Table of Contents

Appendices

Tables

Figures

Maps

These are provided as an attachment to this report.

Map G101	Catchment Areas
MapG201	Maloneys Creek Catchment
Map G202	Long Beach Catchment
Map G203	Surfside Catchment
Map G204	The Water Gardens Catchment
Map G205	Catalina (Hanging Rock Creek) Catchment
Map G206	Batehaven (Joes Creek) Catchment
Map G207	Sunshine Bay / Caseys Beach (Short Beach Creek) Catchment
Map G301	Rainfall Gauges
Map G302	MHL Gauges
Map G303	Batemans Bay Survey Obtained
Map G601	Subcatchments
Map G602	TUFLOW Model Extents
Map G603	TUFLOW Roughness Zones
Map G701	Comparison with Community Observations
Map G702	Sensitivity – Rainfall Increase
Map G703	Sensitivity – Rainfall Decrease
Map G704	Sensitivity – Roughness Increase
Map G705	Sensitivity – Roughness Decrease
Map G706	Sensitivity – Downstream Boundary Increase
Map G707	Sensitivity – Downstream Boundary Decrease
Map G708	Sensitivity – Surfside Culvert Blockage
Map Series G801	Peak Depths for PMF, 1% AEP and 10% AEP
Map Series G802	Peak Velocity for PMF, 1% AEP and 10% AEP
Map Series G803	Hazard for PMF, 1% AEP and 10% AEP
Map Series G804	Flood Function for PMF and 1% AEP
Map Series G805	0.35m Sea Level Rise Impacts for 1% AEP and 5% AEP
Map G806	0.72m Sea Level Rise Impacts for 1% AEP
Mao Series G807	Critical Duration for PMF, 1% AEP and 10% AEP
Map G808	Tidal Inundation
Map Series G901	1% AEP + 0.5m Extents
Map Series G902	Flood Emergency Response Classifications
Map Series G903	Road Overtopping
Map Series G904	Flood Affected Infrastructure
Map Series G905	Pump Station Affectation
Map Series G906	Draft Flood-prone Land Control Areas

Glossary

Annual exceedance probability (AEP)	The chance of a flood of a given size (or larger) occurring in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 m^3/s has an AEP of 5%, it means that there is a 5% chance (i.e., a 1 in 20 chance) of a peak discharge of 500 m^3/s (or larger) occurring in any one year. (See also average recurrence interval).
Australian Height Datum (AHD)	National survey datum corresponding approximately to mean sea level.
Attenuation	Weakening in force or intensity.
Average recurrence interval (ARI)	The long-term average number of years between the occurrence of a flood as big as (or larger than) the selected event. For example, floods with a discharge as great as (or greater than) the 20 year ARI design flood will occur on average once every 20 years. ARI is another way of expressing the likelihood of occurrence of a flood event. (See also annual exceedance probability).
Catchment	The catchment, at a particular point, is the area of land that drains to that point.
Design flood	A hypothetical flood representing a specific likelihood of occurrence (for example the 100 year ARI or 1% AEP flood).
Development	Is defined in Part 4 of the AP&A Act as: - Infill Development: development of vacant blocks of land that are generally surrounded by developed properties. - New Development: development of a completely different nature to that associated with the former land use. - Redevelopment: Rebuilding in an area with similar development.
Discharge	The rate of flow of water measured in terms of volume per unit time, for example, cubic metres per second (m^3/s). Discharge is different from the speed or velocity of flow, which is a measure of how fast the water is moving for example, metres per second (m/s).
Flood	Relatively high river or creek flows, which overtop the natural or artificial banks, and inundate floodplains and/or coastal inundation resulting from super elevated sea levels and/or waves overtopping coastline defences.
Flood Awareness	Awareness is an appreciation of the likely effects of flooding and knowledge of the relevant flood warning, response ad evacuation procedures.
Flood Education	Education that seeks to provide information to raise awareness of the flood problem to enable individuals to understand how to manage themselves and their property in a flood event.
Flood fringe	Land that may be affected by flooding but is not designated as floodway or flood storage.
Flood hazard	The potential risk to life and limb and potential damage to property resulting from flooding. The degree of flood hazard varies with circumstances across the full range of floods.

Flood level	The height or elevation of floodwaters relative to a datum (typically the Australian Height Datum). Also referred to as "stage".
Floodplain	Area of land which is subject to floods up to and including the probable maximum flood.
Floodplain risk management plan	A document outlining a range of actions aimed at improving floodplain management. The plan is the principal means of managing the risks associated with the use of the floodplain. A floodplain risk management plan needs to be developed in accordance with the principles and guidelines contained in the NSW Floodplain Development Manual. The plan usually contains both written and diagrammatic information describing how particular areas of the floodplain are to be used and managed to achieve defined objectives.
Flood planning levels (FPLs)	Flood planning levels selected for planning purposes are derived from a combination of the adopted flood level plus freeboard, as determined in floodplain management studies and incorporated in floodplain risk management plans. Selection should be based on an understanding of the full range of flood behaviour and the associated flood risk. It should also consider the social, economic, and ecological consequences associated with floods of different severities. Different FPLs may be appropriate for different categories of land use and for different flood plans. The concept of FPLs supersedes the "standard flood event". As FPLs do not necessarily extend to the limits of flood prone land, floodplain risk management plans may apply to flood prone land beyond that defined by the FPLs.
Flood prone land	Land susceptible to inundation by the probable maximum flood (PMF) event. Under the merit policy, the flood prone definition should not be seen as necessarily precluding development. Floodplain Risk Management Plans should encompass all flood prone land (i.e. the entire floodplain).
Flood storage	Floodplain area that is important for the temporary storage of floodwaters during a flood.
Floodway	A flow path (sometimes artificial) that carries significant volumes of floodwaters during a flood.
Freeboard	A factor of safety usually expressed as a height above the adopted flood level thus determining the flood planning level. Freeboard tends to compensate for factors such as wave action, localised hydraulic effects and uncertainties in the design flood levels.
Gauging (tidal and flood)	Measurement of flows and water levels during tides or flood events.
Hazard	A source of potential harm or a situation with a potential to cause loss.
Historical flood	A flood that has actually occurred.
Hydraulic	The term given to the study of water flow in rivers, estuaries, and coastal systems, in particular the evaluation of flow parameters such as water level and velocity.
Hydrograph	A graph showing how a river or creek's discharge changes with time.
Hydrologic	Pertaining to rainfall-runoff processes in catchments.
Hydrology	The term given to the study of the rainfall-runoff process in catchments, in particular, the evaluation of peak flows and flow volumes. .

Isohyet	Equal rainfall contour.
Peak flood level, flow or velocity	The maximum flood level, flow or velocity that occurs during a flood event.
Pluviometer	A rainfall gauge capable of continuously measuring rainfall intensity.
Probable maximum flood (PMF)	An extreme flood deemed to be the maximum flood that could conceivably occur.
Probability	A statistical measure of the likely frequency or occurrence of flooding.
Riparian	The interface between land and waterway. Literally means “along the river margins”.
Runoff	The amount of rainfall from a catchment that actually ends up as flowing water in the river or creek.
Stage	See flood level.
Stage hydrograph	A graph of water level over time.
Topography	The shape of the surface features of land.
Velocity	The speed at which the floodwaters are moving. A flood velocity predicted by a 2D computer flood model is quoted as the depth averaged velocity, i.e. the average velocity throughout the depth of the water column. A flood velocity predicted by a 1D or quasi-2D computer flood model is quoted as the depth and width averaged velocity, i.e. the average velocity across the whole river or creek section.

Terminology in this Glossary has been adapted from the NSW Government Floodplain Development Manual, 2005, where available.

Abbreviations

1D	One Dimensional
2D	Two Dimensional
AHD	Australian Height Datum
ARI	Average Recurrence Interval
ARF	Areal Reduction Factor
AR&R	Australian Rainfall and Runoff
BoM	Bureau of Meteorology
BVSC	Bega Valley Shire Council
DCP	Development Control Plan
DEM	Digital Elevation Model
DPE	Department of Planning and Environment
DPIE	Department of Planning Industry and Environment
IFD	Intensity Frequency Duration
FPL	Flood Planning Level
FRMP	Floodplain Risk Management Plan
FRMS	Floodplain Risk Management Study
FPRMSP	Floodplain Risk Management Study & Plan
ha	hectare
km	kilometres
km^2	Square kilometres
LEP	Local Environment Plan
LGA	Local Government Area
LiDAR	Light Detection and Ranging
m	metre
m^2	Square metres
m^3	Cubic metres
mAHD	metres to Australian Height Datum
mm	millimetres
m/s	metres per second
m^3/s	Cubic metres per second
NSW	New South Wales
PMF	Probable Maximum Flood
SES	State Emergency Service (NSW)

1 Introduction

The Batemans Bay Urban Creeks Flood Study has been prepared for Eurobodalla Shire Council (Council) to define the existing flood behaviour in the catchment and establish the basis for subsequent floodplain management activities.

1.1 Study Location

Batemans Bay is located in the Eurobodalla Shire Council Local Government Area (LGA), which is approximately 280 km south of Sydney via the Princes Highway, and 150 km south-east of Canberra via the Kings Highway on the NSW South Coast.

Batemans Bay is located on a wide embayment with settlements located on the northern and southern shores. The study focuses on seven catchments in the Batemans Bay region, namely:

- Maloneys Beach (Maloneys Lagoon)
- Long Beach (Long Beach Lagoon)
- Surfside (Surfside Creek)
- The Water Gardens
- Catalina (Hanging Rock Creek)
- Batehaven (Joes Creek)
- Sunshine Bay / Caseys Beach (Shortbeach Creek).

The catchment locations are shown in **Map G101**.

1.2 Study Objectives

The overall objective of this study is to improve understanding of flood behaviour and impacts, and better inform management of flood risk in the study area through consideration of available information, and relevant standards and guidelines. The study will also provide a sound technical basis for any further flood risk management investigations in the area.

This project is a flood study, which is a comprehensive technical investigation of flood behaviour that provides the main technical foundation for the development of a robust floodplain risk management plan. It aims to provide a better understanding of the full range of flood behaviour and consequences. It involves consideration of the local flood history, available collected flood data, and the development of hydrologic and hydraulic models that are calibrated and verified, where possible, against historic flood events and extended, where appropriate, to determine the full range of flood behaviour.

The overall project provides an understanding of, and information on, flood behaviour and associated risk to inform:

- Relevant government information systems
- Government and strategic decision makers on flood risk
- The community and key stakeholders on flood risk
- Flood risk management planning for existing and future development
- Emergency management planning for existing and future development, and strategic and development scale land-use planning to manage growth in flood risk
- Decisions on insurance pricing (where the information is utilised by insurance companies).

The outputs of this study will assist this by:

- Providing a better understanding of the:
    - Variation in flood behaviour, flood function, flood hazard and flood risk in the study area
    - Impacts and costs for a range of flood events or risks on the existing and future community
    - Impacts of changes in development and climate on flood risk
    - Emergency response situation and limitations
    - Effectiveness of current management measures
- Facilitating information sharing on flood risk across government and with the community.

The study outputs will also inform decision making for investing in the floodplain; managing flood risk through prevention, preparedness, response, and recovery activities; pricing insurance; and informing and educating the community on flood risk and response to floods.

1.3 Study Background and Context

Batemans Bay is the largest urban settlement in the Eurobodalla Shire Council LGA and is home to a significant number of permanent residents, although the population triples in peak holiday periods. This, coupled with a high number of absentee property owners, creates a challenging and complex situation for Council in managing the population during flood events.

Prior flood assessments have been undertaken in the 1980's and 1990's however these primarily focussed on bridge constructions and ocean inundation, with limited catchment flooding data available to assist Council in managing local flood risks.

Anecdotal evidence and community comments have indicated that flooding within the region occurs through a number of mechanisms, namely mainstream and overland flooding from catchment rainfall, ocean inundation, nuisance flooding from ponding behind closed entrances, and in some locations, groundwater inundation. Further information regarding community observations of flooding is provided in **Section 4.4 and 4.5**.

2 Study Area

The catchments are generally characterised by steep upper catchment areas feeding into low lying areas adjacent to the bay. With the exception of Hanging Rock Creek, all the waterways are small ICOLL's (Intermittently Closed and Open Lakes and Lagoons). Flooding can be caused by short duration flooding resulting in 'flash flooding', and longer duration rainfall can also cause flooding issues, particularly if they coincide with certain entrance and tidal conditions.

Development across the study area varies. Some catchment areas such as The Water Gardens and Sunshine Bay have development across the majority of the catchment. Conversely, Maloneys Beach and Long Beach have largely undeveloped catchments, with small townships located along the foreshore.

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<tr>
<td>Maloney Creek Entrance</td>
<td>Long Beach Lagoon Entrance</td>
<td>Surfside Creek Entrance</td>
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<tr>
<td>Hanging Rock Creek Entrance</td>
<td>Joes Creek Entrance</td>
<td>Shortbeach Creek Entrance</td>
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2.1 Catchment Description

2.1.1 Maloneys Beach (Maloneys Lagoon)

Maloneys Beach is located on the northern shore of Batemans Bay, and is the eastern-most catchment area included in this study. The catchment is largely undeveloped, with the majority of the catchment being bushland. There is a single developed area in the catchment, Maloneys Beach, located on the water's edge, immediately east of the Maloneys Lagoon outlet. The developed area is relatively small and has a single evacuation route out of the township, Northcove Road, that crosses Maloneys Creek just upstream of the entrance. The entrance is located immediately downstream of the Northcove Road bridge, adjacent to the township.

While the developed area is small, the overall catchment feeding into this area is the largest of the seven catchment areas to be assessed.

The Maloneys Beach catchment area is shown in **Map G201**.

2.1.2 Long Beach (Long Beach Lagoon)

Long Beach is on the northern side of the Bay and lies adjacent to the Maloneys Creek catchment. The catchment is centred on Long Beach Lagoon, with a ring of development around the Lagoon that occurs both along the Bay edge, as well as the ridge around the Lagoon that forms the catchment boundary.

A waterfront road, Sandy Place, runs between Long Beach Lagoon and the Bay. A small channel runs from the south-east corner of the Lagoon, under Sandy Place via a culvert, to discharge into the Bay.

The Long Beach catchment area is shown in **Map G202**.

2.1.3 Surfside (Surfside Creek)

Surfside Creek is on the northern side of the Bay and is located on the northern shore of the Clyde River outlet into Batemans Bay, at the Princes Highway Bridge crossing. The catchment land use is broadly split by the highway, with extensive areas of development in the downstream portions of the catchment, while it remains largely bushland upstream of the highway. The catchment contains the Batemans Bay Primary School, located adjacent to Surfside Creek, downstream of the highway. Surfside Creek discharges into the Bay through a set of piped culverts under Wharf Road. These pipes have a small freeboard to the road level above (approximately 0.4 metres) and were observed to be partially blocked by beach sand at the time of inspection (July 2018). This crossing is likely to be a significant control on the flows out of the catchment.

The Surfside catchment area is shown in **Map G203**.

2.1.4 The Water Gardens

Located on the southern shores of the Bay, immediately south of the Surfside Creek catchment at the outlet of the Clyde River, is The Water Gardens study area. This catchment is fully developed, save for a constructed water body and green space in the centre of the catchment. Residential development dominates most of the catchment, with some commercial / light industrial development occurring in the upper reaches.

The catchment has a wide water frontage, and is a low-lying, placing it at risk of ocean driven flooding, particularly in the eastern portion of the catchment.

A major road, Beach Road, runs adjacent to the water with very little foreshore between the roadway and the water. Most of the waterfront has had rock armouring or similar applied to protect the adjacent road. The catchment drains under Beach Road through a series of culverts into the Bay.

The Water Gardens catchment area is shown in **Map G204**.

2.1.5 Catalina (Hanging Rock Creek)

The Catalina catchment lies adjacent to The Water Gardens to the east. The landuse within the catchment is varied. The downstream region is dominated by the Catalina Country Club Golf Course, with residential development surrounding the golf club. Some residential development has also taken place in the upstream catchment, but much of this region remains undeveloped.

The entrance to this catchment is unique among that other catchment areas, in that it discharges into the Batemans Bay Marina, which is protected from the Bay via a seawall. The entrance appears to be primarily open, discharging into the ocean.

The Catalina catchment area is shown in **Map G205**.

2.1.6 Batehaven (Joes Creek)

Batehaven lies immediately to the east of Catalina, on the southern shores of Batemans Bay and is the second largest of the seven catchment areas. The downstream half is largely residential development, while the upper catchment remains generally vegetated, with some pockets of rural residential lots. Joes Creek runs through the centre of the catchment area. For most of the creek's length there is a reasonable buffer of vegetation between the creek and the development within the catchment. Near the outlet however, Batemans Bay High School and the Big 4 Batemans Bay Caravan Park directly adjoin the creek.

Joes Creek passes under Beach Road some 300m upstream of the entrance. The caravan park lies along this reach of creek between the bridge and the entrance.

The Batehaven catchment area is shown in **Map G206**.

2.1.7 Sunshine Bay / Caseys Beach (Short Beach Creek)

Sunshine Bay / Caseys Beach is the final of the seven catchments to be investigated and lies to the southeast of the Batehaven region. Similar to the adjacent Batehaven catchment, the lower catchment is largely comprised of residential development, while the upper catchment remains vegetated with some pockets of large lot semi-rural residential development. Short Beach Creek runs through the middle of the catchment area. Again, similar to the Batehaven region, there is a reasonable buffer maintained along the creek for much of its length, until near the outlet where St Bernard's Primary School and the Caseys Beach Holiday Park are located immediately adjacent to the creek.

Shortbeach Creek passes under Beach Road immediately upstream of the Bay entrance. The creek is required to break through a small reach of beach before reaching the Bay.

The Sunshine Bay catchment area is shown in **Map G207**.

2.2 Historical Flooding

There is very little information providing details of catchment flood events. Anecdotal information suggests that catchment flooding has occurred across the seven catchments at various times in the past. Catchment flooding has been noted by residents and business owners to cause flooding of roads, footpaths and on occasion private property.

Specific events identified through a review of previous studies (**Section 3.2**) and information provided by the community (**Section 4.4 and 4.5**) identified catchment flooding to have occurred for the events summarised in **Table 2-1**.

Table 2-1 Historical Flood Events

Date	Details	Source
August 1963	Information (including photographs) are provided for the flood event at a range of locations, which was a combination of catchment and coastal flooding.	Batemans Bay Oceanic Inundation Study (NSW Public Works, 1989)
1973	Identified as a 'large event' by the community.	Community drop-in session November 2018.
1974	Identified as a 'large event' by the community.	Community drop-in session November 2018.
1975	Identified as a 'large event' by the community.	Community drop-in session November 2018.

Date	Details	Source
February 1977	Flood observed by a resident in Surfside.	Community drop-in session November 2018.
1990	Overland flow through easement and onto adjacent private property at Avalon Street.	Community Survey (November 2018)
June 1991	Recorded flood levels for event are provided at 4 locations in Long Beach.	Reed Swamp – Long Beach Flood Study (Willing and Partners, 1991)
January 2000	Flooding on roads observed at Caitlin Avenue and Avalon Street.	Community Survey (November 2018)
November 2013	Drains overflowed into vacant lot on Country Club Drive, Catalina, after 2 days of heavy rain.	Community Survey (November 2018)
January 2014	Flooding on roads observed at Caitlin Avenue and Avalon Street. A newspaper article supplied by the community identified the 2014 flooding as a result of a king tide.	Community Survey (November 2018)
August 2015	Drains overflowed into vacant lot on Country Club Drive, Catalina, after 2 days of heavy rain.	Community Survey (November 2018)

3 Review of Available Data

3.1 Site Inspections

Site inspections were undertaken in July 2018 over a period of two days by two Rhelm staff, Council's project manager, and an DPIE representative:

- Thursday July 19th, 2018: Northern catchments including The Waters Gardens, Hanging Rock Creek, Joes Creek, and Short Beach Creek
- Friday July 20th, 2018: Southern catchments including Surfside Creek, Long Beach Lagoon, and Maloneys Lagoon.

The purpose of the site inspections was to gain an appreciation of the catchment and likely flood risks. The site inspections also identified additional survey requirements and assisted with the definition of the hydraulic model extents.

3.2 Previous Studies and Reports

Relevant studies and reports were collated through liaison with Council and DPIE, and consultation with agency and community stakeholders. Additional studies have been sourced through internet searches. A summary of the studies and reports likely to inform this Flood Study are provided in **Table 3-1**.

Table 3-1 Previous Studies and Reports

Document	Relevance to the Study
Batemans Bay Drainage Study (Willing and Partners, 1984)	This drainage study focuses on flood flows from the catchment, including a review of a proposal presented to Council by Coles Pty Ltd to develop the area upstream of the Soldiers Club, the effectiveness of existing infrastructure within the catchment and possible upgrades to allow development. Key findings of 1984 investigation were: • The wetland area was providing a significant detention effect and was reducing existing peak flows from 9.8m^3/s to 4.6m^3/s • Once the catchment was fully developed, peak flows into the wetland would increase to 15.5m^3/s • Recommendations for the management of flows included: o modification to existing pipe work including raising pipes o upgrade the existing 3 x1.2m culvert to remove a step in the culvert o duplication of the 3 x 1.2m culvert o construction of a detention basin. Work undertaken subsequent to the report was the upgrade of the 3x1.2m culvert to remove a step in it and to raise some of the surrounding low-lying drainage around Orient Street.
Batemans Bay Ocean Inundation Study (Lawson and Treloar, 1987)	This report presents the results of an investigation into elevated ocean water levels at the entrance of the Clyde River at Batemans Bay. Design still water levels were estimated for 20, 50 and 100 year ARI events for 17 locations around the Bay.

Document	Relevance to the Study
Batemans Bay Inundation Study (Willing and Partners, 1988)	Willing and Partners used the ocean inundation study carried out by Lawson and Treloar in 1987 and estimated the joint probability 1% AEP level (for ocean and local catchments) to be 2.66m AHD (2.6m from ocean inundation, 0.06m from catchment flooding) for the area. This is the combined effect of a 100 year ARI oceanic flooding with the 1 year ARI flood from the Soldiers Club catchment. Other combined probability combinations were not possible as the ocean inundation study only considered the 1:100 year event.
Joes Creek Flood Study (Willing and Partners, 1989)	This study assesses the flood behaviour of Joes Creek landward of Corrigans Beach. It includes flood levels for 5, 20, 50 and 100 year ARI events at various profiles and cross-sections along Joes Creek. This flooding assessment informs the main road extension and future urban development.
Short Beach Creek Flood Study (Willing and Partners, 1989)	This flood study investigates the adequacy of existing culverts and assesses future urban development. Flood levels and peak flow estimates were provided for the 1 in 5, 1 in 20, 1 in 50, and 1 in 100 AEP flood events at several cross-sections along the creek. Flood levels were calculated using a combination of high tide level of 0.94m AHD and a 100 year ARI still water level of 2.43m AHD. Mitigation options were assessed and compared.
Batemans Bay Oceanic Inundation Study (NSW Public Works, 1989)	This study quantified the extent and severity of ocean inundation in the Batemans Bay CBD and inner Bay. This study reported on still water levels with ARI's of 20, 50 and 100 years at Wharf Road. The still water levels comprised astronomic tide level plus wind and pressure setup and also included the mean water level setup at the shoreline due to waves. This study indicates that for storm events with recurrence intervals in the range of 20 to 100 years, large sections of the foreshore are overtopped by storm still water levels and/or wave run-up. Information (including photographs) are provided for the August 1963 flood event, which was a combination of catchment and coastal flooding.
Reed Swamp – Long Beach Flood Study (Willing and Partners, 1991)	This report studies the flooding of Sandy Place due to Reed Swamp outflows at Long Beach for 5, 20 and 100 year ARI flood events. Flood levels were calculated using a high water summer solstice level of 0.94m AHD, and a 100 year ARI still water level of 2.48m AHD and were determined for existing and fully developed catchment conditions at several cross sections between Reed Swamp and Batemans Bay. This report investigates culvert options and treatment options for the lagoon outlet. Recorded flood levels for the 1991 event area provided at 4 locations.
Batemans Bay Vulnerability Study (Land and Water Conservation NSW, 1996)	This study defines the impact of present and future coastal hazards on Batemans Bay. Storm bite and beach recession due to different sea level rise by 2050 were described for the beached within Batemans Bay. Wave run-up and still water levels for a 50 year ARI were used for different sea level rise scenarios.
Batemans Bay Vulnerability Study Wave Penetration and Run-up (Lawson and Treloar, 1996)	This study re-assesses wave propagation into Batemans Bay and wave run-up and expands upon the previous work undertaken as part of the PWD Batemans Bay Oceanic Inundation Study (1989).

Document	Relevance to the Study
Wharf Road Drainage Report (Eurobodalla Shire Council, 1997)	This report reviews existing stormwater assets located between Wharf Road and Surfside and provides options for mitigation of minor flooding. Flood events were modelled for high tide levels of RL 1.1m and 100 year ARI ocean inundation of RL 2.7m. Design still water and wave run-up heights were the same as those adopted in the Batemans Bay Vulnerability Study (Land and Water Conservation NSW, 1996). These levels were calculated with a sea level rise of 0.20m by 2050.
Batemans Bay Primary School Relocation – Surfside: Stormwater Drainage Study (Eurobodalla Shire Council, 2000)	This report investigates the drainage impact of the proposed primary school relocation. The water surface profiles were calculated using: • 1, 20 and 100 year ARI flows • 0.6, 1.1, 1.5 and 2.3 mAHD tail water levels • Existing and proposed developed roadways • Culverts unblocked, blocked, and blocked outlet culvert under Wharf Road with an unblocked northern access road culvert.
Batemans Bay Coastline Hazard Management Plan (Webb, McKeown and Associates, 2006)	This plan identifies mitigation and management options for coastal hazards for the whole of the Batemans Bay coastline. Run-up levels, erosion rates, beach recession rates, inundation level, wave setup, wave height and dune height are provided for each beach.
Eurobodalla Flood Risk Assessment (URS, 2006)	This report assesses strategies for Council to progress with flood studies and risk management for the entire Eurobodalla Shire. The report includes a gap analysis of existing information. The impact of climate change on sea level rise, wind and rainfall is described.
Existing catchment flood behaviour and impact of the proposed building for Batemans Bay Soldiers Club car park – Flood Assessment (Storm Consulting, 2009)	As part of the Development Application and Statement of Environmental Effects, this report provides a brief assessment of groundwater and flooding impacts on the proposed Centrelink development in the Batemans Bay Soldiers Club car park. Hydrological modelling was undertaken using RAFTS. The critical duration was found to be the 120 minute storm. This was consistent with the previous studies undertaken by Willing & Partners. No calibration was undertaken. Verification against the previous Willing & Partners reports was undertaken. Hydraulic modelling was undertaken using HEC-RAS 4.0 using the peak storm duration from the RAFTS model.
Eurobodalla Shire Coastal Hazard Assessment (Water Research Lab UNSW, 2017)	This report forms Stage 2 of Council's Coastal Management Program. The report defines the impact of present and future coastal hazards in Eurobodalla Shire. This information will inform the downstream boundary conditions for the urban creek hydraulic models.
Batemans Bay Estuary Processes Study (WBM Oceanics, 1999)	This study was undertaken in order to develop an understanding of the various estuarine processes of Batemans Bay and their interactions.
Batemans Bay & Clyde River Estuary Management Study (WBM Oceanics, 2004)	The study provides a program of strategic actions to manage the waterways, foreshores, and catchments of the estuary.

Document	Relevance to the Study
Batemans Bay Wharf Road Development – Soft Option Coastal Engineering Assessment and Addendum (WMA, 2005)	This report describes a sand transport model and the historical foreshore alignment evolution between 1898 and 1999. The high water mark adopted by Council was chosen from the 1964 most eroded shoreline (100% historical data line). It was assumed that buildings are unlikely to be flooded landward of it. Possible mitigation options were provided as well as wave assessment of erosion, coastal inundation (including setup levels and wave run-up) and sea level rise.
Wharf Road Coastal Hazard Assessment and Hazard Management Plan (BMT WBM, 2009)	This report provides an oceanic inundation level at Wharf Road. The risk of overtopping was detailed, and sedimentation processes assessed. The existing seawall at the corner of Wharf Road was found to be at a high risk of failure due to erosion, overtopping and undersize armour. Some sewer and water supply pipes might also be at risk.
Eurobodalla Shire Coastal Hazards Scoping Study (SMEC, 2010)	This study reviews existing coastal hazard studies for comprehensiveness, adequacy, and currency especially in light of Sea Level Rise and climate change. A gap analysis of coastal hazard assessment studies was carried out to identify areas requiring detailed assessment.
Coastal Zone Management Plan for Batemans Bay (Water Research Laboratory, 2012)	This Plan describes proposed actions to be implemented which address priority management issues in the Batemans Bay coastal zone.
Wharf Road North Batemans Bay Coastal Zone Management Plan (Eurobodalla Shire Council, 2017)	This report focusses on Wharf Road, North Batemans Bay, which was identified by the NSW Government as a coastal erosion 'hotspot', requiring the preparation of a CZMP and an Emergency Action Sub-plan. The back beach area at Wharf Road is low lying, and subject to immediate coastal inundation and erosion hazards.

3.3 Local Emergency Management Plans

A variety of relevant emergency planning documents, where available, were also reviewed and considered as part of the study. These documents are listed in **Table 3-2**.

Table 3-2 Local Emergency Management Plans

Document	Relevance to the Study
Eurobodalla Shire Council Local Emergency Management Plan (EMPLAN)	This document will be used to identify what flood information is necessary to support emergency management activities
Eurobodalla Local Disaster Plan (DISPLAN) 2012	This document will be used to identify what flood information is necessary to support emergency management activities
Draft Emergency Action Sub-plan for the Wharf Road Coastal Erosion 'Hot Spot' 2012	This document will be used to identify what flood information is necessary to support emergency management activities

3.4 Survey Information

3.4.1 Aerial Survey

Aerial survey (LiDAR) has been provided by Council for the full catchment of each study area, which includes publicly available LiDAR data that was flown for the east coast of NSW, and is available as a 1m DEM.

Point cloud data is also available for the study area via the Foundation Spatial Data Framework's online portal, ELVIS (Elevation and Depth Foundation Spatial Data), available from http://elevation.fsdf.org.au/. While the 1m DEM is of sufficient resolution for most modelling requirements, the point cloud data can be useful to ensure that terrain features such as retaining walls, or items with sub-metre sizes are appropriately included in the terrain model.

3.4.2 Ground Survey

No existing ground survey was made available at the beginning on the study.

Ground survey has since been collected as part of this study to obtain selected road levels (including at Long Beach) and berm heights (including at Maloneys Beach and Surfside), in addition to culvert and bridge structures within each catchment. The locations of ground survey collected are shown in **Map G303.**

3.4.3 Bathymetric Survey

Creek cross sections have been surveyed at the locations shown in **Map G303**.

Bathymetry data was available from the Australian Ocean Data Network (https://portal.aodn.org.au/) at a 5m resolution.

It is noted that no bathymetry is available for Joes Lagoon and no survey is being undertaken for this purpose. Joes Lagoon will be modelled as a fully hydrodynamic model to represent the berm breakout processes (see **Section 6.4.8**).

3.4.4 Structures

The flood modelling will include all culverts greater than 600mm diameter. In addition, there are several bridges that cross the waterways that will also be included in the model.

The culvert and bridge details have been obtained from a variety of sources:

- Council data (including GIS data and hand drawings of culvert details of Surfside Creek, Princes Highway);
- Survey (**Map G303**).

3.5 Historical Flood Marks

Data on historical flooding was sourced from previous flooding reports and Council data.

Additional descriptions of historical flooding were provided through consultation with the local community. One flood mark was identified for survey. This location represents flooding on private property in Surfside. This finished floor level, as identified in the survey, is set to 2.773m AHD. Further details regarding the consultation are provided in **Section 4**.

3.6 Rainfall Data

There is an extensive network of rainfall gauges (current and discontinued) across the study area, primarily operated by the Bureau of Meteorology (BoM). These stations are shown in **Map G301**. A list of gauges for the area surrounding the catchment is shown in **Table 3-3** and **Table 3-4** together with key information on whether they are pluviometer or daily gauges.

The suitability of these gauges for use in calibrating / validating the identified historical storms is shown in **Table 3-5** and **Table 3-6**. It is noted that the nearest pluviometer gauge is in Araluen, on the western side of the range, and therefore may not be representative of local rainfall patterns.

Further discussion on recorded rainfall data for historical events is presented with the calibration and validation of the models developed for the study in **Section 7.1**.

Table 3-3 BoM Rain Gauges

ID	Station Name	Commenced	Closed	Daily	Pluviometer
069000	Araluen Post Office	1891	31-Dec-1970	Y	Y (1960 – 1970)
069001	Batemans Bay Post Office	1895	29-Dec-1996	Y	N
069004	Benandra State Forest	1936	31-Dec-1959	Y	N
069006	Bettowynd (Condry)	1896	08-Mar-2010	Y	N
069010	Braidwood (Wallace Street)	1887	Open	Y	N
069016	Milton (Sarah Claydon Village)	1876	Open	Y	N
069018	Moruya Heads Pilot Station	1875	Open	Y	N
069020	Murramurrang	1946	31-Dec-1952	Y	N
069023	Nelligen (Thule Road)	1898	Open	Y	N
069031	Ulladulla	1937	31-Dec-1974	Y	N
069033	Moruya (Burra Creek)	2001	Open	Y	N
069035	Bettowynd (Nobbys Hill)	2000	Open	Y	N
069038	Moruya Bowling Club	1886	31-Dec-1966	Y	N
069040	Kioloa Old Post Office	1957	Open	Y	N
069042	Moruya (The Lagoon)	1960	Open	Y	N
069043	Moruya (Deua River Farm)	1971	31-Dec-1971	Y	N
069046	Mongarlowe	1960	31-Dec-1966	Y	N
069048	Upper Deua (Warawitcha)	2001	Open	Y	N
069052	Batemans Bay – Buckenbowra	1943	Open	Y	N
069053	Burrewarra North	1962	31-Dec-1967	Y	N
069092	Nelligen Clyde Road	1967	31-Dec-1971	Y	N
069098	Bevian Park	1968	31-Dec-1973	Y	N
069102	North Araluen	1969	31-Dec-1980	Y	Y (1970 – 1980)
069105	Merricumbene	1970	31-Dec-1979	Y	N
069106	Woodburn State Forest	1925	31-Dec-1980	Y	N
069113	Geju	1974	31-Dec-1974	Y	N
069121	Brooman (Carisbrook)	1979	Open	Y	N
069124	Bawley Point	1913	31-Dec-1920	Y	N
069126	London Foundation	1980	31-Oct-1986	Y	N
069127	Araluen Lower (Araluen Road)	1980	Open	Y	Y (1980 – 2003)
069132	Braidwood Racecourse AWS	1985	Open	Y	N
069134	Batemans Bay (Catalina Country Club)	1991	Open	Y	N
069138	Ulladulla AWS	1989	Open	Y	N
069141	Currowan (Wild Pig Rd)	1993	27-Feb-2006	Y	N
069142	Moruya (Kiora)	1969	Open	Y	N
069145	Moruya (Plumwood)	1993	Open	Y	N
069148	Moruya Airport AWS	1999	Open	Y	N
069150	Braidwood (Mongarlowe (Leweston))	1998	Open	Y	N

Table 3-4 Rain Gauges by Others

ID	Station Name	Commenced	Closed	Daily	Pluviometer
216420D	Lake Conjola D/S (MHL)	TBC	TBC	Y	N
216002	Clyde River at Brooman (WaterNSW)	1960	Open	Y	N

Table 3-5 Operation of BoM Gauge Data for Identified Historical Events

ID	Station Name	Pluvio meter	Historical Events (with observations or recorded water levels)		
			Aug-63	Feb-77	Jun-91
069000	Araluen Post Office	Y	Pluvio and Daily	N	N
069001	Batemans Bay Post Office	N	Daily	Daily	Daily
069004	Benandra State Forest	N	N	N	N
069006	Bettowynd (Condry)	N	Daily	Daily	Daily
069010	Braidwood (Wallace Street)	N	Daily	Daily	Daily
069016	Milton (Sarah Claydon Village)	N	Daily	Daily	Daily
069018	Moruya Heads Pilot Station	N	Daily	Daily	Daily
069020	Murramurrang	N	N	N	N
069023	Nelligen (Thule Road)	N	Daily	Daily	Daily
069031	Ulladulla	N	Daily	N	N
069033	Moruya (Burra Creek)	N	N	Daily	N
069035	Bettowynd (Nobbys Hill)	N	N	Daily	N
069038	Moruya Bowling Club	N	Daily	N	N
069040	Kioloa Old Post Office	N	Daily	Daily	Daily
069042	Moruya (The Lagoon)	N	Daily	Daily	Daily
069043	Moruya (Deua River Farm)	N	N	N	N
069046	Mongarlowe	N	Daily	N	N
069048	Upper Deua (Warawitcha)	N	N	N	N
069052	Batemans Bay – Buckenbowra	N	Daily	Daily	Daily
069053	Burrewarra North	N	Daily	N	N
069092	Nelligen Clyde Road	N	N	N	N
069098	Bevian Park	N	N	N	N
069102	North Araluen	Y	N	Pluvio and Daily	N
069105	Merricumbene	N	N	Daily	N
069106	Woodburn State Forest	N	Daily	Daily	N
069121	Brooman (Carisbrook)	N	N	N	Daily
069124	Bawley Point	N	Daily	Daily	N
069126	London Foundation	N	N	N	N
069127	Araluen Lower (Araluen Road)	Y	N	N	Pluvio and Daily
069132	Braidwood Racecourse AWS	N	N	N	Daily
069134	Batemans Bay (Catalina Country Club)	N	N	N	Daily
069138	Ulladulla AWS	N	N	N	Daily
069141	Currowan (Wild Pig Rd)	N	N	N	N
069142	Moruya (Kiora)	N	N	Daily	Daily
069145	Moruya (Plumwood)	N	N	N	N
069148	Moruya Airport AWS	N	N	N	N
069150	Braidwood (Mongarlowe (Leweston))	N	N	N	N

Table 3-6 Operation of Other Gauges for Identified Historical Events

ID	Station Name	Pluvio meter	Historical Events (with observations or recorded water levels)		
			Aug-63	Feb-77	Jun-91
216420D	Lake Conjola D/S (MHL)	N	TBC	TBC	TBC
216002	Clyde River at Brooman (WaterNSW)	N	Daily	Daily	Daily

3.7 Flow Data

No flow data is available for the waterways within the study area.

3.8 Water Level Data

Water level data is collected by the Manly Hydraulics Laboratory (MHL) at three locations within Batemans Bay and the Clyde River. A list of available data locations is shown in **Table 3-7** together with data coverage. The location of the gauges is shown on **Map G302**. The water level data will allow calibration of the offshore (boundary) water levels through the study area.

The nearest Water NSW Gauge is outside of the study region, on the Shoalhaven River at Warri.

Table 3-7 MHL Water Level Gauges

ID	Location	Type	Data Coverage
216410	Princess Jetty at Batemans Bay	Water Level	Dec 1985 – Ongoing
216450 / BATBOW	Batemans Bay (Offshore)	Water Level and Direction	Sept 2000 – Ongoing
216453	Clyde River at Nelligen	Water Level	Apr 1994 - Ongoing

3.9 GIS Data

Digitally available information such as aerial photography, cadastral boundaries, topography, watercourses, drainage networks, land zoning, vegetation communities and soil landscapes were provided by Council in the form of GIS datasets.

4 Consultation

4.1 Consultation Strategy

The consultation strategy outlined in **Table 4-1** describes the approach to consultation in accordance with the IAP2 framework and the requirements of the NSW Government's Floodplain Development Manual (2005).

Table 4-1 Consultation Strategy Outline

IAP2 Engagement Strategy Guide	Batemans Bay Urban Creek Flood Study
Context ***The internal and external drivers, pressures and other background information that is of relevance to the consultation strategy, and in particular how these may influence how the community receives and responds to the consultation program.***	The context of the consultation will be defined by the following: • Floodplain Development Manual • Australian Emergency Management Handbook 7 • Council's policies • Flood behaviour (e.g. ocean storms, wave direction, riverine flooding and overland flow and the coincidence of these). • Past flooding experiences and local, regional, and national media on flooding. • Council's contact with flood impacted residents following previous flood events. • Consultation undertaken as part of previous related studies.
Scope ***The scoping statements are based on the project context and articulate why the consultation is being undertaken for this project, what the desired outcomes would be, and what the limitations of the engagement are.***	The scope of the consultation strategy is to engage with stakeholders and the community to better understand the flood risks within the study area and to develop community understanding and ownership of the study outcomes.
Stakeholders ***This section provides an overview of the different categories of stakeholders, and their relative level of interest, influence, and impact.*** ***This process is useful in identifying the level of engagement under the IAP2 Consultation Spectrum that may be suitable for different types of stakeholders.***	A stakeholder matrix has been provided in **Table 4-2**. This will inform the selection of appropriate consultation methods.
Purpose ***The purpose relates to the purpose of the consultation not the overall project.*** ***Stakeholders will be linked to each purpose and the goals within each purpose for each stakeholder will be identified.***	The purpose of the consultation is to: ▪ Inform the community and stakeholders of the study; ▪ Gain an understanding of the community and stakeholders' concerns relating to flooding in the study area; ▪ Obtain historical flood information; ▪ Gather information from the community by participation; ▪ Obtain feedback on the Draft Flood Study; and ▪ Develop and maintain community confidence and collaboration with the study results.
Methods	The methods selection and associated goals is provided in **Table 4-3**.

4.1.1 Stakeholder Matrix

It is important to ensure all those who need to be involved in the floodplain management (i.e. those with responsibility for managing flood risk and those with a vested interest in its management, such as property owners) are kept informed and invited to contribute to the process to establish a common understanding of flood risk and how decisions are made.

Stakeholders may tend to make judgements about risk based solely on their own perceptions. These perceptions can vary due to differences in values, needs, assumptions, concepts, concerns, and degrees of knowledge. Stakeholders' views can have a significant impact on the decisions made, so it is important that differences in their perceptions of risk be identified, recorded, and addressed.

A stakeholder matrix (**Table 4-2**) was developed at project inception to provide an overview of the different categories of stakeholders, and their relative level of interest, influence, and impact on the Flood Study. Each stakeholder has been assigned a recommended type of consultation based on the IAP2 consultation spectrum, conceptualised in **Figure 4-1**.

Figure 4-1 IAP2's Public Participation Spectrum

Table 4-2 Stakeholder Matrix

Stakeholder	Level of Impact	Level of Interest	Level of Influence	Recommended Type of Consultation
Impacted Agency Stakeholders				
Eurobodalla Shire Council	High	High	High	Empower
Office of Environment and Heritage	High	High	High	Empower
Steering Committee	High	High	High	Collaborate
Project Technical Committee	High	High	High	Collaborate
State Emergency Service	High	High	Moderate	Collaborate
Roads and Maritime Service	High	High	Moderate	Involve
Impacted Infrastructure Service Providers (to be confirmed by Council)	High	Moderate	Moderate	Involve
Interested Agency Stakeholders				
Council Engineers	Moderate	Moderate	Moderate	Involve
Council Planners	Moderate	Moderate	Moderate	Involve
Water NSW	Moderate	Moderate	Low	Consult
Manly Hydraulics Laboratory	Moderate	Moderate	Low	Inform
NSW DPI – Crown Lands	Moderate	Moderate	Low	Consult
Bureau of Meteorology	Moderate	Moderate	Low	Inform
Impacted Community Stakeholders				
Flood affected property owners	High	High	Low	Consult
Flood affected residents	High	High	Low	Consult
Flood affected business owners	High	High	Low	Consult

Stakeholder	Level of Impact	Level of Interest	Level of Influence	Recommended Type of Consultation
Residents and owners of properties not affected by flooding but within the study area (e.g. impacted by flood access)	Moderate	Moderate	Low	Consult
Users of the area (e.g. impacted by flood access)	Moderate	Low	Low	Consult
Interested Community Stakeholders				
Community groups (specific groups to be advised by Council)	Low	Moderate	Low	Consult
Wider community	Low	Low	Low	Consult
Impacted Agency Stakeholders				
Eurobodalla Shire Council	High	High	High	Empower
Office of Environment and Heritage	High	High	High	Empower
Steering Committee	High	High	High	Collaborate
Project Technical Committee	High	High	High	Collaborate
State Emergency Service	High	High	Moderate	Collaborate
Roads and Maritime Service	High	High	Moderate	Involve
Impacted Infrastructure Service Providers (to be confirmed by Council)	High	Moderate	Moderate	Involve
Interested Agency Stakeholders				
Council Engineers	Moderate	Moderate	Moderate	Involve
Council Planners	Moderate	Moderate	Moderate	Involve
NSW DPI – Crown Lands	Moderate	Moderate	Low	Inform
Bureau of Meteorology	Moderate	Moderate	Low	Inform
Impacted Community Stakeholders				
Flood affected property owners	High	High	Low	Consult
Flood affected residents	High	High	Low	Consult
Flood affected business owners	High	High	Low	Consult
Residents and owners of properties not affected by flooding but within the study area (e.g. impacted by flood access)	Moderate	Moderate	Low	Consult
Users of the area (e.g. impacted by flood access)	Moderate	Low	Low	Consult
Interested Community Stakeholders				
Community groups (specific groups to be advised by Council)	Low	Moderate	Low	Consult
Wider community	Low	Low	Low	Consult

4.1.2 Engagement Methods Selection

Based on the requirements of the brief, the objectives of the consultation (identified in the consultation strategy outline), the level of consultation identified for each of the stakeholders (in the stakeholder matrix), and discussions with Council engagement methods were selected to achieve the project objectives. A summary of the engagement methods and the key goals of each method are provided in **Table 4-3**.

Table 4-3 Engagement Methods Selection

Method	Stakeholders	Goals	Timing	Details
Media and social media updates.	▪ All stakeholders. ▪ Wider community.	▪ To inform stakeholders of the study. ▪ To increase later engagement with survey and feedback on draft documents. ▪ To capture stakeholders (e.g. visitors and users of the area) not targeted by other consultation methods.	Prior to newsletter and survey release, and drop-in sessions. Prior to and during public exhibition.	Council provided updates to the community on their website, media release for local media, and Council's Facebook Page.
Letter / email of introduction to the study and follow up phone call.	▪ All agency stakeholders. ▪ Community groups.	▪ To inform stakeholders of the study. ▪ To identify any additional relevant documents or data sets to be included in the data analysis and review. ▪ To establish a stakeholder mailing list for ongoing project email updates.	Project inception.	An email of introduction was sent to relevant agency and community stakeholders to inform them of the purpose of the study and how they can provide input. Each email was tailored for the recipient. Follow up was undertaken by email and phone as required.
Project Website	▪ Public	▪ To inform the public of the study. ▪ To provide additional information to interested stakeholders and community. ▪ To provide information of how stakeholders can provide input.	For entire project duration.	Council has provided a webpage on their website providing details of the Flood Study and how the community can be involved. Council included details of the study on their Have Your Say website to facilitate review and feedback from the community during the public exhibition.
Newsletter and questionnaire	▪ All flood impacted landowners, business	▪ Inform. ▪ Gain interest and improve likelihood of participation during the public exhibition period.	Project inception	A newsletter and questionnaire was distributed to the residents and property owners within the study area. The newsletter / questionnaire was also made available on Council's project webpage.

Method	Stakeholders	Goals	Timing	Details
	owners and residents. ▪ Wider community	▪ Gather input on flood risk concerns and historical flood data. ▪ To establish a stakeholder mailing list for ongoing project email updates.		
Public Information Session 1	▪ Impacted Community Stakeholders. ▪ Interested Community Stakeholders.	▪ Provide an overview of the study purpose, methodology and aims. ▪ Gather local knowledge including oral history, photographs. ▪ Increase engagement with survey. ▪ Gain interest and improve likelihood of participation during the public exhibition period. ▪ To establish a stakeholder mailing list for ongoing project email updates.	Project inception	The sessions were formatted to allow attendees to drop in at any time during the session and have a one on one chat with the project team. These discussions were facilitated by posters showing each of the catchments (and key features). Attendees were encouraged to mark up the posters with flood observations and points of interest.
Public Exhibition Period	▪ All stakeholders	▪ Provide an opportunity for feedback on the Draft Study.	Following completion of the Draft Study.	The draft FRMS and FRMP was placed on public exhibition for a period of 4 weeks in June 2021.
Public Information Session 2	▪ Impacted Community Stakeholders. ▪ Interested Community Stakeholders.	▪ Provide an overview of the study purpose, methodology and outcomes. ▪ Provide location specific information to attendees (via one on one sessions). ▪ Provide an opportunity for feedback on the Draft Study.	Following completion of the Draft Study.	A community drop-in information sessions was undertaken during the public exhibition period to allow the community to discuss the draft study with the project team and provide feedback on the outcomes.

4.2 Agency Consultation

There are many agencies with flood-related interests in the LGA. To best approach these agencies, a letter was sent to key stakeholder agencies to introduce the project and an invitation to be involved in the study. It also included a request for any relevant data or information they may have.

The agencies contacted are listed in **Table 4-4** along with the outcomes of this consultation.

Table 4-4 Agency Consultation

Agency Stakeholder	Outcome of Consultation
Office of Environment and Heritage	Ongoing guidance and input throughout the project
Eurobodalla Shire Council	
Coastal and Flood Management Planner	Council's project manager providing project direction
Surveyors	Council's survey team have provided input on available data and assisted in the collection of additional survey as well as input to the scope for external survey requirements.
Development Assessment Planners	A workshop was undertaken with Council's planners and DA assessors on 23 August 2019. The purpose of the workshop was to gain a better understanding of Council existing flood planning and opportunities for review and improvement. The outcomes of this workshop informed the flood planning review in **Section 5**.
Coast and Environment Management Advisory Committee	No engagement has been undertaken by Rhelm with the Committee.
Transport for NSW	TfNSW have been contacted both to provide strategic input to the study and provide structure data at Princes Highway. No inputs were received from TfNSW.
State Emergency Service	A range of SES representatives were contacted by Council and Rhelm via email. The unit commander at Batemans Bay responded and advised that most of the Batemans Bay members have a short timeframe as a member and have not seen a flood of significance in Batemans Bay. Two SES representatives attended the drop-in session during the public exhibition. SES provided written feedback on the draft Flood Study.
NSW Ambulance Greater Southern Area Health Service	Contacted on two occasions. No responses received.
Fire and Rescue NSW	Various members of NSW Fire Service and Rural Fire Service contacted. No response received.
NSW Police Force	Contacted on two occasions. No responses received.
South East Local Land Services	Contacted on two occasions. No responses received.
Marine Rescue	Contacted on two occasions. No responses received.
Red Cross	Contacted on two occasions. No responses received.

4.3 Website and Media

Council utilised the local newspaper, their own website and Facebook profile to provide updates and request input to the study. The media released to date is summarised in **Table 4-5.** Copies of the media releases are provided in **Appendix A**. It should be noted that, in addition to the media releases, residents and property owners likely to be affected by the study were contacted directly by mail on 7-10 November 2018 and all residents, property owners and businesses within the PMF were contacted directly by mail during the public exhibition.

Table 4-5 Media Releases

Media	Date	Purpose
Media Release on Council's website	7 November 2018	To inform the community of project inception and scope. Also, to invite community input to the survey and drop-in sessions.
Media statement to local newspaper	7 November 2018	To inform the community of project inception. Also, to invite community input to the survey and drop-in sessions.
Facebook posts	15 November 2018	Inviting attendees to drop-in sessions, requesting flooding photos and providing a link to the online survey.
Media Release on Council's website and notice issued in Council's newsletter	2 June 2021	Advising the community of the public exhibition, how to access the document, and the details of the drop-in session.

Council created a project webpage on their website. This webpage provides background information on the project, relevant links, and during the preparation of this study, the website provided information on how the community could get involved.

The Facebook post (15/11/2018) generated more than 100 comments, some of the key issues and concerns raised are summarised below.

- A resident of Maloneys Drive from 1992 to 2018 has had no experience of flooding on Maloneys Drive. Some flooding has occurred in the creek at the base of Murramarang which may have entered the back of properties along here.
- Concern that the flood study results will be unrealistic and will exceed actual flood heights.
- Concern that insurance premiums will go up as a result of the flood study.
- Concern that mitigation strategies will not reduce insurance premiums.
- Unclear on the definition of flooding used by Council and insurance companies.
- Concern that there is a 'hidden agenda' to the flood study.
- Concerns that the Facebook post did not provide adequate notice for the drop-in sessions.

4.4 Community Newsletter and Survey

A community newsletter and survey were distributed to property and business owners, as well as residents within the study area. The newsletter and survey were also made available on Council's website, with the survey available to be completed online. A copy of the newsletter and survey is provided in **Appendix A**.

The newsletter provided information on the purpose and scope of the Flood Study and the survey sought information about historical flooding events and other flooding concerns within the community.

The survey was mailed to approximately 650 recipients. A summary was also provided in a media release, informing the community of the Flood Study and advertising that the survey was being undertaken.

From the distribution and availability of the survey on the website, fifteen responses were received, representing a return of only 2.3% of direct distribution. A return rate of 10% is typical for these types of mail-outs. An additional 10 people attended drop-in sessions to provide input face to face (**Section 4.5**). This represents a total return rate of 4%. The low rate of returns may have been due to the fact that very little flooding has occurred within the study area in the last 10 years.

A summary of the responses is provided in **Table 4-6**.

Table 4-6 Community Survey Responses

Question	Responses
How long have you lived, worked or visited in and around Batemans Bay?	Range of responses: 0 to 60 years Average: 27.3 years
Are you aware of flooding in and around Batemans Bay?	Aware: 6 Some Knowledge: 2 Not Aware: 6
Have you seen flooding in and around Batemans Bay?	• Catlin Avenue and Avalon Street, Batemans Bay: flooding on the roads in January 2000 and January 2014. A newspaper article supplied by the community identified the 2014 flooding as a result of a king tide. • Overland flow through easement and onto adjacent private property at Avalon Street in 1990. Water drained away once outlet drain cleared / opened. • Drains overflowed into vacant lot on Country Club Drive, Catalina, after 2 days of heavy rain in November 2013 and August 2015. • Flooding of the road and up to the front step of residential property on Golf Links Drive, Batemans Bay • Backyard flood from flow from Bavarde Avenue, Batemans Bay (35 years ago). Upgrades have since been undertaken and no flooding experienced since then. • Flooding of footpaths and Beach Road near Soldiers Club. • Flooding from waves across the esplanade and up to the shop fronts in Batemans Bay CBD (December 2017) • Myamba Parade, Surfside has experienced very high tides, but the water has never entered the back yard in 30 years. • Flooding of backyards due to inter-allotment drainage along Christopher Crescent properties in Batehaven

4.5 Community Drop-In Information Sessions

4.5.1 Stage 1 Drop-In Sessions

Community drop-in sessions were held during the initial stages of the study to gather information from the community about flooding experiences and concerns. The sessions were held at the Batemans Bay Community Centre on Tuesday 20th November between 10am – 2pm, and 3pm – 6pm.

There were approximately 10 attendees across the two sessions. Information was received regarding:

- Road and property flooding on low-lying areas at the downstream end of Hanging Rock Creek catchment is due to the tidal gates on the outlet not opening or a very high tide not allowing the catchment flows to drain away. The flood waters clear quickly after the tidal gates are opened or the tide recedes. In very large events, water has been seen flowing towards Bavarde Avenue (rather than the creek at Beach Road). In the early 1970s the four houses at the rear of the club carpark had a foot of water over the floor levels. Large flood events have been experienced in 1963, 1973, 1974, 1975, and 1977.
- Flooding of properties has occurred in Timbara Crescent, Surfside. Flooding is caused by overland flow from uphill properties and poor drainage on Timbara Crescent (no kerb and guttering and very flat). Half of the road floods after significant rain. In February 1977 there was a major flood with water coming up to the front door of some houses. Another large event was experience in June 1987 (some uncertainty regarding the date).
- Floodwaters sometimes overtop Wharf Road, Surfside, but usually just backs up until it flushes out or Council clears the culvert / sand away.
- Flooding issues from overland flow and creek flows at Pleasurelea caravan park.

4.5.2 Stage 2 Drop-In Sessions

A community drop-in session was held during the public exhibition of the draft Flood Study. The session was held 12:30pm – 6:30pm June 17th, 2021, at the Hanging Rock Function Centre, Hanging Rock.

The session was attended by Council's project manager, a DPIE representative, Rhelm's project manager and several representatives from SES.

Approximately 40 community members attended the drop in session.

4.6 Public Exhibition

Following the preparation of the draft Flood Study, the report was placed on Public Exhibition for four weeks in June 2021 to allow the community and other stakeholders to review and comment on the report prior to it being finalised and adopted by Council.

During the public exhibition period, the draft report was available for public review online and hard copies were available at Eurobodalla Shire Council Moruya administration centre. There were 419 webpage views.

The project team were available to discuss the draft flood study in person during a drop in session on 17th June 2021 (**Section 4.5.2**).

Letters were sent to 1,732 residents, property owners and businesses located within the Probable Maximum Flood (PMF) extent notifying them that the flood study had identified that their property as having potential flood risk and informing them on the public exhibition and how they could access the draft document and when they could talk to the project team in person (drop in session). A copy of this letter is provided in **Appendix A**.

A media release was issued by Council on 2 June 2021 on its website and newsletter (see **Section 4.3** for more details).

Submissions were invited via email and letter. Twelve (12) unique written responses were received via email during the public exhibition period. All written submissions will at minimum receive a response from Council thanking them for their feedback and contribution to the study.

The comments received during the drop-in sessions and via written submissions are summarised in **Section 4.7.2**, along with the response from the project team.

4.7 Outcomes of Engagement

4.7.1 Stage 1 Engagement

During Stage 1 of the study, engagement was undertaken with the community vie online surveys and drop-in sessions. In addition, community provided input via comments made on Council's Facebook post and directly onto published media.

The key issues raised and the implications for the study are summarised in **Table 4-7**.

Table 4-7 Key Issues Raised and Community Inputs

Comments from the Community	Response and Implications for Flood Study
A resident of Maloneys Drive from 1992 to 2018 has had no experience of flooding on Maloneys Drive. Some flooding has occurred in the creek at the base of Murramarang which may have entered the back of properties along here.	This information will be used to calibrate / validate the flood study model results.
Concern that the flood study results will be unrealistic and will exceed actual flood heights.	The flood models being developed for the flood study are based on a combination of aerial laser and ground survey, along with best available design rainfall datasets and the results are verified against flood observations provided by the community. The flood study will provide a range of flood levels and extents for the study area ranging from more frequent events (e.g. 5 Year ARI) to less frequent events (e.g. 100 Year ARI). Flooding experience by the community may not have been the largest possible event, and may not have even been a particularly rare event. Review of the rainfall data at the time of the flood observation assists in clarifying this.
Concern that insurance premiums will go up as a result of the flood study.	It is Council's understanding that individual insurance companies typically identify Flood Prone Land and assess risk through their own flood studies, analysis and flood mapping exercises, irrespective of whether Council has undertaken a flood study. These calculations are outside Council's control. The information is then used to set policies and premiums.

Comments from the Community	Response and Implications for Flood Study
	The Insurance Council of Australia (ICA) has advised that if you feel that an insurer has incorrectly assessed the risk of flooding at your property, you can contact the insurer to discuss this. Council can provide flood information relevant to your property to assist you with these discussions.
Concern that mitigation strategies will not reduce insurance premiums.	Flood mapping and property flood notation will be reviewed by Council as an outcome of mitigation strategies that reduce flooding for certain locations. Whether insurance companies consider this information is outside of Council's control (see response above).
Unclear on the definition of flooding used by Council and insurance companies.	Flood is defined by the NSW Government in the *Floodplain Development Manual* (2005) as: • Relatively high stream flow which overtops the natural or artificial banks in any part of a stream, river, estuary, lake or dam, and / or local overland flooding associated with major drainage before entering a watercourse, and / or coastal inundation resulting from super-elevated sea levels and / or waves overtopping coastline defences excluding tsunami. Since 2014, all home building, home contents, small business and strata insurance policies have adopted a common definition of "flood": • The covering of normally dry land by water that has escaped or been released from the normal confines of any lake, or any river, creek, or other natural watercourse, whether or not altered or modified; or any reservoir, canal, or dam.
Concern that there is a 'hidden agenda' to the flood study.	Local councils are responsible for managing flood-prone land in NSW with support from the State Government, which provides specialist technical knowledge and significant financial contributions. Council is developing a range of floodplain risk management studies that will help them consider the consequences of living on flood prone land. The plans aim to minimise the losses to our community from flooding. Preparing a flood study is the first step in the floodplain risk management process outlined in the NSW Floodplain Development Manual 2005.

Comments from the Community	Response and Implications for Flood Study
Concerns that the Facebook post did not provide adequate notice for the drop-in sessions.	Owners and residents of properties likely to be impacted by flooding associated with the studies were sent a letter on the 7th November notifying them of the drop-in sessions and providing a hard copy of the feedback survey. A media release was also issued on the 7th November. The Facebook post was issued on 15th November as a follow up to the mail-out and media release. The drop-in sessions were held on the 21st November. During the public exhibition period the Facebook post will be released with two weeks' notice before the drop-in sessions.
Flood observations noted in online and mailout survey (Table 4-6).	This information will be used to calibrate / validate the flood study model results.
Road and property flooding on low-lying areas at the downstream end of Hanging Rock Creek catchment is due to the tidal gates on the outlet not opening or a very high tide not allowing the catchment flows to drain away. The flood waters clear quickly after the tidal gates are opened or the tide recedes. In very large events, water has been seen flowing towards Bavarde Avenue (rather than the creek at Beach Road). In the early 1970s the four houses at the rear of the club carpark had a foot of water over the floor levels. Large flood events have been experienced in 1963, 1973, 1974, 1975, and 1977.	This information will be used to calibrate / validate the flood study model results.
Flooding of properties has occurred in Timbara Crescent, Surfside. Flooding is caused by overland flow from uphill properties and poor drainage on Timbara Crescent (no kerb and guttering and very flat). Half of the road floods after significant rain. In February 1977 there was a major flood with water coming up to the front door of some houses. Another large event was experience in June 1987 (some uncertainty regarding the date).	This information will be used to calibrate / validate the flood study model results.
Floodwaters sometimes overtop Wharf Road, Surfside, but usually just backs up until it flushes out or Council clears the culvert / sand away.	This information will be used to calibrate / validate the flood study model results.
Flooding issues from overland flow and creek flows at Pleasurelea caravan park.	This information will be used to calibrate / validate the flood study model results.

4.7.2 Public Exhibition

During the public exhibition period, engagement was undertaken with the community vie Council's website and drop-in sessions. In addition, community provided input via comments made on Council's Facebook post and directly onto published media.

The key issues raised and the implications for the study are summarised in Table 4-8.

Table 4-8 Key Issues Raised During Public Exhibition

Comments from the Community	Response and Implications for Flood Study
It was requested that Council make the following updates to the public exhibition webpage for the study: • Provide upfront definitions of AEP and PMF as these are shown on the Maps • Upload a copy of the A1 Map from the drop in sessions.	Council added the requested information to the webpage on 24th June 2021.
Concerns that Council would be "rezoning" flood affected land.	No rezoning of land is proposed as an outcome of this study. Flood liable properties (properties within the Flood Planning Area) will have notations related to flooding included on their Section 10.7 Planning Certificates, if not already included.
Queries regarding impacts of the Flood Study on Planning Certificates (10.7 Certificates). Property owners requested notification by letter if there is a change to the notations on their planning certificates.	Properties impacted by coastal inundation already have flood related notation on Section 10.7 Planning Certificates. Properties within the Flood Study Flood Planning Area and above 3 mAHD may not currently have notations. These notation will be added as an outcome of this study. Property owners will be notified by Council by letter if there is a change to the nation on their Section 10.7 Planning Certificates as an outcome of this study.
Several queries were raised about development controls in flood prone areas.	Flood related development controls apply to land below the 1%AEP plus 0.5m Freeboard. These development controls are applied to any new development of property modifications subject to a Development Application submitted to Council. Development within flood prone land is not Complying Development under the *SEPP (Exempt and Complying Development Codes) 2008*, and therefore all applications for development within the Flood Planning Area are not able to be determined through a fast-track assessment by Council or Private Certifier.

Comments from the Community	Response and Implications for Flood Study
	A review of Councils existing flood related development controls is provided in **Section 5** of the Flood Study, and recommendations for revisions to these controls are provided in **Section 5.8**.
A long time Surfside resident (40 years) said that rainfall induced flooding was not an issue for Surfside except when there was a high tide level. Flows from the catchment had been contained to the wetlands and channels in his experience and any sand built up at the entrance scoured out efficiently during large rainfall events once the tide went down.	The flood modelling reflects this flood behaviour. Some flooding outside of the channels is shown in the modelling for more extreme events (i.e. 1% AEP), which may not have been experienced in the catchment in the last 40 years. Flooding in the downstream portion of the catchment is largely driven by ocean conditions rather than rainfall.
A surfside resident was unsure if the culverts at Wharf Road had adequately assessed the impact of the sand built up on their outlets. He wanted to know if the flood mapping had considered any 'downstream constraint' or 'control point' due to the poor hydraulic performance of this culvert during flood events at high tide or during heavy storm events. It was his observation that the culvert has recently been completely blocked by sand and timber debris washed down the Clyde River and during high tides the inverts of the culverts are always inundated so as to restrict the free flow of water from the creek. He would expect that such an effective throttle point would cause a rise in the level of flood water to the point where water flowed over Wharf Road under relatively low storm flow events during high tides. He felt that this hydraulic performance needs to be validated in the model.	The culverts at Surfside have been modelled with elevated ocean levels restricting the outflow of catchment flows, as well as starting the event with the sand fully build up blocking the culvert. The model scours away the sand during the flood event once sufficient pressure has built up or the sand has become sufficiently saturated. This process is supported by observations by Council and DPIE staff. However, to address the concerns raised by this resident, a sensitivity assessment of the impact of fully blocked culverts has been undertaken (see **Section 7.2** for further details).
How were the catchments selected for inclusion in the study and why were Cullendulla Creek and Mcleods Creek catchments not included?	The study areas were defined to include the creeks within the Batemans Bay area that may pose a flood risk to urban areas during large rainfall events. The focus of the study was to define flood risk from intense rainfall, not inundation from East Coast Lows, tidal events or waves; this type of flood risk is considered in the Coastal Management Program. Cullendulla Creek does not pose a flood risk to urban areas. Urban areas impacted by flooding in the Mcleods Creek catchment are primarily impacted by ocean induced flooding (e.g. East Coast Lows). Flood controls and notations from coastal flooding exceed those of catchment

Comments from the Community	Response and Implications for Flood Study
	flooding and hence not catchment flood analysis was considered necessary.
Several residents from Maloneys Beach confirmed that in their experience flooding has always been contained to the waterway and properties immediately adjacent to it (near the entrance).	This information validates the flood mapping included in the Flood Study.
Concerns about access to Maloneys Beach during and following a flood if the culverts and road are overtopped or damaged. Boat access was suggested as an emergency alternative.	The Floodplain Risk Management Study will look at options for emergency access and evacuation across all study areas. For Maloneys Beach, options may include reinstating the boat ramp at the northern end of the beach and upgrading the culverts and road level at Northcove Road to provide flood free access.
Residents from Long Beach noted that they had been told that the properties along the outlet of the Lake had experienced flooding in the past.	Residents were shown the relevant maps and discussed flood impacts for the Long Beach area with project staff.
Concerns about clearing of vegetation and development in the Long Beach catchment contributing sediment to the lake (reducing depth and storage of the lake) and increase in run off.	Request that council's asset management team consider this feedback and consider adding the drain to a routine schedule.
Stormwater pipes draining the Avalon Street area were noted to have one way 'flap' on the outlets. However, it was noted that these often remain open, or become buried with sand and can't open.	Request that council's asset management team consider this feedback and consider adding the drain to a routine schedule.
Drainage channel located between 7 and 9 Avalon Street needs to be maintained and perhaps upgraded. Overtopping of this channel has flooded surrounding properties in the past.	Request that council's asset management team consider this feedback and consider adding the drain to a routine schedule.
The Golf Course has experienced prolonged impacts after heavy rainfall. Recent large rainfall events have resulted in the course being closed for several days following the event. This has not historically been an issue. It is the opinion of Club Catalina staff that this is a result of: • Increased sediment load being deposited within the creeks following the bushfires • Increased weed growth within the creek • Dense mangrove growth at the downstream end of the Golf Course • Increased groundwater level due to rainfall over the last 18 months.	Comment forwarded to Council's environmental health team to progress.

Comments from the Community	Response and Implications for Flood Study
They would like to work with Council to reduce sediment and weed build up in the creeks.	
One resident requested that Council put a measurement stick on the bridge at Surfside culvert with a flood warning.	Flood depth markers will be considered by Council at key locations as part of the FRMS.
A resident in the Joes Creek Catchment had experienced blocked drains at the corner of Edward Road and Claire Crescent, Batehaven. He had reached out to council in the past and had a fast and positive resolution, with council clearing the drain. He noted that such blockages don't occur often but would like to see these drain added to councils routine site inspections for drain performance.	Request that council's asset management team consider this feedback and consider adding the drain to a routine schedule.
A community member indicated that an announcement earlier in the year during a storm event constituted a 1 in 100 Year storm and sought clarity on how advice regarding the categorisation of storm events.	Project staff explained that storm events are defined on a catchment scale and informed by rainfall gauges, and rarely can a single category of storm event apply over many catchments due to widely varying rainfall, catchment storage and topographical conditions.

Twelve (12) unique written responses were received via email during the public exhibition period. The full content of all submissions is attached. A summary of the key issues and the outcomes for the Flood Study are provided in **Table 4-9**.

Table 4-9 Community Issues Raised in Written Submission

Comments from the Community	Response and Implications for Flood Study
There was a desire (in one submission) to include Reedy Ck within the study area	The study areas were defined to include the creeks within the Batemans Bay area that may pose a flood risk to urban areas during large rainfall events. Reedy Ck lies considerably outside the study area, but this feedback will be considered when planning for further studies.
There was a distrust of computer modelling expressed in one submission	The hydrological and hydraulic models were developed using best available topographic data, ground survey and design rainfall inputs. The models were verified, where possible against community observations and historical flooding data.
There were concerns raised about Water Quality in Long Beach Lagoon and the drainage	Request that council's asset management team consider this feedback and consider adding the drain to a routine schedule.
One submission praised the study	Noted and appreciated.
Mapping inquiry: One resident expressed concern over the possibility of a mapping error over her property.	A review of the mapping indicated no error
There was interest in what flood mitigation measures will be adopted. Particularly at Joes Creek and Catalina.	Flood mitigation options will be evaluated at the next stage of the process; the Floodplain Risk Management Study.
A group of Maloneys Beach residents expressed concern over the flooding over the only access to the suburb (Northcote Drive) and a desire to see this road raised as a solution to the potential for the road to be cut off under a 1% AEP event.	This feedback will be noted and will assist council in preparation of a flood risk management study and plan which is undertaken as a separate body of work.
Several long term residents of Maloneys Beach noted that they had never experienced flooding in Maloneys Beach.	This would support the flood modelling that identified that up to and including the 1% AEP would impact properties other than those directly backing on to the creek. The PMF is shown to impact mor extensively, however, no significantly large rainfall events have been recorded.
Property owners expressed concerns about the impact of the flood study, in particular the PMF on insurance premiums.	It is Council's understanding that individual insurance companies typically identify Flood Prone Land and assess risk through their own flood studies, analysis and flood mapping exercises, irrespective of whether Council has undertaken a flood study. These calculations are outside Council's control. The information is then used to set policies and premiums. The Insurance Council of Australia (ICA) has advised that if you feel that an insurer has incorrectly assessed the risk of flooding at your property, you can contact the insurer to discuss this. Council can provide flood

Comments from the Community	Response and Implications for Flood Study
	information relevant to your property to assist you with these discussions.