems

There are no specific mitigation systems identified within Sussex Inlet.

### Dams

There are no dams upstream of Sussex Inlet.

### At Risk Facilities

Sussex Inlet has a large number of caravan parks that are particularly at risk of flooding, many of which are located within the Low Flood Island.

Retirement homes and a childcare centre are located near the edges of flood affected areas in Sussex Inlet and may be indirectly affected, or else potentially isolated due to other road closures.

The facilities that are at risk of flooding and/or isolation within the Shoalhaven City LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 2.

### **Other Considerations**

The population of Sussex Inlet increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

There are approximately 670 sites located in Caravan Parks in addition to holiday rentals. Businesses have also reported that most of their yearly incomes comes from the peak holiday season.

There is a large community of elderly people who live alone in Sussex Inlet and rely on daily visits from health care workers (including meals on wheels). This community will be particularly vulnerable in any flood event resulting in isolation.

## HUSKISSON, WOOLLAMIA AND MYOLA

### Community Overview

Huskisson and Myola are located on the shores of Jervis Bay, 24km south-east of Nowra. Woollamia is situated between the Princes Highway and Jervis Bay. There is no actual township with the nearest town being Huskisson

Huskisson, Myola and Woollamia are situated alongside Currambene Creek which serves also as an anchorage and fishing port. Huskisson and Myola are popular tourist destination, and the populations increase in peak seasons.

In the 2021 census the population of Huskisson was 840 with 724 private dwellings. People aged 65 and over made up 30.3% of the population (52).

In the 2021 census the population of Myola was 94 with 43 occupied private dwellings and 154 unoccupied private dwellings (an increase from the last Census 2016 total of 105 private dwellings). People aged 65 and over made up 53% of the population (52).

In the 2021 census the population of Woollamia was 653 with 306 private dwellings. People aged 65 and over made up 25.1% of the population (52).

Huskisson, Woollamia and Myola are shown on Map 15.

### Characteristics of Flooding

Huskisson is affected by flash flooding from both Moona Moona Creek and Currambene Creek.

Myola and Woollamia are affected by flash flooding from Currambene Creek.

Myola and Huskisson may also be affected by coastal influences from Jervis Bay.

### Flood Behaviour

In the Currambene catchment, flood ways are generally restricted to the floodplain, however, may impact properties adjacent to the creek in Myola and Woollamia. All other flood affected areas are generally located with flood storage areas (34).

### Classification of Floodplain

All flood affected areas in Huskisson and Myola are classified as having Rising Road Access (34).

In Woollamia, the areas between Goodland and Willowford Roads, at the eastern end of Streamside Street, Edendale Street and Sunnyside Avenue and Coulon Street are classified as Low Flood Islands.

The area in Woollamia between Falls Road and Knoll Parade is classified as being a Low Trapped Perimeter (34).

All other locations in Woollamia have Rising Road Access (34).

### **Inundation**

There are no flood level gauges in the Moona Moona Creek or Currambene Creek catchments.

### **Huskisson**

Properties in Huskisson at risk of flooding from Moona Moona Creek are located on Calala Street, Beecroft Street, Waddell Street and Currambene Street (34).

Properties in Huskisson at risk of flooding from Currambene Creek are located on Dent Street, Wood Crescent, Duranbah Drive and Bolten Road (34).

**Table 25: Properties inundated above floor level and over ground in Huskisson in Moona Moona and Currambene Creeks**

Design Flood Event	No. properties with above floor flooding	No. properties with over ground flooding	No. properties with above floor flooding	No. properties with over ground flooding
	Moona Moona Creek	Moona Moona Creek	Currambene Creek	Currambene Creek
10% AEP	0	1	0	0
1% AEP	0	1	1	5
PMF	6	15	7	14

### **Myola**

Properties in Myola at risk of flooding are located on Catherine Street, Cartwright Street and Arnott Lane (34).

**Table 26: Properties inundated above floor level and over ground in Myola**

Design Flood Event	No. properties with above floor flooding	No. properties with over ground flooding
10% AEP	0	0
2% AEP	1	2
1% AEP	1	2
PMF	33	33

### **Woollamia**

Properties in Woollamia at risk of flooding are located on Edendale Street, Woollamia Road, Streamside Street, Allora Close, Goodland Road, Coulon Street and Jervis Bay Road. This includes rural properties located alongside the creek and within the catchment (34).

**Table 27: Properties inundated above floor level and over ground in Woollamia**

Design Flood Event	No. properties with above floor flooding	No. properties with over ground flooding
10% AEP	0	0

5% AEP	2	0
2% AEP	8	26
1% AEP	14	39
PMF	91	91

### **Falls Creek**

In the PMF event there are also three properties in Falls Creek with over floor flooding (34).

### **Isolation**

There are no isolations as Huskisson Road does not become flooded.

### **Flood Mitigation Systems**

There are no flood mitigation systems located in Huskisson, Woollamia or Myola.

### **Dams**

There are no dams located upstream of Huskisson, Woollamia or Myola.

### **At Risk Facilities**

The facilities that are at risk of flooding in Huskisson, Woollamia and Myola are shown in Annex 2.

### **Other Considerations**

The population of Huskisson, Woollamia and Myola increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## **CURRARONG**

### **Community Overview**

Currarong is a small village located 33km south-east of Nowra.

In the 2021 census the population of Currarong was 479 with 556 private dwellings. People aged 65 years and over made up 38.8% of the population (52).

Currarong is shown on Map 16.

### **Characteristics of Flooding**

Currarong township is affected by flooding from riverine and overland flow. The relatively undeveloped upstream catchment flows unobstructed until the township of Currarong. Currarong Road acts as a key hydraulic control with water backing up behind the road embankment until the road is overtopped. The Currarong Creek Bridge constricts the flow and attenuates the flood peak (62).

### **Flood Behaviour**

Numerous roads are affected by overland flooding once the storm system is overwhelmed with some roads including Currarong Road being overtopped by Currarong Creek (62).

### **Classification of Floodplain**

Classification of the floodplain has not been undertaken for Currarong.

### **Inundation**

Important roads overtopped in the 20% AEP event include Currarong Road, Walton Way, and Fishery Road. There are numerous smaller streets which suffer some degree of inundation from overland flooding in relatively frequently occurring flood events. Low-lying crossings, the holiday park and a few creekfront properties are inundated to some extent in a 1% AEP event. Buildings in the caravan park are inundated above floor level in a 1% AEP event, this may present a heightened risk during events as short stay residence are unlikely to be familiar with the risk and may not take adequate precautions.

Roads are often overtopped where culvert capacity is exceeded for events as low as a 20% AEP event.

Houses surrounding the drainage channel along Walton Way, Currarong Parkway and Fishery Road which may be inundated above floor level from overland flooding / local drainage in events larger than a 20% AEP event.

The caravan park, which is inundated once Currarong Road overtops and has a heightened risk due to short term residents being unfamiliar with the risk. The southwestern corner of the park has the largest risk and may be inundated above floor level for events lower than a 20% AEP event.

**Table 28: Properties inundated above floor level and over ground in Currarong**

Design Flood Event Currarong Creek Gauge (mAHD)	No. properties with above floor flooding	No. properties with over ground flooding
20% AEP (1.01m)	16	251
1% AEP (1.62m)	31	339
PMF (3.54m)	174	422

### Isolation

Areas to the east of Currarong Creek have a high risk of isolation from the main town due to Currarong Road's low flood immunity. The eastern side of town becomes isolated by floodwaters and the Currarong Road becomes impassable in events larger than a 20% AEP event (62).

The main access road to Currarong from Nowra, Greenwell Point Road will be flooded during Shoalhaven River flooding, however access along Forest Road should be available.

### Flood Mitigation Systems

There are no flood mitigation systems located in Currarong.

### Dams

There are no dams located upstream of Currarong.

### At Risk Facilities

The facilities that are at risk of flooding in Currarong are shown in Annex 2.

### Other Considerations

The population of Currarong increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## CULBURRA BEACH, ORIENT POINT AND CROOKHAVEN

### Community Overview

Culburra Beach, Orient Point and Crookhaven are located 18 km east-southeast of Nowra.

In the 2021 census the population of Culburra Beach including Crookhaven, and Orient Point 3,575 with 2,621 private dwellings. People aged 65 years and over made up 32.5% of the population. Aboriginal and Torres Strait Islander people made up 13% of the population of Orient Point. The NSW average is 3.4% (52).

Culburra Beach, Orient Point and Crookhaven are shown on Map 17.

### Characteristics of Flooding

The lower Shoalhaven River is connected to the Crookhaven River via Berry's Canal. The Shoalhaven generally flows out to the ocean via the Crookhaven River entrance, however in floods generally flows out the Shoalhaven River entrance, as the entrance is opened (naturally or by Council). As a result, flooding in Orient Point, Crookhaven and Culburra Beach can be influenced by the behaviour of the Crookhaven Shoalhaven Rivers and by tides, large seas, and prevailing winds (3).

Culburra Beach is affected by a combination of riverine and flash flooding from the Crookhaven/Shoalhaven River system, Lake Wollumboola and Sheepwash Creek (6).

Orient Point and Crookhaven are affected by riverine flooding from the Crookhaven/Shoalhaven River system

Culburra Beach, Orient Point and Crookhaven also experience overland flooding across the urban areas (6).

There is a gauge on Lake Wollumboola operated by Manly Hydraulics Laboratory, Wollumboola (215454), however no predictions are made to this gauge.

### Flood Behaviour

Flood modelling up to the PMF shows that floodwaters from Lake Wollumboola are considered flood fringe in areas where property and roads are affected, with floodway areas being contained to the Lake and foreshore areas (6).

Properties in Culburra Beach are susceptible to flooding from overland flow during intense local rainfall events. The majority of affected properties are located along West Crescent adjacent to Sheepwash Creek, or along East Crescent.

The number of properties at risk of flooding from elevated water levels in Lake Wollumboola is relatively minor. These properties are primarily located in a single section of West Crescent, in the cul-de-sac off Cross Street. Other properties in Culburra Beach are susceptible to flooding from overland flow during intense local rainfall events. The majority of affected properties are located along West Crescent adjacent to Sheepwash Creek, or

along East Crescent. The flooding is relatively shallow, however some properties appear to be affected by above floor flooding in events as frequent as the 20% to 10% AEP event, potentially producing high average annual flood damages. The primary cause of this flood affectation is development within low-lying hollows with limited drainage, combined with a lack of sufficient elevation above surrounding ground levels (e.g., slab-on-ground construction). It is recommended that this area be a focus for future flood mitigation investigations as part of subsequent Floodplain Risk Management Study / Plan stages. The bridge on Coonemia Road at Coonemia Creek was found to be at approximately the 1% AEP flood level.

A significant flood risk to existing development is posed by potential sea level rise. Any sea level rise will result in an equivalent raising of the entire Lake Wollumboola system by a similar amount. A rise of in sea levels (projected by 2100) would therefore be expected raise all flood levels by the same amount. Under these circumstances the current 1% AEP lake level could occur between five to ten years on average. The increase in flood risk and average annual damages to existing development below 3.2mAHD in Culburra Beach would be severe (6).

Flood modelling shows that floodwaters from the Crookhaven River are considered flood storage, with properties on Whistler Street located within a floodway in the PMF event (3).

### Classification of Floodplain

Flood affected areas in Culburra Beach, Crookhaven and Orient Point have rising road access (6).

### Inundation

In 2011 some properties experienced inundation in Greenbank Grove, East Crescent, Park Street and West Crescent (6).

From the 20% AEP to the PMF flood event, modelled overland flooding affects properties on West Crescent and Greenbank Grove with depths up to 0.5-1.0m. In the 20% AEP, overland flooding is also experienced along Prince Edward Ave with depths over 1m (6).

**Table 29: Properties inundated above floor level in Orient Point, Crookhaven and Culburra Beach related to the Greenwell Point gauge**

Greenwell Point Gauge (mAHD)	No. properties with above floor flooding
20% AEP	0
10% AEP	14
5% AEP 2.4m	85
2% AEP 2.9m	257
1% AEP 3.4m	346
0.2% AEP 3.7m	489

PMF 5.2m	648
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**Isolation**

There is one access into Culburra Beach, Orient Point and Crookhaven via Culburra Road. Isolation may occur if this road is affected by flooding at a 1% AEP flood event.

Orient Point becomes isolated by road from Culburra Beach when Prince Edward Drive closes at a 1% AEP flood event.

**Flood Mitigation Systems**

There are no known flood mitigation systems in Culburra Beach, Orient Point or Crookhaven.

**Dams**

There are no known dams upstream of Culburra Beach, Orient Point or Crookhaven.

**At Risk Facilities**

There are no vulnerable facilities at risk of flooding in Culburra Beach, Orient Point or Crookhaven.

**Other Considerations**

The population of Culburra Beach, Orient Point and Crookhaven increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## LAKE CONJOLA

### Community Overview

Lake Conjola (village) is located approximately 50kms south of Nowra on the southern side of Lake Conjola.

In the 2021 census the population of Lake Conjola was 687 with 520 private dwellings. People aged 65 years and over made up 38.5% of the population (52).

Lake Conjola is shown on Map 18.

### Characteristics of Flooding

There are 19 tributaries that flow into Lake Conjola with most joining at the upstream end of the lake. The majority of the catchment is State Forest with the Fisherman's Paradise and Lake Conjola located upon the shores of the lake. The lake has a surface area of approximately 4.3km<sup>2</sup> and a catchment area of 145km<sup>2</sup>.

Currently flooding around Lake Conjola can occur from three mechanisms (and combinations thereof) (40):

- Catchment flooding, as a result of intense rainfall within the local catchments
- Oceanic inundation, as a result of high ocean tides, storm surge, wave penetration, and
- Low-level persistent flooding, occurring through a gradual and prolonged rise in lake levels during periods of entrance closure.

### Flood Behaviour

In the PMF flood event the floodway areas are located within the lake, the foreshore areas in Lake Conjola Entrance Holiday Park, Lake Conjola Deepwater Resort, and Ingenia Holidays Lake Conjola (53).

Areas in Carroll Avenue, Edwin Avenue, Spinks Avenue, Milham Street and Garrad Way are located in flood storage areas. All other flood affected located are located in flood fringe areas (53).

### Classification of Floodplain

Lake Conjola (to the east of Pattimore Creek) is classified as a Low Flood Island (53).

Lake Conjola (to the west of Pattimore Creek) is classified as having Rising Road Access with access to Ulladulla (53).

### Inundation

Properties at risk of being affected by flooding are located in Milham St, Edwin Ave, Garrad Way, Spinks Avenue, Carroll Ave, Conley Avenue, Aney Street, Marshal Avenue, Craig Street, Thorne Street and Lake Conjola Entrance Road.

**Table 30: Properties inundated above floor level and over ground in Lake Conjola related to the Lake Conjola gauge**

Lake Conjola gauge (mAHD)	No. properties with above floor flooding	No. properties with over ground inundation
10% AEP (2.0m)	70	291
5% AEP (2.2m)	107	
2% AEP (2.3m)	142	
1% AEP (2.4m)	184	352
PMF	335	396

**Isolation**

Depending on the severity of the event, there is potential for isolation periods up to four hours per day on the high tide extending over a number of days.

**Flood Mitigation Systems**

There is an existing ground level on the foreshore which is in the range of 1.2m to 1.5mAHD, however it is not classified as an official levee.

**Dams**

There are no dams located upstream of Lake Conjola.

**At Risk Facilities**

The facilities that are at risk of flooding in Lake Conjola are shown in Annex 2.

**Other Considerations**

The population of Lake Conjola increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## MILTON

### Community Overview

Milton is a town located 6km northwest of Ulladulla. In recent years, several new housing estates have been developed on the fringes of the village.

In the 2021 census the population of Milton was 1,801 with 801 private dwellings. People aged 65 years and over made up 36.2% of the population (52).

Milton is shown on Map 19.

### Characteristics of Flooding

Numerous creeks and water courses make up the flood plain. Overland and flash flooding are the primary risks within this locality.

### Flood Behaviour

No flood modelling has been undertaken in Milton.

### Classification of Floodplain

Classification of the floodplain has not been undertaken in Milton.

### Inundation

There number of properties affected by flood inundation in Milton is unknown.

### Isolation

Milton is serviced by the Princes Highway, there is potential for isolation of outlying and rural sectors.

To the west of Milton are popular wilderness areas of North Brooman State Forest, Clyde State Forest, and Morton National Park. The area is accessed by fire trails which may become impassable when wet. Milton is also the gateway to the popular Pigeon House Mountain walking track and the Budawang Ranges.

There are small landholdings along the Upper Clyde River within Shoalhaven LGA. Dwellings on the western side of the river become isolated when access routes are flooded.

Shallow Crossing Campground located on The River Road becomes isolated.

Yadboro Flat dwellings and camping areas are isolated when the Clyde River rises, and tributaries become flooded along the access trails. The first creek along Yadboro Road from the east, Boyne Creek, rises quickly and becomes impassable cutting access. The Clyde River and Currowan Creek can block access to Yadboro Flats from the west.

### Flood Mitigation Systems

There are no known flood mitigation systems located in Milton.

**Dams**

There are no dams located upstream of Milton.

**At Risk Facilities**

There are no known vulnerable facilities at risk of flooding in Milton.

**Other Considerations**

The population of Milton increases during peak holiday periods. The Princes Highway can experience choke points merging on to this major road and heavy traffic queues. Road choke points could back up traffic from evacuating or being relocated to an evacuation location.

## ULLADULLA

### Community Overview

Ulladulla is a coastal town about halfway between Batemans Bay to the south and Nowra to the north and is about 180 km south of Sydney. The Ulladulla area is a seven-kilometre stretch of continuous urban residential development from the southern edge of Ulladulla, through the town of Mollymook, to Narrawallee in the north, terminating at the Narrawallee estuary.

In the 2021 census the population of Ulladulla town ship was 7,262 with 3,695 private dwellings. People aged 65 years and over made up 31.2% of the population (52).

The surrounding areas including Mollymook, Mollymook Beach and Narrawallee have a population of 5,213 with 3,601 private dwellings in the 2021 ABS Census data. People aged over 65 years make up between 29.8% to 37.3% of the population (52).

Ulladulla, Mollymook, Mollymook Beach, and Narrawallee are shown on Map 20.

### Characteristics of Flooding

Millards Creek, Blackwater Creek, Mollymook Creek, Mollymoke Farm Creek, and Narrawallee Creek flow through the Ulladulla area.

Millards Creek discharges through the Ulladulla Harbour and into the Tasman Sea. The Millards Creek catchment area extends approximately 3km inland from the Ulladulla Harbour and the upper western boundary of the catchment extending up to top of the catchment at Slaughterhouse Road, Milton.

Only the very lower reaches of the creek are tidal, with the tidal limit defined by a stone weir within the main channel of Millards Creek, immediately upstream of the St Vincent Street Bridge (63).

### Flood Behaviour

There is limited recorded information of flood duration, flood hotspots or frequently flooded areas available. (54) The Millards Creek entrance conditions were shown to have an impact on water levels and velocities through the lower reaches of Millards Creek. A shoaled entrance has the effect of causing water to back up through the estuary and may exacerbate flooding (54).

Millards Creek is an ephemeral stream and discharges into the Ulladulla Harbour. Tributaries of Millards Creek converge to the main water body through overland flow, creek flow and through the Ulladulla urban stormwater system. The urbanised catchment of Millards Creek significantly alters natural flow paths with water often flowing down roads as opposed to natural channels creating a flood risk to numerous roads in the catchment (54).

Roads are often overtopped where culvert capacity is exceeded for events as low as a 20% AEP. Key roads overtopped in the 20% AEP event include North Street, Village Drive and Croft Avenue (54).

Despite a few low-lying crossings being overtopped, Millards Creek remains mostly inside its main channel up to and including the 1% AEP even (54).

### Classification of Floodplain

The Millards Creek catchment is steep and as such there is minimal flood storage. The main tributaries and overland flow paths are classified as Floodway with some roads, such as St Vincent Street which is known to be flood affected also being classified as floodway.

Most houses around Millards Creek are located in dry or flood fringe areas however Carramar Drive, Jindelara Rd, Warden St, Spencer Street and of Princes Hwy have buildings in areas zoned as flood storage or floodway. These areas have been discussed in previous sections. Many properties that back onto Millards Creek and its tributaries backyards are classified as floodway or flood storage (65).

### Inundation

Some areas that experience inundation in a 1% event include Carramar Cr which is affected by creek flooding, Warden and Spencer St which are affected by overland flow once the stormwater system is exceeded (54).

St Vincent Street downstream of the bridge which is affected by creek flooding and houses next the Princes Hwy which are affected by overland flow (54).

Although the roads are only likely to be overtopped for a brief period there remains the risk of key access roads being damaged for prolonged periods, particularly where velocities are high (54).

Developed areas most at risk of damage from flooding (overland or waterways) include dwellings along; Timbs Street and Carramar Crescent above the piped waterway (between Warden Street and Spencer Street), St Vincent Street (that are closest to Millards Creek), on top of an overland flow path (between Church Street and North Street next to the Princes Highway), and on North Street (near the crossing with Millards Creek).

Table 31: Properties inundated above floor level related Millards Creek (upstream of Princes Highway)

Millards Creek Gauge Water Level (mAHD)	No. properties with above floor flooding
20% AEP (1.38m)	9
10% AEP (1.58m)	No data
5% AEP (1.89m)	No data

2% AEP (2.48m)	No data
1% AEP (2.90m)	24
0.5% AEP (3.22m)	No data
PMF (4.80m)	143

\*Above floor flooding. Taken as ground level plus 150mm

### Isolation

The short critical duration for the catchment also indicates that roads are unlikely to be isolated for an extended period.

### Flood Mitigation Systems

There are no known flood mitigation systems in Ulladulla.

### At Risk Facilities

The facilities that are at risk of flooding in Ulladulla are shown in Annex 2.

### Other Considerations

The population of Ulladulla increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## **BURRILL LAKE/KINGS POINT/DOLPHIN POINT**

### **Community Overview**

Burrill Lake and Kings Point are located approximately 60kms south of Nowra adjacent to Burrill Lake.

In the 2021 census the population of Burrill Lake was 1,782 with 980 private dwellings. People aged over 65 made up 28.2% of the population (52).

In the 2021 census the population of Kings Point was 609 with 301 private dwellings. People aged over 65 made up 22.8% of the population (52).

In the 2021 census the population of Dolphin Point was 354 with 197 private dwellings. People aged over 65 made up 24.8% of the population (52). There is a large development occurring within Dolphin Point, so population figures are expected to increase.

Burrill Lake, Kings Point and Dolphin Point are shown on Map 21.

### **Characteristics of Flooding**

The lake has a catchment area of approximately 78km<sup>2</sup> and an estimated surface area of 4.1km<sup>2</sup>. The principal tributary is Stony Creek, which enters from the north. The lakes entrance is generally open and untrained.

Flooding within Burrill Lake can be the result of a number of very different mechanisms, including:

- Catchment flooding from the local catchment rainfall
- Ocean inundation as a result of high ocean tides / storm surge; and

### **Low-level persistent flooding due to elevated Lake levels during periods of entrance closure (9) Flood Behaviour**

Floodway areas at Burrill Lake in the 1% AEP event are generally limited to the Lake and immediate foreshore area, with the majority of properties affected by flooding located in flood storage areas. These areas are considered to be high hazard (9).

### **Classification of Floodplain**

The area known as Bungalow Park Village (on the western side of Burrill Lake, north of the Princes Highway) is classified as a Low Flood Island, with all properties inundated in the extreme flood event (9).

Dolphin Point is classified as a High Flood Island when it loses access at 1.8m at the Burrill Lake Gauge (216435) (9).

Kings Point and other areas of Burrill Lake have Rising Road Access up to the extreme flood event (9).

## Inundation

Overground flooding begins to occur from 1.1m to 1.2m at the Burrill Lake Gauge (216435) on Kendall Crescent, Thistleton Drive and Balmoral Drive. Additionally, the public foreshore areas become inundated, particularly around Rackham Crescent, Ireland Street and MacDonald Parade.

**Table 31: Properties inundated above floor level and over ground in Burrill Lake, Kings Point and Dolphin Point related to the Burrill Lake Gauge**

Burrill Lake Gauge Height (mAHD)	No. properties with above floor flooding	No. properties with over ground flooding
10% AEP (2.1m)	70	380
5% AEP (2.2m)	140	430
2% AEP (2.3m)	270	460
1% AEP (2.4m)	318	460
PMF (4.1m)	510	540

## Isolation

Properties on the western side of Burrill Lake, north of the Princes Highway (in the area known as Bungalow Park Village) experience isolation as the roadways become inundated from as low as 1.1m at the Burrill Lake Gauge (416435)

At 1.8m at the Burrill Lake Gauge (216435) Dolphin Point Road becomes inundated causing the isolation of Dolphin Point (148 properties plus the caravan park) (55).

Roads and Maritime Services completed the new Burrill Lake Bridge on the Princes Highway, just south of Ulladulla in March 2018. Key features of the project include the new bridge and highway are designed to be above the 1%AEP flood level. This will reduce the impact of flooding and providing a lake crossing and road approaches designed above the 1%AEP flood level. The approaches now not flooded until 2.6mAHD on the northern side of the bridge at the Burrill Lake Gauge (216435).

Burrill Lake may become isolated from Ulladulla due to the closure of the Princes Highway at Racecourse Creek (no height indicated) (40).

## Flood Mitigation Systems

The current entrance management policy recommends opening at a lake level of 1.25mAHD. The floodplain risk management study will provide an opportunity to analyse the utility of entrance management for flood mitigation. Analysis can focus on the timing and effectiveness of previous openings particularly in relation to the peak level at the time of opening e.g., June 2005 at RL 1.15mAHD and April 2007 at RL 0.99mAHD. The main hazards associated with inundation at levels above RL 1.0mAHD are the potential for sustained inundation to reduce soil bearing capacity leading to footing failure and building damage, road pavement failure due to prolonged saturation and traffic incidents associated with flooded roads e.g., Balmoral Road (61).

## **Dams**

There are no dams located upstream of Burrill Lake.

## **At Risk Facilities**

The facilities that are at risk of flooding in Burrill Lake and Dolphin Point are shown in Annex 2.

## **Other Considerations**

The population of Burrill Lake increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## **LAKE TABOURIE**

### **Community Overview**

Tabourie Lake is a small village located approximately 11km south of Ulladulla.

In the 2021 census the population of Lake Tabourie was 689 with 442 private dwellings. People aged 65 years and over made up 28.4% of the population.

Lake Tabourie is shown on Map 22.

### **Characteristics of Flooding**

Lake Tabourie is affected by flash flooding from Lake Tabourie, along with potential ocean inundation. The majority of significant flooding in Tabourie Lake has coincided with a build-up of the entrance berm height and/or rainfall events occurring with high antecedent water levels in the lake.

### **Flood Behaviour**

At 2.6m at the Lake Tabourie Gauge (216440) (1% AEP) floodway areas are limited to the waterways, with areas immediately adjacent to the waterways classified as flood storage. All other areas are classified as flood fringe areas (56).

At 4.2m at the Lake Tabourie Gauge (216440) (PMF) floodway areas include the waterway, properties on the Princes Highway, Portland Way, and Centre Street. All other flood affected areas are classified as flood storage (56).

### **Classification of Floodplain**

Properties located in Lulworth Crescent/Portland Way and properties on the east side of Lemon Tree Creek up to Dermal Street are classified as being a Low Flood Island. The rest of the properties on the eastern side of Lemon Tree Creek are on a High Trapped Perimeter (56).

All other flood affected areas having Rising Road Access or are located on High Flood Islands (56).

### Inundation

The following streets are the locations of properties at risk of flooding related to the Lake Tabourie Gauge (216440):

- 2.0m: the Princes Highway and Oak Ave
- 5% AEP: Lyra Dr, Dermal Street, Centre Street, Beach Street and Portland Avenue
- 1% AEP: Weymouth Road, Bridge Street, Short Street and River Road
- PMF: South Street, Surf Street, Saturn Avenue and Torquay Drive

**Table 32: Properties inundated above floor level and over ground in Lake Tabourie related to the Lake Tabourie gauge**

Lake Tabourie gauge (216440) (mAHD)	No. properties with above floor flooding	No. properties with over ground flooding
20% AEP 2.0m	31	2
10% AEP 2.2m	38	6
5% AEP 2.4m	75	14
1% AEP 2.6m	152	50
0.2% AE) 2.8m	158	82
PMF 4.2m	223	201

### Isolation

Lake Tabourie may become isolated when the Princes Highway closes on the east of the Tabourie Creek Bridge at 2.4m at the Lake Tabourie Gauge (216440) (41).

Off the Princes Highway, local roads may also be cut by flooding at 2.4m at the Lake Tabourie Gauge (216440) (41) including:

- Portland Way potentially isolating properties on Portland Way and Lulworth Crescent.
- Centre Street potentially isolating residents in the Lake Tabourie Village to the east of Lemon Tree Creek.

### Flood Mitigation Systems

There are no flood mitigation systems located in Lake Tabourie.

### Dams

There are no dams located upstream of Lake Tabourie.

### At Risk Facilities

The facilities that are at risk of flooding in Lake Tabourie are shown in Annex 2.

### Other Considerations

The population of Lake Tabourie increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## **BAWLEY POINT**

### **Community Overview**

Bawley Point is a small coastal village hamlet located 30km south of Ulladulla and 40km north of Batemans Bay.

In the 2021 census there was a population of 844 with 753 private dwellings. It should be noted that 58% of dwelling were unoccupied (large number of holiday rentals). Almost 30% of the population was aged over 65 years (52).

Bawley Point is shown on Map 23.

### **Characteristics of Flooding**

Bawley point can experience coastal flooding and overland flooding. There are no major river systems within the township, however Willinga Lake to the north can reach peak capacity and influence road access routes.

### **Flood Behaviour**

No modelling for Bawley Point has been undertaken.

### **Classification of Floodplain**

Bawley Point is at risk of rising road access, and high trapped perimeter areas.

### **Inundation**

There is no flood modelling for Bawley Point.

### **Isolation**

There is only one major access road into Bawley Point (Bawley Point Road), if this access is cut the population will be isolated.

### **Flood Mitigation Systems**

There are no known flood mitigation systems located in Bawley Point.

### **Dams**

There are no dams located upstream of Bawley Point.

### **At Risk Facilities**

The facilities that are at risk of flooding and/or isolation in Bawley Point including caravan parks are shown in Annex 2.

### **Other Considerations**

The population of Bawley Point increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community. There is a water level road gauge on Bawley Point, road east of the Princes Highway.

## DURRAS NORTH

### Community Overview

Durras North is a small coastal village located approximately 280kms south of Sydney and 15kms north of Batemans Bay.

In the 2021 census, the population of Durras North was 50 people (which has almost doubled from 2016 with 27 people), with 57 private dwellings. In addition, there are approximately permanent 300 cabins/caravans located in three tourist parks, with an additional unknown camping capacity across four tourist parks (52).

Durras North is shown on Map 24.

### Characteristics of Flooding

North Durras is vulnerable to lake/estuary flooding from Durras Lake.

### Flood Behaviour

No flood modelling has been undertaken for Durras North.

### Classification of Floodplain

Durras North has rising road access and possible high trapped perimeter areas.

### Inundation

Durras Lake has a trigger point of 1.8mMHL gauge (216445) for manual opening to prevent further flooding at South Durras. No flood modelling has been undertaken for Durras North.

### Isolation

The only road access is North Durras Road, if this road is cut the entire population of North Durras will be isolated. This may occur due to fallen trees in storm conditions.

### Flood Mitigation Systems

There are no known flood mitigation systems in Durras North.

### Dams

There are no dams located upstream of Durras North.

### At Risk Facilities

The facilities that are at risk of flooding and/or isolation within the Shoalhaven City LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 2.

### Other Considerations

The population of Durras North increases during peak holiday periods and the level of flood awareness of visitors to the area is likely to be significantly lower than within the resident community.

## SPECIFIC RISK AREAS – COASTAL EROSION

### Shoalhaven City LGA Coastline

The Coastal Management Act 2016 does not include authorised locations but identifies coastal hotspots. There are currently no identified hotspots in the Shoalhaven LGA.

The following beaches were recognised as authorised locations under the Coastal Protection Act:

- Part of Mollymook Beach
- Part of Collingwood Beach
- Part of Callala Beach

An Emergency Action Sub Plan was prepared for these beaches in 2011 as well as for Culburra Beach, Currarong Beach, Narrawallee Beach, and beaches where Surf Lifesaving Club buildings are located.

There are two sets of coastal hazards identified in the:

1. Beach erosion, inundation, wave run-up and long-term recession. The following beaches are partially backed by urban development and are considered to have assets at risk (Map 23 Coastal Beach Erosion Hazard).

- Shoalhaven Heads
- Culburra Beach
- Warrain Beach
- Currarong Beach
- Callala Bay
- Collingwood Beach
- Narrawallee Beach
- Mollymook Beach
- Collers Beach
- Boat Harbour, Bendalong (included after the 2016 east coast low (ECL) event)

If dune levels are low or the foreshore not protected by dunes, the coincidence of elevated ocean water levels and wave run-up can result in flooding and damage to structures. In Shoalhaven this has happened at sections of Culburra, Warrain, Collingwood, Narrawallee and Collers Beaches.

2. Coastal cliff and slope instability

- Penguin Head
- Plantation Point
- Hyams Point
- Berrara Point
- Inyadda Point, Manyana

- Narrawallee
- Bannisters Point
- Collers Beach Headland
- Rennies Beach
- Racecourse Beach.

### **PART OF MOLLYMOOK BEACH**

Mollymook and Bannisters Point is an established seaside residential area, developed in the 1960s and 1970s. Mollymook is a highly urbanised beach with very high summer visitation rates. The Mollymook Surf Club is at the southern end of the beach, and both ends of the beach are patrolled during peak holiday times. The Mollymook Golf Club is also at the southern end of the beach. Low dunes and narrow foreshore reserves provide easy public beach access at multiple locations.

- 1 x Golf Club (Zone of Reduced Foundation Capacity)

Natural entrances tend to migrate along the beach in response to freshwater flooding and coastal storm effects (NSW Government, 1990). This phenomenon has been seen at some beaches in Shoalhaven, including Mollymook, where Blackwater Creek and Mollymoke Farm Creek entrances had migrated north in some storms, threatening both public and private assets. Training walls have been constructed on the northern side of both creeks to mitigate these threats.

### **PART OF COLLINGWOOD BEACH**

- 1 x property (Zone of Reduced Foundation Capacity)

If dune levels are low or the foreshore not protected by dunes, the coincidence of elevated ocean water levels and wave run-up can result in flooding and damage to structures. In Shoalhaven this has happened at sections of Collingwood Beach.

### **PART OF CALLALA BEACH**

The Jervis Bay Marine Park area includes the larger centres of Huskisson and Vincentia and the smaller villages of Currarong, Callala Bay, Callala Beach and Hyams Beach. The villages are separated by National Park. The white sands of Jervis Bay, the low wave energy and low gradient beaches are a major attraction for visitors. Both residents and visitors also value foreshore access ways for walking and cycling. The beach with the highest number of residential lots and buildings within the coastal hazard area is Callala Beach. A major storm event can also cause entrance break through at unexpected locations. This leads to destruction of dunes that have formed near creek entrances and renders any assets behind

the dunes vulnerable to future storms. At Currambene Creek (southern end of Callala Beach) a training wall was constructed to reduce the risk of creek breakout at Myola.

Callala Beach - 16 residences are within the immediate coastal erosion risk area (ZSA). Every private property along the seaward side of Quay Rd is partially within the immediate hazard area (ZRFC). Community infrastructure at immediate risk are the community centre, tennis club and tennis courts.

Depending on the direction of the storm, different beaches are impacted. Callala Beach, which faces east, was more exposed to erosion in the 1974 storm. Currarong Beach, which faces north, was more heavily impacted during the June 2016 storm.

- 53 x buildings ZRFC (Zone of Reduced Foundation Capacity).
- 16 x buildings ZSA (Zone of Slope Adjustment)

Storm bite erosion - the 1974 and 1978 storms that affected the NSW coastline resulted in well documented severe erosion of the beach and dunes at Callala Beach. For Callala Beach, although risk to private property is high, the risk can be managed through the use of the DCP/LEP for future development. Erosion risk can be managed in the short term through temporary coastal protection works (i.e., post-storm beach scraping with approval from JBMPA). Coastal protection works other than temporary coastal protection works are not considered feasible at this stage but the need for works would be reassessed in subsequent revisions of the CZMP.

**Table 33: Shoalhaven LGA Coastal Assets**

	Beach / foreshore area	Coastal assets	Potential risks
1.	Shoalhaven Heads	7 beach accesses 1 lookout 2 service vehicle accesses	erosion accretion (vehicle access at SLC) inundation
2.	Culburra Beach/Penguin Head	19 beach accesses 2 lookouts (beach) 3 lookouts (Penguin Head)	erosion inundation slope instability (Penguin Head)
3.	Warrain Beach	10 beach accesses 3 lookouts 1 service vehicle access	erosion inundation
4.	Currarong Beach & Abrahams Bosom Beach	5 beach access ways 1 tractor access (Currarong) 1 beach access (Abrahams Bosom)	erosion inundation accretion (at Peel St)
5.	Callala Bay – beach and cliffs	9 beach accesses	erosion inundation
6.	Callala Beach	18 beach accesses 2 lookouts	erosion inundation
7.	Huskisson urban area, includes Shark Net Beach and Huskisson Beach	14 beach accesses 3 lookouts	erosion inundation
8.	Collingwood Beach	14 beach accesses	erosion inundation

9.	Vincentia south, includes Orion, Barfler, Nelsons and Blenheim Beaches	12 beach accesses 1 lookout 1 service vehicle access	erosion inundation
10.	Hyams Beach	2 beach accesses 1 lookout	erosion inundation
11.	Cudmirrah Beach	2 beach accesses 1 service vehicle access 1 lookout	erosion inundation
12.	Cudmirrah / Berrara foreshore, includes Kirby Beach	9 beach accesses 5 lookouts 1 service vehicle access	erosion inundation
13.	Manyana Foreshore, includes Inyadda (south) Beach, Inyadda Point and Manyana Beach (to Cunjurong Pt)	8 beach accesses 2 lookouts	erosion inundation
14.	Conjola coast	3 beach accesses 1 boardwalk 1 lookout	erosion inundation
15.	Narrawallee Beach Jones Beach (north side of Bannister Point)	11 beach accesses 1 beach access at Jones Beach	erosion inundation
16.	Mollymook Beach	12 beach accesses 2 service vehicle accesses 2 creek training walls, foreshore protection structures (south Mollymook)	erosion, inundation
17.	Bogey Hole/Collers Beach	4 beach accesses	erosion, inundation
18.	Ulladulla Harbour	2 beach accesses Foreshore protection structure	erosion, inundation
19.	Rennies Beach/The Bombie	5 beach accesses 4 lookouts	erosion, inundation
20.	Burrill Beach/Dolphin Point	7 beach accesses 1 lookout	erosion, inundation
21.	Wairo Beach	5 beach accesses 2 lookouts 1 service vehicle access	erosion, inundation
22.	Bawley Point shoreline, includes Bawley, Cormorant & Gannet beaches.	20 beach accesses 3 lookouts 2 service vehicle accesses	erosion, inundation
23.	Racecourse (1 beach access on an easement), Shelly (1 beach access on an easement), Kioloa (south end) Beaches.	6 beach accesses 1 lookout 1 service vehicle access Shoreline protection structures at Kioloa boat ramp.	erosion, inundation

## ROAD CLOSURES AND ISOLATED COMMUNITIES

### ROAD CLOSURES

Table 34: Roads liable to flooding in Shoalhaven City LGA.

Road	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Princes Highway	Berry (Broughton Mill Creek)	Can be closed for more than 24 hours; road access from highway to David Berry Hospital lost. Rail line also subject to closure	None New section of the Berry to Bomaderry upgrade opened to traffic May 2021	
Princes Highway	South Nowra (Browns Creek, near Btu Road)	Can be closed for some hours to light traffic; severe event may deny access to heavy vehicles.	Possible alternative route to Btu Road and Albatross Road.	
Princes Highway	Wandandian (between Wandean Road and The Wool Road)	Can be closed for 12 hours to all traffic; no practical detour.		
Princes Highway	Conjola (at Conjola Creek)	Possibly closed for more than 24 hours	No detour available.	
Princes Highway	South of Ulladulla (Racecourse Creek, north of Kings Point Road)	Frequent closure for some hours; occurs even in non-serious events including storms.	Emergency detours via Wood stock Road.	
Princes Highway	Burrill Lake	New bridge and highway 2019 are higher than the future 1%AEP year flood level and reduce the impact of flooding		Lake crossing and road approaches designed above the 1%AEP year flood level
Bomaderry / Moss Vale Road	Can be closed in Barrengarry and Cambewarra Mountains by landslides and by floodwaters in the vicinity of Nugents Creek.			
Moss Vale Road	Outside No. 126 and No. 110	Isolation of 12 properties between two closure points including RFS and NSWA	None	13.3m at the Hampden Bridge gauge (215220) (38)

Road	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Moss Vale Road	Nugents Creek crossing	Loss of access to Nowra and Berry	Northern part of the town via southern highlands. Rest of town none	16.6m at the Hampden Bridge gauge (215220) (38)
Moss Vale Road	Between No. 100 and 130	Isolation of 91 properties on Moss Vale Road and Jarretts Lane	None	16.6m at the Hampden Bridge gauge (215220) (38)
Moss Vale Road	Cullen Crescent intersection	Nil	Yes, via Mt Scanzi Road	16.6m at the Hampden Bridge gauge (215220) (38)
Moss Vale Road	Hampden Bridge	Isolation of properties on Jenanter Drive, Cullen Crescent, and Moss Vale Road	None	17.5m at the Hampden Bridge gauge (215220) (38)
Upper Kangaroo River Road	Immediately east of No. 262	Isolation of 90 properties in Upper Kangaroo Valley	None	11.7m at the Hampden Bridge gauge (215220) (38)
Upper Kangaroo River Road	Barrengarry Creek crossing	Isolation of 5 properties (in addition to the 90 above)	None	13.3m at the Hampden Bridge gauge (215220) (38)
Bendeela Road	Moss Vale Road intersection	Isolation of 60 properties on Bendeela Road and Jacks Corner Road	None	25.3m at the Hampden Bridge gauge (215220) (38)
Beach Road (Berry to Gerroa Road)	Broughton Creek Bridge	David Berry Hospital can be isolated from the east; closure may last for more than 24 hours.		
Coolangatta Road (Berry to Gerroa Road)	Along Wharf Road and near Broughton Creek Bridge	Can be closed for more than 24 hours.		
Bolong Road (Bomaderry to Shoalhaven Heads)	Broughton Creek and along the Shoalhaven River floodplain	Can be closed for 3-4 days		Closure may occur when the Shoalhaven River Gauge at Nowra reaches 2.25 metres

Road	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Comerong Island Road (Nowra to Comerong Ferry)	Between Nowra and Terara and Numbaa to Comerong Island ferry ramp	Closure may last for 2 days.		Closure occurs at about 4.5 metres on Nowra Gauge (1.88mAHD)
Greenwell Point and Culburra Roads (Nowra to Greenwell Point and Culburra)	Mayfield Road at Crookhaven Creek Pyree Lane, at Eelwine Creek. Jindy Andy Lane at Eelwine Creek	Closure for more than 24 hours. Closure of Greenwell Point Road results in Greenwell Point being isolated	None for Greenwell Point	Access is cut in as little as the 10% AEP event (below 2m at Greenwell Point gauge) (26). Greenwell Point Rd cut at: 1.46mAHD Mayfield Rd 1.48mAHD Jindy Andy Lane
Albatross Road (Nowra to HMAS Albatross), Berry Street	Nowra Creek	Possible closure for more than 24 hours.		
Woollomia Road	Near Pritchard Avenue	Closure for up to 24 hours.		
Jervis Bay Road (Falls Creek to Jervis Bay)	Falls Creek			
Sanctuary Point Road North	Tomerong Creek	Closure in severe events only; local streets may be inundated.	Alternative access via Grange Road to Princes Highway.	
Sussex Inlet Road/Jacobs Drive (Princes Highway to Sussex Inlet)	Near Sandpiper Way and Ellmoos Avenue	Closure for up to 4 days; numerous local streets also inundated, and access lost. Badgee can be isolated except to emergency vehicles.		
Bawley Point Road (Termeil to Bawley Point)	Willinga Lake	Closure for hours only.		
Battunga Drive, Tomerong		Access lost to Princes Highway; problem for school		

Road	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
		bus travel and Battunga Estate		
Yalwal Road (Nowra to Burrier)	Nowra Creek; possibly other closure points upstream of Barringella Creek.	Closure occurs at about 3.5m on Nowra Gauge when backwater flooding occurs from the Shoalhaven River.		3.5m Nowra Gauge
Princes Highway (Lake Tabourie)	East of Tabourie Creek Bridge	Lake Tabourie becomes isolated from Ulladulla	Nil (Possible 25km inland via Monkey Mountain Road, Woodburn Road, and Woodstock Road)	2.4m at the Lake Tabourie Gauge (216440) Depth 0.15m
Portland Way, Lake Tabourie	Corner of Torquay Drive	With Weymouth intersection closure –isolation of properties on Portland Way and Lulworth Crescent	Nil	2.4m at the Lake Tabourie Gauge (216440) Depth 0.21m
Portland Way, Lake Tabourie	Corner of Weymouth Road	With Torquay Drive intersection closure –isolation of properties on Portland Way and Lulworth Crescent	Nil	2.4m at the Lake Tabourie Gauge (216440) Depth 0.22m
Centre Ave, Lake Tabourie	Oak Ave intersection	Isolation of properties on the east of Lemon Tree Creek	Nil	2.4m at the Lake Tabourie Gauge (216440) Depth 0.27m
Centre Ave, Lake Tabourie	Dermal Street intersection		Nil	2.4m at the Lake Tabourie Gauge (216440) Depth 0.19m
Lyra Rd, Lake Tabourie	River Road intersection	Nil	Via Saturn Avenue	2.4m at the Lake Tabourie Gauge (216440) Depth 0.40m
Lyra Rd, Lake Tabourie	Venus Ave intersection	Nil	Via Saturn Avenue	2.55m at the Lake Tabourie Gauge (216440) Depth 0.36m
Berry Street, Nowra	Corner of Bice Road	Nil	Via McDonald Ave	Depth of 0.58m in the 20% AEP (37)

Road	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Albatross Road, Nowra	Corner of Albert Street	Nil	Via McDonald Ave or Kinghorne Street	Depth of 0.33m in the 20% AEP (37)
Albatross Road, Nowra	At Nowra Creek	Nil	Numerous alternate roads	Depth of 0.30m in the 20% AEP (37)
Hillcrest Ave, South Nowra	Browns Creek	Nil	Via Greenwell Point Rd/ Old Southern Road	Depth of 0.24m in the 10% AEP (37)
Browns Road, South Nowra	Browns Creek (end of road)	Nil	N/A	Depth of 0.30m in the 20% AEP (37)
Quinns Lane, South Nowra	Browns Creek	Nil	Via Greenwell Point Rd/ Old Southern Road	Depth of 0.28m in the 20% AEP (37)
Old Southern Road, South Nowra	Browns Creek (end of road)	Nil	N/A	Depth of 0.56m in the 20% AEP (37)
Flinders Road, South Nowra	Nowra Creek	Nil	Nil	Depth of 0.11m in the PMF (37)
Jellicoe Street, South Nowra	Nowra Creek	Nil	Via Flinders Road	Depth of 0.27m in the 1% AEP (37)
Corner Bice Road and Berry Street	Nowra Creek	Isolation of Westborne Dive Rainford Road Osborne Street Kerwick Close	Nil	Depth of 0.58 in the 20% AEP (37)
Jellicoe Street, South Nowra	Western end	Nil	Via Flinders Road	Depth of 0.25m in the 1% AEP (37)
Central Ave, South Nowra	Nowra Creek	Nil	Via Bellevue Street/Flinders Road	Depth of 0.21m in the 2% AEP (37)
Central Ave, South Nowra	Oxford Street intersection	Nil	Via Bellevue Street/Flinders Road	Depth of 0.81m in the 1% AEP (37)
Bolong Road, Bomaderry	Brinawarr Street and Meroo Road intersections			Flash flooding risk (44)
Princes Highway	Bomaderry Creek crossing			Flash flooding risk (44)
Illaroo Road	Near Page Ave and near Bingarra Lane			Flash flooding risk (44)
Taylors Road	Near Moss Vale Road			Flash flooding risk (44)

Road	Closure location	Consequence of closure	Alternate Route	Indicative gauge height
Hockeys Lane				Flash flooding risk (44)
Moss Vale Road				Flash flooding risk (44)
Main Road				Flash flooding risk (44)
Tapitallee Road				Flash flooding risk (44)
Princes Highway	Millards Creek	Once these roads are cut there is an increased risk to the community as access to services may be limited		0.5 – 0.2% AEP 5.33mAHD (54)
St Vincent Street	Millards Creek	As above		2 – 5% AEP 4.63mAHD (54)
North Street	Millards Creek	As above		<20% AEP 4.18mAHD (54)
Village Drive	Millards Creek	As above		<20% AEP 4.18mAHD (54)
Bolwarra Avenue	Millards Creek	As above		>0.2% AEP 5.25mAHD (54)
Croft Avenue	Eastern Tributary	As above		<20% AEP 4.18mAHD (54)
Spencer Street	Eastern Tributary	As above		<20% AEP 4.18mAHD (54)
Warden Street	Eastern Tributary	As above		<20% AEP 4.18mAHD (54)
Village Drive	Eastern Tributary	As above		<20% AEP 4.18mAHD (54)
Church Street	Northern Tributary	As above		10 – 20% 4.18mAHD AEP (54)
North Street	Northern Tributary	As above		<20% AEP 4.18mAHD (54)
Royal Mantle Drive	Eastern Tributary	As above		5 - 10% AEP 4.63mAHD (54)



Table 35: Potential Periods of Isolation for communities in the Shoalhaven City LGA during major/moderate flooding.

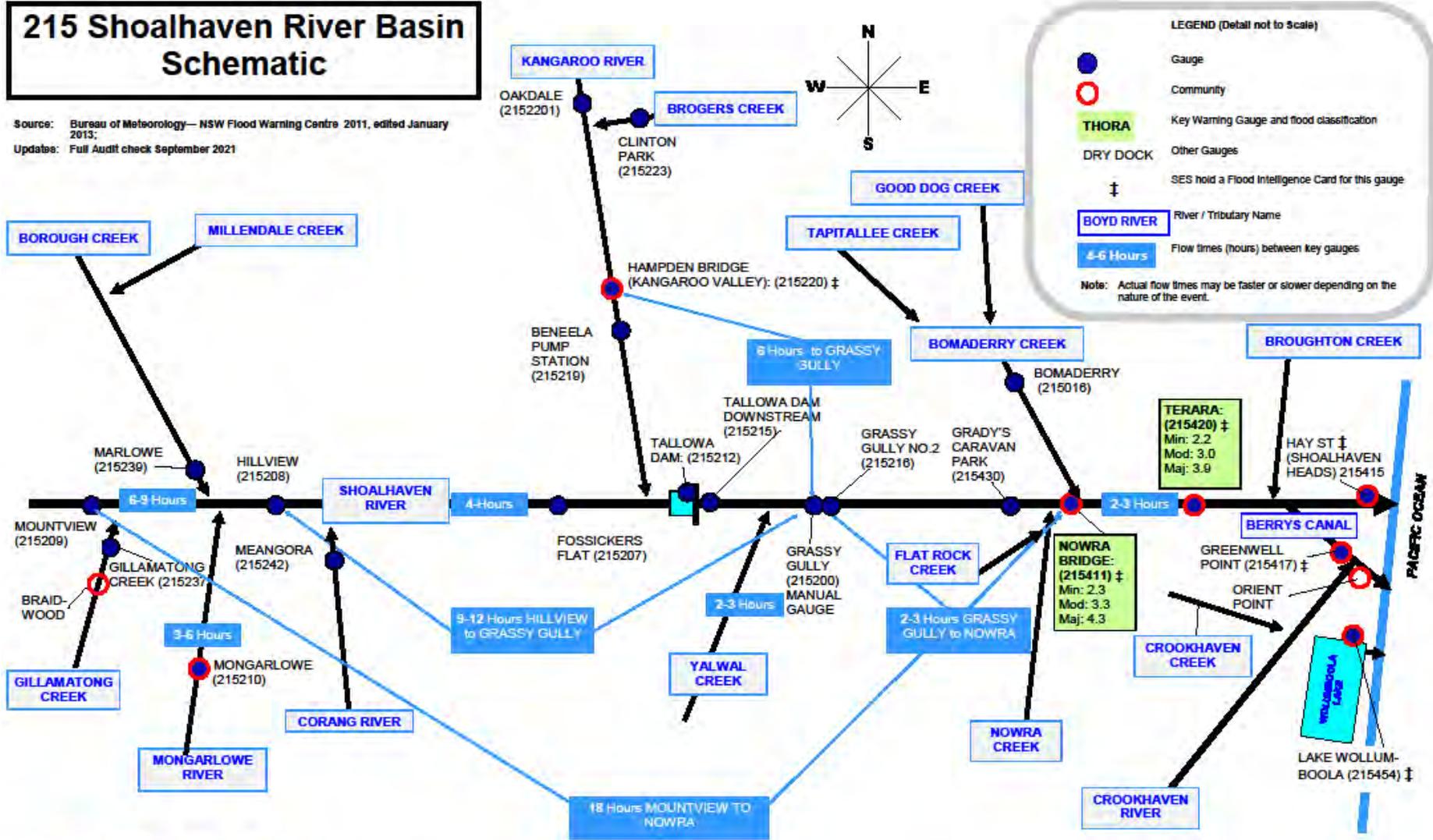
Town / Area (River Basin)	Population/ Dwellings	Flood Affect Classification	Approximate period isolation	Days								NOTES	
				1	2	3	4	5	6	7	8		
North Nowra / Bomaderry	16,098pp 6,956dw	Riverine / Flash	1 day										
Kangaroo Valley	856pp 529dw	High flood Island	2-7 days										Resupply likely to after 5 days
Berry	3,098pp 1,429dw	Rising Road Access	2-3 days										Berry Boys Farm may be isolated up to 3 days
Terara	305pp 191dw	Riverine / Flash	1 day										
Shoalhaven Heads	3,248pp 1,833dw	High Trapped Perimeter	1 day										
Greenwell Point	1,245pp 767dw	High Trapped Perimeter	7-10 days										Resupply likely to be required after 5 days
St Georges Basin	3,215pp 1,654dw	Rising Road Access	3 hours over 1 day										
Sussex Inlet	3,888pp 2,648dw	High Trapped Perimeter	3 hours repeating over 2-3 days										
Culburra Beach	2,946pp 2,262dw	High Trapped Perimeter	5-6 days										
Burrill Lake	1,782pp 980dw	Rising Road Access	3 hours										Low-lying areas may be affected by a combination of factors (including high tides) causing renewed flooding repeating over 3-5 days
Lake Tabourie	689pp 442dw	Rising Road Access	3 hours over 1 Day										

**Note:** Periods of isolation are a guide only. Colours indicate the potential range of days of isolation. Liaison with the Local Controller and communities/residents involved is essential during periods of potential and actual isolation. The table does not reflect the duration of isolation expected in larger and extreme events.

# ANNEX 1A: SHOALHAVEN BASIN SCHEMATIC

## 215 Shoalhaven River Basin Schematic

Source: Bureau of Meteorology— NSW Flood Warning Centre 2011, edited January 2013;  
 Updates: Full Audit check September 2021



**DISCLAIMER**  
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## ANNEX 1B: CLYDE RIVER BASIN / ST GEORGES BASIN SCHEMATIC

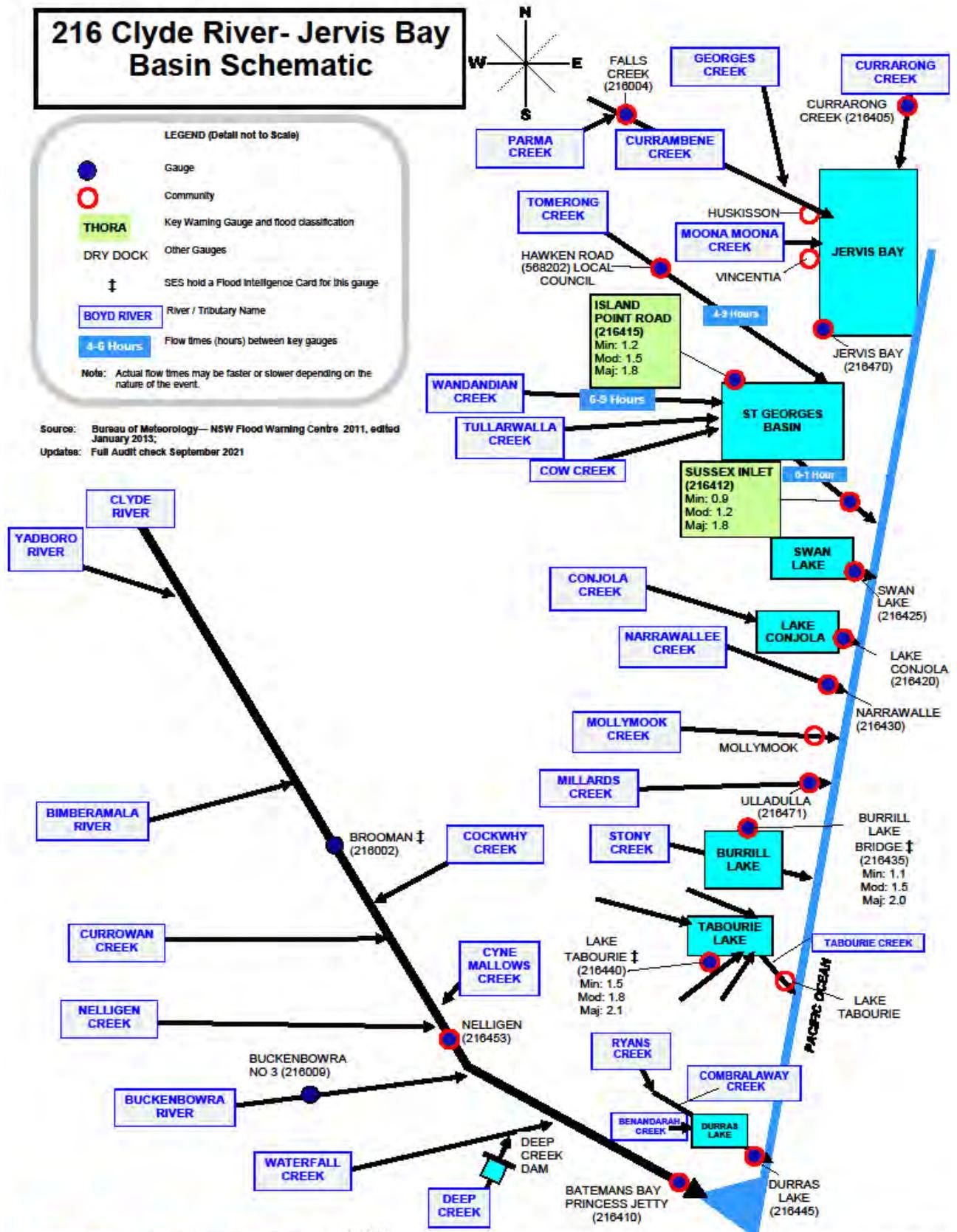
### 216 Clyde River- Jervis Bay Basin Schematic

**LEGEND (Detail not to Scale)**

- Gauge
- Community
- THORA Key Warning Gauge and flood classification
- DRY DOCK Other Gauges
- † SES hold a Flood Intelligence Card for this gauge
- BOYD RIVER River / Tributary Name
- 4-6 Hours Flow times (hours) between key gauges

*Note: Actual flow times may be faster or slower depending on the nature of the event.*

Source: Bureau of Meteorology— NSW Flood Warning Centre 2011, edited January 2013;  
 Updates: Full Audit check September 2021



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## ANNEX 2: FACILITIES AT RISK OF FLOODING AND/OR ISOLATION

### The Shoalhaven River Valley

Facility Name	Street	Suburb	Comment
<b>Schools</b>			
Kangaroo Valley Public School	Moss Vale-Nowra Rd	Kangaroo Valley	The school experiences over floor flooding in the PMF event (25.3m at the Hampden Bridge gauge (215220)), however loses road access in the 2% AEP event (16.6m at the Hampden Bridge gauge (215220)). In the PMF event overland access is available behind the school (38).
Terara Public School	Millbank Rd	Terara	The school will begin to experience flooding from 3.5m at the Terara Gauge (215420), and over floor flooding from 4.2m (50)
Nowra High School	Moss St	Nowra	Within the PMF footprint, not the 1% (51)
St John High School	John Purcell Way	Nowra	Located in the PMF extent for Browns Creek flooding (37).
<b>Child Care Centres</b>			
Berry Community Pre-School	20 Edward Street	Berry	May be affected by flooding in the 20% AEP from Town Creek
Boori Pre-School Aboriginal Corporation	Lot 424 Albatross Road	Nowra	Affected by flooding in the 1% AEP on Nowra Creek (37)
Kangaroo Valley Pre-School	Kangaroo Valley Public School, 140 Moss Vale Road	Kangaroo Valley	The pre-school experiences over floor flooding in the PMF event (25.3m at the Hampden Bridge gauge (215220)), however loses road access in the 2% AEP event (16.6m at the Hampden Bridge gauge (215220)). In the PMF event overland access is available behind the pre-school (38).
Lyrebird Pre-School Kindergarten Nowra East	Lyrebird Pre School, 101 Jervis Street	Nowra	Located in the PMF flood extent for the Shoalhaven River (51)
<b>Facilities for the aged and/or infirm</b>			
Berry Masonic Village	41 Albany Street	Berry	Affected by flooding in the 20% AEP from Broughton Creek (30)
IRT Greenwell Gardens	Brereton Street	Nowra	Affected by flooding in the 5% AEP from the Shoalhaven River
Bupa Residential Care	Pepper Farm drive	Berry	Affected by flooding in the PMF, may be isolated in the 20% (30)
<b>Utilities and infrastructure</b>			

Berry STP	43 Wharf Road	Berry	
Bomaderry STP	52 Railway Street	Bomaderry	
Nowra STP	Terara Road	Terara	
Shoalhaven Heads STP	31 Gerroa Road	Shoalhaven Heads	
Berry Telephone Exchange	18 Albert Street	Berry	
Kangaroo Valley Telephone Exchange	139 Moss Vale Road	Kangaroo Valley	
Shoalhaven Heads Telephone Exchange	10 Renown Avenue	Shoalhaven Heads	
<b>Camping Ground / Caravan Parks</b>			
Anglers Rest	Adelaide Street	Greenwell Point	Vulnerable in the 10% AEP (2.0m Greenwell Point Gauge (215417)) (3)
Bendeela Camping and Picnic Ground	Jacks Corner Road	Kangaroo Valley	Becomes isolated in the PMF event (25.3m at the Hampdon Bridge gauge (215220)). Unknown when facility becomes inundated (38).
Berry Showground	Alexander Street	Berry	Affected by flooding in the PMF (57)
Bilberry on Edwards	Edwards Avenue	Bomaderry	Affected by 1% + 1/2m (57)
Burrawong Park	32 Shoalhaven Heads Rd	Shoalhaven Heads	Affected by 1% + 1/2m (57)
Camellia Caravan Park	108 Jerry Bailey Rd	Shoalhaven Heads	Vulnerable in the 10% AEP (3)
Coastal Palms Holiday Park	Shoalhaven Heads Rd	Shoalhaven Heads	Affected by 1% + 1/2m (57)
Coolendel Bush Camping & Nature Reserve	Grassy Gully Rd	Buangla	Flood impacts are unknown – located on the Shoalhaven River (57)
Coral Tree Lodge	Greens Road	Greenwell Point	Vulnerable in the 10% AEP (2.0m Greenwell Point Gauge (215417)) (3)
Grady's Riverside Retreat	Burrier Rd	Burrier	Flood impacts are unknown – located on the Shoalhaven River (57)
Jans Riverside Caravan Park	32 Hay Av	Shoalhaven Heads	Vulnerable in the 10% AEP (3)
Kangaroo Valley Holiday Park	Moss Vale Road	Kangaroo Valley	Caravan park begins to experience inundation of grounds in the 10 % AEP event (13.3m at the Hampden Bridge gauge (215220)) (38)
Mountain View Caravan Village	Shoalhaven Heads Rd	Shoalhaven Heads	Vulnerable in the 10% AEP (3)
Nowra Gateway Caravan Park	Pleasant Way	Nowra	Affected by 1% + 1/2m (57)
Pine Park Tourist G. Marina	West Street	Greenwell Point	Vulnerable in the 10% AEP (2.0m Greenwell Point Gauge (215417)) (3)

Shoalhaven Caravan Village	Terara Rd	Terara	Affected by 1% + 1/2m (57)
Shoalhaven Ski Park	Rock Hill Rd	North Nowra	Vulnerable in the 10% AEP (3)
Shoalhaven Heads Holiday Park	McIntosh	Shoalhaven Heads	Vulnerable in the 10% AEP (3)
Shoalhaven Zoo	Rock Hill Rd	North Nowra	Affected by 1% + 1/2m (57)
Tall Timbers Caravan Park	Shoalhaven Heads Rd	Shoalhaven Heads	Vulnerable in the 10% AEP (3)
<b>Emergency Services</b>			
Police Station	Moss Vale Road	Kangaroo Valley	Becomes inundated in the PMF event (25.3m at the Hampden Bridge gauge (215220)) (38)
NSW Ambulance	Broughton Street	Kangaroo Valley	Becomes isolated in the 10% AEP event (13.3m at Hampden Bridge gauge (215220)). Becomes inundated in the 2% AEP event (16.6m at the Hampden Bridge gauge (215220)) (38)
NSW RFS – Kangaroo Valley	Broughton Street	Kangaroo Valley	Becomes isolated in the 10% AEP event (13.3m at Hampden Bridge gauge (215220)). Becomes inundated in the 1% AEP event (17.5m at the Hampden Bridge gauge (215220)) (38)
NSW RFS - Wandandian	Princes Highway	Wandandian	May be affected by flooding in the PMF (2013 study)

## Clyde River Basin

Facility Name	Street	Suburb	Comment
<b>Child Care Centres</b>			
Tabourie Child Care Centre	20 River Road	Lake Tabourie	Overground flooding occurs at 2.4m at the Lake Tabourie Gauge (216440) with over floor flooding occurring at 4.2m (PMF) (41)
Tasman Park Children's Centre	9 Park Rd	St Georges Basin	Affected by flooding in the PMF from St Georges Basin (39)
<b>Facilities for the aged and/or infirm</b>			
Inasmuch Retirement Village	Sussex Road	Sussex Inlet	The facility is affected in the 1% AEP flood event (potentially earlier) (24)
<b>Utilities and infrastructure</b>			
Burrill Lake Sewer Pumps		Burrill Lake	Station B2 could be impacted at 1.5m at the Burrill Lake Gauge (216435) (55) Stations B3, B5, B6 and B7 could be impacted at 2.0m at the Burrill Lake Gauge (216435) (55)
Kings Point Sewer Pump		Kings Point	Pump could be affected at 1.96-2.01m at the Burrill Lake Gauge (216435) (55)
Vincentia and Huskisson Sewer Pumps		Vincentia and Huskisson	Pumping stations are situated on the floodplain on Currambene and Moona Moona Creeks – They are above the 1% but are flooded in the PMF (34)
			There are 19 sewage pumping stations within the St Georges Basin floodplain which are generally flood affected in 10% AEP floods (13).
			Telephone, electricity, and water supply should only experience minor (if any) flood damages (13).
Sanctuary Point Telephone Exchange	30 Sanctuary Point Road	Sanctuary Point	
<b>Camping Ground / Caravan Parks</b>			
Alamein Caravan Pk	Alamein Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Aloha Caravan Park	Island Point Road	St Georges Basin	Affected by 1% + 1/2m (57)

Badgee Caravan Park	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Bundilla Caravan Park		Durras North	Approx. 105 cabins/caravans plus unknown camping capacity, Flood impacts are unknown
Big 4 Bungalow Pk on Burrill Lake	Princes Highway	Burrill Lake	Begins to be affected by floodwaters at 1.2m at the Burrill Lake Gauge (216435) (55)
Burrill Lake Holiday Park	Princess Avenue	Burrill Lake	Affected by flooding from 1.5m at the Burrill Lake Gauge (216435) (55)
Cedar Pines Caravan Park	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Currarong Beachside Holiday Park	Nowra Road	Currarong	Located adjacent to Currarong Creek so may experience overland/flash flooding from the creek
Dolphin Point Tourist Park	Dolphin Point Road	Dolphin Point	Affected by flooding at 1.8m at the Burrill Lake Gauge (216435) (55)
Durras Beach North Tourist Park		Durras North	Lakeside - Camping only – unknown capacity. Flood impacts are unknown
Durras Lake North Holiday Park		Durras North	79 vans, 8 cabins, 20 camping. Flood impacts are unknown
Gateway Lifestyle Myola	Myola Road	Myola	Affected by PMF (57)
Hidden Creek	Goodland Road	Woollamia	Affected by 1% + 1/2m (57)
Joalah Holiday Park		Durras North	Approx. 100 caravan/cabins plus unknown camping capacity. Flood impacts are unknown
Ingenia Holidays Lake Conjola	Norman Street	Lake Conjola	Affected by 1% + 1/2m (57)
Inlet Anchorage Caravan Park	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Jervis Bay Caravan Park	Woollamia Road	Woollamia	Frequently flooded (34)
Kalua Caravan Park	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Laguna Lodge	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Lake Conjola Deepwater Resort	Garrad Way	Lake Conjola	Affected by 1% + 1/2m (57)
Lake Conjola Entrance Holiday Park	Lake Conjola Entrance Road	Lake Conjola	Affected by 1% + 1/2m (57)
Lake Conjola Waterfront Holiday Park	Lake Conjola Entrance Road	Lake Conjola	Affected by 1% + 1/2m (57)
Lake Tabourie Holiday Park	Princes Highway	Lake Tabourie	Access is lost at 2.0m at the Lake Tabourie Gauge (216400) with grounds experiencing inundation (41).
Paperbark Camp 'glamping' resort	Woollamia Road	Woollamia	Flooded and isolated in a 10% AEP event (34)
Racecourse Beach Tourist Park		Bawley Point	Unknown capacity – estimated over 360 sites. Flood impacts are unknown

Riverside Caravan Park	Sussex Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Riviera Caravan Park	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Seabreeze Man. Home Village	Camden Street	Ulladulla	Flood impacts are unknown (57)
Seacrest Caravan Park	Sussex Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Shallow Crossing Camping Ground	The River Road	Mogood	Access from the east requires crossing a ford, which can be affected by king tides/high rainfall. Shallow Crossing is accessed from the Princes Highway at East Lynne or from the Kings Highway at Nelligen. Both involves travel along dirt roads.
Siesta Van Park	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Sussex House Caravan Park and Holiday Cottages	Jacobs Drive	Sussex Inlet	Affected by 1% + 1/2m (57)
Sussex Palms Holiday Park	Sussex Road	Sussex Inlet	Affected by 1% + 1/2m (57)
Talofa Caravan Park	River Road	Sussex Inlet	Affected by 1% + 1/2m (57)
<b>Emergency Services</b>			
Marine Rescue Sussex Inlet	Sussex Road	Sussex Inlet	Affected in the 1% AEP (potentially much earlier) (24)
Sussex Inlet Police Station	Banksia Street	Sussex Inlet	Affected in the 1% AEP (potentially much earlier) (24)

# MAP 1 - THE SHOALHAVEN RIVER BASIN

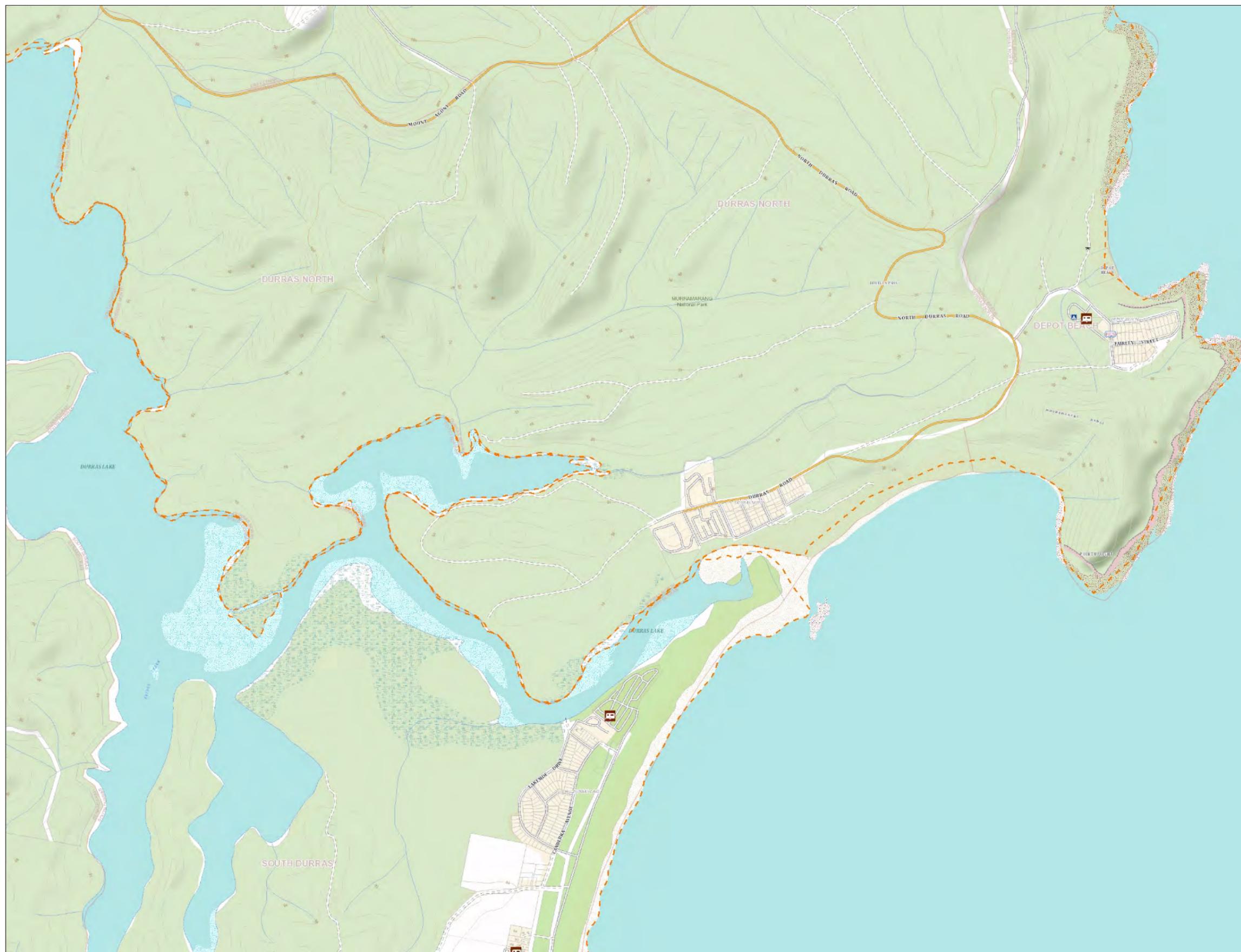


## MAP 2 - CLYDE RIVER-JERVIS BAY RIVER BASIN

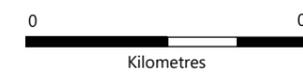


Legend

-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
-  Aged Care Facilities
-  Caravan Park / Camping
-  Airports
-  Rail Stations
-  Evacuation Centres
-  Road Closure Points
-  SES Headquarters
-  SES Units
-  Gauges (BOM Forecast)
-  Declared Dams
-  Levees
-  1% AEP
-  Probable Maximum Flood



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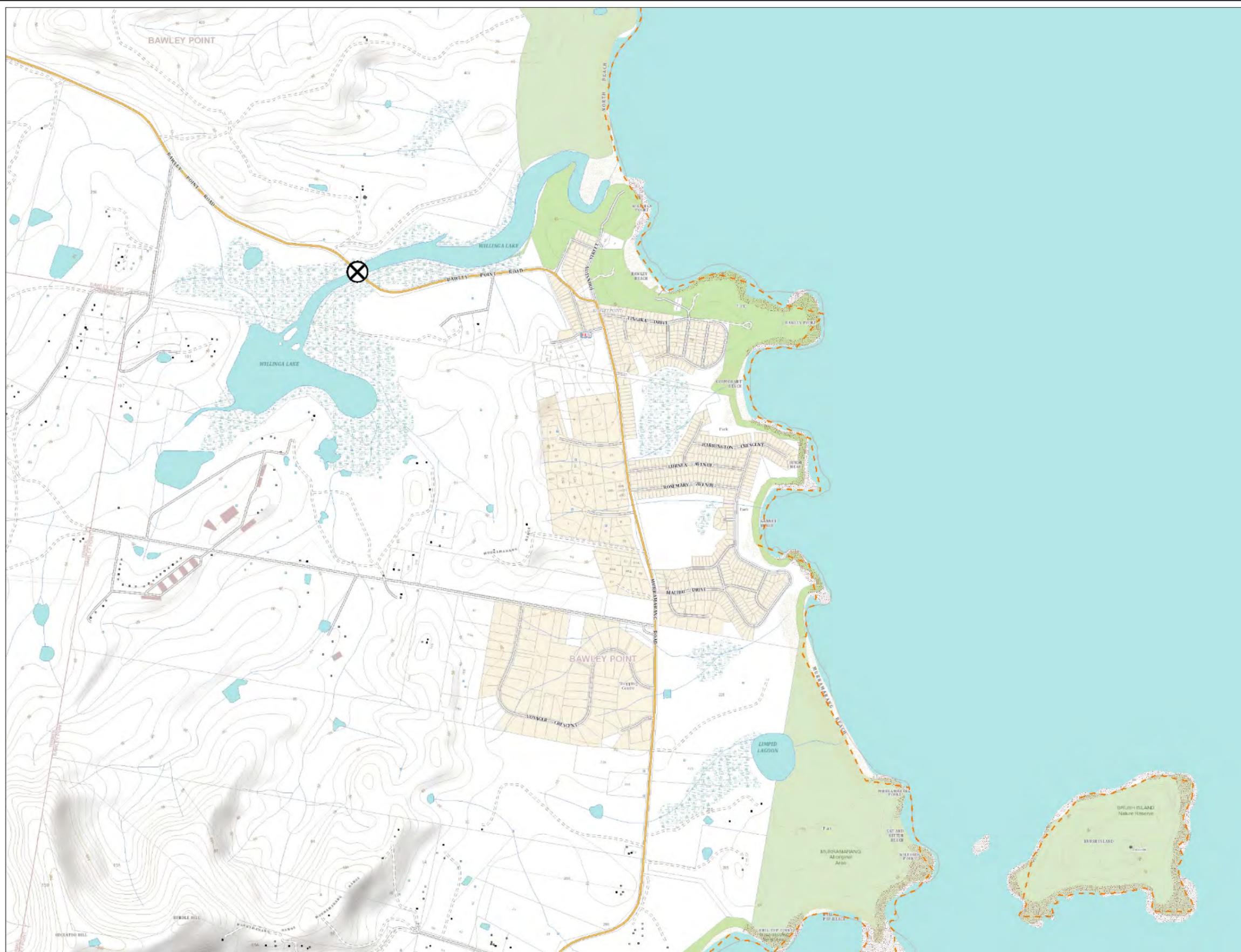


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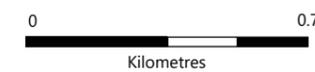
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Legend

-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
-  Aged Care Facilities
-  Caravan Park / Camping
-  Airports
-  Rail Stations
-  Evacuation Centres
-  Road Closure Points
-  SES Headquarters
-  SES Units
-  Gauges (BOM Forecast)
-  Declared Dams
-  Levees
-  1% AEP
-  Probable Maximum Flood



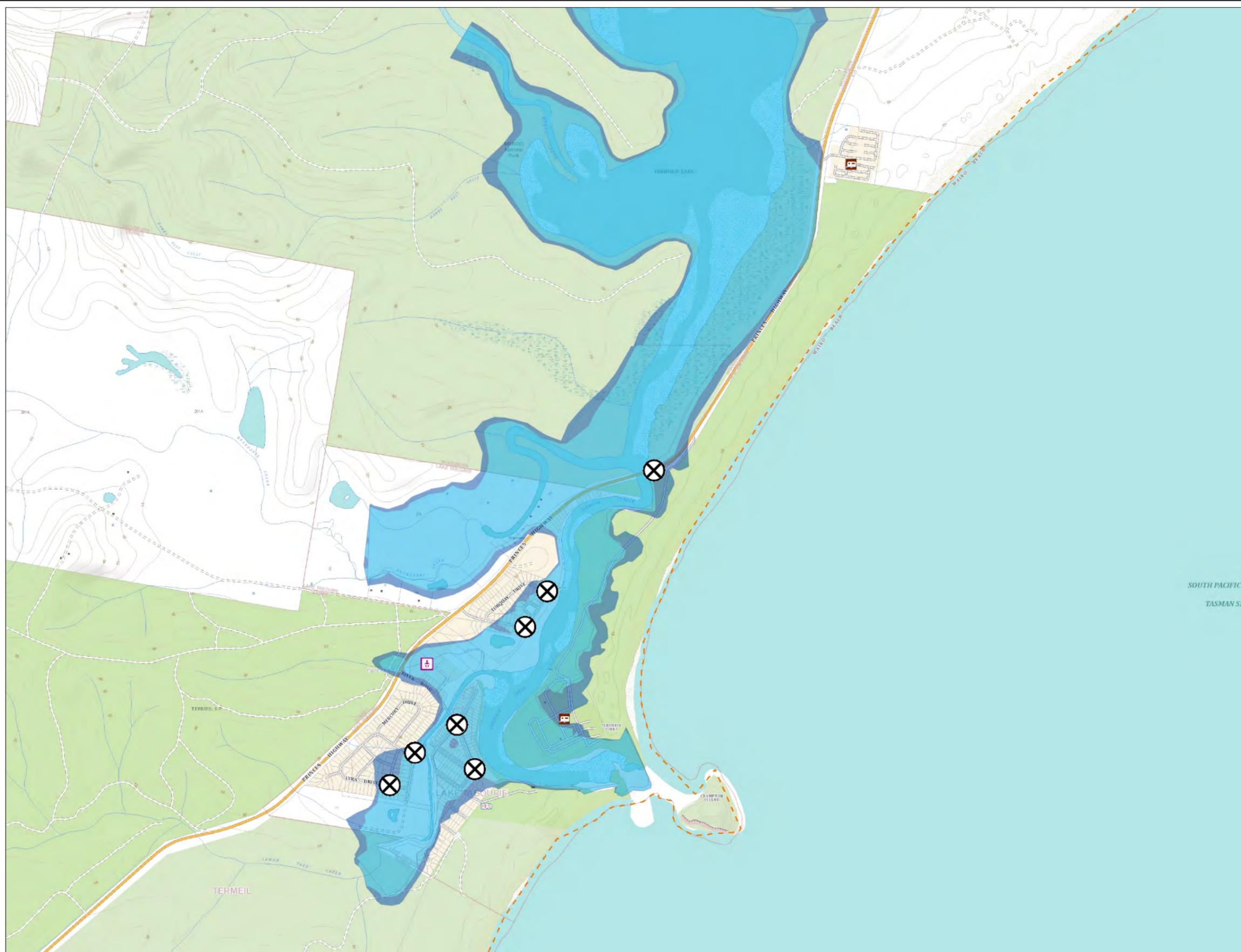
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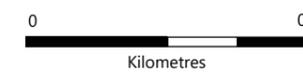
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Legend

-  Educational Facilities
-  Child Care Facilities
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-  Aged Care Facilities
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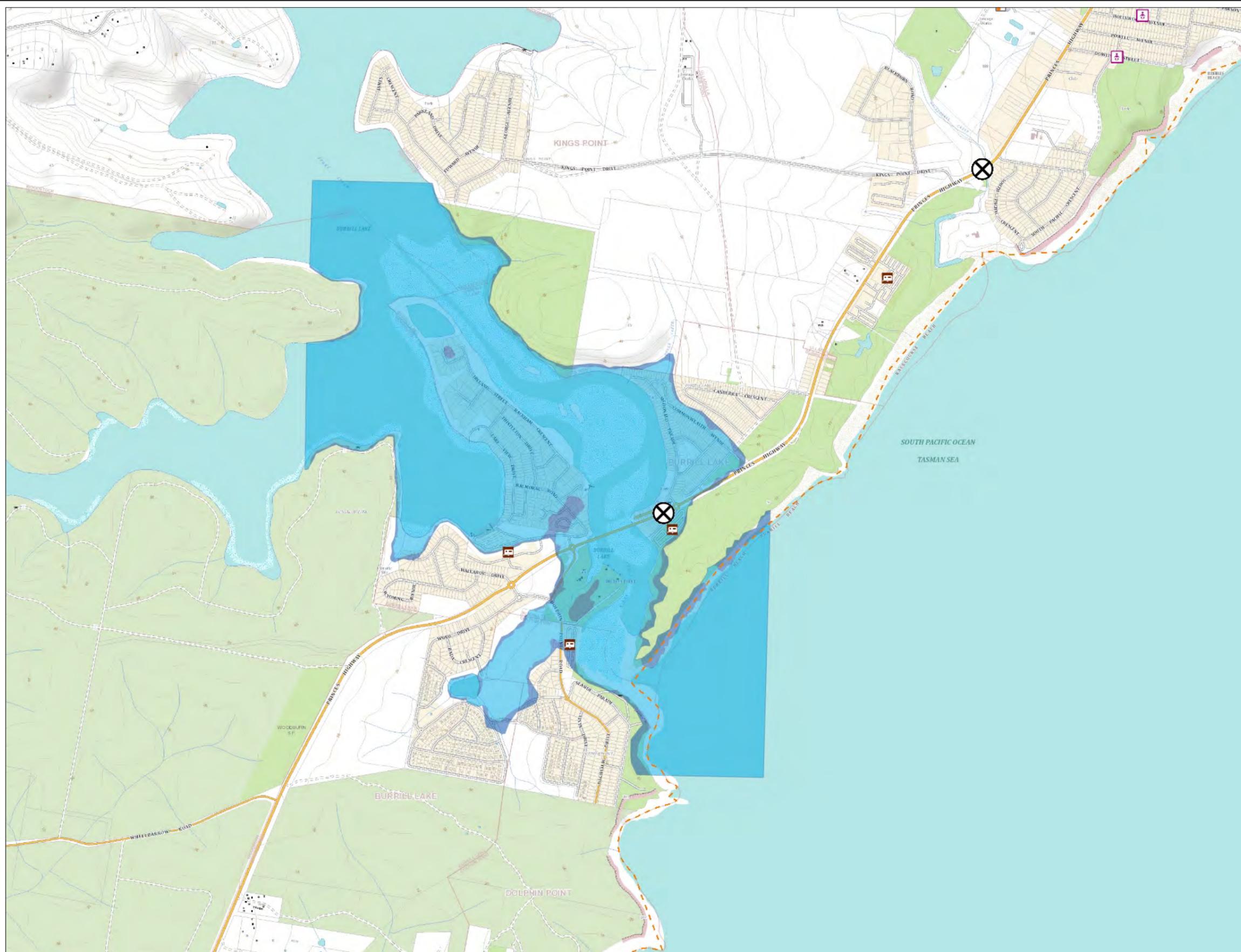


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Legend

-  Educational Facilities
-  Child Care Facilities
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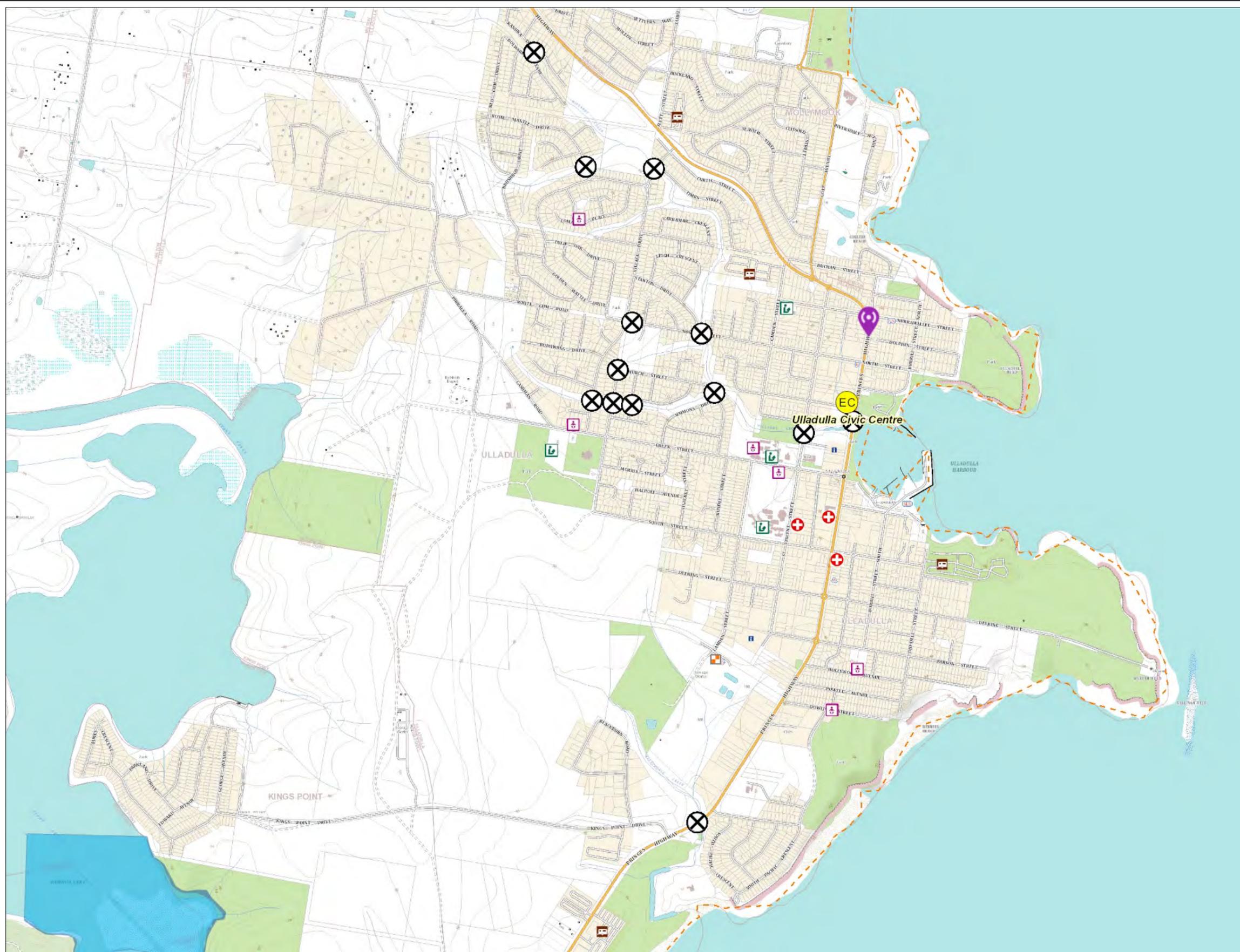


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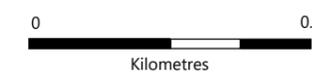
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Legend

-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
-  Aged Care Facilities
-  Caravan Park / Camping
-  Airports
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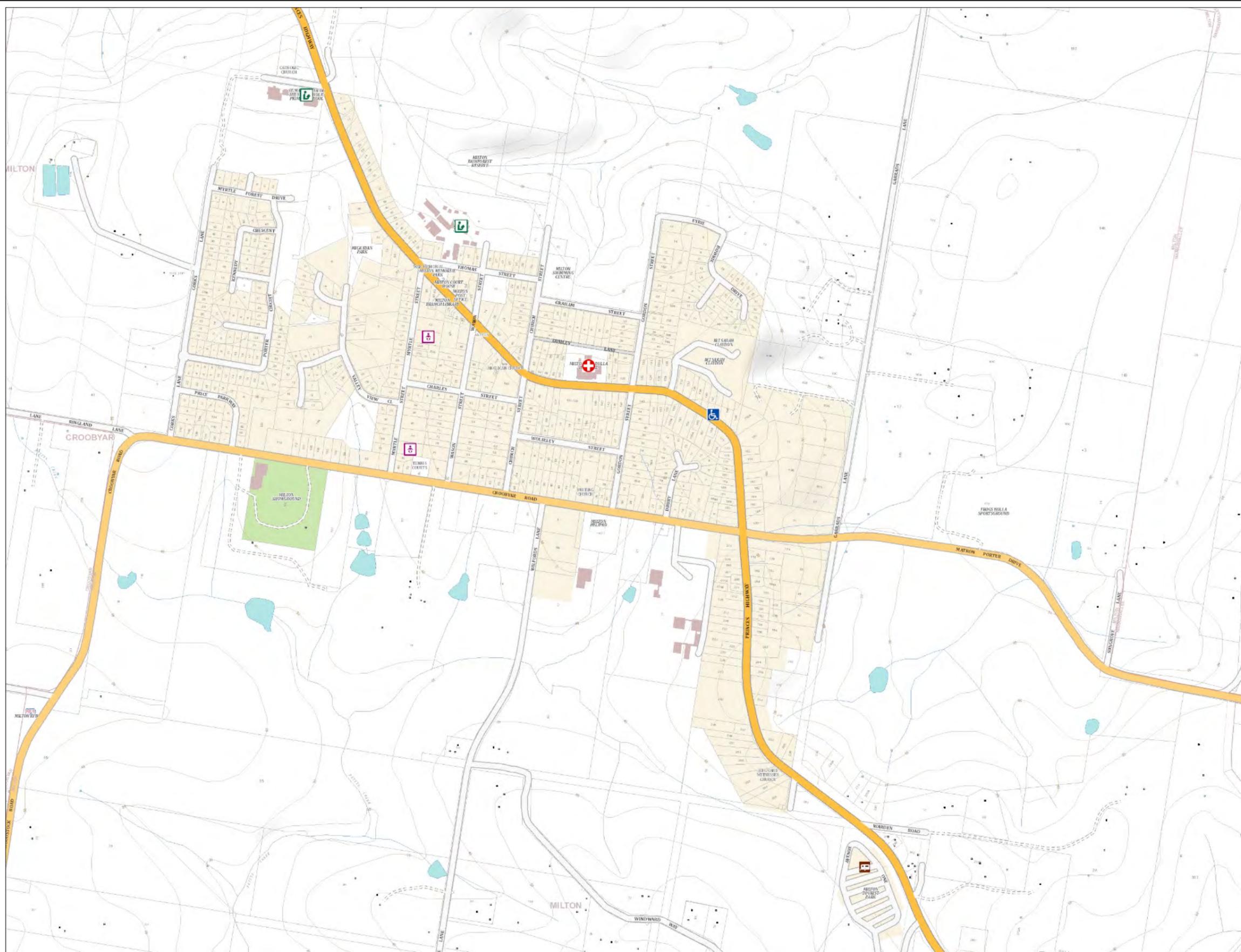


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Legend

-  Educational Facilities
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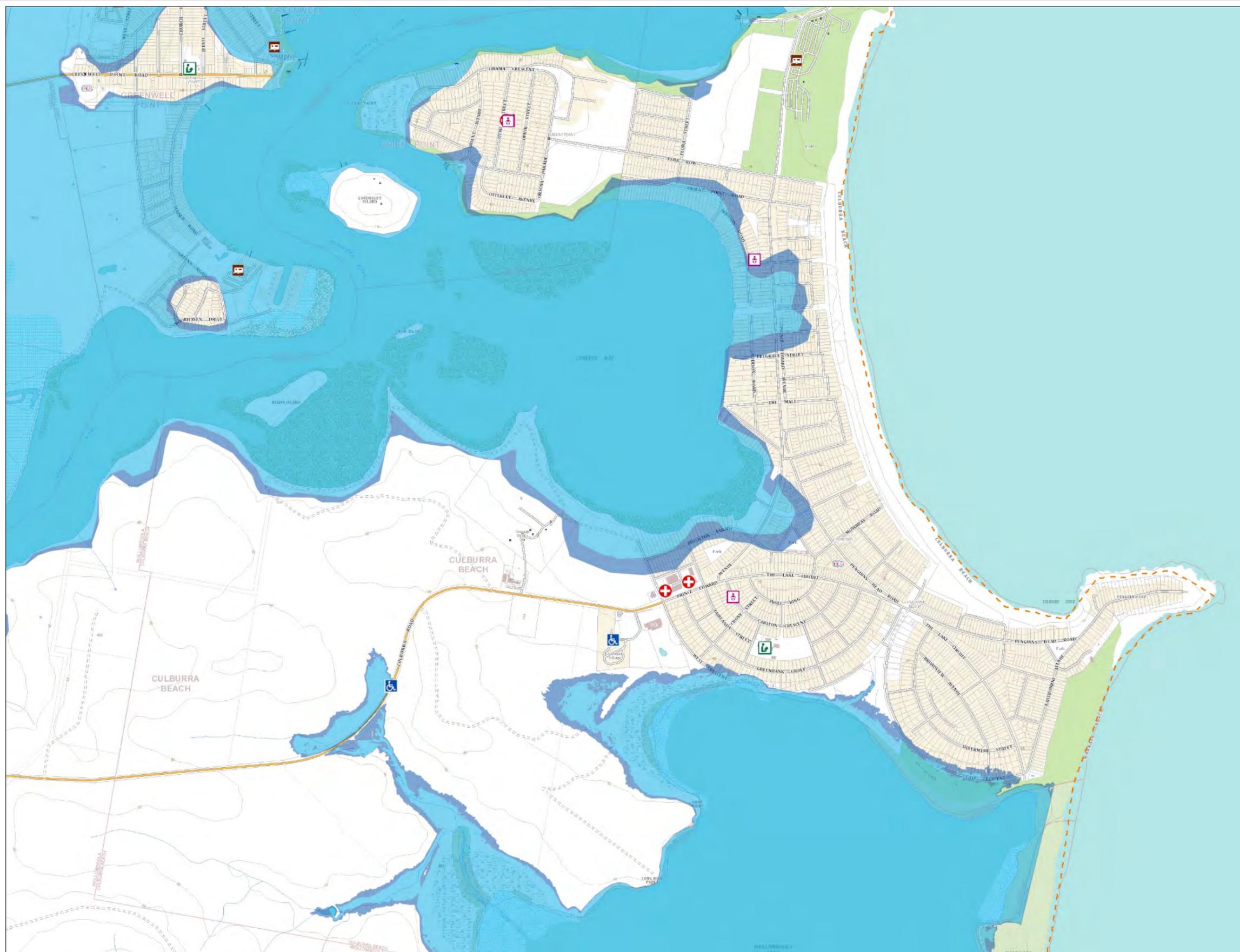


### Map 17 Culburra Beach Town Map

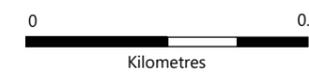
Shoalhaven LGA Local Flood Emergency Sub Plan

#### Legend

-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
-  Aged Care Facilities
-  Caravan Park / Camping
-  Airports
-  Rail Stations
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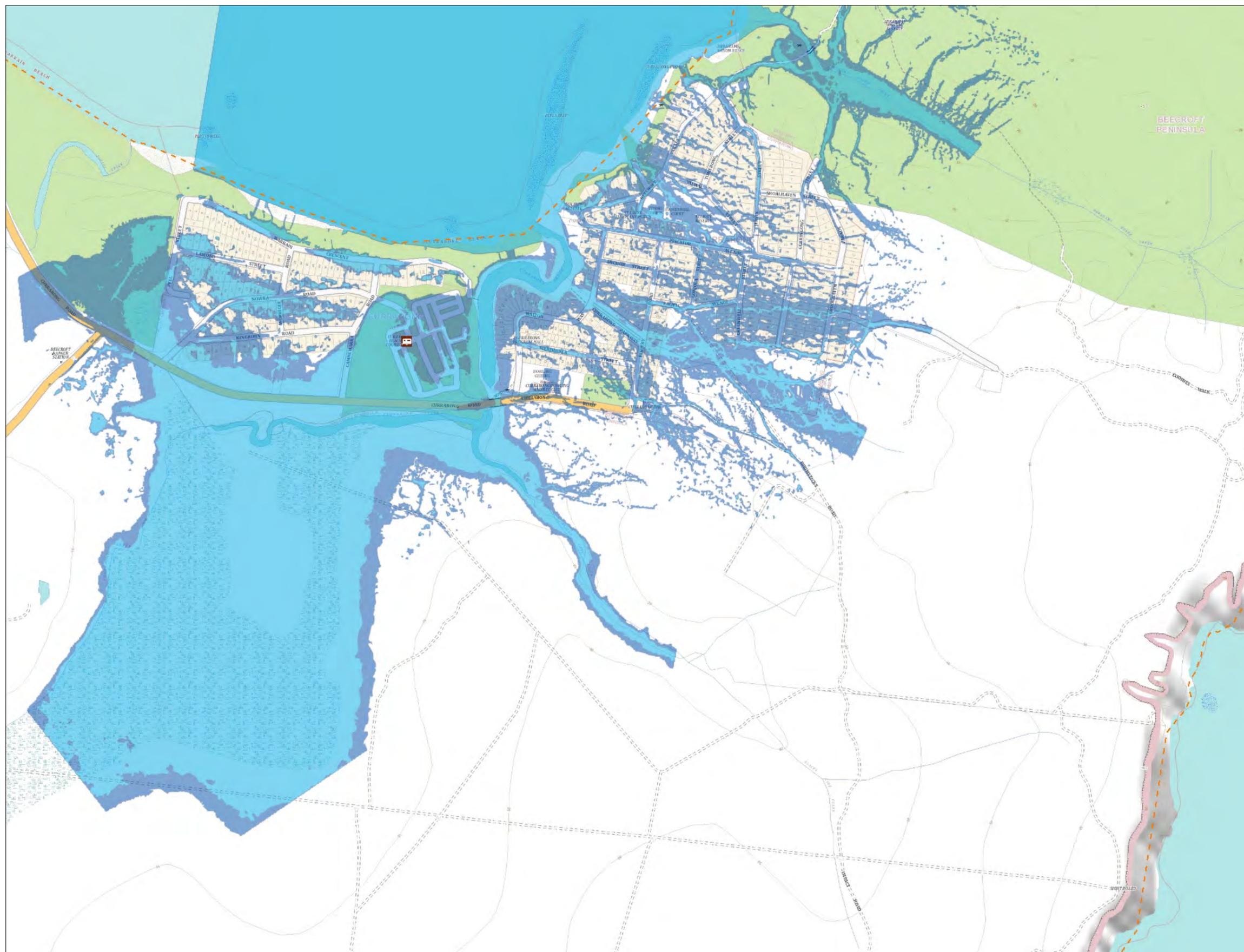


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Legend

-  Educational Facilities
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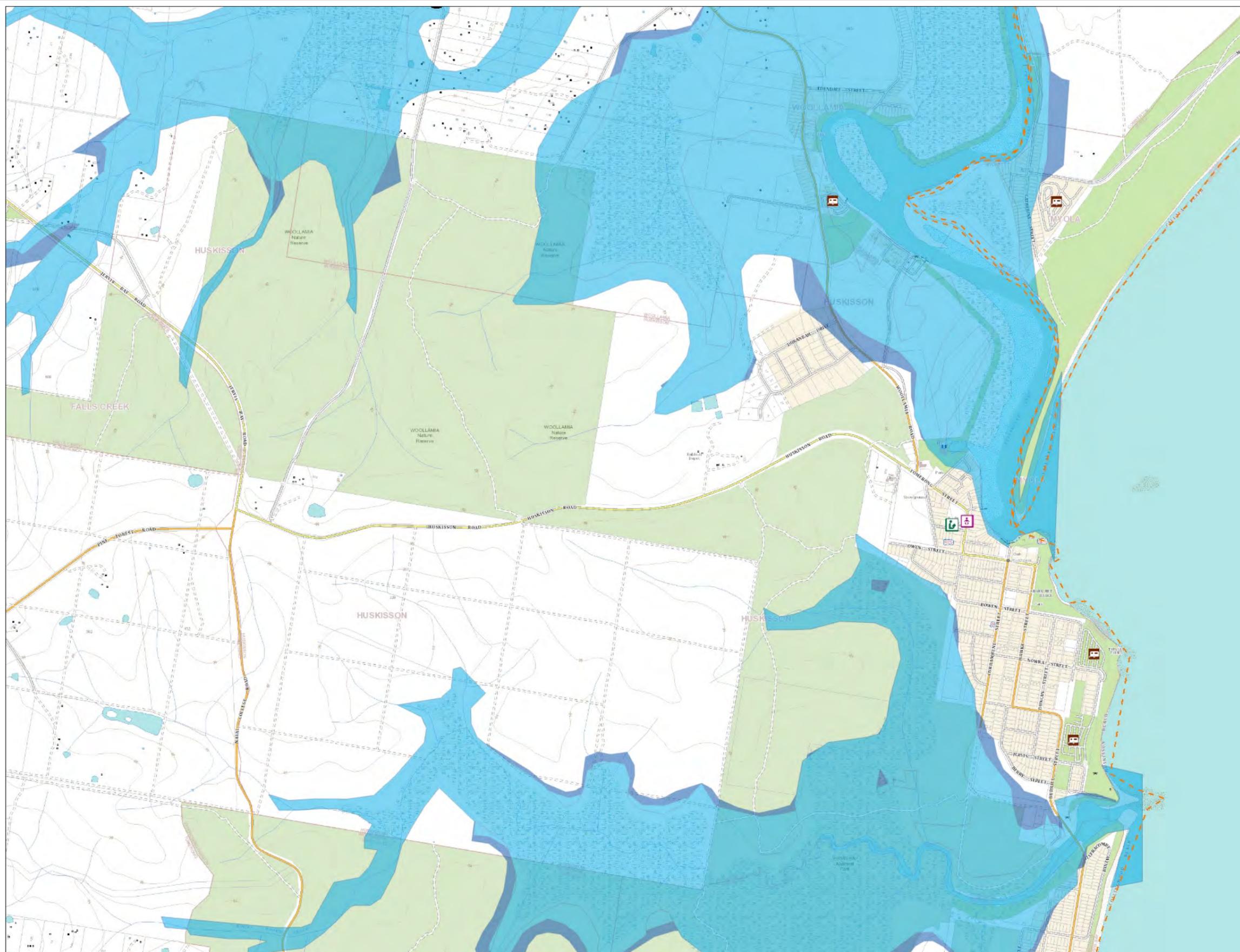
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### Map 15 Huskisson and Wollamia Town Maps

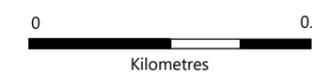
Shoalhaven LGA Local Flood Emergency Sub Plan

#### Legend

-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
-  Aged Care Facilities
-  Caravan Park / Camping
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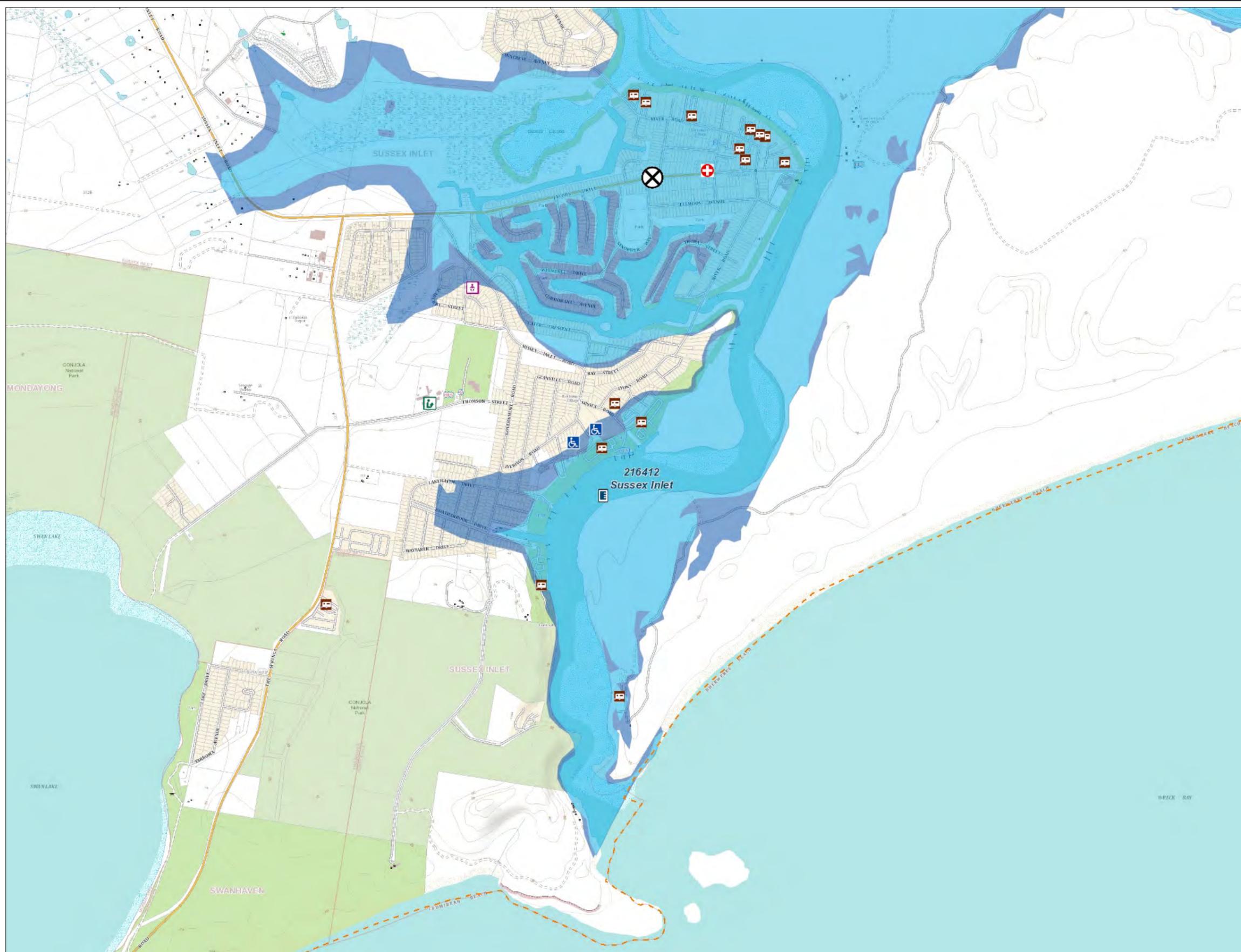


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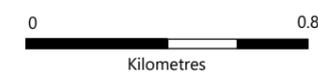
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Legend

-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
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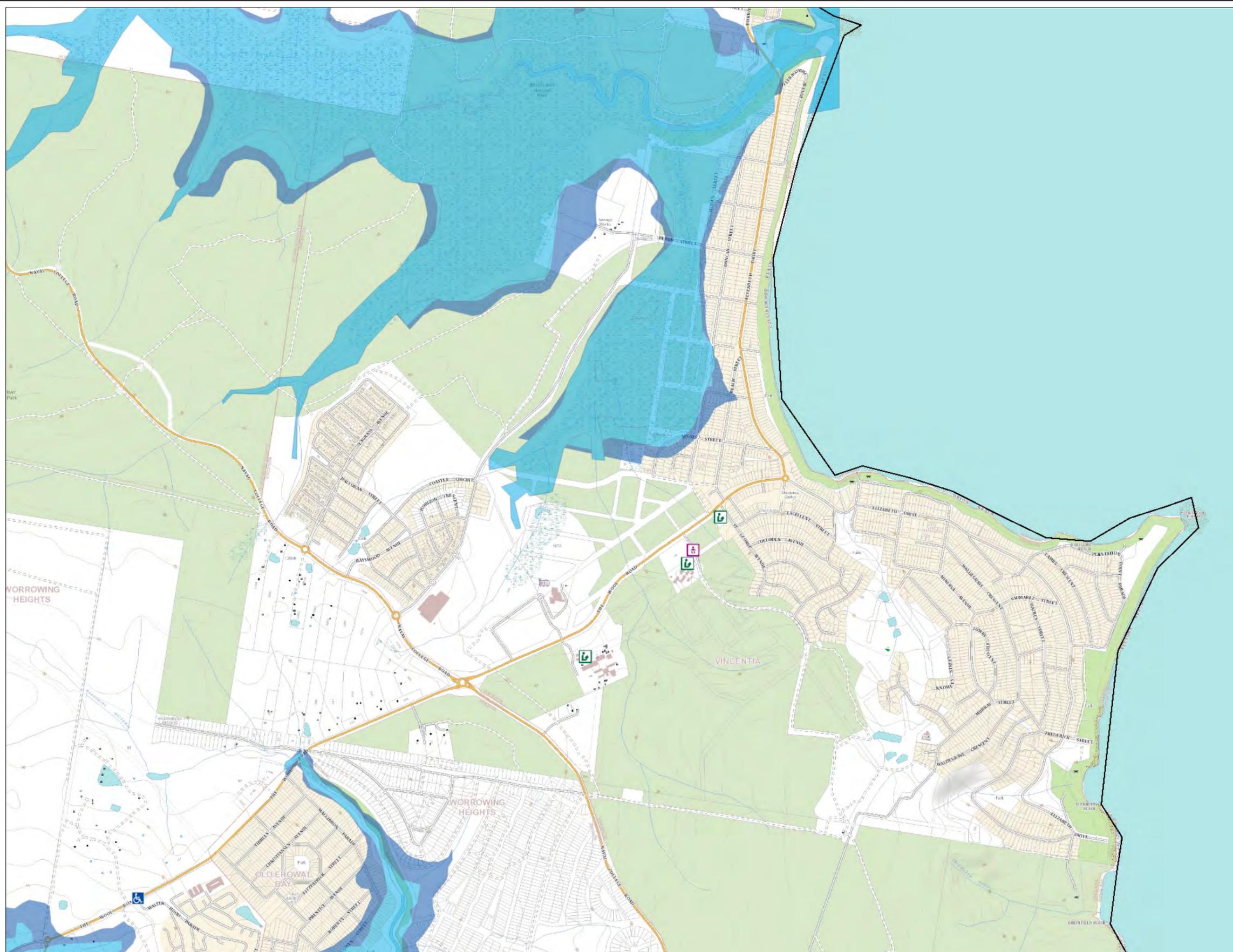


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Legend

-  Educational Facilities
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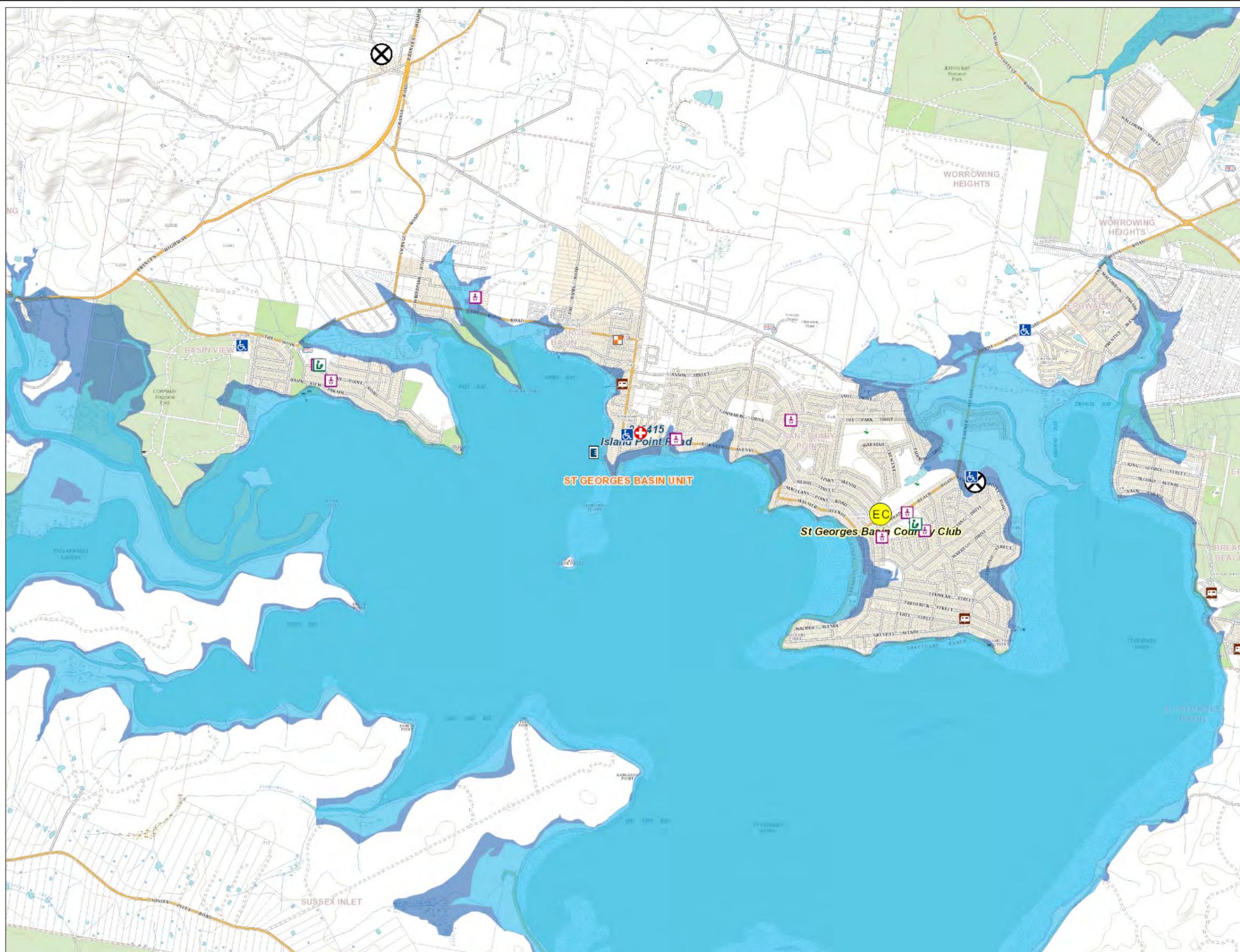


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Legend

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-  Aged Care Facilities
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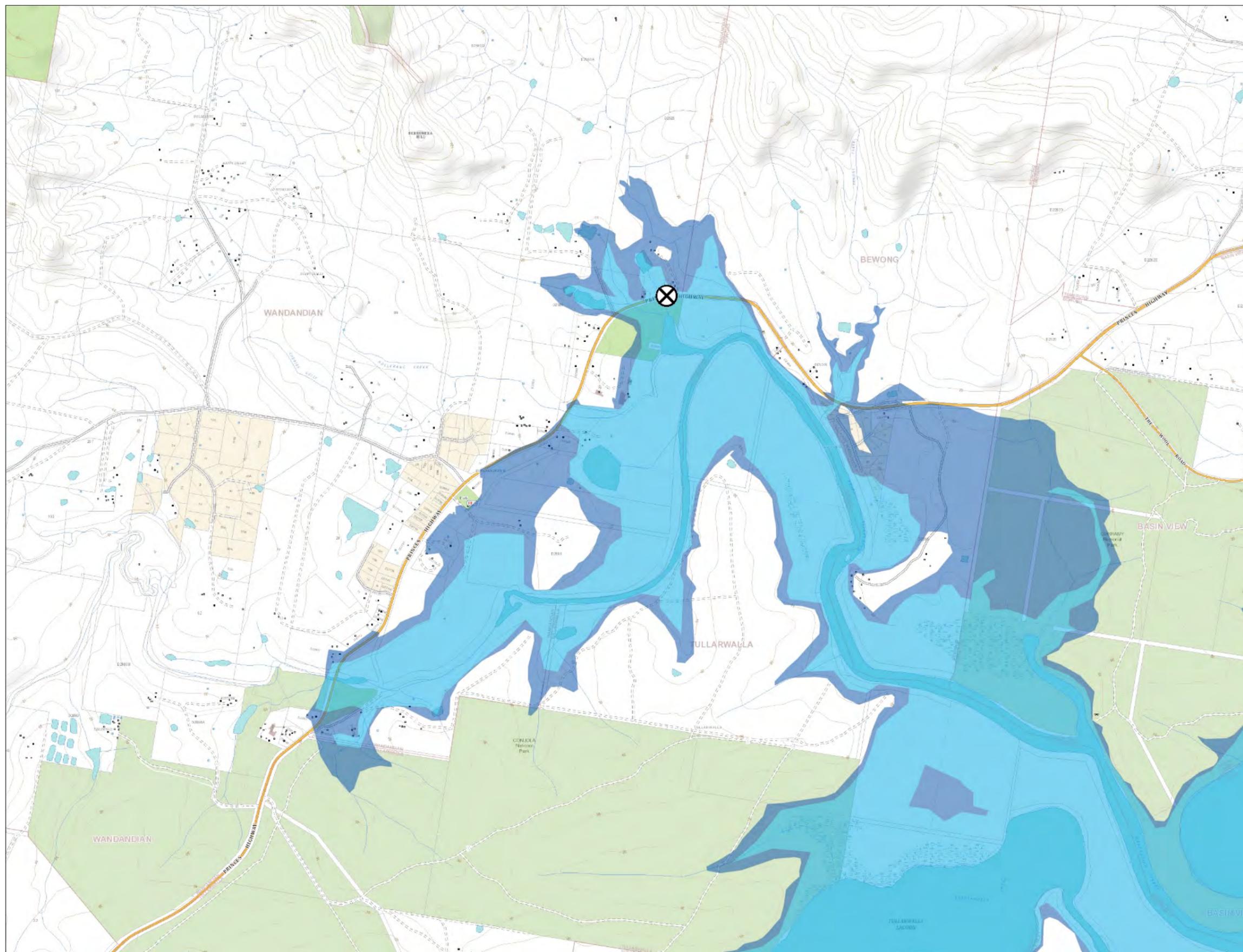
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### Map 11 Wandandian and Bewong Town Map

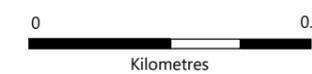
Shoalhaven LGA Local Flood Emergency Sub Plan

#### Legend

-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
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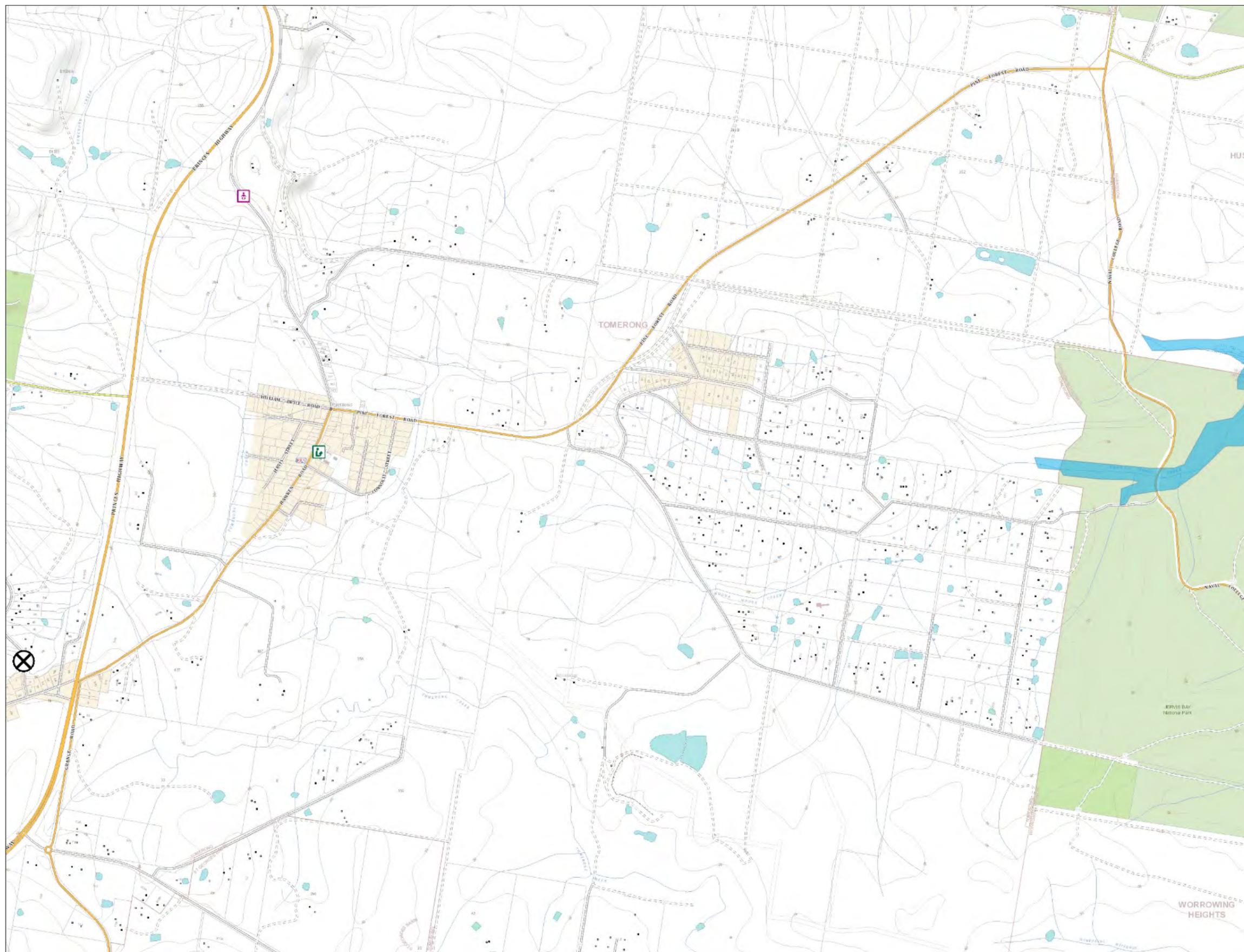


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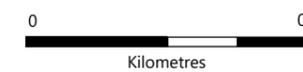
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Legend

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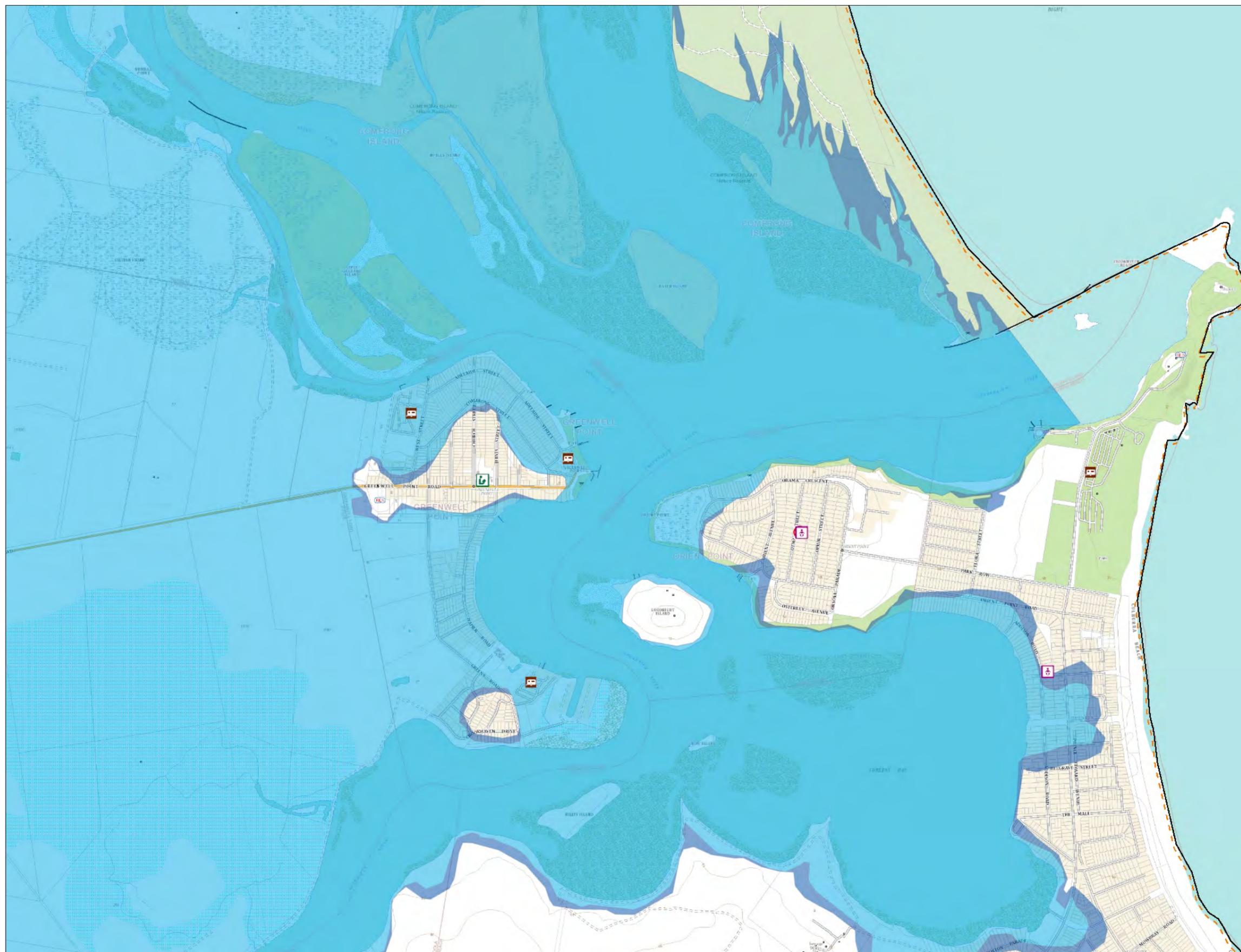
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### Map 9 Greenwell Point Town Map

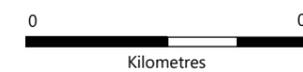
Shoalhaven LGA Local Flood Emergency Sub Plan

#### Legend

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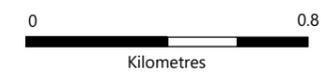
Map 8 Shoalhaven Heads Town Map

Shoalhaven LGA Local Flood Emergency Sub Plan

Legend

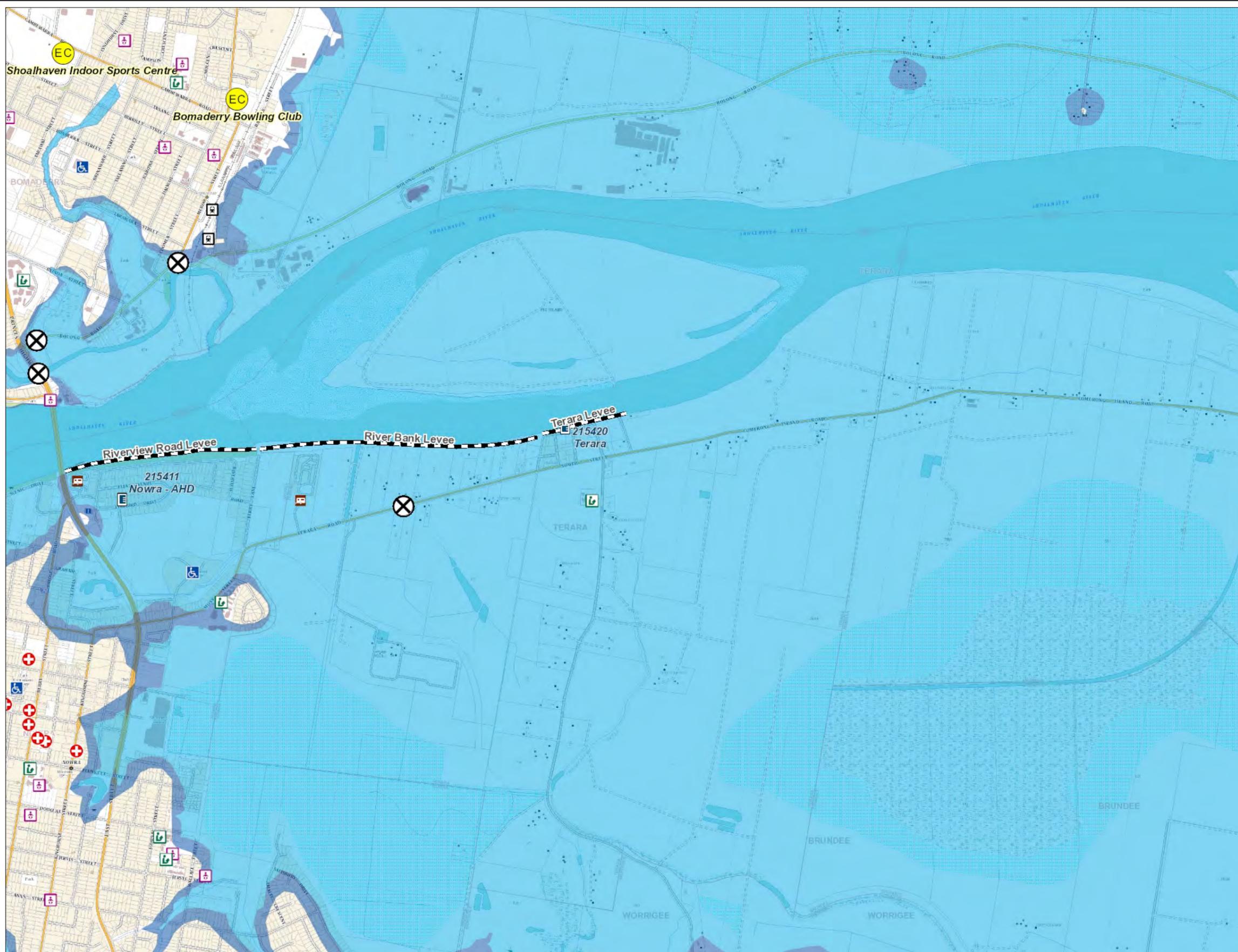
- Educational Facilities
- Child Care Facilities
- Health Care Facilities
- Aged Care Facilities
- Caravan Park / Camping
- Airports
- Rail Stations
- Evacuation Centres
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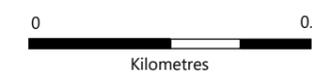
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Legend

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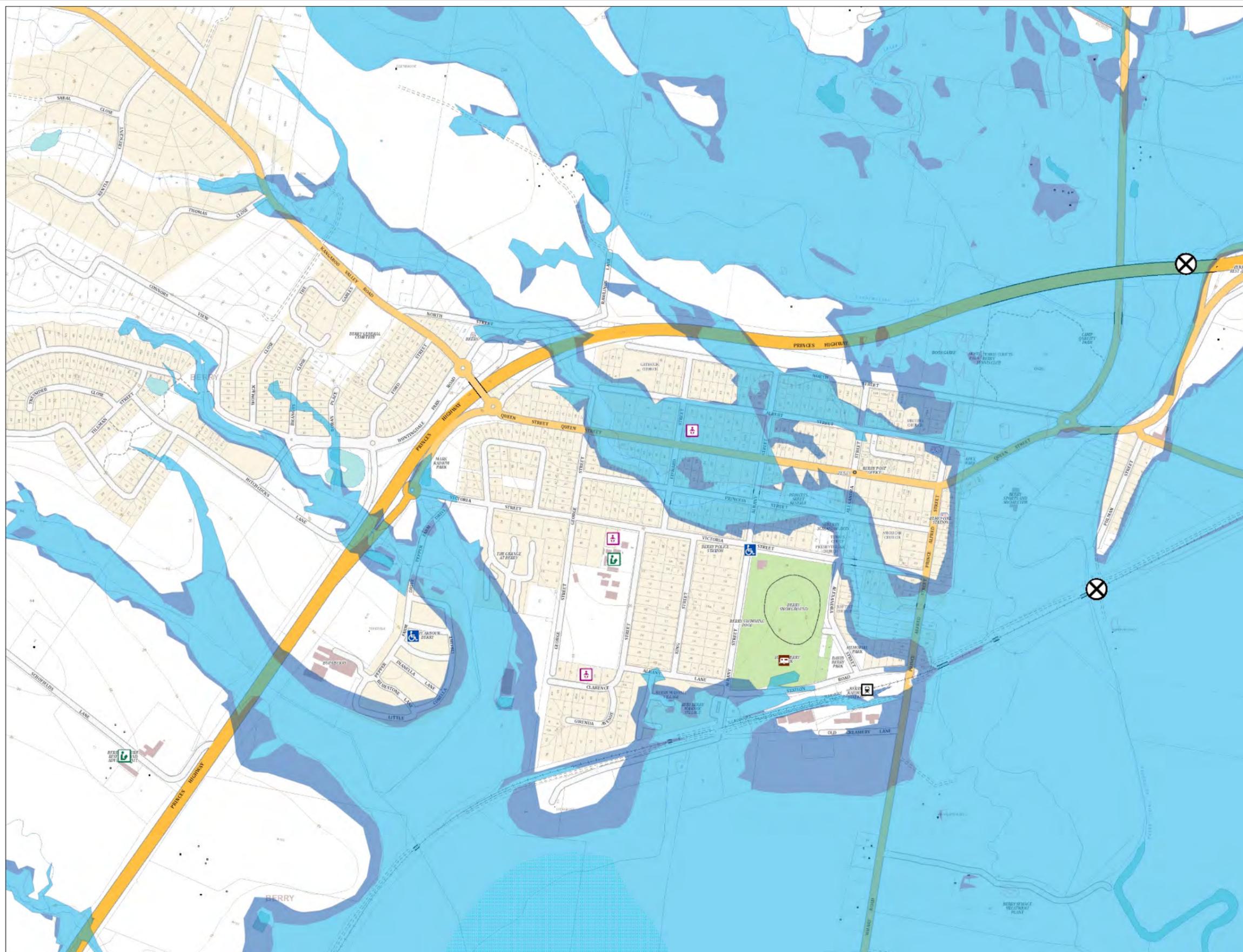
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Legend

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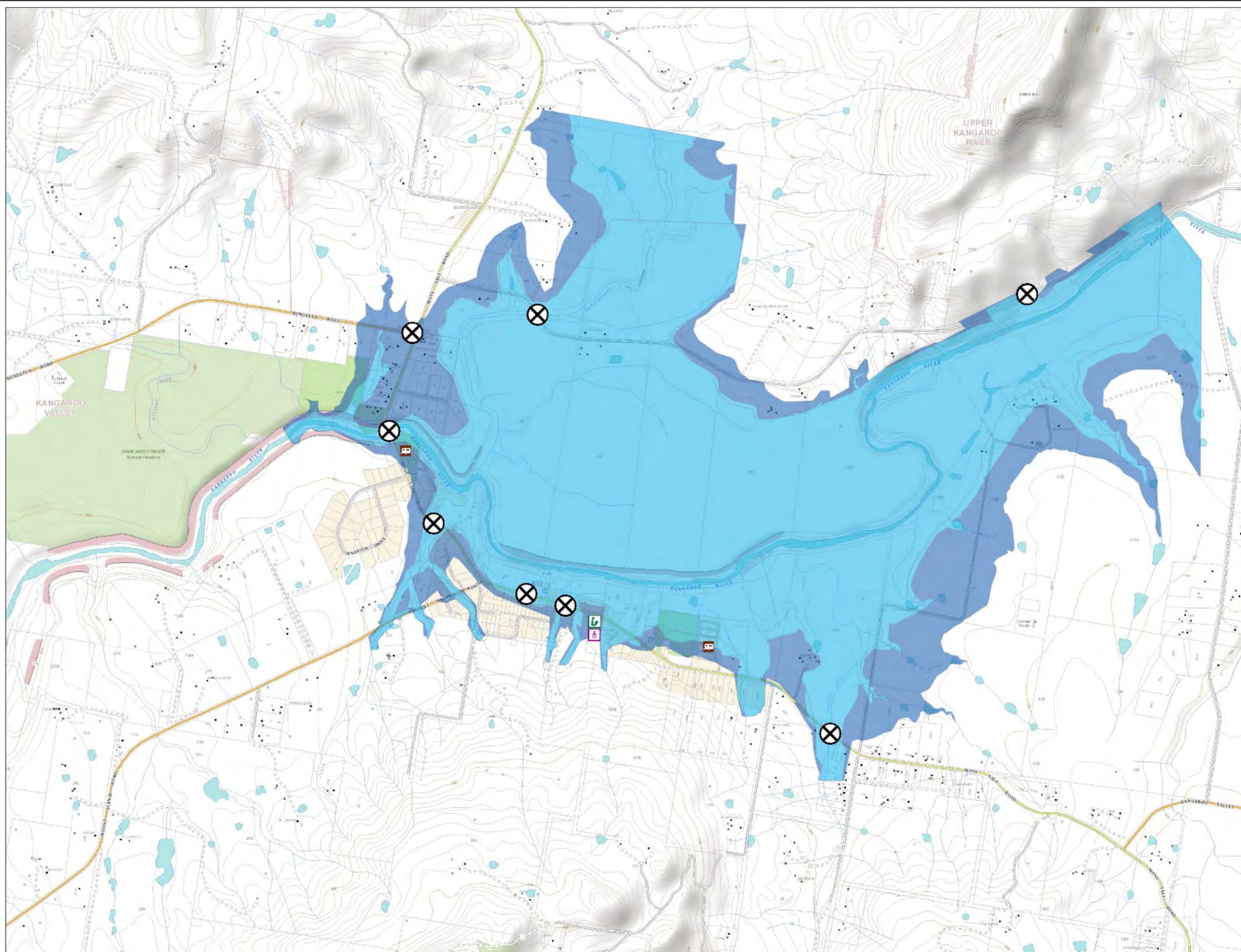
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### Map 5 Kangaroo Valley Town Map

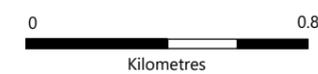
Shoalhaven LGA Local Flood Emergency Sub Plan

#### Legend

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-  SES Units
-  Gauges (BOM Forecast)
-  Declared Dams
-  Levees
-  1% AEP
-  Probable Maximum Flood



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Legend

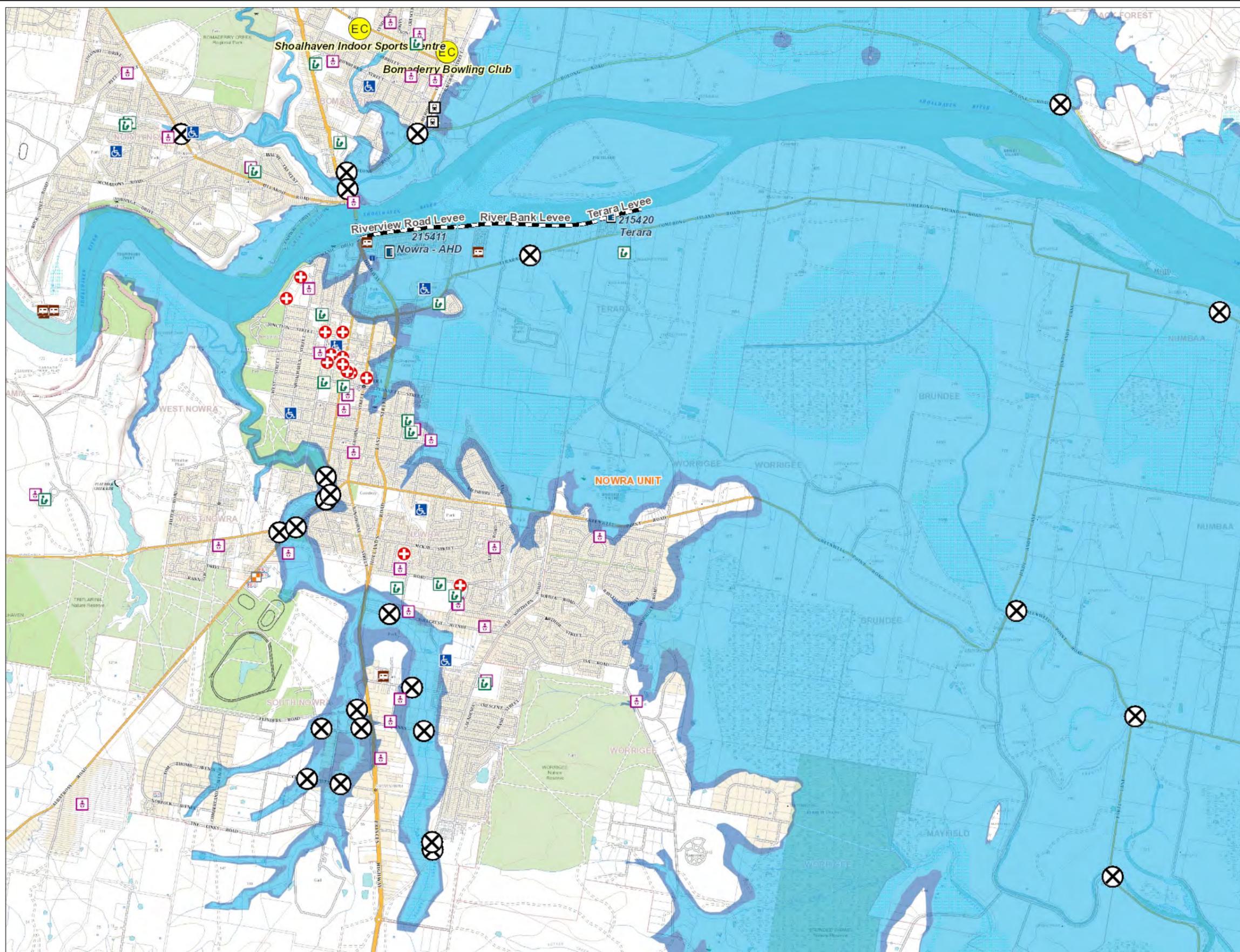
-  Educational Facilities
-  Child Care Facilities
-  Health Care Facilities
-  Aged Care Facilities
-  Caravan Park / Camping
-  Airports
-  Rail Stations
-  Evacuation Centres
-  Road Closure Points
-  SES Headquarters
-  SES Zones
-  SES Units
-  Gauges (BOM Forecast)
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Legend

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Shoalhaven City LGA  
Coastal Erosion Hazard



Legend

-  SES Units
-  1% AEP

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