NSW STATE EMERGENCY SERVICE

Tweed Shire

Local Flood Emergency Sub Plan

FloodSafe

TWEED SHIRE
FLOOD EMERGENCY
SUB PLAN

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

Volume 1 of the Tweed Shire Flood Emergency Sub Plan

Endorsed by the Tweed Byron Local Emergency Management Committee

Endorsed Date 10th May 2023

AUTHORISATION

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

Authorised

Signature: _____

NSW SES Local ~~Unit~~ Commander

Print Name: PETER MAIR

Date: 10 MAY 2023

Endorsed

Signature: _____

Chair, Local Emergency Management Committee

Print Name: DOREEN HARWOOD

Date: 17 MAY 2023

VERSION HISTORY

Version Number	Description	Date
2	Tweed Shire Flood Emergency Plan	May 2014
1	Tweed Shire Local Flood Plan	November 2008

AMENDMENT LIST

Suggestions for amendments to this plan should be forwarded to:

Manager Emergency Planning
NSW State Emergency Service
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Amendments in the list below have been entered in this plan.

DISTRIBUTION LIST

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

CONTENTS

1 OUTLINE AND SCOPE

1.1 PURPOSE

1.1.1 The purpose of this plan is to set out the multi- arrangements for the emergency management of flooding in the Tweed Shire 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 Tweed Byron Local Emergency Management Plan (EMPLAN) and is endorsed by the Tweed Byron 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 Tweed Byron 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 Tweed Shire LGA. The Tweed Shire 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 North Eastern Zone and for emergency management purposes, is part of the North Coast Emergency Management Region.

1.4.3 The plan sets out the local emergency management arrangements for prevention, preparation, response and initial recovery for flooding in the Tweed LGA.

1.4.4 In this plan a flood is defined as a relatively high water level which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and/or local overland flooding associated with drainage before entering a watercourse, and/or coastal inundation resulting from super-elevated sea levels and/or waves (including tsunami) overtopping coastline defences.

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

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.

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 Tweed Shire 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:

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

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

1.8 PLAN MAINTENANCE AND REVIEW

1.8.1 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. Conduct a minimum of one exercise every five years or within two years of the plan being reviewed.

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.
- 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: https://www.ses.nsw.gov.au/about-us/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 NSW SES maintains information on the nature of flooding and effects of flooding on the community in the Tweed LGA.

2.1.2 Declared dams in or upstream of the Tweed LGA.

Dam Name	Owner	High Risk Dam
Clarrie Hall Dam	Tweed Shire Council	No
Korrumbyn Creek Dam	National Parks and Wildlife Service	No

3 PREVENTION/ MITIGATION

3.1 INTRODUCTION

3.1.1 The NSW Floodplain Development Manual outlines the NSW Government's Flood Prone Land 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.

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

4 PREPARATION

4.1 INTRODUCTION

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

4.2 FLOOD EMERGENCY PLANNING

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

Actions:

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

b. Review plans as per Section 1.8.

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

4.3 FLOOD INTELLIGENCE SYSTEMS

4.3.1 **Strategy**: NSW SES develop and maintain a flood intelligence system to identify

flood behaviour, its impact on the community and required response actions.

Actions:

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

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

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).

c. 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 maintains Operational Readiness.
- 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 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.

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 of Meteorology Severe Weather Warning or Thunderstorm Warning that includes heavy rain or storm surge; or

b. On the receipt of a Bureau of Meteorology 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 NSW.

Actions:

a. 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. 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. 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. 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.
- Coordinate information flow, including warnings, public information and social media.

5.2.3 **Strategy**: Provide effective liaison between 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 Centre(s) and/or Emergency Operation Centres as required.

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

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

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 Functional Area to assist with the gathering of flood intelligence including (but not limited to) maximum flood extents, peak flood heights, recording major flood damage at key high velocity locations and preparation of After-Flood Reports.

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

making.

Action: 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 of Meteorology issues public weather and flood warning products before and during a flood. These may include:

- 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.
- 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 Warnings aligning to the Australian Warning System:

- Advice;
- Watch and Act; and
- Emergency Warning.

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

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

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

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

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

h. The Public Information and Inquiry Centre will be established by 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 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 including critical infrastructure through flood protection systems (e.g. sandbagging) to minimise entry of water into buildings.

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. Tweed Shire 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. NSW Police Force may close and re-open roads but will normally only do so (if the Tweed Shire 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.

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 the Local and Regional EMPLANS. 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. Transport Services Functional Area is to coordinate the provision of information about the assessment and restoration of transport network infrastructure.

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

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

d. 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 NSW SES informed of the status of utilities and infrastructure.

5.8 EVACUATION

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

5.8.2 **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.
- Evacuation of people where essential energy and/or utility services are likely to fail or where buildings have been or may be made uninhabitable.

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

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

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

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

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

e. Potential Evacuation Centres are located in the Local EMPLAN.

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

5.8.3 **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. NSW SES Commissioner (or delegate) will warn communities to prepare for a possible evacuation, where circumstances allow such lead time.

c. 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 NSW SES and Welfare Services.

f. School administration offices (Government and Private) will coordinate the evacuation of schools in consultation with 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 Emergency Warning will be referred to 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. 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 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 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.

g. The decision to establish Major Evacuation Centres or Mass Care Facilities will be made by 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.

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 NSW State 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 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 NSW SES. Notification arrangements with NSW Police Force are outlined in the State Rescue Board NSW State Rescue Policy.

d. Rescue agencies will conduct rescue of domestic small and large animals as per the State Rescue Board NSW State 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 Functional Area 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.

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

5.12 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; or
- Limited access by Emergency Services and response Agencies; or
- Limited access by residents and/or business operators; or
- Full access.

c. NSW SES Incident Controller will issue an Advice Warning advising "Reduced Threat: Return with Caution" when the immediate danger to life and property has passed for areas.

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

5.13 END OF RESPONSE OPERATIONS

5.13.1 **Strategy**: Conclude response operations.

Actions:

a. Response operations will conclude when:

- There is a reduced likelihood of additional flooding within the Area of Operation and flood waters have receded.
- All requests for assistance related to the flood have been completed.
- The need for warning and evacuation no longer exist.
- There is no further likelihood of rescuing people.
- Resupply is no longer required (resupply operations may occur concurrently with the recovery phase).
- Response to fire and hazardous material incidents have concluded (not including subsequent clean-up of contaminated sites).
- All affected areas have had an "Reduced Threat: Return with Caution" 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 Tweed Shire 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 NSW SES as lead agency to transition to NSW Reconstruction Authority 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 Tweed Shire 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. The Tweed Byron Local Recovery Plan provides a framework for the management and coordination of local recovery operations.

6.2 NSW SES RECOVERY ROLE

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

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 NSW Reconstruction Authority to support applications to Treasury for Natural Disaster Relief and Recovery Arrangements.

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

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 the SEOCON and SERCON.

7 ABBREVIATIONS

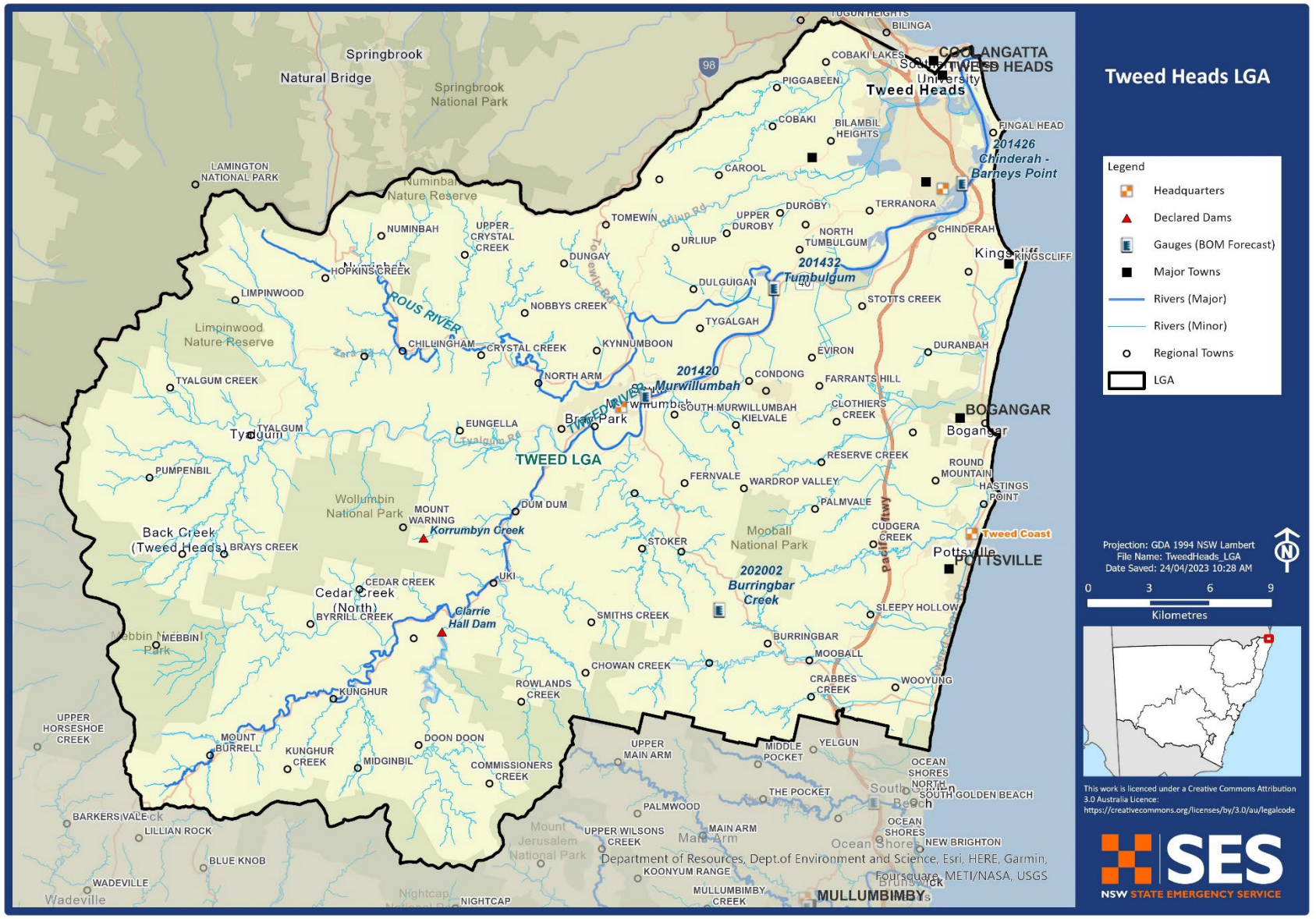
For a full list of abbreviations refer to the NSW State Flood Plan - Abbreviations

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

9 Appendix A – Map of Tweed Shire LGA Area



10 Appendix B – Roles and Responsibilities

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

AGENCY	RESPONSIBILITIES
Agriculture and Animal Services Functional Area	The roles and responsibilities for Agriculture and Animal Services are outlined in the Agriculture and Animal Services Supporting Plan and NSW State Flood Plan.
Australian Government Bureau of Meteorology	The roles and responsibilities for the Australian Government Bureau of Meteorology are outlined in the NSW State Flood Plan.
Tweed Shire Council	**Preparedness** • Establish and maintain floodplain and risk management committee and the Tweed Coast and Waterways Committee and ensure that key agencies are represented. • Develop and implement floodplain risk management plans in accordance with the NSW Government's Flood Prone Land Policy and the Floodplain Development Manual. • Provide available levee studies, flood studies and floodplain management studies to NSW SES. • Maintain Dam Emergency Plan for the Clarrie Hall Dam and provide a copy to NSW SES. • Provide information on the consequences of dam failure to NSW SES for incorporation into planning and flood intelligence. • Coordinate the development of warning services for catchments prone to flash flooding (small catchments), where appropriate. • Maintain council-owned flood warning networks and flood mitigation works. • Participate in NSW SES-led flood emergency planning meetings, to assist in the preparation of Flood Sub Plans. • Contribute to community engagement activities. **Response** • Subject to the availability of council resources, assist NSW SES with flood operations including:

AGENCY	RESPONSIBILITIES
	– Traffic management on council managed roads. – Provision of assistance to NSW SES. – Property protection and sandbagging of Council owned facilities. – Assist with the removal of caravans from Council managed caravan parks. – Warning of residents and other people in flood liable areas. – Technical advice on the impacts of flooding. – 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. – Assist NSW SES to provide sandbag filling facilities to residents and businesses in areas where flooding is expected. • Assist with making facilities available for domestic pets and companion animals of evacuees during evacuations. • Maintain and operate established flash flood warning systems. • Operate established flood mitigation works including critical structures such as flood pumps, flood gates and levees and advise NSW SES regarding their operation. • Manage and protect council-owned infrastructure facilities during floods. • 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. • Advise the Environmental Protection Authority of any sewerage overflow caused by flooding. • Manage the disruption to water supply and sewage services. • Work with NSW SES and NSW Department of Planning and Environment to collect flood related data during and after flood events. **Recovery** • Provide for the management of health hazards associated with flooding including removing debris and waste from public lands under the care and control of Council. • Ensure all Council owned, and managed facilities are fit and safe for reoccupation and assess any need for demolition. • Provide services, assistance and advice to State Government in accordance with the State Recovery Plan.

AGENCY	RESPONSIBILITIES
Caravan Park Proprietor(s)	• Prepare a flood emergency plan for the Caravan Park. • Ensure that owners and occupiers of movable dwellings are aware that the caravan park is flood liable by providing a written notice to occupiers taking up residence and displaying this notice and emergency management arrangement within the park. • Ensure that owners and occupiers of movable dwellings are aware that if they are expecting to be absent for extended periods, they should: – Provide the manager of the caravan park with a contact address and telephone number in case of an emergency. – 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). • Ensure that occupiers are informed of Flood Information. At this time, occupiers should be advised to: – Ensure that they have spare batteries for their radios. – Listen to a local radio station for updated flood information. – Prepare for evacuation and movable dwelling (cabins) relocation. • Ensure that owners and occupiers of caravans are aware of what they must do to facilitate evacuation and movable dwelling relocation when flooding occurs. • Assist with the evacuation of people when floods are rising and their return when flood waters have subsided. • Inform NSW SES of the progress of evacuation and/or movable dwellings relocation operations and of any need for assistance in the conduct of these tasks.
Childcare Centres and Preschools	• When notified of possible flooding or isolation, childcare centres and preschools should. – 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. – Assist with coordinating the evacuation of preschools and childcare centres.
Dams Safety NSW	The roles and responsibilities for Dams Safety NSW (formerly NSW Dam Safety Committee) are outlined in the NSW State Flood Plan.

AGENCY	RESPONSIBILITIES
Department of Defence	Arrangements for Defence Assistance to the Civil Community are detailed within the State EMPLAN (section 448).
Energy and Utilities Services Functional Area	The roles and responsibilities for Energy and Utilities Services are outlined in the Energy and Utility Services Supporting Plan (EUSPLAN). Roles and responsibilities in addition to the Supporting Plan are: • Assist NSW SES with identification of infrastructure at risk of flood damage where resources are available. • Facilitate local utility service distribution providers (electricity, gas, water, wastewater) to: – Provide advice to NSW SES of any need to disconnect power/gas/water/wastewater supplies or of any timetable for reconnection. – Advise NSW SES of any hazards from utility services during flooding and coastal erosion/inundation. – Advise the public with regard to electrical hazards during flooding and coastal erosion/inundation, and to the availability or otherwise of the electricity supply. – Clear or make safe any hazard caused by power lines or electricity distribution equipment. – Reconnect customers' electrical/ gas/ water/wastewater installations, when certified safe to do so and as conditions allow. – Assist NSW SES to identify infrastructure at risk of flooding for incorporation into planning and intelligence.
Engineering Services Functional Area	The roles and responsibilities for Engineering Services are outlined in the Engineering Services Supporting Plan and NSW State Flood Plan.
Environmental Services Functional Area	The roles and responsibilities for Environmental Services are outlined in the Environmental Services (ENVIROPLAN) Supporting Plan.
Floodplain Management Australia	The roles and responsibilities for Floodplain Management Australia are outlined in the NSW State Flood Plan**.**
Fire and Rescue NSW	The roles and responsibilities for Fire and Rescue NSW are outlined in the NSW State Flood Plan.
Forestry Corporation of NSW	The roles and responsibilities for Forestry Corporation of NSW are outlined in the NSW State Flood Plan.

AGENCY	RESPONSIBILITIES
Health Services Functional Area	The roles and responsibilities for Health Services are outlined in the Health Services (HEALTHPLAN) Supporting Plan and NSW State Flood Plan.
Local Emergency Operations Controller (LEOCON)	• Monitor flood operations. • If requested, coordinate support for the NSW SES Incident Controller.
Local Emergency Management Officer (LEMO)	• If requested by the NSW SES Incident Controller, advise appropriate agencies and officers of the start of response operations.
Manly Hydraulics Laboratory (MHL)	The roles and responsibilities for Manly Hydraulic Laboratory are outlined in the NSW State Flood Plan.
Marine Rescue NSW	The roles and responsibilities for Marine Rescue NSW are outlined in the NSW State Flood Plan.
NSW Ambulance	The roles and responsibilities for NSW Ambulance are outlined in the Health Services (HEALTHPLAN) Supporting Plan and NSW State Flood Plan.
NSW Department of Education, Association of Independent Schools of NSW, and National Catholic Education Commission	The roles and responsibilities for NSW Department of Education, Association of Independent Schools of NSW, and National Catholic Education Commission are outlined in the NSW State Flood Plan.
NSW Department of Planning and Environment (Environment and Heritage Group)	The roles and responsibilities for NSW Department of Planning and Environment (Environment and Heritage Group) are outlined in the NSW State Flood Plan (referred to as DPIE EES).
NSW Department of Planning and Environment (Water)	The roles and responsibilities for NSW Department of Planning and Environment (Water) are outlined in the NSW State Flood Plan.
NSW Food Authority	The roles and responsibilities for NSW Food Authority are outlined in the Food Safety Emergency Sub Plan.
NSW National Parks and Wildlife Services	The roles and responsibilities for NSW National Parks and Wildlife Services are outlined in the NSW State Flood Plan. Maintain Dam Emergency Plan for the Korrumbyn Creek Dam and provide a copy to NSW SES.
NSW Police Force	The roles and responsibilities for NSW Police Force are outlined in the NSW State Flood Plan.
NSW Rural Fire Service	The roles and responsibilities for NSW Rural Fire Service are outlined in the NSW State Flood Plan.
Public Information Services Functional Area	The roles and responsibilities for Public Information Services are outlined in the Public Information Services Supporting Plan and NSW State Flood Plan**.**

AGENCY	RESPONSIBILITIES
NSW Reconstruction Authority	The roles and responsibilities for the NSW Reconstruction Authority are outlined in the NSW State Flood Plan.
SEOCON/SEOC	The roles and responsibilities for the SEOCON/SEOC are outlined in the NSW State Flood Plan**.**
Surf Life Saving NSW	The roles and responsibilities for Surf Life Saving NSW are outlined in the NSW State Flood Plan.
Telecommunications Services Functional Area	The roles and responsibilities for Telecommunications Services are outlined in the Telecommunications Services (TELCOPLAN) Supporting Plan.
Transport for NSW (TfNSW)	• Transport for NSW (TfNSW) coordinates information on road conditions for Emergency Services access. • Transport for NSW (TfNSW) coordinates the management of the road network across all modes of transport. • Transport for NSW (TfNSW) in conjunction will assist NSW SES with the evacuation of at-risk communities by maintaining access and egress routes. • 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. • Assist NSW SES with identification of road infrastructure at risk of flooding.
Transport Services Functional Area	The roles and responsibilities for Transport Services are outlined in the Transport Services Functional Area Supporting Plan and NSW State Flood Plan.
VRA Rescue NSW	The roles and responsibilities for VRA Rescue NSW are outlined in the NSW State Flood Plan.
Water NSW	The roles and responsibilities for Water NSW are outlined in the NSW State Flood Plan.
Welfare Services Functional Area	The roles and responsibilities for Welfare Services are outlined in the Welfare Services Functional Area Supporting Plan and NSW State Flood Plan.

11 Appendix C – Community Specific Roles and Responsibilities

NSW SES Community Action Teams (CATs) **Current CATs –** **Uki** **Tumbulgum**	**Prevention** • Maintain awareness of land use and development in their local community that may become a flood hazard or be impacted by flooding and inform the SES Unit Commander of any concerns. **Preparedness** • Be involved in local emergency planning processes – set up communication links and phone trees. • Inform new residents of any flood threat and local procedures. • Act as the point of contact between the NSW SES and the community. **Response** • Inform local NSW SES about flood conditions and response needs. Where able, support community with low skill level tasks e.g. sandbagging, assisting the vulnerable and neighbours. • Disseminate flood information to local community, including flood and evacuation warnings. **Recovery** • Assist with community clean-up if required and able to do so. • Participate in After Action Reviews if required.
Community Resilience Networks	• The Council has a Community Resilience Network (CRN) that brings together local community organisations such as sporting clubs, community recreation and cultural groups, school groups, faith-based groups, Landcare groups, surf clubs and Progress Associations. • These act as a community reference connection to the Local Emergency Management Committee, contributing to emergency planning activities and the development of local Recovery Plans. • This enables community capabilities and resources to be incorporated into emergency and recovery planning and support an all-hazards approach to emergency preparedness. • During an emergency, the CRN also acts as a community reference network when a recovery committee is established, to facilitate collaboration between the committee and community services and assist with coordination of recovery initiatives.

	• They operate under the auspices of the Local Recovery Officer and are integral to the Local Recovery Sub-Plan. • Provide awareness of local hazards and risks. • Provide awareness of Emergency Management arrangements in NSW. • Conduct tabletop exercises to practice recovery processes. • Share recovery needs between communities and the formal recovery system if established.
Community Resilience Teams	• Community Resilience Teams (CRT's) are a Red Cross initiative. They form at a local level to prepare their communities before emergencies using the all-hazards approach, the PPRR model and local knowledge. • Emergency Service Organisations can use the CRT communication systems to convey warnings and obtain feedback from the community during an event. • This boosts resilience during an emergency and provides a platform to begin recovering after an emergency. Establishing telephone trees and street coordinators to create community and neighbourhood connections are strategies used to disseminate warnings and to collect information. • Some CRT's are formalised by Incorporation and have/are seeking funding for local resilience projects.
Community Members	**Preparedness** • Understand the potential risk and impact of flooding. • Prepare homes and property to reduce the impact of flooding. • Understand warnings and other triggers for action and the safest actions to take in a flood. • Households, institutions and businesses develop plans to manage flood risks, sharing and practicing this with family, friends, employees and neighbours. • Have an emergency kit. • Be involved in local emergency planning processes. **Recovery** • Assist with community clean-up if required and able to do so. • Participate in After Action Reviews if required.

Cross-border assistance arrangement	• A formal Cross-Border Sub Plan between the Tweed Byron LEMC and the City of Gold Coast Local Disaster Management Group to facilitate information sharing via Liaison Officers participating in each other's Local EOC's when established and as appropriate. • There is a governmental level agreement between NSW and Qld that establishes a cross border mutual aid zone that extends 50kms on each side of the NSW/Qld border. Requests for assistance are managed at the state level of each government department of agency.
Aboriginal organisations or groups	• Act as the point of contact between NSW SES and the Bundjalung community. • Disseminate flood information, including flood and evacuation warnings, to the Bundjalung community

HAZARD AND RISK IN TWEED SHIRE

Volume 2 of the Tweed Shire Flood Emergency Sub Plan

Last Update: November 2023

AUTHORISATION

The Hazard and Risk in Tweed Shire 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 Coordinator Planning

Print Name: Michael Stubbs

Date: 7 November 2023

Approved

Signature:

NSW SES North Eastern Zone Commander

Print Name: Joanna Jones

Date: 7 November 2023

Date Tabled at LEMC 8 November 2023

CONTENTS

LIST OF TABLES

LIST OF FIGURES

VERSION LIST

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

Description	Date
Tweed Valley Flood Emergency Sub Plan – Volume 2	2008

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 3-02052016

1 THE FLOOD AND COASTAL EROSION THREAT

1.1 OVERVIEW

a. The Tweed Shire Local Government Area (LGA) is located in the Northern Rivers Region of New South Wales and is located adjacent to the NSW/QLD border and adjoins the NSW Shires of Byron, Lismore and Kyogle.

b. The LGA is made up of a mix of urban and rural land. The Tweed Shire is a fast growing area of residential and rural-residential land use and encompasses large areas of coastline, national parks, wetland, forest as well as commercial, agricultural and industrial land use.

c. Settlement is based around the north-east corner of the LGA in Tweed Heads and along the coastal fringe, from Kingscliff to Pottsville, with an urban centre inland at Murwillumbah. There are also several smaller townships and villages.

d. The Tweed Shire has a humid, subtropical climate, with warm summers and mild, drier winters. Weather patterns are influenced by the mountain ranges which form a semi-circle around the valley, resulting in reliable rainfalls which are not often drought affected. Rainfall is heaviest between January through to March, with an annual mean rainfall of 1595mm (1).

e. The Tweed Shire estimated resident population is 97,151 based on the latest census data from 2021. More detailed information on demographic information within the Tweed Shire can be found in Table 5.

f. Main arterial roads in the shire are the Pacific Motorway, Tweed Coast Rd and Kyogle Rd. There is an airfield located at Murwillumbah which can accommodate up to twin propellor aircraft and can be open to use by general aviation. The Tweed Shire also houses part of the Gold Coast Airport, which is an Australian domestic and International Airport. The entrance to the airport is situated in Bilinga and the runway spans the Queensland-NSW border (1).

g. There are two main River Basins within the Tweed Shire LGA. The majority of the LGA falls within the Tweed River Basin, with a portion of the south-east corner falling within the Brunswick River Basin. The Tweed Coastal Creeks Catchment is also contained within the LGA.

h. The Tweed Shire is shown on Maps 1 and 2.

1.2 LANDFORMS AND RIVER SYSTEMS

Tweed River Valley

a. The Tweed Valley catchment has a complex, diverse topography, with steep, channelised valleys to wide deep floodplain areas and coastal estuaries. Within the Tweed Shire, it has a total catchment area of 1303km^2. The catchment is bounded by the Border Ranges and Mebbin National Park to the west, the McPherson Range on the Queensland/New South Wales border to the north and the Nightcap, Mount Jerusalem and Mooball National Parks to the south. The catchment outlets to the ocean via the Tweed River between Point Danger and Fingal Head (2).

b. The Tweed Valley consists of flat floodplain land of alluvial sediments, surrounded by higher ground of bedrock. The extensive floodplains form an important cane-growing area.

c. The Tweed River is the main stream, which flows in a general north-easterly direction through the towns of Murwillumbah, Tweed Heads and past the villages of Condong, Tumbulgum, Chinderah and Fingal Head. The Tweed River originates near Mount Burrell and flows approximately 80km until it reaches the ocean at tweed Heads. Significant tributaries of the Tweed River include:

   i. Oxley River, which joins at Byangum, about 5 km upstream of Murwillumbah.

   ii. Dunbible Creek, which joins upstream of Murwillumbah.

   iii. Rous River, which joins at Tumbulgum.

   iv. Terranora and Cobaki Broadwaters, which join 2 km upstream of the river mouth at Tweed Head via Terranora Inlet, along with Duroby, Tomewin Catchments and Ukerebagh Passage.

d. The Tweed River floodplain commences near Murwillumbah and includes South Murwillumbah (Blacks Drain) to the east of the river. On the northern side of the river a large area of floodplain occurs between the Tweed and Rous Rivers (including the Dulgigan and Dungay areas) to Stotts Island and southeast to the Condong Range. Other floodplain areas are located between Stotts Island and Chinderah on the southern bank of the Tweed River.

e. Inland of Tweed Heads are the Terranora and Cobaki Broadwaters which are fed by numerous local catchment creeks. These Broadwaters join together just west of Tweed Heads and meet with the Tweed River south of Tweed Heads prior to discharging to the ocean between Tweed Heads and Fingal Head. Breakwaters were constructed at the mouth of the river from 1962-1964 to control the entrance.

f. The Tweed River is affected by tidal influence upstream of Murwillumbah at Bray Park Weir, with a tidal extent of approximately 30km. The Rous River is affected tidally to Boat Harbour at Nobbys Creek (3).

Brunswick River Valley

a. The South-Eastern corner of the Tweed Shire lies within the Brunswick River Basin.

b. The Brunswick River begins in the Burringbar Ranges and drains an area of approximately 280km^2.

c. Within the Tweed Shire, there are minimal emergency management considerations associated with the Brunswick River Basin. Refer to the Byron Shire Flood Emergency Sub Plan for more detail on the Brunswick River Basin (4).

Tweed Coastal Creeks

g. The Tweed Coastal Creeks catchment area is approximately 255km^2, and is bounded by Kingscliff to the north, and the Tweed-Byron Shire boundary to the south. The Coastal Creeks system is separate to the main Tweed River Basin, with catchment areas for each system described below.

h. Coastal Creek catchments within the Tweed Shire include Cudgen, Cudgera, Mooball and Yelgun Creeks. These catchments are bisected by the Pacific Highway, with the upper catchments predominantly agricultural and forested land, whilst the lower part of the catchments area a mixture of agricultural land, sugar cane farms, forested and urban areas.

i. The upper catchments are steep meaning that travel times of flood peaks are short. Towns including Burringbar, Mooball and Crabbes Creek are subject to flash flooding with high velocity flood flows. The flatter topography of the lower catchments can mean that drainage from rural areas including from within cane fields can be slow (5).

j. **Cudgen Creek Catchment**. Cudgen Creek catchment is approximately 100km^2 in area and is bounded by the Burringbar Range to the west. It is approximately 20km long and drains to the ocean at Kingscliff. Towns within the Cudgen Creek catchment include Bogangar, Cabarita Beach, Tanglewood, Casuarina and Kingscliff. The main creeks in the Cudgen catchment include Cudgen, Reserve and Clothiers Creeks. Reserve and Clothiers Creek combine and flows into Cudgen Lake, which is located west of Bogangar.

k. **Cudgera Creek Catchment**. Cudgera Creek catchment is approximately 34km^2 in area, 11km long, and drains to the ocean at Hastings Point. Townships within the Cudgera Creek catchment include Pottsville and Hastings Point, as well as the Seabreeze and Koala Beach Estates. The catchment is linked to the Cudgen Creek catchment to the north, with Christies Creek flowing into the Cudgera Creek floodplain downstream of

the Pacific Highway. To the south, the Cudgera catchment is linked to the Mooball Creek catchment via culverts underneath Pottsville Road.

l. **Mooball Creek Catchment**. The Mooball Creek catchment is approximately 110km^2 in area and drains to the ocean at Pottsville. Townships within the Mooball Creek catchment include Burringbar, Mooball and Crabbes Creek upstream of the Pacific Highway, as well as Wooyung and Pottsville in the lower floodplain. The two main creeks within the Mooball catchment are Burringbar Creek and Crabbes Creek. Burringbar Creek and Crabbes Creek join to become Mooball Creek north of Wooyung. The Mooball Creek catchment is hydraulically linked to the Cudgera Creek catchment via culverts under Pottsville Road. The Mooball Creek catchment is also linked with the Yelgun Creek catchment, with both floodplains connecting hydraulically south of Wooyung in the corridor east of the old coastal dune system.

m. **Yelgun Creek Catchment.** The Yelgun Creek catchment lies between the Mooball and Marshalls Creek catchments. The catchment is approximately 11km^2 in area and flows both south into Marshalls Creek and north into Mooball Creek through Billinudgel Nature Reserve. There are no major townships within the Yelgun Creek catchment. The Yelgun Creek catchment is linked to the Marshalls Creek catchment at North Ocean Shores via culverts at Kallaroo Circuit (6).

1.3 STORAGE DAMS

a. Dam locations are shown on Map 1: Tweed River Basin.

b. There are two prescribed Dams located within the Tweed LGA, Clarrie Hall Dam and Korrumbyn Creek Dam.

c. Clarrie Hall Dam is located around 4km upstream of Uki. The location of Clarrie Hall Dam is shown on Map 1 and is further described in Section 2.2.8

d. Korrumbyn Creek Dam is located 12km southwest of Murwillumbah within Wollumbin National Park (7). The location of Korrumbyn Creek Dam is shown on Map 1 and is further described in Section 2.2.8

Table 1: Prescribed Dams in Tweed Shire LGA; summary of information about each storage.

Clarrie Hall Dam (8)	
Owner / Operator	Tweed Shire Council
Description of Dam	Clarrie Hall Dam is a water supply dam built to augment the water supply to towns in the Tweed Shire Water Supply District. This dam consists of a 43m high concrete face rockfill structure with a crest length of 175m and width of 6.4m. The spillway is 23m wide and consists of a concrete lined chute with an ogee crest. The storage capacity of the dam is 16,000 ML at full supply (61.5m AHD) and the catchment area is 60.2km2. The maximum flood level is at 70.4m AHD

Location	Located on Doon Doon Creek about 1.5km upstream from the confluence with the Tweed River, 15km south-west of Murwillumbah. It lies within the Tweed LGA and Tweed River Basin.
Communities Downstream	Number of people at risk is approximately 482. The major population areas effected by dam failure will include Uki, Uki Village and below Uki from Smith Creek Rd and downstream to the Byangum Bridge. In a Sunny Day Dambreak, there may be approximately 172 inundated houses and 482 people at risk. The flood wave travel time from Clarrie Hall Dam to Uki is approximately 30 minutes, and to its downstream location at Tumbulgum is approximately 2 hours and 15 minutes. In a Dam Crest Failure without dambreak, there may be 401-478 inundated houses and 1122-1338 people at risk. In a Probable Maximum Flood (PMF) without Dambreak, there may be 476 inundated houses and 1332 people at risk. In a PMF with Dambreak, there may be 508 inundated houses and 1422 people at risk. The flood wave travel time from Clarrie Hall Dam to Uki is approximately 23minutes, and to its to the downstream location at Camden Haven is approximately 1 hour and 34 minutes (9).
Monitoring System	Clarrie Hall Dam is monitored by a network of instrumentation comprising surface settlement points, seepage weir, continuous water storage monitoring, rainfall, spillway seepage monitoring and site inspections.
Warning System	The owner operates an Emergency Warning System and is required to inform SES immediately upon potential or actual dam failure.
Other	The dam spillway was upgraded in 2014 to allow it to pass the theoretical PMF without overtopping the parapet wall (dam crest).

Korrumbyn Creek Dam (10)	
Owner / Operator	National Parks & Wildlife Service
Description of Dam	Korrumbyn Creek Dam is a fully silted dam. The 14.1m high dam is a thin concrete single arch with concrete gravity abutment on the left bank. The reservoir originally had a capacity of 27,300 m^3, however an outlet blockage means it now stores an estimated 9,060 m^3 of sediment. It has an ungated spillway.
Location	Korrumbyn Creek Dam is located 12km southwest of Murwillumbah within Wollumbin National Park. Normal access to the dam is from Mount Warning Road, 4.2km form the intersection with Kyogle Rd.
Communities Downstream	**Communities Downstream:** Mount Warning Road, including a local carpark 200m downstream, Mt Warning Rainforest park, and three locations providing accommodation approximately 3900m downstream. **Key Consequences:** During a Sunny Day Failure, if silt outflow is modelled, there is no population at risk, if silt is assumed to be water, there may be approximately a 6 -11 population at risk, varying from low to high tourist season.

	During a Dambreak during Probable Maximum Precipitation Design Flood population at risk may be up to 55.9 during high season car park occupancy.
Monitoring System	No telemetered monitoring or alert system has been implemented for the dam. Alerts are linked to structural surveillance.
Warning System	No telemetered monitoring or alert system has been implemented for the dam. Alerts are linked to structural surveillance.
Other	The dam is currently silted to approximately the spillway crest level.

1.4 WEATHER SYSTEMS AND FLOODING

a. Tropical cyclones originating near the equator (Pacific Basin) can move south and affect the Tweed Shire area. While it is rare for a cyclone to enter north-eastern NSW, those that approach southern QLD (Gladstone to Maroochydore) or which travel southwards past the coast of northern NSW may bring rain of sufficient intensity and duration as to cause flooding. There are also occasions when a heavy rain system advances well ahead of the cyclone.

b. The most frequent origin of flooding is caused by the development of East Coast Lows close to the coast. Pressure systems fall below 980 hPa causing rain, increases in the wind strength, increases in the wave height, and increases in the storm surge.

c. These depressions may develop at any time, but the flood rain events are most likely during that part of the year when sea surface temperatures are high, and the air is humid. As tropical cyclones can also be expected at this time, most flood events in the Tweed Valley occur in the first half of the year with a peak period of around February and March.

d. The seasonal distribution of flooding is during the period November to July with the highest incidence during February, March and June. The predominance of flooding in late summer reflects the fact that the Tweed Valley is more affected by tropical cyclones than by winter depressions (6).

e. Isolated heavy falls in the Tweed River catchment on one of the river arms is unlikely to cause a major flood, whereas similar rainfall on two arms may cause significant riverine flooding. Another influencing factor is soil moisture and rainfall producing run off “collection” water. Indicative flood producing rainfall levels are as follows:

   i. 50-150mm over a period of 1-3 days usually results in river rises with nuisance to minor flooding (this range is more likely to be influenced by a wet catchment);

   ii. 175-300mm over a period of 1-3 days usually results in moderate flooding

   iii. 300-450mm over a period of 1-5 days usually results in major flooding (this is dependent on the time period that the rain falls - 25mm/hr with a wet catchment is likely to cause major flooding)

iv. 500-700mm over a period of 1-3 days may result in extreme flooding such as the 1954, 2017 and 2022 flood events (11).

Figure 1: Monthly Flood Distribution, North Murwillumbah Gauge

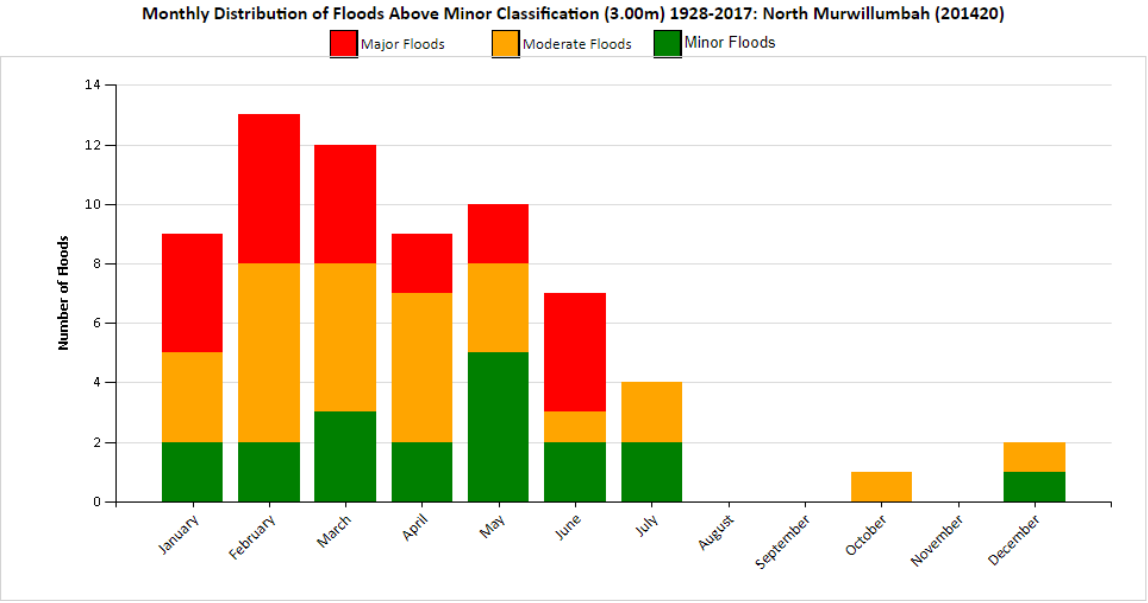


Figure 2: Monthly Flood Distribution, Tumbulgum Gauge

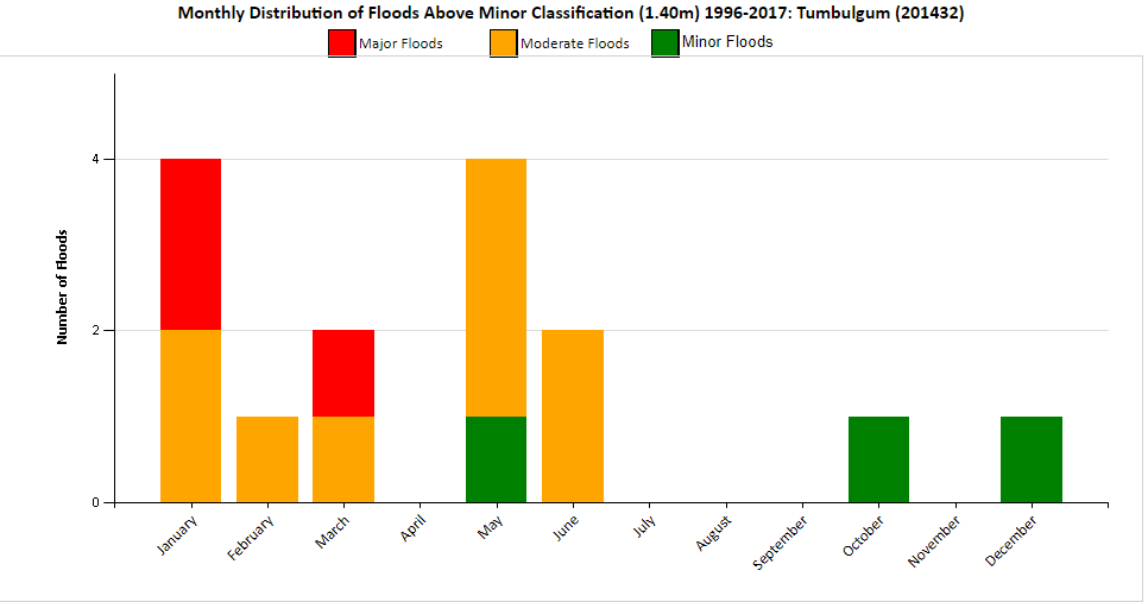
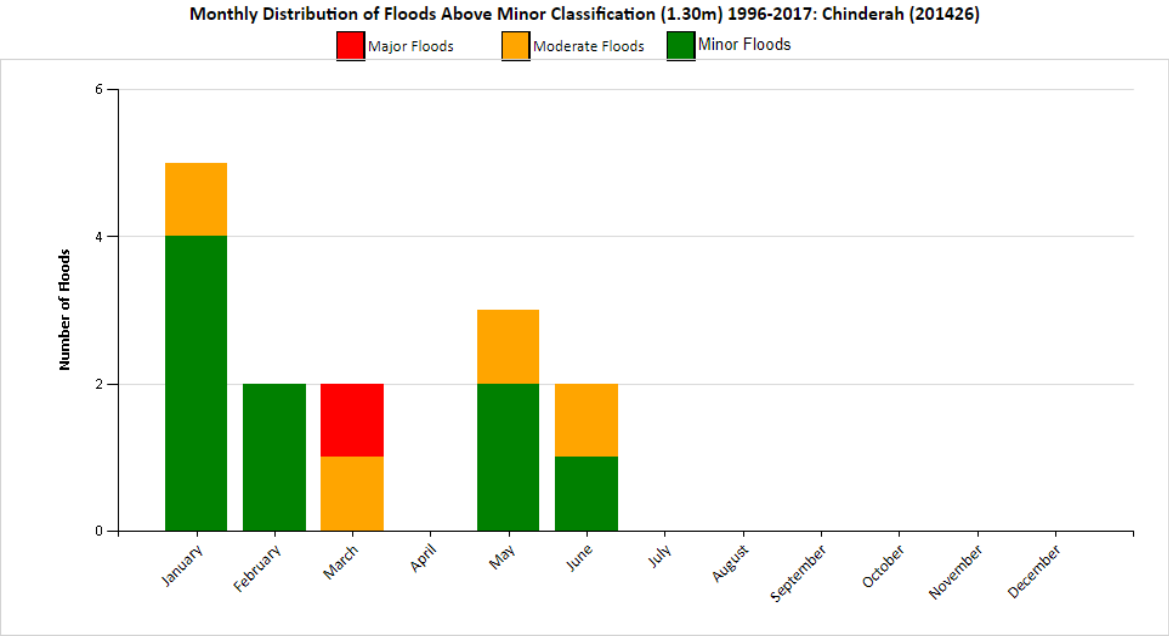


Figure 3: Monthly Flood Distribution, Chinderah Gauge



1.5 CHARACTERISTICS OF FLOODING

a. The Tweed Valley catchment is diverse and complex, and can be impacted by riverine, overland, flash flooding and coastal flooding (2).

b. The Tweed Valley is generally wide and flat with few structures that significantly control the hydraulics of the floodplain, with the exception of Murwillumbah.

c. Flood depths and flows, particularly within the upper catchments can be of a dangerous magnitude, with quick flood rises and short warning times.

Riverine / Catchment Flooding

d. In smaller events water is modelled to flow from the Rous River to the Tweed River via Mayal Creek, which lies in the Chillingham and Murwillumbah sectors. The Tweed River will become the dominant flow as floodwater rises, and water will flow from the Tweed River to the Rous River.

e. In larger events (in the magnitude of a 1% Annual Exceedance Probability (AEP) event), riverine or catchment flooding will be dominant along the Tweed River floodplain downstream to Shallow Bay, and in the Cobaki/Piggabeen Creek floodplains down to Terranora Creek. High flowpaths will exist in Bray Park, upstream of Murwillumbah, and from Blacks Drain to Condong Creek via the Murwillumbah airfield.

f. In the mid-Tweed, large areas of floodplain convey high flow between the Tweed and Rous Rivers, and from Condong to Stotts Island.

g. In the Lower Tweed, the valleys of the Broadwater tributaries described above will have high flows in a larger event (12).

h. A system of levees protects Murwillumbah and South Tweed Heads up to certain design heights. If these levees are breached, overtopped, or fail, the communities behind them are at risk of inundation.

i. Only major floods seriously affect the rural areas upstream of Byangum and Boat Harbour in the Tweed Valley. Local runoff may cause minor problems in some lower lands, but backwater from the main channels is very localised and would affect farmland only once in ten to twenty years. A disruption of access to areas however, is fairly frequent.

j. Flooding in the Tweed Coastal Creeks can originate from heavy rainfall over the catchments, high tail water levels in the ocean due to storm surge or tidal conditions, and/or localised rainfall not being able to drain due to high creek levels or constrictions caused by flood drainage structures.

k. The rural areas of the Tweed Coastal Creeks floodplains have no structural protection against inundation. Flooding of some of the lower areas occurs as often as once a year and some areas, particularly upstream of Cudgen Lake, suffer from slow drainage.

l. Storm surge and abnormally high tides can contribute to catchment flooding by impeding the outflow of water from creeks and waterways to the ocean (3).

Flash Flooding

m. Townships within the steep upper catchments of the Tweed LGA are most at risk of high velocity flash flooding including:

   i. The upper Tweed River townships of Uki and Chillingham as well as Tyalgum, Mt Burrell, Byrrill Creek, Kunghur and Stokers Siding.

   ii. Within the Tweed Coastal Catchments townships of Burringbar, Mooball and Crabbes Creek as well as the coastal fringe around Cudgen Lake, Tanglewood, Cabarita, Bogangar, Hastings Point and Pottsville.

   iii. The small tributaries in the Bilambil and Terranora areas are prone to Flash Flooding (12).

Storm Surge and Tidal Influences

j. A storm surge could affect the Tweed River downstream of Chinderah (including South Tweed Heads) and the lower lying coastal areas of:

   i. Fingal to Kingscliff

   ii. Cabarita - Bogangar

   iii. Hastings Point

iv. Pottsville

v. Wooyung

k. Storm surge inundation is modelled to dominate the lower Tweed River floodplain; from Shallow Bay to the mouth, and the Terranora Creek floodplain from the lower Bilambil / Duroby Creek floodplains down to Tweed Heads (2).

Peak height flow times

i. Indicative travel times for floodwaters to travel between locations within the Tweed River catchment are provided in Table 2. These are shown schematically in Annex 1. Travel times of flood peaks can vary significantly between floods, and therefore the times listed below should be regarded as approximations only.

Table 2: Indicative Flow Travel Time for the Tweed River

Locations	Travel Time
Chillingham to Kynnumboon Bridge	3.5 hours
Kynnumboon Bridge to Tumbulgum	2-3 hours
Tyalgum to Murwillumbah	3-6 hours
Uki to Murwillumbah	2-3.5 hours
Murwillumbah to Tumbulgum	1.5-3 hours
Tumbulgum to Chinderah (Barneys Point gauge)	3.5-4 hours
Chinderah (Barneys Point) to River mouth*	1.5-2 hours

k. Table 3 outlines the design peak heights for select gauge locations in the Tweed Catchment.

Table 3: Tweed River Design Flood Heights (2)

Gauge Location	20% AEP (m AHD)	5% AEP (m AHD)	1% AEP (m AHD)	0.20% AEP (m AHD)	PMF (m AHD)
Letetia 2A	0.62	0.63	2.21	2.60	4.87
Dry Dock	0.69	0.78	2.27	2.60	4.94
Terranora	0.83	1.02	2.33	2.68	4.94
Cobaki	1.03	1.39	2.50	2.85	4.94
Cobaki Creek	6.36	6.62	7.08	7.22	8.89
Barneys Point	1.08	1.61	2.83	2.77	7.00
Chinderah	1.16	1.75	2.92	2.91	7.12
Tumbulgum	2.73	3.33	4.04	4.29	8.53
Boat Harbour – Rous River	6.18	6.90	7.34	7.52	9.96
Boat Harbour – Nobbys Creek	9.17	9.72	9.98	10.17	12.95
Eungella	20.84	22.94	23.48	23.92	26.63
Chillingham Bridge	30.21	31.35	31.61	32.14	35.41
Tyalgum Bridge	51.56	53.36	53.9	54.48	58.68

Murwillumbah Bridge	4.82	5.34	5.70	6.34	10.36
US Murwillumbah Bridge	4.91	5.48	5.89	6.51	10.46
Bray Park Weir	7.04	8.60	9.33	10.00	14.94
Uki	18.97	20.78	21.43	21.98	29.17
Clarrie Hall Dam	63.42	64.08	64.42	65.08	68.77

*Please note these new heights from the 2023 Tweed Valley Flood Study update may vary from historical design event heights. This applies especially for the Chinderah, Dry Dock, and Tumbulgum gauges. Where possible, these new design heights have been incorporated into this document.

1.6 FLOOD HISTORY

a. Regular flooding occurs within the Tweed Shire LGA, with moderate and major flooding occurring on numerous occasions (12).

b. **February 1954:** In 1954 a tropical cyclone passed over Northern NSW causing rainfall between 400mm and 900mm over a 72-hour period in the upper catchment area. The 1954 flood reached 6.05m at the Murwillumbah Gauge. High velocity floodwater caused significant damage to homes in South Murwillumbah and storm activity caused extensive damage in other areas of the LGA.

c. **December 1972:** The Tweed River peaked in Murwillumbah at 4.6m (moderate flood) on 28 December 1972. Extensive inundation of property occurred along the floodplain of the river at Murwillumbah and Cane growers in the valley suffered substantial losses.

d. **January 1974:** the remains of tropical cyclone “Wanda” and a moist north-easterly low-pressure system combined to cause major flooding in the Tweed Valley. The river peaked at 5.42m at Murwillumbah and a total of 100 people were evacuated from South Murwillumbah. All roads north were cut, either by major flooding on the Tweed River, or by swollen streams beyond the Gold Coast. The coastal town of Kingscliff became completely isolated and was threatened with serious food shortages. The gauge at Chinderah reached 2.4m AHD.

e. **February 1974:** The effects of tropical cyclone “Pam” which was out to sea, moved along the coast from February 5 to 7, and together with unusually high tides, caused havoc along the north coast from Evans Head to Tweed Heads. Extreme erosion of the foreshores, as well as inundation of low-lying areas by seawater resulted in damage to many buildings and properties on two successive days. The storm surge was estimated at 0.61m and combined with very rough seas caused anxiety to coastal residents.

f. **March 1974:** On March 10 the Tweed Valley experienced major flooding. Flooding resulted from heavy rainfall with a series of small intense depressions. In the 48hr period to March 11 recorded rainfall ranged between 400 – 600mm. The Tweed Valley experienced very serious and prolonged inundation with high commercial, domestic,

and rural losses (3). The Tweed River at Murwillumbah (201420) reached a height of 5.82m. The commercial centre was inundated when water overtopped the levee, with some shops being flooded to a depth of 1.5–2m. Water up to 2.5m entered parts of the Tumbulgum and Chinderah (2.1m) areas. Approximately 1,000 persons from Murwillumbah and South Murwillumbah were evacuated. Murwillumbah was completely isolated with roads in the area badly scoured and potholed. Damage to homes and personal effects were estimated at over $A1 million. The levee has since been upgraded in the early to mid-1990's (3).

g. **March 1978:** The 1978 flood resulted from heavy rainfall occurring between March 17 and 19. Rainfall for the 48hrs to March 19 averaged 300 – 500mm. At Murwillumbah the Tweed River went within a few centimetres of breaking the levee bank at the western side of the river. The river peaked at 5.24m at Murwillumbah (201420) with the worst affected areas being east and south Murwillumbah.

h. **April 1989:** Rainfall in the area for the 48hrs to March 3 averaged 100-400mm. The intensity of the rain and sudden river rise caused extensive flooding of local areas with the Tweed River peaking at 5.6m at Murwillumbah. Several medical evacuations were carried out in the Murwillumbah area over the weekend and road closures resulted in the necessity of conducting food drops to isolated communities. An additional weather system brought further heavy rain to the catchment with new flood warnings issued on April 11. The river at Murwillumbah peaked at 3.76m (3).

i. **June 2005:** Flash flooding occurred in the Tweed coastal creeks, with approx. 500mm of rain falling in a 12hour period resulting in severe flash flooding for the majority of Tweed Heads CBD, West Tweed, South Tweed and Bilambil, with disruption to major roads including Dry Dock Road, Kennedy Drive, Machinery Drive and Minjungbal Drive. Over floor inundation occurred in the Machinery Drive industrial estate and the Tweed Police station was evacuated. The Tweed Heads Hospital, Fire and Ambulance Stations became isolated. Approximately 100 people, 8-9 houses from Pottsville, and 50 houses from Cabarita were evacuated due to inundation (13).

j. **December 2008:** Riverine and Flash Flooding occurred over the Tweed River catchment with 300mm total falling and a rate of 100mm/hr, resulting in the evacuation of South Murwillumbah. Flash flooding impacts were evident along the coastal creeks and upper Tweed villages including Chillingham with a number of flood rescues undertaken (13).

k. **January 2012:** An east coast low caused 550mm of rain to fall within the upper Tweed catchment over 3 days between 24-26 January. This resulted in a flood peak of 4.7m at Murwillumbah and minor flooding at Chinderah with a peak of 1.52m. Evacuations were conducted across the Tweed including South Murwillumbah, Tumbulgum, Condong, Fingal, South Tweed, Chinderah and parts of Kingscliff, and the emergency alert system was utilised for the first time in the region. The tide was low when the

flood waters peaked at Chinderah and there was insignificant rainfall in the Cobaki Lakes area, so the main impacts were from the Tweed River.

l. **January 2013:** Ex-cyclone Oswald bought widespread heavy rain, gale force winds and dangerous surf conditions, causing flooding and coastal erosion. The rainfall totals in the upper catchment over a five-day period from 26 January included 870mm in Couchy Creek, 803mm in Bald Mountain, 675mm at Clarrie Hall Dam, 642mm in Uki, 428mm in Murwillumbah, 252mm in Tumbulgum and in excess of 1027mm at Hopkins Creek. This resulted in moderate flooding in both Murwillumbah and Chinderah with peaks of 4.7m and 1.7m respectively.

m. **March/April 2017:** Flooding in the area reached 6.2m at the Murwillumbah gauge (201420) leading to the overtopping of the levee in South Murwillumbah, and over-floor flooding in Condong and Tumbulgum. The flood peaked at a height of 2.3m at Chinderah (201426) resulting in flooding in low lying areas of Chinderah and Fingal Head. The towns of Burringbar, Mooball and Crabbes Creek experienced high velocity flash flooding whilst the rural township of Bilambil was flooded from Bilambil Creek. Approximately 2,100 houses were flooded (14).

n. **February/March 2022:** During the 2022 flood The Tweed River experienced major flooding over February and March 2022, inundating properties throughout the catchment. River level gauges along the Tweed River recorded peak levels at 1.74mAHD at Dry Dock, 3mAHD at Chinderah, 4.78mAHD at Tumbulgum and 6.51mAHD at North Murwillumbah (15). Notably, the estimated AEP of the 2022 event exceeded 0.2% in some parts of the catchment. The upper Tweed catchment was heavily impacted by landslips, which caused mass damage to road and communication infrastructure (16).

Table 4: Peak flood levels for major historical flood events in the Tweed Shire (2)

Year	Murwillumbah gauge height (m)	Uki gauge height (m)	Eungella gauge height (m)	Tyalgum gauge height (m)	Chillingham gauge height (m)	Tumbulgum gauge height (m)
February 1954	6.04	10.90	-	8.08	-	
March 1974	5.82	11.40	-	8.46	5.60	
April 1989	5.62	10.9	-	10.95	6.80	
January 2012	4.67	9.98	6.24	-	5.84	2.72
January 2013	4.68	9.34	6.4	-	5.95	3.29
March 2017	6.20	12.91	9.85	8.77	5.97	3.91
February 2020	3.81	9.2	6.28	5.92	5.09	
February 2022	6.51	12.92	7.83	7.07	6.50	4.78

1.7 FLOOD MITIGATION SYSTEMS

a. There are seven levees within the Tweed Shire LGA;

   i. East Murwillumbah Levee located between the Tweed River and Tumbulgum Rd and George St, Murwillumbah;

   ii. Dorothy/William Street Levee located at Murwillumbah;

   iii. Murwillumbah CBD Levee located at Commercial Road, Murwillumbah;

   iv. South Murwillumbah Levee located along the eastern bank of the Tweed River.

   v. Quarry River Road Levee protects a part section of the of the industrial area located west of Quarry Road (17).

   vi. Tweed Heads South Levee located along the northern foreshore of Terranora Creek (3) (2).

   vii. The Seabreeze Levee is situated along Cudgera Creek to protect the Seabreeze Estate at Pottsville

b. Each levee is further described within Part 2 - Specific Risk Areas

c. Levee locations will be shown on Maps 6, 10 and 16 once they have been uploaded into GIS.

d. The areas downstream of Byangum and Boat Harbour are generally protected by rural levees. Upstream of Murwillumbah, local pooling occurs behind rural levees in areas of the floodplain between Murwillumbah, Byangum and Boat Harbour, which occurs about once a year. Overtopping of these rural levees from the Tweed River occurs once every two years on average.

e. Additional flood mitigation measures including flood gates, backwater devices and the construction of drainage systems have also been undertaken within the catchment (2).

f. There are no prescribed detention basins within the Tweed Shire (3).

1.8 EXTREME FLOODING

a. The extent of the modelled Probable Maximum Flood (PMF) is significant within the Tweed Valley, with very high depths throughout some parts of the LGA. There are over 15,000 properties having some level of property flood inundation during a PMF event (2). Many more would be affected by isolation. Flood depths and flows would be high, and flood waters may rise quickly, with short warning periods, causing both extensive inundation and isolation (18).

b. Within the Tweed Coastal Creeks there are up to 3,130 properties (8,347 people) are located within the PMF extent with 385 properties (1,557 people) at risk during a 1% AEP event. As with the Tweed River Valley, many locations can be flooded in relatively

frequent events with 79 properties (310 people) at risk during a 5% AEP flood event (6).

1.9 COASTAL EROSION

a. The most severe problems of coastal erosion occur as a result of oceanic storm conditions associated with the passage of ex-tropical cyclones and east coast low pressure systems. These storms may cause temporary sea level rises with large associated waves. The worst erosion is likely when severe weather conditions occur in conjunction with unusually high tides.UKI TOWN MAP

b. Whilst no areas in the Tweed Valley have been identified by the NSW Government as Coastal Hazard "Hot Spots," there are still significant areas of the coastline where coastal processes may cause threat to property or recreation space, particularly in a severe oceanic storm event (19).

c. Further detail regarding coastal erosion can be found in sections 2.17 to 2.21.

2 EFFECTS ON THE COMMUNITY

2.1 TWEED SHIRE COMMUNITY PROFILE

a. In the 2021 census, approximately 97,392 people live in Tweed Shire with 26.5% of the population aged over 65 years and 16.5% under 15 years of age. It has an indigenous population of 4.4%.

b. Table 5 shows the 2021 'usual resident' counts for key statistics within the Tweed Shire Local Government Area.

c. Please note that key community statistics are also provided for each sector in sections 2.2 – 2.16.

Table 5: Census of Population and Housing data (2021)

Census Description	Tweed Shire LGA	Tweed Heads	Murwillumbah	Pottsville	Burringbar	Cudgen
Total Persons	**97392**	**9176**	**9,812**	**7209**	**878**	**952**
Aged 0-4 yrs.	4623	396	470	456	56	57
Aged 5-14 yrs.	11461	609	1291	1232	94	149
Aged 65 + yrs.	25881	3298	2430	1499	165	156
Of Indigenous Origin	4329	277	355	250	38	58
Who do not speak English well	269	53	34	12	4	4
Have a need for assistance (profound/severe disability)	7241	780	824	422	35	36
Living alone (Total)	10,812	1590	1150	504	65	47
Living alone (Aged 65+)	6356	970	617	271	25	23
Residing in caravans, cabins or houseboats or improvised dwellings	1006	9	28	58	0	0
Occupied Private Dwellings (Households)	**37602**	4149	**3757**	**2508**	**299**	**310**
No Motor Vehicle	2,181	446	256	57	3	8
Caravan, cabin, houseboat or improvised dwell	699	6	16	31	0	0
Rented via State or Housing Authority	812	6	127	18	0	5
Rented via Housing Co-Op or Community Church Group	242	6	36	3	0	0
Unoccupied Private Dwellings	**3892**	**679**	**273**	**223**	**39**	**12**
Average persons per occupied dwelling	2.4	2	2.4	2.7	2.6	2.9
Average vehicles per occupied dwelling	1.8	1.5	1.6	1.9	2.23	2.2

Census Description	Hastings Point	Nunderi	Tumbulgum	Tyalgum	Uki
Total Persons	**661**	**696**	**454**	**521**	**685**
Aged 0-4 yrs.	10	34	29	46	19
Aged 5-14 yrs.	33	73	68	69	99
Aged 65 + yrs.	367	171	64	103	16
Of Indigenous Origin	21	16	34	27	6
Who do not speak English well	0	0	0	0	0
Have a need for assistance (profound/severe disability)	56	40	18	37	37
Living alone (Total)	155	29	24	47	51
Living alone (Aged 65+)	105	9	7	22	25
Residing in caravans, cabins or houseboats or improvised dwellings	39	0	0	0	0
Occupied Private Dwellings (Households)	**330**	**240**	**156**	**184**	**226**
No Motor Vehicle	25	0	3	5	6
Caravan, cabin, houseboat or improvised dwell	22	0	0	0	0
Rented via State or Housing Authority	0	0	0	0	0
Rented via Housing Co-Op or Community Church Group	0	0	0	0	0
Unoccupied Private Dwellings	**80**	**10**	**11**	**13**	**29**
Average persons per occupied dwelling	1.7	2.7	2.6	2.5	2.5
Average vehicles per occupied dwelling	1.3	2.4	2.2	2.1	2

d. For emergency management purposes, the Tweed Shire Council area has been broken up divided into 15 sectors which have been numerically ordered in the general direction of river flow. Each sector can experience significant flood threats and emergency response should not be considered in isolation of the other sectors.

Table 6: Sectors and Catchments

Sector	Name of Sector	GEMS ID	Major Catchment
1	Uki	46512	Upper Tweed
2	Tyalgum	46519	Upper Tweed
3	Chillingham	46518	Upper Tweed
4	Murwillumbah/ South Murwillumbah	46522	Middle Tweed
5	Tumbulgum / North Tumbulgum / Condong	46520	Middle Tweed
6	Chinderah/Kingscliff	46515	Lower Tweed
7	Banora Point	46521	Lower Tweed
8	Terranora	46523	Lower Tweed
9	Bilambil and Duroby	46517	Lower Tweed (Terranora Broadwater)
10	Tweed Heads South	46526	Lower Tweed (Junction Broadwaters and Tweed River)
11	Tweed Heads West	46516	Lower Tweed (Terranora Broadwater and Cobaki Broadwater)
12	Tweed Heads	46524	Lower Tweed (Junction Broadwaters, Tweed River and Ocean)
13	Fingal Head	46525	Lower Tweed River junction with Ocean
14	Bogangar/ Cabarita Beach / Hastings Point	46514	Tweed Coastal Creeks
15	Pottsville / Wooyung	46513	Tweed Coastal Creeks

SPECIFIC RISK AREAS - FLOOD

2.2 UKI

2.2.1 Community Overview

a. The Uki Sector is located within the upper reaches of the Tweed River Catchment.

b. The Uki sector includes the suburbs of Uki, Dum Dum, Dunbible, Stokers Siding, Smiths Creek, Chowan Creek, Rowlands Creek, Commissioners Creek, Doon Doon, Terragon, Midginbil, Kunghur Creek, Kunghur, Mount Burrell, Cedar Creek, Byrrill Creek and part of Mount Warning.

c. The major settlement is in the rural village of Uki, which is located on the southern bank of the Tweed River approximately 20km southwest of Murwillumbah along the Kyogle Road, upstream of the confluence with Smiths Creek. It has a population of 665 people living within 226 dwellings (20).

d. Uki is shown on Map 3.

2.2.2 Characteristics of flooding

a. Uki can be affected by riverine flooding from the Tweed River, as well as flash flooding.

2.2.3 Flood Behaviour

a. The river has extremely high banks and there are limited local effects before 6.1 metres on the Uki gauge (201900 - 58617).

b. Areas of Uki along the banks of the river can experience inundation and isolation during flood events, with rural areas experiencing isolation prior to this.

2.2.4 Classification of Floodplain

a. Townships in the Upper Tweed, including Uki, have Rising Road access out of the PMF extent into the hinterland (2).

b. For emergency management purposes, the Uki sector has further been broken down into subsectors for floodplain classification. These are as follows;

OBJECTID	Polygon Name	Gauge Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
44822	Dunbible C	Tweed River at Murwillumbah	3	1	2	Rising Road Access
45636	Dunbible B	Tweed River at Murwillumbah	25	10	18	Rising Road Access

2.2.5 Inundation

a. Gauges exist in the Uki sector at Uki (201900 - 58167), as well as Palmers Road (201015 - 558018), which is approximately 6.5km upstream, and can give an indication of likely flows to Uki (2).

b. Floodwaters begin to breach the riverbanks at Uki above 6.1m on the Uki gauge.

c. Around 20 properties in low lying parts of Uki can be progressively flooded from around 6.9m on the Uki gauge. This includes properties in:

   i. Kyogle Road (near Old Convent Road)

   ii. Kyogle Road (river side)

   iii. North Norco Street

   iv. Meadow Place

   v. Smiths Creek Road (3)

d. The table below shows the number of properties experiencing over-ground flooding during select design flood events in the Uki sector. It should be noted this does not represent over-floor flooding.

e. Within the sector, the greatest number of properties experiencing over ground flooding in the events modelled below are within the suburbs of Uki and Stokers Sliding.

Table 7: Estimated number of properties inundated over ground in the Uki Sector related to select design flood events (2)

Design Event (%AEP)	No. Properties with Over-ground Flooding
20% AEP	716
5% AEP	794
1% AEP	842
0.2% AEP	859
PMF	990

2.2.6 Isolation

a. Areas and properties around Uki can become isolated when local roads are cut due to flash flooding or riverine flooding, as well as landslips affecting road access.

b. Isolation of rural areas in the Uki sector may begin from approximately 1.5m at the Uki gauge (201900 - 58167), or 1.75m at the Palmers Rd gauge (201015 - 558018), when the Palmers Rd causeway can flood, causing short term isolation for approximately 9 rural properties and a local earth moving business. At 2m at the Uki gauge, local creek flooding can cause short term isolation for rural properties in Cedar Creek, Pretty Gully and Byrrill Creek.

c. Access to Uki from Murwillumbah is cut when Smiths Creek Road and Roberts Bridge closes at around 6.9m on the Uki gauge.

d. Dallis Park, of which lies between the Uki and Murwillumbah sectors, is isolated at around 6.9m on the Uki gauge when Rowlands Creek Road is closed. This affects 50-60 small acreage properties.

e. The Mt Warning Rainforest Park, Mount Warning and several houses are isolated at around 6.9m on the Uki gauge when Dum Dum Bridge over the Tweed River is closed (21).

2.2.7 Flood Mitigation Systems

a. There are no known flood mitigation systems in Uki (3).

2.2.8 Dams

a. Clarrie Hall Dam lies 4km upstream of Uki and would impact Uki and surrounds in the event of a dam failure (9).

b. The flood wave travel time from Clarrie Hall Dam to Uki is estimated to be approximately 30 minutes in a Sunny Day Dambreak, 21 minutes in a Dam Crest Failure Dambreak and 23 minutes in a PMF Dambreak (9).

c. Korrumbyn Creek Dam lies within the Uki sector, with downstream areas located in Korrumbyn Creek Picnic area and carpark.

d. See section 1.3 for further detail.

2.2.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.2.10 Other Considerations

a. The entire village of Uki is a Heritage Conservation area which includes some historical sites (3).

b. There are a significant number of people living in unrecorded multiple occupancy dwellings in the Uki area. Accurate statistics for the number of people and dwellings are not held and it is likely that telecommunications may be limited.

2.3 TYALGUM

2.3.1 Community Overview

a. The Tyalgum sector is located in the upper reaches of the Tweed River catchment, along the Oxley River.

b. It includes the areas of Tyalgum, Tyalgum Creek, Limpinwood, Back Creek, Brays Creek, Mebbin, Eungella, Pumpenbil and part of Mount Warning. The sector has a population of approximately 1063 people, with 22.3% aged 65 or over, and a 3.1% indigenous population.

c. Main settlement in the area is focused around the rural village of Tyalgum, which is located in the Tweed hinterland on the western bank of Tyalgum Creek where it joins the Oxley River. It is approximately 24kms west of Murwillumbah, just northwest of Mount Warning on Tyalgum Road (3).

d. The population of Tyalgum is 521, however of those, just 206 are located in the village area. The remainder of the population are scattered throughout the sector, with approximate populations of 129 in Tyalgum Creek, 234 in Limpinwood, 27 in Back Creek, 119 in Brays Creek and 350 in Eungella (20).

e. Tyalgum is shown on Map 4.

2.3.2 Characteristics of Flooding

a. Tyalgum is affected by flash flooding from Tyalgum Creek and the Oxley River.

b. Localised overland flooding may also occur in this area as a result of heavy localised rainfall.

2.3.3 Flood Behaviour

a. Flood velocities in Tyalgum can be high and are likely to be destructive in places (3).

2.3.4 Classification of Floodplain

a. Tyalgum has Rising Road Access out of the PMF extent into the hinterland (2).

2.3.5 Inundation

a. No Bureau of Meteorology warning or forecast gauge exists for the Tyalgum Sector, however there is a gauge at Tyalgum Bridge (558088) which may provide some indication of inundation.

b. The table below shows the number of properties experiencing over-ground flooding during select design flood events in the Tyalgum sector. It should be noted this does not represent over-floor flooding.

c. Within the sector, the greatest number of properties experiencing over ground flooding in the events modelled below are within the suburbs of Tyalgum, Limpinwood and Eungella.

Table 8: Estimated number of properties inundated over ground in the Tyalgum Sector related to select design flood events (2).

Design Event (%AEP)	No. Properties with Over-ground Flooding
20% AEP	359
5% AEP	425
1% AEP	466
0.2% AEP	472
PMF	540

2.3.6 Isolation

a. The township can be isolated for up to 48 hours due to flooding when the EJ Batrim Bridge closes at 8.5m on the Tyalgum (558088) gauge.

b. This area is also prone to landslip which could potentially isolate it for longer periods (3).

2.3.7 Flood Mitigation Systems

a. There are no known flood mitigation system located in Tyalgum. (3)

2.3.8 Dams

a. There are no dams located upstream of Tyalgum. (3)

2.3.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.3.10 Other Considerations

a. The water supply at Tyalgum is sourced from the weir pool on the Upper Oxley River, if compromised during a flood event this would impact on the town water supply.

b. There are a significant number of people living off the grid in multiple occupancy dwellings in the Tyalgum area. Accurate statistics for the number of people and dwellings are not held and it is likely that telecommunications may be limited.

2.4 CHILLINGHAM

2.4.1 Community Overview

a. The Chillingham sector includes the suburbs of Numinbah, Hopkins Creek, Zara, Upper Crystal Creek, Chillingam, Crystal Creek, North Arm, Nobbys Creek, Dungay, Kynnumboon, Tygalgah, Dulgiugan, Urliup, Tomewin, Glengarrie, Upper Duroby, Carool, Piggabeen and part of Cobaki.

b. The total population of the Chillingham sector is approximately 1900. 19.6% are aged 65 or over, and 23.5% are aged 14 or under (20).

c. Chillingham is shown on Map 5.

2.4.2 Characteristics of flooding

a. Chillingham is considered to have a high potential for severe flash flooding with rapid onset water rises (3).

2.4.3 Flood Behaviour

a. Rainfall in the upper catchment area, particularly the Bald Mountain area can significantly impact on the Chillingham village, with flash flooding often preceding riverine inundation. Rainfall gauges in Bald Mountain, Numinbah and Couchy Creek may provide an indication of rainfall in the catchment area.

b. Over 350mm of rain fell in Bald Mountain area over a 24hr period in January 2008 which caused significant flash flooding at Chillingham (3).

c. Areas in the Chillingham sector can be classified as flood storage during modelled events as frequent as a 5% AEP, particularly the Tygalgah area, which is also classified a H4-5 hazard, indicating high velocity flow and considered unsafe for people and vehicles. Areas situated along the Rous River, including parts of Kyynumboon and Nobbys Creek can also be high hazard flood ways or flood storage areas in events from the 5% AEP (2).

d. Areas of the Chillingham sector which lie outside the flood extent may be indirectly affected due to closure of local and main access roads, causing them to become isolated.

2.4.4 Classification of Floodplain,

a. Chillingham and Crystal Creek have flood free land outside of the PMF extent, allowing for evacuation from North Arm via Numinbah Road.

b. The Chillingham sector can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
41194	Tyalgah A	61	25	45	Low Flood Island
41177	North Tumbulgum A	7	3	5	Overland Escape Route
42408	Dulguigan A	68	28	50	Rising Road Access
42406	North Murwillumbah B	10	4	7	Low Flood Island
42409	Dulguigan B	81	35	63	Overland Escape Route
44820	North Arm	46	18	32	Overland Escape Route
46440	Tumbulgum G2	2	1	2	Low Flood Island
42407	Kynnumboon A	126	52	94	Overland Escape Route
46446	Tyalgah B	29	12	22	Low Flood Island

2.4.5 Inundation

a. The Chillingham gauge (201008 - 058011) is located on the Rous River at Chillingham Bridge. Further downstream there are the Boat Harbour gauges (Boat Harbour - Nobbys Creek 201005 – 558077 and Boat Harbour- Rous River 201906 -058204) and the Kynnumboon gauge (201422 - 558051). However, these are not Bureau of Meteorology forecasting gauges. Rainfall gauges in the Bald Mountain, Couchy Creek and Numinbah areas may be utilised as described in section 2.4.3.

b. The table below shows the number of properties experiencing over-ground flooding during select design flood events in the Chillingham sector. It should be noted this does not represent over-floor flooding.

Table 9: Estimated number of properties inundated over ground in the Chillingham sector related to select design flood events (2).

Design Event (%AEP)	No. Properties with Over-ground Flooding
20% AEP	762
5% AEP	804
1% AEP	826
0.2% AEP	841
PMF	951

2.4.6 Isolation

a. This area can become isolated by road within 2-3 hours and can remain so for 2-3 days.

b. Minor flooding closes most access roads with the North Arm Road and Numinbah Road cutting early in minor and flash flooding events. Aerial movement in the area is usually restricted in the early stages of a flood due to poor visibility and low cloud cover (3).

c. Nobbys Creek Road closes at approximately 3m at the Boat Harbour (Nobbys Creek) gauge (201005 – 558077) which may cause isolation to properties along this road. At 4.5m Numinbah Rd is closed to the east and west of Boat Harbour Bridge, and North Arm Rd is closed, affecting access between Murwillumbah and Chillingham (22).

2.4.7 Flood Mitigation Systems

a. There are no known flood mitigation systems located in Chillingham. (3)

2.4.8 Dams

a. There are no dams upstream of Chillingham. (3)

2.4.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Valley LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.4.10 Other Considerations

a. The possibility of debris banking up against the bridge makes it difficult to relate spot heights to the Chillingham gauge, consequently little flood intelligence exists.

2.5 MURWILLUMBAH, SOUTH MURWILLUMBAH AND BRAY PARK

2.5.1 Community Overview

a. The Murwillumbah, South Murwillumbah and Bray Park sector includes the suburbs of Murwillumbah, Bray Park, parts of South Murwillumbah directly adjacent to the Tweed River, and part of Byangum.

b. Murwillumbah is situated on the Tweed River approximately 8km east of the junction of the Tweed and Oxley Rivers.

c. Murwillumbah has a population of 9812 people living in 3757 dwellings,

d. South Murwillumbah has a population of 1064 people living in 395 dwellings, however, only the area bounded by the Tweed River to the North and West and Tweed Valley Way to the East, is included in this sector. The remainder of South Murwillumbah is included in the Tumbulgum and Condong sector.

e. Bray Park has a population of 822 people living in 296 dwellings (20).

f. Murwillumbah, South Murwillumbah, and Bray Park are shown on Map 6.

2.5.2 Characteristics of flooding

a. Murwillumbah is primarily affected by riverine flooding from the Tweed River.

b. The Murwillumbah township is surrounded by several waterways, the Tweed River, Mayal Creek, and the Rous River, with Lavender Creek draining through and discharging to the Tweed River under Commercial Rd.

c. Murwillumbah CBD, East Murwillumbah, South Murwillumbah and Bray Park are protected by levees. The South Murwillumbah levee is lower in height and South Murwillumbah therefore floods more frequently.

d. Behind the levee in the Murwillumbah CBD, Knox Park is subject to flash flooding, with Hartigan Street being the lowest point. The intersection of Nullum and Wollumbin St becomes impassable with alternate routes being available along Byangum Rd and Brisbane Street.

e. Although the Rous River does not join the Tweed River until near Tumbulgum, flooding in this tributary can affect Murwillumbah from Mayal Creek, which connects the two rivers immediately downstream of Murwillumbah.

f. Ponding can occur in the following locations:

   i. Bray Park Basin east of Kyogle Road;

   ii. Football fields Queensland Road;

   iii. Knox Park Nullum Street;

   iv. Football fields Willward Park;

v. South Murwillumbah Black's Drain;

vi. South Murwillumbah adjacent to Holland Road and Wardrop Street; and

vii. Condong Creek Wardrop Valley (3).

2.5.3 Flood Behaviour

a. In Murwillumbah, the effects of flooding are varied. Much of Murwillumbah is initially protected from flooding by a number of levees, which provide varying levels of flood immunity, as discussed in section 2.5.7. However, levels of flooding behind each levee may also be impacted by the ability of the local stormwater system to drain under gravity to the river, which is impeded when river levels have risen (23).

b. During Riverine flooding, floodways in Murwillumbah and South Murwillumbah are located adjacent to the main rivers and in the Dunbible Creek, South Murwillumbah and Bray Park basins (3).

c. Bray Park initially acts as a storage basin, and once full, acts as a flow path. This may occur from approximately the 20% AEP flood and larger, with depths up to 6 metres and velocities up to 0.5 m/s in the 1% AEP flood event.

d. Flood storage areas include parts of the Rous River floodplain, South Murwillumbah basin and Murwillumbah business centre.

e. Inundation in the 1% AEP event in the CBD area is minimal, however widespread flooding occurs in the 0.2% AEP event after the levees are completely overtopped (2).

f. South Murwillumbah is affected by flooding in small events with depths up to 4 metres in some low-lying areas (between Wardrop Street and Tweed Valley Way, and River Street) in the 20% AEP event. The South Murwillumbah levee provides some protection but begins to overtop when levels at the Murwillumbah Bridge gauge (201465 – 558067) reach approximately 4.8 m AHD.

g. The airport acts as the major flow path from South Murwillumbah to Condong Creek during flood events Velocity-depth products are greater than 0.3 m2/s across much of South Murwillumbah during the 1% AEP flood event (2).

2.5.4 Classification of Floodplain

a. The CBD is inundated in a PMF event but has Rising Road Access to the west. However, once people are evacuated to the west, there is no connection to other townships, and they become stranded.

b. There is a portion of Murwillumbah which is a High Flood Island, north of Wollumbin Street bridge, that is not impacted in a PMF event but surrounded by water. This region is fully isolated as the roads out of the area are fully submerged.

c. South Murwillumbah is fully impacted in the PMF event but has rising road access to the south/ south-east towards the border of the Tweed catchment (2).

d. Sector 4 can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
44818	Dunbible A	113	43	75	Rising Road Access
41185	Murwillumbah Byangum B	2	1	2	High Flood Island
46452	Dorothy Street Murwillumbah	153	87	157	Rising Road Access
44824	Murwillumbah B	707	342	616	Low Flood Island
41581	Murwillumbah G	554	222	400	Rising Road Access
46453	Murwillumbah East Public School	N/A	N/A		Low Flood Island
41180	Murwillumbah East B	577	281	506	High Flood Island
41693	Murwillumbah South Greenhills B	97	39	70	Rising Road Access
41200	Murwillumbah F	691	299	538	Rising Road Access
41186	Murwillumbah Myall Creek F	2	1	2	High island, isolated in PMF, unlikely to be inundated.
46450	Murwillumbah Hockey Fields	110	47	85	Low Flood Island
41704	Murwillumbah Byangum A	N/A	N/A		Rising Road Access
46451	Byangum Road to Bray Park	1858	790	1422	High Flood Island
41184	Murwillumbah Riveroak Drive D	219	96	172	Low Flood Island
45629	Byangum A	N/A	N/A		Rising Road Access
46454	Murwillumbah Budd Park	N/A	N/A		Low Flood Island
41193	North Murwillumbah	22	9	16	Low Flood Island
41697	Murwillumbah South A	413	203	365	Low Flood Island
44823	Murwillumbah Uniting Church on Murwillumbah Street	247	147	265	High Flood Island
41179	Murwillumbah East A	608	284	511	Rising Road Access
41153	Murwillumbah South C	125	76	137	Low Flood Island

2.5.5 Inundation

a. This area utilises the North Murwillumbah gauge (201420 -58186) for Bureau of Meteorology flood forecasting purposes. Gauges also exist at Murwillumbah Bridge (201465 - 558067) and Bray Park Weir (201455 - 558065).

b. Of note, the SES Murwillumbah Unit utilises the Murwillumbah Bridge gauge (201465 - 558067) as the North Murwillumbah gauge (201420 - 58186) has been noted to over-read by up to 30-40cm during major events (24).

c. River levels at Uki provide early warning of possible effects at Murwillumbah. Readings of 5m at the Uki gauge (201900 - 058167) indicate possible significant flooding at Murwillumbah 2 to 3.5 hours later (21).

d. **Murwillumbah:** Inundation behind the levees can occur in events as frequent as a 20% AEP, with the most susceptible area in the vicinity of Knox Park, as well as low lying sections of Proudfoots Lane and Williams St (25).

e. At the peak of the 1% AEP flood event, inundation in Murwillumbah CBD is minimal with small patches near Princes Street, Princes Lane and King Street. There is a bit of inundation near the Dorothy Street levee near the Murwillumbah Leagues Club. Near the northern end of the Murwillumbah CBD levee near Mayal Creek there is a pocket of inundation behind the levee on Tumbulgum Road.

f. In a 0.2% AEP event both the Dorothy Street Levee and the Murwillumbah CBD levee are completely overtopped leading to widespread flooding behind the levees (2).

g. **South Murwillumbah** is predicted to be fully inundated during the 1% AEP event from both Tweed River breakout and local runoff. Peak depths are up to 5 metres in low lying areas, and up to 1.5 metres over Tweed Valley Way (Bray Street) (2).

h. Initial overtopping of the South Murwillumbah levee occurs at Alma St, a known low point. Time to overtopping from onset of rainfall in a modelled flood event shows overtopping can occur from 32 hours in a more frequent event, in the vicinity of 20% AEP, to as little as 15 hours in 0.2% AEP event (17). These times are modelled results only and may vary in subsequent events.

Table 10: Estimated number of properties inundated above floor level and over ground in Murwillumbah, South Murwillumbah and Bray Park related to select design flood events (2).

Design Flood Event (%AEP)	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20% AEP	13	884
5% AEP	63	1348
1% AEP	186	1622
0.2% AEP	335	2007
PMF	1409	2700

2.5.6 Isolation

a. The entire township of Murwillumbah becomes isolated in flood events. Tweed Valley Way closes at several locations, including between Tumbulgum and Murwillumbah when flood levels exceed 3.5 - 4.0m on the North Murwillumbah gauge (201420 - 58186) (3).

b. Behind the CBD levee, major ponding at Knox Park will flood nearby Nullum St, with a number of surrounding roads becoming progressively inundated. This may isolate a significant number of properties between Knox Park and Commercial Rd in large floods (17).

c. Behind the East Murwillumbah levee, modelling has predicted major access roadways, such as Murwillumbah St and Reynolds St, may become cut approximately 27 hours after the initial onset of rainfall in a 1% AEP event. The time to these streets becoming cut off is modelled to be shorter in events larger than a 1% AEP (25).

d. Once inundation of South Murwillumbah occurs it would be isolated for at least 12 hours (>40 hours during a 0.2% AEP flood).

e. Once inundation of South Murwillumbah occurs, it would typically take at least 3 days for the floodwater to recede across most of the area. During the 0.2% AEP flood, it could take more than 4 days for floodwaters to recede (17).

2.5.7 Flood Mitigation Systems

Table 11: Levees in Murwillumbah summary of information

Murwillumbah CBD Levee (Commercial Road Levee)	
Location	The Murwillumbah CBD Levee runs from the sports fields to the east of Murwillumbah High School towards the Tweed River. The levee then runs north along Commercial Rd continuing along Tumbulgum Rd to where it ties into high ground near the Murwillumbah YHA.
Type of Levee	Total length: 1.65km, being part grass covered earthen and part concrete wall (approx. 1.2km) with non-removable horizontal sliding flood gates.
Owner	Tweed Shire Council
Design Height and freeboard	Estimated to provide protection up to a 1% AEP event. Overtopping may occur at heights greater than 6.2m AHD on the North Murwillumbah gauge (201420 - 58186) and 5.8m AHD on the Murwillumbah Bridge gauge (201465 - 558067) (26).
Overtopping Height	The levee is predicted to commence overtopping once heights exceed 6.2m AHD on the North Murwillumbah gauge (201420 -58186). However minor overtopping has previously occurred at this height.
No. of properties protected	Murwillumbah CBD and residential properties to the west of Commercial Rd (3). Most of the houses in Murwillumbah which are protected by the main town levee have (27).
Known low points	Initial overtopping is predicted to occur near Murwillumbah High School sports fields and approximately 130m west of Commercial Rd.
Location and sequence of inundation	Prior to overtopping backwater flooding within the levee may occur as a consequence of flooding along Lavender Creek. Initial overtopping is predicted to occur near Murwillumbah High School sports fields and approximately 130m west of Commercial Rd. Modelled events show overtopping may occur approximately 33hours after initial rainfall onset in a 1% AEP event, and 22 hours in a 0.2% AEP event. Once overtopping commences, water levels will rise quickly, peaking in 2.5-5 hours. These observations are based on design floods, and actual times may vary. It may take up to 4 days for the area behind the levee to fully drain post a 0.2% AEP peak (25).

Consequences of levee overtopping or failure	Inundation of CBD and properties behind the levee. Note high ground is available in parts of Murwillumbah which is a High Flood Island *(3)*.
Deficiencies	No known deficiencies.

East Murwillumbah Levee	
Location	The East Murwillumbah Levee begins to the east of the Murwillumbah YHA backpackers between the Tweed River and Tumbulgum Rd. Once it reaches Mayal Ck it continues along the creek to the north and then west along George St.
Type of Levee	Total length: 1.3km with concrete wall (for approx. 275m) and earthen for the remainder.
Owner	Tweed Shire Council
Design Height and freeboard	Raised to the old 1% AEP flood level in 2006. Estimated to protect to approx. 0.2m below this level, which is equivalent to approximately 6.4m AHD on the North Murwillumbah gauge, with overtopping commencing at 6.5m.
Overtopping Height	During the 2017 flood event which reached 6.2m on North the Murwillumbah gauge (201420 - 58186) the East Murwillumbah levee experienced minor overtopping by about 300mm at the peak of the event (28). This is lower than the previously expected overtopping height of 6.5m AHD (3).
No. of properties protected	Residential properties in East Murwillumbah and the Essential Energy Electrical substation.
Known low points	The crest elevation drops to 5.1m AHD near Murwillumbah East Primary School (25).
Location and sequence of inundation	Levee overtopping time in a 0.2% AEP flood event is estimated at 26.4 hours from the start of the rainfall event, with a 15.6 hour duration of overtopping. This is a guide only and cannot be used as exact timing. It is modelled that it would take approximately 24 hours for the area behind the levee to drain once it passes its peak stage in the 0.2% AEP event (25).
Consequences of levee overtopping or failure	During a flood equivalent to a 0.2% AEP, the vast majority of properties behind this levee would be inundated *(25)*.
Deficiencies	No known deficiencies.

Dorothy Street Levee	
Location	The Dorothy St – William St Levee surrounds the Murwillumbah Sewage Treatment Plant and extends east towards Murwillumbah St.
Type of Levee	Partial levee. The Dorothy Street Levee comprises a grassed earthen embankment.
Owner	Tweed Shire Council

Design Height and freeboard	The crest height is located at an elevation of 4.9m AHD and has been estimated to provide protection in excess of a 1% AEP event, or 4.8m AHD on the Kynnumboon gauge (201422 - 558051).
Overtopping Height	Overtopping height is estimated to be 4.8m AHD at the Kynnumboon gauge (201422 - 558051) *(26)*.
No. of properties protected	Murwillumbah Sewage Treatment Plant and residential properties in the nearby area *(13)*.
Location and sequence of inundation	The area behind the levee is not predicted to be exposed to significant flow velocities, as it is impacted by backwater inundation from the Rous River. A pump station is to be constructed in 2024 *(29)*.
Consequences of levee overtopping or failure	During the 2017 flood event the Dorothy St Levee overtopped by about 300mm. This combined with significant local catchment flooding around Brothers Leagues Club filled this basin. The leagues club and several properties around William St were impacted by water *(25)*.
Deficiencies	No known deficiencies.

South Murwillumbah Levee	
Location	The South Murwillumbah Levee is located between the Tweed River and River St on the eastern side of the river. It extends from Smith St to the western end of Prospero St.
Type of Levee	The levee is an earthen levee.
Owner	Tweed Shire Council
Design Height and freeboard	Originally designed to protect to approx. the 20% AEP flood but estimated to protect to approx. 0.6m below the 20% AEP event. The levee crest height varies from 4.8m AHD to 5.25m AHD.
Overtopping Height	Overtopping is expected to begin when the North Murwillumbah gauge (201420 - 58186) reaches approximately 4.85m AHD (27) (30).
No. of properties protected	South Murwillumbah commercial district and residential properties in South Murwillumbah. The South Murwillumbah levee protects about 150 houses and a population of about 400.
Known low points	A low point causes initial overtopping near Alma Street, at which point the levee has an elevation of approximately 4.4m AHD.
Location and sequence of inundation	Prior to the levee overtopping water will come across Budd Park and Alma Street into the industrial and then the urban area at approximately 3.2 metres on the North Murwillumbah gauge (201420 - 58186). The earthen section of the levee 60m west of River St will then overtop, followed by a location 50m southwest of the southernmost tip of River St. Once overtopped, floodwaters move southwards towards Prospero St, and continue south. After the second location is overtopped west of River St, floodwaters move quickly inundating River Rd, and River St near Colin St.

Consequences of levee overtopping or failure	The basin behind the levee fills quickly once overtopping occurs, and all flood liable properties behind the levee would be inundated. River St would also be exposed to velocities over 1.5m/s, affecting a main evacuation route (17).
Deficiencies	In the March 2017 event, which reached 6.3m on the North Murwillumbah gauge (201420 - 58186), the South Murwillumbah levee overtopped by around 2m, flooding South Murwillumbah. River flows caused major scour on the river side of the levee. North of Colin St the levee breached when a large tree collapsed. Water flows through South Murwillumbah towards the storage basin behind the industrial estate were high velocity and caused significant damage to properties as well as eroding large sections of the railway embankment. Work has since been completed to restore the levee design protection level of 20% AEP.

Quarry Road Levee	
Location	The Levee extends in a northerly direction from elevated ground near Airfield Avenue along the eastern edge of the Murwillumbah Airfield. The levee then "turns" east near Condong Creek and meets up with the higher ground formed by Quarry Road before continuing east along the southern edge of Condong Creek for an additional 350m where it joins higher ground.
Type of Levee	The levee is a grass lined earthen embankment.
Owner	Tweed Shire Council
Design Height and freeboard	The levee crest is generally located above 4.8m AHD. However, the levee crest varies along its length; near Airfield Avenue approximately 4.5m AHD (though adjoining terrain is typically above 5m AHD), between Airfield Road and Quarry Road 4.8m AHD and 5.1m AHD, and East of Quarry Road 5.1-5.3m AHD.
Overtopping Height	It is noted that the ground surface elevations near Airfield Avenue are generally no greater than 4.7 m AHD. Accordingly, the southern end of the levee affords a lower level of protection relative to the northern end of the levee and is the likely location where overtopping would first occur *(17)*. Levee predicted to overtop once South Murwillumbah basin fills up, approximately a few hours after the North Murwillumbah gauge (201420 - 58186) exceeds 5.0m and fills very quickly once overtopped *(29)*.
No. of properties protected	The levee protects part of the industrial area west of Quarry Rd, South Murwillumbah.
Known low points	Southern end of the levee.
Location and sequence of inundation	It is expected that the southern end of the levee along Airfield Avenue will overtop first *(17)*. The levee has no spillways or pumps *(29)*.
Consequences of levee overtopping or failure	This is primarily an industrial area and evacuation should be possible before the North Murwillumbah gauge (201420 - 58186) reaches 4.8m AHD.
Deficiencies	No known deficiencies.

a. The Bray Park levee to the southwest of Murwillumbah on the banks of the Tweed River is an agricultural levee at the southern end of the Murwillumbah levee that was constructed to 0.5 metres above natural ground level to compensate for increased upstream levels caused by the increase of wall levees in the main part of the Murwillumbah levee. (3).

b. During rainfall events, runoff is collected via a piped stormwater system and discharged to the Tweed and Rous Rivers through pipes under the levee system. The outlets are fitted with flood gates which close when river levels rise.

c. There are two council operated pumping stations in Murwillumbah to assist with drainage to pump local runoff from the Lavender Creek and CBD sub catchments to the Tweed River. This is designed to occur when the floodgates prevent the stormwater system draining under gravity. These pumps are located at Lavender Creek, with pump capacity increasing as certain trigger levels are reached in a water sensor chamber, and at Wharf St which is activated once water level in its pit reaches 3.315m AHD and is discharged into the Tweed River (25) (31).

2.5.8 Dams

a. Clarrie Hall Dam lies upstream, with the flood wave extent modelled to reach Murwillumbah (8), with a Sunny Day Dambreak also expected to reach high depths and velocity at the Byangum Bridge.

b. Flood wave travel time to upstream of the Byangum bridge is modelled at 1 hour 27 minutes on a Sunny Day Dambreak and 45-48 minutes in a Dam Crest Failure Dambreak without and with a PMF (9).

c. More information can be found in section 1.3.

2.5.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Valley LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.5.10 Other Considerations

a. Most fuel stations in the Murwillumbah area are located on Tweed Valley Way, which is inundated in major flood events.

b. The Tweed District water supply is a run-of-river supply augmented by released from Clarrie Hall Dam. Raw water is drawn from upstream of Bray Park Weir, which is a salt-water barrage in the Tweed River. The weir has a level of 1.23mAHD and if overtopped, raw water may be contaminated by salt-water resulting in water quality incidents, as occurred in 2017 (2).

c. Events occurring in Murwillumbah may mean an increased number of visitors to the area include;

   i. The Murwillumbah Show in November with anticipated attendance of 5000+ people.

   ii. White Claw Christmas Day Race in December.

   iii. Murwillumbah Art Trials in May, with anticipated attendance of 2000+ people.

   iv. The Kinship Festival in May, with anticipated attendance of 3500+ people.

   v. World Environment Day in June, with anticipated attendance of 1500 people.

2.6 TUMBULGUM AND CONDONG

2.6.1 Community Overview

a. The Tumbulgum and Condong sector includes the suburbs of Condong, Tumbulgum, part of South Murwillumbah, Eviron, Nunderi, Kielvale, Fernvale, Wardop Valley, Palmvale, Reserve Creek, Nunderi, Farrants Hill, Stotts Creek, Clothiers Creek, Reserve Creek, and part of Cudgera Creek.

b. The sector has a total population of approximately 3070, living in 1220 dwellings. Main areas of settlement within the sector are in Tumbulgum and Condong. Part of South Murwillumbah is also included in this sector, from the area bounded by the Tweed Valley way and extending out towards to Airfield.

c. **Tumbulgum** is located 10km downstream of Murwillumbah on the eastern bank of the Tweed River. The village is opposite the confluence of the Rous River. Tumbulgum has a population of 454 people, with 382 of those living in the residential village area. Tumbulgum has a 7.5% Indigenous population, with 14% of the population 65 and over (20). The Tweed Valley Way runs along the eastern border of the village, generally separating the village from agricultural activities.

d. **Condong** is located 4km downstream of Murwillumbah. The village has a population of 314 living in 115 dwellings. It has a 2.9% Indigenous population, with 19.4%of the population under 14 years of age, and 15.2% over 65 (20).

e. **South Murwillumbah** has a population of 1064, living in 485 dwellings. However, the part of South Murwillumbah between the Tweed River and Tweed Valley Way is included in the Murwillumbah, South Murwillumbah and Bray Park Sector.

f. Tumbulgum and Condong are shown on Map 7.

2.6.2 Characteristics of flooding

a. Tumbulgum and Condong are affected by riverine flooding from the Tweed and Rous Rivers. They are also impacted by overland flooding through the neighbouring cane fields. Flooding in Tumbulgum is also tidally influenced (2).

2.6.3 Flood Behaviour

a. **Tumbulgum:** Initial flooding within Tumbulgum is generally from overland flooding through the cane fields from the west behind the houses. This is followed by riverine flooding from the Tweed and Rous Rivers to the east.

b. As the Rous River joins the Tweed River at Tumbulgum the amount of riverine flooding is highly dependent on whether or not both rivers are in flood at the same time. Whilst the Murwillumbah gauge is a good indicator of flooding at Tumbulgum, gauges within the Rous River also need to be monitored to understand the potential for additional flood inputs from this catchment.

c. Tweed River flows between Murwillumbah and Tumbulgum range from 1-1.5 hours, and Rous River flows between Chillingham and Tumbulgum range from 6-16 hours.

d. In events larger than approximately 3.82m at the Tumbulgum gauge (201432 - 558014), Tweed Valley Way and the floodplain to the south become high-flow floodways (with velocity-depth products above 0.3m2/s) (3).

e. Indicative rainfall triggers over the catchments for flood events are described below. However, depending on location of rainfall and other conditions, these should be used as a guide only (32).

   i. 50-150mm over 1-3 days may lead to minor flooding

   ii. 75-300mm over 1-3 days may lead to moderate flooding

   iii. 300-450mm over 1-5 days may lead to major flooding (32).

f. **Condong:** Based on modelling of flood events, during a 5% event, areas of Condong directly alongside the river are classified as flood fringe or unaffected, with surrounding areas classified as flood storage. By a 1%, the majority of Condong is classified as flood storage, with areas around the Sugar Mill becoming floodway (2) .

g. **South Murwillumbah:** South Murwillumbah is affected by flooding in small events equivalent to a 20% AEP, with depths up to 4 metres, however this generally occurs in low lying areas which are situated in the Murwillumbah, Bray Park and South Murwillumbah sector. The South Murwillumbah levee provides some protection but begins to overtop when levels at the Murwillumbah Bridge gauge (201465 – 558067) reaches approximately 4.8 m AHD. The airport may act as the major flow path from South Murwillumbah to Condong Creek during flood events (2).

2.6.4 Classification of Floodplain

a. For emergency management purposes, the Tumbulgum and Condong sector can be further broken into down into subsectors for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
41197	Tumbulgum J	3	1	2	Low Flood Island
41191	Condong B	20	10	18	Low Flood Island
46481	Reserve Creek	11	4	7	Overland Escape route
41171	Tumbulgum C	23	8	14	Low Flood Island
41998	Chinderah A	12	4	7	Low Flood Island
42405	Kielvale A	17	7	12	Overland Escape Route
172	Murwillumbah South H	655	329	592	Rising Road Access
41157	Murwillumbah South D	20	6	11	Low Flood Island
46418	Hattons Road	6	2	3	Rising Road Access
41698	Murwillumbah South B	37	17	30	Low Flood Island
41189	South Tumbulgum A	82	29	52	Overland Escape Route

41160	Murwillumbah South I	4	2	3	High Flood Island - South Murwillumbah HFI 1%AEP
41169	Tumbulgum A	352	149	268	Low Flood Island
44821	Murwillumbah South G	19	9	16	Rising Road Access
41687	Stotts Creek A	11	4	7	Low Flood Island
41192	North-East Murwillimbah	306	128	230	Low Flood Island
41195	Condong C	108	42	76	Overland Escape Route
46419	Clothiers Creek West A	3	1	2	Overland Escape Route
45635	Murwillumbah South F	7	4	7	Low Flood Island
41685	Chinderah D	3	1	2	Low Flood Island
41198	Stotts Island Nature Reserve	N/A	N/A		Low Flood Island
41155	Murwillumbah South E	N/A	N/A		Low Flood Island
41170	Tumbulgum B	45	16	29	Low Flood Island
42404	Nunderi A	169	60	108	Rising Road Access
41703	Murwillumbah Kielvale A	55	23	41	Rising Road Access
46480	Fernvale	N/A	N/A		Overland escape route
41196	Condong E	59	24	43	Low Flood Island

2.6.5 Inundation

a. **Condong:** Parts of Condong may be inundated in smaller events including the 20% AEP flood, however there is expected to be little inundation of property. In the 1% AEP flood, most of Condong is inundated apart from a small area around Maria Ct and Carmen Place. Peak depths are up to 2 metres in low lying areas, and up to approximately 1 metre over Tweed Valley Way. However, most buildings are located on higher ground along Tweed Valley Way where depths are lower (2).

b. **Tumbulgum:** This area utilises the Tumbulgum gauge (201432 - 558014) for Bureau of Meteorology flood forecasting, with the Murwillumbah gauge (201420 – 58186) also utilised for warning and intelligence purposes. As stated above, flooding in Tumbulgum is affected by flows from both the Tweed and Rous Rivers, so it is important to monitor upstream gauges for both the streams.

c. Tumbulgum may be inundated by more frequent flood events including the 20% AEP flood, which is equivalent to approximately 2.73m AHD at the Tumbulgum gauge (201432 - 558014). At the peak of the 20% AEP flood event, most of the town is inundated apart from small areas of higher ground, with depths up to 1.5 metres in low lying areas. During the 1% AEP flood event, which is equivalent to 4.04m AHD at the Tumbulgum gauge, the whole town is inundated, with depths up to 3 metres in low lying areas. Velocities through town are small. In events larger than the 1% AEP flood event, Tweed Valley Way and the floodplain to the south become high flow areas (2).

d. **South Murwillumbah:** See section 2.5.5.

Table 12: Estimated number of properties inundated above floor level and over ground in Tumbulgum and Condong Sector related to select design heights* (2).

Design Event (%AEP)	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20% AEP	9	689
5% AEP	21	761
1% AEP	66	844
0.2% AEP	127	867
PMF	460	1011

* ***Whilst parts of South Murwillumbah are included in this sector, inundated properties for this area have been counted in the sector Murwillumbah, Bray Park and South Murwillumbah in section 25.5.***

2.6.6 Isolation

a. Access roads to both Condong and Tumbulgum have historically been inundated early in moderate to major flood events.

b. Tumbulgum and Condong start to become isolated when the Tweed Valley Way is cut 3-4 hours after reaching 3.4 to 4m at the North Murwillumbah gauge (201402 - 58186) (Approximately 2m on the Tumbulgum gauge 201432 - 558014) (3).

c. Terranora Rd, which provides access towards Banora Point and Tweed Heads, has historically been the last main access road to be cut off.

d. Condong and Tumbulgum would require early evacuation due to closure of evacuation routes to Murwillumbah early in an event.

e. For South Murwillumbah see section 2.5.6.

2.6.7 Flood Mitigation Systems

a. At Condong, low riverside levees protect the sugar mill from low level flooding and all houses have floor levels above the major flood level. A 1% AEP flood would affect all residential and commercial premises, including the sugar mill.

b. There are no flood mitigation systems for Tumbulgum. (3)

c. Levees in South Murwillumbah are described in section 2.5.7

2.6.8 Dams

a. Clarrie Hall dam is located upstream on the Tweed River, with modelled downstream flood wave predicted to reach Tumbulgum (8).

b. See section 1.3 for more detail.

2.6.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Valley LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.6.10 Other Considerations

a. No additional considerations have been identified in this sector.

2.7 CHINDERAH AND KINGSCLIFF

2.7.1 Community Overview

a. The Chinderah/Kingscliff sector includes the suburbs of Chinderah, Kingscliff, and the northern part of Cudgen. The sector has a population of approximately 9983 people, living in 4027 dwellings.

b. **Chinderah** has a population of 1,639 people living in 973 dwellings and is located on the eastern bank of the Tweed River, just south of Barney's Point Bridge. 8.7% of the population are Indigenous population and 45.7% of the population are aged 65 or older.

c. **Kingscliff** has a population of 8,355 people living in 4077 dwellings. 4.1% of the population are Indigenous, 25.6% are aged 65 and over, and 17.5% are under 14 (20) (20).

d. Chinderah and Kingscliff are shown on Map 8.

2.7.2 Characteristics of flooding

a. Chinderah and West Kingscliff can experience flooding from both rainfall events over the Tweed River catchment causing riverine flooding and ocean storm surge, often during the same event.

b. Flood extent in this sector can be influenced by tidal anomalies, storm surge and storm water flooding (3). The southern end of Kingscliff lies within the Tweed Coastal Creeks catchment, more specifically the Cudgen Creek catchment, and can also be susceptible to catchment flooding from this source.

2.7.3 Flood Behaviour

a. **Chinderah:** Large areas of Chinderah experience flooding in the 5% AEP event with depths up to 1.5 metres in low lying areas adjacent to the Kingscliff drain (2).

b. Chinderah village is adjacent to a fast-flowing section of the Tweed River. Flood flows through the village generally in a south to north direction and can have significant depth. Floodwaters will enter the floodplain at Stotts Island and return to the river at Chinderah (30).

c. **Kingscliff:** The western edge of Kingscliff, extending approximately halfway from Sand Street to Kingscliff Street, is inundated in the 1% AEP flood event with depths up to approximately 1 metre in the lots, and 1.5 metres in the streets. Velocities are generally less than 0.01 m/s and velocity-depth products are less than 0.1 m2/s in the 1% AEP event in this area (2).

d. In extreme events, flood levels in the Lower Tweed are controlled by constriction at the river mouth / entrance between Kingscliff and Fingal Head (13).

2.7.4 Classification of Floodplain

a. Parts of the Kingscliff community including the hills around Cudgen are High Flood Islands, however the majority of Kingscliff will be flooded during a PMF (30).

b. Chinderah is a Low Flood Island with an Overland Escape Route to the west.

c. For emergency management purposes, the Chinderah and Kingscliff sector can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
41675	Kingscliff D	1179	569	1024	Low Flood Island
42413	Kingscliff H	1837	940	1692	High Flood Island
41690	Kingscliff E	1395	844	1519	Low Trapped Perimeter
41684	Chinderah C	215	85	153	Overland Escape Route
41688	Cudgen A	6	2	4	Overland Escape Route
46449	Kingscliffe L	214	104	187	Low Flood Island
42003	Kingscliff A	281	257	463	Low Flood Island
41691	Chinderah E	N/A	N/A		Low Flood Island
41674	Kingscliff B	131	44	79	Low Flood Island
41683	Kingscliff C	747	352	634	Low Flood Island
157	Chinderah	684	376	676	Low Flood Island
41657	Chinderah B	684	376	676	Low Flood Island

2.7.5 Inundation

a. This sector utilises the Chinderah gauge (201426 - 558010), which is a Bureau of Meteorology Flood Forecasting gauge.

b. **Chinderah:** Large areas of Chinderah experience flooding in the 5% AEP event with depths up to 1.5 metres in low lying areas adjacent to the Kingscliff drain. In the 1% AEP event, most of Chinderah is inundated with depths up to 2.5 metres (2).

c. Chinderah begins to flood when river levels reach between 1.5m and 2.0m AHD on the Chinderah gauge and is inundated for between 1 and 2 days during a major flood (3).

d. The lower parts of the village of Chinderah will begin to experience low-level flooding at river heights as low as 1.3m AHD on the Chinderah gauge (201426 - 558010), and significant flooding by 2.0m AHD (30).

e. Above 3m AHD at Chinderah gauge (201426 - 558010), most of Chinderah is inundated with depths up to 2.5 metres.

f. **Kingscliff:** Low lying parts of Kingscliff begin to flood at major flood level around 2m AHD at the Chinderah gauge (201426 - 558010).

g. All of the area except for the hills around Cudgen to the south and the high sand dunes at the beachfront are inundated in the PMF event.

h. The western edge of Kingscliff, extending approximately halfway from Sand Street to Kingscliff Street, is inundated in the 1% AEP flood event with depths up to approximately 1 metre in the lots, and 1.5 metres in the streets. Velocities are

generally less than 0.01 m/s and velocity-depth products are less than 0.1 m2/s in the 1% AEP event in this area (2).

Table 13: Estimated number of properties inundated above floor level and over ground in the Chinderah and Kingscliff sector related select design flood events (2).

Design Flood Event	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20% AEP	1	95
5% AEP	15	282
1% AEP	181	587
0.2% AEP	341	1021
PMF	1036	1444

2.7.6 Isolation

a. Roads begin to flood in Chinderah during minor floods from around 1.3m on the Chinderah gauge (201426 - 558010), .The Pacific Motorway and Wommin Bay Road remain open during small events, however local access roads including Chinderah Road and Chinderah Bay Drive close early (6). By the major flood level (2m on the Chinderah gauge 201426 - 558010) most of Chinderah is flooded with access only possible by boat.

b. Kingscliff becomes cut off from Tweed Heads when the Pacific Motorway closes from above 2.2m on the Chinderah gauge (201426 - 558010). (3)

2.7.7 Flood Mitigation Systems

a. There are no flood mitigation systems in place for Chinderah or Kingscliff.

2.7.8 Dams

a. Clarrie Hall Dam is located upstream on the Tweed River, however dam failure is not anticipated to cause any affects within the Chinderah or Kingscliff areas (8).

2.7.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

b. The new Tweed Valley Hospital site is located at 771 Cudgen Rd, Cudgen. It is expected to open to patients in early 2024. Development associated with the hospital is at or above the level of the PMF, with the operational capacity of the hospital expected to be protected during extreme flood events. The site has local access points off Cudgen Road that are flood free in events up to the PMF event, however roads connecting to Cudgen Rd may be flood impacted including the M1 and Tweed Coast Rd. Modelling has determined flood free access to Kingscliff from the hospital site is maintained up to a PMF level (33).

2.7.10 Other Considerations

a. Events occurring in Kingscliff which may mean an increased number of visitors to the area include;

   i. Kingscliff Triathlon in November with anticipated attendance of 3000-4000 people.

   ii. Carols by the Coast in December with anticipated attendance of 2000+ people.

   iii. Seas the Day Women's Surf Festival in May with anticipated attendance 1500-2000 people.

b. The Barneys Point and Chinderah area have a large number of caravan parks and will see large increases in visitors during holiday periods. Many Caravans within the area are fixed, and are not able to be moved easily.

2.8 BANORA

2.8.1 Community Overview

a. The Banora Sector includes the western parts of the suburbs of Banora Point and Tweed Heads South bounded by the Pacific Motorway to the east. It also includes the eastern portion of Terranora that borders Banora Point.

b. **Banora Point** has a population of 16,460. 31.8% of the population is 65 years of age or older, and 15.2% is under 14. There is a 5.1% Indigenous population (20).

c. **Tweed Heads South** has a population of 7941. 34% of the population is 65 years of age or older, and 13.5% is under 14. There is a 7.2% Indigenous population (20). Only part of Tweed Heads South lies within this sector as noted above.

d. Banora Point is shown on Map 9.

2.8.2 Characteristics of flooding

a. Banora Point can experience flash flooding due to runoff from local catchments, as well as riverine flooding from backwater flows from Terranora Broadwater or the Tweed River. Flooding can also be influenced by tides and storm surge (3).

2.8.3 Flood Behaviour

a. Parts of **Banora Point** which lie within the Banora sector are expected to be largely flood free during a 1% AEP riverine flood as well as storm surge flooding. The Banora Point Golf Course provides flood storage in events larger than the 20% AEP, with depths between 1.5 and 2 metres in the 1% AEP event (2).

b. Flooding in this sector can occur due to runoff from local catchments or backwater flows from the Terranora Broadwater or the Tweed River, making the area susceptible to local flash flooding (30).

c. Inundation may occur due to stormwater flooding independent of riverine flooding, usually caused by shorter duration, high intensity local rainfall events (30).

d. **Tweed Heads South** has a levee system which is designed to protect the floodplain to the west of the Tweed River. Levee overtopping may begin at the 5% AEP flood event. However, the area of Tweed Heads South within the Banora Sector is not in the modelled extent of the area protected by the levee and may experience inundation from runoff from local catchments or backwater flows from the Terranora Broadwater or the Tweed River as described above (34).

2.8.4 Classification of Floodplain

a. The Banora Point Sector can be further broken into down into subsectors for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
44394	Tweed Heads South P	747	296	533	Low Flood Island
41686	Banora Point A1	89	44	79	Rising Road Access
42791	Banora Point E	1055	597	1075	Low Flood Island
41689	Banora Point B1	3	1	2	Overland Escape Route
46435	Banora Point B4	468	206	370	Low Flood Island
42794	Banora Point F	1000	475	855	Rising Road Access
42439	Tweed Heads South M	365	150	270	Overland Escape Route
46436	Banora Point B5	N/A	N/A		Low Flood Island
41713	Tweed Heads South O	N/A	N/A		Rising Road Access
44386	Banora Point H	8116	3421	6157	High Flood Island
42440	Tweed Heads South N	3	1	2	Overland Escape Route
44395	Tweed Heads South Q	35	15	27	Low Flood Island
46433	Banora Point B2	3	1	2	Low Flood Island
42437	Tweed Heads South K	1253	509	916	High Flood Island
42400	Tweed Heads South R	721	459	826	Low Flood Island
43588	Banora Point G	2642	1244	2239	Rising Road Access
44788	Banora Point I	1215	512	921	Low Flood Island
42438	Tweed Heads South L	21	15	27	High Flood Island
42790	Banora Point D	121	56	100	Low Flood Island
46434	Banora Point B3	238	115	207	Low Flood Island
41711	Banora Point C	951	516	928	Low Flood Island

2.8.5 Inundation

a. The Chinderah gauge (201426 - 558010), is currently utilised for flood forecasting purposes for communities within this sector.

b. **Banora Point:** During Riverine Flooding, no above floor inundation of property is expected until a flood equivalent to a 0.2% AEP.

c. Banora Point is expected to be mostly flood free in the 1% AEP flood with the exception of the Kirkwood Road area which is inundated from Terranora Creek in the 5% AEP flood and larger.

d. Note however, that this is only based on flooding from either storm surge or a catchment flood. It does not include areas inundated by stormwater flooding, usually caused by shorter-duration, higher-intensity local rainfall events, such as that which occurred in June 2005 (2).

e. **Tweed Heads South**: Some of areas of Tweed Heads South are vulnerable to inundation in the 5% AEP event, along both Dry Dock Road and Minjungbal Drive. During a 1% AEP event, depth of inundation in residential areas are mostly between 0.5 and 1m. During the 1% AEP event most of the southern commercial area is flood free with the exception of some of the northern streets including Minjungbal Drive north of Machinery Drive (2).

Table 14: Estimated number of properties inundated above floor level and over ground in the Banora Sector* related to select design flood events (2).

Design flood event (%AEP)	No. Properties with Over floor Flooding		No. Properties with Over-ground Flooding	
	Banora Point	Tweed Heads South*	Banora Point	Tweed Heads South*
20% AEP	0	0	172	55
5% AEP	0	0	270	95
1% AEP	0	256	486	1111
0.2% AEP	5	596	643	1314
PMF	1545	1394	2048	1792

Note this data includes properties in Tweed Heads South, some of which may be located in the Tweed Heads South Sector.

2.8.6 Isolation

a. **Banora Point:** Flood free land is available in Banora Point during a PMF, however access is constrained from at risk properties in lower lying areas due to the lack of access roads, with residents unable to drive directly to the nearest high ground (12)

b. **Tweed Heads South:** At risk areas of Tweed Heads South, may have key access routes cut off early in a flood event.

2.8.7 Flood Mitigation Systems

a. There are no specific flood mitigation systems within Banora Point.

b. The Tweed Heads South Levee may provide some flood immunity up to a 5% AEP from flooding occurring from the Tweed River, however inundation of the area can occur from other sources, and the levee does not provide protection from Terranora Creek for the area of Tweed Heads South that is included in this sector.

2.8.8 Dams

a. Whilst Clarrie Hall Dam is upstream it is not expected to cause any impacts at Banora Point (8)

2.8.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Valley LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.8.10 Other Considerations

a. There are a large number of aged care facilities and a relatively high percentage of the population identifying as having a need for assistance, or profound or severe core activity limitation (9.8% Banora Point and 11.9% Tweed Heads South (20) in the Banora sector.

2.9 TERRANORA

2.9.1 Community Overview

a. The Terranora sector includes North Tumbulgum, Bungalora, and the parts of Terranora to the west of the intersection of Terranora Rd and Winchelsea Way.

b. **North Tumbulgum** has a population of 238. 17.2% of the population is 65 years of age or older, and 21.4% is under 14. There is a 1.7% Indigenous population (20).

c. **Bungalora** has a population of 73 living in 38 dwellings (20).

d. **Terranora** has a population of 3365. 17.8% of the population is 65 years of age or older, and 21.2% is under 14. There is a 3.7% Indigenous population (20). Part of Terranora lies within the Banora sector as noted above.

e. Terranora is shown on Map 10.

2.9.2 Characteristics of flooding

a. **Terranora:** To the north of Terranora is the Terranora Broadwater and to the South the Tweed River both of which can be flooded due to riverine flooding with potential contributions from tidal influences and storm surge.

b. **North Tumbulgum:** North Tumbulgum can be affected by riverine flooding from the Rous and Tweed Rivers, which join at Tumbulgum.

2.9.3 Flood Behaviour

a. **Terranora:** The majority of the area remains flood free during a PMF (3).

b. **North Tumbulgum:** At Tumbulgum, the Rous River joins the Tweed River. In both Tumbulgum and North Tumbulgum, the amount of riverine flooding is highly dependent on whether or not both rivers are in flood at the same time.

c. Both Terranora and North Tumbulgum flooding will be tidally influenced (2).

2.9.4 Classification of Floodplain

a. The Terranora sector can be further broken into down into subsectors for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
41174	Tumbulgum F	25	10	18	Overland Escape Route
41177	North Tumbulgum A	7	3	5	Overland Escape Route
41172	Tumbulgum D	20	8	14	Low Flood Island
46439	Tumbulgum G1	5	4	7	High Flood Island
44387	Terranora A	104	35	6	Overland Escape Route
41175	Tumbulgum G	30	12	22	High Trapped Perimeter
46440	Tumbulgum G2	2	1	2	Low Flood Island

41176	Tumbulgum H	5	2	4	Overland Escape Route
41173	Tumbulgum E	10	4	7	High Trapped Perimeter

2.9.5 Inundation

a. Bureau of Meteorology flood forecasting gauges exists at Tumbulgum (201432 - 558014) and Chinderah (201426 – 558010).

b. The majority of properties inundated within the sector are in North Tumbulgum, with some inundation of property in Terranora modelled in a PMF event. See the table below for more detail.

Table 15: Estimated number of properties inundated above floor level and over ground in the Terranora sector related to select design flood events (2).

Design Flood Event (%AEP)	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20% AEP	0	97
5% AEP	1	116
1% AEP	4	126
0.2% AEP	8	131
PMF	33	169

2.9.6 Isolation

a. **North Tumbulgum:** At approximately 2m AHD at the Tumbulgum gauge (201432 - 558014), the main access routes out of North Tumbulgum are cut. This includes Terranora Rd, causing isolation for the area.

b. **Terranora:** Whilst there is land above the PMF in Terranora, flooding or landslips of key access roads may lead to isolation.

2.9.7 Flood Mitigation Systems

a. There are no flood mitigation systems in the Terranora sector (3).

2.9.8 Dams

a. Whilst Clarrie Hall Dam is upstream it is not expected to directly affect the Terranora sector (3).

2.9.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.9.10 Other Considerations

a. Terranora Road is susceptible to land slips during heavy rain (3).

2.10 BILAMBIL AND DUROBY

2.10.1 Community Overview

a. The Bilambil and Duroby sector includes the suburbs of Bilambil and Bilambil Heights, and the area of Duroby to the north of Duroby Creek.

b. Bilambil and Duroby are small rural areas situated predominantly to the west of the Terranora Broadwater.

c. **Bilambil** has a population of 441 living within 167 dwellings. 23% of the population is 65 years of age or older, and 15.6% is under 14. There is a 1.6% Indigenous population.

d. **Bilambil Heights** has a population of 3,491 people in 1388 dwellings. 22.4% of the population is 65 years of age or older, and 17.3% is under 14. There is a 3.7% Indigenous population.

e. **Duroby** has a population of 74 people in 32 dwellings (20).

f. Bilambil is shown on Map 11

2.10.2 Characteristics of flooding

a. Bilambil is subject to flash flooding from the Bilambil Creek catchment. Duroby is subject to flash flooding from the Duroby Creek catchment (12). The areas are also affected by storm surge and tidal influences in the Terranora Broadwater.

2.10.3 Flood Behaviour

a. Both Bilambil and Duroby Creeks can convey high velocity flows. If major rain falls within the Tomewin or Duroby Creek catchment areas, then the effects of flooding can be less than 3 hours (3).

2.10.4 Classification of Floodplain

a. Bilambil itself has Rising Road Access, however roads within this area are at risk of flash flooding and may become closed. Except for the immediate foreshore, Bilambil Heights is located on high ground and is largely unaffected by flooding, however it may become isolated due to road closures.

b. The Bilambil and Duroby sector can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
44391	Bilambil B	51	19	34	High Flood Island
44392	Bilambil C	17	9	16	Overland Escape Route
44390	Bilambil A	14	5	9	Overland Escape Route

2.10.5 Inundation

a. There are limited upstream gauges available for flood warning or intelligence purposes in this sector. Bilambil Creek and Duroby Creek are ungauged streams and may have significant impacts on flooding within these areas.

b. Flood modelling indicates parts of Bilambil, including the school and the retirement village, lie within close proximity to Bilambil Creek and are within the PMF flood extent (30). This area is also subject to potentially high velocity flood flows. Some properties along the eastern foreshore of Bilambil Heights on Broadwater Esplanade can be flood affected during a 1% AEP event and would also be subject to high velocity flows.

c. Up to 200 residents in Bilambil could be inundated from flooding with adjacent sports fields and retirement village complex being affected by inundation.

d. The Bilambil Creek Residential Village, situated at 382 Bilambil Rd Bilambil is located on the western bank of the Bilambil Creek and consists of residents over the age of 55 years housed in mobile homes. During the March 2017 as well as the January 2008 event around 0.5m of flood water entered the retirement complex with the residents closest to Bilambil Creek being worst affected. During the 2017 flood event the Bilambil West Sport Field Club, the Equestrian Club and Bilambil Jets Rugby Leagues Club all experienced flood damage (35).

Table 16: Estimated number of properties inundated above floor level and over ground in the Bilambil and Duroby sector related to select design flood events (2).

Design Flood Event (%AEP)	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20% AEP	0	109
5% AEP	0	113
1% AEP	1	134
0.2% AEP	1	139
PMF	10	184

2.10.6 Isolation

a. Bilambil and Bilambil Heights can be isolated when the intersection of Duroby Creek Rd and Bilambil Road is cut north of the Duroby Creek Bridge, and when Kennedy Drive to the north-east of Bilambil is cut. Some rural properties can be isolated for up to 5 days.

b. Within the Duroby area, Naponyah Road, Benevis Place and Ribbonwood Place can be affected by inundation which may cause isolation (3).

c. Rural properties can also become isolated, with the potential for landslips cutting major roads.

2.10.7 Flood Mitigation Systems

a. There are no flood mitigation systems in the Bilambil and Duroby area.

2.10.8 Dams

a. There are no dams upstream that would influence flooding in this area.

2.10.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.10.10 Other Considerations

a. No other considerations have been identified for this sector.

2.11 TWEED HEADS SOUTH

2.11.1 Community Overview

a. The Tweed Heads South sector includes the parts of Tweed Heads South and Banora Point to the east of the Pacific Motorway.

b. **Tweed Heads South** has a population of 7941 living within 3424 private dwellings. 34% of the population is 65 years of age or older, and 13.5% is under 14. There is a 7.2% Indigenous population (20). Only part of Tweed Heads South lies within this sector as noted above.

c. **Banora Point** has a population of 16,460. 31.8% of the population is 65 years of age or older, and 15.2% is under 14. There is a 5.1% Indigenous population (20). Only part of Banora Point lies within this sector as noted above.

d. Tweed Heads South is shown on Map 12.

2.11.2 Characteristics of flooding

a. Tweed Heads South is affected by backwater flooding from the Terranora Broadwater and Tweed River.

b. Tweed Heads South can also be affected by flash flooding and oceanic storm surge (3).

2.11.3 Flood Behaviour

a. A levee protects Tweed Heads South from the more frequent floods up to around 2m on the Chinderah gauge and 1.8m on the Dry Dock gauge (201428 – 558029) (26). Once this levee overtops it is expected to fill quickly, however velocities are expected to be relatively low (12).

b. The Tweed Heads South levee was designed to provide immunity for a 5% AEP flood. However, based on the survey of the levee, there are some sections of the levee that are overtopping. The levee is overtopped by up to 0.3 metre near the South Tweed Bowls Club (2).

c. **Banora Point:** Part of Banora Point which lies within the Tweed Heads South sector experiences flooding from Terranora Creek from the 5% AEP flood around Kirkwood Rd (2).

2.11.4 Classification of Floodplain

a. Tweed Heads South is a Low Flood Island meaning that it can become isolated and completely flooded.

b. The majority of Tweed Heads South is within the PMF extent but has Rising Road Access to the south to Banora Point (2).

c. The Tweeds Heads South sector can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
42436	Tweed Heads South J	258	99	178	Rising Road Access
41709	Tweed Heads South I	604	272	490	Low Flood Island
42433	Banora Point B	159	62	112	Overland Escape Route
42431	Tweed Heads South E	N/A	N/A		Low Flood Island
42434	Tweed Heads South G	962	611	1099	Low Flood Island
46431	Banora Point A2	289	119	214	Low Flood Island
42432	Banora Point A3	N/A	N/A		Low Flood Island
41702	Tweed Heads South B	N/A	N/A		Low Flood Island
42435	Tweed Heads South H	N/A	N/A		High Flood Island
42430	Tweed Heads South D	370	192	345	Rising Road Access
42384	Tweed Heads South C	1948	1020	1836	Low Flood Island

2.11.5 Inundation

a. The Dry Dock gauge (201428 – 558029) is utilised in this sector for areas around Tweed Heads South.

b. The Tweed Heads South levee is designed to provide immunity for the 1954 flood level. Overtopping of the levee has been predicted in some sections at the 5% AEP event, around Dry Dock Rd and Munjungbal Drive, and at the South Tweed Bowls Club.

c. Depth of inundation in the northern residential areas are mostly between 0.5 and 1 metre in the 1% AEP event. Velocity-depth products are less than 0.3 m2/s in the 1% AEP event. Most of the southern commercial area is flood free in the 1% AEP event with the exception of some of the northern streets including Minjungbal Drive north of Machinery Drive (2).

d. The Pacific Highway traverses the sector in a north south direction. Minjungbal Drive allows traffic access into the township proper of Tweed Heads. Dry Dock Road which generally traverses the sector in an east/west direction is one of only two evacuation routes from the sector and is inundated at approximately a 5% AEP event.

Table 17: Estimated number of properties inundated above floor level and over ground in the Tweed Heads South sector related to select design flood events (2).

Design flood event (%AEP)	No. Properties with Over floor Flooding		No. Properties with Over-ground Flooding	
	Banora Point*	Tweed Heads South*	Banora Point*	Tweed Heads South*
20% AEP	0	0	172	55
5% AEP	0	0	270	95
1% AEP	0	256	486	1111
0.2% AEP	5	596	643	1314
PMF	1545	1394	2048	1792

**It should be noted only parts of these suburbs lie within this sector, numbers therefore should be used as a guide only, as some may lie within the Banora sector.*

2.11.6 Isolation

a. The key evacuation route out of Tweed Heads South is Dry Dock Road. This road will begin to be flooded from around 1.4m and will be impassable by around 1.7m on the Dry Dock gauge (201428 – 558029). Other local roads including Floral Ave to Minjungbal Drive can close early during flood events isolating residents. Many vulnerable facilities and caravan parks can become isolated during relatively small flood events (3).

2.11.7 Flood Mitigation Systems

Table 18: Levees in Tweed Heads South summary of information

Tweed Heads South Levee	
Location	The levee runs along the eastern perimeter of the Tweed Heads South urban area towards the Ukerabagh Passage before turning west/north-west and following the alignment of Water Street and then Minjungbal Drive. It then turns south-west following Dry Dock Road before tying into an elevated section of Dry Dock Road immediately east of the Pacific Motorway bridge (23).
Type of Levee (ring etc.)	Earthen levee, 5.75km long with sections that tie into high ground (36) (34)
Owner	Tweed Shire Council
Design Height and freeboard	The original design height is listed as 5% AEP or around 2m on the Dry Dock gauge (201428 – 558029) (34).
Overtopping Height	Varying crest heights of 1.64m AHD and greater. The majority of the levee is above 2m AHD.
No. of properties protected	Schools, shopping centres, Essential Energy Depot and residential properties in the South Tweed area.
Known low points	Several locations along Dry Dock Road and Minjungbal Drive sections of the levee. • 1.64 m AHD at the Boyds Bay Holiday Caravan Park foot gate access (Chainage 1,900 m); • 1.84 m AHD in the proximity of the South Tweed sports Club (Chainage 3,100 m). The levee is overtopped by around 0.3m near the South Tweed Bowling Club at approximately 1.8m on the Dry Dock gauge (201428 – 558029) (2).
Location and sequence of inundation	Flood levels can rise rapidly once levee overtopping begins (12).
Consequences of levee overtopping or failure	Depth of inundation in the northern residential area is expected to be between 0.5- 1m at 2.3m on the Dry Dock gauge (201428 – 558029). During larger flood events including the PMF the majority of South Tweed Heads will be flood affected to significant depths.
Deficiencies	A visual audit in 2015 indicated that the levee was generally in acceptable condition. As noted above there are a number of locations along the levee which are lower than the original design height. Areas of particular concern are in the vicinity of the Tweed Heads South Bowling club and the foot gate access to the Boyds Bay Holiday Caravan Park (36).

2.11.8 Dams

a. There are no dams upstream that would result in flood affects in this area (3).

2.11.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.11.10 Other Considerations

a. There are no additional considerations identified for this sector.

2.12 TWEED HEADS WEST

2.12.1 Community Overview

a. Tweed Heads West sector includes the suburbs of Tweed Heads West, Cobaki Lakes, and the northern parts of Piggabeen, Cobaki and Bilambil Heights. The sector has a population of approximately 6727 people living in 3614 dwellings (20).

b. **Tweed Heads West** is located to the west of the main centre of Tweed Heads, just upstream of the junction of the Terranora Broadwater with the Tweed River and the outlet through Tweed Heads to the ocean. It has a population of 6176 living in 3051 dwellings. It has a 6.5% Indigenous population, with 13.3% of the population under 14 years of age, and 29% over 65 (20).

c. **Cobaki Lakes** has a population of 42 living in 11 dwellings (20). Additionally, the Banksia Waters retirement village consists of residents over 55 years of age, housed in mobile homes. There are approximately 280 mobile homes situated on the eastern bank of the Cobaki Creek.

d. **Seagulls Estate** is located in the suburb of Tweed Heads; however it is of special interest due to its location. The Seagulls Estate is located southwest of Tweed Heads. Part of this residential estate is located on an island within the Terranora Broadwater that is connected to the mainland by Lakes Drive. The remainder of the Seagulls Estate to the west of this island is bounded by Scenic Drive and Inlet Drive.

e. Bilambil Heights is described in more detail in Section 2.10

f. Tweed Heads West is shown on Map 13.

2.12.2 Characteristics of flooding

a. Tweed Heads West sector is affected by flooding from the Cobaki and Terranora Broadwaters. Flooding from the Terranora Broadwater is likely to be influenced by:

   i. Localised flash and catchment flooding from Cobaki, Piggabeen and Bilambil Creeks.

   ii. Storm surge and tidal anomalies.

   iii. Backwater flooding from the Tweed River and constriction at the ocean entrance (3).

2.12.3 Flood Behaviour

a. Parts of Tweed Heads West are flooded in 5% AEP events and larger. This area is generally considered to be flood fringe with low flood velocities expected (30).

b. Storm surge and tidal anomalies are expected to have a significant impact on flooding within this area as well as intensive localised flash flooding from the Cobaki, Piggabeen and Bilambil Creek areas (3).

c. In extreme events, flood levels in the Lower Tweed area are controlled by the constriction at the river mouth / entrance and the dunes between Kingscliff and Fingal Head (12).

d. In addition to catchment flooding, stormwater flooding can affect this area.

2.12.4 Classification of Floodplain

a. The Tweed Heads West sector can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
42399	Tweed Heads West F	N/A	N/A		Low Flood Island
46429	Tweed Heads West B2	410	390	702	Rising Road Access
42396	Tweed Heads West C	703	374	673	Rising Road Access
42397	Tweed Heads West D1	109	46	83	Low Flood Island
46425	Tweed Heads West D2	237	71	128	Overland Escape Route
42395	Tweed Heads West B1	N/A	N/A		Low Flood Island
46448	Tweed Heads West D3	951	387	697	High Flood Island
42398	Tweed Heads West E	2363	1451	2610	Low Flood Island

2.12.5 Inundation

a. The Dry Dock gauge (201428 – 558029) is utilised in this sector.

b. Low lying areas of Tweed Heads West are expected to be inundated in the 5% AEP event and larger. Widespread inundation occurs in the 1% AEP event including most properties along Kennedy Drive, Gray Street, Rose Street, Blue Waters Crescent and Wyuna Road. Depths are typically 1 to 1.5 metres in this event (2).

c. Approximately two thirds of Seagulls Estate are inundated in the 1% AEP (approximately 2.27m AHD at the Dry Dock gauge (201428 – 558029)), with depths up to 1.5 metres along Sunset Boulevard (2).

Table 19: Estimated number of properties inundated above floor level and over ground in the Tweed Heads West sector related to select design flood events (2).

Design Flood Event (%AEP)	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20% AEP	0	223
5% AEP	0	267
1% AEP	347	1089
0.2% AEP	610	1161
PMF	993	1252

2.12.6 Isolation

a. Evacuation is constrained from this area as roads can be cut early from both catchment and stormwater flooding.

b. This area can become isolated due to local road closures:

i. Kennedy Drive can start to flood from around 0.9m AHD near Rose Street on the Dry Dock gauge (201428 – 558029). At 1.8m on the Chinderah gauge (201426 - 558010) it is highly likely that Kennedy Drive will be covered by almost 0.3m of water and impassable to normal traffic near the vicinity of Rose Street (3).

ii. Kennedy Drive and Piggabeen Road are also known to close due to stormwater flooding which can occur quickly (12).

c. **Seagulls Estate:** The only access route in and out of the estate, Lakes Drive, may flood to a depth of 0.6m in the 5% AEP flood.

d. The main evacuation route is Kennedy Drive to the north which begins to flood from 0.9m at the Dry Dock gauge (201428 – 558029) (3). Kennedy Drive can also be affected by stormwater flooding which can impede evacuation along this road (12).

2.12.7 Flood Mitigation Systems

a. There are no known flood mitigation systems in this sector (3).

2.12.8 Dams

a. There are no known dam effects in this sector (3).

2.12.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.12.10 Other Considerations

a. No other considerations have been identified in this sector.

2.13 TWEED HEADS

2.13.1 Community Overview

a. Tweed Heads sector includes the suburb of Tweed Heads and encompasses the main central business district. It has a population of 9176 people living within 5309 dwellings. It has a 3% Indigenous population, with 11% of the population under 14 years of age, and 29.9% over 65. (20). The area adjoins the Queensland state border and is located at the mouth of the Tweed River.

b. Tweed Heads is shown on Map 14.

2.13.2 Characteristics of flooding

a. Tweed Heads is affected by riverine flooding from the Cobaki and Terranora Broadwaters, which is influenced by flooding in the Tweed River.

b. Storm surge and tidal anomalies are expected to have a significant impact on flooding within this area as well as any events of intensive localised flash flooding from the Cobaki, Piggabeen and Bilambil Creek areas (3).

c. In extreme events, flood levels in the Lower Tweed area are controlled by the constriction at the river mouth / entrance and the dunes between Kingscliff and Fingal Head (12).

2.13.3 Flood Behaviour

a. Terranora Creek and the Tweed River to the south of Tweed Heads can be subject to high velocity flows (30).

b. Terranora Creek may overtop its banks from 1.4m at the Dry Dock gauge (201428 – 558029).

2.13.4 Classification of Floodplain

a. In the PMF high land between Razorback and Flagstaff Hill forms a High Flood Island.

b. The rest of Tweed Heads is a Low Flood Island, with Rising Road Access to the North along Wharf Street.

c. The Tweed Heads sector can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
42385	Tweed Heads B	112	83	149	High Flood Island
42393	Tweed Heads H	1250	609	1096	High Flood Island
42391	Tweed Heads F	709	456	820	Rising Road Access
41707	Tweed Heads A	2209	1426	2566	Rising Road Access
42388	Tweed Heads E	80	42	75	Low Flood Island
42392	Tweed Heads G	1689	806	1450	Low Flood Island
42386	Tweed Heads C	359	218	392	Low Flood Island

42387	Tweed Heads D	895	638	1148	Low Flood Island
42785	Tweed Heads I	1846	932	1677	Low Flood Island

2.13.5 Inundation

a. The Dry Dock (201428 - 558029) or Chinderah (201426 – 558010) gauges may be utilised in this sector.

b. Most of the developed areas of Tweed Heads are flood free in the 1% AEP event with the exception of a few properties along Endeavour Parade in the north and Margaret Street near the canals. Some streets are also inundated in this event, including sections of Kennedy Drive up to 1 metre, Ducat Street up to 1 metre and Keith Compton Drive up to 0.5 metre near the Tweed Heads District Hospital (2).

c. In a PMF event many parts of this sector are expected to be inundated, except for high land near Point Danger headland.

Table 20: Estimated number of properties inundated above floor level and over ground in the Tweed Heads sector related to select design flood events (2).

Design Flood event (%AEP)	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20% AEP	0	225
5% AEP	0	240
1% AEP	10	663
0.2% AEP	183	1052
PMF	1199	1567

2.13.6 Isolation

a. At 1.4m at the Dry Dock gauge (201428 - 558029), Kennedy Road is expected to be covered with approximately 0.5m of water and impassable to all traffic at approximately 1.7m.

b. It is highly likely that during an event greater than 2m at Chinderah gauge (201426 – 558010), properties may become isolated due to localised flooding.

c. During an event greater than 3.0m Chinderah gauge (201426 – 558010) the following road closures which may cause isolations are expected:

   i. Sections of Kennedy Drive flooded by up to 1m.

   ii. Ducat Street by up to 1m.

   iii. Keith Compton Drive by up to 0.5m near the Tweed District Hospital (30).

2.13.7 Flood Mitigation Systems

a. There are no levees, detention basins or groynes in this area (3).

2.13.8 Dams

a. No downstream dam effects have been identified in this sector (3).

2.13.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweeds Heads LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.13.10 Other Considerations

a. Events occurring in Tweed Heads may mean an increased number of visitors to the area include;

   i. Kids in Need Dragon Boat Festival in November with anticipated attendance of 1500+ people.

   ii. HCCA 8th International Tour on 26 May – 1 June, with anticipated attendance of 200-240 people and 100 vehicles travelling from Tweed Heads to the Tweed Valley.

b. There is likely to be an increase in visitors to the area during peak holiday periods.

c. There are also a large number of aged care facilities and a relatively high percentage of the population identifying as having a need for assistance, or profound or severe core activity limitation (8.5%) in the Tweed Heads sector.

2.14 FINGAL HEADS

2.14.1 Community Overview

a. The Fingal Head Sector includes the suburb of Fingal Head. Fingal Head encompasses the coastal strip bounded by the Tweed River to the north and west, the Pacific Ocean to the east and Wommin Bay Rd to the south.

b. It has a population of 615 people living within 318 dwellings. It has a 11.2% Indigenous population, with 15.3% of the population under 14 years of age, and 34.6% over 65 (20).

c. Fingal Head is shown on Map 15.

2.14.2 Characteristics of flooding

a. This sector can be affected by coastal inundation and riverine flooding from the Tweed River in the Chinderah floodplain (3).

2.14.3 Flood Behaviour

a. Fingal Head can experience flooding from rainfall events over the Tweed River catchment as well as due to storm surge events (6).

b. The main centre of Fingal Head is not affected by riverine flooding up to the 0.2% AEP flood event (2).

2.14.4 Classification of Floodplain

a. The Fingal Head sector can be further broken into down into subsector for floodplain classification, these classifications are as follows:

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
45609	Fingal Head C	306	170	306	Low Trapped Perimeter
41699	Fingal Head A	135	61	110	Low Trapped Perimeter
45610	Fingal Head D	237	112	201	Low Trapped Perimeter
41700	Fingal Head B	9	4	7	Low Trapped Perimeter

2.14.5 Inundation

a. Gauges utilised within this sector include the Chinderah Gauge (201426 – 558010) and Letitia 2A gauge (201429 – 558041).

b. Letitia Road to the north (including some adjacent properties) and Fingal Road leading into Fingal Head from the south (also including some adjacent properties) are predicted to be inundated in the 5% AEP event. The depth of inundation over Fingal Road is up to 1.5 metres near Wommin Lake in the 1% AEP flood event (2).

c. During the 2004 moderate flood event which reached 1.6m at the Chinderah gauge (201426 – 558010) water was over Fingal Road and entered the yards of some properties (37).

d. Flood water is expected to breakout across the peninsula to the ocean in a PMF event. There is anecdotal evidence that such breakouts have previously occurred in major historic floods (12).

Table 21: Estimated number of properties inundated above floor level and over ground in Fingal Head related to select design flood events (2).

Design Flood Events	No. Properties with Over floor Flooding	No. Properties with Over-ground Flooding
20%	0	25
5%	1	61
1%	58	185
0.2%	82	200
PMF	175	267

2.14.6 Isolation

a. Fingal Road/ Wommin Lake Crescent are affected at 1.3m on Chinderah gauge (201426 - 558010) isolating Fingal Head (3).

2.14.7 Flood Mitigation Sytems

a. There are no levees or detention basins in this area. Groynes exist along the Tweed River in this area (3).

2.14.8 Dams

a. There no downstream dam consequences identified for this area (3).

2.14.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.14.10 Other Considerations

a. No other considerations have been identified in this sector.

2.15 BOGANGAR, CABARITA BEACH AND HASTINGS POINT

2.15.1 Community Overview

a. This sector includes the suburbs of Casuarina, Kings Forest, Duranbah, Tanglewood, Bogangar, Cabarita Beach, Round Mountain and Hastings Point. It also includes the part of Kingscliff to the east of Cudgen Creek and along South Kingscliff Beach, as well as the northern part of Pottsville. The sector has a total population of 12667 people living in 5697 dwellings.

b. The majority of settlement is along the coastal fringe, with Kingscliff, Casuarina, Bogangar, Cabarita Beach, Hastings Point and Pottsville the largest centres.

c. **Casuarina** has a population of 3256 people living within 1355 dwellings. It has a 2.4% Indigenous population, with 24.4% of the population under 14 years of age, and 12.3% over 65.

d. **Cabarita Beach** has a population of 101 people living within 71 dwellings.

e. **Bogangar** has a population of 3313 people living within 1430 dwellings. It has a 5.3% Indigenous population, with 21% of the population under 14 years of age, and 15.4% over 65.

f. **Hastings Point** has a population of 661 people living within 484 dwellings. It has a 3.2% Indigenous population, with 6.5% of the population under 14 years of age, and 55.5% over 65 (20) (20).

g. Kingscliff is described in further detail in the Chinderah-Kingscliff sector, and Pottsville in the Pottsville-Wooyung sector.

h. Bogangar and Cabarita Beach are shown on Map 16 and Hastings Point is shown on Map 17.

2.15.2 Characteristics of flooding

a. Bogangar, Cabarita Beach and Hastings Point are affected by flooding generated by heavy rainfall over the Cudgen catchment. They can also be affected by storm surge or exceptional tidal conditions (3).

2.15.3 Flood Behaviour

a. Flooding in this sector is influenced by the Cudgen and Cudgera Creek catchments.

b. **Cudgen Creek:** Cudgen Creek is the main creek affecting Bogangar and Cabarita Beach and further to the north towards Kingscliff where Cudgen Creek eventually discharges to the ocean. Cudgen Creek is fed by the catchments of Reserve Creek and Clothiers Creek, however is also linked to the Christies Creek catchment upstream of the Pacific Highway. These creeks drain into Cudgen Lake located to the west of Bogangar which provides only minimal flood attenuation due to its shallow nature. Downstream of

Cudgen Lake flood flows are constricted within Cudgen Creek before discharging onto the broader floodplain. Old Bogangar Road near the Tweed Coast Road forms a barrier to flood flows, except for the bridge over Cudgen Creek. Downstream of Old Bogangar Road the flood behaviour is influenced by tidal conditions. The flood gradient within this section is relatively flat.

c. **Cudgera Creek:** Hastings Point is primarily affected by flooding from the Christies Creek and Cudgera Creek Catchments which meet just prior to discharging into the ocean at Hastings Point. Christies Creek is also linked to the Cudgen Creek Catchment upstream of the Pacific Highway (6).

2.15.4 Classification of Floodplain

a. The Bogangar/Cabarita Beach/Hastings Point sector is a High Trapped Perimeter to the east of Tweed Coast Road from south of Casuarina Beach to the North of Hastings Point with Rising Road Access from the hinterland.

b. There is another High Trapped Perimeter from Hastings Point to the northeast of Pottsville with Rising Road Access (38).

OBJECTID	Polygon Name	Population Estimate	Dwelling Estimate	Vehicle Estimate	Comment
45628	Kingscliff J	9	3	5	Rising Road Access
46415	Pottsville A	7	3	5	Rising Road Access
46421	Clothiers Creek East A	5	2	4	Overland Escape Route
46017	Kingscliff K	33	13	23	Rising Road Access
45625	Kingscliff South B	2569	1171	2107	High Trapped Perimeter
45626	Kingscliff South C	432	234	421	Rising Road Access
45620	Cabarita North A	636	291	524	Low Flood Island
46416	Clothiers Creek East B	14	6	10	Overland Escape Route
45623	Kingscliff South A	710	271	488	Rising Road Access
45617	Cabarita West	3	1	2	Rising Road Access
46018	Kingscliff South D	N/A	N/A		Rising Road Access
42414	Kingscliff I	1974	893	1607	High Trapped Perimeter
46479	Depot Road	2	1	2	High Flood Island
46482	Round Mountain Road West	N/A	N/A		Overland Escape route
46016	Cabarita South B	952	429	772	Indirectly Affected Area
45618	Reef Water Circuit	107	40	72	Low Flood Island
45621	Cabarita North B	91	59	106	Rising Road Access
41708	Kingscliff G	424	153	275	Rising Road Access
46417	Pottsville B	N/A	N/A		Rising Road Access
46483	Cudgera Creek	N/A	N/A		Rising Road Access
45627	Cabarita East A	284	157	283	High Trapped Perimeter
45616	Cabarita South	1883	812	1461	Rising Road Access

2.15.5 Inundation

a. There is no flood forecasting gauge within this sector. However, water level gauges exist at Cudgen Creek south of Kingscliff (202434), and at Cudgen Lake in Bogangar (202416 - 558043), as well as a barometric gauge at Kingscliff (202418 – 558050).

b. **South Kingscliff** lies mainly outside of the flood extent, however, can become isolated.

c. **Cabarita-Bogangar**

d. 20-10% AEP: Clothiers Creek Road is predicted to be inundated at the creek crossing west of Cabarita Road from a 10% AEP design flood event. Access to the Pacific Motorway via Clothiers Creek Road however is lost in flood events less than the 20% AEP design event on the Tanglewood floodplain.

e. 5% AEP: Parcels along Tamarind Avenue, Bogangar start to be inundated from backwaters from Cudgen Lake and the Cudgen Creek floodplain in events less than the 5% AEP design event. Tamarind Avenue in Cabarita-Bogangar is a low-lying area that is frequently flooded.

f. 2% AEP: In a 2% AEP design event, the inundation also covers the area between Rosewood Avenue and Mimosa Avenue and into Hastings Road Bogangar, with waters predicted to break out of the Friday Island canal across Rosewood Avenue.

g. 1% AEP: Most of the area to the north of Rosewood Avenue Bogangar is predicted to be inundated, with depths generally below 0.5m. Flood waters are also predicted to cross over east of Hastings Road towards commercial land in the Cabarita Beach CBD for this event.

h. PMF: In a PMF event, peak flood levels are predicted to reach 5.7m AHD in this area, generating flooding for most of the area north of Sandalwood Drive, Bogangar and west of the Tweed Coast Road, (this floodplain area was filled for residential development). Cabarita Beach to the east of the Tweed Coast Road is located on the high coastal dune, so is predicted to remain flood free (39).

Hastings Point

i. 5% AEP: Land parcels along Creek Street to the north of Christies Creek are predicted to be flooded in a 5% AEP event with peak flood levels of around 2.2m AHD. Overland flooding is also predicted in Young Street near the bend in Cudgera Creek.

j. 1% AEP: During a 1% AEP event flood levels are predicted to reach up to 2.5m AHD, which would mean up to 1m of floodwater over the ground level in places.

k. PMF: During a PMF event water levels are predicted to be as high as 3.9m AHD, or 2.5m of water above ground level. During a PMF event the area south of Peninsula Street and east of Tweed Coast Road is also expected to be flooded (39).

2.15.6 Isolation

a. Access from the south can be cut by local heavy rainfalls, but usually for periods of less than 12 hours. Access from the north depends on the flood situation at Chinderah. Roads can be inundated for up to 3 days (3).

b. Main access roads for this area include the Tweed Coast Rd running north/south, which may experience inundation in major flood events.

2.15.7 Flood Mitigation Systems

a. There are no flood mitigation systems within this area (3).

2.15.8 Dams

a. There are no dams within this area (3).

2.15.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.15.10 Other Considerations

a. This area attracts people for regular daily visits as well as short term holidays and scheduled school holidays.

b. Additionally, events occurring in Cabarita may mean an increased number of visitors to the area include;

    i. Tweed Coast Pro in February with anticipated attendance of 500-1000 people, at Lions Park, Norries Cove and Cabarita Headland.

2.16 POTTSVILLE WOOYUNG

2.16.1 Community Overview

a. The Pottsville sector includes the suburbs of Pottsville, Wooyung, Crabbes Creek, Upper Burringbar, Burringbar, Mooball, Sleepy Hollow and part of Cudgera Creek.

b. The northern part of Pottsville Village, Seabreeze Estate and Koala Beach Estate are in the Cudgera Creek Catchment. The southern part of Pottsville Village, Pottsville Waters and Black Rocks Estate are in the Mooball Creek Catchment.

c. **Pottsville** has a population of 7209 people living within 2884 dwellings. It has a 3.5% Indigenous population, with 23.4% of the population under 14 years of age, and 20.9% over 65.

d. **Wooyung** has a population of 139 people living within 62 dwellings.

e. **Crabbes Creek** has a population of 343 people living within 137 dwellings.

f. **Upper Burringbar** has a population of 289 people living within 151 dwellings.

g. **Mooball** has a population of 193 people living within 74 dwellings.

h. **Sleepy Hollow** has a population of 123 people living within 48 dwellings.

i. Burringbar, Mooball and Crabbes Creek villages are located within the upper Mooball Creek catchment within the Tweed Coastal Creek catchments, upstream of the Motorway. Burringbar has a population of 878 living in 299 dwellings. Mooball has a population of 193 living in 74 dwellings and Crabbes Creek has 343 people living in 137 dwellings (20).

j. Pottsville and Wooyung are shown on Map 18.

2.16.2 Characteristics of flooding

a. Pottsville and Wooyung are affected by flooding generated by heavy rainfall over the Cudgera and Mooball Creek Catchments, storm surge or exceptional tidal conditions.

b. Burringbar, Mooball and Crabbes Creek lie within the Mooball Creek catchment and are affected by high flow flash flooding from the two main creeks within the catchment, Burringbar Creek and Crabbes Creek (5).

2.16.3 Flood Behaviour

a. Cudgera Creek is constricted by high land upstream of Seabreeze Estate. Downstream the floodplain widens into an estuarine creek. Significant flows also occur between Cudgera Creek and Christies Creek across agricultural (sugar cane) land. Cudgera and Christies Creek converge at Hastings Point before discharging to the ocean.

b. Downstream of the Pacific Highway the Mooball floodplain becomes wider. Mooball Creek runs parallel to the coastline, has a flat gradient and wide floodplain. Water is

constricted by filled developments of Black Rock and Pottsville Waters Estates. The area west of Pottsville has a very flat gradient and low flood velocities (39).

c. The upper catchment areas including Burringbar, Mooball and Crabbes Creek convey high flood flows and are part of the floodway. Flooding within these areas can be very fast from the onset of rainfall (6).

d. Burringbar Creek is relatively constrained by the topography in this area, so that the extent of flooding does not vary much between the different flood events (except for extreme events like the PMF). This also means that the floodwaters cannot spread out, resulting in high velocities and depths (3).

e. Mooball experiences similar high velocities and depths to Burringbar (6). The area north of the railway line lies within the 'active' floodplain of Burringbar Creek, where secondary flow paths develop during flood events (3).

2.16.4 Classification of Floodplain.

a. The areas of Black Rocks Estate, Pottsville Area, southeastern parts of Koala Beach Estate are Low Flood Islands (6).

b. The Koala Beach Estate is primarily a High Flood Island predicted to remain flood free over nearly the entire area (6) (39). Part of south Pottsville (around Kellehers Road area) is also a High Flood Island in a PMF event (6).

c. Mooball and Crabbes Creek are both Low Flood Islands.

d. Burringbar has Rising Road Access (38).

2.16.5 Inundation

a. A Flash Flood Warning System is in place for parts of Burringbar and Mooball for the Burringbar Creek catchment and Crabbes Creek Village in the Crabbes Creek catchment. Local rain and stream gauge data along with Bureau of Meteorology predictions are used to provide warning messages to local residents who have opted into the system. This system is owned and operated by Tweed Shire Council.

b. Gauges within this area exist on Mooball Creek at Pottsville (202435), as well as rainfall and water level gauges in Burringbar Creek and Crabbes Creek.

Seabreeze Estate

c. 1% AEP: Inundation of open spaces and roadways is predicted for events similar or greater than a 1% AEP flood event, including flooding of the north-eastern corner of Lennox Circuit and the intersection of Seabreeze Boulevard and Ballina Street. Flood levels in this event range from 5.04m AHD at Newcastle Drive, to 3.03m AHD at Lennox Circuit (39).

d. 0.2% AEP: Flooding extends east along Seabreeze Boulevard, with depths of water of more than 0.5m (but less than 1m) at the Koala Beach Link Road. Flood levels in this event range from 5.05m AHD at Newcastle Drive, to 3.09m AHD at Lennox Circuit (39).

e. PMF: Peak flood levels are predicted to reach up to 4.6m AHD, generating up to 2m of flooding north of Mylestom Circle and Korora Parkway. The northern part of Lennox Circuit is also predicted to be flooded in this extreme event, with depths below 1m. Seabreeze Boulevard is predicted to become a major flow path in this event (39).

Koala Beach Estate

f. 2% to 0.2% AEP: Only the reserve to the east of Muskheart Circuit is predicted to start being inundated in a 2% AEP event, with peak depths below 0.5m in a 0.2% event. Flood levels in a 0.2% AEP event may range from 2.51m AHD at Link Road Bridge, to 2.51m AHD at Cudgera Ave Bridge (39)

g. PMF: Cudgera Avenue and properties on the eastern half of Muskheart Circuit, and west of Lomandra Avenue are predicted to be inundated with depths of water of up to 2m in a PMF event. Local streets such as Muskheart Circuit, Bandicoot Street and Sugar Glider Drive are predicted to become major flow paths during this event (39).

Pottsville

h. 2% AEP: The creek linking Mooball Creek and Cudgera Creek catchments is predicted to break out downstream of Pottsville Road and generate minor flooding along and to the north of Coronation Avenue (Pottsville Village CBD) (12). Mooball Creek is also predicted to break out and inundate residential land along Philip Street.

i. 1% AEP: Inundation extends northward across the village green between Phillip St and Tweed Coast Road.

j. 0.2% AEP: Pottsville Road and Coronation Avenue may be inundated, with floodwaters from Mooball Creek and Cudgera Creek connecting overland through the CBD.

k. PMF: Almost the entire area is predicted to be inundated, with depths of water of up to 2m creating a major flow path with the connection of floodwaters from Mooball Creek and Cudgera Creek, with velocity higher than 1 m2/s in some sections (39).

Pottsville Waters & Black Rocks Estates

l. 1% AEP: Pottsville Waters and Black Rocks Estates are predicted to remain flood free for all flood events up to the 1% AEP design event.

m. 0.2% AEP: In a 0.2% AEP event, floodwaters are predicted to inundate most filled estates north of McKenzie Avenue as water from the Sheens Creek floodplain joins waters from Mooball Creek.

n. PMF: The entire area is predicted to be underwater in a PMF event, with flood levels up to 5.6m AHD at the southern end of the development. Peak flood depths of up to 3m in places are predicted although flow velocities remain low (39).

Wooyung

o. Wooyung Road is inundated at the canal crossing west of Tea Tree Road from Crabbes Burringbar Creeks. It is then overtopped east of Tea Tree Road when floodwaters from Mooball Creek backup to the South in the vicinity of the Wooyung Caravan Park (30).

p. Historical: In 2017, 7 properties in Wooyung Beach Holiday Park were damaged. This included caravans, 1 severe, 3 moderate and the remainder slightly damaged (35).

q. 1% AEP: Flood velocities are anticipated to change from low flow to medium flows at the canal crossing flow path as velocities increase across the road (30).

r. 0.2% AEP: The floodplain east of Tea Tree Road is constrained by the coastal dune system, hence the extent of flooding does not vary. Peak flood levels are however predicted to go up by approximately 1m between the 20% and 0.2% AEP events.

s. PMF: Another 1m depth is predicted. In this event, the entire length of Wooyung Road east of the high ground is predicted to be overtopped with depths of up to 4m (12).

Burringbar

t. In a flash flood event, key areas of inundation in Burringbar include areas in the vicinity of Dignan St, Hunter St and Tweed Valley Way.

u. 20% AEP: Overland flooding is predicted in relatively frequent flood events along Burringbar Creek affecting residential properties around Hunter Street and Tweed Valley Way, south of the Burringbar Creek Bridge. Depths of up to 2m are predicted for the 20% AEP design flood event at the back of parcels east of the Tweed Valley Way, where creek breakouts create a major flow path. Peak flood levels for this event may be approximately 17.76m AHD at the Tweed Valley Way bridge at Burringbar (39).

v. 5-10% AEP: Properties on the southern side of the Broadway begin to be affected, as the creek breaks out and water travels northwards. Peak flood levels for this event may range from approximately 18.08-18.57m AHD at the Tweed Valley Way bridge at Burringbar (39).

w. 1% AEP: Many parts of the township are predicted to be inundated by flooding from Burringbar Creek, including rural residential development in Greenvale Court. This area is predicted to remain subject to low flood flows, whereas the other inundated areas are located within the floodwater conveyance paths and as such are characterised by medium to high flows (particularly east of Tweed Valley Way). Peak flood levels for this event may be approximately 19.01mAHD at the Tweed Valley Way bridge at Burringbar (39)

x. PMF: In a PMF event, the entire area between Burringbar Creek and Burringbar Road is predicted to be inundated, and the railway line is predicted to be overtopped in two sections: near Greenvale Court entrance, and north of the Hunter Street / Tweed Valley Way junction (39).

Mooball

y. In a flash flood event, both northern and southern sections of Mooball in proximity to the railway embankment are susceptible to inundation.

z. 20% AEP: Extensive developed areas are predicted to be inundated in the 20% AEP design flood event. It is noted that backwater flooding is also predicted to the south of the railway line and Tweed Valley Way. However, this area is characterised by low velocities and depths of less than 0.5m. Peak flood levels for this event may be approximately 12.77m AHD at the Quinns Bridge on Pottsville Mooball Rd at Mooball (39).

aa. 1% AEP: In a 1% AEP event, the entire floodplain north of the railway line is expected to be inundated, with depths up to 2m in places. Ponding of backwater on the southern side of the Tweed Valley Way is also predicted to increase to depths of about 2m locally. Peak flood levels for this event may be approximately 13.21 m AHD at the Quinns Bridge on Pottsville Mooball Rd at Mooball (39).

bb. PMF: In a PMF event, the entire township of Mooball is predicted to be inundated, extending some 250m south of the Tweed Valley Way. High peak depths and velocities are predicted to the north of the railway line, with most of the floodplain subject to high flood flows. The area south of the Tweed Valley Way is predicted to be subject to medium flood flows (39).

Crabbes Creek

cc. Although Crabbes Creek is predicted to break out at the Crabbes Creek Road bridge in a 20% AEP design flood event, the inundation is not predicted to reach the school and general store (at the road) up to the 1% AEP design flood event. This flooding is mainly due to the constrictions of flow downstream at the Tweed Valley Way. In a PMF event, the entire township is expected to be underwater, with the main path to convey flood waters (high to medium flows) breaking out of the creek and into the back of the school and general store (12).

2.16.6 Isolation

a. Koala Beach Estate becomes isolated by road in the PMF event (3).

b. Burringbar, Mooball and Crabbes Creek can all be isolated during flood events, with road closures occurring along major access routes including the Tweed Valley Way.

2.16.7 Flood Mitigation Systems

a. Levees within the sector are described below.

Seabreeze Levee	
Location	The Seabreeze Levee is situated along Cudgera Creek to protect the Seabreeze Estate at Pottsville *(40)*.
Type of Levee (ring etc.)	Partial levee
Owner	Tweed Shire Council
Design Height and freeboard	Designed to the June 2005 flood of record + freeboard.
Overtopping Height	The levee is designed to provide protection to an approximately 1% AEP event.
No. of properties protected	The levee is designed to protect properties within the Seabreeze Estate
Known low points	-
Location and sequence of inundation	The levee has no spillways or pump. Expected time to fill to levee height is approximately 1-2 hours *(40)*.
Consequences of levee overtopping or failure	Inundation of properties within the estate.
Deficiencies	No known deficiencies

2.16.8 Dams

a. There are no known dam effects within this sector (3).

2.16.9 At Risk Facilities

a. The facilities that are at risk of flooding and/or isolation within the Tweed Shire LGA including schools, childcare centres, hospitals, aged and infirm, infrastructure and caravan parks are shown in Annex 3.

2.16.10 Other Considerations

a. Events occurring in Pottsville may mean an increased number of visitors to the area include;

   i. Tweed Coast Enduro on 24-25 February with anticipated attendance of 2000-3000 people.

   ii. The Northern Rivers Rail Trail also experiences regular use between Mooball and Murwillumbah, which can result in an increase in visitors to the area.

SPECIFIC RISK AREAS – COASTAL EROSION

Point Danger to Cape Byron

b. Tweed Shire's coastline extends some 37 kilometres from Wooyung in the south to Point Danger on the NSW – Queensland border. It comprises extended sandy beaches between rocky headlands and nearshore reefs, the entrances to coastal estuaries at Pottsville, Hastings Point, Kingscliff and the Tweed River.

c. The most significant threat to development and assets in the region due to severe beach erosion is at Kingscliff (41). This is due to a number of processes;

d. The Coastline in the Tweed Shire is broken up into five units which include:

   i. Wooyung to Hastings Point

   ii. Hastings Point to Norries Head

   iii. Norries Head to Sutherland Point (Cabarita, Bogangar and Casuarina Beaches)

   iv. Sutherland Point to Fingal Head (Kingscliff/Dreamtime Beach)

   v. Fingal Head to Point Danger (3).

2.17 WOOYUNG TO HASTINGS POINT

a. There is no development within the immediate hazard zone that is under threat from coastal erosion or oceanic inundation.

2.18 HASTINGS POINT TO NORRIES HEAD

a. There is no development within the immediate hazard zone (41).

2.19 NORRIES HEAD TO SUTHERLAND POINT - CABARITA, BOGANGAR AND CASUARINA BEACHES

a. The immediate hazard zone does not impinge on any developed areas within this beach unit.

b. The dune system is generally sufficiently high to accommodate elevated water levels during storm events without direct inundation from the sea. However, there are some areas at the southern end of the Cabarita township where the dunes are only around 5m AHD and under extreme conditions it is possible that some oceanic inundation may occur.

2.20 SUTHERLAND POINT TO FINGAL HEAD

a. Dreamtime Beach extends northward from Sutherland Point some 7 km to Fingal Point. The township of Kingscliff fronts the southern-most 3 km of the beach. At Fingal, a small settlement (about 26 allotments) is located on the seaward side of Wommin Lake, extending about 700 metres south of Fingal Point.

b. Development is set back from the beach along this beach unit except at Kingscliff where the Kingscliff Bowls Club is located on the dune system and has been protected from erosion by a rock revetment seawall (3)

c. A number of coastal hazards may threaten property or assets within Kingscliff, those which may threaten development include;

   i. Erosion, including immediate storm erosion. The main area where the immediate hazard line for coastal erosion extends into development is between the Cudgen Surf Lifesaving Club and the Kingscliff Bowls Club. It should be noted the hazard line has been drawn landward of the Bowls Club building on the basis of no seawall being in place. The realisation of the erosion threat at this location will be dependent on future management decisions on whether the seawall is to be maintained to a suitable standard to withstand cyclonic erosion.

   ii. Coastal inundation due to ocean wave runup and overtopping of dune barriers may also threaten the area stated above (41).

d. The surf club suffered coastal erosion problems in the events of 2012.

2.21 FINGAL HEAD TO POINT DANGER

a. Letitia Spit extends some 3.6 km in a north-northwest direction from Fingal Head towards Point Danger, controlled at its northern end by the Tweed River break walls. It is bounded on its western side by the training walls of the Tweed River.

b. The village of Fingal extends a short distance north from the headland, generally set back from the main dune escarpment except for the Surf Club and caravan park.

c. There is a small area in the vicinity of the Tweed Holiday Park and Fingal Surf Life Saving Club that lies seawards of the immediate erosion hazard line (41).

d. The surf club suffered coastal erosion problems in the events of 2012

e. At Duranbah Beach the alignment and sand supply are primarily governed by the operation of the Tweed River Entrance Sand Bypassing Project. Under the project

Duranbah Beach is receding to a position some 50 to 80 metres landward of its 2002 position.

f. Coastal erosion and oceanic inundation may impact on Flagstaff Beach Road (3).

ROAD CLOSURES AND ISOLATED COMMUNITIES

2.22 ROAD CLOSURES

a. Table 22 lists major roads liable to flooding in the Tweed Shire LGA, [these locations are shown on Maps 3-17 Town Maps). Please note this includes only major thoroughfares and that there will also be local road closures.

Table 22: Roads liable to flooding in Tweed Shire LGA.

Sector	Road	Closure location	Consequences of closure	Alternate route	Indicative Gauge height
Chillingham	Numinbah Road	Bridge over Rous River	Evacuation route to Chillingham cut	None	5m at North Murwillumbah gauge (201420 - 58186)
Murwillumbah					
	Queensland Road	Before Murwillumbah Showgrounds	Access to Dungay cut off	None	2.1m at North Murwillumbah gauge (201420 - 58186)
	Kyogle Road	50m west of SES HQ	Alternate route available	Via local roads to evacuation routes	3m at North Murwillumbah gauge (201420 - 58186)
	Nullum Street	Wollumbin Street	Access to evacuation center cut off	Alternate route on local roads	3.5m at North Murwillumbah gauge(201420 - 58186)
	Commercial Road	Hartigan Street	Nil	Alternate route available	4.5m at North Murwillumbah gauge (201420 - 58186)
(South Murwillumbah)	Tweed Valley Way	Intersection of Buchanan St	Evacuation route from South Murwillumbah cut off. Up to 3 days for flood waters to recede, 4 days or more during 0.2% AEP event (17).		5.2m at North Murwillumbah gauge (201420 - 58186)
	Kyogle Road	Southern Bride at intersection of Oxley and Tweed rivers	Evacuation route to Uki cut off	Park Avenue and North Arm Road	5.8m at North Murwillumbah gauge (201420 - 58186)
Tumbulgum	Tweed Valley way	East of Riverside Drive	All access out of Tumbulgum is cut		2m at Tumbulgum gauge (201432 – 558014)
Chinderah	Chinderah Road	North of Pacific Motorway offramp	Evacuation route cut off	None, evacuation should occur	1.8m at Chinderah

				before Tweed Coast Road is closed to the south	gauge (201426 - 558010)
	Tweed Coast Road	Southeast of Chinderah Golf Course	Evacuation route cut off		1.7m at Chinderah gauge (201426 - 558010)
Terranora	Bilambil Road over Duroby Creek		Access to Terranora and Bilambil evacuations centers cut. Bilambil isolated.		
Tweed Heads South	Dry Dock Road	West of Pacific Motorway bridge over Terranora Creek	Isolation of Tweed Heads South	None	1.2m at Dry Dock gauge (201428 - 558029)
Tweed Heads West	Scenic Drive	Scenic Drive and Gull Place intersection	Access to Bilambil evacuation center cut off	None	2.8m AHD at Dry Dock gauge (201428 - 558029)
	Kennedy Drive	Kennedy Drive bridge over Tweed River	Evacuation routes cut		2.5m AHD on Dry Dock gauge (201428 - 558029)
Tweed Heads	Minjungbal Drive	South of the bridge in various locations	Access to evacuation routes cut off		
Fingal Head	Fingal Road	Bambery Street	Fingal isolated	None	1.3m at Chinderah gauge (201426 - 558010)
Bogangar, Cabarita and Hastings Point	Tweed Coast Road	From Intersection of Yugari Drive in the south, to Round Mountain Road to the South	Evacuation routes cut		
Pottsville Wooyung	Tweed Coast Road	Elanora Avenue	Evacuation Route cut in PMF event		

2.23 SUMMARY OF ISOLATED COMMUNITIES AND PROPERTIES

a. Table 23 lists communities liable to isolation and potential periods of isolation. Information presented here is based on historical information and does not reflect the duration of isolation expected in larger and extreme events.

b. Arterial roads can be cut by floodwater which can isolate the villages of Nobby's Creek, Chillingham, Crystal Creek, Dungay (access to Qld via Tomewin), Stokers Siding (access Smiths Creek Road), Uki, Richard's Deviation, Stokers Siding Road, Byangum Road, North Arm Road, Kyogle Road, Dallas Park, Bakers Road at Anthony's Flats become flood affected resulting in difficulty with movement out of and into the council area from the south and west (3).

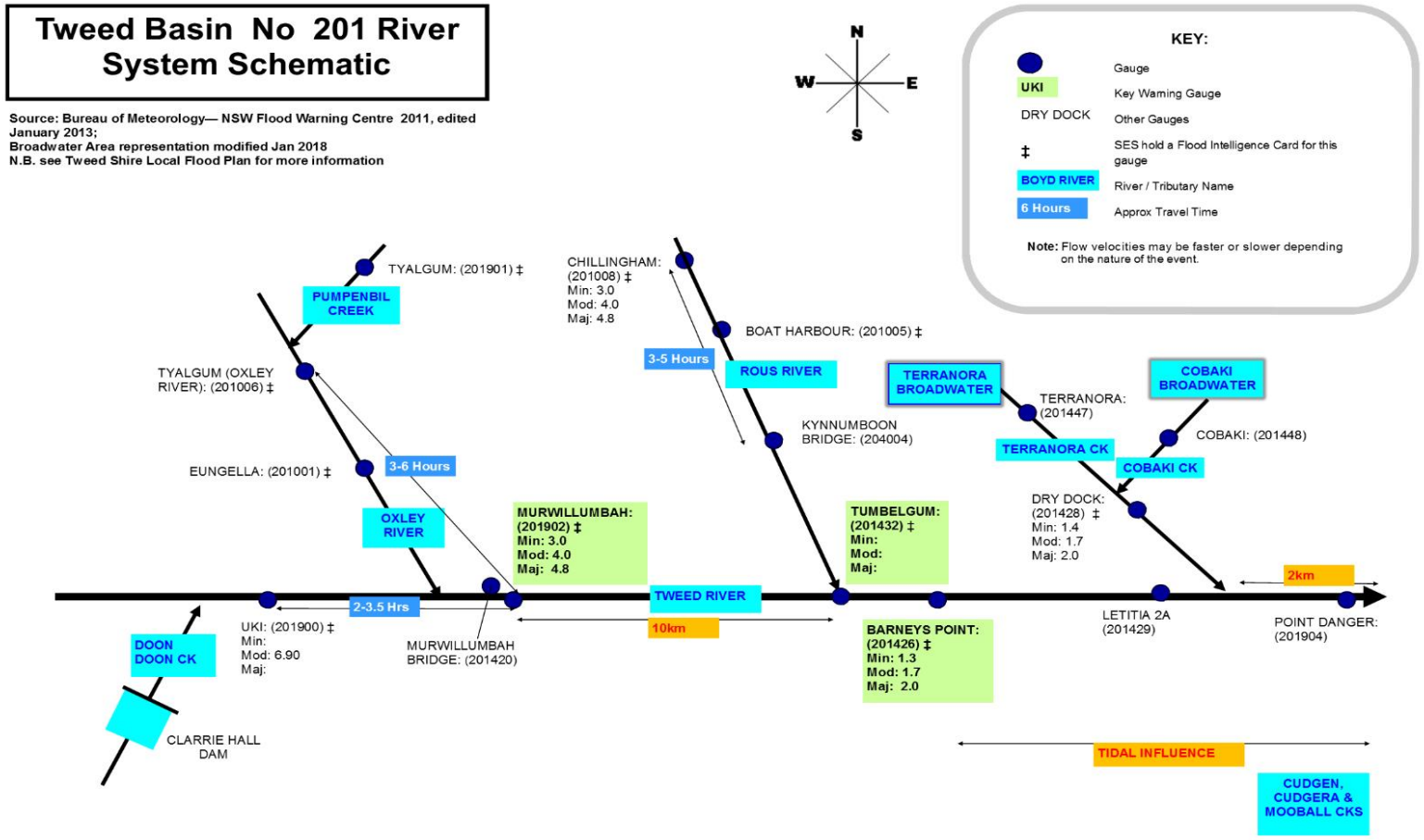
Table 23: Potential Periods of Isolation for communities in the Tweed Valley LGA during a Major flood.

Town / Area (River Basin)	Population/ Dwellings	Flood Affect Classification	Approximate period isolation	Days								NOTES
				1	2	3	4	5	6	7	8	
Fingal Heads	687pp, 347 dwellings	Low Trapped Perimeter	Up to 4 days									Sewerage, power and water services at risk of failure. Becomes isolated when Fingal Road Cuts.
Kingscliff	Up to 8355 pp, 4077 dwellings	High Flood Island	Up to 5 days									Sewerage, power and water services at risk of failure.
Tweed	Up to 9176 pp, 5309	Low Flood Island	Up to 4 days									Sewerage, power and water services at risk of failure.
Banora	Up to 18,467pp, 8310 dwellings	Rising Road Access	Up to 4 days									The Banora sector may become isolated with closure of main access routes.
Condong	314pp, 115 dwellings	Low Flood Island	Up to 4 days									Isolation may occur from 4m at Murwillumbah gauge
Terranora	Up to 3365pp, 1157 dwellings	High Flood Island/ Overland Escape Route?	Up to 4 days									
Tumbulgum	382pp, 156 dwellings in village area. 72 in rural area.	Low Flood Island	Up to 4 days									
North Tumbulgum	238pp, 82 dwellings	Overland Escape route into a High Trapped Perimeter.	Up to 4 days									
Bilambil/ Bilambil Creek	3935pp, 1555 dwellings	Rising Road Access to High Flood Island	Up to 3 days									
Duroby	Up to 192 in 80 dwellings	Indirectly affected area	Up to 3 days									Isolated after Beltana Drive cut

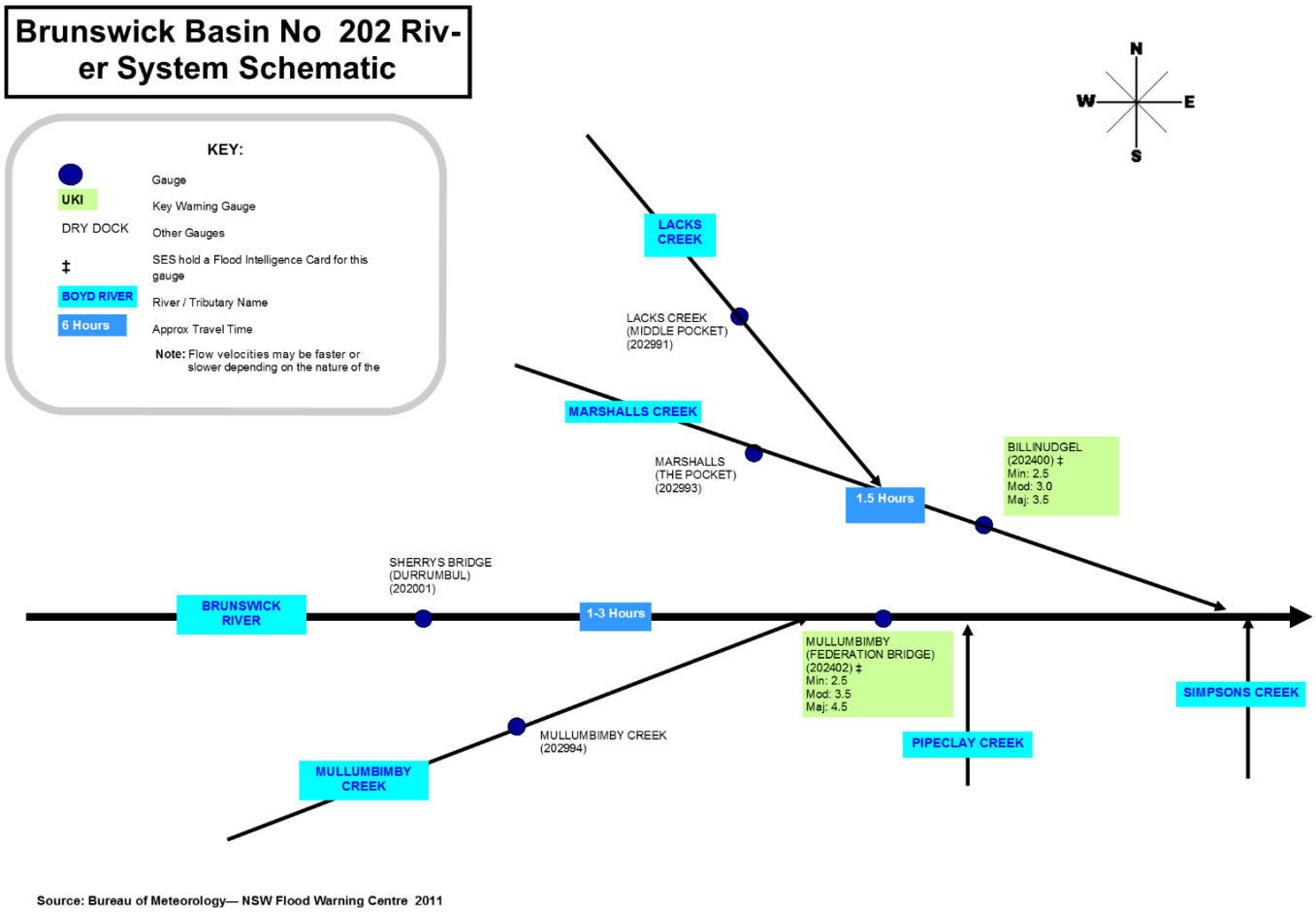
Bogangar/ Cabarita	12,667pp within sector	Rising road access to High Flood Islands.	Up to 4 days								Sewerage under threat
Hastings Point	661pp, 484 dwellings	High Trapped Perimeter	Up to 4 days								
Chillingham	Up to 3000	Rising Road Access	Up to 3 days								Aerial movement usually restricted in early stages of flood due to low cloud and poor visibility
Murwillumbah	7616pp, 3360 dwellings.	Low Flood Island	Up to 4 days								Sewerage, power and water services at risk of failure.
Tyalgum	206pp, 98 dwellings in township, 1063pp, 499 dwellings in sector	Rising Road Access	Up to 2 days								Sewerage, power and water services at risk of failure.
Uki	211pp, 104 dwellings in village, 2020pp in sector.	Rising Road Access	Up to 3 days								Multiple rural settlements which have single road access which may also become isolated in the Uki sector.
Wooyung	Up to 700pp, 273 dwellings	Low Flood Island	Up to 3 days								Includes Crabbes Creek, Mooball.
Pottsville	Up to 7209pp, 2884 dwellings	Rising Road Access	Up to 3 days								
Burringbar	1200pp in 522 dwellings	Rising Road Access	Up to 3 days								

Note: Periods of isolation are a guide only. Liaison with the Local Controller and communities/residents involved is essential during periods of potential and actual isolation.

ANNEX 1: TWEED RIVER BASIN SCHEMATIC



ANNEX 2: BRUNSWICK RIVER BASIN SCHEMATIC



Source: Bureau of Meteorology— NSW Flood Warning Centre 2011

ANNEX 3: FACILITIES AT RISK OF FLOODING AND/OR ISOLATION

Tweed River Valley

- Please note that inundation data is based on inundation layers currently available to SES and will need to be updated once inundation layers from the 2023 Tweed Valley Flood Study are finalized and uploaded onto GEMS. References to either AEP design event or gauge height are based on available data on GEMS and from Flood Intelligence Cards. References to both Design events and gauge heights for the Dry Dock gauge (201428 - 558029) have been updated with new data from the 2023 Tweed Valley Flood Study Update and vary significantly from the previous 5% AEP design height.

Facility Name	Street	Suburb	Comment
Schools			
Centaur Primary School	1 Eucalyptus Drive	Banora Point	This school is vulnerable to a PMF event (38)
Banora Point High School	2 Eucalyptus Drive	Banora Point	This school is vulnerable to a PMF event (38).
St James' Primary School	2 Boyle Avenue	Banora Point	This school is vulnerable to a flood event equal to or greater than a 5% AEP event (0.78m AHD Dry Dock gauge 201428 - 558029). In a 20yr ARI event it is estimated that the flood depth within the school will be between 0.0m – 0.5m.
St Joseph's College	2 Doyle Drive	Banora Point	This school is vulnerable to a flood event equal to or greater than a 5% AEP (0.78m AHD Dry Dock gauge 201428 - 558029). In a 5% AEP event it is estimated that the flood depth within the school will be between 0.0m – 0.5m.
Bilambil Public School	418 Bilambil Rd	Bilambil	This school is vulnerable to a PMF event (38).
Carool Public School	411 Carool Road	Carool	
Chillingham Primary School	1420 Numinbah Rd	Chillingham	This school is vulnerable to a flood event equal to or greater than a 5% AEP event (0.78m AHD Dry Dock gauge). In a 5% AEP event it is estimated that the flood depth within the school will be 0-0.5m.
Condong Public School	77 McLeod St	Condong	This school is vulnerable to a 20% AEP event (38).

Crystal Creek Public School	813 Numinbah Rd	Crystal Creek	Outside of PMF extent (38).
Cudgen Public School	11 Collier St	Cudgen	Outside of PMF extent (38).
Dungay Public School	305 Tomewin Road	Dungay	Tomewin Rd is closed at around 4.5m on the Boat Harbour gauge. Students may require early release prior to this height.
Duranbah Public School	105 Duranbah Road	Duranbah	
Fingal Head Public School	100 Letitia Rd	Fingal Head	Fingal Head township is isolated when Fingal head Road closes around 1.3m at Chinderah gauge. Unclear if this is flooded or not during a PMF.
St Anthony's Primary School	23 Boomerang Street	Kingscliff	Identified within the Tweed Coastal Creeks Floodplain Risk Management Study (2015) as a vulnerable institution (6)
Kingscliff High School	33 Oxford Street		Outside of PMF extent and able to access evacuation centres
Mount St Patrick Primary School	30 Mooball Street	Murwillumbah	Vulnerable in events greater than 20% AEP but located close but evacuation route accessible.
Murwillumbah East Public School	45 George St Murwillumbah	Murwillumbah	Located outside of the East Murwillumbah levee. Inundation is predicted during events as frequent as the 20% AEP event
Mount St Patrick College	143 Murwillumbah Street	Murwillumbah	One space on grounds may be inundated by events as frequent as a 20%AEP, however buildings are not inundated up to and including a 0.2%AEP flood.
Murwillumbah High School	86 Riverview St	Murwillumbah	The grounds are partially affected in a 20% AEP, however buildings are not affected until the PMF (12)
Murwillumbah Primary School	Prince St	Murwillumbah	Shallow inundation of the southern portion of the school grounds is predicted from a 20% AEP, and access may be cut.
Sathya Sai College	9 Nullum Street	Murwillumbah	May be inundated or have access roads cut from a 20%AEP
TAFE NSW - North Coast Institute Murwillumbah Campus	Murwillumbah Street	Murwillumbah	The TAFE buildings are predicted to remain flood free during all design flood events.
Tweed Valley Adventist College	9 Hall Drive	Murwillumbah	Vulnerable from 20% AEP event.
The Small School	8 King St	Murwillumbah	Vulnerable to inundation from events greater than 2% AEP
Murwillumbah South Infants School	427-433 Tweed Valley Way	South Murwillumbah	Access will be cut off from a 5% AEP event.

St Joseph's Primary School	3 Greville Street	South Murwillumbah	The school is located behind the South Levee and is affected at 4.8m when the levee overtops. Its located in a high hazard area with depths over 2m.
Stokers Siding Public School	246 Stokers Rd	Stokers Siding	
Aetaomah Steiner School	2486 Kyogle Rd	Terragon	
Terranora Public School	650 Terranora Road	Terranora	
Lindisfarne Anglican Grammar School	86 Mahers Lane	Terranora	
Tumbulgum Public School	Fawcett St	Tumbulgum	
Caldera School	37 Corporation Circuit	Tweed Heads South	
Pacific Coast Christian School	3a Acacia St	Tweed Heads	This school is vulnerable to a flood event equal to or greater than a 5% AEP event (0.78m AHD Dry Dock gauge). In a 5% AEP event it is estimated that the flood depth within the school will be between 0.0m – 0.5m.
Pacific Gulgangali Jarjums Christian School	3a Acacia St	Tweed Heads South	
Southern Cross University - Lakeside Campus	Caloola Drive	Tweed Heads	May have some flooding during a PMF event
Southern Cross University - Tweed Heads Riverside Campus	Brett St	Tweed Heads	May have some flooding during a PMF event
St Joseph's Primary School	3 Frances St	Tweed Heads	Vulnerable in a PMF event (38).
Lindisfarne Anglican Grammar School, Junior School	Sunshine Avenue	Tweed Heads South	Vulnerable from a 5% AEP event (38).
Tweed Heads South Public School	10 Heffron St	Tweed Heads South	This school is vulnerable to a flood event equal to or greater than a 5% AEP event (0.78m AHD Dry Dock gauge). In a 5% AEP event it is estimated that the flood depth within the school will be between 0.0m – 0.5m.
Tweed River High School	4 Heffron St	Tweed Heads South	This school is vulnerable to a flood event equal to or greater than a 5% AEP event (0.78m AHD Dry Dock gauge). In a 5% AEP

			event it is estimated that the flood depth within the school will be between 0.0m – 0.5m.
Tyalgum Public School	2 Coolman St	Tyalgum	
Uki Public School	1463 Kyogle Rd	Uki	
Childcare Centres			
Banora Point Early Learning and Childcare Centre	38 Woodlands Drive	Banora Point	This facility may become inundated in a PMF event (38).
Bright Buttons Learning Centre Banora Point	101-110 Leisure Drive	Banora Point	This facility may become inundated in a PMF event (38).
Kids Fun Club (OSHC)	Centaur State Primary School, 1 Eucalyptus Drive	Banora Point	This facility may become inundated in a PMF event (38).
Little Angels World of Learning	17 Covent Gardens Way	Banora Point	This facility may become inundated in a PMF event (38).
Wallum Community Preschool & Family Centre	Woodlands Drive	Banora Point	This facility may become inundated in a PMF event (38).
Bilambil Community Preschool	418 Bilambil Road	Bilambil	This facility is on the edge of the PMF extent but close to the Bilambil Public School evacuation centre (38).
Bili Kids	24 Buenavista Drive	Bilambil Heights	This facility is outside the flood extent and able to access evacuation route (38).
Chillingham Community Preschool	1411 Numinbah Rd	Chillingham	Outside of flood extent and close to evacuation centre (38).
Smiley Tots Childrens Centre	65 Wommin Bay Road	Chinderah	This facility may become inundated from 5% AEP event (38).
Beach Kids Early Learning & Preschool Centre	11 Waugh St	Chinderah	This facility may become inundated from 5% AEP event (38).
Story House Early Learning	30 Naru St	Chinderah	This facility may become inundated from 5% AEP event (38).
Kunghur Community Preschool	Corner Kyogle & Cooloon Streets	Kunghur	Outside of flood extent (38).
Petit Early Learning Journey Murwillumbah	5 Central Pde	Murwillumbah	This facility may become inundated from the 1% AEP event (38).

Uniting Preschool Murwillumbah	2-6 Byangum Road	Murwillumbah	The centre is located on sufficiently high ground to remain flood free during all design events up to and including the 0.2%AEP.
Joeys Pouch Early Years Educational and Preschool Centre Inc	40 Ewing St	Murwillumbah	This facility may become isolated at PMF event, evacuation should occur before this (38).
Murwillumbah Early Education Centre	55 Commercial Road	Murwillumbah	This facility may become inundated from the 20% AEP event (38).
Rosellas Community Preschool	Banner Street	Murwillumbah	This facility is outside the flood extent and able to access evacuation route (38).
Lindisfarne Anglican Grammar School OOSHc	Lindisfarne Anglican School, 36 Sunshine Avenue	Tweed Heads South	This facility may become inundated from the 5% AEP event (38).
Teddy Bears Child Care Centre	27 Corporation Circuit	Tweed Heads South	This facility may become inundated in a PMF event (38).
Jellybeans Family Day Care	1 Sands St	Tweed Heads South	This facility may become inundated in a PMF event (38).
Cooloon Children's Centre	2 Park Street	Tweed Heads	This facility may become inundated in a PMF event (38).
Creative Care Oshap	St Joseph's Primary School, 3-5 Frances Street	Tweed Heads	This facility may become inundated in a PMF event (38).
Freckles Kindy & Learning Centre	205-207 Kennedy Drive	Tweed Heads	This facility may become isolated before the 5% AEP event and require evacuation before this (38).
Goodstart Early Learning Tweed Heads	53-55 Greenway Drive	Tweed Heads	This facility may become inundated in a PMF event (38).
Tweed Heads Kindy Care	239 Kennedy Drive	Tweed Heads	This facility may become inundated before a 5% AEP event requiring evacuation beforehand (38).
Twin Towns Early Learning Centre	44 Recreation St	Tweed Heads South	This facility may become inundated in a PMF event (38).
Capturing Kids Minds	20 Sullivan St	Tweed Heads South	This facility may become inundated before a 5% AEP event requiring evacuation beforehand (38).
Erlibyrds Preschool & Early Learning Centre	1 Seymour St	Tweed Heads South	This facility may become inundated before a 5% AEP event requiring evacuation beforehand (38).
Tweed Heads South Public School Preschool	Heffron Street	Tweed Heads South	This facility may become inundated before a 5% AEP event requiring evacuation beforehand (38).

Little Grommets Early Learning Centre	62 Greenway Drive	Tweed Heads South	This facility may become inundated in a PMF event, but may require evacuation before the 5% AEP event due to water over Enterprise Avenue (38).
Mt Warning Childcare	120 Glenrock Rd	Uki	
Facilities for the aged and/or infirm			
Banora Point Retirement Village	57-59 Leisure Drive	Banora Point	This facility may be inundated at the PMF event but would requires evacuation before the 20% AEP event due to local road closures (38).
Bolton Clarke Darlington	126 Leisure Drive	Banora Point	This facility may be inundated at the PMF event but would requires evacuation before the 20% AEP event due to local road closures (38).
Bolton Clarke Winders	26 Winders Pl	Banora Point	This facility may become inundated at the 2% AEP event requiring evacuation before this (38).
Bupa Aged Care Banora Point	18 Ballymore Court	Banora Point	This facility may be inundated at the PMF event but would requires evacuation before the 20% AEP event due to local road closures (38).
Southern Cross St Martha's Residential Aged Care	3-7 Leisure Dr	Banora Point	This facility may start to become inundated at the 1% AEP event (38).
Southern Cross Care St. Martha's Village	81-83 Leisure Drive	Banora Point	This facility may become inundated in the PMF event, however would require evacuation before evacuation routes are cut at 20% AEP event (38).
Winders Retirement Community	Winders Pl	Banora Point	This facility may become inundated in a 1% AEP event, however would require evacuation before evacuation routes are cut at 20% AEP event (38).
Bilambil Creek Residential Village	382 Bilambil Rd	Bilambil	This facility may become inundated at the 20% AEP event (38).
Aveo Mountain View	1 Ingram Pl	Murwillumbah	Some housing may be affected in a PMF (38)
McKenzie Aged Care - Heritage Lodge	194 Byangum Road	Murwillumbah	This facility is on the edge of the PMF extent (38).

Murwillumbah Greens (Opal HealthCare)	18 Ingram Place	Murwillumbah	This facility is outside of the PMF extent (38).
Greenhills Lodge	437 Tweed Valley Way	South Murwillumbah	This facility may be inundated in a PMF event (38).
Adventist Senior Living	20 Banks Ave	Tweed Heads	This facility may be inundated in a PMF event (38).
Serene Retirement Living	31 Florence St	Tweed Heads	This facility may be inundated in a PMF event (38).
Tweed Fairways Retirement Village	1-3 Soorley St	Tweed Heads	This facility may be inundated in a PMF event (38).
Canowindra Aboriginal Community Care	65 Ducat Street	Tweed Heads	This facility may be inundated in a PMF event (38).
Tweed River Care Community	7-9 Florence Place	Tweed Heads	This facility may be inundated in a PMF event (38).
Tweed Transitional Aged Care Service	Tweed Hospital	Tweed Heads	This facility may be inundated in a PMF event (38).
The Tweed District Hospital	14 Powell Street* *The new Tweed Valley Hospital is expected to open in early 2024 at 771 Cudgen Rd, Cudgen.	Tweed Heads	The hospital has a bed capacity of 214 beds and is affected by floodwaters in a 1% AEP event or greater. In a PMF event the extent of flooding would be between 1.0m and 2.0m of floodwaters throughout the ground level. The provision of medical supplies including linen/laundry and prescribed medications has been de-centralised and the hospital would require re-supply during an event of more than 3 days of isolation (12)
Bangalor Retreat	27 Stott St	Tweed Heads South	This facility is outside of the flood extent (38).
Southern Cross St Joseph's Apartments	1-9 Blundell Boulevarde	Tweed Heads South	Considered vulnerable in an event equal to or greater than a 5% AEP event. The ACF has 44 residents with nine high care patients. The facility has no transport facilities and would require assistance if required to evacuate.
Raffles Mckenzie Assisted Aged Care	Lot 9 Peregrine Way	Tweed Heads South	This facility may become inundated in a PMF event (38).
Banksia Waters Over 50s Living	192 Piggabeen Rd	Tweed Heads West	The Retirement Village consists of residents over 55 years of age, housed in mobile homes. There are approximately 280 mobile homes situated on the eastern bank of the Cobaki Creek. Piggabeen Road is cut at Cobaki Creek at 1.6m (Chinderah gauge).

			This facility may become inundated in a PMF event (38).
Tweed Valley Care Community	Carramar Drive	Tweed Heads West	The Centre is considered flood free however the facility would be isolated by road closures which could affect staffing levels of the facility. In 2005 this facility required assistance to convey staff and medical supplies to the facility.
Utilities and infrastructure			
Banora Point Telephone Exchange	9 Pioneer Pde	Banora Point	This facility is outside of the flood extent (38).
Bilambil Telephone Exchange		Bilambil Heights	
Condong Essential Energy Zone Substation	McLeod St	Condong	This facility may become inundated from a 1% AEP event (38).
Duranbah Telephone Exchange	Clothiers Creek Rd	Duranbah	
Murwillumbah Telephone Exchange	118 Murwillumbah Street	Murwillumbah	This facility may become inundated from a 1% AEP event (38).
Murwillumbah Essential Energy Zone Substation	3 Charles St	Murwillumbah	This facility may become inundated from a 1% AEP event (38).
Murwillumbah Water Treatment Plant	15 Frances Street	Murwillumbah	This is facility is in proximity to the PMF extent (38).
Tumbulgum Telephone Exchange	8576 Tweed Valley Way	Tumbulgum	This facility may become inundated from a 1% AEP event (38).
Tumbulgum Water Treatment Plant	8814 Tweed Valley Way	Tumbulgum	This facility may become inundated in the 20% AEP event (38).
Tweed Heads Telephone Exchange	Corner Enid Street & Empire Lane	Tweed Heads	This facility may become inundated in a PMF event (38).
Banora Point Water Treatment Plant	46 Enterprise Avenue	Tweed Heads South	This facility may become inundated in a PMF event (38).
Stokers Siding Telephone Exchange	Pacific Hwy	Stokers Siding	

Mooball Wastewater Treatment Plant	Pottsville Rd	Mooball	
Terranora Lodge Telephone Exchange		Terranora	
Tweed Heads West Telephone Exchange	55 Inlet Drive	Tweed Heads West	This facility may become inundated in a PMF event (38).
Tweed Heads West Water Treatment Plant	Grey Street	Tweed Heads West	
Tumbulgum Telephone Exchange		Tumbulgum	
Tyalgum Wastewater Treatment Plant	85 Brays Creek Rd	Tyalgum	
Uki Wastewater Treatment Plant	165 Smiths Rd	Uki	
Uki Telephone Exchange			
Camping Ground / Caravan Parks			
Chinderah by Gateway Lifestyle	2-6 Tweed Coast Rd	Bogangar	This facility is outside of the flood extent (38).
Chinderah by Gateway Lifestyle	16 Anne Street	Chinderah	This facility may become inundated in the 5% AEP event (38).
Chinderah Lakes Caravan Pk	101 Anne St	Chinderah	This facility may become inundated in the 5% AEP event (38).
Chinderah Village Tourist Caravan Pk	94-104 Chinderah Bay Drive	Chinderah	This facility may become inundated in the 5% AEP event (38).
Royal Pacific Caravan Pk	109 Chinderah Rd	Chinderah	This facility may become inundated in the 5% AEP event (38).
Homestead Holiday Pk	25 Chinderah Bay Drive	Chinderah	This facility may become inundated in the 5% AEP event (38).
Tweed Heritage Caravan Pk	92 Chinderah Bay Drive	Chinderah	This facility may become inundated in the 5% AEP event (38).
Tweed River Hacienda Caravan Pk	37-63 Chinderah ay Drive	Chinderah	This facility may become inundated from the 20% AEP event (38).

Fingal Caravan Pk	9 Prince St	Fingal Head	Flood waters begin to enter the lower parts of the caravan park at approximately 2.1m (Chinderah gauge) necessitating the re-location of the caravans and residents (6)
Cutters Camp campground	Cutters Camp Road	Mebbin	Expected maximum occupancy of 51
Midginbil Eco Resort	252 Midginbil Road	Midginibil	
Mt Warning Rainforest Park	153 Mount Waring Road	Mount Warning	Can become isolated when Dum Dum Bridge closes around 8m on Uki gauge. Maximum occupancy of up to 655 people.
Greenhills Caravan Pk	488 Tweed Valley Way	South Murwillumbah	This facility may become inundated from the 20% AEP event (38).
Border Caravan Pk	3 Dry Dock Rd	Tweed Heads	This facility may become inundated from a 5% AEP event (38).
River Retreat Caravan Park	8 Philip Parade	Tweed Heads	It is recommended that at a height of 1.25m (Dry Dock gauge) with further rises expected, the mobile caravans and cars are relocated from the caravan park to the Tweed Heads Recreational area adjacent to the Police and Community Youth Club (PCYC).
Palms Village Caravan Park	112 Dry Dock Rd	Tweed Heads	It is recommended that at a height of 1.25m (Dry Dock gauge) with further rises expected, the mobile caravans and cars are relocated from the caravan park to the Tweed Heads Recreational area adjacent to the Police and Community Youth Club (PCYC).
Pyramid Holiday Park	145 Kennedy Drive	Tweed Heads	This facility may become inundated from a 5% AEP event (38).
Tweed Billabong Holiday Village	Holden St	Tweed Heads	It is recommended that at a height of 1.25m (Dry Dock gauge) with further rises expected, the mobile caravans and cars are relocated from the caravan park to the Tweed Heads Recreational area adjacent to the Police and Community Youth Club (PCYC).
Colonial Tweed Caravan Park	158 Dry Dock Rd	Tweed Heads	It is recommended that at a height of 1.25m (Dry Dock gauge) with further rises expected, the mobile caravans and cars are relocated from the caravan park to the Tweed Heads Recreational area adjacent to the Police and Community Youth Club (PCYC).

Boyds Bay Holiday Park	3 Dry Dock Rd	Tweed Heads	It is recommended that at a height of 1.25m (Dry Dock gauge) with further rises expected, the mobile caravans and cars are relocated from the caravan park to the Tweed Heads Recreational area adjacent to the Police and Community Youth Club (PCYC).
Tweed Broadwater Village	250 Kirkwood Rd	Tweed Heads South	It is recommended that at a height of 1.25m (Dry Dock gauge) with further rises expected, the mobile caravans and cars are relocated from the caravan park to the Tweed Heads Recreational area adjacent to the Police and Community Youth Club (PCYC).

Brunswick River Valley

Facility Name	Street	Suburb	Comment
Schools			
Burringbar Public School	59 Burringbar Road	Burringbar	Burringbar Public School was undamaged during the 2017 flood event (35). It is identified within the Tweed Coastal Creeks Floodplain Risk Management Study (2015) as a vulnerable institution (6)
Crabbes Creek Public School	Crabbes Creek Rd	Crabbes Creek	Crabbes Creek Public School was severely damaged during the 2017 flood event with water damage to all school buildings with water levels reaching between 50 and 100cm (35)
Pottsville Beach Public School	Tweed Coast Road	Pottsville	Identified within the Tweed Coastal Creeks Floodplain Risk Management Study (2015) as a vulnerable institution (6)
St Ambrose	1 Charles St	Pottsville	This facility may become inundated in a PMF event (38).
Childcare Centres			
Burringbar Community Preschool	Gumnut Community Pre School, 27 Greenvale Court	Burringbar	Unknown. Not identified as a vulnerable institution within the Tweed Coastal Creeks Floodplain Management Study (6)

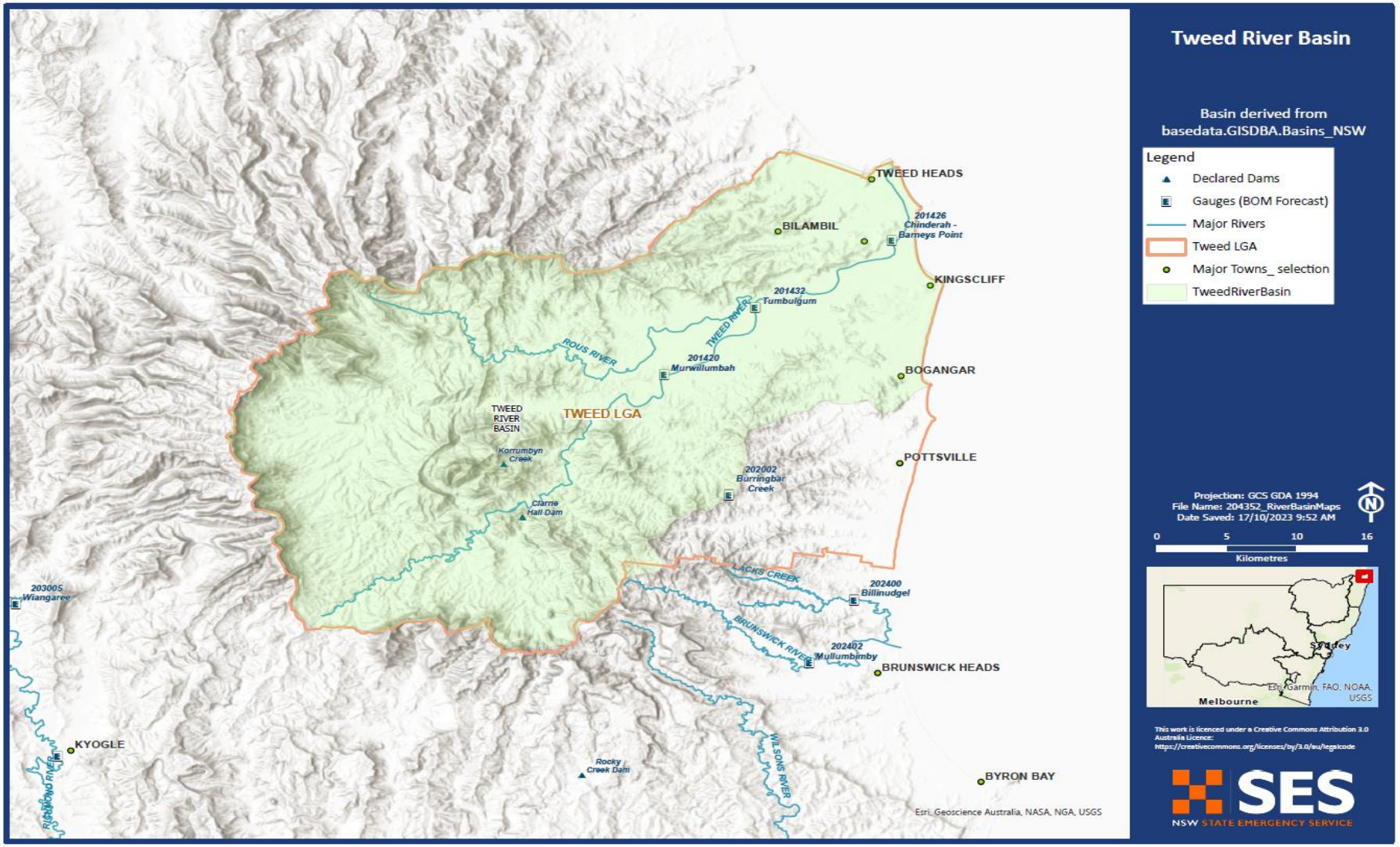
Natural Elements Early Learning Centre	44 Seabreeze Boulevard	Pottsville	This facility may become inundated in the PMF event (38).
Pottsville Gumnuts Preschool and Childcare Centre	8 Hampton Court	Pottsville	Unknown. Not identified as a vulnerable institution within the Tweed Coastal Creeks Floodplain Management Study (6).
Facilities for the aged and/or infirm			
Hastings Point Retirement Village	87-89 Tweed Coast Road	Hastings Point	This facility is outside of the flood extent (38).
Bupa Aged Care Pottsville Beach	41-51 Ballina Street	Pottsville	This facility is in close proximity to the PMF extent and may require evacuation before evacuation route is cut at 5% AEP event (38).
Utilities and infrastructure			
Mooball Telephone Exchange	6045 Tweed Valley Way	Burringbar	This facility may be inundated in a PMF event (38).
Hastings Point Wastewater Treatment Plant	139 Round Mountain Rd		This facility is in close proximity to the PMF (38).
Hastings Point Telephone Exchange	Tweed Coast Rd	Hastings Point	Hastings Point Telephone Exchange
Camping Ground / Caravan Parks			
Tweed Coast Holiday Park: Hastings Point	7 Tweed Coast Road	Hastings Point	This facility outside the PMF extent (38).
North Star Holiday Resort	1 Tweed Coast Road	Hastings Point	This facility may become inundated in the 1% AEP event (38).
Pottsville North Caravan Park	27 Tweed Coast Road	Pottsville	This facility is outside the flood extent (38).
Pottsville South Caravan Park	2 Tweed Coast Road	Pottsville	This facility may become inundated in the 5% AEP event (38).
Wooyung Beach Holiday Park	515 Wooyung Rd	Wooyung	This facility may become inundated in the 20% AEP event (38).

Tweed Coastal Creeks

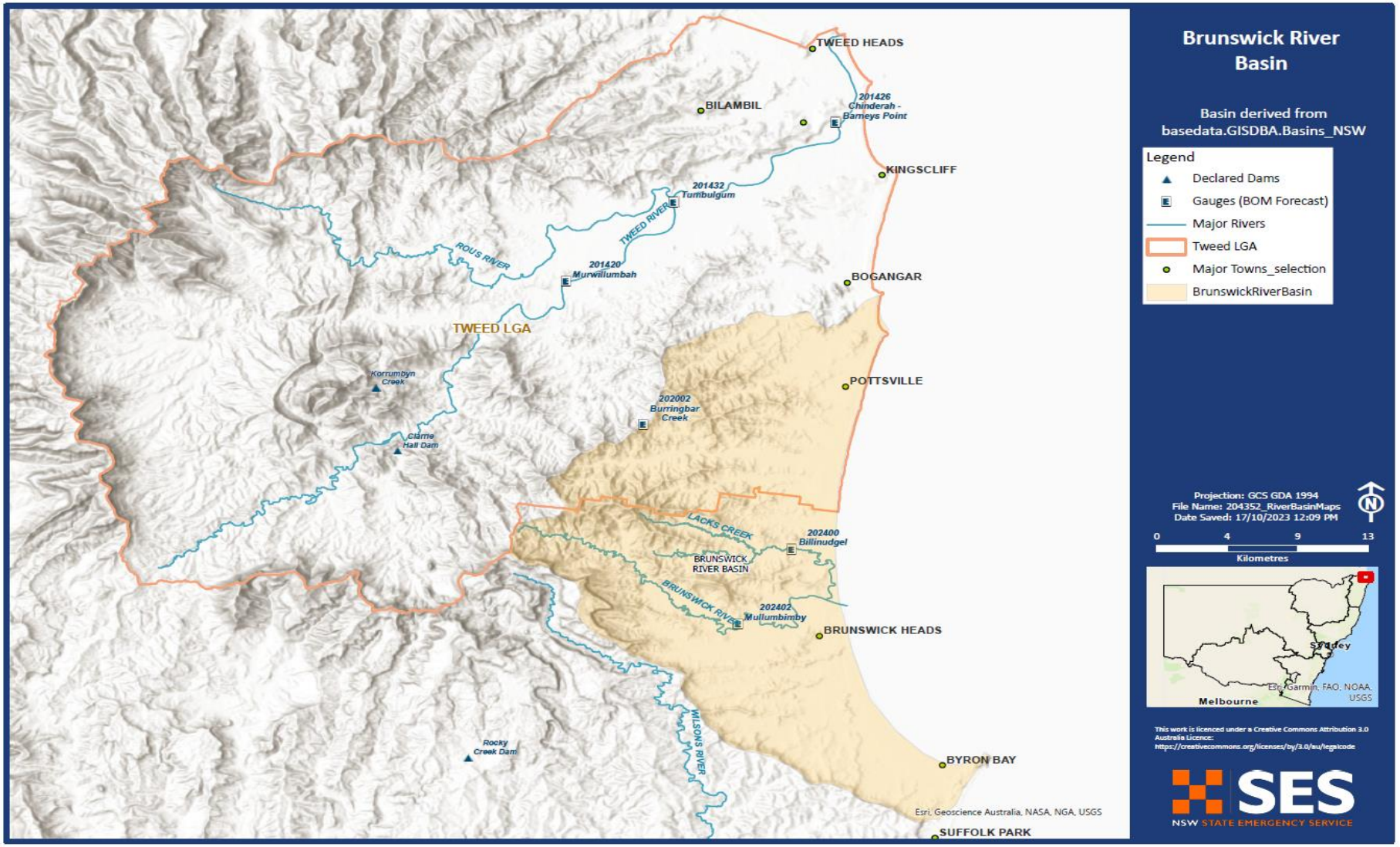
Facility Name	Street	Suburb	Comment
Schools			
Bogangar Public School	123-147 Tweed Coast Road	Bogangar	Evacuation Centre
Kingscliff High School	33 Oxford Street	Kingscliff	This facility may become inundated in a PMF event (38).
Kingscliff Public School	12 Orient Street	Kingscliff	Evacuation Centre
St Anthony's Primary School	23 Boomerang St	Kingscliff	This facility may become inundated in the 5% AEP event (38).
TAFE NSW – North Coast – Kingscliff Campus	Cudgen Road	Kingscliff	Evacuation Centre
Childcare Centres			
Beach Kids Early Learning & Preschool Centre	68 Hastings Road	Bogangar	This facility may become inundated in the PMF event (38).
Pippies Early Childhood Centre	34 Tallowood Drive	Bogangar	This facility may become inundated in the PMF event (38).
Kingscliff Mini School	60-62 Kingscliff St	Tweed Heads	This facility may become inundated in the PMF event (38).
Facilities for the aged and/or infirm			
Kingscliff Retirement Village	1-9 Blue Jay Circuit	Kingscliff	This facility may become inundated in the PMF event (38).
Uniting Kingscliff	24A Kingscliff St	Kingscliff	This facility may become inundated in the 1% AEP event (38)
Noble Lakeside Park	34 Monarch Drive	Kingscliff	This facility may become inundated in the PMF event (38)
Feros Village, Wommin Bay	1 McKissock Drive	Kingscliff	This facility may become inundated in the PMF event (38)
Utilities and infrastructure			
Banora Point Essential Energy Zone Substation	Corner Johnson St & Pioneer Parade	Banora Pt	This facility is outside the flood extent (38).
Bungalora Essential Energy Zone Substation	Terranora Rd	Bungalora	

Facility Name	Street	Suburb	Comment
Cudgen Essential Energy Zone Substation	571 Cudgen Rd	Cudgen	This facility is outside the flood extent (38).
Kingscliff Point Waste Treatment Plant	Altona Rd	Chinderah	
Kingscliff Telephone Exchange	17 Pearl Street	Kingscliff	This facility may become inundated in the PMF event (38)
Camping Ground / Caravan Parks			
Ingenia Holidays Kingscliff	46 Wommin Bay Rd	Kingscliff	This facility may become inundated in the 5% AEP event (38)
Kingscliff Beach Holiday Park	125 Marine Parade	Kingscliff	This facility is outside the flood extent (38).
Kingscliff North Holiday Park	277 Marine Parade	Kingscliff	This facility is in close proximity to the PMF extent (38).

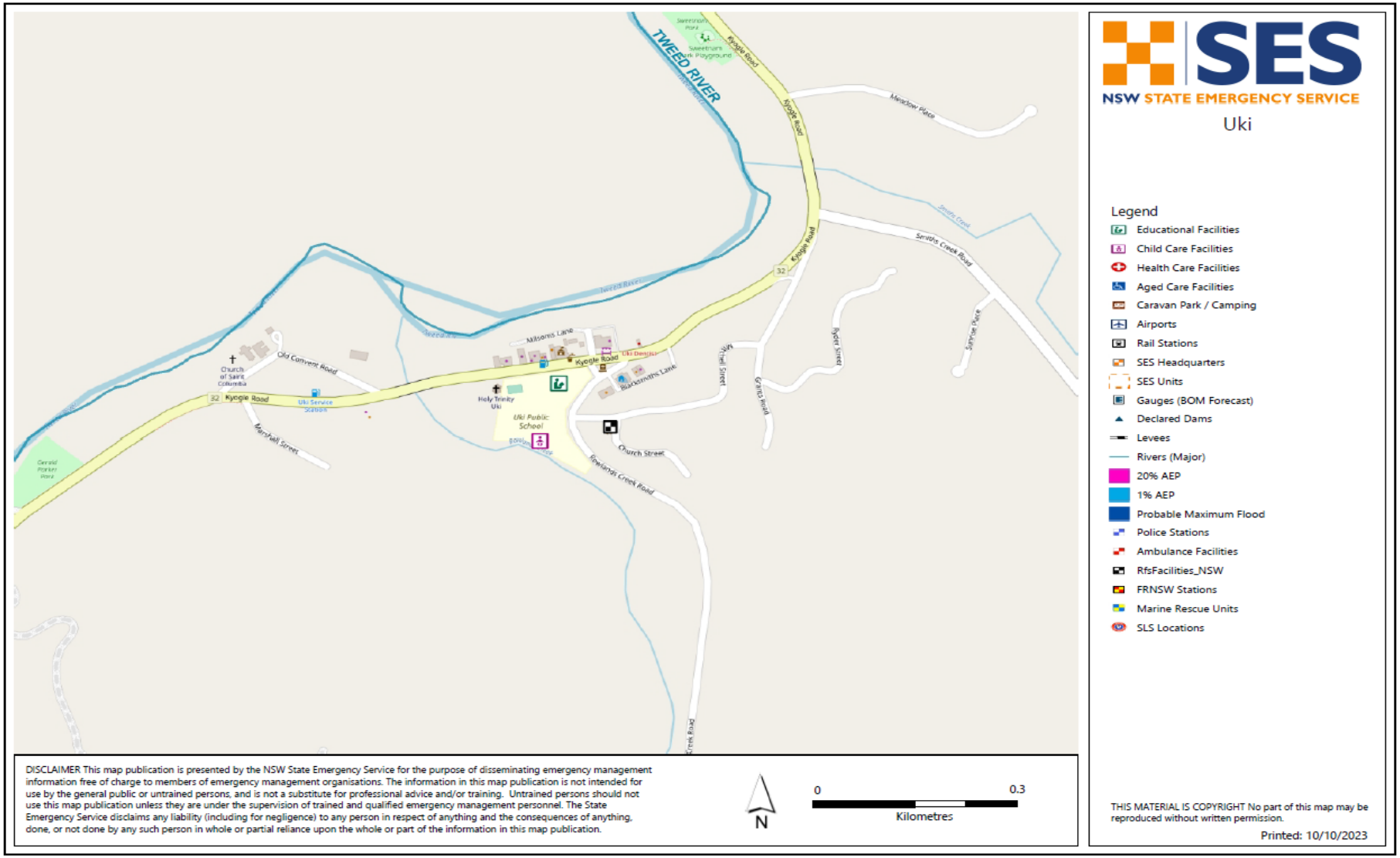
MAP 1: TWEED RIVERBASIN MAP



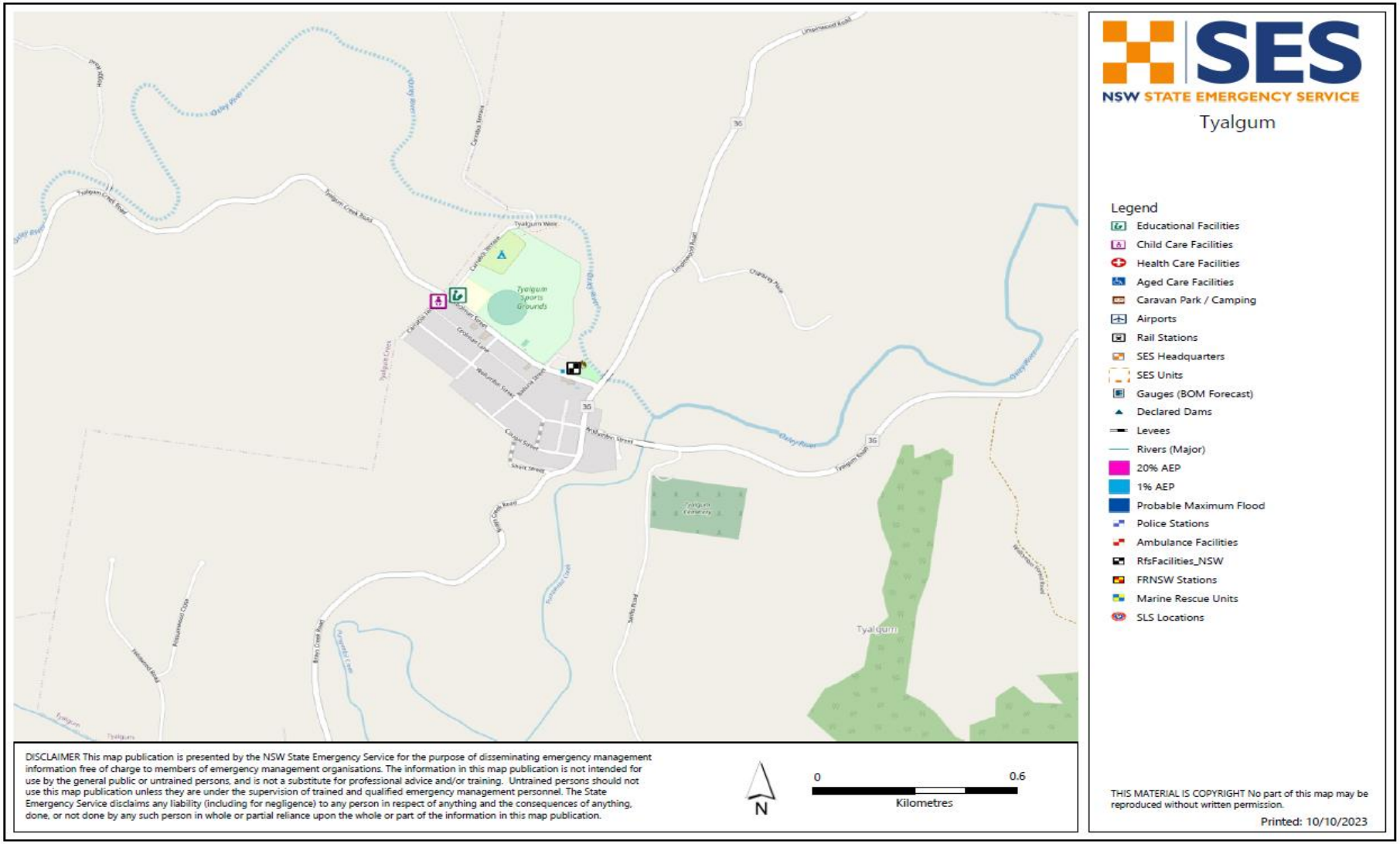
MAP 2: BRUNSWICK RIVERBASIN MAP



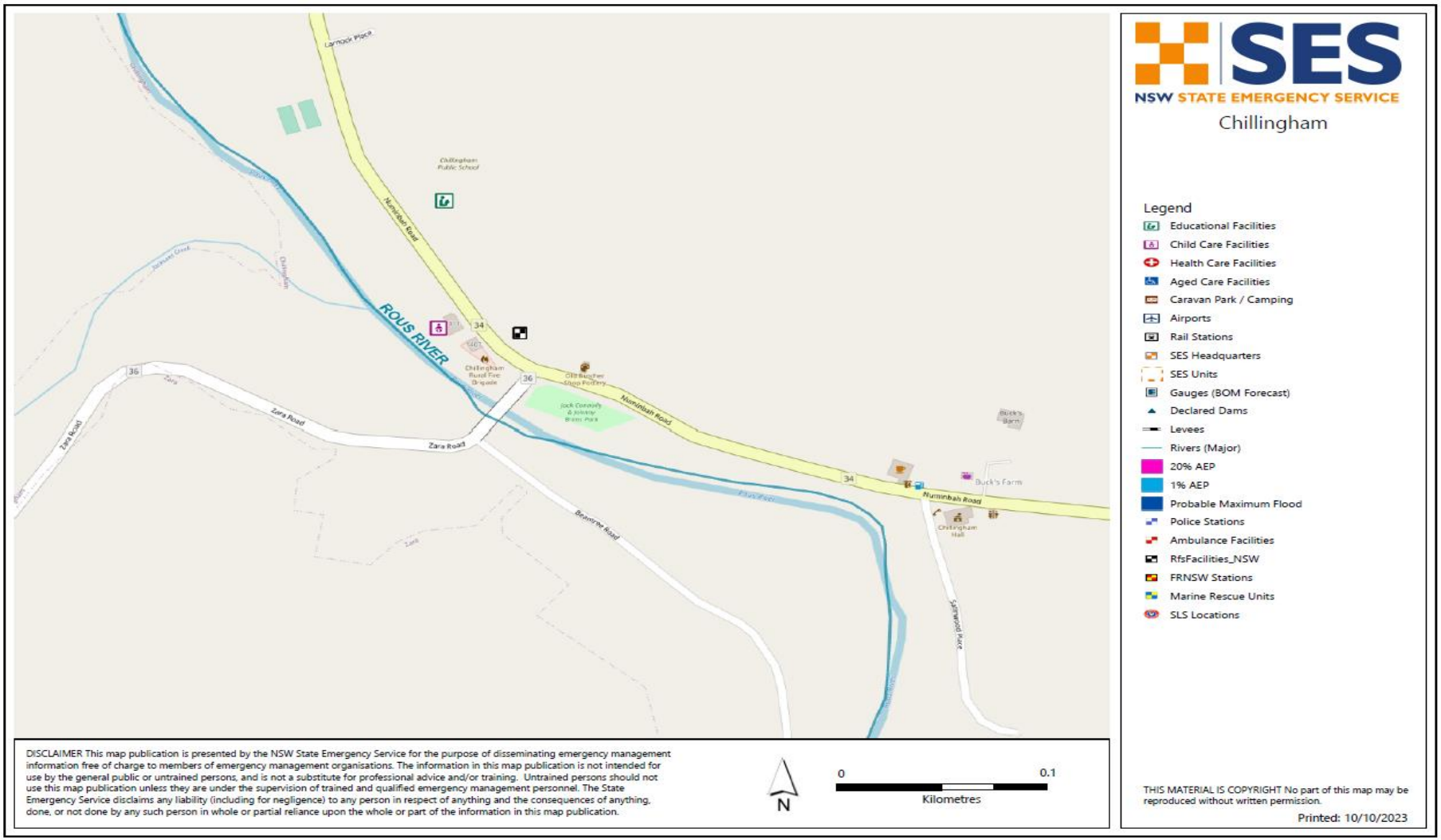
MAP 3: UKI TOWN MAP



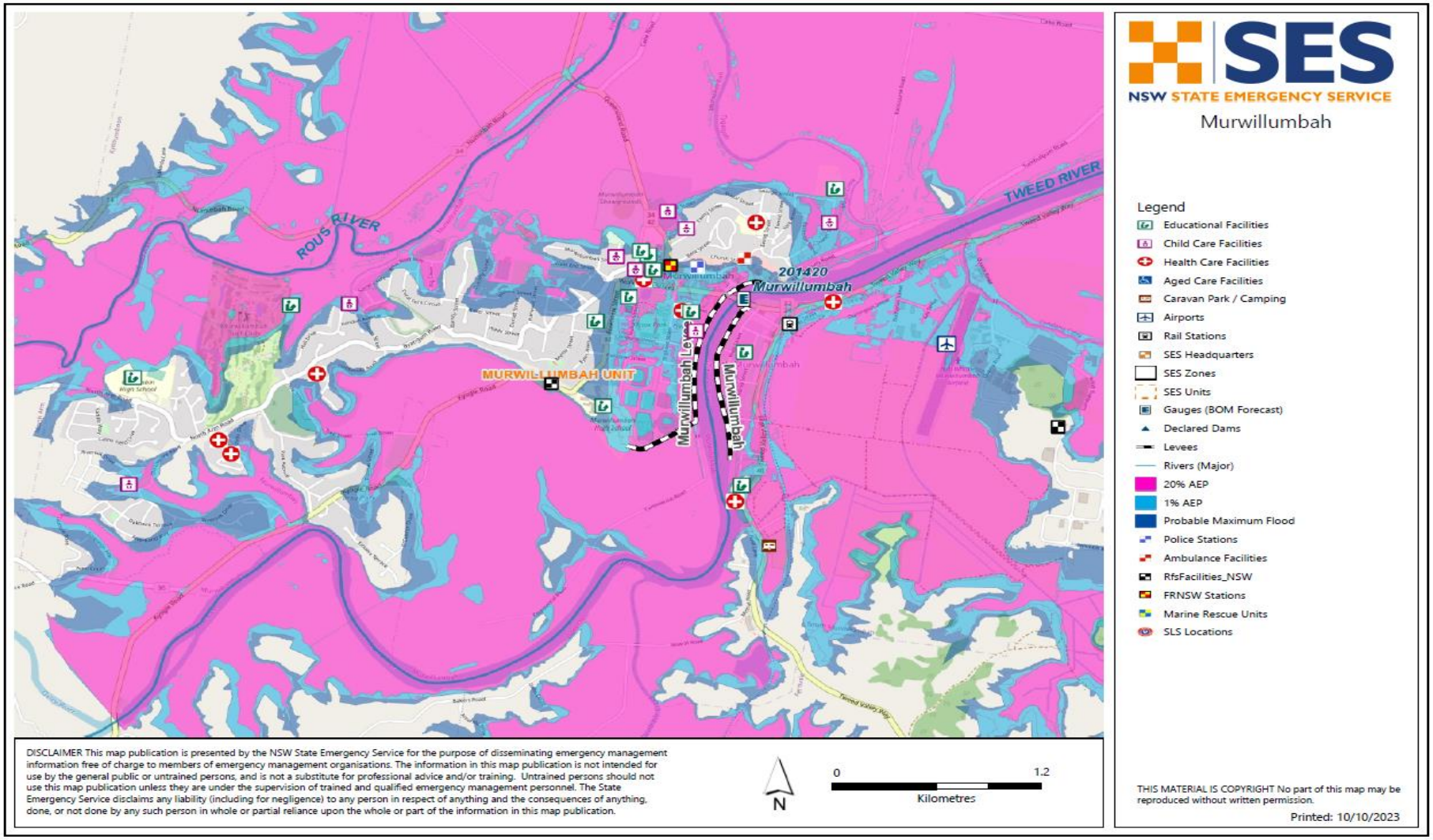
MAP 4: TYALGUM TOWN MAP



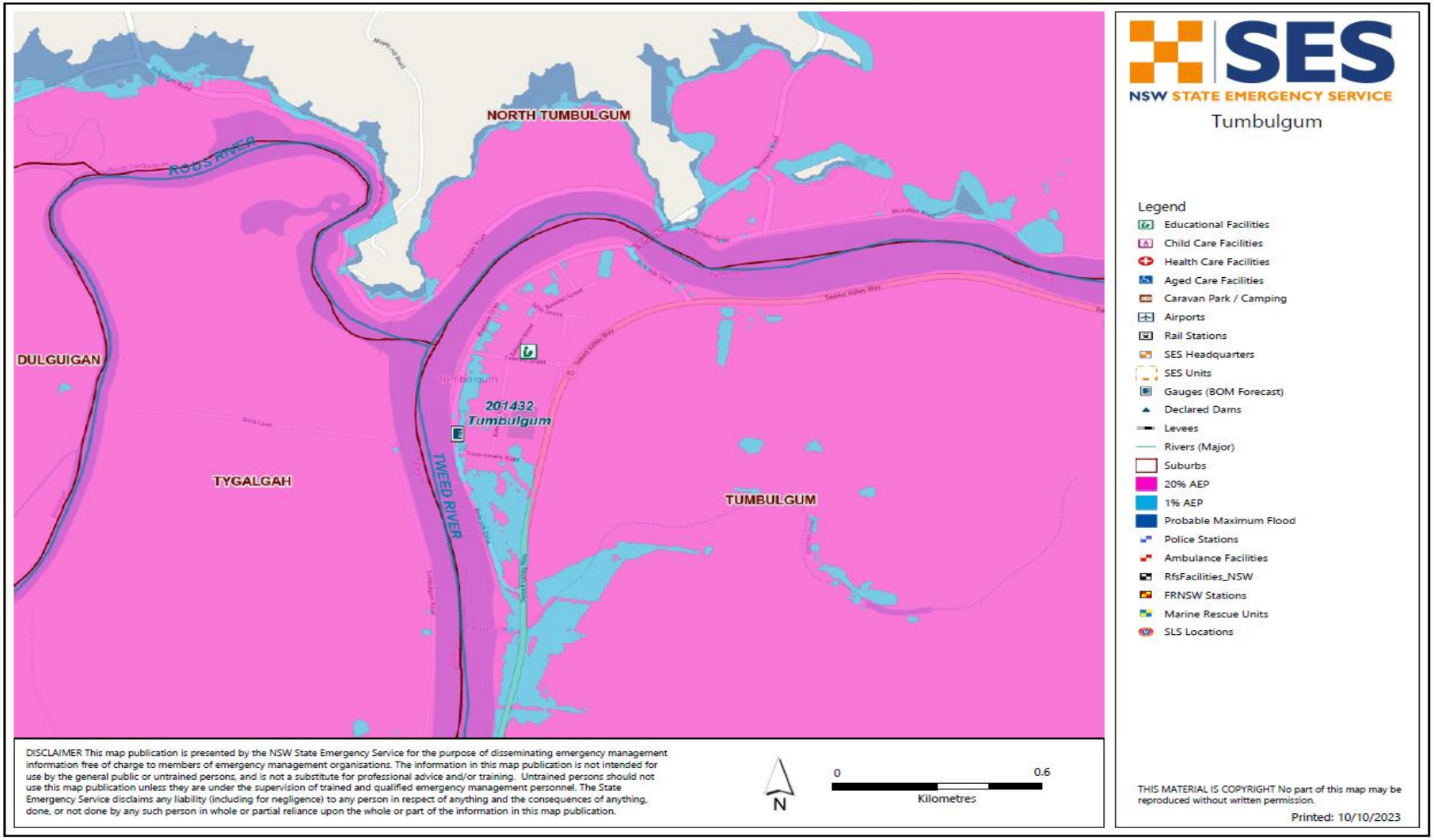
MAP 5: CHILLINGHAM TOWN MAP



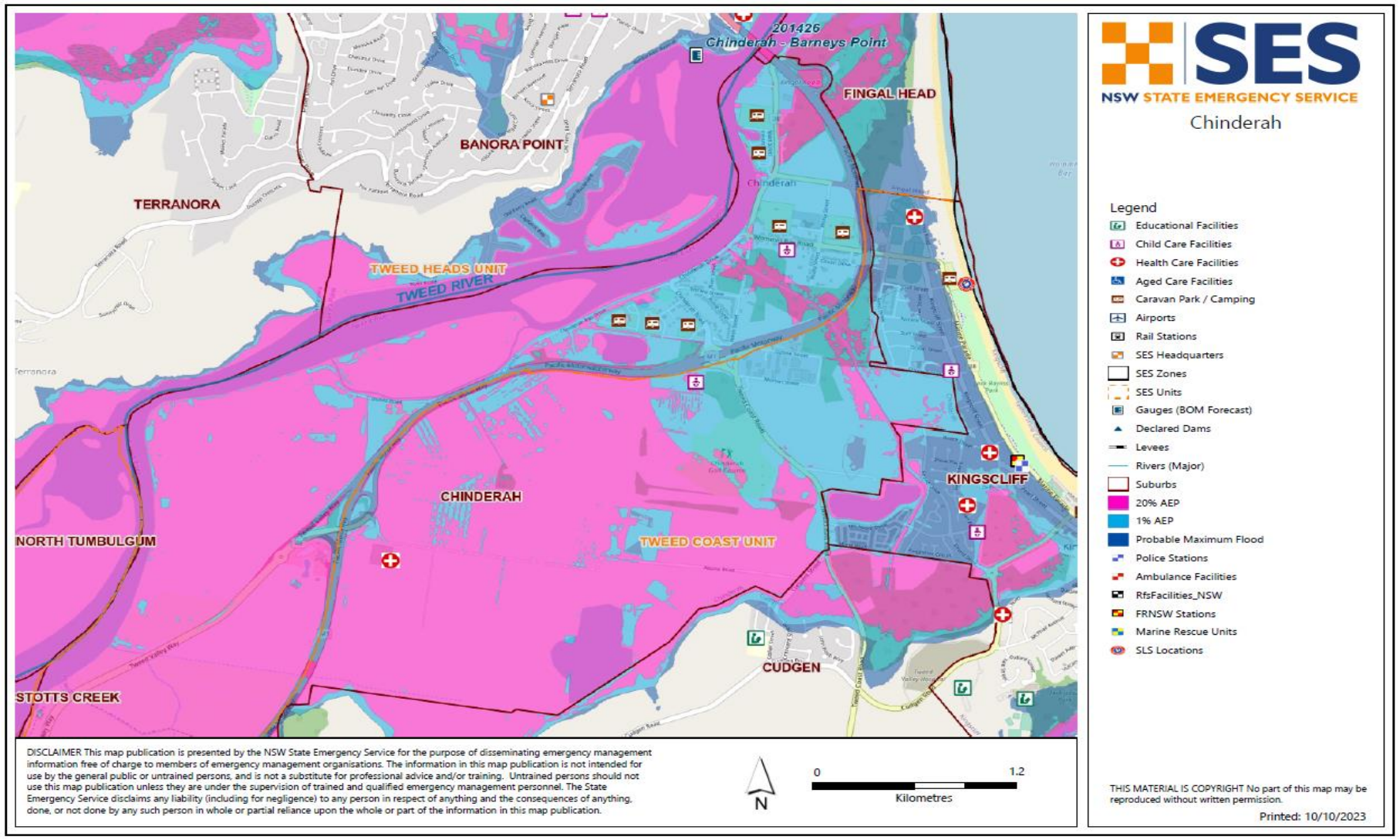
MAP 6: MURWILLUMBAH TOWN MAP



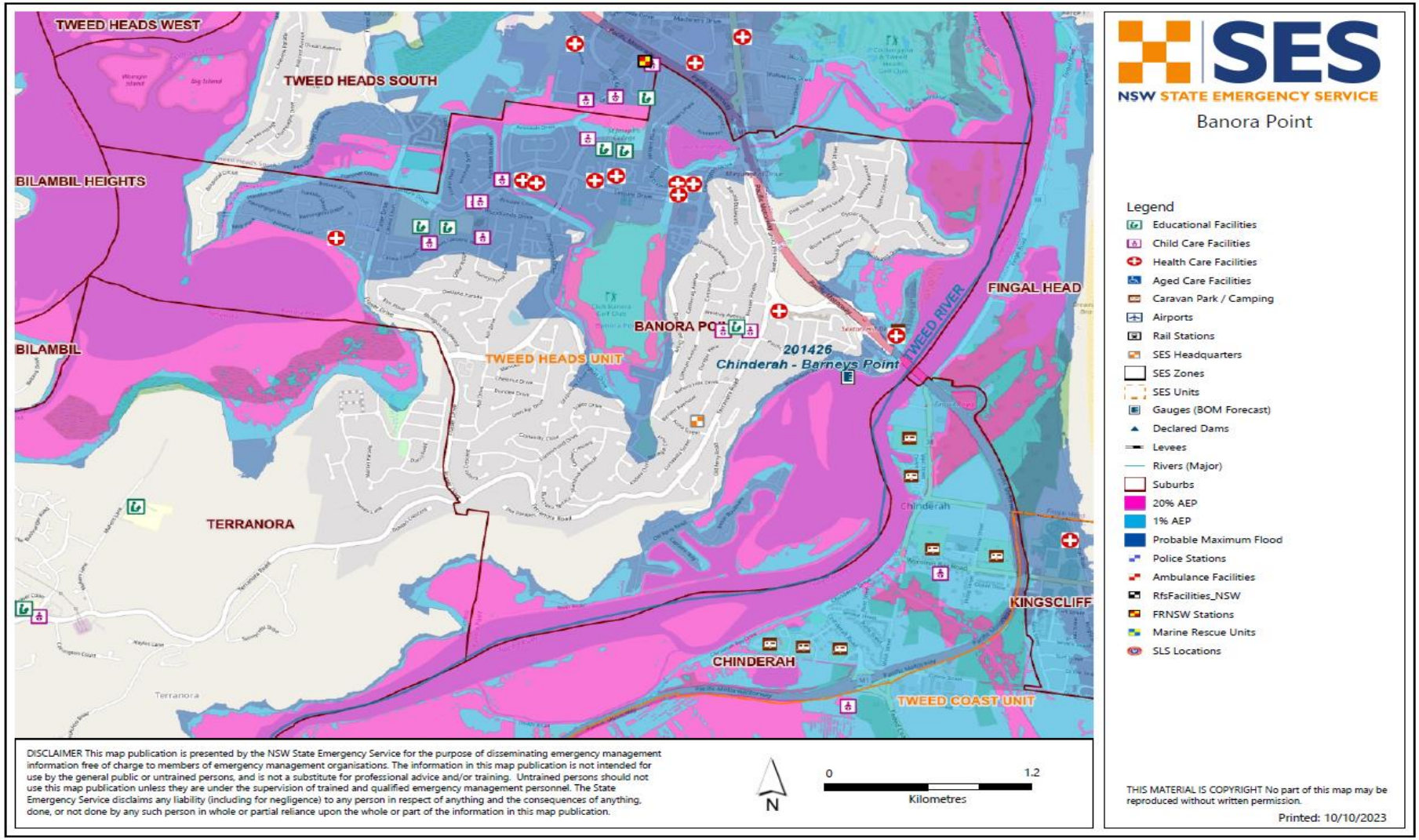
MAP 7: TUMBULGUM TOWN MAP



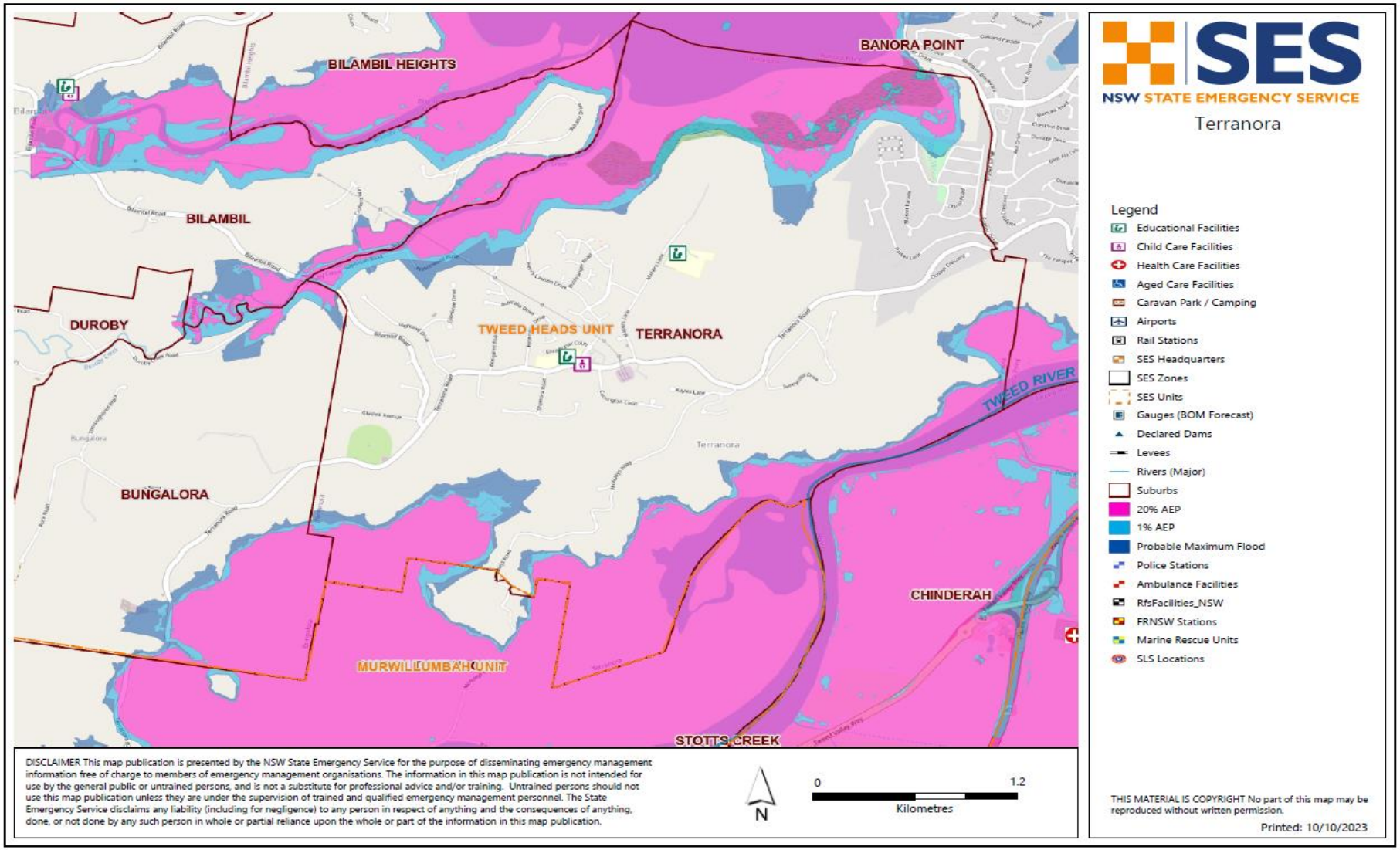
MAP 8: CHINDERAH TOWN MAP



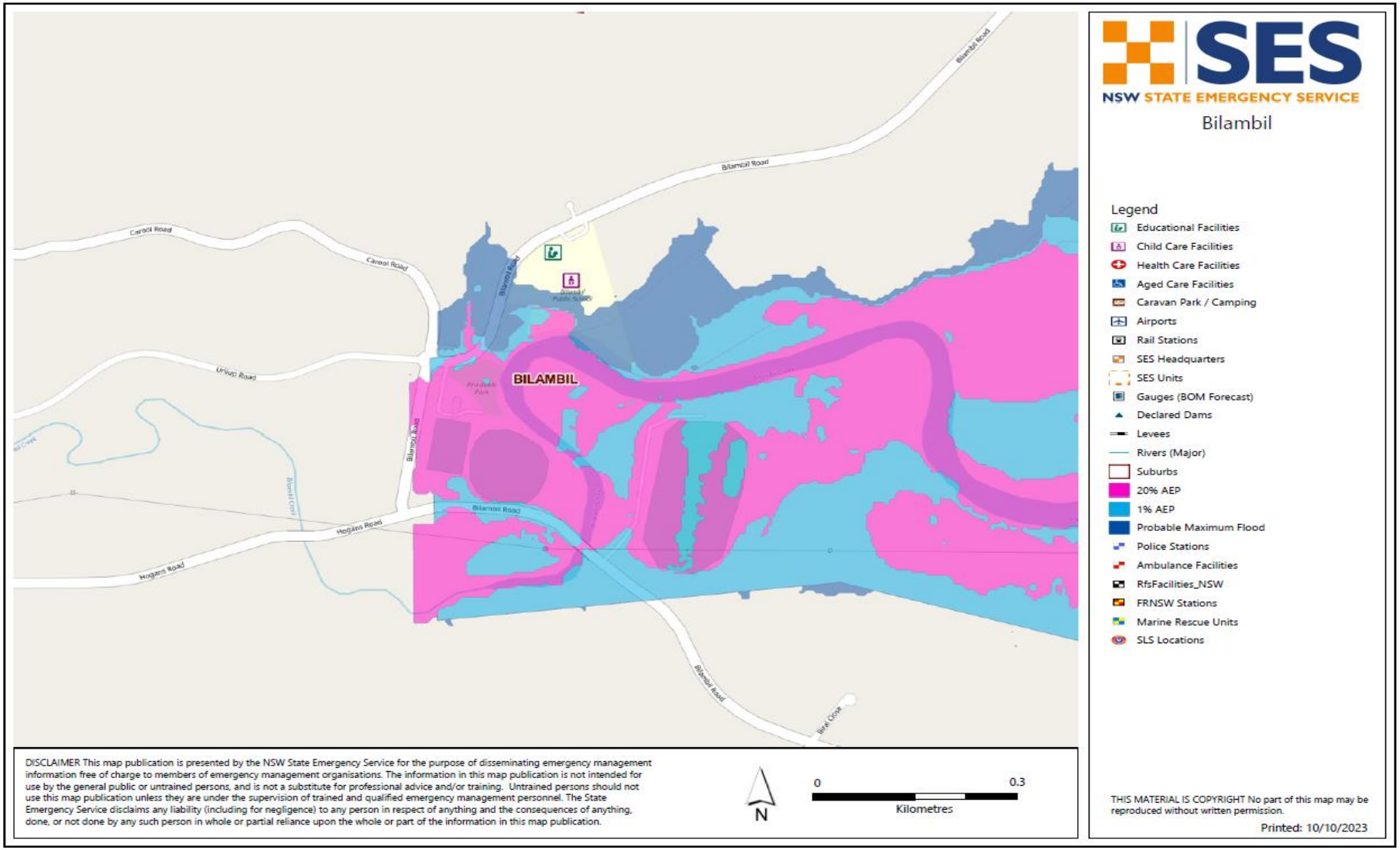
MAP 9: BANORA POINT TOWN MAP



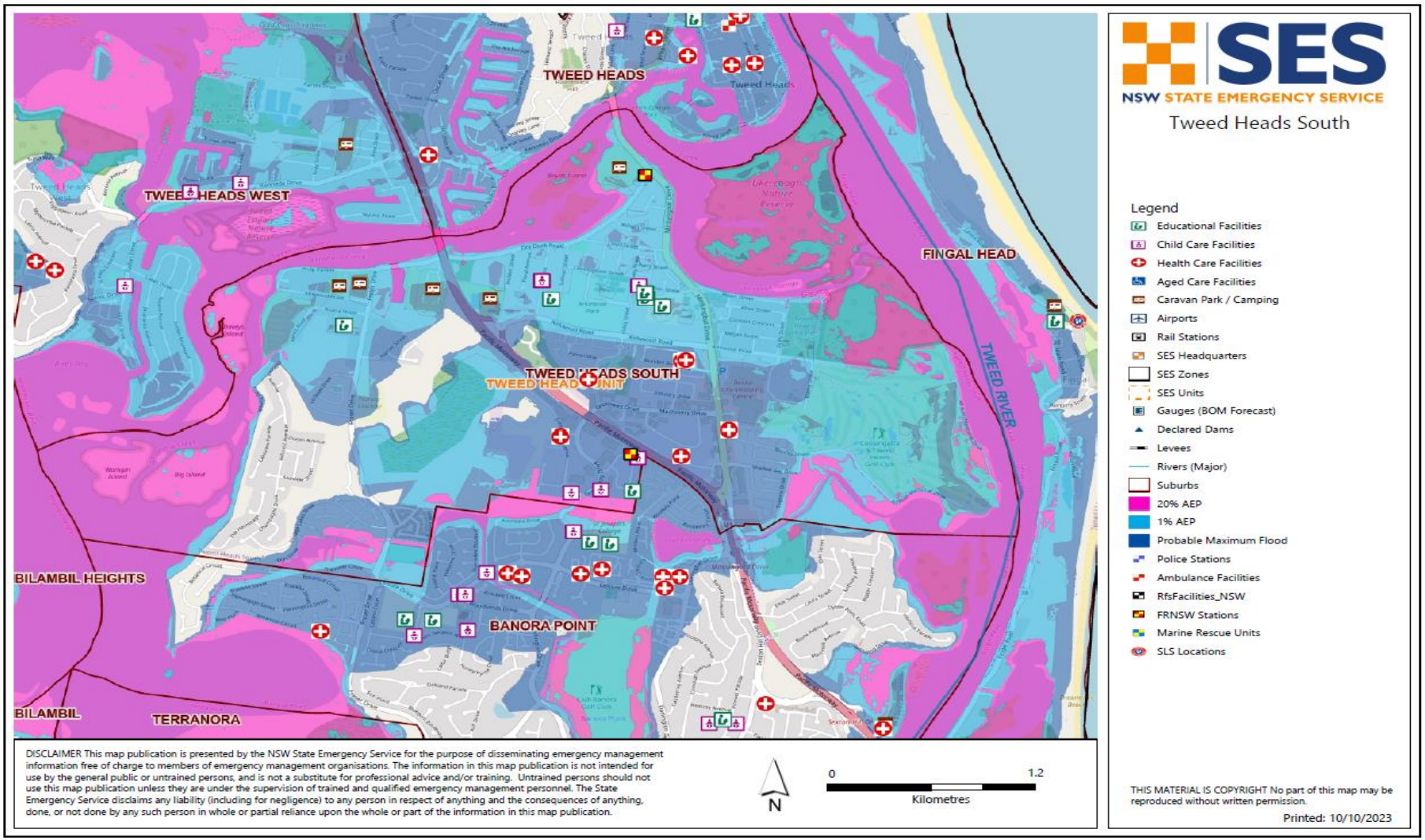
MAP 10: TERRANORA TOWN MAP



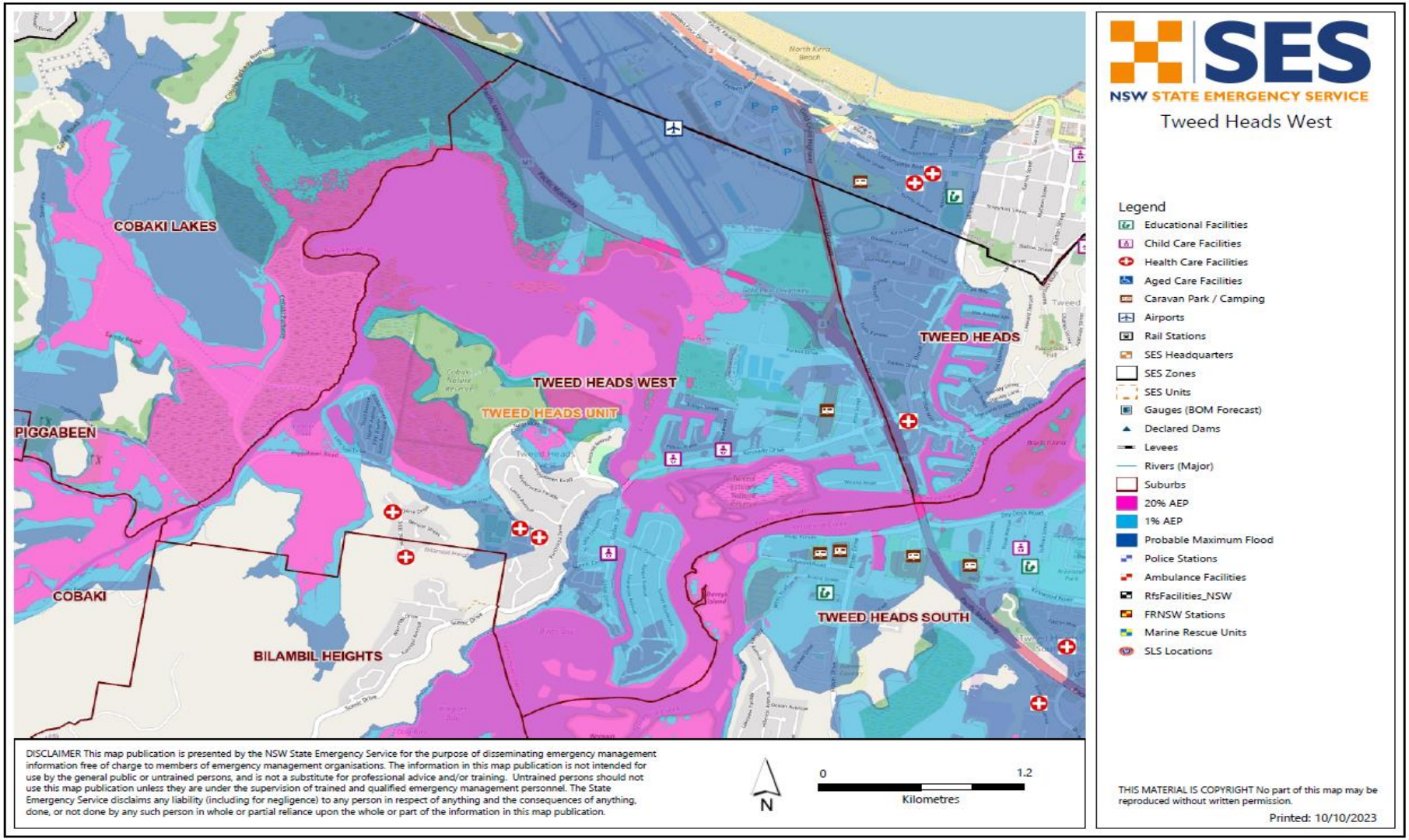
MAP 11: BILAMBIL TOWN MAP



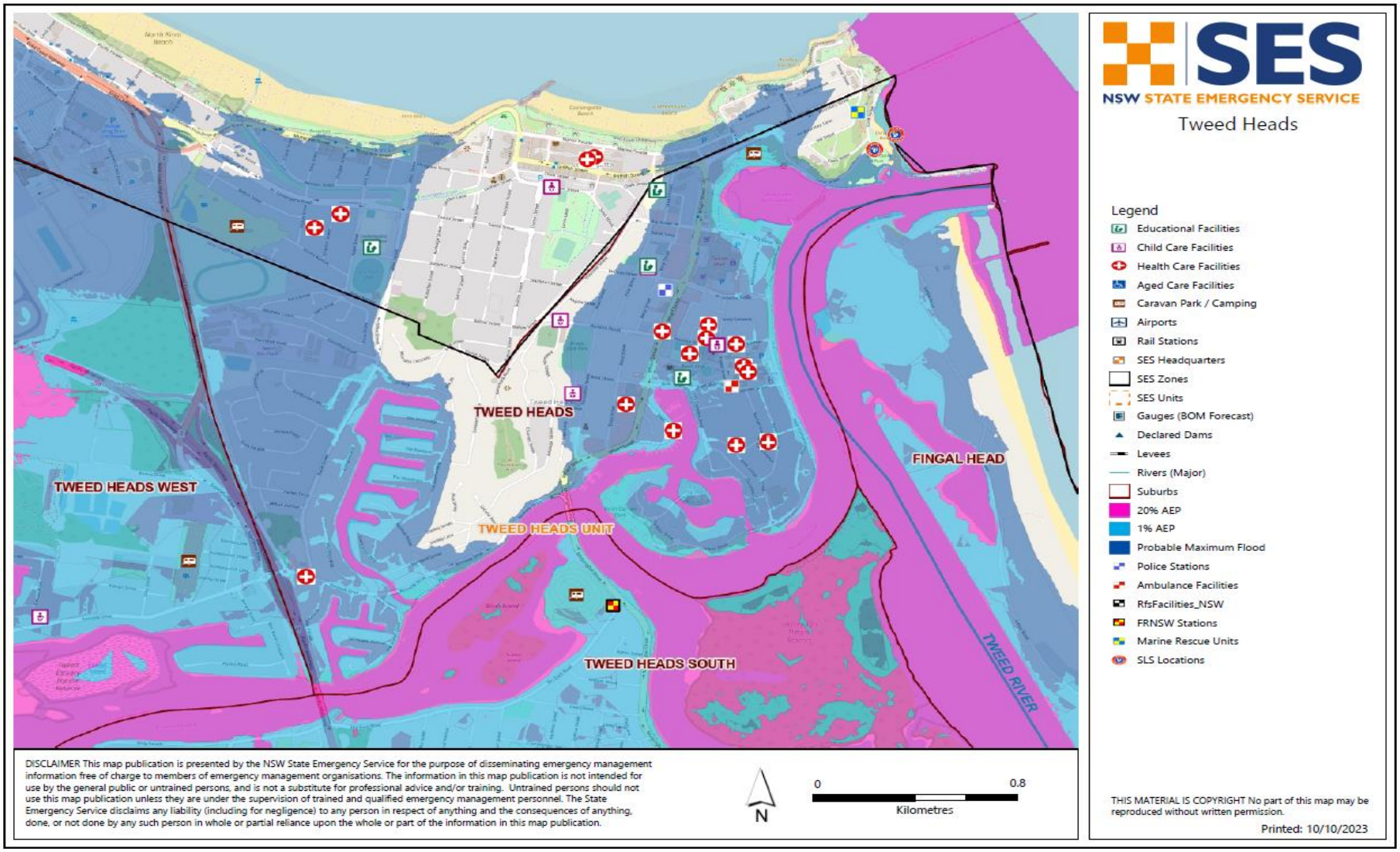
MAP 12: TWEED HEADS SOUTH TOWN MAP



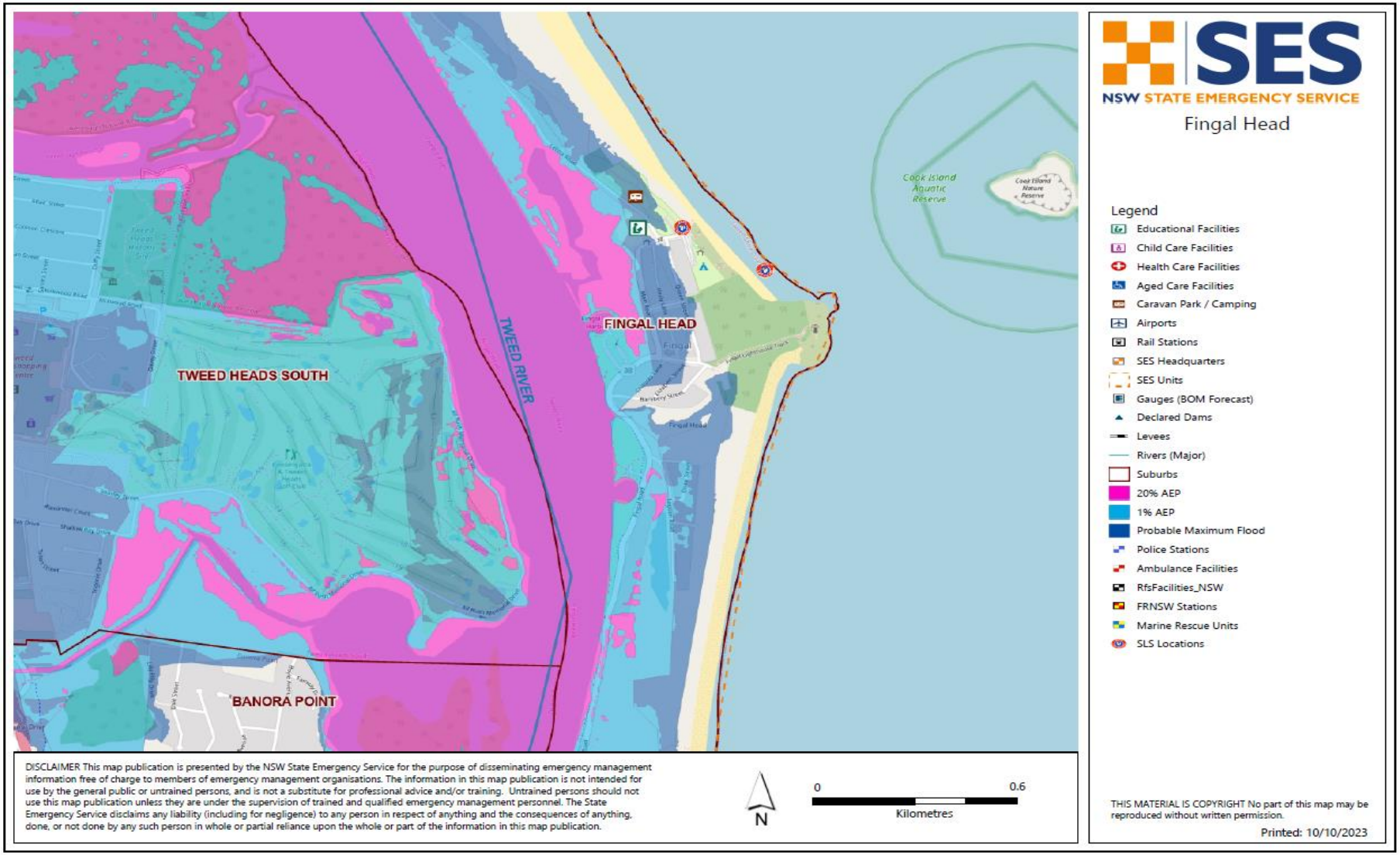
MAP 13: TWEED HEADS WEST TOWN MAP



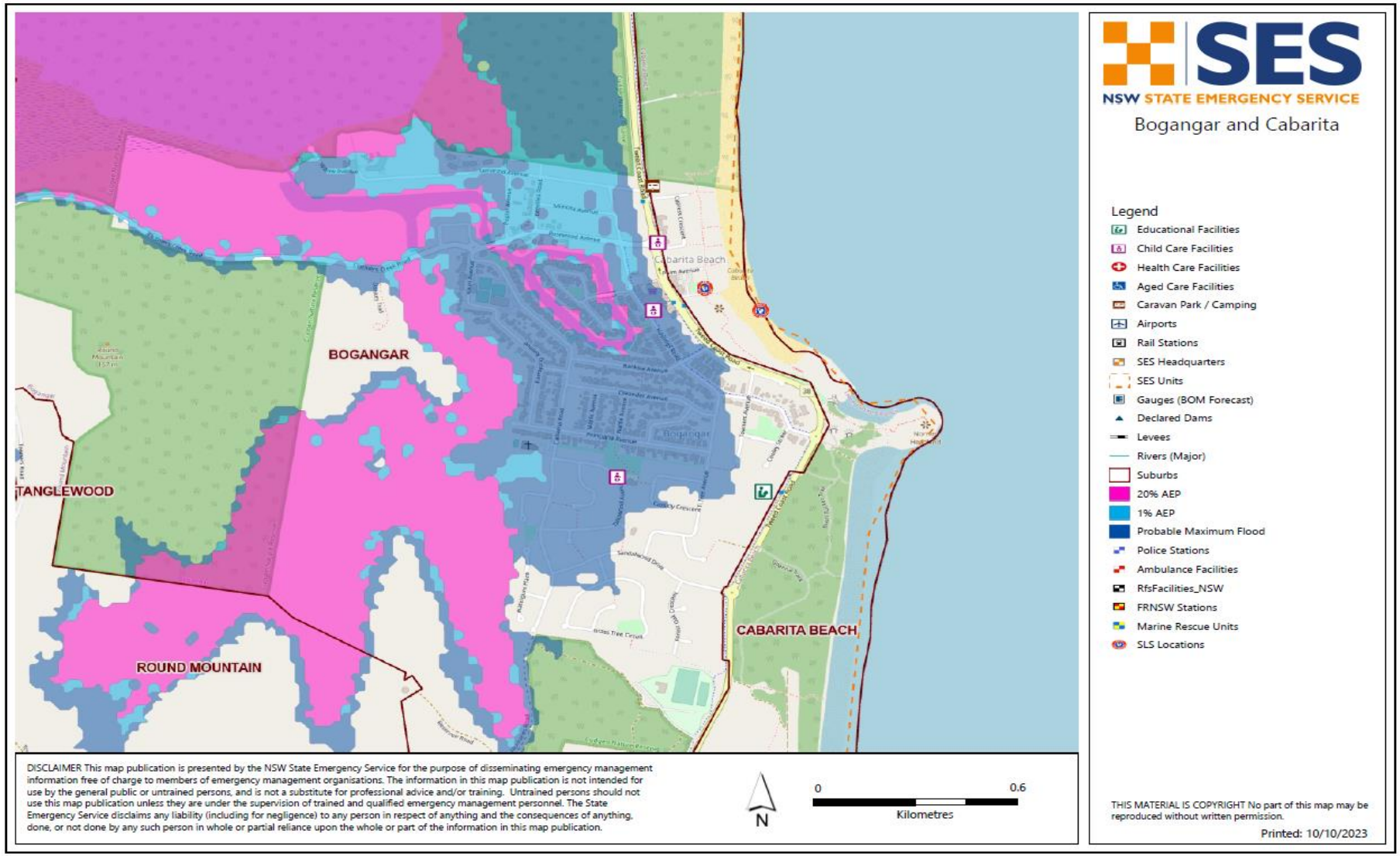
MAP 14: TWEED HEADS TOWN MAP



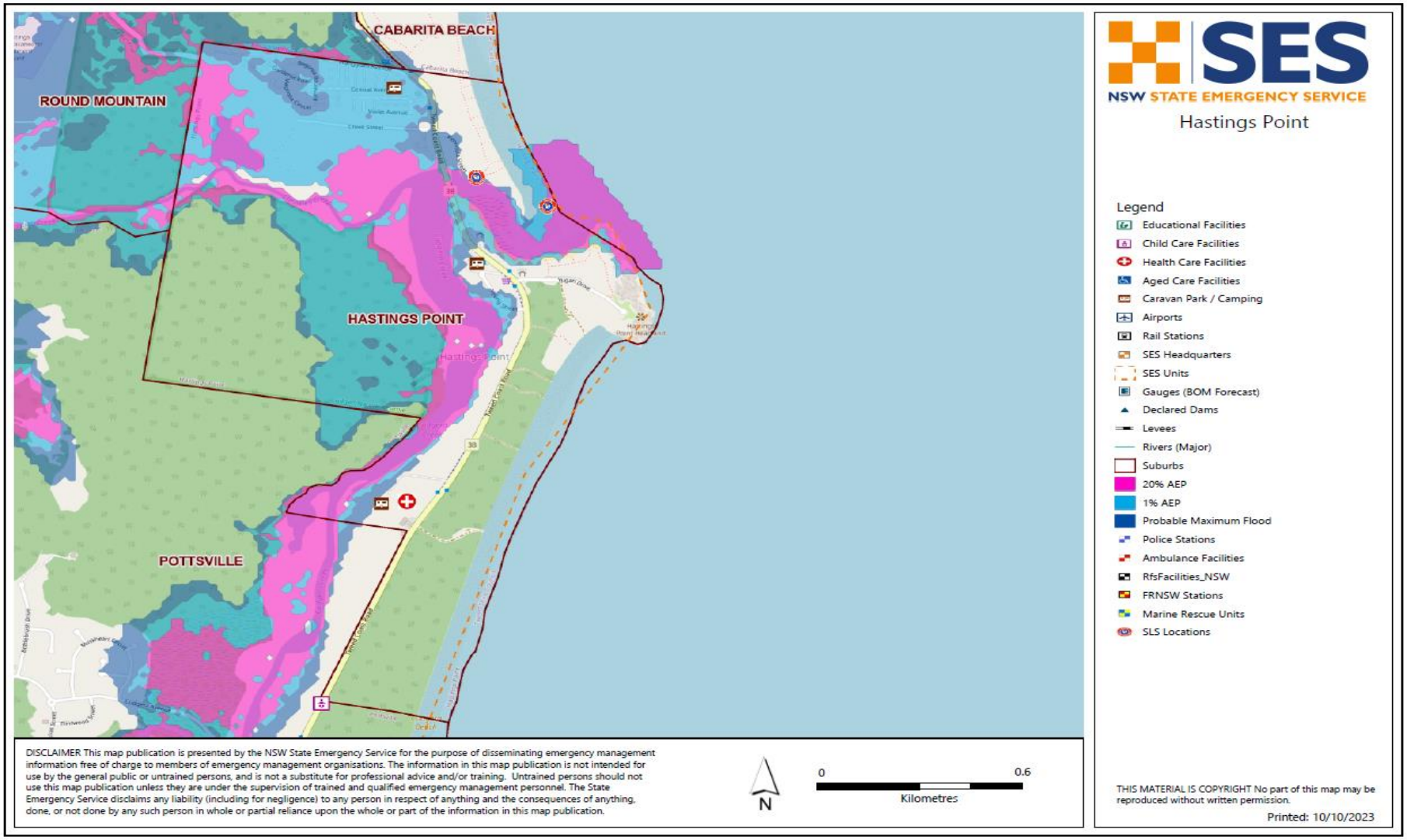
MAP 15: FINGAL HEADS TOWN MAP



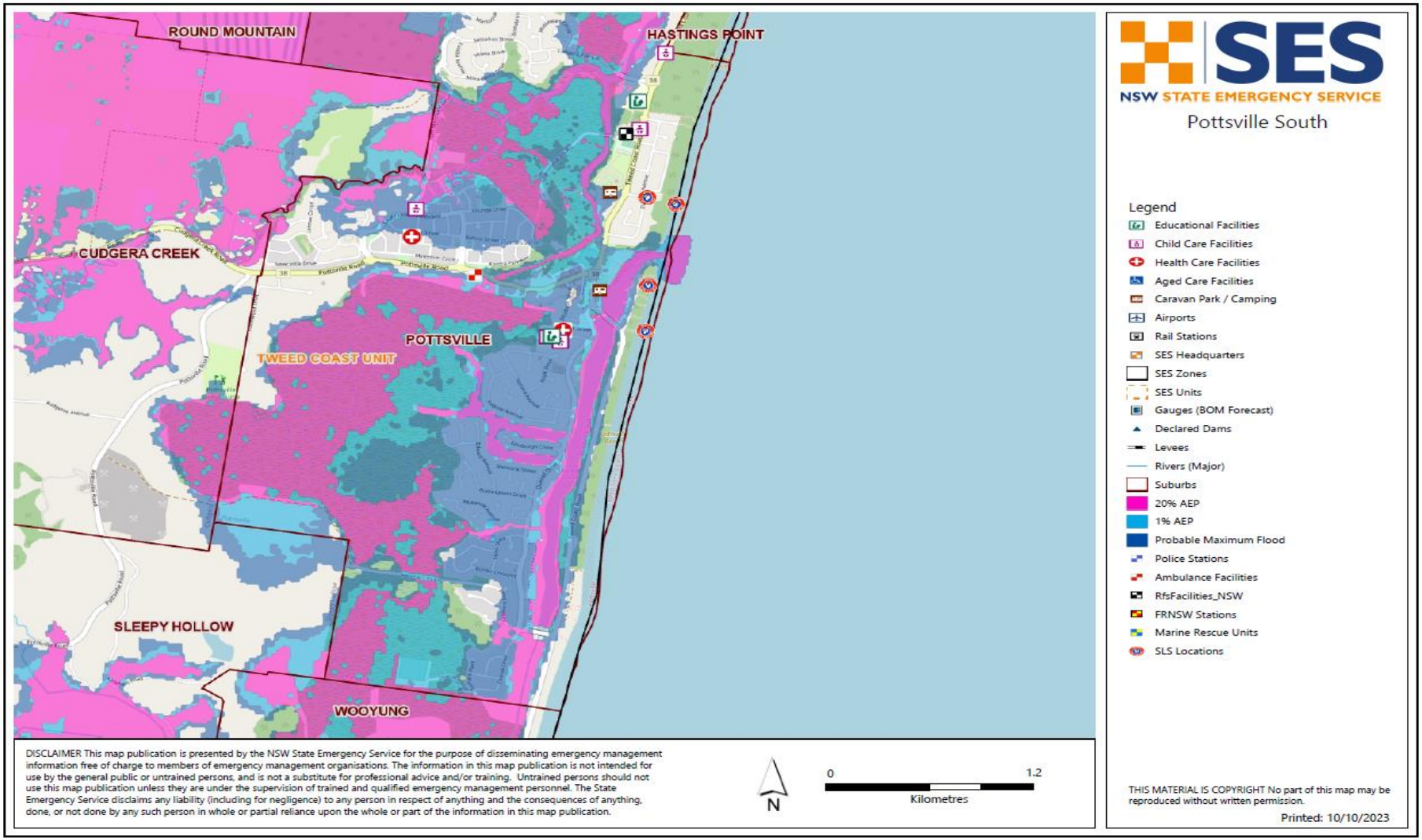
MAP 16: BOGANGAR AND CABARITA TOWN MAP



MAP 17: HASTINGS POINT TOWN MAP



MAP 18: POTTSVILLE TOWN MAP



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NSW STATE EMERGENCY SERVICE

SES RESPONSE ARRANGEMENTS FOR TWEED SHIRE

Volume 3 of the Tweed Shire Local Flood Plan

Last Update: November 2008

FloodSafe

ANNEX C - GAUGES MONITORED BY THE TWEED SHIRE SES LOCAL HEADQUARTERS

Gauge Name	River	AWRC No	Easting	Northing	Projection	Datum	Zero Gauge	Conversion to AHD	Type	Owner
Boat Harbour No.3	Rous River	201005	532938.255	6868452.004	MGA 94	ASS	3.738	N/A		DWE
Kynnumboon	Rous River		538179	6867895	MGA 94	TRHD		-0.926	Telemeter	MHL
Eungella‡	Oxley River	201001	528723.666	6863585.036	MGA 94	ASS		+13.285	Telemeter	DWE
Uki‡	Tweed River	201900	532742.434	6856977.060	MGA 94	ASS		+9.04	Telemeter	DWE
Tyalgum (Oxley River)‡	Oxley River	201006							Manual	
Bray Park Weir	Tweed River		536209	6864484	MGA 94	TRHD		-0.934	Telemeter	MHL
Chillingham‡	Rous River	201008							Manual	
Tyalgum‡	Pumpenbil Ck	201901							Manual	
Murwillumbah Bridge	Tweed River	201420	539219	6866353	MGA 94	TRHD		-0.909	Telemeter	MHL
Murwillumbah*‡	Tweed River	201902	539295	6866485	MGA 94	AHD		0	Telemeter	TSC/BoM
Tumbulgum‡	Tweed River	201432	545172	6871996	MGA 94	TRHD		-0.893	Telemeter	MHL
Tumbulgum			545212	6872325	MGA 94					TSC
Barneys Point (Chinderah) *^	Tweed River	201426	554110	6877724	MGA 94	TRHD		-0.883	Telemeter	MHL
Barneys Point	Tweed River		554505	6877666	MGA 94	AHD		0	Telemeter	MHL
Dry Dock	Tweed River	201428							Telemeter	TSC
Letitia 2A	Tweed River	201429	554314	6882414	MGA 94	TRHD		-0.886	Telemeter	MHL
Terranora	Broadwater	201447	548941	6880375	MGA 94	TRHD		-0.853	Telemeter	MHL
Cobaki	Broadwater	201448	549348	6883136	MGA 94	TRHD		-0.863	Telemeter	MHL
Point Danger‡	Tweed River	201904							Manual	

Notes:

1. The Bureau of Meteorology provides flood warnings for the gauges marked with an asterisk (*).
2. SES Local Flood Advices are provided for the gauges marked with a single cross (†).
3. The SES holds a Flood Intelligence Card for the gauges marked with a double cross (‡).
4. Murwillumbah and Banora SES monitor Enviromon from their HQ locations.
5. Barneys Point Gauge has replaced Chinderah (Oxley Cove) as the BoM warning gauge (see ^)

ANNEX D - DISSEMINATION OF SES FLOOD BULLETINS

The Richmond Tweed SES Region Headquarters distributes SES Flood Bulletins and other flood related information (including Flood Warnings) to the following regional media outlets:

Television Stations:

Station	Location
Prime	Lismore
Prime	Gold Coast
NBN	Lismore
NBN	Gold Coast
SC Ten	Goonellabah

Radio Stations:

Station	Location	Frequency	Modulation
2MW Radio 97	Tweed Heads	972 100.4	AM FM
ABC North Coast	Lismore	720 & 94.5	AM/FM
ABC Gold Coast	Gold Coast	91.7	FM
Gold Coast FM	Gold Coast	92.5	FM
Sea FM	Gold and Tweed Coast	90.9	FM
2 LM/ 2ZZZ FM	Lismore	100.9	FM
2 NCR	Lismore	92.9	FM
2 SM	Sydney	1269	AM
Bay FM	Byron Bay	99.9	FM
Coraki FM	Coraki	88.9	FM
Cow FM	Casino	107.9	FM
Gold FM	Gold Coast	1043	FM
Hot Tomato FM	Gold Coast	102.9	FM
Nimbin FM	Nimbin	102.3	FM
Paradise FM	Ballina	101.9	FM
Sea FM	Gold Coast	90.9	FM

Newspapers:

Name	Location
Daily News	Tweed Heads
Gold Coast Bulletin	Gold Coast
Lismore Echo	Lismore
Northern Star	Lismore

Other Agencies:

Name	Location
NSW Department of Primary Industries	Lismore
Ambulance Control Centre	Lismore
ARMY 41 Bn	Lismore
Ballina LEMC	Ballina
Byron Bay LEMC	Mullumbimby
Dept Community Services	Ballina
Country Energy	Lismore
DEMO	Lismore
Dept of Commerce	Lismore
Dept Environ & Climate Change	Alstonville
Gold Coast City Council	Gold Coast
Health Services	Lismore
HeliBase- Admin	Lismore
Kyogle LEMC	Kyogle
Lismore LEMC 1	Lismore
Lismore LEMC 2	Lismore
Lismore LEMC 3	Lismore
NSWFB	Lismore
Police Command- Northern Region	Newcastle
Ports Authority	Newcastle
Qld CDRS	Brisbane
NSW Police/Tweed/Byron LAC	Tweed Heads
RFS - North	Newcastle
Rich Valley LEMC	Casino
RTA	Ballina
Telstra Country Wide	
Ministry of Transport	Lismore
Tweed LEMC	Tweed Heads
Workcover Authority	Ballina

ANNEX E - TEMPLATE EVACUATION WARNING MESSAGE FOR [ENTER NAME OF AREA]

Evacuation Warning for [ ]

Date/Time of Issue: [ ]

Authorised By: [ ]

The Bureau of Meteorology has predicted a flood level of [ ] metres at [ ] ***(place)*** at [ ] ***(time).*** This means that the following area(s) may be inundated **[ ]**.

It is recommended that you prepare to evacuate/for evacuation within the next [ ] hours. If you leave it later, the roads may be congested or closed.

To prepare for evacuation, you should:

- Raise belongings by placing them on tables, beds and benches. Put electrical items on top. Some items may be able to be placed in ceilings.
- Gather medicines, personal and financial documents and mementos together to take with you.
- Listen to radio stations [enter station] for further information and to confirm this warning.
- If possible, check to see whether your neighbours need help.
- Make arrangements for care of pets or companion animals.

If evacuation is necessary:

- Turn off the electricity, gas and water.
- Take three days' supply of clothes with you.
- If you have a car, drive to the evacuation centre at [ ] ***(specify route if appropriate)***.
- If you don't have a car, buses will operate on normal routes. Special transport can also be provided on request if necessary, telephone [ ].
- So that you can be accounted for, it is important that you register at the evacuation centre.
- After registering, you may go to the house of a friend or relative. Alternatively, accommodation will be arranged for you.
- The Police will provide security for your property while you are away.

ANNEX F - EVACUATION ARRANGEMENTS FOR THE TWEED SHIRE COUNCIL AREA

Background

1. Flooding affecting the Tweed Shire may require the evacuation of small isolated communities (e.g. Fingal Head Sector) or larger communities (e.g. Tweed Heads Sector). Flood evacuation warning time could be less than six hours and, given the diversity and variation in community demographics, significant resources may be required to effect an evacuation of priority.

2. Evacuations are made difficult by flash flooding affecting evacuation routes.

3. Approximately 12,000 people in Tweed Shire Council area will require evacuation in an event equal to or greater than 1 in 100yr ARI flood event.

Arrangements

4. **Control.** During floods evacuations will be controlled by the NSW SES. Small-scale evacuations will be controlled by the Tweed Shire SES Local Controller. Should the evacuations operations escalate beyond the capabilities of local resources control may be handed over to the Richmond Tweed SES Region Controller.

5. **Conduct.** Evacuations will be controlled by the SES and conducted in four phases:

    a. Phase 1 - Warning.

    b. Phase 2 – Withdrawal.

    c. Phase 3 – Shelter.

    d. Phase 4 – Return.

Decision to Evacuate

6. Responsibility for issuing any general evacuation order during flooding rests with the Tweed Shire SES Local Controller who exercises authority in accordance with Section 22(1) of the State Emergency Service Act 1989. However, the decision to evacuate may be taken after consultation with the Local Emergency Operations Controller and the Richmond-Tweed SES Region Controller.

7. When deciding to evacuate the following should be considered:

    a. Predicted flood level and rate of rise.

    b. Rainfall situation and rainfall predictions.

c. Condition of levee banks.

d. Condition of evacuation routes.

e. Characteristics of the at risk population.

f. Time of day.

g. Likely duration of evacuation operations and time available to conduct evacuations.

h. Likely duration of any isolation and preparedness of the community to cope with isolation.

i. Condition of essential services.

j. Environmental risks posed to evacuees in evacuating

8. As far as possible, evacuations will be carried out before inundation occurs.

9. Self-motivated evacuation. Some people will make their own decision to evacuate earlier and move to alternative accommodation using their own transport. These evacuees will be advised, via the media, to inform the Police or SES of their evacuation and their temporary address.

10. Operational Sectors For the purpose of managing evacuations during severe floods and instances of coastal erosion/inundation, Tweed Shire Council has been divided into sectors as listed in Annex B Table 8. Evacuation procedures and information for each sector has been outlined below.

11. **Evacuation triggers**. The following conditions are triggers for evacuation:

a. **Failure of Essential Services**. The failure of public utilities such as sewerage, power, telephones and water pose a significant health risk to residents on the floodplain or in flood affected areas. In the event of any or all of these systems failing or potentially failing, the need for evacuations will be discussed with the members of the LEMC.

b. **Flooding affecting properties**. Evacuations are to occur, if it is likely properties will be flooded.

c. **Isolation of properties**. Persons who are not prepared for isolation or unsuited due to medical conditions etc should be encouraged to evacuate.

d. **Sector Evacuation Triggers**. Evacuation triggers relative to specific sectors are detailed as part of this Annex.

Phase 1 – Warning

12. **Evacuation warnings.** On the receipt of flood warnings predicting peak heights at relative gauges as detailed in Annex C, the Tweed Shire SES Local Controller will consult as necessary to determine the level of the threat and the

need to consider evacuations. As soon as possible after the decision to evacuate is made, the Richmond Tweed Region Headquarters will issue evacuation warnings to the 'at risk' residents, via media outlets, indicating what people should do before evacuating and when actually doing so. The Tweed Shire SES Local Controller will ensure that the evacuation warnings will be disseminated at a local level.

13. **Content of Evacuation Warnings.** A template guide to the content of evacuation warning messages is at Annex E. These are disseminated via:

- The radio and TV stations listed in Annex D. Bulletins may be preceded by the Standard Emergency Warning Signal (Authorisation required by Richmond Tweed SES Region Headquarters).
- Door-knocks by emergency service personnel.
- Public address systems from emergency service vehicles.
- Telephone.
- Two-way radio.
- Direct access to Radio Stations as listed in Annex D.
- SES Flood Bulletins.
- Variable Message Signs.

Phase 2 – Withdrawal

14. **Introduction.** Withdrawal involves the actual removal of the community/individuals from dangerous or potentially dangerous areas to safer areas.

15. **Movement.** Evacuees should initially be encouraged to move by foot if practical or use their own transport where distance and circumstances prevent movement by foot to a safe area. The Tweed Shire SES Local Controller is responsible for the arrangement of transport for those people without their own vehicles.

16. **Phasing**. Evacuation and warning priorities will vary depending on the trigger as described below:

Triggers	Priority 1	Priority 2	Priority 3	Priority 4
Severe Weather Warning	Schools and Child Care Centres, Special needs/home care patients	Elderly and infirm		

Triggers	Priority 1	Priority 2	Priority 3	Priority 4
Failure of Essential Services	Hospitals* Special* needs/home care patients	Aged Care Facilities	Identified at risk home residents	Other residents and pets as possible.
Flooding affecting properties	Special needs/home care patients	Ground Level residents/Caravan Parks	Other residents and pets when possible	
Tsunami Warning	Beaches	Residences within 1 kilometre from high tide mark and less than 10 metres above mean high tide levels	Schools	Other
Isolation of properties	Elderly and infirm	Single Parent families	Re-supply	

Table 10

17. **Large-scale evacuations.** When large scale evacuations are likely, the Tweed Shire SES Local Controller will liaise with the Richmond-Tweed SES Region Headquarters and request the deployment of helicopters and additional flood boats/resources if required.

18. **Health Demographics**. There are a number of persons within the community who have special needs and support in the event of an evacuation and these may include:

    a. Persons with pre-existing medical conditions, in particular asthma, diabetes and epilepsy, and communicable diseases.

    b. Pregnant women.

    c. Home care patients (location data maintained by NSW Health via NCAHS Community Health Facilities); and

    d. Aged care facilities.

19. **Animals.** Assistance animals (guide dogs, hearing assistance animals, etc) will remain in the care of their owners throughout the evacuation. This includes transport and access into evacuation centres etc. Due to safety restrictions, it may not be possible to allow companion animals to accompany their owners when being transported via aircraft or flood rescue boats. DPI will make separate arrangements for the evacuation and care of companion animals.

20. **Doorknocking.** Field teams conducting doorknocks will record and report back the following information to the Operations Centre:

    - Addresses and locations of houses doorknocked and/or evacuated.
    - The number of occupants.
    - Details of support required (such as transport, medical evacuation, assistance to secure house and/or property and raise or move belongings).
    - Details of residents who refuse to comply with the evacuation order.

21. **Refusal to evacuate.** Field teams cannot afford to waste time dealing with people who are reluctant or refuse to comply with any evacuation order. These cases should be referred to the Local Emergency Management Operations Controller who will arrange for Police to ensure their evacuation.

22. **Security.** The NSW Police Force will provide security for evacuated areas.

23. **Transport and storage**. Transport and storage of furniture from flood threatened properties will be arranged as time and resources permit.

Phase 3 – Shelter

24. **Evacuation centres/areas**. The usual purpose of evacuation centres is to meet the immediate needs of victims, not to provide them with accommodation. Evacuees will be advised to go to or be taken to the nearest accessible evacuation centre, which may initially be established at the direction of the Tweed Shire SES Local Controller, but managed as soon as possible by the DoCS. Identified Evacuation Centres/Areas specific to sectors are listed in their respective Sector Evacuation Strategies below.

25. **Action on arrival.** On arrival, evacuees will be:

    a. registered;

    b. medically checked, if necessary; and

    c. provided with their immediate welfare needs.

26. **Registration.** The NSW Police Force will ensure that all evacuees are registered on arrival at the designated evacuation centres.

27. **Animal shelter compounds**. Animal shelter compounds will be set up for the domestic pets and companion animals of evacuees if required. Facilities will be managed by DPI.

Phase 4 – Return

28. Once it is considered safe to do so, the Tweed Shire SES Local Controller will authorise the return of evacuees to their normal or alternative place of residence. This decision will be made in consultation with Engineering Services Functional Area Co-coordinator in regards to matters such as the electrical safety of buildings.

29. The return will be controlled by the Tweed Shire SES Local Controller and may be conducted, at his/her request, by DoCS.

Sector 1 - Uki

General

30. This sector is dominated by single dwelling residential development. The village is serviced by a small commercial precinct and there is no designated industrial area within the village, however it is surrounded by agricultural activities. Uki sector is within a flash flood environment.

Community Profile

Census Description – Uki	Result (2006 Census)
Total persons	2590
Total persons aged 5 years and younger	136
Aged 65 Over	248
Total persons where English is 2nd language	94
Single parent families	144
Resident of 5yrs or less	506
Dwellings without vehicles	38
Total number of dwellings	1113
Total persons of indigenous origin	58

Sector Control

31. **Control.** The Tweed Shire SES Local Controller will co-ordinate evacuations in this sector with the assistance of the NSW Rural Fire Service.

32. **Conduct.** The NSW Rural fire Service and NSW SES will assist in the conduct of evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

33. Evacuation occurs when the Uki gauge (201900) is expected to exceed 6.0m. 10-12 houses in Smith Street will be affected at this height.

Method of Evacuation

34. Historically, telephone contact and door knocking by local residents and NSW RFS volunteers have effected the previous evacuations.

Evacuation Centres

35. Uki Public School, Main Street Uki is most suitable location

36. Uki Public Hall & Recreation Reserve, Main Street Uki

Evacuation Routes

37. Residents should be encouraged to take local roads/streets to Main Street Uki.

Evacuation Route Closure

38. Evacuation routes to Murwillumbah will be closed at Anthony's Flat on Bakers Road at a height of 6.9m on the Uki gauge. The Kyogle Road will be cut at Perch Creek Kunghur.

Vulnerable Institutions and Facilities Affected

39. Nil identified.

Time

40. The available time to warn the community is variable as the sector is a flash flood environment and it could be as short as 2 hours.

Sector 2 - Tyalgum

General

41. Located 24kms west of Murwillumbah on the Tyalgum Road. The area is dominated by single dwelling residential development. The village is serviced by a small commercial precinct with no designated industrial area. The area is surround be agricultural activities. The entire area is subject to flash flooding.

Community Profile

Census Description - Tyalgum	Result (2006 Census)
Total persons	1150
Total persons aged 5 years and younger	77
Aged 65 Over	108
Total persons where English is 2nd language	27
Single parent families	64
Resident of 5yrs or less	206
Dwellings without vehicles	23
Total number of dwellings	502
Total persons of indigenous origin	34

Sector Control

42. Control. The Tweed shire SES Local Controller will control evacuations in this sector

43. Conduct The NSW Rural Fire Service and NSW SES will conduct evacuations in this sector with assistance from the NSW Police Force.

Evacuation Trigger

44. Evacuation is to proceed when the Tyalgum gauge (201006) reaches 9.2m with further rises expected.

Evacuation Centres

45. Tyalgum Public School, Coolman Street Tyalgum

46. Tyalgum Hall, 1 Cudriga Street Tyalgum

Evacuation Routes

47. Local roads and streets to above locations

Evacuation Route Closure

48. Tyalgum village can become isolated by floodwaters. Time of isolation is expected to be less than 48 hours.

Time

49. The available time to warn the community is variable as the area is a flash flood environment.

Sector 3- Chillingham

General

50. Located west of Murwillumbah on the Rous River this sector is located in a flash flood environment. Rainfall in the catchment area, particularly the Bald Mountain area can significantly impact upon the Chillingham village

Community Profile

Census Description - Chillingham	Result (2006 Census)
Total persons	2685
Total persons aged 5 years and younger	154
Aged 65 Over	325
Total persons where English is 2nd language	69
Single parent families	116
Resident of 5yrs or less	523
Dwellings without vehicles	31
Total number of dwellings	1119

Sector Control

51. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

52. Conduct The NSW Rural Fire Service and NSW SES will conduct evacuations in this sector with assistance from the NSW Police Force.

Evacuation Trigger

53. Rainfall in the Bald Mountain area should be monitored. Over 350mm of rain fell in Bald Mountain area over a 24hr period in January 2008 which caused significant flash flooding at Chillingham

Evacuation Centres

54. Chillingham Village Hall

Time

55. Flash flood environment with rapid onset of localised flash flooding.

Sector 4 - Murwillumbah

General

56. The township of Murwillumbah has a population of 7696, with approximately 400 residents living in the south Murwillumbah area. The majority of people live in separate houses, with a small percentage living in flats, units and apartments. The main commercial /retail area is located in central Murwillumbah and is protected by a levee system. An industrial/commercial area is located at South Murwillumbah with protection from a 1 in 10yr (ARI) event.

57. Murwillumbah also has a 102 bed hospital located in Ewing Street.

Community Profile

Census Description –Murwillumbah	Result (2006 Census)
Total persons	7696
Total persons aged 5 years and younger	446
Aged 65 Over	1614
Total persons where English is 2nd language	161
Single parent families	462
Resident of 5yrs or less	1684
Dwellings without vehicles	415
Total number of dwellings	3334
Total persons of indigenous origin	145

Sector Control

58. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

59. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police Force.

Evacuation Trigger

60. Evacuation from South Murwillumbah will occur when the Murwillumbah gauge (201902) is predicted to exceed 4.85m. In January 2008 evacuations commenced when the Murwillumbah gauge height reached 2.68m at midnight 5th January. Evacuations were successfully competed by 3.00am where the gauge height was 3.95m.

61. The CBD of Murwillumbah should be evacuated when the height is predicted to reach and exceed 6.3m (Murwillumbah gauge). The Tweed Flood Study 2005 suggests that the levee system will overtop near the road bridge at a height of 6.3m AHD which is equivalent to a 1 in 60-80 yr ARI flood.

Method of Evacuation

62. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged with the assistance of the Regional Transport Co-ordinator. Once road access is cut SES Flood Rescue boats will be utilised.

Evacuation Centres

63. Murwillumbah TAFE, Main Street Murwillumbah

64. Sacred Heart (Catholic Hall) Murwillumbah Street Murwillumbah

65. Wollumbin High School, North Arm Rd Murwillumbah

Evacuation Routes

66. South Murwillumbah/Condong Residents:

    a. Local streets to Tweed Valley Way - Alma Street – Wollumbin St – Brisbane St – Murwillumbah St towards TAFE/Hall

67. Murwillumbah residents:

    a. Local Streets to Wollumbin St – Brisbane St – Murwillumbah St to TAFE/Hall OR

    b. Local Streets to Byangum Rd/Nullum St towards TAFE/Hall

68. Wollumbin High/North Arm Rd residents:

    a. Local streets to North Arm Rd – East/West to Wollumbin High

Evacuation Route Closure

69. The Tweed Valley Way is cut at a height of between 3.5m – 4.0m (Murwillumbah gauge) which prevents evacuation to the Lower Tweed.

70. Water will be over Alma Street at Budd Park at a height of 4.0m on the Murwillumbah gauge. This will need to be considered when evacuations of South Murwillumbah are commenced.

Vulnerable Institutions and Facilities Affected

71. The following institutions and facilities may require evacuation;

    a. Greenhill's Caravan Park will have water approaching when flood height reaches 4.0m (Murwillumbah gauge)

b. East Murwillumbah School which is located outside the levee wall

Time

72. The available time to warn the community is between 3-4 hours.

Sector 5 – Tumbulgum And Condong

General

73. This sector consists of 94 houses and a population of 330 people in the Tumbulgum area and 153 houses and 250 residents in the Condong area.

74. If evacuation is necessary the village of Tumbulgum is to be evacuated prior to Condong.

Community Profile

Census Description - Tumbulgum	Result (2006 Census)
Total persons	2536
Total persons aged 5 years and younger	145
Aged 65 Over	297
Total persons where English is 2nd language	72
Single parent families	97
Resident of 5yrs or less	569
Dwellings without vehicles	24
Total number of dwellings	983
Total persons of indigenous origin	46

Sector Control

75. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

76. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police Force.

Evacuation Trigger

77. In January 2008 a flood height of 2.42m (AHD) was reached which caused ground surface flooding in Bawden Street, Irving Street, Fawcett Street and Gray Street. At this height properties in Riverside Drive were above the flood level, except for houses in the vicinity of Tumbulgum Bridge. Evacuation did not occur at this height with residents remaining inside their premises. Further to this, at this height access routes to Lower Tweed and Upper Tweed via Tweed Valley Way were closed.

Method of Evacuation

78. There are no suitable evacuation centres in the Sector but the following evacuation centres from Sector 4 (Murwillumbah) and 8 (Terranora) can be used for Evacuation Centres as long as the Tweed Valley Way remains open (closes at 3.5m AHD at the Murwillumbah gauge) and the Terranora Road remains open.

Evacuation Centres

79. Murwillumbah Sector

    a. Murwillumbah TAFE, Main Street Murwillumbah

    b. Sacred Heart (Catholic Hall) Murwillumbah Street Murwillumbah

80. Terranora Sector

    a. Lindisfarne Anglican School, Mahers Lane Terranora

Evacuation Routes

81. To Murwillumbah:

    a. Tweed Valley Way to Murwillumbah - Alma Street – Wollumbin St – Brisbane St – Murwillumbah St towards TAFE/Hall

82. To Terranora:

    a. Cross Tumbulgum Bridge to Terranora Rd – Mahers Lane – Lindisfarne Anglican School

Evacuation Route Closure

83. The Tweed Valley Way will close at a height of 3.5m (Murwillumbah gauge) at Tumbulgum and 3.9m (Murwillumbah gauge) at Condong. Closure of this evacuation route will prevent access to Murwillumbah evacuation centres. The Flood Intelligence Collection and Review Draft Report July 2008 suggests that Terranora Road had been cut by floodwaters between Tumbulgum Bridge and high ground to the north.

Vulnerable Institutions and Facilities Affected

84. The following institutions may require evacuation (at risk)

    a. Tumbulgum Public School

Time

85. The speed of onset between Murwillumbah and Tumbulgum/Condong is between 3-4 hours.

Sector 6 – Chinderah/Kingscliff

General

86. This sector is located on the Chinderah Floodplain and will become isolated when road access is lost and can remain isolated for up to 5 days. The average ground level of the Chinderah and Barney's Point area is about 2.0metres.

Community Profile

Census Description – Chinderah/Kingscliff	Result (2006 Census)
Total persons	7357
Total persons aged 5 years and younger	343
Aged 65 Over	1881
Total persons where English is 2nd language	79
Single parent families	389
Resident of 5yrs or less	2173
Dwellings without vehicles	356
Total number of dwellings	3982
Total persons of indigenous origin	306

Sector Control

87. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

88. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police Force.

Evacuation Trigger

89. Evacuation is to proceed when it is predicted to reach and/or exceed 2.0m (Barney's Point gauge). The removal of caravans from caravan parks, particularly the Chinderah Village Caravan Park should commence when it is predicted to reach and/or exceed 1.5m (Barney's Point gauge). Staged evacuations of lowest lying caravans and residents should commence at this height. Caravans should be re-located to Marine Parade Kingscliff unless cyclonic weather is predicted.

90. Complete road access will be lost at a height of 2.1m (Barney's Point gauge) when the Pacific Highway is cut.

Method of Evacuation

91. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

92. The most suitable evacuation centres are located within the Kingscliff and Cudgen villages. A secondary evacuation centre can be located in the Banora Point sector.

    a. Kingscliff Public School Orient Street Kingscliff

    b. Kingscliff TAFE Campus Cudgen Rd Kingscliff

    c. Cudgen Public School Collier Street Cudgen

    d. Banora Pt Public School Pioneer Drive Banora Pt

Evacuation Routes

93. Kingscliff Evacuation Centre:

    a. Chinderah Road - Tweed Coast Rd – Cudgen Rd – McPails St/Orient St

94. Cudgen Evacuation Centre:

    a. Local streets to Tweed Coast Rd – Crescent St - Cudgen Rd – Collier St.

95. Banora Evacuation Centre:

    a. Wommin Bay Rd – Pacific Highway – Short Street – Pioneer Parade

Evacuation Route Closure

96. Closure of evacuation routes will occur systematically as the predicted height rises.

97. Chinderah Bay Road will have water across the road west of River Street at a height of 1.5m (Barneys Point gauge) requiring closure.

98. Jenners Corner (Chinderah Bay Rd & Wommin Bay Road) will have water across the road at a height of 1.6m (Barney's Point gauge)

99. Chinderah Rd which will be used for an evacuation route for the residents in the south western area of the sector will have water across the Pacific Highway at the roundabout/interchange at a height of 2.0m (Barney's Point gauge)

Vulnerable Institutions and Facilities Affected

100. The following vulnerable institutions will require evacuation when it is predicted to reach and/or exceed the heights specified, relevant to the Barneys Point gauge, with the suggested evacuation route.

a. On Tweed Caravan Park

- Water enters park at 1.51m

b. Homestead Caravan Park

- Water enters park at 1.6m

c. Hacienda Caravan Park

- Water enters park at 1.6m

d. The suggested evacuation route for the above three caravan parks is Wommin Bay Road to Kingscliff with the secondary evacuation route being Waugh Street to Banora Point Public School

e. Chinderah Village Caravan Park

- Water enters park at 1.6m

f. Drifter's Caravan Park

- Water enters park at 2.0m

g. The suggested evacuation route for the above two caravan parks is Wommin Bay Road to Kingscliff

h. Heritage Caravan Park

- Water enters park at 1.5m

i. Chinderah Lake Caravan Park

- Water enters park at 1.6m

j. Royal Pacific Caravan Park

- Water enters park at 1.55m

k. The suggested evacuation route for the above three caravan parks is Chinderah Rd to Tweed Coast Road to Kingscliff.

Time

101. The approximate speed of onset for flooding in this sector is nine (9) hours from Murwillumbah to Chinderah.

Sector 7 – Banora

General

102. This sector covers the area north of the Tweed River known as Banora Point, which includes the commercial and residential areas centred around Darlington Drive and Leisure Drive as well as the new development Vintage Lakes.

Community Profile

Census Description Banora	Result (2006 Census)
Total persons	14682
Total persons aged 5 years and younger	777
Aged 65 Over	3569
Total persons where English is 2nd language	179
Single parent families	742
Resident of 5yrs or less	3672
Dwellings without vehicles	32
Total number of dwellings	6191
Caravan Park residents	333
Total persons of indigenous Origin	468

Sector Control

103. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

104. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police Force.

Evacuation Trigger

105. Evacuation of vulnerable areas is to proceed at the following locations when the Barney's Point gauge is predicted to reach and/or exceed 2.2m.

Method of Evacuation

106. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

107. The Banora Point Public School located at Pioneer Parade Banora Point is suitable for use as an evacuation centre.

Evacuation Routes

108. Local Streets to Fraser Drive to Leisure Drive to Woodlands Drive to Darlington Drive to Banora Hills Drive

109. Local Streets to Vintage Lakes Drive to Leisure Drive to Woodlands Drive to Darlington Drive to Banora Hills Drive

110. Local Streets to Pacific Drive to Terranora Drive to Johnson Drive to Pioneer Drive

Evacuation Route Closure

111. If the above three evacuation routes prevent access to the Banora Point evacuation centre an alternate Evacuation Centre can be located at the Lindisfarne Anglican School, Mahers Lane Terranora which can be accessed by Frazer Drive to Terranora Road.

Vulnerable Institutions and Facilities Affected

112. The following institutions may require evacuation and/or re-supply;

a. Amity Nursing Home, 18 Ballymore CRT Vintage Lakes

- Approximate property level of 2.76m. Would suggest that facility is un-effected by 20% or 5% flood event but would commence to suffer flood effects in a 1% event (3.0m Barney's Point gauge). It may suffer isolation in a lesser event.

b. St Martha's Hostel Leisure Drive Banora Point

- Inundation would occur during a 5% event (2.2m Barneys Point gauge) and isolation may occur during lesser events. In a 5% event flood depth is modelled to exceed .22m.

c. Winder's Lodge and Cottages Winders Place Banora Point

- Similar effects as St Martha's as facilities are neighbouring properties. In a 5% event (2.2m Barneys Point gauge) flood depth is predicted to exceed 0.17m and up to 0.61m in a 1% event.

d. Banora Point Retirement Village, 57 Leisure Drive

e. RSL Darlington, Leisure Drive Banora Point

Time

113. The available time to warn the community is variable but may be as short as three hours dependant upon rainfall in the Tomewin Catchment.

Sector 8 – Terranora & North Tumbulgum

General

114. Majority of sector is flood free and will remain out of the flood extent. However may require re-supply for up to 2000 people.

115. This sector also encompasses the North Tumbulgum area which is isolated during flooding.

Community Profile

Census Description Terranora	Result (2006 Census)
Total persons	3137
Total persons aged 5 years and younger	184
Aged 65 Over	337
Total persons where English is 2nd language	39
Single parent families	109
Resident of 5yrs or less	617
Dwellings without vehicles	14
Total number of dwellings	1069
Caravan Park residents	643
Total persons of indigenous Origin	47

Sector Control

116. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

117. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

118. If evacuation of rural dwellings in North Tumbulgum and outside of Terranora Village is required evacuation should be initiated before access roads are cut. However, in previous events this area has been successfully re-supplied with minimal evacuation required.

Method of Evacuation

119. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged. A majority of residents from both Tumbulgum and North Tumbulgum park their private motor vehicles on the Tumbulgum Bridge and Terranora Road during times of flood. The parked motor vehicles may have an impact upon the evacuation route and should be monitored.

Evacuation Centres

120. The Lindisfarne Anglican School, Mahers Lane Terranora is the most suitable evacuation centre. The secondary evacuation centre is the Terranora Public School located on the corner of Terranora Road and Mahers Lane.

Evacuation Routes

121. Evacuees should be encouraged to take the following route;

    a. Local roads to Terranora Rd – Mahers Lane – Lindisfarne Anglican School

Evacuation Route Closure

122. Terranora Road is susceptible to land slips during times of heavy rain. An alternate evacuation centre is the Bilambil Public School, Bilambil Road Bilambil however access may be limited due to flooding of the Duroby and Bilambil Creeks

Time

123. The available time to warn the community is variable but may be as short as three hours dependant upon rainfall in the Tomewin Catchment.

Sector 9 – Bilambil

General

124. This sector encompasses the areas of Bilambil and Bilambil Heights and frequently suffers the effects of flash flooding from the Bilambil and Duroby Creeks. Some rural properties are isolated in floods for up to five (5) days and will need either early evacuation or re-supply.

Community Profile

Census Description Bilambil	Result (2006 Census)
Total persons	3691
Total persons aged 5 years and younger	224
Aged 65 Over	511
Total persons where English is 2nd language	76
Single parent families	129
Resident of 5yrs or less	759
Dwellings without vehicles	36
Total number of dwellings	1365
Caravan Park residents	643
Total persons of indigenous Origin	84

Sector Control

125. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

126. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

127. A predicted height of 1.5m (Barney's Point gauge), which is equivalent to a 20 yr ARI event, will isolate the village of Bilambil. At this height the intersection of Duroby Creek Road and Bilambil Rd will close.

Method of Evacuation

128. Early evacuation is necessary or after evacuation routes close the strategy becomes shelter in place and area will require re-supply.

Evacuation Centres

129. The preferred evacuation centres are;

    a. Lindisfarne Anglican School, Mahers Lane Terranora

    b. Terranora Public School, Cnr Terranora Rd & Mahers Lane Terranora

    c. Bilambil Primary School, Bilambil Rd Bilambil

Evacuation Routes

130. Local Roads to Bilambil Rd to Terranora Rd to Mahers Lane

Evacuation Route Closure

131. In the event of the preferred evacuation route closing as a result of reaching the predicted height of 1.5m (Barney's Point gauge) the Bilambil Primary School can be accessed by local roads to Bilambil Road (cooking facilities at the Jets Junior Football Club).

Vulnerable Institutions and Facilities Affected

132. Within this sector an over 55 years mobile home, retirement village complex is located at the intersection of Bilambil Rd and Carool Rd. In the January 2008 event the complex was inundated with floodwater from the nearby Bilambil Creek to a height of between 0.1m – 0.5m

Time

133. If major rain falls within Tomewin Catchment area warning time could be less than 3 hours. If rain falls within Duroby Creek catchment area warning time could be less than 3 hours. Tidal anomalies can also impact upon this sector.

Sector 10 – Tweed Heads South

General

134. This sector covers the area of South Tweed Heads. Many residences and businesses are affected by floods as small as a 20 YR ARI event.

135. Some of the flood prone areas in this sector are protected by levees to 2.18m (crest height) (Barneys Point gauge)

Community Profile

Census Description – Tweed Heads South	Result (2006 Census)
Total persons	7321
Total persons aged 5 years and younger	321
Aged 65 Over	2681
Total persons where English is 2nd language	108
Single parent families	381
Resident of 5yrs or less	1890
Dwellings without vehicles	453
Total number of dwellings	3939
Caravan Park residents	489
Total persons of indigenous Origin	324

Sector Control

136. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

137. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

138. Evacuation needs to begin when there is a prediction at Barney's Point gauge to reach and/or exceed 2.2m.

139. Some roads (Floral Ave to Minjungbal Drive) within the Sector close early in the flood due to inundation from flood water, evacuations need to begin early otherwise residents will become isolated and some areas will require rescue.

140. Many vulnerable facilities are affected, as detailed in Annex B. Of note are the two (2) Aged Care facilities, six (6) Caravan Parks and six (6) schools which are vulnerable to a flood event equal to or exceeding a 20 YR ARI event (2.2m Barney's Point gauge).

141. A height of 1.1m on the Dry Dock gauge is the first trigger for removal of caravans (River Retreat CP) from the area; however the evacuation process should begin when there is a prediction at Barneys Point gauge to reach/exceed 1.5m (TBC). This will begin a staged evacuation of lowest lying caravans to the Tweed Heads Recreation Ground.

Method of Evacuation

142. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

143. There are no evacuation centres within this sector that are above the PMF, however neighbouring sectors have evacuation centres and are listed below in the preferred order;

a. Police & Citizens Youth Club (PCYC) Cnr Florence & Adelaide Street Tweed Heads

b. Banora Point Public School Pioneer Drive Banora Point

Evacuation Routes

144. Local streets to Dry Dock Rd – north in Minjungbal Drive – continue north in Wharf Street – turn left into Florence Street heading west.

145. Local streets to Minjungbal Drive to Pacific Highway then south and right turn into Terranora Road, right at Kittawaki St and left onto Pioneer Parade

Evacuation Route Closure

146. Parts of Dry Dock Rd, Fraser Drive and Philip Parade can be inundated early in floods. Dry Dock Road will be cut at a height of 1.7m on the Dry Dock gauge. Early warning and evacuation is required for this sector

Vulnerable Institutions and Facilities Affected

147. Many vulnerable facilities are affected, as detailed in Annex B. Of note are the two (2) Aged Care facilities, six (6) Caravan Parks and six (6) schools which are vulnerable to a flood event equal to or exceeding a 20 YR ARI event (2.2m Barney's Point gauge).

Time

148. Nine (9) hours in a riverine flood however storm surge and tide anomalies could reduce this time significantly.

Sector 11 – Seagulls Estate

General

149. The Seagulls Estate is a low flood island that will be completely inundated in a PMF flood event.

150. Approximately 1200 to 1500 people will need to be evacuated prior to the access roads closing. Inundation can last up to 4 days within this Sector, but evacuees may need to be accommodated longer if residential areas are considered not suitable to re-inhabit immediately after the flood.

Community Profile

Census Description – Seagulls Estate	Result (2006 Census)
Total persons	1179
Total persons aged 5 years and younger	62
Aged 65 Over	354
Aged 75 Over	145
Total persons where English is 2nd language	No data available
Single parent families	25
Resident of 5yrs or less	503
Dwellings without vehicles	48
Total number of dwellings	570

Sector Control

151. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

152. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

153. When the predicted height for Barney's Point gauge is to reach and/or exceed 2.2m.

Method of Evacuation

154. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

155. There is no suitable evacuation centre in this sector. The preferred list of evacuation centres are listed below in order of preferred options;

a. Police & Citizens Youth Club (PCYC) Cnr Florence & Adelaide Street Tweed Heads

b. Tweed Shire Civic Centre, Brett Street Tweed Heads

c. Bilambil Public School, Bilambil Rd, Bilambil

Evacuation Routes

156. Evacuees should be encouraged to take the following routes as listed below;

a. Local Streets to Lakes Drive right into Gollan Drive – onto Kennedy Drive - left into Ducat Street – Mugga Way – Kent St – Dutton St – Florence St

b. Local Streets to Lakes Drive right into Gollan Drive – onto Kennedy Drive - left into Ducat Street – Mugga Way – Kent St – Dutton St – Florence St – left into Brett St

c. Local Roads to Lakes Drive, Gollan Drive, Bilambil Heights Scenic Drive, Bilambil Rd to the School

Evacuation Route Closure

157. There is no alternate evacuation route. This sector has only one access/egress route in and out of the estate. (The Lakes Drive) According to Tweed Flood Study (2005) The Lakes Drive in the vicinity of Jacaranda Ave, will flood to a depth of 0.6m in a 20 yr ARI event ((2.2m Barney's Point gauge).

Time

158. Nine (9) hours in a riverine flood however storm surge and high tide could reduce this time significantly.

159. In the event of intensive localized flash flooding influenced by Cobaki, Piggabeen and Bilambil Creek, evacuation time is 3 to 4 hours.

Sector 12 – Tweed Heads West

General

160. This sector includes the area surrounding Cobaki Broadwater including Cobaki Creek and the residential and commercial area's west of the Pacific Highway.

161. Areas within this sector can be isolated up to four (4) days.

Community Profile

Demographic Data	(2006 Census)
Total persons	6097
Total persons aged 5 years and younger	282
Aged 65 Over	1707
Total persons where English is 2nd language	70
Single parent families	349
Resident of 5yrs or less	1343
Dwellings without vehicles	326
Total number of dwellings	2988
Total persons of indigenous Origin	219

Sector Control

162. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

163. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

164. Consideration of evacuation of this sector should begin when the Barneys Point gauge is predicted to exceed 2.0m AHD.

165. The Retirement Village on Piggabeen Rd needs to be evacuated when the Barneys Point gauge is predicted to reach/exceed 1.2m (0.9m on the Dry Dock gauge), at which point the access road closes (Kennedy Drive)). This will begin a staged evacuation of lowest lying residents, in particularly caravans from the Pyramid Caravan Park, to the Tweed Heads Recreation Ground

Method of Evacuation

166. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

167. There is no suitable evacuation centre in this sector. The preferred list of evacuation centres are listed below in order of preferred options;

a. Police & Citizens Youth Club (PCYC) Cnr Florence & Adelaide Street Tweed Heads

b. Tweed Shire Civic Centre, Brett Street Tweed Heads

c. Bilambil Public School, Bilambil Rd, Bilambil

Evacuation Routes

168. Local Streets to Gollan Drive – onto Kennedy Drive - left into Ducat Street – Mugga Way – Kent St – Dutton St – Florence St

169. Local Streets to Gollan Drive – onto Kennedy Drive - left into Ducat Street – Mugga Way – Kent St – Dutton St – Florence St – left into Brett St

170. Local Roads to Gollan Drive, - Scenic Drive, Bilambil Rd to the School

Evacuation Route Closure

171. Kennedy Drive near intersection of Rose Street will be cut at a height of 1.6m (Barney's Point gauge), which will prevent access to Kennedy Drive in the east which will prevent evacuation centres 1 & 2 from being utilised.

172. Access to the evacuation centre located at Bilambil will be prevented in a flood event greater than a 20yr ARI (2.2m Barney's Point gauge)

Vulnerable Institutions and Facilities Affected

173. There is one (1) caravan park, one (1) Aged Care Facility and one (1) Retirement Complex within this sector which are outlined in Annex B.

Time

174. Nine (9) hours in a riverine flood however storm surge and high tide could reduce this time significantly.

175. In the event of intensive localized flash flooding influenced by Cobaki, Piggabeen and Bilambil Creek, evacuation time is 3 to 4 hours.

Sector 13 – Tweed Heads

General

176. This sector encompasses the main Central Business District of the Tweed Local Government Area.

177. Many residential properties will be affected in a flood as frequent as a 1:20 YR ARI, and this will increase with the magnitude of the flood. In the Probable Maximum Flood, Tweed Heads becomes a high flood island with land between Razorback and Flagstaff Hill the only land free from flood water.

Community Profile

Demographic Data	(2006Census)
Total persons	7125
Total persons aged 5 years and younger	256
Aged 65 Over	2567
Total persons where English is 2nd language	127
Single parent families	284
Resident of 5yrs or less	1647
Dwellings without vehicles	552
Total number of dwellings	4042
Total persons of indigenous Origin	137

Sector Control

178. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

179. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

180. Consideration for the evacuation of this sector should begin when there is a prediction at Barneys Point gauge to exceed 2.0m.

Method of Evacuation

181. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

182. Police & Citizens Youth Club (PCYC) Cnr Florence & Adelaide Street Tweed Heads

183. Tweed Shire Civic Centre, Brett Street Tweed Heads

Evacuation Routes

184. Local streets to Florence Street

185. Local Streets to Brett Street

Vulnerable Institutions and Facilities Affected

186. Several identified institutions and facilities have been identified which are located within this sector. See Annex B. Many residential properties will be affected by a flood as frequent as a 20 yr ARI event.

187. Of note is the Amaroo Nursing Home and the Hospital which are affected in a 1:100 YR ARI flood event, and evacuation may need to be considered if this height is predicted on the Barneys Point gauge (3.0m).

Time

188. Approximate available time will be Nine (9) hours riverine flood. (Storm surge and Tidal influence could reduce this significantly)Intensive localised flash flooding will reduce evacuation time to 4 to 5 hours.

Sector 14 – Fingal Head

General

189. Unless evacuation is completed early residents will become isolated and if the flood increases in size some residents will need to be rescued.

190. Fingal Village becomes a flood island and can act as an area of last resort, but can not offer any suitable shelter for flood refugees. Fingal Rovers Surf Club is above the flood PMF but may not be above the storm surge PMF.

Community Profile

Demographic Data	(2006 ABS Census)
Total persons	575
Total persons aged 5 years and younger	37
Aged 65 Over	114
Single parent families	32
Resident of 5yrs or less	122
Dwellings without vehicles	4
Total number of dwellings	318
Total persons of indigenous Origin	70

Sector Control

191. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

192. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

193. Evacuation Triggers for Fingal head include;

a. Fingal Head Road begins to be inundated at 0.8m (Barneys Point gauge), at a height greater than 1.1m Fingal Head Rd would become impassable to normal vehicles, which would isolate Fingal Head village.

b. When there is a prediction for Barneys Point gauge (201426) to reach and/or exceed 1.5m, evacuation should begin.

Method of Evacuation

194. Early unassisted evacuation will be necessary before the Fingal Rd/Wommin Lake Crescent intersection is cut, otherwise high clearance vehicles will be necessary.

Evacuation Centres

195. There is no suitable evacuation centre in this sector. The preferred list of evacuation centres are listed below in order of preferred options;

a. Kingscliff TAFE Campus, Cudgen Road Kingscliff

b. Kingscliff Public School, Orient Street Kingscliff

c. Cudgen Public School, Collier Street Cudgen

d. Banora Point Public School, Pioneer Pde Banora Pt

Evacuation Routes

196. Evacuees should be encouraged to take the following routes as listed below;

a. Fingal Head Rd – Pacific Highway - Tweed Coast Rd – Cudgen Rd

b. Fingal Head Rd – Pacific Highway - Tweed Coast Rd – Cudgen Rd – McPails St -Orient St

c. Fingal Head Rd – Pacific Highway - Tweed Coast Rd – Crescent St - Cudgen Rd – Collier St

d. Fingal Head Rd – Pacific Highway – Short Street – Pioneer Parade

Evacuation Route Closure

197. Early evacuation is necessary as the Fingal Head Road in the vicinity of Wommin Lake Crescent will become impassable at a height of 1.1m (Barney's Point gauge) and completely isolate the village of Fingal Head.

198. Temporary accommodation is available in the following location when there is no longer road access, but the first priority should be evacuation to the centres listed above.

199. Fingal Rovers Surf Club, Marine Parade: Local Streets to Fingal Rd, Lighthouse Parade, Main Rd, Marine Parade

Vulnerable Institutions and Facilities Affected

200. The Fingal Holiday Park is located in Prince Street Fingal Head.

Time

201. Approximately 9 hours warning is available before the onset of flooding.

Sector 15 – Cabarita - Bogangar

General

202. In the Bogangar/Cabarita Sector evacuation will focus on areas most at risk close to Cudgen Creek, Cudgen Lake, Cudgera Creek, and Mooball Creek. Other residents should shelter in place for the duration of the event

203. There are up to 100 properties in Bogangar that require evacuation and up to 10-20 houses in Pottsville.

204. Roads surrounding Bogangar/Cabarita can be inundated for up to 3 days and the area will become isolated. Hastings point can also become isolated. Hastings Point has up to 440 caravans and can have a significant population during holiday periods.

Community Profile

Census Description – Bogangar/Cabarita	Result (2006 Census)
Total persons	5226
Total persons aged 5 years and younger	320
Aged 65 Over	695
Total persons where English is 2nd language	83
Single parent families	278
Resident of 5yrs or less	1809
Dwellings without vehicles	128
Total number of dwellings	2382
Total persons of indigenous Origin	195

Sector Control

205. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

206. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

207. Evacuation of areas should be considered when a flood watch for the area is issued by the BoM, as no flood warning products are issued for gauges in the Cabarita-Bogangar areas.

208. Evacuation of most ‘at risk’ properties north of Banksia Ave will be required.

Method of Evacuation

209. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

210. The following places can be used for Evacuation Centres in this Sector:

a. Bogangar (Cabarita) Public School:

b. Cabarita Surf Club, Pandanus Parade, Cabarita Beach

c. Duranbah Public School, Duranbah Rd, Duranbah: Local Streets to Duranbah Rd

Evacuation Routes

211. Local streets to Tweed Coast Road

212. Local streets to Tweed Coast Road, Pandanus Parade

213. Local streets to Tweed Coast road – north to Cudgen Rd – Duranbah Rd

Vulnerable Institutions and Facilities Affected

214. There are several vulnerable institutions and facilities within this sector. These establishments are outlined in Annex B

Time

215. Flooding within Cabarita -Bogangar is characteristically of a flash flood nature and warning time is less than 6 hours

Sector 16 – Pottsville/Wooyung

General

216. This sector is characteristically a flash flood environment with Pottsville Waters, Black Rocks, the western end of Koala Beach, and Elanora Avenue areas subject to inundated by local stormwater and flooding from either Cudgera or Mooball Creeks.

Community Profile

Census Description - Wooyung (Pottsville)	Result (2006 Census)
Total persons	5454
Total persons aged 5 years and younger	404
Aged 65 Over	746
Total persons where English is 2nd language	104
Single parent families	279
Resident of 5yrs or less	1813
Dwellings without vehicles	92
Total number of dwellings	2436
Total persons of indigenous Origin	132

Sector Control

217. Control. The Tweed Shire SES Local Controller will control evacuations in this sector

218. Conduct The NSW Rural Fire Service, NSW Fire Brigade and NSW SES will conduct evacuations in this sector with assistance from the NSW Police.

Evacuation Trigger

219. Evacuation of areas should be considered when a flood watch for the area is issued by the BoM, as no flood warning products are issued for gauges in the Pottsville/Wooyung area.

Method of Evacuation

220. Initial evacuations will be by road using private transport. For those without transport, transport will be arranged.

Evacuation Centres

221. The following places can be used for Evacuation Centres in this Sector:

    a. Burringbah School of Arts, Old Pacific Hwy Burringbah

    b. Pottsville Beach Public School, Tweed Coast Rd, Pottsville

    c. Crabbes Creek Public School, Crabbes Creek Road Crabbes Creek (Wooyung)

Evacuation Routes

222. Local roads to Old Pacific Highway.

223. Upper Burringbah Rd to corner of Upper Burringbah Rd and Old Pacific Highway/Tweed Valley Way

224. Tweed Valley Way (South/North) to corner of Upper Burringbah Rd and Tweed Valley Way

225. Local roads to Tweed Coast Road (South/North)

226. Local Roads to Cudgera Avenue, South on Tweed Coast Rd

227. Local streets to Crabbes Creek Rd, East to School

228. Local streets to Wooyung Rd, West to Tweed Valley Way, North to Crabbes Creek Road, West to School

229. Local streets to Tweed Valley Way, South to Crabbes Creek Rd, West to School

Vulnerable Institutions and Facilities Affected

230. Wooyung Beach Motel & Caravan Park, 515 Wooyung Road Wooyung

231. Pottsville North Holiday Park, 27 Tweed Coast Rd, Pottsville Beach

Time

232. Riverine Flood – 1 -2 days

233. Storm Water flooding – 1-2 hours, possibly longer

ANNEX G - ARRANGEMENTS FOR THE EVACUATION OF CARAVAN PARKS AND THE RELOCATION OF CARAVANS

General

1. The following caravan parks are flood liable:

a. Chinderah/Kingscliff Sector

- On Tweed Caravan Park, 1/3 Chinderah Rd Chinderah
- Chinderah Village Caravan Park 94 Chinderah Bay Drive Chinderah
- Tweed River Hacienda Holiday Park 37-63 Chinderah Bay Drive, Chinderah
- Homestead Caravan Park Chinderah Bay Drive Chinderah
- Tweed Heritage Caravan Park 92 Chinderah Bay Drive, Chinderah
- Chinderah Lake Caravan Park 101 Anne Street Chinderah
- Royal Pacific Caravan Park 109 Chinderah Rd Chinderah
- Drifters Caravan Park, Wommin Bay Rd Kingscliff

b. Tweed Head South Sector

- River Retreat Caravan Park, 8 Philip Parade Tweed Heads
- Tweed Broadwater Village, Kirkwood Rd Tweed heads South
- Palms Village Caravan Park, 112 Dry Dock Rd Tweed Heads
- Tweed Billabong Holiday Park, Holden Street Tweed Heads
- Colonial Tweed Caravan Park 158 Dry Dock Rd Tweed Heads
- Boyds Bay Holiday Park, Dry Dock Rd Tweed Heads

c. Tweed Head West Sector

- Pyramid Caravan Park, 145 Kennedy Drive Tweed Heads West

d. Fingal Head Sector

- Fingal Holiday Park, Prince Street Fingal Head

Advising Procedures

2. Caravan Park proprietors will ensure that the owners and occupiers of caravans are:

   a. Made aware that the caravan park is flood liable by:

   - Handing a printed notice to occupiers taking up residence. The notice will indicate that the caravan park is liable to flooding and outline the evacuation and van relocation arrangements as detailed in this Annex.
   - Displaying this notice prominently in each van.

   b. Made aware that if they are expecting to be absent from their vans for extended periods, they must:

   - Provide the manager with a key; in a sealed envelope; to the van.
   - Provide a contact address and telephone number.
   - Inform the manager if a vehicle will be required to relocate the van during flood time.
   - Leave any mobile van in a condition allowing it to be towed in an emergency (i.e.: tyres inflated, jacks wound up, personal effects secured and annexes and lines for water, sewer, electricity and gas readily detachable).

   c. Informed when a flood is rising. At this time, occupiers will be advised to:

   - Ensure that they have spare batteries for their radios.
   - Listen to a local radio station for updated flood information.
   - Prepare for evacuation and van relocation.

3. The Tweed Shire SES Local Controller will ensure that the managers of caravan parks are advised of flood warnings and the details of any evacuation order.

Evacuation of Occupants and Relocation of Vans

4. Caravan park proprietors will install flood depth indicators and road alignment markers within their caravan parks.

5. When an evacuation order is given:

   a. Occupiers of non-movable vans should:

   - Secure their vans by tying them down to prevent flotation.
   - Isolate power to their vans.

- Collect personal papers, medicines, a change of clothing, toiletries and bedclothes.

- Lift the other contents of their vans as high as possible within the van.

- Move to a designated evacuation centre in [enter location] if they have their own transport, or move to the caravan office to await transport.

- Where possible, vans that can be moved will be relocated by their owners. Park managers will arrange for the relocation of mobile vans whose owners do not have a vehicle. Council and SES personnel will assist if required and may be able to provide additional vehicles. Vans are to be moved to either Kingscliff Amenities Centre or the Recreation Street sports field.

6. Occupants of vans that are being relocated should go to a designated evacuation centre if they have their own transport. Those without their own transport are to report to the caravan park office.

7. Caravan park managers will:

   a. Ensure that their caravan park is capable of being evacuated within three (3) hours.

   b. Advise the Tweed Shire SES Local Controller of:

   - The number of people requiring transport.

   - Details of any medical evacuations required.

   - Whether additional assistance is required to effect the evacuation.

   c. Check that no people remain in non-removable vans that are likely to be inundated.

   d. Inform the Tweed Shire SES Local Controller when the evacuation of the caravan park has been completed.

   e. Provide the Tweed Shire SES Local Controller with a register of people that have been evacuated.

Return of Occupants and Vans

8. The Tweed Shire SES Local Controller, using council resources as necessary, will advise when it is safe for the caravan parks to be re-occupied.

9. Vans will be towed back to the caravan park(s) by van owners or by vehicles and drivers arranged by the park managers. Again, Council and SES personnel will assist if available.

ANNEX H - RESUPPLY REQUIREMENTS AND OPERATIONS

1. During periods of severe flooding the following sectors of Tweed Shire Council may become isolated. This may involve up to 63,000 people requiring re-supply in a significant event. (refer to Annex B):

    a. Sector 1 - Fingal

    b. Sector 2 – Kingscliff;

    c. Sector 4 – Tweed Heads (approx 6000 in a 1:100 flood event);

    d. Sector 6 – Banora

    e. Sector 7 – Terranora and North Tumbulgum

    f. Sector 8 – Bilambil and Duroby

    g. Sector 10 – Bogangar/Cabarita and Hastings Point;

    h. Sector 11 – Chillingham;

    i. Sector 12 – Murwillumbah;

    j. Sector 14 – Tyalgum;

    k. Sector 15 – Uki; and

    l. Sector 16 – Wooyung, Pottsville, Burringbar and Mooball.

2. Areas are detailed within Annex B and in the relevant Sector Maps.

3. Individual urban and rural properties in the Tweed Shire Council area can also become isolated and may require re-supply.

4. Likely durations of isolation are described in Annex B. These are assumed average durations and will vary depending upon infrastructure damage and flood magnitude.

Arrangements

Control

5. During floods re-supply of isolated communities and properties will be controlled and coordinated by the NSW State Emergency Service (SES). Small-scale re-supply operations will be controlled by the Tweed Shire SES Local Controller. Should re-supply operations escalate beyond the capabilities of local resources control may be handed over to the Richmond Tweed SES Region Controller.

Conduct

6. The SES will conduct re-supply operations with assistance from the Rural Fire Service and Department of Community Services.

Responsibilities

7. **Tweed Shire SES Local Controller**. Control and coordinate the re-supply of isolated communities and properties.

8. **Department of Community Services**. Provide welfare services for flood affected people.

9. **NSW Rural Fire Service**. Assist the SES with the re-supply of isolated properties and communities

10. Assistance from other emergency services and functional areas may be required as per DISPLAN arrangements.

Concept of Operations

11. Normal supply arrangements will be maintained for as long as practicable. The main supply routes will be kept open to essential and emergency vehicles for as long as it is safe to do so. Given the variable nature of flood events, detailed re-supply arrangements for isolated towns and villages will be prepared relative to priority, time and resources available.

Re-supply Procedures

12. **Pre-Stocking**. As part of flood warning procedures residents and storekeepers likely to become isolated will be warned to pre-stock. Residents in particular should ensure they have an adequate supply of high usage non-perishable items, pet food, fuel, water and essential medications.

13. **Re-supply of Isolated Towns and Villages**. When isolation occurs, storekeepers will be expected to place orders on suppliers where they have a line of credit or make temporary payment arrangements and to instruct those suppliers to package their goods and deliver them to loading points designated by the SES. Similarly, essential services (eg. hospitals) will make arrangements to acquire their re-supply needs from normal sources and have the supplies delivered to loading points designated by the SES.

14. The SES may establish a vetting committee to ensure that only essential goods are ordered. The committee will consist of representatives from the SES, Tweed Shire Council, Police, DoCS and the Chamber of Commerce. The committee will ensure that businesses requesting supplies are not using the flood as a means of restocking free of charge and also that load space in re-supply vehicles and aircraft is optimally used.

15. Where supplies are not available within the council area, the Tweed Shire SES Local Controller may request them through the Richmond Tweed SES Region Headquarters.

16. The outline of the re-supply system for isolated properties is represented in Figure 4.

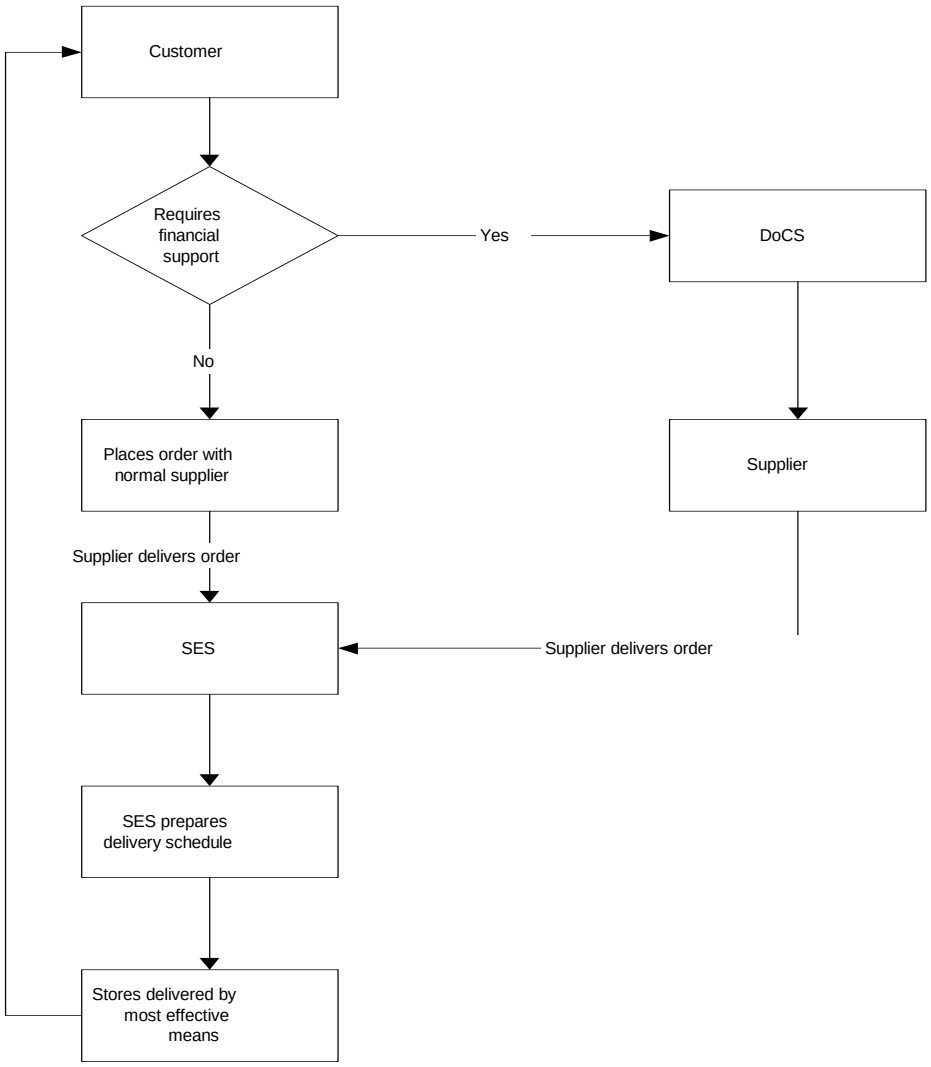


Figure 5 Outline of re-supply system for isolated properties.

17. **Pharmaceutical Supplies and Prescription Medicine.** The SES can deliver completed prescriptions to isolated properties or communities. It is the responsibility of the individual to ensure that the prescription is completed.

18. **Mail Delivery**. The SES is prepared to deliver mail to isolated communities and properties but may not be able to do so according to Australia Post timetables.

19. **Personnel Movement**. Where possible, the SES will assist isolated communities and properties with the movement of people to and from isolated areas.

20. **Transport Methods**. Re-supply will be conducted using high clearance vehicle, SES flood rescue boat, fixed wing or rotary wing aircraft.

21. If air re-supply is necessary the Tweed Shire SES Local Controller will liaise with the Richmond Tweed SES Region Controller who will make arrangements for air re-supply. Loading points for air re-supply can be established at Casino airport.

22. The Tweed Shire SES Local Controller may task aircraft within the council area. However, during floods affecting more than one council area, aircraft will normally be tasked by the Richmond Tweed SES Region Controller.

23. Landing zones for air-re-supply should be selected and used in accordance with Civil Aviation Safety Authority "Guidelines for Establishing and Using Helicopter Landing Sites (HLS) Jan 96. Other landing sites will be identified and used as required for re-supply operations within specific sectors

Table 11 - Sector Re-supply Data

COMMUNITY RESUPPLY DATA

Community	Isolation Duration (approx)	Re-supply Means		Location for Delivery/Distribution		Vulnerable /Sensitive Communities	Re-supply Assets Required	Notes
		Primary	Alternate	Primary	Alternate			
Fingal	Up to 4 Days	Helicopter	Boat	South End of Marine Parade,	Car Park near Fingal Heads SLSC		Sewerage, Power, Water at risk of failure.	Up to 700 persons isolated
Kingscliff	Up to 5 Days	Helicopter	Boat	North Coast Institute (NSW TAFE), Kingscliff Campus	Kingscliff High School	2 Nursing Homes	Hazmat, Water, Power, Sewerage	Up to 7,000 will require re-supply
Tweed	Up to 4 Days	Helicopter	Boat	Oval at Crn Florence St and Adelaide St, Tweed Heads	Razorback Lookout, Razorback Rd, Tweed Heads	Hospital, Nursing Home (Greenback Island), 2 Schools,	Water, Power, Sewerage	Up to 8,000 will require re-supply
Banora	Up to 4 Days	Helicopter	High Clearance Vehicle up to when roads close to these vehicles	Banora Point Primary School, Pioneer Parade, Banora				Up to 15,500 will require re-supply
Terranora	Up to 4 Days	Vehicle from Banora	Helicopter	Lindisfarne Anglican School	Terranora Public School			Up to 2000 will require re-supply
North Tumbulgum	Up to 4 Days	Vehicle from Banora	Helicopter	Lindisfarne Anglican School				Up to 75 will require re-supply
Bilambil (Bilambil Creek)	Up to 3 Days	Helicopter	High Clearance Vehicle up to when roads close to these vehicles	Bilambil Rugby League Oval	Bilambil RFS Headquarters	School Children, Mobile Home Park		Up to 2500 people isolated

Community	Isolation Duration (approx)	Re-supply Means		Location for Delivery/Distribution		Vulnerable /Sensitive Communities	Re-supply Assets Required	Notes
		Primary	Alternate	Primary	Alternate			
Duroby (Duroby Creek)	Up to 3 Days	Helicopter	High Clearance Vehicle up to when roads close to these vehicles	North End Crofters Way. Crn Beltana Drive and Aroona Cres.				2 areas isolated after Beltana Drive is cut, Up to 250 people isolated
Bogangar/ Cabarita/	Up to 4 Days	Helicopter	Boat	Bogangar Sports Field (South of Bogangar)	Cabarita Beach Surf Club Car Park.	School, Caravan Park	Sewerage under threat	Up to 6000 will require re-supply
Hastings Point	Up to 4 Days	Helicopter	Boat/High Clearance Vehicle	Camping Area on South Side of Yugari Drive	Cul-de-sac at end of Yugari Drive			Up to 1000 will require re-supply
Chillingham	Up to 3 Days	Helicopter		Chillingham RFS Headquarters		4 Schools		Up to 3000 will require re-supply. Aerial movement usually restricted in the early stages of a flood by low cloud and poor visibility.

Community	Isolation Duration (approx)	Re-supply Means		Location for Delivery/Distribution		Vulnerable /Sensitive Communities	Re-supply Assets Required	Notes
		Primary	Alternate	Primary	Alternate			
Murwillumbah	Up to 4 Days	Helicopter	Boat, High Clearance Vehicles	Mount St Patrick Public School	Wollumbin High School, North Arm Road	Hospital, Schools	Hazmat, Water, Power, Sewerage	Up to 8,000 will require re-supply
Tyalgum	Up to 2 Days	Helicopter		Tyalgum Public School Oval	Tyalgum RFS Headquarters		Hazmat, Water, Power, Sewerage	Up to 1500 will require re-supply
Uki	Up to 3 Days	Helicopter	High Clearance Vehicles	Uki Sports Oval, Kyogle Rd	Uki Public School, Crn Kyogle Rd & Rowlands Creek Rd			Up to 3000 will require re-supply
Wooyung	Up to 3 Days	Helicopter		Crabbes Creek Public School, Crabbes Creek Road				Up to 700 people will require re-supply
Pottsville	Up to 3 Days	Helicopter		Pottsville Beach Public School				Up to 2500 will require re-supply
Burringbar	Up to 3 Days	Helicopter		Burringbar School of Arts, Old Pacific Highway	Burringbar Public School, Upper Burringbar Road; Burringbar RFS Headquarters			Up to 1200 will require re-supply

ANNEX I - DETAILS OF THE DAM-FAILURE WARNING AND EVACUATION SYSTEM FOR CLARRIE HALL DAM

Introduction

1. Clarrie Hall Dam is a water supply dam located on the Doon Doon Creek, about 1.5km upstream from the confluence with the Tweed River. Uki is located 5km and Murwillumbah is located about 20.5km downstream of the Dam.

2. Clarrie Hall Dam consists of a 42m high concrete face rockfill dam with a crest length of 185m. The capacity of the dam is 15,600 ML at full supply (61.5m AHD). The maximum flood level is at 67.1m AHD. The spillway is 23m wide and consists of a concrete lined chute with an ogee crest.

3. There are three major possible causes of Clarrie Hall Dam failure:

   a. Failure due to extreme flood levels overtopping the embankments.

   b. Failure due to a rapidly deteriorating structural deficiency such as may be induced by internal erosion or by an extreme earthquake. (This is the so-called “Sunny Day” failure, i.e. not induced by an inflow flood).

   c. Failure combining a) and b).

4. Although the dam is currently in good condition, it is recognised that an unsafe or emergency condition could occur at any time due to extreme natural events.

5. Clarrie Hall Dam spillway is capable of passing as little as 70% of the PMF.

6. The NSW Public Works Clarrie Hall Dam break Study dated May 1995 indicates that the dam would not be capable of safely passing the Probable Maximum Flood (PMF).

7. The report on the Study indicates that during an extreme storm event the water level could rise from the full supply level (FSL) of 61.5m AHD by about 7 m over a period of some 6 hours. At this height of 68.5 m AHD the water would start to flow over the top of the wave wall. This is classed as the Imminent Failure Level (IFL) and equates to a flood, which is about 72% of the Probable Maximum Flood.

8. Sometime after the IFL is reached, this water will start to erode away the rock fill on the downstream face of the wall and this could lead to the failure of the dam. It is estimated that this process could take about 1 ¾ hours and the peak of the Dam break flood wave could reach Uki about 15 minutes after the failure and Murwillumbah a further 1 hour later.

9. Flood conditions that might precede this event would be extreme. For example, the flood height at Uki could be up to 1m above the 1974 flood level of 22.4m

AHD. Below the dam, the valley along the Doon Doon Creek and Tweed River is generally narrow and rugged. Downstream of Byangum Bridge the valley starts to widen out onto extensive river flats and any Dam break flood wave would spread out on top of existing floodwaters. Any increased flood levels at Murwillumbah can be managed within the general arrangements documented within this plan.

Aim

10. This Annex describes the arrangements for the failure of Clarrie Hall Dam and should be referred to in conjunction with Section 1 through 4 of the plan as well as Annexes B and F.

Consequences of Failure

11. Number of people at risk is in excess of approximately 200. The major population areas effected by dam failure will include the areas above Uki, Uki Village and below Uki from Smith Creek Rd and downstream to the Byangum Bridge.

12. Severe flooding would also likely damage power supply facilities in the area resulting in loss of power, put telephone facilities out of action, and cut off evacuation routes.

13. In all failure scenarios, extreme velocities and depths are likely to be experienced resulting in the destruction of private property and public infrastructure.

14. Travel times for a dambreak:

Table 12- Clarrie Hall Dambreak Travel Times

Dambreak Scenario/Type	Travel Time to Uki (5km)	Travel time to Byangum (12km)	Travel time to Murwillumbah (20.5km)
Failure due to deteriorating structure (‘Sunny Day’ Failure)			
Imminent Failure Flood (with no Dambreak)			
Imminent Failure Flood (with Dambreak)	2 hours		3 hours

Dam Break Flood Levels

15. Levels and extent of inundation, rates of rise and flood wave travel times will depend on a number of factors including:

    a. Pre-existing flood conditions.

b. Dam storage levels.

c. The cause of failure (eg. flood or earthquake).

d. The actual mode of failure.

e. Actions taken at the dam to control releases and to contain damage

Operation and Procedures

16. **Monitoring procedures** – Dam levels are monitored by Tweed Shire Council by:

    a. Rainfall gauges upstream

    b. The principal storage level indicator is a recorder and data logger located on?

17. Manual readings of the gauge boards at the dam will be taken for dam levels above FSL?

18. **Notification Procedures** - The primary contact for dam failure warning notification is the NSW SES State Headquarters Communications Centre. This centre will subsequently notify the Richmond Tweed Region Headquarters duty officer who will contact the Tweed Shire SES Local Controller. An alternate NSW Police Force contact is available if this notification procedure was to fail.

Monitoring

19. Clarrie Hall Dam owner (Tweed Shire Council) will undertake monitoring and inspections of their respective dams to ensure any situations, which may lead to potential dam failure, are identified.

20. If a situation is identified which may lead to potential dam failure, the dam owner will notify the SES.

21. Tweed Shire Council must ensure that appropriate agencies are made aware of any threat to the dam to maximise the time available for mobilising necessary resources

Warning

22. Once an amber alert level is reached dam failure warnings will be disseminated.

23. The SES will disseminate dam failure warnings with assistance from NSW Police Force, NSW Fire Brigades, NSW Rural Fire Service, VRA, Service Clubs and Tweed Shire Council.

24. Dam Failure Warnings will be disseminated by the following means:

    a. Doorknocking of at-risk dwellings.

b. Telephone calls being made to at-risk dwellings.

c. Mobile public address systems fitted to emergency service vehicles.

d. Sirens fitted to emergency service vehicles.

e. Broadcasts over radio and television stations.

f. By two-way radio.

25. Broadcast dam failure warning messages will describe the situation; say what is happening currently: what is expected to happen: when it will occur and indicate how people should act. If evacuation is required the message will be preceded by the playing of the Standard Emergency Warning Signal (SEWS) and will detail:

a. Instructions to evacuate.

b. The location of assembly areas for transport to evacuation centres.

c. The location of evacuation centres for those using private transport

d. Authorised or recommended evacuation routes.

e. Arrangements for children in schools and pre-schools.

f. Arrangements for elderly or infirm residents unable to self-evacuate.

Evacuation

26. If necessary, evacuations will be undertaken. Refer to Annex B and F of this plan for detailed evacuation arrangements.

ANNEX J - THE MANAGEMENT OF COASTAL EROSION/OCEANIC INUNDATION

Background

1. Tweed Shire's coastline extends some 37 kilometres from Wooyung in the south to Point Danger on the NSW – Queensland border. The most severe problems of coastal erosion occur as a result of oceanic storm conditions associated with the passage of ex-tropical cyclones and temperate-zone low-pressure systems. These storms may cause temporary sea level rises with large associated waves. The worst erosion is likely when severe weather conditions occur in conjunction with high tides.

2. Coastal storms in the 1960's and 1970's highlighted the threat to coastal developments at Kingscliff, the Kingscliff Bowling Club Kingscliff Holiday Park and Cudgen Surf Life Saving Club.

3. The main coastal erosion and inundation problem in the Tweed Shire is at Kingscliff foreshore, and to a lesser extent at Duranbah Beach. It takes two forms:

   a. Undercutting of dunes on their seaward sides, threatening the collapse of buildings and other infrastructure.

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

4. The Coastline in the Tweed Shire is broken up into five units which include:

   a. Wooyung to Hastings Point

   b. Hastings Point to Norries Head

   c. Norries Head to Sutherland Point (Cabarita, Bogangar and Casurina Beaches)

   d. Sutherland Point to Fingal Head (Dreamtime Beach)

   e. Fingal Head to Point Danger

Areas at Risk

Wooyung to Hastings Point

5. There is no development within the immediate hazard zone that is under threat from coastal erosion or oceanic inundation.

Hastings Point to Norries Head

6. All development is landward of the 50 year erosion hazard zone however at Hastings Point the 100 year erosion hazard zone extends into existing properties to varying degrees.

Norries Head to Sutherland Point

Cabarita, Bogangar and Casuarina Beaches

7. The immediate hazard zone does not impinge on any developed areas within this beach unit.

8. At Cabarita (at the southern end of Bogangar Beach) all existing structures are landward of the best estimate 50 year line except for the surf pavilion building.

9. The dune system is generally sufficiently high to accommodate elevated water levels during storm events without direct inundation from the sea. However, there are some areas at the southern end of the Cabarita township where the dunes are only around 5m AHD and under extreme conditions it is possible that some oceanic inundation may occur. .

Sutherland Point to Fingal Head

10. Dreamtime Beach extends northward from Sutherland Point some 7 km to Fingal Point. The township of Kingscliff fronts the southern-most 3 km of the beach. At Fingal, a small settlement (about 26 allotments) is located on the seaward side of Wommin Lagoon, extending about 700 metres south of Fingal Point.

11. Development is set back from the beach along this beach unit except at Kingscliff where the Kingscliff Bowls Club is located on the dune system and has been protected from erosion by a rock revetment seawall.

Kingscliff / Dreamtime Beach

12. The immediate hazard line is typically 30 to 40m landward from the 1999 erosion scarp along this beach unit with some areas of southern Kingscliff extending to 50m where the dunes are lower. This immediate hazard zone extends into the Kingscliff Holiday Park and the Cudgen Headland Surf Life Saving Club building is also under immediate threat from severe storm erosion.

13. The Kingscliff Bowls Club is protected by a rock revetment seawall constructed in the late 1960s and upgraded in 1995. Tweed Shire Council is progressing with a foreshore protection strategy south of the Bowls Club to encompass the Kingscliff Holiday Park and Cudgen Surf Life Saving Club. Coastal erosion at Kingscliff will depend on the implementation of the protection strategy and ongoing maintenance requirements to withstand coastal storm attack. The hazard line has been drawn landward of the Bowls Club building on the basis of no seawall being in place. The realisation of the erosion threat at this location will be dependent on future management decisions on whether the seawall is to be maintained to a suitable standard to withstand cyclonic erosion.

14. To the north of the Bowls Club the immediate hazard zone extends into the parkland but no structures are threatened. However some public structures may be threatened within the 50 year planning period.

15. The entrance to Cudgen Creek was stabilised in 1967 and is no longer subject to significant migration and impact on the adjacent foreshore. A seawall was built to protect the Bowls Club following the 1967 cyclone erosion. Interference with the dune system has ceased and dune management practices are in place to ensure no losses of sand by wind drift.

16. Some of the lower sections of dune at the southern end of Kingscliff are prone to being over-topped during extreme storm events. Elsewhere direct oceanic inundation of hind dune areas is unlikely.

Fingal Head to Point Danger

17. Letitia Spit extends some 3.6 km in a north-northwest direction from Fingal Head towards Point Danger, controlled at its northern end by the Tweed River breakwalls. It is bounded on its western side by the training walls of the Tweed River.

18. The village of Fingal extends a short distance north from the headland, generally set back from the main dune escarpment except for the Surf Club and caravan park.

Fingal / Letitia Spit

19. No development is located within the immediate hazard zone. The 50 and 100 year hazard zones extend into the caravan park area but are well seaward of the development further to the north. The remainder of Letitia Spit is undeveloped.

Duranbah Beach

20. The alignment and sand supply to Duranbah Beach is primarily governed by the operation of the Tweed River Entrance Sand Bypassing Project. Under the project Duranbah Beach is receding to a position some 50 to 80 metres landward of its 2002 position.

21. Coastal erosion and oceanic inundation may impact on Flagstaff Beach Road.

Concept Of Operations

22. **Control**. The SES is the designated combat agency for damage control from storms, including coastal erosion from storm activity.

23. The Coastal Erosion Annex details **all** of the arrangements for the emergency management of coastal erosion.

24. Evacuation arrangements for Tweed Shire are contained in Annex F.

25. Within this role and as specified under the State Storm Plan the SES is responsible for the following during and in the period immediately prior to a storm event occurring out at sea:

    a. Advising the community at risk of the likely problem and actions they should take;

    b. The protection of life through the warning and evacuation of residents at risk; and

    c. The coordination of the lifting and/or relocation of readily movable household items and commercial stock and equipment.

26. The role of the SES as the combat agency for storms does not include coastal erosion and inundation caused by astronomical high tides when severe weather is not actually developing or occurring.

27. **DECC** will provide ongoing advice to local councils and coastal zone management committees on the formulation and implementation of coastal zone management plans including procedures for addressing coastal processes, coastline hazards and risks, management options and coastal policies.

28. **BoM** will provide Severe Weather Warnings.

Responsibilities

Before the Storm

29. The SES will:

    a. Conduct educational activities to ensure that people in locations potentially threatened by coastal erosion and associated flooding can understand the threat and its management.

    b. Consult with councils, coastal zone management committees, DECC, and other agencies during the development of emergency management arrangements for the management of coastal erosion.

30. BoM will:

    a. Formulate and issue official forecasts and Severe Weather Warnings and provide them to the SES, radio stations and other organisations prior to and during potential and actual coastal erosion events. (Note: Severe Weather Warnings for dangerous surf are issued when onshore waves in the surf zone are expected to reach at least 5 metres within the following 24 hours or when a storm surge of 0.5 metres or greater is anticipated).

31. DECC will:

    a. Develop and advise on state wide coastal policy, planning and management.

b. Provide ongoing advice to local councils and Coastal Zone Management Committees on coast and estuary management including procedures for addressing coastal hazards, coastal processes and risks, management options and coastal policies.

c. Provide the SES and councils with advice on likely erosion 'hotspots' along the New South Wales coastline.

32. Tweed Shire Council will:

a. Carry out ecologically sustainable planning and management of the coastal zone.

b. Prepare Coastal Zone Management Plans in accordance with the Coastal Protection Act, 1979 including arrangements for the emergency management of coastal erosion.

c. Consult with the communities at risk, Coastal Zone Management Committees, DECC and other agencies during the development of emergency management arrangements for the management of coastal erosion for inclusion in council Coastal Zone Management Plans and SES Local Flood Plans.

d. Participate in education campaigns and assist the SES in the development and delivery of educational material to ensure that people in areas potentially threatened by coastal erosion understand the threat and its management.

e. Other supporting agencies responsibilities are listed in section 1.5, and in Tweed Shire DISPLAN.

During the Storm

33. Response operations will be initiated when:

a. The BoM issues a severe weather warning for dangerous waves or storm surge (forecast on-shore waves of 5 metres or more, or storm surge of 0.5 metres or more) for the NSW north coast.

b. Response operations may also be initiated by the SES when large storm induced waves are observed locally and no BoM warning has been issued.

34. The SES will:

a. Advise local council and other emergency agencies of the likelihood of coastal erosion in the council area.

b. Coordinate the conduct of regular reconnaissance at locations identified as being susceptible to coastal erosion.

c. Coordinate the provision of advice to the community at risk regarding the likely problem and the actions they should take. These actions may include evacuation and/or removal of portable property from households and businesses.

d. Coordinate the evacuation of people at risk.

e. Coordinate transport of removal household possessions and stock, records and equipment from business premises (if time and resources permit).

f. Provide a phone in service for the local community to take requests for assistance and give advice as necessary.

g. The SES is not responsible for controlling or conducting any physical mitigation works to protect properties or structures at risk from coastal erosion/inundation, either during or outside the period of storm activity. This includes, but is not limited to:

h. The placement of rocks or other materials on beaches or foreshore areas

i. The construction of temporary walls made of sandbags, geotechnical tubes, or other material.

35. Tweed Shire Council will:

a. Conduct reconnaissance at coastal erosion trouble spots in consultation with the SES.

b. Undertake relevant emergency coastal zone management actions as detailed in the Coastal Zone Management Plan.

c. DECC will provide advice and approval to councils regarding the most appropriate methods of dealing with coastal erosion and placement of temporary mitigation measures during storm events, via the Engineering Services Functional Area Coordinator (ESFAC).

d. BoM will formulate and issue official forecasts and Severe Weather Warnings and provide them to the SES, radio stations and other organisations prior to and during potential and actual coastal erosion events.

e. Other supporting agencies responsibilities are listed in section 1.5, and in Tweed Shire DISPLAN.

After the Storm

36. The SES will:

a. Assign personnel to gather intelligence in areas susceptible to coastal erosion/inundation.

b. Review and update the arrangements for managing coastal erosion/inundation.

c. Liaise with DECC to obtain information on the impact of storm events on coastal properties, once the storm has abated.

d. Liaise with DoCs regarding the return of evacuees.

37. Tweed Shire Council will:

a. Liaise with DECC to determine any changes to the coastal zone and any new areas at risk following storms at sea.

b. Maintain and review council Coastal Zone Management Plans in consultation with other stakeholders.

c. Remove and/or mitigate the impact of temporary physical protection measures on the beach.

d. Review and update changes to the emergency action plan for coastal erosion in the Coastal Zone Management Plan.

38. DECC will provide the SES and council with updates on the current state of the coastal zone and any new areas at risk following a storm event.

39. A summary of agency responsibilities and support agencies for coastal erosion is listed in Table 12.

Action	Agency Responsible	Support
1. Before the Storm		
(TSC does not have any interim measures in place. Council is in the process of preparing an EAP)	Tweed Shire Council (TSC)	DECC
1.2 Monitor potential coastal storms	Bureau of Meteorology	SES, DECC, TSC
2. During the Storm		
2.1 Issue Severe Weather Warnings	BoM	
2.2 Conduct reconnaissance of at risk areas	SES	Other Emergency Services, TSC
2.3 Control Evacuations	SES	
2.4 Conduct Evacuations	SES	Other Emergency Services
2.5 Coordinate removal of evacuated peoples belongings to safety	SES	Other Emergency Services
2.6 Coordinate welfare for domestic pets and companion animals from evacuated areas.	DPI	
2.7 Register Evacuated People	Police	
2.8 Provide welfare support to evacuated people	DoCS	
2.9 Manage traffic and control evacuation routes	Police	
2.10 Provide security to evacuated areas	Police	
2.11 Resupply Area isolated by coastal storms/floods	SES	RFS
3. Recovery After the Storm		
3.1 Assess damage to property, roads, coastal protection works	TSC	
3.2 Establish Recovery Committees as required	LEOCON	
3.3 Co-ordinate return of evacuated people	Recovery Coordination Committee	
3.4 Assess any development in imminent danger of collapse because of proximity to eroded dune escarpment	TSC, SES	
3.5 Erect relevant safety warning signs where unstable dune escarpments present a public safety hazard. In high use areas the erosion escarpment may be collapsed to a more stable slope by machinery	TSC	
3.6 Re-instate damaged beach access	TSC	

Table 13 - Responsibilities Emergency Mitigation of Coastal Erosion

ANNEX K - AIRCRAFT MANAGEMENT

Purpose

1. During floods aviation assets can be used to perform numerous tasks including resupply, evacuation, personnel movement and reconnaissance.

2. This Annex should be read in conjunction with the SES Air Management Policy

Coordination of Aviation Assets

3. The Tweed Shire SES Local Controller may task aircraft for flood operations within the council area if other transport means are not available or not suitable. During floods affecting more than one council area, aircraft will normally be tasked centrally by the Richmond Tweed SES Region Controller; however this does not prevent tasking by the Tweed Shire SES Local Controller.

Refuelling facilities

4. Refuelling facilities within the Richmond Tweed Region are only available at Lismore and Ballina.

Refuelling facility	Aircraft Suitability	Features
Casino S28 53.0 E153 04.0 (1100m runway available)	C-130, Caribou, All Rotary	No permanent arrangements
Lismore S28 49.8 E153 15.6	Dash 8, C130, Caribou, SAAB 340	Refuelling from Mobil, Lismore or Air BP, Lismore.
Ballina S28 50.0 E153 33.7	Boeing 737, C130, Dash 8, SAAB 340, Caribou	Refuelling from Shell – Skyhigh Ground Services Pty Ltd.
Coolangatta S28 09.9 E153 30.3	Boeing 747,737, C130, Dash 8, SAAB 340, Caribou	Refuelling BP, Shell and MOBIL/Caltex
Ballina S28.50.0 E153.33.7	All Rotary, 737, A320. SAAB 340, DASH 8, C130,Caribou	Shell AVGAS & Jet A1

Table 14 - Aircraft Refuelling Details

Landing Zones

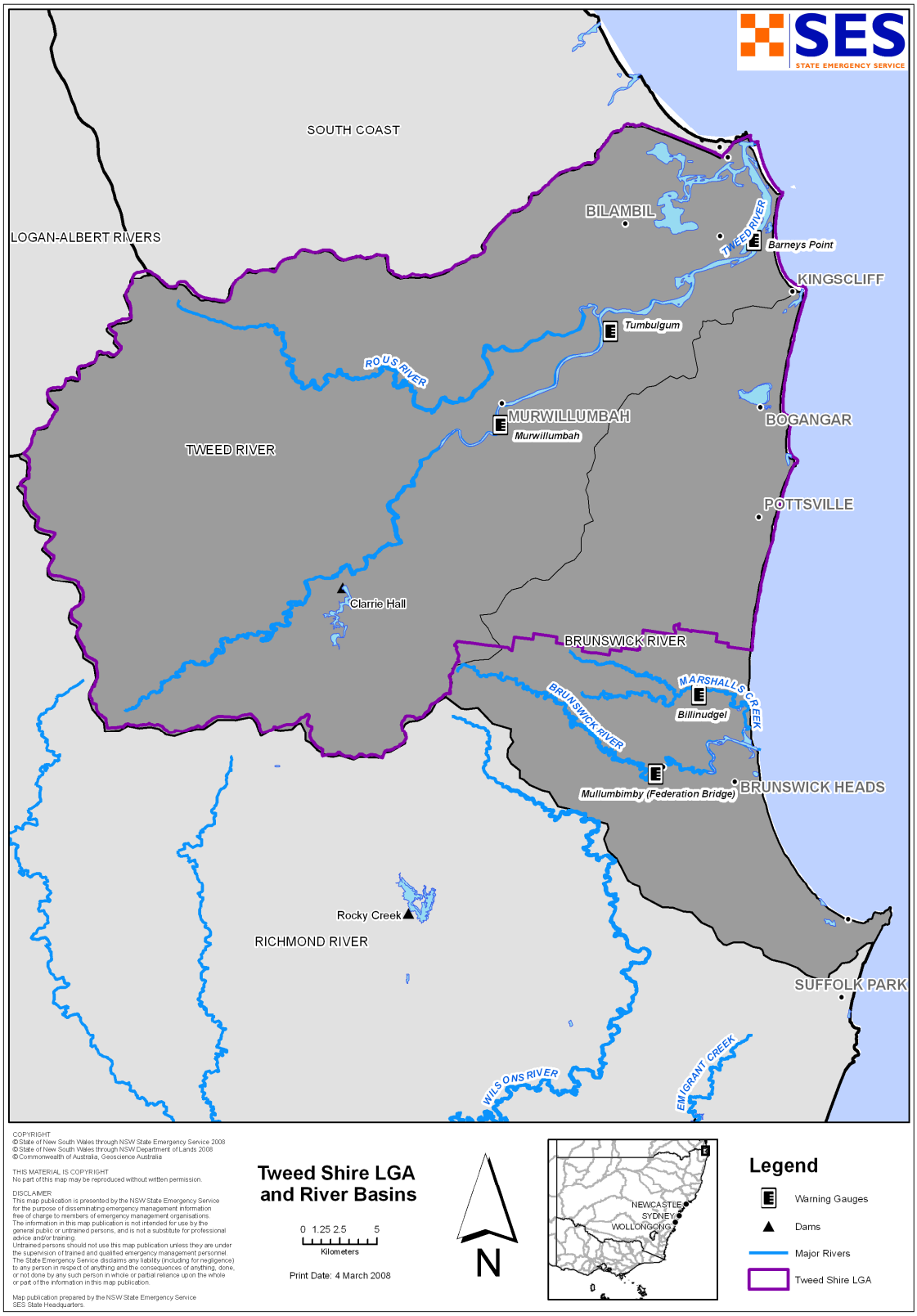
5. The following sites can be used for the landing of aircraft:

Sector	Location	Latitude / Longitude	Known Hazards	Comments
Uki	Uki Sports Oval, Kyogle Rd	Helicopter		
Tyalgum	Tyalgum Oval	S 28 21 17.5 E 153 12 20.4	Goal posts at NE & SW end of LZ	Suitable for multiple Light and medium Helo's
Chillingham	Chillingham RFS Station	S 28 18 48.5 E 153 16 32.8		No Suitable Landing Site
Murwillumbah	Sth Murwillumbah Infant School	S 28 20 24.7 E 153 23 58.3	Power lines at Sth end, Trees W and E side of LS	Suitable for Light helicopters or BK 117 only
	Murwillumbah Airfield	S 28 19 52.8 E 153 24 50.4		Grass strip 800m long suitable for Light and Medium helicopters
	Mt Saint Patricks High School Murwillumbah	S 28 19 27.2 E 153 23 37.3	Light towers & powerlines on Nth end of LZ	Shelter on W side, suitable for multiple Light and medium Helo's
	Wollumbin High School Murwillumbah	S 28 19 59.6 E 153 21 47.3	Goal posts at NE & SW end of LZ	Suitable for multiple Light and medium Helo's
Tumbulgum	Tumbulgum / Terranora Rd	S 28 16 05.6 E 153 28 12.5	Power lines in Sthn Paddock on western side of road	LZ located on Nthn side of bridge on both sides of road
Chinderah/ Kingscliff	Kingscliff TAFE Evac centre	S 28 16 02.5 E 153 34 06.9	Slopes from west to east	Area over 200m long suitable for multiple light and mediums
Banora	Banora Public School	S 28 13 20.1 E 153 32 37.8	Slopes from Nth to Sth	Suitable for multiple Light and medium Helo's.
	Banora Headquarters	S 28 13 42.1 E 153 32 32.3		Not suitable for Helo unless car park empty
Terranora/North	Lindisfarne School	S 28 14 07.4 E 153 30 23.7	No wires Goal posts at each end of field	Suitable for multiple Light and medium Helo's
Bilambil	Bilambil Sports field Evac centre	S 28 13 19.2 E 153 28 07.7	Goal posts at East & West end, powerlines Parallel to road & light towers on boundary of LZ	Suitable for multiple Light and medium Helo's.

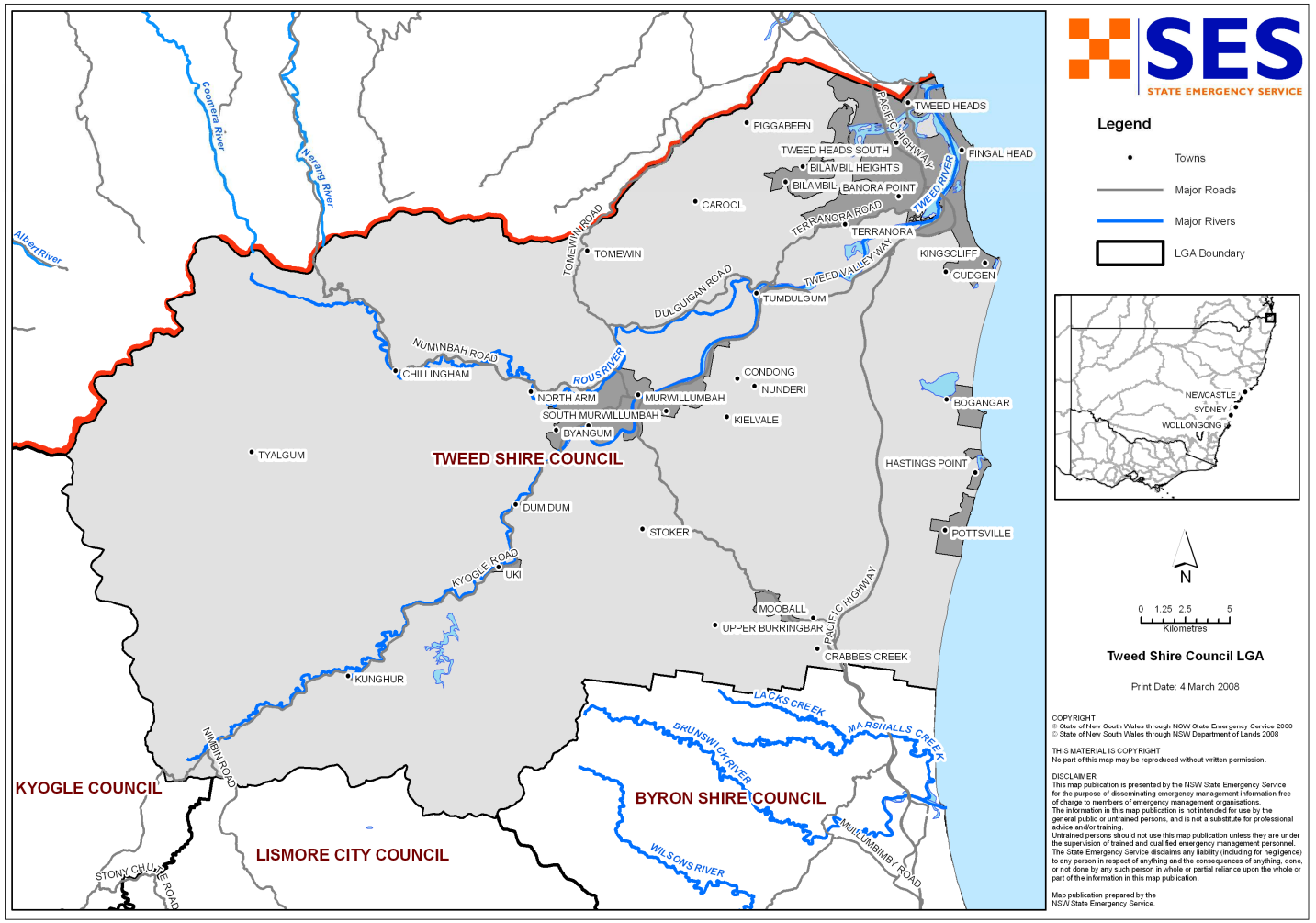
Tweed Heads	Tweed Heads PCYC Evac Centre	S 28 10 34.2 E 153 32 16.4	Trees on all boundaries of LZ	Suitable for multiple Light and medium Helo's.
Fingal	Fingal Head School	S 28 11 50.5 E 153 33 54.7	Small trees on boundaries	Suitable for 2-3 Light or 2 Mediums
Bogangar/Cabarita	Cabarita Beach village	S 28 19 41.9 E 153 34 09.4		
Hastings Point	Hastings Point Village	S 28 21 41.4 E 153 34 37.9		
Wooyung	Crabbes Creek Public School, Crabbes Creek Road	Helicopter		
Pottsville	Pottsville Village	S 28 23 04.6 E 153 34 00.0		
Burringbar	Burringbar School of Arts, Old Pacific Highway	Helicopter		

Table 15 - Aircraft Landing Zone

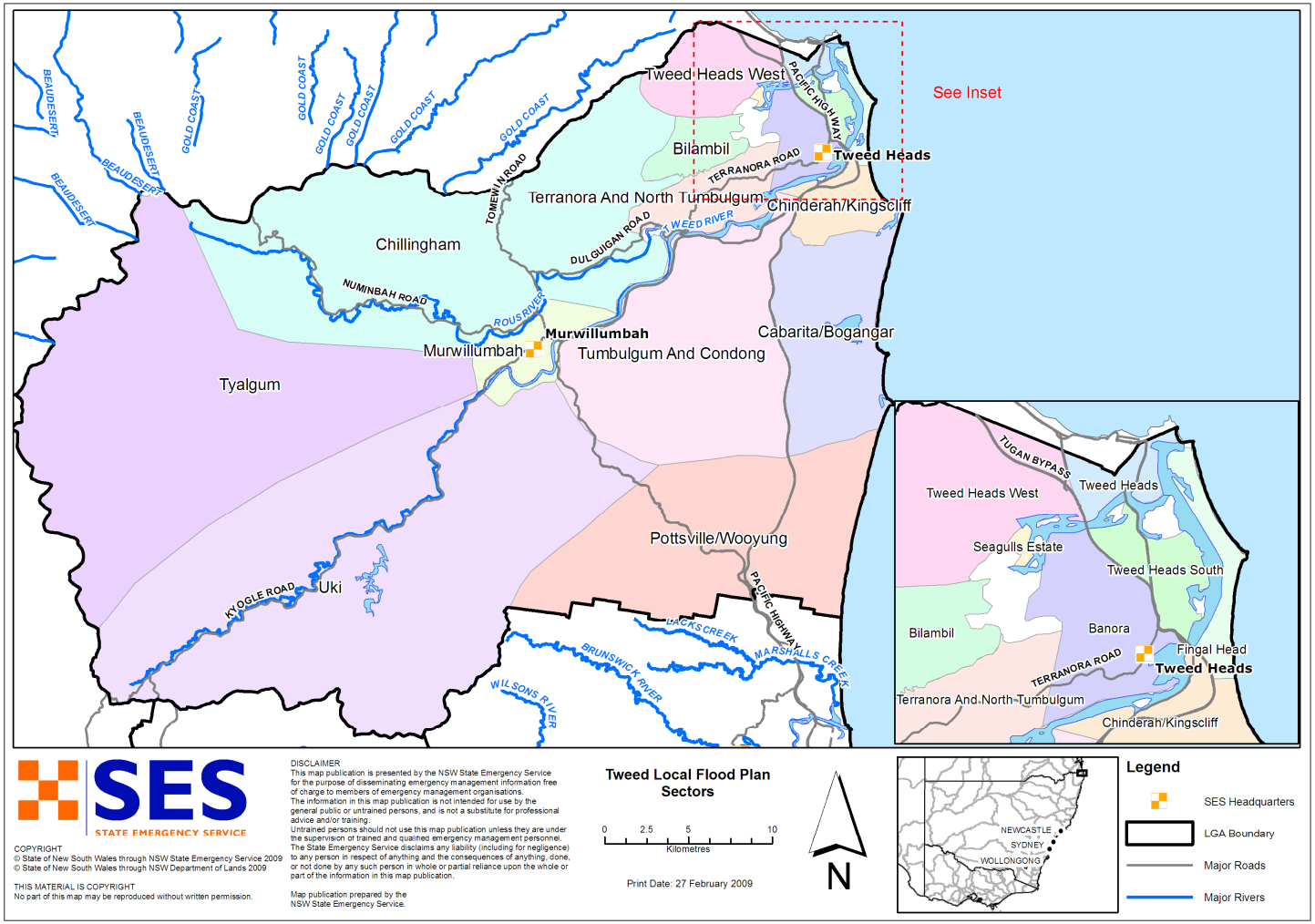
MAP 1 - TWEED AND BRUNSWICK RIVER BASINS



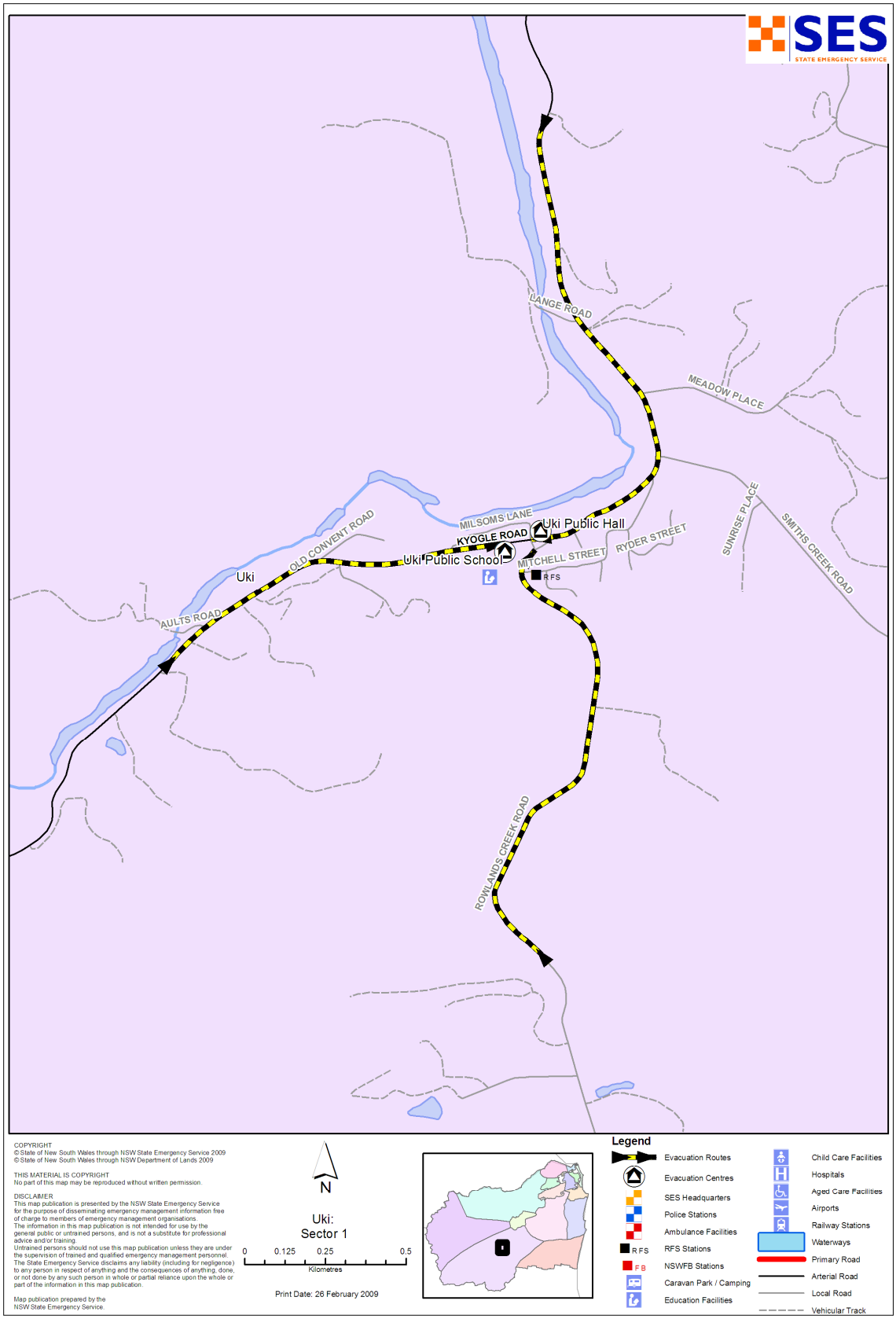
MAP 2 - TWEED SHIRE COUNCIL AREA



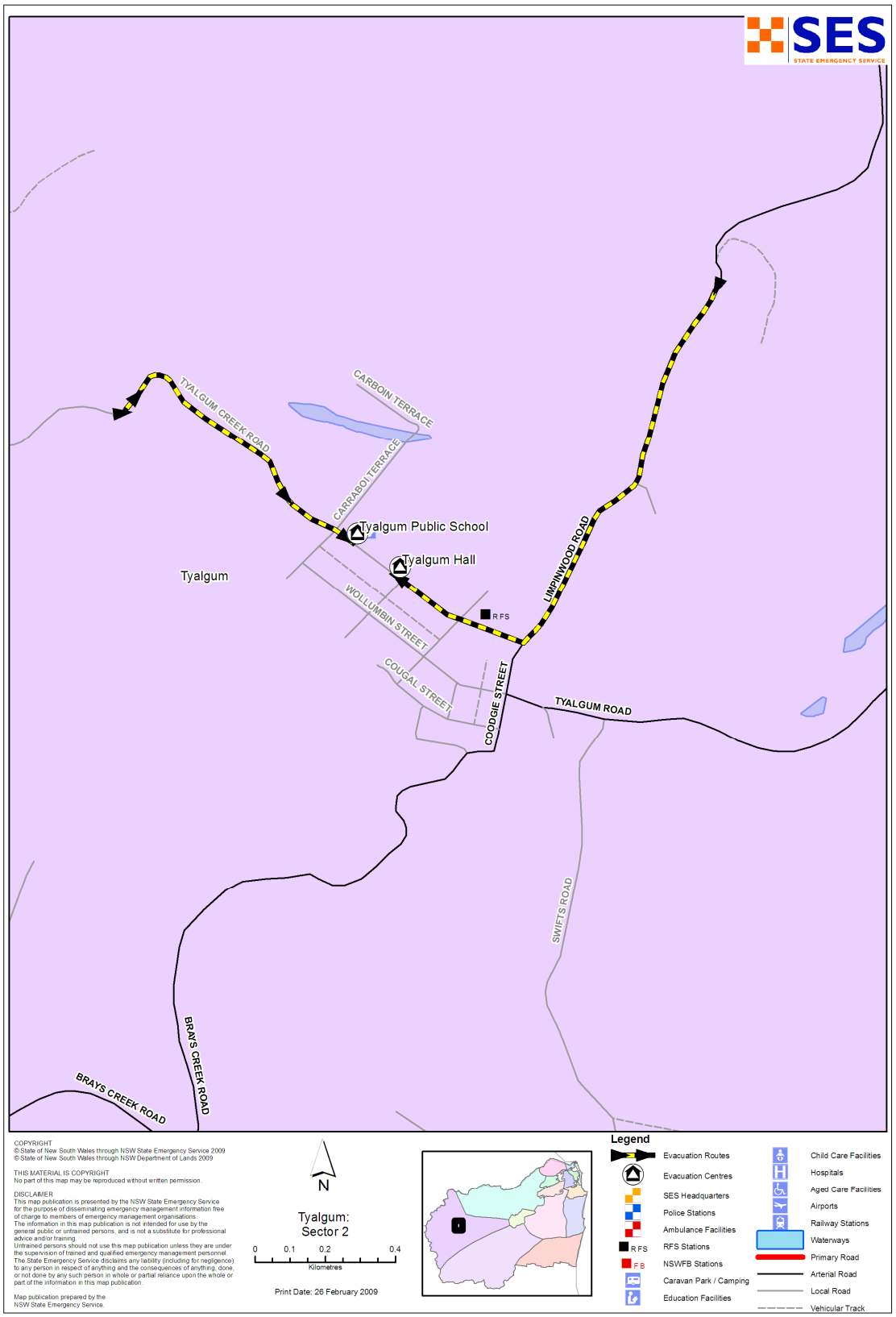
MAP 3 - TWEED SHIRE SECTORS



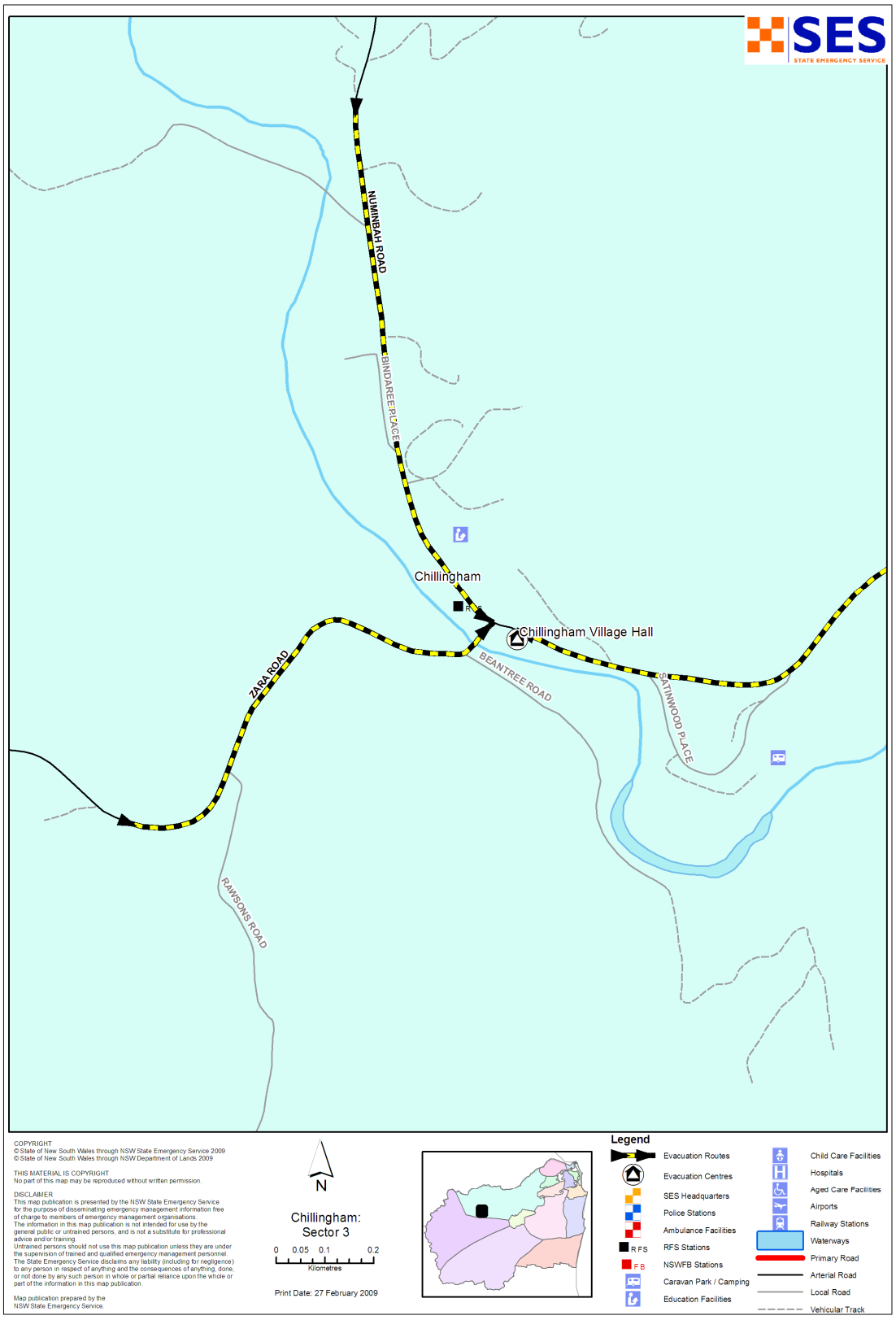
MAP 4 - UKI SECTOR EVACUATION MAP



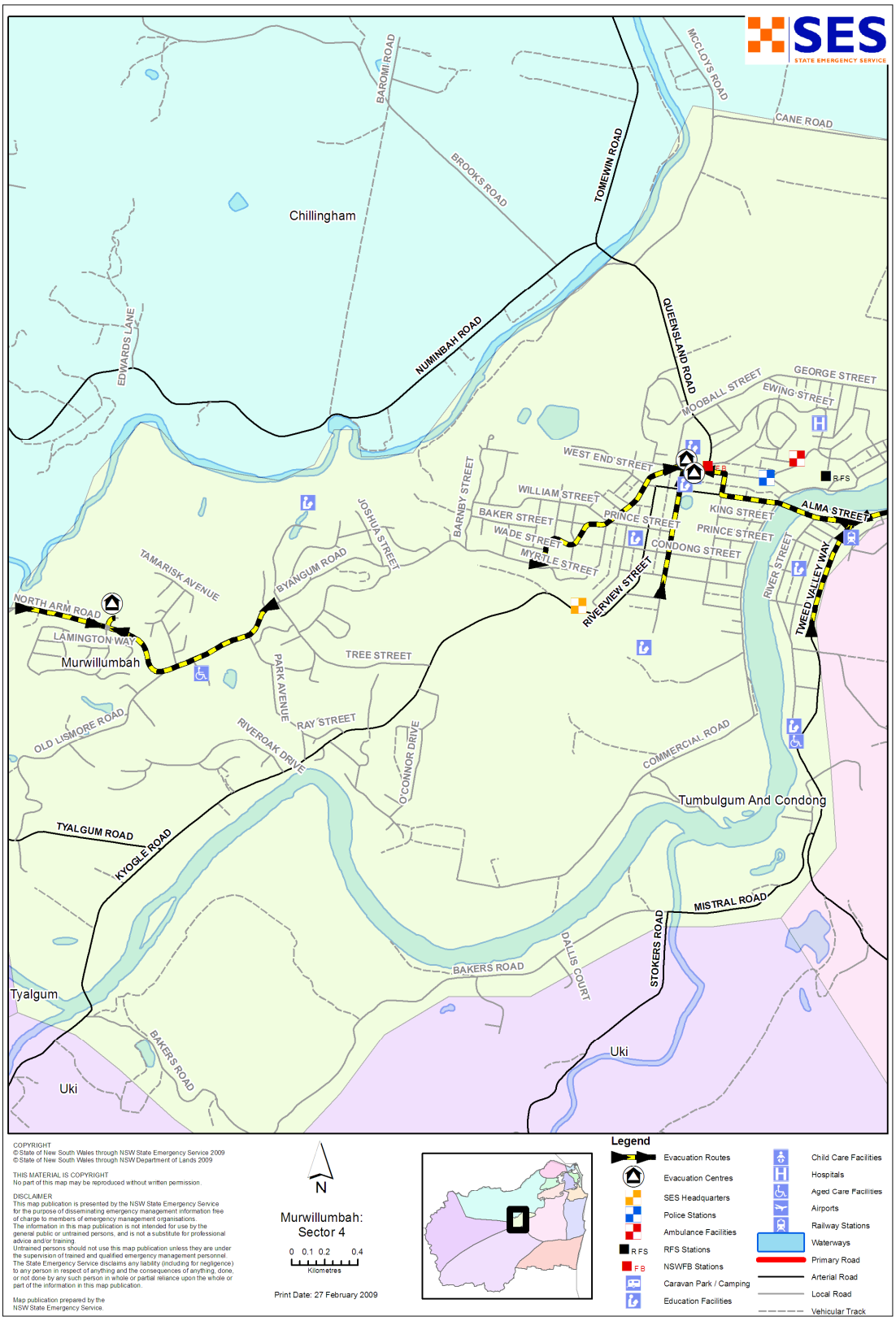
MAP 5 - TYALGUM SECTOR EVACUATION MAP



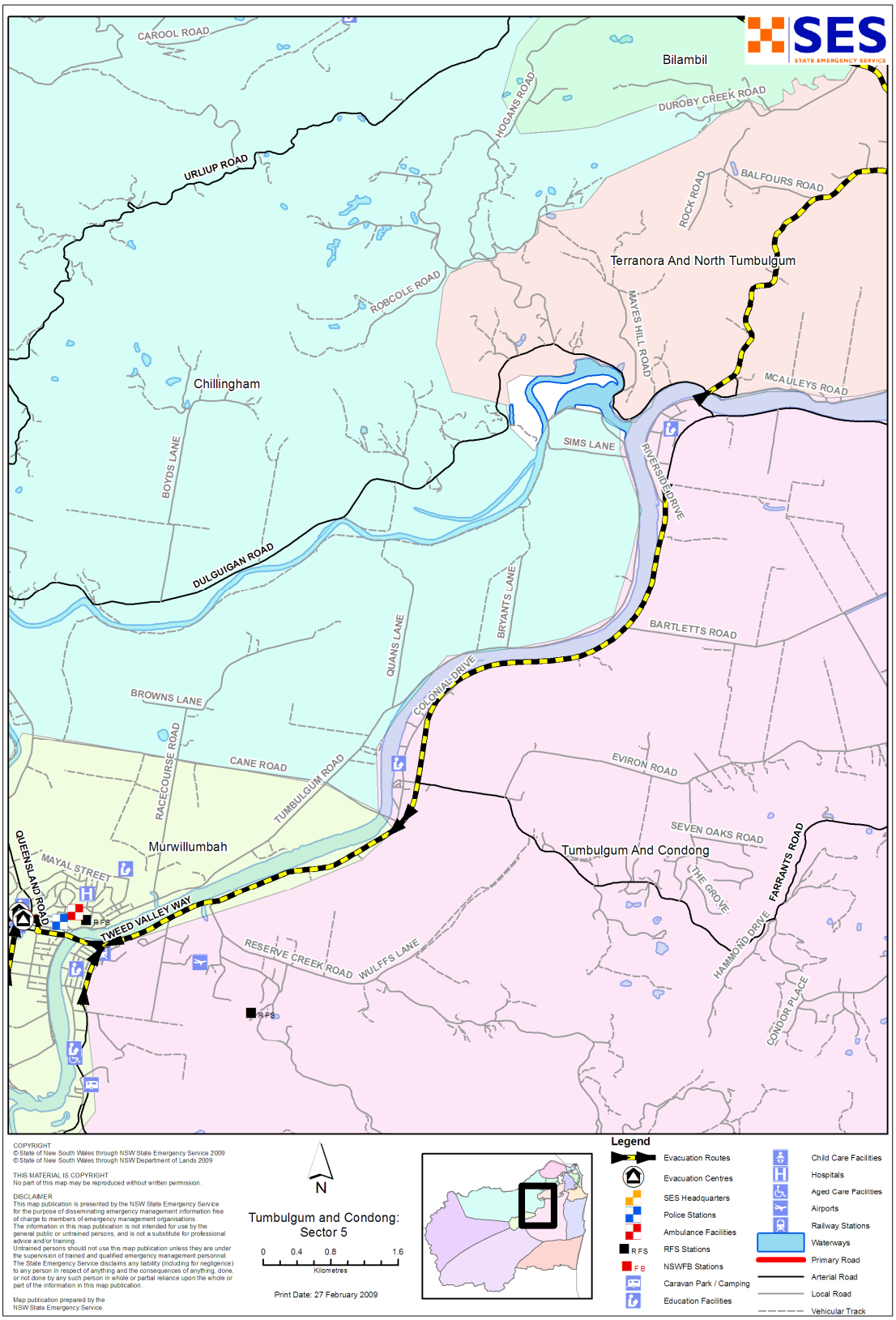
MAP 6 - CHILLINGHAM SECTOR EVACUATION MAP



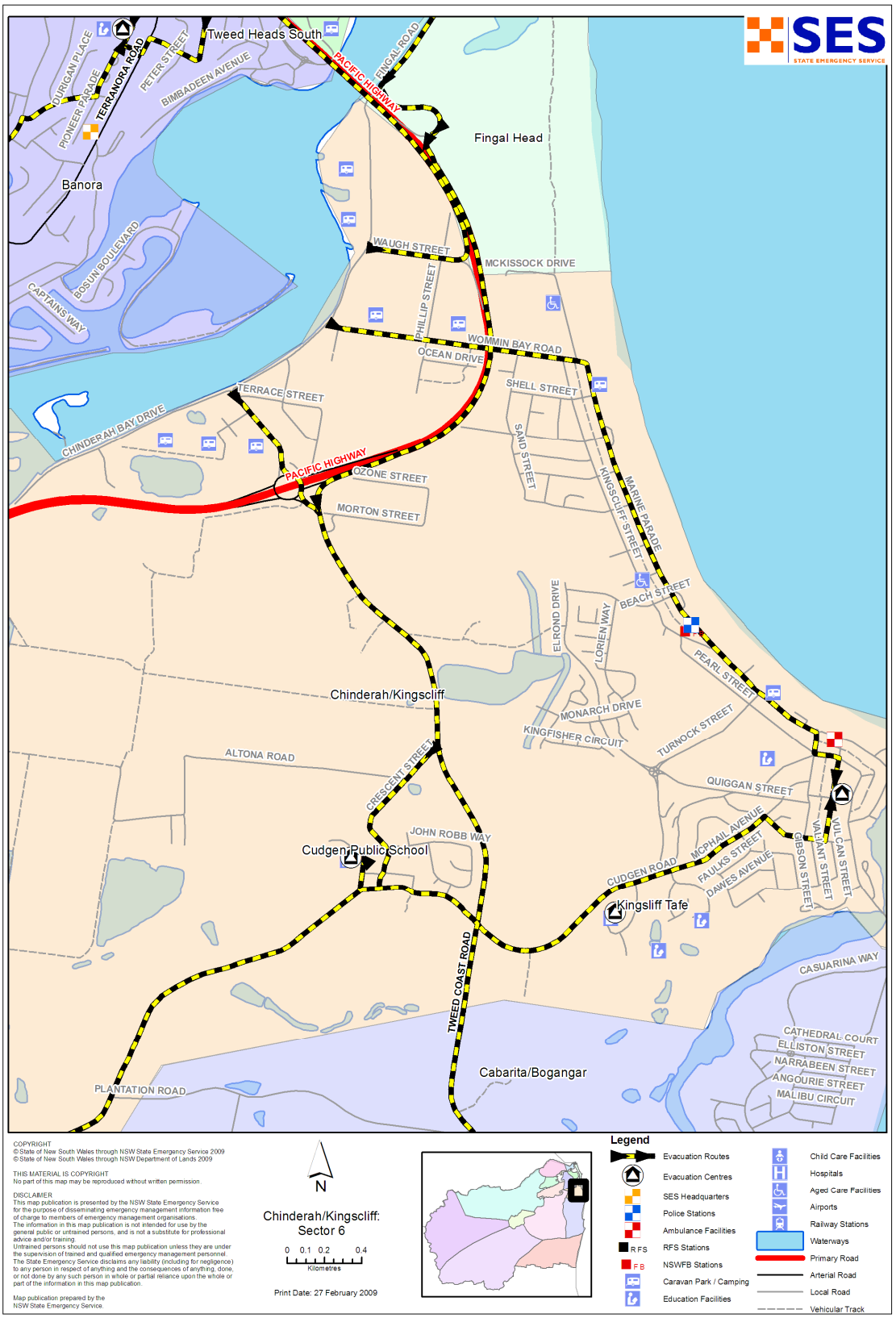
MAP 7 - MURWILLUMBAH SECTOR EVACUATION MAP



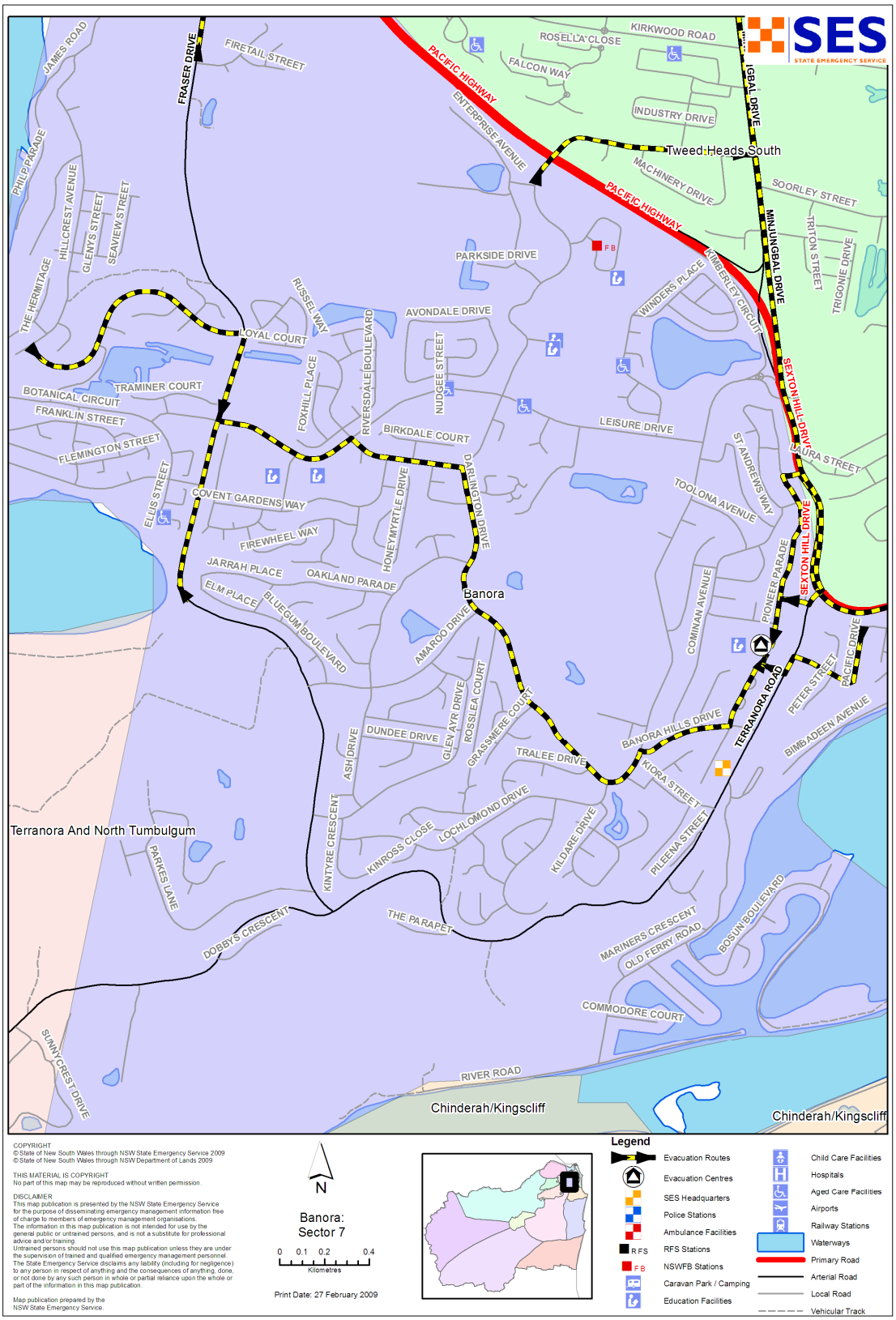
MAP 8 - TUMBULGUM AND CONDONG SECTOR EVACUATION MAP



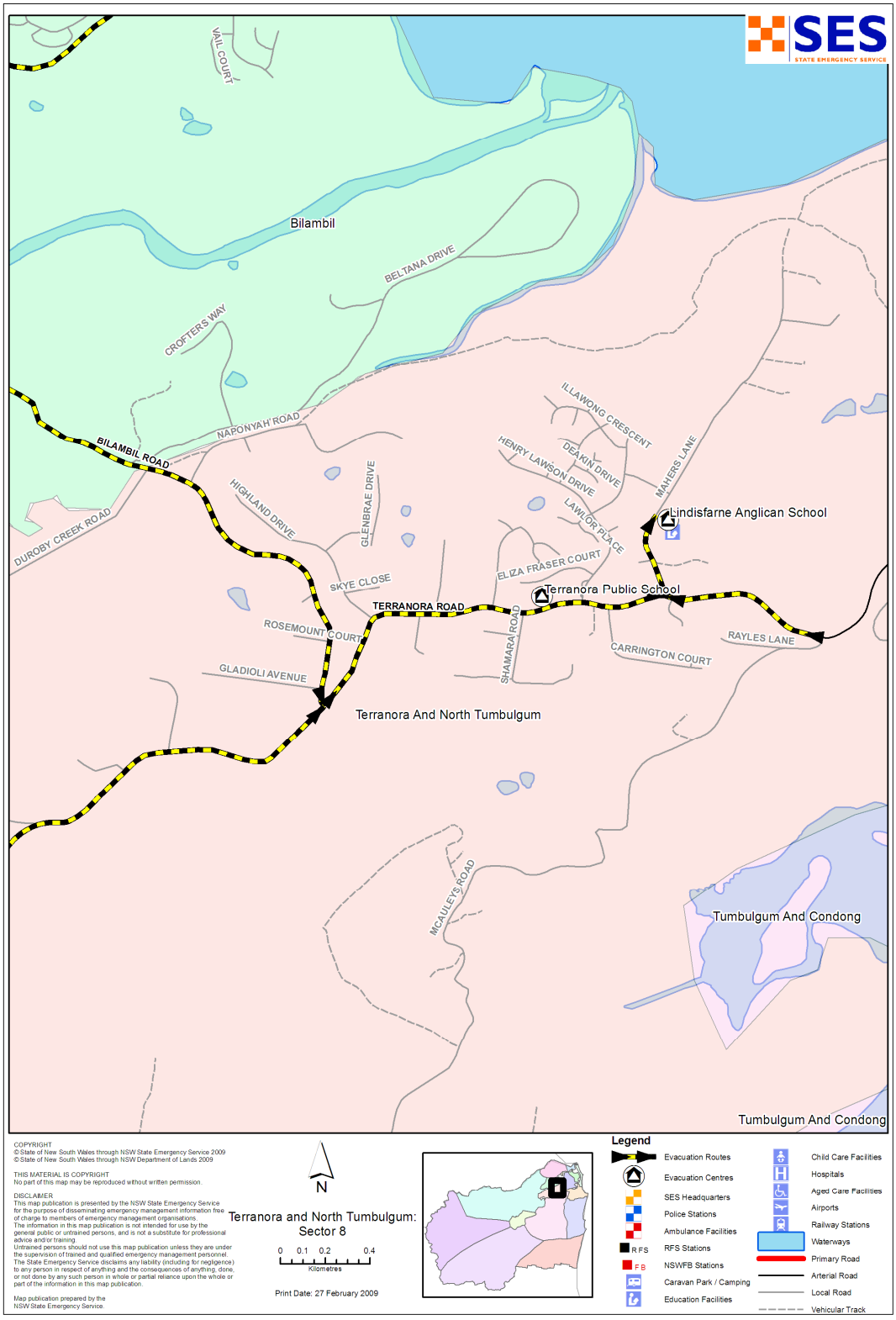
MAP 9 - CHINDERAH/KINGSCLIFF SECTOR EVACUATION MAP



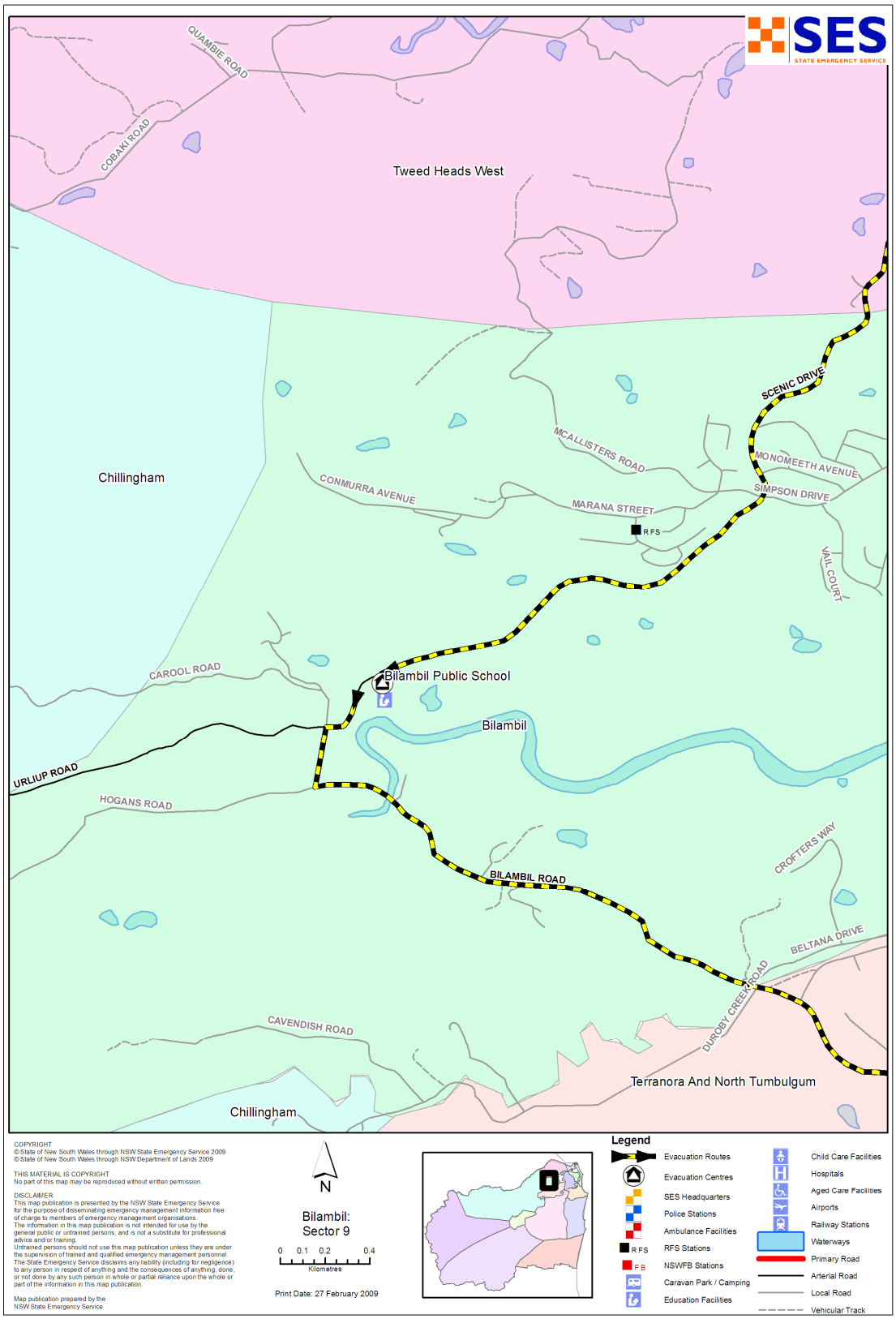
MAP 10 - BANORA SECTOR EVACUATION MAP



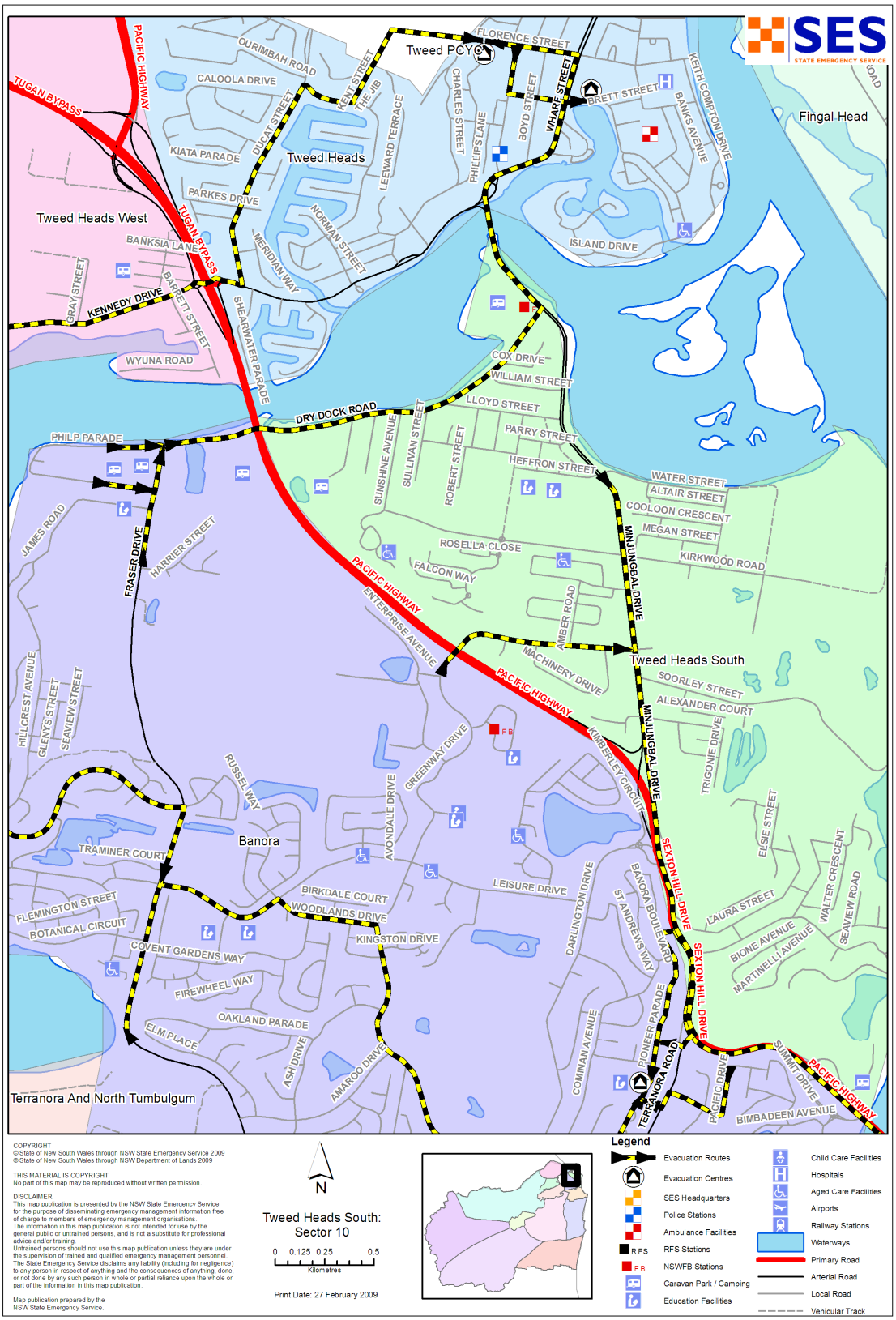
MAP 11 - TERRANORA AND NOTH TUMBULGUM SECTOR EVACUATION MAP



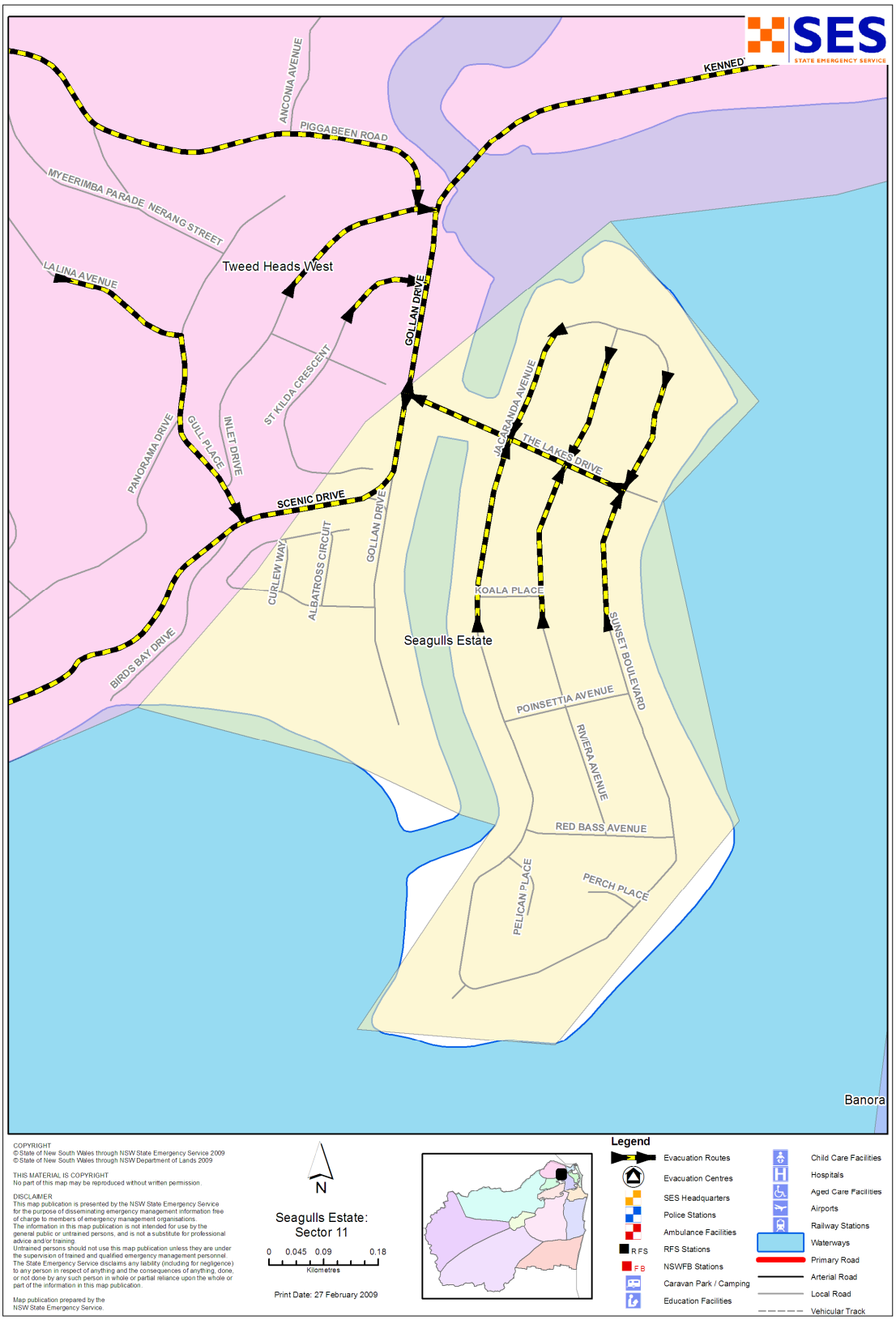
MAP 12 - BILAMBIL SECTOR EVACUATION MAP



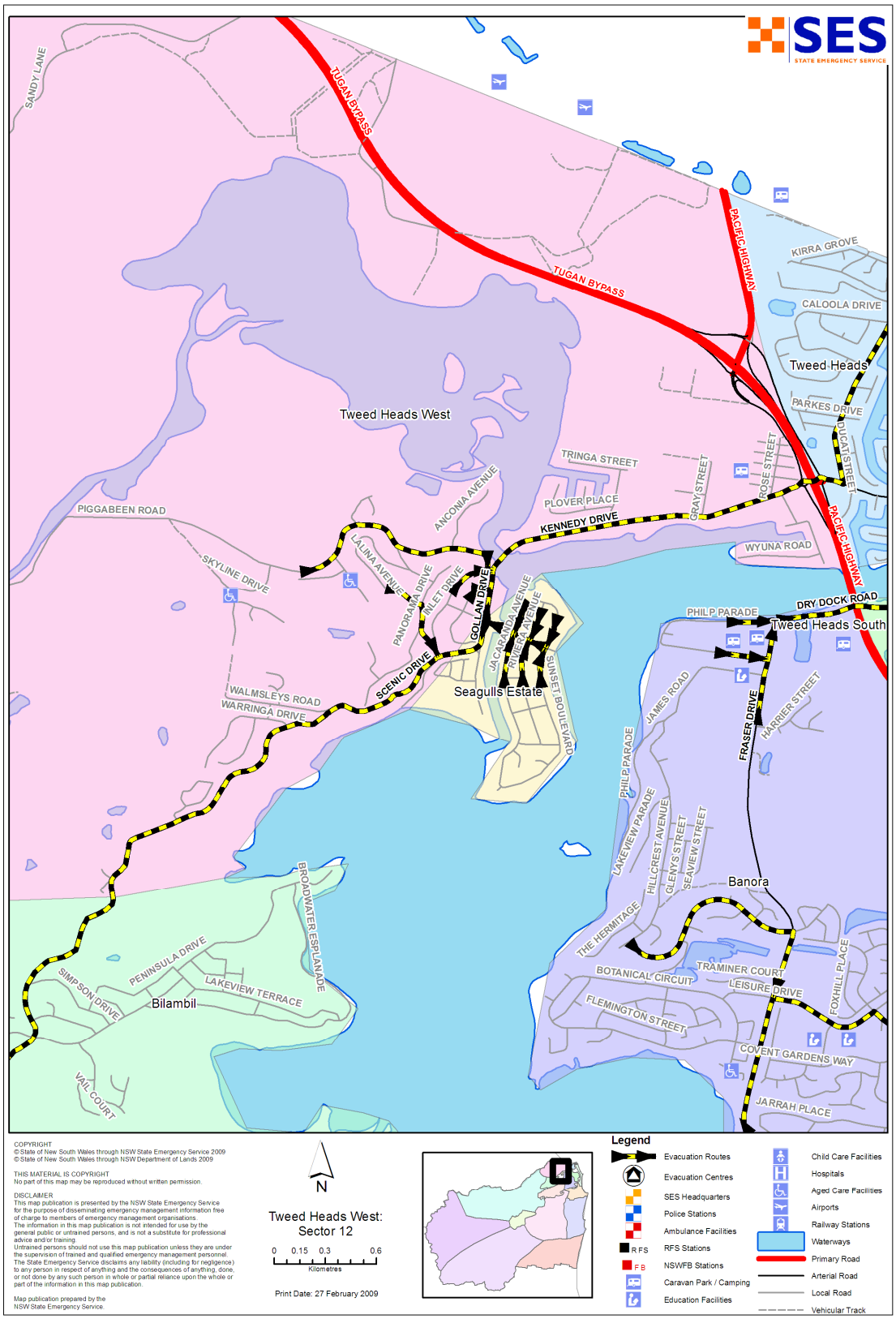
MAP 13 - TWEED HEADS SOUTH SECTOR EVACUATION MAP



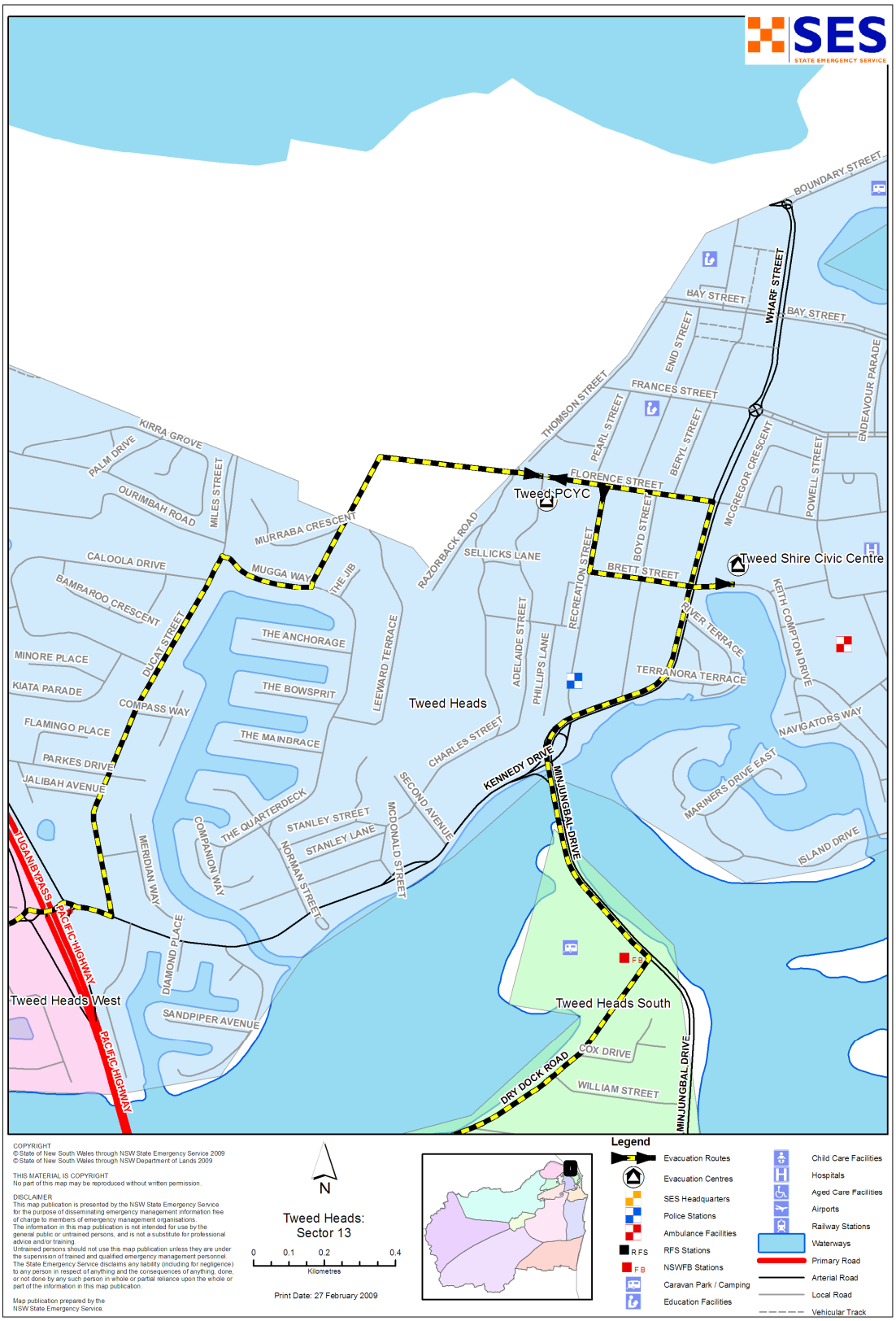
MAP 14 - SEAGULLS ESTATE SECTOR EVACUATION MAP



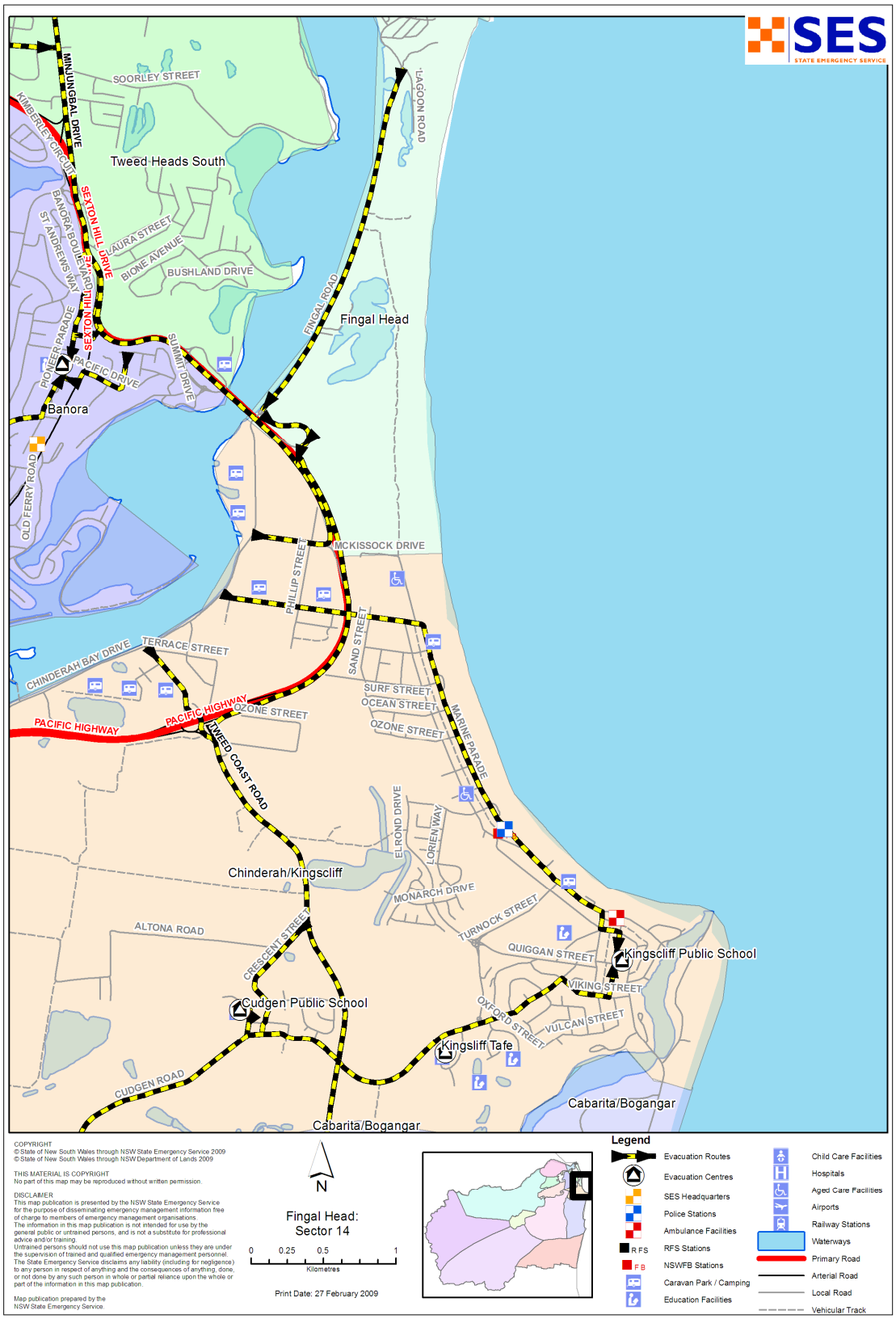
MAP 15 - TWEED HEADS WEST SECTOR EVACUATION MAP



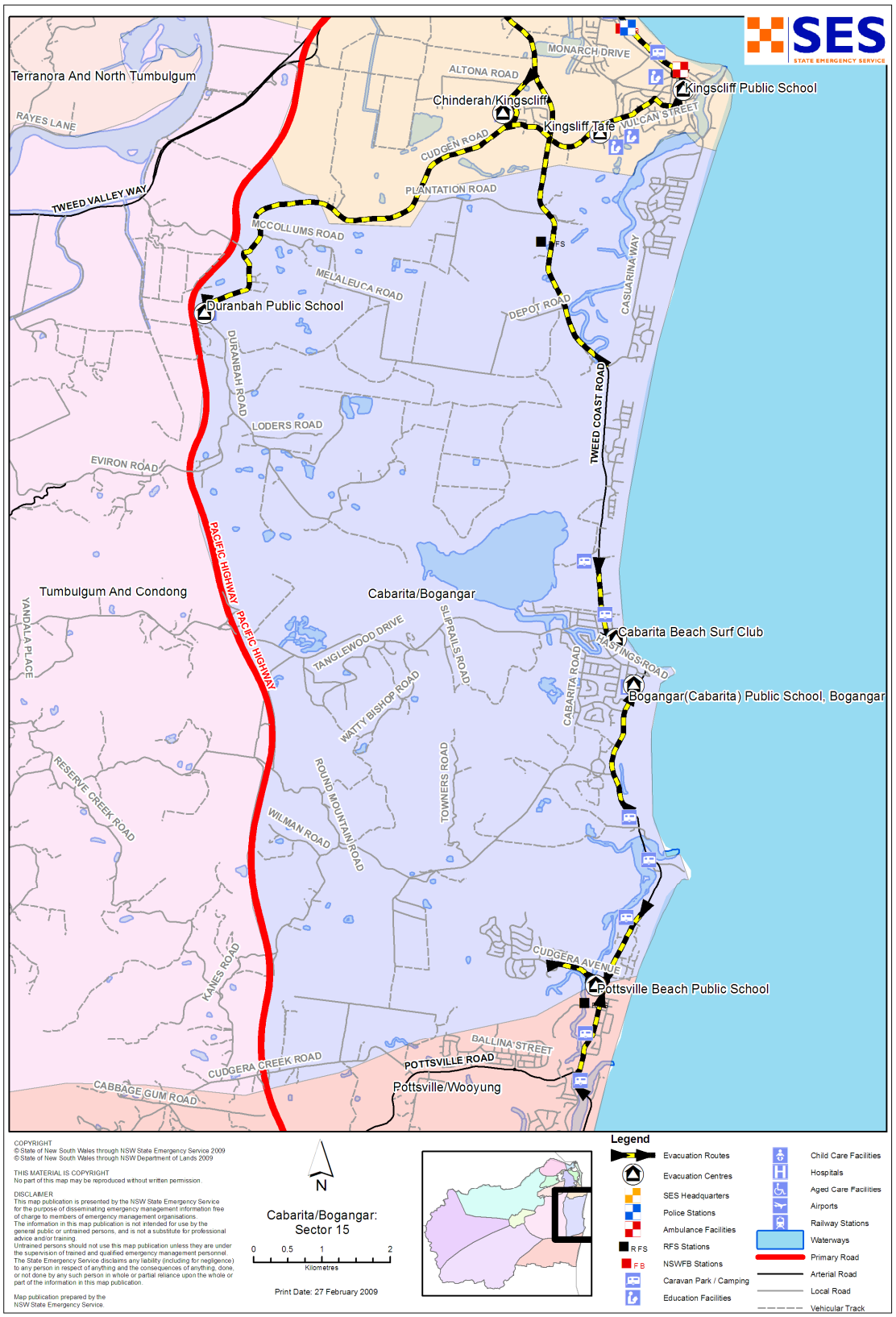
MAP 16 - TWEED HEADS SECTOR EVACUATION MAP



MAP 17 - FINGAL HEAD SECTOR EVACUATION MAP



MAP 18 - CABARITA/BOGANGAR SECTOR EVACUATION MAP



MAP 19 - POTTSVILLE/WOOYUNG SECTOR EVACUATION MAP