EUROBODALLA SHIRE
COASTAL MANAGEMENT PROGRAM

Coastal hazards and risks

October 2017
Five stages in preparing a CMP:

- **Stage 1 Scoping Study**: Complete
- **Stage 2 Detailed technical assessments**: Complete Coastal hazard studies
- **Stage 3 Identify and evaluate options**: In progress – consult to inform options and evaluation
- **Stage 4 Prepare CMP, through to certification**: In progress
- **Stage 5 Implementation, monitoring and review**: In progress

Eurobodalla CMP – a new approach
Stage 1 Scoping Study showed that many Eurobodalla beaches and communities have a low risk from coastal hazards – a natural and resilient coast.

- The scoping study used results from site inspections at every beach (including dunes, stormwater outlets, access ways and sea walls), information from OEH and preliminary hazard assessments over the last 10 years.

17 beaches identified for further hazard studies:

- Beach erosion, coastal recession – develop hazard maps for multiple scenarios (10 beaches)
- Tidal inundation and coastal inundation hazards (17 beaches), including sea level rise
Stage 2 of preparing the CMP – detailed technical studies to improve management decisions

As a result of these studies, council has access to detailed information about areas affected by coastal hazards and risks over different time frames and scenarios – essential for good decision making

Coastal hazards in Eurobodalla:

• what are they?
• how have they been assessed?
• which areas are affected, and over what time frames?
• how many properties and which council assets are affected?

How is risk related to coastal hazards?

How can council and local communities manage risk?
Coastal processes

- Elevated water levels
- Waves and currents
- Vary with tide, storms, structures

Coastal hazards

- Beach erosion
- Shoreline recession
- Coastal inundation
- Tidal inundation
- Cliff and bluff instability
- Unstable entrances
- Erosion and inundation of estuary foreshores, from tides, waves and floodwaters

Focus for these hazard studies
<table>
<thead>
<tr>
<th>Information used in the coastal hazard studies</th>
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<tbody>
<tr>
<td><strong>Site inspections</strong></td>
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<tr>
<td>• By expert coastal engineers and geomorphologists, over 5 years, + local knowledge of long term change</td>
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<tr>
<td>• All beaches have been inspected</td>
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<tr>
<td><strong>Tide and wave monitoring</strong></td>
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<tr>
<td>• Tide gauge at Clyde River Princess Jetty since 1985</td>
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<td>• Wave Rider buoy off Batemans Bay since 1986, part of state network</td>
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<td><strong>Long term beach monitoring</strong></td>
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<tr>
<td>• Eurobodalla has the longest monitored beach profiles in NSW at Bengello (since 1972)</td>
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<tr>
<td>• Monitoring also at South Moruya</td>
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<tr>
<td>• Provides calibration of models</td>
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<tr>
<td><strong>Photogrammetry</strong></td>
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<tr>
<td>• Stereo aerial photographs used to analyse beach profile change. Photos from 1942 to 2014</td>
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<tr>
<td><strong>Bathymetry</strong></td>
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<td>• Most of study area surveyed in 2014/2015</td>
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<tr>
<td><strong>Numerical modelling</strong></td>
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<tr>
<td>• Wave transformation from deep water onto the beach</td>
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<tr>
<td>• Calculation of erosion by single or successive storms, as storm bite. Recession from long term trends in aerial photos and other records</td>
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Sand Sample Analysis

Sample 1
First buoy 1971 off Botany Bay
100 year average recurrence interval wave height: 7.7 m
Long-term coastal monitoring programs worldwide

Criteria:
> 25 consecutive years
<= annual survey frequency
4 beach profiles just north of the airport

Measured monthly since 1972

Very rare dataset

Used to calibrate numerical erosion modelling
Bengello Beach (South Broulee-Moruya)

May-June 1974 is the most erosive event in the dataset.

Considered to be ~100 year average recurrence interval.

Up to 170 m$^3$/m above mean sea level was eroded.

Bengello Beach, 25 May 1974
Photogrammetry

Stereo aerial photographs used to analyse beach profiles

May-June 1974 storm sequence only captured at 3 beaches (1972-1975)

<table>
<thead>
<tr>
<th>Coastline Sub-Section</th>
<th>Year</th>
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Batemans Bay, 1942
Photogrammetry

Barlings Beach

Legend
- Photogrammetry Profiles

- N
- 200 metres

Graph:
- Elevation (m AHD)
- Chainage (m)
- Landward Limit (m)
- Z_eff (m AHD)

Water Research Laboratory
Figure C-28: Example Underlying Shoreline Movement Analysis from Photogrammetry Data - Movement of Representative Contour, Surfside Beach (east), Block B, Profile 3

Underlying Shoreline Movement
Representative Contour ($Z_{ref}$) = 1.5 m AHD
Linear Trend = -0.14 m/year
Shoreline Recession

- Progressive onshore shift of the long term average land-sea boundary
- Due to sediment loss and/or sea level rise
- Cullendulla Beach
Shoreline Recession

1930 - 2020

Average Beach Volume Change Relative to 1942 (m$^3$/m)

Cullendulla Beach

1942 to 2011

Recession Rate 0.8 m/year
Beach Erosion

- Erosion of sand by single or successive storms
- Expressed as storm demand
- Depends on: wave conditions, water levels, state of beach prior to storm etc…

Long Beach
6 June 2012

Source: Mr Lindsay Usher, 2012
Key inputs - water level and wave records for coastal erosion

Water level and sea level rise
- Global mean sea level increasing 1.7mm/year from 1901 to 2010 (IPCC)
- Fort Denison (Sydney), 0.7mm/year on average since 1914
- Princess Wharf Batemans Bay, 4.2mm/year 1996-2013
- Projected sea level rise from south coast regional sea level rise policy and planning framework, 2014

Wave heights
- 100 year ARI wave height is 7.7m, highest waves from South East-South
- Offshore wave height and direction modified as wave moves shoreward – friction, refraction, e.g. June 2012 6m wave offshore, Long Beach 2.0m, Surfside 1.3m

Storm demand
- May-June 1974 is the most erosive event in the Bengello dataset, approximately a 100 year average recurrence interval
- Up to 170m3/m of sand above MSL was eroded
SWAN Numerical Wave Modelling

Waves transformed from offshore to shallow water
Broulee Island

Sand tombolo to the island has been severed every ~ 15-25 years since 1828

The island has now been connected for at least 28 years (since 1989)

Now in its most heavily vegetated state (from available aerial photographs), but is likely to be severed again in the future

Attached and detached hazard lines
Global mean sea level increasing **1.7 mm/year** from 1901 – 2010 (IPCC)

Fort Denison Sydney – **~0.7 mm/year** on average since 1914

Fort Denison - [https://tidesandcurrents.noaa.gov/sltrends/sltrends_global_station.htm?stnid=680-140](https://tidesandcurrents.noaa.gov/sltrends/sltrends_global_station.htm?stnid=680-140)
Projected Sea Level Rise

- Max: RCP8.5 (high)
- Mode: RPC6.0 (high)
- Min: RCP2.6 (low)

Year:
- 2020
- 2040
- 2060
- 2080
- 2100

Sea level relative to 2017 levels (m)
Coastal inundation

Factors
• Due to elevated water levels coupled with extreme waves; also local and regional wind effects on water levels
• 1, 20 and 100 year average recurrence interval events
• Calculated for present day (2017), 2050, 2065 and 2100
• Most vulnerable areas have low or no frontal dune or a low seawall, exposed to waves

Four cases explored
• Wave run-up does not overtop the frontal dune
• Limited overtopping, moderate energy, may mix with local freshwater or tidal inundation behind the dune
• Wave overtopping flows into development behind the dune, may mix with other sources of flooding
• Water level exceeds dune height – even without waves – high energy flooding
Due to elevated water levels coupled with extreme waves

1, 20 and 100 year average recurrence interval events

Calculated for present day (2017), 2050, 2065 and 2100
Methodology verified with WRL debris line measurements at Malua Bay from August 1986 storm

Maximum runup: 5.5 m AHD
Wave Runup (and Overtopping) of Seawalls

Methodology calibrated with WRL debris line measurements at Caseys Beach from June 2016 storm
382 Beach Road, Caseys Beach
Historical Coastal Inundation Photos

Soldiers Club, Beach Road
CBD
29-30 August 1963
(Mr R. Prior)

Mariners on the Waterfront
CBD
1 July 1984
(Mr T. Williams)
Historical Coastal Inundation Photos

6 June 2012, Bay Road, Long Beach (Mr Lindsay Usher)
Historical Coastal Inundation Photos

6 June 2012, Surfside Beach (West) (Mr Lindsay Usher)
Historical Coastal Inundation Photos

6 June 2012, CBD Foreshore (Mr Mark Swadling)
Erosion/Recession

- Building setbacks
- Construction techniques (piled buildings)
- Physical works
  - Dune management
  - Sand nourishment
  - Groynes
  - Offshore reefs/breakwaters
  - Seawalls
  - Retreat
Inundation

- Consider access and evacuation plans
- Services (drainage, sewerage, power, comms)
- Minimum floor levels
- Co-ordinated land raising
- Physical works (Dykes/levees)
- Development freeze
- Retreat
Evaluating management options

Feasibility
- Is the option technically feasible?
- Is there evidence that this action can achieve the outcome that council and its community want?
- Is it compliant with legislation and policy?
- Are impacts manageable?

Viability
- Business case for management
- Economic evaluation of costs and benefits
- Distribution analysis – who benefits and should contribute to funding (including capital and maintenance)?
- Does council have reasonable funding and financing options?
- Is it affordable in the context of other priorities?

Acceptability
- Have public authorities confirmed support for works on their land or that will be their responsibility?
- Does the option meet community needs and vision for the future?
- Are there opportunities for community involvement?
The **coastal vulnerability area** is the mapped area where planning controls will be used to manage coastal risks caused by coastal hazards.

Coastal risks linked to hazards occur when hazards impact on:

- public and private assets
- community infrastructure and essential services
- public safety
- the coastal environment
- public access, use and enjoyment of the coast
- coast dependent businesses
- council’s budget
- council’s reputation

In mapping the CVA to apply for planning purposes, council must decide which:

- hazards
- timeframes
- climate change and sea level rise scenarios, and
- social and economic scenarios are appropriate for planning decisions to reduce risks in areas affected by coastal hazards.
## Potential actions to get started

<table>
<thead>
<tr>
<th>Key strategy</th>
<th>Partners</th>
<th>Examples</th>
</tr>
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<tbody>
<tr>
<td>Replace Interim Adaptation Code</td>
<td>Council, DP&amp;E, OEH, community consultation</td>
<td>Will affect zoning and development controls for new development at Long Beach East, Surfside, Batemans Bay CBD, Tomakin (CMA2)</td>
</tr>
<tr>
<td>Prepare for big and high cost decisions: Adaptation plans focus on providing opportunities and a level of service for residents in vulnerable areas to enjoy their lifestyle for as long as possible without compromising services and lifestyle of other residents outside vulnerability areas</td>
<td>Council with affected communities; consult with DP&amp;E, OEH, DI-Lands</td>
<td>Prepare coastal adaptation plans for: Long Beach Surfside Batemans Bay CBD Caseys Beach Tomakin Corrigans Beach Malua Bay Broulee What are the best short and long term uses of land affected by hazards?</td>
</tr>
<tr>
<td>Be ready for emergencies</td>
<td>Council, with vulnerable communities and key public authorities – SES, OEH</td>
<td>Coastal zone emergency action plans for each local area</td>
</tr>
</tbody>
</table>
Develop management options for local areas

• Based on risks and local objectives, outcomes

Evaluate management options

• Effectiveness
• Cost and benefit, funding options
• Acceptable to the community

Prepare the draft CMP

• Priorities, roles, responsibilities
• Implementation plans
• Planning proposal

Exhibit draft CMP

• Community feedback
• Public authorities
• Coastal Council

Certification processes

• Council
• OEH
• Coastal Council
• Minister