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Wollongong Coastal Zone Management Plan: Implementation Action Plan

Final Report September 2017

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The Coomaditchie United Aboriginal Corporation is an Aboriginal organisation dedicated to raising the esteem, pride and dignity of young Aboriginal people in their Aboriginal culture and heritage. The Coomaditchie Artists' Cooperative is a vital organisation.

In addition to the Artists' Cooperative, as custodians of the Coomaditchie Lagoon and surrounding area, the Corporation provides employment and training for local community members. The Corporation is also committed to the regeneration and care of the land around the Coomaditchie Lagoon. Each time a product is purchased from the Coomaditchie United Aboriginal Corporation, a significant contribution towards these objectives is made.

Front Cover Design 'Let's Stop Coastal Destruction' by Lorraine Brown and Narelle Thomas, Coomaditchie United Aboriginal Corporation.

The artwork shows waves at the bottom, then the middens, the people, the rivers, the helping hand, gathering places and meeting circles and plant life.

Lorraine Brown is the premier artist of the Coomaditchie United Aboriginal Corporation. Lorraine is a Jerrinjah woman born in Bega, one of 7 children. Lorraine views her ability to paint as a gift. She uses bold colours that reflect her coastal upbringing. "We're East Coast Saltwater People", Lorraine says. "My colours symbolise my life. I had a great childhood, great parents and family and extended family".

Narelle Thomas is one of Lorraine's sisters and they paint together. Lorraine does the fine work and Narelle fills in the details. Lorraine and Narelle work like professional dancers, one leads and the other follows and no-one steps on any toes. It is clear they have been working together for many, many years.

Wollongong Coastal Zone Management Plan: Implementation Action Plan

Prepared For:	Wollongong City Council
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Title :	Wollongong Coastal Zone Management Plan: Implementation Plan
Author :	Dr Philip Haines
Synopsis :	This is the action plan for implementing strategies to address coastal risks along the Wollongong Coastline. It is supported by the Coastal Zone Management Study, which identifies the main coastal risks, and then details and assesses options for addressing these risks. Document updated by WCC in September 2017.

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1 INTRODUCTION & BACKGROUND

1.1 Purpose

The Wollongong Coastal Zone Management Plan (CZMP) has been prepared to direct management of risks from coastal hazards along the Wollongong LGA coastline (see study area map in Section 18). The CZMP covers lands currently affected and potentially affected by coastal hazards up to the year 2100. The Wollongong CZMP comprises this Implementation Action Plan and the companion Management Study [CZM Study].

Coastal hazards have been quantified through the Wollongong City Council Coastal Zone Study (Cardno, 2010), while risks associated with these hazards have been identified and evaluated as part of the Wollongong Coastal Zone Management Plan: Management Study (BMT WBM, 2016). This document (the CZMP: Implementation Action Plan) presents the strategies and actions required to manage and mitigate the risks to existing and future development and community assets and values in Wollongong associated with coastal hazards, both now and in the future.

The Wollongong CZMP has been prepared in accordance with the *NSW Coastal Protection Act 1979*, the NSW Coastal Policy and the *Guidelines for Preparing Coastal Zone Management Plans* (OEH, 2013), as well as other legislation applicable to managing the coastal zone (refer Chapter 2 of the CZM Study for details).

An Australian Standards Risk Management Framework (ISO 31000: 2009 *Risk Management Principles and Guidelines*) has been applied in identifying, evaluating and treating risks associated with coastal hazards (refer Figure 1). The risk assessment has considered impacts of coastal hazards on public and private properties, infrastructure and uses of coastal land. Risks were classed as 'low', 'medium', 'high' and 'extreme' for the immediate, 2050 and 2100 timeframes. Differences between risks today and those in the future relate primarily to the predicted response of the Wollongong coastline to future climate change, and sea level rise in particular. Generally, 'high' and 'extreme' risks were considered to be intolerable, 'medium' risks were seen to be tolerable, and 'low' risks were seen to be acceptable. Management of 'high' and 'extreme' risks present at the current timeframe is considered to be the highest priority.

The objectives of the CZMP therefore are to reduce or mitigate the risks associated with coastal hazards, focusing on the 'extreme' and 'high' risks at the current timeframe as a priority. This CZMP Implementation Action Plan also guides management of future intolerable risks (i.e., 'high' and 'extreme' risks at 2050 and 2100), in the instance where such risk manifest earlier than projected.

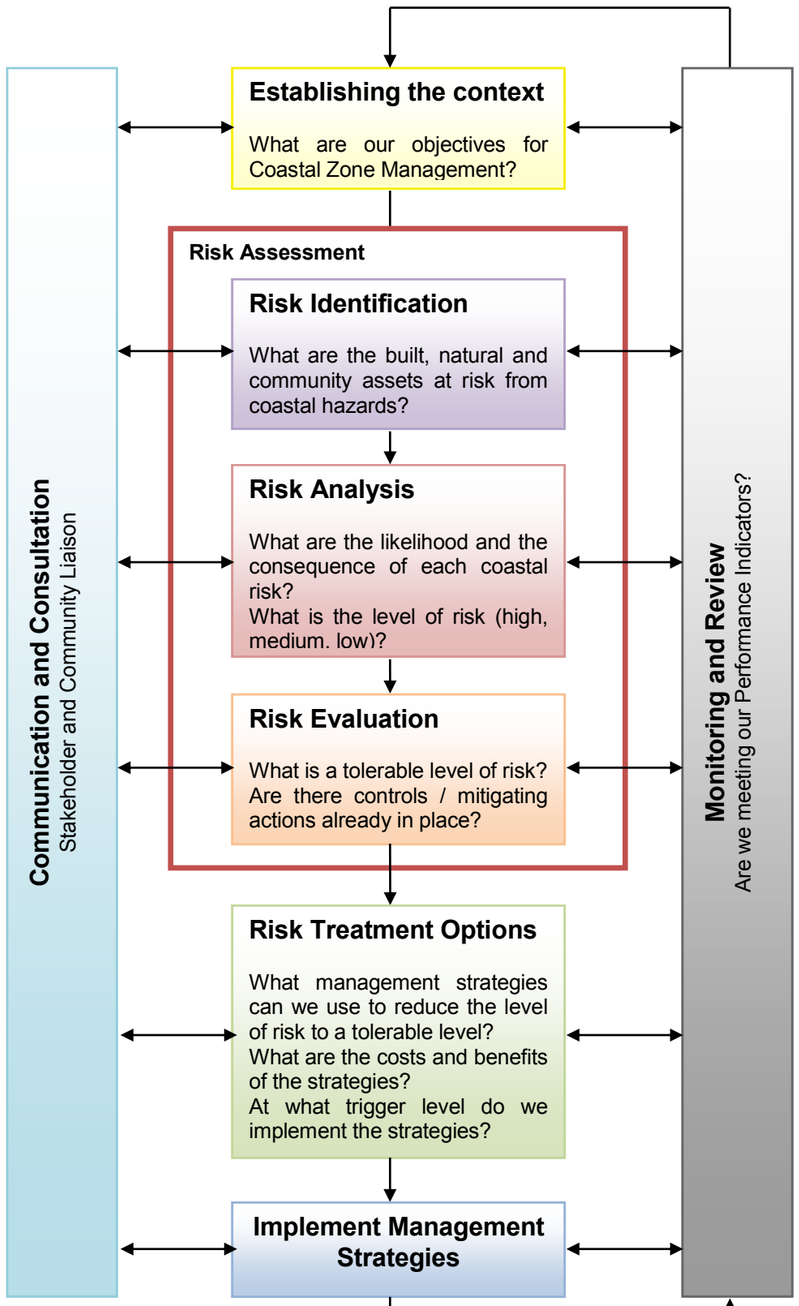


Figure 1 Risk Management Framework used to identify, assess and manage risks to the Wollongong Coastline, adapted from ISO 31000: 2009

1.2 Coastal Hazards

Natural coastal processes create hazards when they interact and conflict with current uses and assets located within the coastal zone. A summary of coastal processes and coastal values at Wollongong is given in Sections 1.3 and 1.4. The main coastal hazards affecting Wollongong's coast are:

- **Beach erosion** (during a short term storm event or series of events in close succession) and resulting dune slope instability. Erosion of beaches is typically balanced by accretion during non-storm periods, as the sand eroded is temporarily stored as nearshore storm bars, which are moved onshore under normal wave conditions;
- **Shoreline recession**, where there is a net long term migration of the shoreline in a landward direction. Shoreline recession typically occurs in response to man-made coastal structures, an increase in mean sea level or permanent changes to typical wave climate (wave height and/or direction);
- **Coastal inundation** (during high tides combined with storms and sea level rise) can occur as both wave overtopping of beaches and dunes or inundation of land behind the open coastline via coastal creeks, estuaries or stormwater systems connecting to the ocean (note that the level of coastal inundation within Lake Illawarra is much lower than the 1 in 100yr flood level from catchment rainfall);
- **Cliff instability and geotechnical hazards**, which may be exacerbated by higher sea levels and therefore greater wave attack at the base of coastal cliffs. A Coastal-Influenced Geotechnical Hazard Zone has been defined (GHD, 2010) representing the areas along the Wollongong Coastline where coastal processes (including climate change) will directly affect geotechnical hazards;
- **Coastal entrance instability** (notably at creeks and lagoons that have a variable entrance condition, such as Bellambi and Fairy Lagoons);
- Erosion of beaches at **stormwater outlets / drainage lines** (although this is very localised to the proximity of the stormwater outlet and would not have an influence on overall beach conditions);
- **Sand drift**, which apart from Windang and Port Kembla, has practically been eliminated due to extensive dune rehabilitation works along Wollongong's beaches.

All of the above hazards were assessed by Cardno (2010) for the current year (2010), 2050 and 2100 timeframes taking into account climate change, specifically sea level rise, with hazard mapping provided for the beach erosion and shoreline recession, coastal inundation and geotechnical hazards for the current, 2050 and 2100 timeframes.

1.3 Summary of Coastal Processes and Interactions at Wollongong

1.3.1 Geomorphology

The beaches of Wollongong's coastline range from long, south-easterly facing sandy beaches (such as Perkins and City Beaches), to highly embayed pocket beaches (such as Austinmer and Stanwell Park) towards the northern end of the LGA coastline. The coastal ranges comprising the Illawarra Escarpment are located along the shoreline at the northern end of the LGA, and the higher backing cliffs and shoreline rock platforms tend to form short embayed (or closed) beach units. As the Escarpment trends away from the shoreline, the beach embayments become longer, with outcropping of rocks forming smaller headlands and rock platforms, such as Sandon Point and Bellambi Head. Further south, the beach units tend to become longer and continuous, with Wollongong Harbour / Flagstaff Hill and Port Kembla forming larger headland features to separate the longer embayments. The shoreline generally is oriented towards the south east, with City Beach, Bellambi Beach, Woonona and Bulli facing slightly more east, and Perkins beach facing slightly more south compared to the other embayments.

Sandon Point Rock platform with distant headlands

1.3.2 Wave Climate

The Wollongong coastal zone is exposed to waves from the north east to south east sectors. Waves dominantly arrive from the south to south east sector throughout the year at Wollongong, with easterly and north easterly waves occurring in the wave record over the summer to autumn months. Typical for most NSW locations, the largest waves typically arrive from the south-east to south sector.

Over all months, south easterly swell waves and storm waves can arrive at Wollongong generated by storms in the Southern Ocean and Tasman Sea travelling northwards to NSW. During winter, south east is the dominant wave direction. The storm systems in the Tasman Sea and Southern Ocean form closer to the NSW coast during winter, generating storm waves at the coastline. During the summer months, strong afternoon sea breezes from the north east can generate short period wind swell from the north east to east, although south east sector waves remain the dominant wave direction. During late summer to autumn, tropical cyclones off the Queensland coast can send storm waves propagating southwards into the Wollongong area, however this is rare as such waves are usually dissipated before reaching the Wollongong coastal zone. During autumn, east coast low cyclones may form off the NSW coast, and can generate large storm waves arriving from the east to south east at Wollongong, in addition to the southerly storm systems which continue through autumn. East coast low cyclones are said to be the most damaging storm system for the NSW coast forming close to the shoreline (Short, 2007). The low pressure of east coast low storm systems also generate high water levels (due to barometric pressure set up), and as the high water levels coincide with high waves, this enhances the erosion potential of these storms.

While the dominant storm wave direction at Wollongong is south east, the nearshore wave modelling has indicated that east-south-east (ESE) is the critical offshore wave direction for Wollongong, as this direction produces the largest nearshore wave heights for a specified offshore wave height (Cardno, 2010). That is, for the same offshore wave height from all directions, wave heights are largest at the shoreline from the ESE direction. East coast low cyclones are typically associated with ESE wave directions, as these storm cells form at easterly locations off the NSW coast.

The greatest erosion extents on record in the NSW coast are associated with the series of storms during 1974, particularly the storms of May to June of that year. These storms generated extensive erosion on many beaches in NSW, including Wollongong. The May-June storms were also associated with unusually high water levels, which significantly enhanced the erosion. The storms of 1974 occurred during the highly stormy decade of the 1970s, during which there were a series of erosive coastal storms. After the 1970s until recently (~2007), the wave record has been relatively calmer, although isolated large storms have still occurred. Since 2007, there have been a number of notable storms occurring along the NSW coast, including at Newcastle and south east Queensland in 2007 and sequential storms in 2009 that have caused extensive recession on the mid north NSW coast.

Wollongong's beaches are highly embayed by headlands, rock platforms and rocky reefs. The larger headland features and reefs, such as Flagstaff Hill, Port Kembla and the Five Islands immediately offshore and Bellambi Point, will refract incoming waves from the south to south east direction, and shorelines in the lee of these larger headlands and reefs are more protected from incoming waves. However, the majority of beach length in Wollongong is highly exposed to wave impacts.

Inside Lake Illawarra, the wave climate is comprised of locally generated wind waves, as there is no penetration of offshore swell energy into the lake. Given the limited fetch within the Lake to generate waves, the wind waves are typically short period, steep and small.

1.3.3 Sediment Transport

Sediment transport on beaches is typically generated by waves that induce currents in the surf zone. Sediment may be transported onshore, offshore and / or alongshore, causing the beach to undergo erosion and accretion cycles over periods of time ranging from days to decades (NSW Government, 1990).

Longshore sediment transport refers to the movement of sand parallel to the shoreline, and this is typically driven by waves arriving at an angle to the shoreline. Cross shore sediment transport refers to sand moving both onshore or offshore perpendicular to the shoreline. Cross-shore transport is driven by breaking waves and currents, including rip currents, which form perpendicular to the shoreline. Under low swell wave conditions, transport is directed onshore to assist accretion of sand onto the beach face (and associated movement of sand bars in the surfzone in a landward direction). Under storm wave conditions, the breaking waves generate offshore transport, and the higher waves breaking at the shoreline will erode the beach face. Rip currents form under low and high waves, however the strength and width of the current is greater during high waves, and these currents allow for significant transport of sediment offshore from the beach during a storm.

Embayed beaches, as are typical of Wollongong's coastline, are assumed to experience longshore and cross shore sediment transport that is retained within the embayment. The dominant south easterly swell arriving at the longer, south easterly sandy embayments in Wollongong (such as Perkins, City and Fairy Meadow Beaches) will generate longshore sediment transport towards the north. This will allow for movement of beach sand from south to north, which is retained within the closed embayments. At the more easterly facing beaches, south easterly swell is likely to generate a smaller rate of northerly transport within the embayment. Under north easterly waves (such as may occur in summer), the sediment transport may be directed towards the south. However, the net transport will be towards the north under dominant south easterly waves. The processes of sediment shifting from south to north to south again is often termed 'beach rotation'.

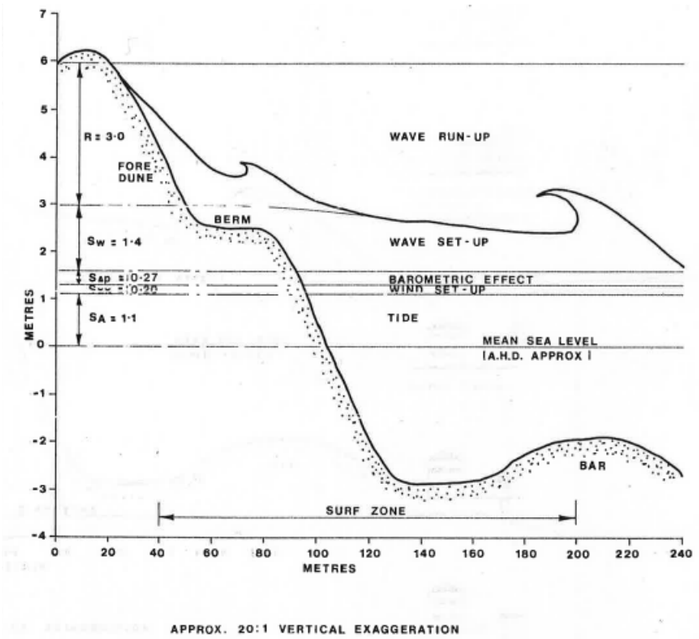
Within embayed beaches, the offshore sediment transport generated under storm wave conditions is retained within the embayment, and will be

returned to beach face under regular swell waves. While the storm erosion may occur quickly (hours, days) the recovery period occurs more slowly (months to years). Cumulative storms may have a severe impact upon beaches, as there is insufficient time to allow the beach to recover before the next storm arrives.

Rip currents are generated in most wave conditions as a mechanism for water arriving at shore under breaking waves to flow back offshore. During storm conditions, rip currents tend to be more widely spaced, however the current itself is much wider and stronger. The landward end of these currents typically generates an eroded scarp and under storm conditions, the erosion formed at the landward end of rip currents can be significant, in fact greater than the erosion generated elsewhere along the beach under breaking waves.

1.3.4 Water Levels

Another important component of erosion during storms is water level. The low pressure of storm systems causes the water level to increase (called barometric set up), onshore winds during a storm can cause water to pile up on the shoreline and further increase the water level (wind set up), and the high waves also increase the water level through the release of energy during wave breaking (wave set up). When storm water levels are additionally combined with a high tide, the high water levels enable the breaking waves to reach higher on the beach face and cause erosion at the sand dunes behind the beach.



The high water levels during storms (combined with high tide) can also penetrate into coastal creek and lagoon entrances and stormwater systems, and this can cause inundation of low lying land behind the beach.

The tidal range at Wollongong is ~ 1.8 m, with the highest astronomical tide (HAT) up to 1.13 m above AHD (Cardno, 2010). Extreme water levels (that is barometric set up with some wind set up, but excluding wave set up and wave run up) from Fort Denison were adopted for Wollongong. The 100 year Average Recurrence Interval (ARI) Still Water Level at Fort Denison that was adopted at Wollongong is 1.44 m AHD (which includes high tide). The use of Fort Denison statistics has been recommended by OEH (DECCW, 2009c), as there is little difference in tidal range for open coastal regions of the NSW Coast and the Fort Denison data set provides a far longer record from which to derive reliable extreme value analysis. The contribution of wave set up to water levels is typically 10 – 20% of the breaking wave height. Cardno (2010) used nearshore wave modelling to determine the wave set up component of still water levels at each beach profile location in the study area.

In addition to changes in water levels during storms, there may also be variability in the sea level relating to climatic processes such as the El Nino Southern Oscillation (ENSO), which can vary sea levels by ~ 0.1 m, and coastal trapped waves that can vary sea levels by up to 0.2 m (Cardno, 2010).

Wave run up is important in causing overtopping of dunes behind the beach during a storm. Wave run up is defined as the maximum vertical height that a breaking wave reaches on the shoreline. Modelling to investigate wave run up was conducted at Wollongong. Wave run-up includes water levels discussed above (i.e. high tide, barometric, wind and wave set up) plus the vertical height of wave uprush after breaking.

1.3.5 Coastal Entrances

Wollongong's coastline is also shaped by a number of coastal creek entrances, some of which also convey stormwater, and occasional stormwater outlets. Lake Illawarra is, conversely, a very large coastal lake system, that forms the southern end of the LGA. Lake Illawarra remains typically open due to the recent emplacement of training walls at the lake mouth at Windang.

The remaining creeks in the Wollongong LGA are far smaller, and typically classified as Intermittently Closed and Open Lakes or Lagoons (ICOLLs). These small water bodies from south to north include:

- Tom Thumb Lagoon (within Port Kembla):
- Fairy Lagoon, which divides North Beach and Fairy Meadow Beach;
- Towradgi Lagoon, which exits at the southern end of Corrimal Beach,
- Bellambi Lagoon, located south of Bellambi Head and exiting to the ocean on the northern end of Corrimal Beach , and is opened either naturally, or artificially by Council to alleviate flooding of low-lying adjacent property;
- Bellambi Gully, located at the southern end of Bellambi Beach, which has a small training wall at the northern side of its entrance, and rock protection along its southern side;
- An unnamed creek which exits to the ocean at the boundary between Woonona and Bellambi Beaches,
- Collins and Whartons Creeks which exit at the south and towards the north on Bulli Beach respectively
- Slacky Creek on Sandon Point Beach
- Hewitts Creek and Tramway Creek on the northern and southern ends of McCauleys Beach respectively
- Flanagans Creek and Thomas Gibson Creek which exit to the north and south respectively on Thirroul Beach
- A small creek / drainage outlet on Little Austinmer Beach
- Carricks, Stockyard and Dalys Creek which are now essentially stormwater drainage outlets at the south, north and centre of Coledale Beach respectively;
- A small creek / drainage outlet on Scarborough Beach;
- Stoney Creek on Coalcliff Beach;
- Stanwell Creek and Hargraves Creek on Stanwell Beach.


Entrance to Bellambi Gully

Waves, which generate longshore and cross shore transport, combined with tides, form a sandy berm across the creek entrances. Coastal processes act to build an entrance berm across the creeks however, where

there is sufficient flow out of the creeks through the entrance, the entrance will remain typically open. Where flows from the creeks are not sufficient to counter-balance coastal processes, the entrances will typically remain closed. The majority of coastal creek entrances in Wollongong are typically closed, as waves dominate the coastal entrance behaviour.

Catchment rainfall of sufficient volume will cause a breakout through the entrance berm, enabling flow out of the creek into the ocean. Many of the coastal creeks on Wollongong's coast respond quickly to rainfall and may open frequently. Fairy and Towradgi Lagoons respond quickly to rainfall, with water levels rising rapidly and which generates natural lagoon breakouts. Likewise, Bellambi lagoon opens frequently with sufficient rainfall (DECC, 2008). However, the small sized catchments and waterways have limited flow, and so waves and tides act quickly to re-close the entrance.

Where property has been sited too close to the lagoon edge, Council may be required to artificially open the lagoon entrance to alleviated inundation of such properties. To protect low-lying property (particularly the Live Steamers Site at 1.8 m AHD at Fairy Lagoon, and Park Parade crossing, stormwater assets and floor levels above 1.94 m), both Towradgi and Fairy Lagoons are opened artificially at 1.6 m (when rain is falling or impending), or 1.8 m and 1.85 m, respectively, to alleviate potential flooding (Cardno, 2007a; b).

The process of entrance breakouts may enable erosion of the entire unvegetated area of the entrance berm, and in extreme cases, (e.g. very high creek outflows combined with high wave conditions) there may be erosion of adjacent vegetated dune regions also.

At present, the migration of the Bellambi Lagoon entrance channel to the north is causing erosion of the northern dunes. Historical aerial photography indicates that vegetation of the foredune regions both south and particularly north of the channel has increased markedly since the late 1970s, from an active unvegetated region to a well-established vegetated dune. The erosion is said to be threatening sites of Aboriginal heritage significance within the northern dunes.

1.3.6 Stormwater Outlets

Under high rainfall events, as water is conveyed to the ocean via outlets on the beach, the high velocity flows may cause significant erosion around the outlet. Some of the smaller drainage lines and creeks noted in the section above act to convey stormwater from the urbanised catchment (such as Carricks, Dalys and Stockyard Creeks on Coledale Beach, and the unnamed creeks on Little Austinmer, Sharkies and Scarborough Beaches), and some of these creek lines contain stormwater infrastructure. The erosion around such outlets can also pose a hazard, and inundation in the future with sea level rise may cause flooding into urban areas upstream.

1.3.7 Aeolian (Windborne) Transport and Dune Vegetation

The key process for dune building is wind which transports sand landward from the sub-aerial beach berm (i.e. dry beach face) to form incipient dunes and foredunes. Dune vegetation will act to trap windborne sediments, allowing for ongoing accretion and increase in dune height. Dune evolution over thousands of years can allow for very high sand dunes to form (where the beach position remains stable over this time), for example up to 10 – 15 m high on the NSW north coast. However, on the Wollongong coastline, dunes are typically less than 5 m in height, demonstrating that such features formed relatively recently.

Unvegetated regions are termed active dunes or blowouts, where the sand is free to be mobilised by wind. In some cases, the sand blown from active dunes landward can represent a loss from the beach system (where it is not captured by dune vegetation). Sands can also drift into back beach development to become a nuisance.

Dune revegetation programs occurred widely across the Wollongong coast in the 1980s and 1990s, following damaging storms during the 1970s. It was recognised that dune vegetation captures beach sand, to provide a buffer to erosion during high wave and water level events. Dune heights have increased significantly across the Wollongong coastline since the revegetation program, as the revegetated areas have acted to capture mobile windborne sand. It is not known whether dunal systems were generally active and unvegetated in the Wollongong coastal zone prior to urban settlement. It is possible that the small sediment stores held within the rocky embayments typical of Wollongong's coast may have been frequently reworked by both storm events and wind, and so significant dune vegetation could not establish. Since the establishment of urban settlement, there has been a need to minimise losses of sediment from the beach system through windborne transport. Further, the sediment stores held within dune vegetation provide a buffer from storms. The revegetation program has provided well established dunes that can act to buffer back beach development from coastal erosion during storms.

Dune vegetation and sand buffering City SLSC

In some locations, active dunes allow for sand to be transported between embayments. One example of this is the sand drift that once formed on the road way below Flagstaff Hill between City Beach and Brighton Beach. Local community noted such drifts could form up to 1 - 2 m deep. This sand drift probably enabled sediment transport from City Beach into Brighton Beach. Since dune revegetation works commenced at City Beach, the windborne sediment transport is now captured within the City Beach dunal system and sand drifts across the roadway are rare. The contribution of this to ongoing erosion observed at the southern end of Brighton Beach is unknown. However, it is widely accepted that the enhancement of sediment stores at City Beach (and other locations within Wollongong) through dune revegetation works has afforded protection from short term storm impacts.

1.3.8 Climate Change

Climate change induced by anthropogenic forces, particularly the burning of fossil fuels for energy (coal, oil and gas) is now widely accepted. In relation to coastal processes, climate change may increase sea levels and change rainfall (annual, seasonal, extreme), wind (speed and direction) and the frequency and intensity of extreme events. Current projections for these parameters were investigated during the Wollongong Coastal Zone Study. A summary of the parameters used by Cardno (2010) is given below:

- **Sea level rise** is projected to rise by up to 0.4 m by 2050 and 0.9 m by 2100, according to the latest science incorporated with the NSW Government's Sea Level Rise Policy Statement;
- **Rainfall** in the Illawarra region was assumed to increase in intensity by 10% to 2050 and by 20% to 2100, based on CSIRO predicted seasonal changes in average runoff depth of an increase in summer (-1% to +22%), possible increase in autumn (-6% to +14%), decrease in winter (-12% to +3%) and decrease in spring (-19% to +1%);
- **Wind** change predictions by CSIRO (2007) contained large uncertainty, and so no change from current and historical recorded winds were assumed for the study; and
- **Frequency of Extreme Events** is also highly uncertain, with IPCC (2007) suggesting the potential for an increase in frequency and intensity of coastal storms, compared with recent studies (CSIRO, 2007; McInnes et al., 2007) that are inconclusive as to whether storm events shall increase or decrease, depending on the model and / or climate change scenario selection, therefore there was

assumed to be no change in the frequency or intensity of coastal storm conditions from the current climatology and historical records.

While it is probable that, in addition to sea level rise, climate change will alter wind, rainfall and wave conditions and frequency of storm events, there is as yet no consensus regarding to what extent changes may occur. Climate change induced changes may modify the extent of coastal hazards experienced in the future, however, the current projections suggest changes that are within the natural climate variability already experienced. In this case, it is reasonable to assume the current wave and storm conditions for future time periods

1.4 Summary of Coastal Values and Features

1.4.1 Ecological Values

Key ecological attributes of the Wollongong coastal zone were investigated and mapped. A variety of different environments exist within the coastal zone including marine, intertidal, estuarine and terrestrial zones, resulting in a high diversity of flora and fauna.

Endangered Ecological Communities (EECs) in the study area (which are protected under the *Threatened Species Conservation Act 1995*) include (Cardno, 2010):

- Coastal Saltmarsh
- Freshwater Wetlands in the Sydney Basin Bioregion
- Freshwater Wetlands on Coastal Floodplains
- Swamp Oak Floodplain Forest
- Swamp Schlerophyll Forest on Coastal Floodplains
- Littoral Rainforest
- Illawarra Subtropical Rainforest
- Bangalay Sand Forest
- Illawarra Coastal Grassy Woodlands
- Southern Sydney Sheltered Forest and
- Themeda Grasslands.

Mapping of the EECs within the coastal zone has been included within the risk assessment conducted in preparing this CZMP. The study area also contains some SEPP No. 14 – Coastal Wetlands. There are also a number of threatened flora and fauna species listed on the *Threatened Species Conservation Act 1995*, *Fisheries Management Act 1994* or *Environment Protection and Biodiversity Conservation Act 1999* (including migratory terrestrial and marine species) that are likely or known to occur within the Wollongong coastal zone. The species were listed within the Wollongong Coastal Zone study (Cardno, 2010), and have been considered within the mapping databases used as part of the risk assessment to prepare this CZMP.

A condition assessment for coastal vegetation was also conducted, comparing changes in such vegetation observed between aerial photography dates (1977, 1987, 1999, 2006). In general, it was found that over the ~ 30 year period, the total observed area of dune vegetation has increased, most likely as a result of extensive dune rehabilitation works, such as on Perkins Beach, carried out by on in partnership with Council. In contrast, the total observed area of estuarine vegetation has slightly decreased, mainly in areas around Port Kembla, as the port and industrial area has expanded. The majority of restoration works by Council over the last five years has occurred within the coastal zone, and has included both dune and estuarine areas.

An estuary condition assessment was also conducted, based upon estuary type (e.g. wave-dominated etc); catchment land use; waterway use; water quality (based upon monitoring data from Council); probability of acid sulphate soils; tributaries; entrance management (e.g. artificial, natural breakouts); and vegetation types. The condition assessment found:

- Hewitts Creek and Tramway Creek to be in good condition;
- Bellambi Gully, Bellambi Lagoon, Towradgi Creek and Lake Illawarra to be in extensively modified condition; and
- Fairy Creek to be in modified condition.

The other coastal creeks and lagoons in the study area were not investigated.

1.4.2 Human Values and Features

Mapping of infrastructure, such as roads, railways, stormwater features, parks, car parks, and public buildings (including SLSCs, amenities blocks) and heritage items was conducted as part of preparing the Wollongong CZMP.

1.4.3 Recreational Values

Coastal areas are known to have a high recreational value and offer aesthetic values to urban dwellers (DCC, 2009). The Wollongong coastal zone offers numerous recreational opportunities, particularly at the open coastal beaches and lagoon entrances. Recreational activities include (Cardno, 2010):

- Water based activities such as swimming (including within the numerous tidal rock pools along the coast), surfing, fishing and prawning, scuba diving, snorkelling, sailing, canoeing, kayaking, water skiing, wind surfing, kite surfing, boating (with many boat ramps in Lake Illawarra, as well as boat ramps at Bellambi, Sharkies Beach and Wollongong Harbour itself), parasailing and model boats;
- Land based activities such as walking and running (using the numerous coastal paths, bushland trails, including the cycleway), cycling (for example, using the shared coastal cycleway, or numerous off-road mountain bike trails in the area), bird-watching, pet exercising, picnicking (with the majority of beaches offering either park or coastal reserve with facilities), abseiling, rock climbing, and other sports; and
- Air based activities, such as hang gliding and paragliding (including the oldest hang gliding and paragliding club at Stanwell Park), and sky diving (such as into Stuart Park in North Wollongong).

Surfers and sunbathers at City Beach

Commercial operators, such as kiosks and restaurants also offer leisure and dining at a number of Wollongong's beaches.

There are a number of recreational clubs that operate from the coastal zone, including the Illawarra Yacht Club, Koonawarra Bay Sailing Club, the Port Kembla Sailing Club and the 17 Surf Life Saving Clubs (SLSCs) in the LGA. The facility of 17 patrolled beaches, through both volunteer and Council lifeguard patrols, is said to be a key attractant for residents and visitors to the Wollongong coast (Cardno, 2010). Further, the SLSCs provide for a sense of community for local beach users and members of the clubs, which run a range of competitions, sporting and social activities in addition to volunteer patrols for the community.

Private recreational facilities include the Wollongong Golf Club behind City/Coniston Beach, the Port Kembla Golf Club at Primbee, WIN Football Stadium (and associated Entertainment Centre) at City Beach. There are additional leisure centres, sports grounds, gyms in the coastal zone, however not in proximity to the identified hazard areas. Each of the private and public recreational assets of the coastal zone was mapped as part of preparing the Wollongong CZMP.

1.4.4 Aboriginal Heritage

The Aboriginal custodians of the Illawarra (from Stanwell Park to Bass Point, south of Wollongong) are the Wodi Wodi (Wadi Wadi), or are also known as the Dharawal, Tharawal or Thurrawal (Cardno, 2010 citing Organ and Speechley, 1997). Aboriginal people are thought to have inhabited the Illawarra region for 20,000 – 30,000 years. The land and landscape of the Illawarra is central to the culture of the local Aboriginal people, including the coastal zone. Cardno (2010) make reference to a number of documents outlining the occupation of coastal areas, first contact with Europeans and the impact on the Aboriginal people, including local land rights struggles until the 1960s.

Aboriginal objects and sites (listed or unlisted) are protected under the *National Parks and Wildlife Act* 1974. There are a number of significant Aboriginal places within the study area, for example the areas of Sandon Point, the Bulli Area, and Breakfast Creek area. There are also known to be midden sites located near to Bellambi Lagoon, Sandon Point, Waniora Point and Fairy Lagoon. There are known burial sites in the Windang and Lake Illawarra regions also. There are at least 766 recorded Aboriginal sites within the study area, and the number of unrecorded sites is likely to be many more than this. The exact location of Aboriginal sites and places of significance must be kept confidential, not only for their cultural sensitivity, but often to protect the sites from vandalism or (unwitting) damage by the wider public. Management of these sites particularly when they are uncovered due to the impacts of coastal processes (for example, erosion at midden sites) is outlined within the CZMP.

1.4.5 Non-indigenous Heritage

The Illawarra region was explored by European settlers in the early 1800s, with settlement soon after (from around 1817). The coastal zone, particularly Wollongong Harbour and Port Kembla has been utilised from the beginning of settlement, including shipping coal from the harbour until the late 1800s. After that time, Port Kembla became the primary facility for coal exports, due to its size and industrial development.

Wollongong Harbour itself has a convict built wall and steps, comprising the southern boundary of the harbour. The site is listed on the state heritage register. There are numerous other sites of local and state historical importance along the coastal zone, including North Beach Bathers Pavilion and nearby kiosk building, the many tidal rock pools, Continental Pool, Thirroul Pool and the nearby kiosk building, coal cuttings at the cycleway leading from the harbour, and stands of Norfolk Island Pines which form a marker of beachside settlement. Heritage items have been included in the coastal asset mapping prepared for the Wollongong CZMP.

Convict Heritage at Wollongong Harbour

1.4.6 Economic Values

Commercial and industrial operations in Wollongong form a significant part of the economy. Wollongong City is a local, regional and state level economic hub, comprising nearly half of the businesses within the region.

In terms of the coastal zone, the port facility at Port Kembla (although not strictly included within the plan) is a major facility of the region, providing for coal and steel exports, and base for general and bulk cargoes, containers, motor vehicle imports and grain exports. Port Kembla contributes $418 million to the regional economy annually.Another key industry that is supported by the coastal zone is the Tallawarra natural gas power station located on the Lake Illawarra foreshore at Yallah, which powers 200,000 homes.

The coastal zone including beach and lake amenity are vital to Wollongong's tourism industry. After dining out, the next most popular activity for tourists (international and domestic) was going to the beach. This demonstrates the importance of the beach amenity to visitors as well as the resident community.

The scenic qualities and recreational activities supported by the beach amenity directly support the tourism industry. There are 4100 business that are tourist operations including surf schools, scuba diving, boat and fishing trips, sky diving, hotels, motels, camp grounds and other accommodation services, cafes, as well as restaurants and other food and beverage facilities that require the additional visiting population to survive.

The various beach reserves, tidal and formal ocean pools, parks and coastal kiosks business that support both the resident and visiting community were included in the coastal asset mapping prepared as part of the Wollongong CZMP.

1.5 Coastal Risks

Risk is defined as the combination of the likelihood of occurrence of an event and the consequence of the impacts if the event occurs.

Risk = likelihood x consequence

The likelihood of coastal risks is determined as part of the definition of coastal hazards, and in accordance with the Australian Standard Risk Management Framework, ranges from 'almost certain' to 'rare'. The consequence of risks is dependent on the uses and values attributed to the coastal land affected by the hazard, and can range from 'insignificant' to 'catastrophic'. This means that shoreline recession within a National Park will have a different risk level than recession of an existing suburban development, given different land uses and community values.

Council's Enterprise-wide Risk Management Risk Ranking Tool outlines the risk hierarchy from 'low' to 'extreme' based on the combination of risk likelihood and consequence in **Error! Reference source not found.**.

Figure 2 Risk Hierarchy based on likelihood and consequence of risk

Determining what risks to treat as part of the CZMP is based upon Council (and the community's) tolerance to risk, within Council's Enterprise-wide Risk Management Risk Ranking Tool. Thus the prioritised objectives for management actions in this CZMP are:

1. **'High' and 'extreme' risks are intolerable** and must be treated as a priority to eliminate or reduce the risk, and accept residual risk providing it is understood**.** Specific management actions are detailed in this Implementation Action Plan
2. **'Medium' risks are tolerable**, and may be reduced or accepted providing the residual risk is understood. Specific management actions were noted in the CZM Study for future use as required.
3. **'Low' Risks are acceptable**, with care given to monitoring to ensure management response can be changed should the risk level increase in the future. Specific management actions are not required.

Giving consideration to both likelihood and consequence, coastal risks along the Wollongong Coastline were defined as 'Low', 'Medium', 'High' or 'Extreme'. Risks were established for 2010, 2050 and 2100 timeframes, highlighting a shift in risk profile with time, as sea levels rise and other climate change impacts begin to manifest. 'Extreme' and 'High' risks were considered to be intolerable. That is, these risks cannot be accepted by the community, and as such, require mitigation or treatment through specific risk management actions. The land and assets determined to have the highest levels of risk along the coastline include:

- Beaches themselves (in terms of amenity and social value) and associated coastal dunes.
- Wollongong's impressive list of ocean (rock) pools;
- Various Surf Club buildings, amenities and pavilions (some of which are heritage-listed);
- Existing seawalls and promenades;
- Stormwater infrastructure;
- Beach access and carparks, local roads servicing residential properties, and a couple of arterial roads (including Lawrence Hargrave Drive);
- The coastal cycleway that extends from Thirroul to City Beach;
- Infrastructure, such as Bellambi and Austinmer Boat Harbours, Bellambi STP and WIN stadium;
- Important habitat areas (such as EECs) and coastal vegetation; and

Residential properties (some potentially affected by coastal erosion and recession, while many more are potentially affected by coastal inundation).

1.6 Management Approaches & Options

This CZMP has approached management of coastal risks in a number of ways. Firstly, risks associated with Future Development are different from risks to Existing Development. For Future Development, risks can be 'avoided' by not permitting vulnerable developments within high-risk areas (considered over the full design life of the development). Future development can also 'accommodate' risks by including provisions that reduce the consequence of impacts (e.g. having minimum floor levels to reduce property damage resulting from future coastal inundation) or 'accept' the risk where appropriate to the design life of the development.

Existing development is typically much harder to manage as works and infrastructure are already in place that limits the opportunity for both 'avoiding' and 'accommodating' the risk. Thus, risk management options become either 'protecting' the land or asset, or 'accepting' the potential for damage or loss given the expected timeframe and likelihood of impact. Replacement structures should either be relocated landward, thus progressively retreating from high-risk areas; or redesigned to accommodate the risk, where appropriate. Options for managing existing development therefore include the following approaches:

Protection options, which aim at protect existing coastal development (private or public) from erosion and recession and / or wave overtopping. Protection may be in the form of hard structures (e.g. seawalls, groynes, offshore breakwaters or reefs, artificial headlands) or soft measures (e.g. beach nourishment). Some protection works can cause impacts to adjacent areas ('offsite impacts'), and therefore, the decision to implement a 'protect' option must consider all potential impacts;

Retreat options, which aim to preserve beach amenity by allowing natural retreat due to coastal processes, particularly in response to future sea level rise. The options for existing development involve relocating or sacrificing infrastructure, public assets or private property, if and when impacts occur. The retreat options typically include compensation to private property owners where feasible, if existing landuse is diminished; and

Accommodate options, which aim to re-develop or retrofit existing infrastructure, public assets and private property in a manner that minimises losses from potential impacts (e.g. stronger foundations) or avoids losses from potential impacts (e.g. relocatable structures) through careful design.

A series of 'No regrets' options have also been considered that offer a range of assessments and works to provide further information (including approvals) required prior to implementing larger scale options for specific assets, particularly where a more costly or difficult option may be needed. The 'no regrets' options also include activities that will improve resilience and preparedness for coastal risks in the future.

1.7 How to Read This Document

The technical assessment associated with identifying and defining the coastal risks and evaluating the potential management options is contained within the accompanying CZM Study. This Implementation Action Plan details the recommended Management Strategies that were found to be the most effective for management of the coastal risks along the Wollongong Coastline.

The following pages present a series of 'Implementation Schedules' for key management strategies. These schedules include specific details on what actions need to be undertaken and a timeframe or trigger for commencement. The schedules also include relative prioritisation, estimated costs and responsibilities for the various actions.

A series of maps is given in Section 18 immediately after the Implementation Schedules that show the relevant locations for actions from the 15 Management Strategies, where they can be feasibly shown, for each beach along the Wollongong Coastline.

Recommended Management Strategies, in alphabetical order are:

BM	Beach Management
C	Cycleways
DC	Development Controls
H	Heritage
I	Infrastructure, Assets and Boat Harbours
M	Monitoring
P	Ocean Pools
PL	Private Land Acquisition
R	Roadways and Parking
RF	Recreational Facilities
S	Seawalls and Training Walls
SC	Surf Clubs and Public Buildings
SP	Further Studies and Plans
ST	Stormwater
V	Vegetation and Habitats
W	Whole of Council Actions

2 BEACH MANAGEMENT (BM)

Description:

Beach Management involves moving sand on individual beaches to promote the formation of dunes in the upper beach profile. Coastal dunes are critical in providing protection to land and assets located behind beaches. The dunes provide for sacrificial losses of beach sand during severe storm events. Thus, the more sand held within the dunes, the greater the protection for land and assets behind.

Trial beach scraping at Bellambi Lagoon entrance (2010)

The purpose of beach management is to move sand from the beach berm (which is affected by average wave action) into the dunes (where it is not affected by average wave action, and thus remains stored until the next storm event). Beach scraping is carried out when the beach begins to recover following beach erosion events, with sand taken as thin layers from the intertidal zone and moved above the area of fair weather wave action. Re-contouring of eroded profiles is not covered by this strategy, but rather is an emergency action to provide safe beach access following storms, as detailed in the Wollongong Emergency Action Sub Plan, Appendix G to the CZM Study.

Beach management generally requires earthmoving plant and equipment to move sand from the lower and intertidal sections of the beach profile up into the upper dune profile. Vegetation of the dunes is then required to help contain the sand from wind-blown drift and capture additional sands blown from the beach face.

Beach management in the form of 'beach scraping' was trialled by Wollongong City Council (WCC) at Bellambi Lagoon entrance in mid 2010. While the trial was aimed at management of the lagoon entrance, the success of the trial does justify the use of beach scraping elsewhere along the Wollongong coast, in this case to increase sand volume held within the beach dunes and thus enhance protection of the coastline.

Management of beaches and associated assets that are at a 'high' or 'extreme' level of risk at the current timeframe takes highest priority (i.e. Priority ranking '1'), while 'high' or 'extreme' risks that are not expected to materialise until 2050 or 2100 are given secondary priority (i.e. Priority ranking '2'). It is noted that, while all beaches are at high – extreme risk from erosion, beach management has only been suggested for those beaches where dunes are currently limited and need to be enhanced to protect the beach or back beach assets and / or the action is considered likely to be successful in enhancing coastal dune volumes.

The beach management actions noted below for individual beaches would be subject to the appropriate regulatory and approval processes under the Crown Lands Act 1989.

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Helensburgh / Stanwell Park SLSC	Medium	High	Extreme	Woonona Beach	High	Extreme	Extreme
Coalcliff Beach	High	Extreme	Extreme	North Beach	High	Extreme	Extreme
Scarborough Wombarra Beaches	High	Extreme	Extreme	North Beach: Stuart Park (on heritage list, local significance)	Medium	High	Extreme
Coledale Beach	High	Extreme	Extreme	City Beach: Football Ground (WIN Stadium) and Showground	High	Extreme	Extreme
Sharkys Beach	High	Extreme	Extreme	Coniston Beach	High	Extreme	Extreme
Little Austinmer Beach	High	Extreme	Extreme	Coniston Beach: Wollongong Golf Course	Medium	Medium	High
Austinmer Beach	High	Extreme	Extreme	Coniston Beach: Coastal Dune Systems	High	Extreme	Extreme
Sandon Point Local Roads: Blackall St, Ursula St, Alroy St	Medium	Medium	High				

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Req'd	Preceding Actions	Further Info.
BM.1	Develop, adopt and implement a Council policy that requires any sand removed from estuary/lagoon entrances to be returned to the adjacent beaches, along with any local excavation material from construction sites immediately adjacent to beaches that have a suitable particle size distribution.	Entire LGA coastline	1	2016/17 or as soon as practical	WCC	Staff time only	nil	See 'BM' Option in Sect.5.4.2 of CZM Study report
BM.2	Undertake beach scraping and re-contouring to increase sand volumes of dunes directly in front of Helensburgh / Stanwell Park SLSC	Helensburgh / Stanwell Park	2	Opportunistically when monitoring shows that beaches are accreted following recovery from storm erosion	WCC	$5,000 - $10,000 per episode	M.1	See 'BM' Option in Sect.5.4.2 of CZM Study report
BM.3	Undertake beach scraping and re-contouring to increase sand volumes of dunes in front of existing wall.	Austinmer	1	Opportunistically when monitoring shows that beaches are accreted following recovery from storm erosion	WCC	$5,000 - $10,000 per episode	M.1	See 'BM' Option in Sect.5.4.2 of CZM Study report
BM.4	Undertake beach scraping and beach re-contouring to increase sand volumes of dunes directly in front of WIN Stadium. Investigate opportunities for financial contributions from stadium owner/manager	City Beach	1	Opportunistically when monitoring shows that beaches are accreted following recovery from storm erosion	WCC	$5,000 - $10,000 per episode	M.1	See 'BM' Option in Sect.5.4.2 of CZM Study report
BM.5	Undertake beach scraping and beach re-contouring to increase sand volumes held in upper beach profile dunes, thus enhancing storm protection. Investigate opportunities for financial contributions from golf course owner/manager for section on Coniston Beach	Coalcliff Scarborough / Wombarra Coledale Sharkys Little Austinmer Woonona North Beach Coniston (including golf course and dunes)	1	Opportunistically when monitoring shows that beaches are accreted following recovery from storm erosion	WCC	$7,000 - $10,000 per episode	M.1	See 'BM' Option in Sect.5.4.2 of CZM Study report
BM.6	Undertake revegetation works for sand dunes supplemented through beach scraping and re-contouring episodes (see also Action V.1 – Dune Management Strategy)	Helensburgh / Stanwell Park Coalcliff Scarborough / Wombarra Coledale Sharkys Little Austinmer Austinmer Sandon Point Woonona North Beach City Beach Coniston	1	Immediately following beach scraping and re-contouring episodes	WCC Bushcare Groups	$2,000 per episode	BM.2 – BM.5	See 'BM' Option in Sect.5.4.2 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Req'd	Preceding Actions	Further Info.
BM.7	Undertake beach scraping and re-contouring to increase sand volumes of dunes directly in front of Blackall St, Ursula St, Alroy St	Sandon Point Beach: Blackall St, Ursula St, Alroy St	2	Opportunistically when monitoring shows that beaches are accreted following recovery from storm erosion	WCC	$5,000 - $10,000 per episode	M.1	See 'BM' Option in Sect.5.4.2 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- NSW Government Coastal Management Program (for one-off beach scraping / dune building episodes)
- Council's parks and reserves maintenance and works program
- New Council levies or increased land rates
- South East Local Land Services/ State Government assisted Dunecare Program

3 CYCLEWAYS (C)

Description:

The Wollongong Coastline is served well by a sealed coastal cycleway extending from Thirroul to Coniston Beaches. The cycleway is an important recreational facility for the community, and provides a commuter link for many city workers living along the northern beaches. The cycleway is also an excellent pedestrian walkway, with commanding vistas over the beaches and headlands along the coastline.

Sections of the cycleway have been damaged due to storm erosion in the past, such as at Bellambi, resulting in *ad hoc* emplacement of protection works as an emergency response. It is expected that sections of the cycleway will again be damaged in the future due to storm erosion and sea-level rise induced shoreline recession. This strategy aims to provide a coordinated response to management of future damage to the cycleway as part of a whole of coastline plan. Remediation of the cycleway shall form part of Council's existing Asset Management Plan. That is, the cycleway needs to first be included as a specific Council asset, with future maintenance and repairs provided in accordance with Council's forward planning schedule for asset management.

Repairs to the cycleway following an erosion event will still need to be carried out as prioritised emergency works, while longer-term retreat and relocation of the cycleway in certain vulnerable sections needs to be planned in conjunction with future maintenance and as opportunities for relocation arise.

Land ownership and available space for landward retreat of the cycleway are two issues that will need to be resolved as part of long term management of this special and highly valued community asset.


Cycleway at Bellambi Gully

No cycleways are under an immediate intolerable risk (i.e. 'high' or 'extreme' level of risk), therefore all actions associated with management of cycleways are given secondary priority (i.e. Priority ranking '2'), except for forward planning actions (C.1, C.2).

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
McCauleys Beach Cycleway / Shared Pathway (Northern Coastal Cycleway)	Medium	Medium	High	Bellambi Point Beach: Cycleway / Shared Pathway (W of Bellambi Lagoon, along Dobbie & Murray Ave)	Medium	Medium	High
Sandon Point Northern Cycleway / Shared Pathway (at S end of beach)	Medium	Medium	High	Corrimal: Cycleway (across & next to Towradgi Lagoon)	Medium	Medium	High
Bulli Beach Cycleway / Shared Pathway (extent between beach and tourist park)	Medium	High	Extreme	Towradgi Beach Cycleway / Shared Pathway	Medium	High	High
Woonona Beach Cycleway / Shared Pathway	Medium	Medium	High	North Beach Cycleway / Shared Pathway (includes heritage railway cuttings and embankments)	Medium	High	Extreme
Bellambi Beach Cycleway / Shared Pathway (N of Bellambi Gully entrance)	Low	Medium	Medium	City Beach Cycleway / Shared Pathway	Medium	High	Extreme
Bellambi Beach Cycleway / Shared Pathway (S of Bellambi Gully entrance)	Medium	Medium	High				

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
C.1	Undertake audit of cycleway to identify options available for at-risk sections. Where relocation is not possible due to constraints from other land uses, consider the feasibility (technical and financial) for rock protection and / or raising the cycleway.	McCauleys Sandon Point Bulli Woonona Bellambi Bellambi Point Towradgi North Beach City Beach	1	2016/17, or as soon as practical	WCC	Staff time only or minor consultancy (say approx. $25,000)	nil	See 'NR6' Option in Sect.5.4.1 of CZM Study report
C.2	Add cycleways to Council's Asset Management Plan, and based on the outcomes of the audit, incorporate remediation, maintenance, relocation or retrofit works into forward works programs. *Actions C.3 to C.6 apply if supported by the Asset Management Plan*.	As above	1	2016/17 (as soon as practical following Action C.1)	WCC	Staff time only	C.1	See 'NR6' Option in Sect.5.4.1 of CZM Study report
C.3	Secure ownership of land (if not currently public land) and undertake detailed design, site investigations, and approvals as necessary to relocate cycleway outside of hazard zone. There appears to be sufficient land to relocate all of the at risk cycleway sections in the future, conducted progressively as impacts manifest.	Sandon Point Bulli Woonona	2	When monitoring shows that the Zone of Reduced Foundation Capacity (ZRFC) measured from erosion escarpment encroaches cycleway	WCC	Dependent on scale of works required and existing land ownership (say $100 – 200,000, at each location)	C.2 SP.3 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
C.4	Secure ownership of land (if not currently public land) and undertake detailed design, site investigations, and approvals as necessary to relocate cycleway outside of hazard zone. There appears to be sufficient land to relocate all of the at risk cycleway sections in the future when erosion impacts manifest. The cycleway section between Bellambi Gully and the pool may be protected by the existing seawall if this structure is maintained (refer Action S.5).	Bellambi	2	When monitoring shows that ZRFC measured from erosion escarpment encroaches cycleway There is a low to medium risk at present, thus there is no immediate need for action.	WCC	Dependent on scale of works required and existing land ownership (say $100 – 200,000)	C.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
C.5	Secure ownership of land (if not currently public land) and undertake detailed design, site investigations, and approvals as necessary to relocate cycleway outside of hazard zone. There are alternative locations for the at risk sections of cycleway.	Towradgi	2	When monitoring shows that ZRFC measured from erosion escarpment encroaches cycleway A long section of cycleway is at risk over time.	WCC	Dependent on scale of works required and existing land ownership (say $100 – 200,000)	C.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
C.6	Secure ownership of land (if not currently public land) and undertake detailed design, site investigations, and approvals as necessary to relocate cycleway outside of hazard zone. The cycleway could feasibly be relocated along the street landward of WIN Stadium to rejoin the existing cycleway at Wollongong Golf Course, in the future when erosion impacts manifest.	City Beach	2	When monitoring shows that ZRFC measured from erosion escarpment encroaches cycleway	WCC	Dependent on scale of works required and existing land ownership (say $100 – 200,000)	C.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- NSW Government Coastal Management Program or other recreational/leisure-based funding program
- State and Federal Government Grants (especially climate change adaptation and resilience building funds)

- Council's routine asset maintenance and works program
- New Council levies or increased land rates

4 DEVELOPMENT CONTROLS (DC)

Development set back behind coastal dunes at Towradgi

Description:

Wollongong's coastal zone is largely developed, with only a handful of undeveloped "greenfields" sites remaining. Most future development therefore will consist of either complete redevelopment of a site, including possible subdivision, or major alterations or refurbishments to existing structures and dwellings.

Redevelopment of coastal land offers an opportunity to avoid or accommodate existing and future coastal risks through the application of development controls, expected to last for the duration of the development. For residential development, a design life of 100 years is considered practical. This means that new developments today needs to accommodate coastal risks that span to approximately 2100. For other development types, the design life may be shorter or longer.

Applying development controls as properties are redeveloped improves resilience to potential future climate change impacts. Importantly, development controls do not affect the future ability to protect or indeed retreat from the properties. The development controls can be revised and updated in the future in line with improving knowledge of climate change, including sea level rise, and the predicted coastline responses to these changes.

Development controls are already imposed in Flood Planning Areas across the Wollongong LGA as part of Council's integrated Development Control Plan (DCP) Chapter E13 Floodplain Management. Areas of coastal inundation should be specifically incorporated into the existing Chapter E13 Flood DCP provisions. Geotechnical hazard areas are already included in Council's Geotechnical DCP Chapter E12 Geotechnical Assessment, however the DCP chapter requires update to include actions of the sea as part of geotechnical assessments.

It is proposed that new development controls relating to coastal erosion and recession and wave overtopping be captured within a new Coastal DCP Chapter. Different development controls can apply based on different levels of coastal risk, subject to further development of these planning provisions by Council.

Development Controls will address a range of intolerable risks, many of these being intolerable at the current timeframe. Although the level of risk differs from one beach to the next, the Development Controls are to be prepared for the whole LGA at the same time. As such, the actions for preparing and implementing Development Controls take highest priority (i.e. Priority ranking '1').

Risks Addressed by Implementation of Strategy:

All risks to existing development and infrastructure, as well as potential future development along every beach within the Wollongong LGA (literally too many to itemise here – refer beach by beach assessment in Chapter 6 of the accompanying CZM Study report for details. Note that for Council's use, a summary table of recommended current and future actions for all private properties at risk to 2100 is given in Appendix A.

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
DC.1	Prepare, adopt and implement a new Coastal Management Chapter of Council's Development Control Plan (DCP) that specifies controls upon future development and re-development (including minor and major alterations and extensions) in erosion / recession risk areas. Different levels of development control will reflect the different levels of risk to individual properties. That is, less stringent controls are applied to land at lower risk and / or land uses considered to have a shorter timeframe (design life), and vice versa. The types of controls may relate to foundation capacity (bedrock), structural design (relocatable or permanent), minimum floor levels, distance to hazard zones (development setbacks) or distance based approvals. The controls shall address wave overtopping as well as erosion, and shall apply to all land uses including roads and stormwater infrastructure, and both private and public landholders. The DCP shall also apply to properties where a protection option is proposed (e.g. seawall) until such time as the protection option is implemented and risk level for properties revised.	All beaches All lands affected by coastal risks. (See further details below)	1	2016/17 or as soon as practical	WCC	Staff time only	Nil	See Sect.5.3 and 'DCP' option in Section 5.4.4 of CZM Study report
DC.2	Revise/update, adopt and implement Chapter E13 – Floodplain Management of Council's Development Control Plan (DCP) to include areas affected by Coastal Inundation as Low Risk Flood Precincts. This option involves assigning areas within the Coastal Inundation Area but outside of the existing Flood Planning Area into the Low Flood Risk Precinct of the Flood Planning Area, then managing this area according to the provisions in DCP Chapter E13 – Floodplain Management. This will include flood proofing or relocatable structures etc as required on a site by site basis as assets are redeveloped or replaced.	Stanwell Park Coledale Sharkys Austinmer Thirroul McCauleys Sandon Point Bulli Woonona Bellambi Bellambi Point Corrimal North Beach Lake Illawarra (See further details below)	1	2016/17 or as soon as practical	WCC	Staff time only	nil	See Sect.5.3 and 'FDCP' option in Section 5.4.4 of CZM Study report
DC.3	Revise/update, adopt and implement Chapter E12 – Geotechnical Assessment of Council's Development Control Plan (DCP) to ensure actions of the sea (overtopping, sea level rise) are included in the assessment of geotechnical stability and the DCP is applied to all areas of geotechnical hazard area on a case by case basis as property (private or public) is developed or re-developed.	Areas of identified geotechnical hazard	1	2016/17 or as soon as practical	WCC	Staff time only	nil	See Sect.6.22 and 'GDCP' option in Section 5.4.4 of CZM Study report

Further Details:

Beach	Coastal DCP Details	Flood DCP details
Stanwell	Erosion and inundation impacts are likely to affect private land holdings at the southern end of the beach (refer map), however, the buildings are not likely to be affected for some time. Applying development controls when these buildings are redeveloped would improve their structural integrity and therefore the longevity of the developments. Management options to either retreat from or protect the buildings can be revised in the future, as the estimates for hazard impact change or impacts become imminent. Development controls for erosion may include foundation piles down to bedrock, set back distances for structures etc.	The existing Flood DCP chapter is to be applied to properties at risk of coastal inundation, until Flood Studies are conducted for Stanwell and Hargraves Creeks (for combined catchment and ocean water level events, see Action SP.2). Development controls are to be applied at the "low risk" level.
Coalcliff	*Private Properties* Erosion and overtopping impacts are shown to affect private properties, however, the residences are situated far landward and higher than the area identified at risk. Applying development controls to redevelopment ensures coastal erosion and overtopping are considered, but given the distance and building footprint, controls are unlikely to be extensive or burdensome. *Public Assets: SLSC, Boatshed, carpark* These public assets are currently at low risk, so there is no immediate need for action. Investigations and action can be delayed until asset replacement is required.	Inundation at Coalcliff is related to wave overtopping, rather than backwater inundation, and should be managed through Coastal DCP controls.
Scarborough / Wombarra	The amenities building and local access road are currently at low risk, so there is no immediate need for action. Investigations and action can be delayed until asset replacement is required.	Inundation at Scarborough and Wombarra is related to wave overtopping, rather than backwater inundation and should be managed through Coastal DCP controls.
Coledale	The amenities and roadway are currently at low risk, so there is no immediate need for action. The risk to the school applies to the grounds only. Applying the DCP will flag investigations to ensure future re-developments/developments consider and mitigate erosion and overtopping risks if required.	The existing Flood DCP chapter is to be applied to those areas identified at risk from coastal inundation, as an interim measure until Flood Studies for Dalys, Stockyard and Carricks Creek are completed (refer Action SP.2). Development controls are to be applied at the "low risk" level.
Sharkys	Vacant Land at Shark Park, Sharkys carpark and Austinmer Boat Harbour amenities building are currently at low risk, so there is no immediate need for action. Investigations and action can be delayed until asset replacement is required. The Coastal DCP shall manage both inundation related to wave overtopping as well as erosion and recession.	The existing Flood DCP chapter is to be applied to the small area of Lawrence Hargrave Drive affected by coastal inundation. The controls are applied at the "low risk" level, until more detailed studies as to flood levels are undertaken at this location.
Little Austinmer	There is one private property where the Coastal DCP should be applied. The buildings on the property are at the edge of the risk zones and may not be affected for some time. Applying the DCP allows redesign of buildings upon the land when the buildings are redeveloped, thus improving longevity of the development. Additional controls can be considered as needed in the future, should risk levels be revised or hazard impacts advance more quickly. The DCP shall also be applied to public assets such as Lawrence Hargrave Drive, as well as the local carpark and amenities. Again, this will ensure that investigations that will govern the redesign or relocation of these assets are prepared, when the asset needs to be replaced (either through wear and tear or coastal damage).	While the majority of inundation will be managed in combination with erosion controls, the backwater inundation risk to Lawrence Hargrave Drive and to stormwater assets should consider the combined catchment flood and ocean water level event. In the interim, the existing Flood DCP chapter controls are to be applied at the "low risk" level, until such studies are conducted.
Austinmer	Planning controls shall apply to development in areas at risk regardless of protective structural options. Public assets including Lawrence Hargrave Drive, SLSC, carpark, boatshed and amenities are potentially at risk. The DCP will trigger investigations that will govern whether the asset needs to be relocated or redesigned to withstand impacts, either independently or prior to a seawall being implemented. Given risk is currently high at assets affected, the DCP controls may be imposed in conjunction with the expected cost and timeframe for asset maintenance and replacement, or sooner should erosion and wave overtopping impacts threaten the development.	As above
Thirroul	Planning controls should apply to development that reflect the level of risk to the property and expected functional life of the development. DCP controls will apply to affected land prior to implementation of any seawall options, should seawalls be maintained or implemented in the future.	The existing Flood DCP chapter is to be applied to those areas identified at risk from coastal inundation outside of the existing Flood Planning Area at the "low risk" level, until Flood Studies are completed and updated for Flanagans Creek and Thomas Gibson Creek, respectively. The majority of properties affected by coastal inundation in the Thomas Gibson catchment are also within the existing Flood Planning Area, therefore this strategy would have no additional effect on existing development restrictions.
McCauleys	Coastal DCP controls shall apply to any redevelopments in areas at risk. This includes the Aboriginal Tent Embassy and the beachfront property at the northern end of the beach. The DCP controls will reflect the level of risk and development lifespan. The DCP will trigger investigations regarding foundation capacity (depth to bedrock), alternative locations, distance to erosion escarpments, permissible fixed	The existing Flood DCP chapter is to be applied to those areas identified at risk from coastal inundation outside of the existing Flood Planning Area at the "low flood risk" level prior to updated Flood Studies for Hewitts and Tramway Creeks. There are limited additional properties outside the Flood Planning

Beach	Coastal DCP Details	Flood DCP details
	structures etc that will govern the relocation or suitable design for developments.	Area. The majority of properties affected by coastal inundation are also within the existing Flood Planning Area, therefore this strategy would have no additional effect on existing development restrictions for the majority of properties.
Sandon Pt	Planning controls shall apply to four (4) private properties and some public assets currently in areas at risk, with less stringent controls applied to land at lower risk and / or land uses considered to have a shorter timeframe (design life), and vice versa. For the Sandon Point SLSC, a new development at the current site is already underway. Applying the DCP controls will ensure any future re-development adequately considers alternative locations outside of the hazard zone.	The existing Flood DCP chapter is to be applied to those areas identified at risk from coastal inundation outside of the existing Flood Planning Area at the "low risk" level, until Flood Studies are completed and updated for Whartons Creek and Slacky Creek, respectively. There are limited additional properties around Slacky Creek, with most properties already within the Flood Planning Area, however, properties along Trinity Row are not currently within a flood planning area.
Bulli	Public assets at risk including the SLSC, kiosk, caravan park, cycleway and stormwater assets shall be subject to Coastal DCP controls. The DCP will ensure that future upgrades/redevelopment involve assessments to determine whether the asset shall to be relocated or redesigned to withstand impacts at the current location.	The existing Flood DCP chapter is to be applied to those areas identified at risk from coastal inundation outside of the existing Flood Planning Area at the "low flood risk" level, until Flood Studies are conducted for Whartons and Collins Creeks (for combined catchment and ocean water level events, see Action SP.2). A flood study should be completed at Whartons Creek as a priority, as many houses may be affected.
Woonona	Coastal DCP controls are to apply to redevelopment of 18 existing properties and public assets currently in areas at risk. Controls are applied such that less stringent controls apply to land at lower risk and / or land uses considered to have a shorter timeframe (design life), and vice versa. The DCP may require assessment of foundation capacity (depth to bedrock), alternative locations, distance to erosion escarpments, etc as relevant to the level of risk, to determine design controls for assets to remain in their current location or require relocation of developments landward of hazard zones. Wave overtopping shall also be managed by the Coastal DCP, as existing Flood DCP controls may not be applicable to the overtopping risk.	The existing Flood DCP chapter is to be applied to all properties identified at risk from coastal inundation that are outside of an existing Flood Planning Area applied at the "low flood risk". A Flood Study (for combined catchment and ocean water level events, see Action SP.2) should be completed for the creek at Lighthorse Drive as a priority, as many houses may be affected.
Bellambi / Bellambi Point	This option applies proposed Coastal DCP controls to any redevelopments on the Sewage Treatment Works site, as well as cycleways, Bellambi Pool and associated pool infrastructure (amenities etc) until such time as S.5 is implemented and local road access to the harbour (until such time as action R.4 is implemented).	The existing Flood DCP chapter is to be applied to Bellambi SLSC and carpark, and local roads, carpark and 10 properties adjacent to Bellambi Lagoon at the "low flood risk" level, until Flood Studies for Bellambi Gully and Bellambi Lagoon are conducted.
Corrimal	The Coastal DCP shall apply to minor public buildings (amenities blocks), to ensure erosion and overtopping risks are adequately managed (including relocating the structures) in the future when the assets require redevelopment.	The existing Flood DCP chapter is to be applied to those areas identified at risk from coastal inundation outside of the existing Flood Planning Area at the "low flood risk" level, until a Flood Study is updated for Towradgi Lagoon (for combined catchment and ocean water level events, see Action SP.2). The majority of land and assets within the coastal inundation area are already within the Flood Planning Area for Towradgi Lagoon, therefore this strategy would result in little to no change to extent of existing development controls.
Towradgi	Coastal DCP controls shall apply to redevelopments of at risk private property and public assets, and shall also manage wave overtopping. The development controls will reflect the level of risk and lifespan of the (re-)development. The location of the private properties and local road at the northern end of the beach suggests there may be stable foundation zone (bedrock) at close depth. In this case, private landowners (or Council's road) may be able to accommodate the risk to their buildings and / or the hazard estimate for recession could be revised. The geotechnical investigation for suitable foundation capacity would be initiated through the Coastal DCP for any proposed re-developments.	Inundation is related to wave overtopping, rather than backwater inundation and so shall be managed through Coastal DCP controls.
Fairy Meadow	Coastal DCP controls should apply to any future re-development of the lifeguard tower or other recreational facilities.	
North	Coastal DCP controls should apply to any proposed redevelopment of existing assets (SLSC, Kiosk, Pavilion, cycleway) in addition to other options, including seawall options, to improve resilience of future structures to coastal risks. The controls shall accommodate wave overtopping impacts.	The existing Flood DCP chapter is to be applied to assets (e.g. Lagoon Restaurant) at risk from coastal inundation at the "low risk" level, until a Fairy Lagoon Flood Study is completed (for combined catchment and ocean water level events, see Action SP.2).
City	The Coastal DCP shall apply to re-development of the Stadium and associated grounds to minimise future risk from hazards. The controls shall encompass both erosion and overtopping impacts.	Inundation is related to wave overtopping, rather than backwater inundation and so shall be managed through Coastal DCP controls.
Coniston	Coastal DCP development controls shall apply to Wollongong Golf Course lands, in the case of redevelopments on the site. The controls shall encompass both erosion and overtopping impacts.	Inundation is related to wave overtopping, rather than backwater inundation and so shall be managed through Coastal DCP controls.

Beach	Coastal DCP Details	Flood DCP details
Perkins	Coastal DCP controls shall apply to redevelopment of Windang SLSC and amenities buildings to manage wave overtopping and additionally erosion at Port Kembla Pool in conjunction with seawall options.	
Lake Illawarra		Given that the existing Flood Planning Area extends over and beyond the coastal inundation area at Lake Illawarra, all affected properties will already be subject to the Flood DCP. This strategy re-iterates the use of the Flood DCP throughout Lake Illawarra, with the flood planning levels from the Flood Study to override levels given for coastal inundation alone. A recent Flood Study was conducted using a combined ocean water level and catchment flood event, providing a current and applicable flood level calculation for use in planning.

Relevant Programs and Possible Funding Opportunities:

- No external funding required. To be undertaken by Council staff.

5 HERITAGE (H)


Wollongong Harbour lighthouse

Description:

The Wollongong Coastline is rich in heritage value from both an indigenous and non-indigenous perspective. While the non-indigenous heritage value is tied to specific features and structures, such as Norfolk Island Pines, War Memorials and Pavilions, the indigenous heritage value is more ubiquitous across the landscape. There are still many specific sites of significance to local Aboriginal people within the coastal zone, including middens, burial sites and significant places, however, many of these are not publicly known or listed for privacy and preservation purposes. A particular issue may arise in the future when coastal erosion starts to uncover previously buried heritage items in coastal dunes and foreshore lands. Where actions are proposed on Crown Land, consideration of Aboriginal Land Claims lodged under the NSW Aboriginal Land Rights Act 1983 will need to occur. In addition, any works will need to be compliant with the Commonwealth Native Title Act 1993.

Risks to heritage locations identified through the CZM process have therefore weighed in favour of non-indigenous heritage, as these have been more easily identified. Managing heritage locations that are under threat from existing or future hazards is a particular challenge for Council. While specific structures can feasibly be relocated to safer sites (e.g. a war memorial or even a building), others cannot be relocated (e.g. a jetty or an avenue of trees), and as such, may need to be sacrificed or abandoned in the future. Compensatory heritage may need to be considered, such as planting new Norfolk Island Pines to maintain the cultural connection with this species along the Wollongong coastline (see Action V.2). Heritage actions outlined below relate to identified sensitive sites as well as currently unidentified sites. For identified non-indigenous heritage items, specific strategies are contained as part of other strategies within this Implementation Action Plan (e.g. ocean pools, surf clubs and public buildings, etc).

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Coledale: Heritage Site: Norfolk Island Pines	Medium	Medium	High	Heritage Site: Sandon Point (also under NPW Act)	High	Extreme	Extreme
Sharkys: Heritage Site: Norfolk Island Pines (backing entire beach)	Medium	Medium	High	Heritage Site: Sandon Point Boat Sheds	Medium	High	High
Sharkys: Heritage Site: Site of Austinmer Jetty	High	Extreme	Extreme	Heritage Site: Sandon Pt Norfolk Island Pines (S end of beach)	Medium	Medium	High
Sharkys / Austinmer Boat Harbour (Heritage listed)	High	Extreme	Extreme	Bulli: Waniora Point (Heritage site) *Note works already in progress at site.*	High	Extreme	Extreme
Little Austinmer Heritage Site: Norfolk Island Pines (backing entire beach)	Medium	Medium	High	Bellambi Pt Heritage Site: Bellambi Lagoon and associated habitat	High	Extreme	Extreme
Austinmer Heritage Site: Norfolk Island Pines (backing entire beach)	Medium	Medium	High	Heritage Sites: Bellambi (Sandpit) Point	High	Extreme	Extreme
Austinmer War Memorial (Heritage Site)	High	Extreme	Extreme	North Beach: Stuart Park (on heritage list, local significance)	Medium	High	Extreme
Thirroul Pool (also heritage site)	High	Extreme	Extreme	North Beach: Puckeys Estate including Seafield House, Saltworks and gardens ruins	High	Extreme	Extreme
Heritage site: Thirroul Pavilion (being used as kiosk / restaurant) and residence	High	Extreme	Extreme	Heritage Site: North Beach Kiosk	Low	Medium	High
Heritage Site: Thirroul Beach Reserve (S of pool)	Medium	High	Extreme	Heritage Site: North Beach Pavilion	Low	Medium	Medium
Thirroul Heritage Site: Norfolk Island Pines	Low	Low	Medium	North Beach Heritage Site: Norfolk Island Pines	Medium	Medium	High
McCauleys Significant Aboriginal Site (Tent Embassy).	Medium	High	High	North Beach Cycleway / Shared Pathway (includes heritage railway cuttings and embankments)	Medium	High	Extreme
				Perkins Beach Heritage listed: Hill 60 Nature Reserve	Low	Medium	Medium

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
H.1	In close consultation with NPWS, Local Aboriginal Groups and Historical Societies, develop a decision framework for managing Aboriginal and Non-Indigenous Heritage Items and places affected by coastal hazards. The decision framework would include what actions are necessary when currently buried sites are uncovered by erosion. This may include relocating the item (for example, as is conducted for burial sites), re-burying the item elsewhere (for example as is done for midden sites), sacrificing the item or protecting the item (as is done for midden sites also).	Applicable to all beaches. Specific sites of known heritage have not been identified for privacy reasons. This option also aims to manage assets that are currently unidentified.	1	2016/17 or as soon as practical. Implementation of the Framework is then only triggered once heritage items are uncovered or seriously threatened by future coastal erosion.	WCC	Staff time only	nil	See 'NR13' Option in Sect.5.4.1 of CZM Study report
	See also Norfolk Pines Planting - Action V.2, for Coledale: Heritage Site: Norfolk Island Pines Sharkys: Heritage Site: Norfolk Island Pines (backing entire beach) Little Austinmer Heritage Site: Norfolk Island Pines (backing entire beach) Austinmer Heritage Site: Norfolk Island Pines (backing entire beach) Thirroul Heritage Site: Norfolk Island Pines Sandon Point Norfolk Island Pines (S end of beach) North Beach Heritage Site: Norfolk Island Pines							
	Sharkys / Austinmer Boat Harbour – See Action I.4							
	Austinmer War Memorial (Heritage Site) – See Action S.4							
	Thirroul Pool - See Action P.4							
	Thirroul Pavilion (being used as kiosk / restaurant) and residence – See Action SC.6							
	Heritage Site: Thirroul Beach Reserve (S of pool) – See Action S.1							
	North Beach: Stuart Park (on heritage list, local significance) – See Action S.8							
	See Action S.7 for: Heritage Site: North Beach Kiosk Heritage Site: North Beach Pavilion North Beach Cycleway / Shared Pathway (includes heritage railway cuttings and embankments)							

Relevant Programs and Possible Funding Opportunities:

- No external funding required. To be undertaken by Council staff.

6 INFRASTRUCTURE, ASSETS & BOAT HARBOURS (I)

Description:

In addition to the cycleways, seawalls, roadways and stormwater assets, which are addressed separately, there are other assets and infrastructure along the Wollongong Coastline that are under current and future risk of damage due to coastal processes and hazards. These include the boat harbours and associated boatramps and facilities at Austinmer and Bellambi, as well as the Bellambi Sewage Treatment Plan (STP).

Other services are also at risk, including electricity, telecommunications, gas, water and wastewater services, which are located on both public and private lands within the affected coastal zone. Indeed loss of key services and infrastructure may potentially affect a much larger catchment area, and should be considered and managed very carefully by the service providers.

The infrastructure, assets and boat harbours identified all have 'high' or 'extreme' level of risk at the current timeframe. As such, all actions associated with this strategy take highest priority (i.e. Priority ranking '1').

Bellambi Boat Harbour and ramp

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100
Sharkys / Austinmer Boat Harbour (Heritage listed)	High	Extreme	Extreme
Bellambi Boat Harbour	High	Extreme	Extreme
Bellambi / Bellambi Point Sewage Treatment Plant	High	Extreme	Extreme
Lake Illawarra Tru Energy Gas Powered Station	High	Extreme	Extreme

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
I.1	For all Council assets within their Asset Management Plan, add a notation indicating its proximity to the coastal hazard zones and the type of coastal hazard(s) relevant (i.e., erosion/recession, inundation, geotechnical) and estimated timeframe for impacts on the assets (immediate/2010, 2050, 2100). Prioritisation and maintenance scheduling of forward works programs should then be re-considered based on the timeframe and type of hazard exposure. All relevant information is readily available to Council.	All beaches	1	2016/17 / Immediately	WCC	Staff time only	nil	See 'NR1' Option in Sect.5.4.1 of CZM Study report
I.2	Ensure all Council infrastructure, including boat harbours and other relevant services, are included in Council's Asset Management Plan, with appropriate consideration given to asset condition and functional life such that redesign, upgrade and protection works are included into forward works programs. *Actions I.4 and I.6 apply if supported by the Asset Management Plan. Land status and management arrangements relevant to these actions will need to be clarified. It is highly likely that upgrades to*	All beaches	1	2016/17 or as soon as practical	WCC	Staff time only	nil	See 'NR2 to NR7' Options in Sect.5.4.1 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
	existing infrastructure or new infrastructure may be sited, partly or fully on Crown Land. As a result, land owner consent and/or authorisation of the proposed works by way of Crown tenure/s is likely to be required in order to formalise the occupation of Crown Land and define ongoing maintenance responsibilities.							
I.3	For non-Council assets, such as water supply, wastewater, gas, telecommunications and electricity services infrastructure, undertake an audit and investigate design elements for infrastructure to withstand inundation with seawater and / or wave action. This would be facilitated by Council providing relevant coastal hazard mapping to all infrastructure owners and managers. The audit will identify where and when non-Council infrastructure will be affected by wave attack and/or permanent inundation with sea level rise. The audit is also to determine functional lifespan of existing infrastructure, noting that seawater is expected to yield shorter design life.	All beaches, notably: Trinity Row (Sandon Pt Beach), Woonona Beach (Beach Drive, Kurraba Road), STP at Bellambi, Marine Parade (Towradgi Beach), and other locations where erosion may affect infrastructure positions within road reserves and vulnerable private properties	1	2016/17 or as soon as practical	**WCC** to advise asset owners of risks and encourage them to adopt this action, in consultation with WCC. Asset Owners include: **SWC** **Ausgrid** **AGL** **Optus** **Telstra** etc	Staff time only with financial contributions from asset owners	nil	See 'NR8' Option in Sect.5.4.1 of CZM Study report
I.4	Undertake detailed design, assessment, planning and works to redesign or retrofit Austinmer Boat Harbour to withstand wave forces and inundation due to sea level rise. Austinmer Boat Harbour could feasibly be redesigned, including raising the boat ramp and breakwalls, to remain a functional regional recreational boat access point. Given there is a small patch of sandy beach below the ramp at present, the redesign will need to consider retaining the sandy strip with nourishment following storm events. Alternative designs without sand that retain or improve current functioning may also be acceptable.	Sharkys	1	2016/17 or as soon as practical: Investigate options, prepare designs and approvals (as required) Undertake works when wave overtopping and mean sea level inundation causes the harbour to not be functional for the majority of sea conditions OR at major asset maintenance cycles, as required.	WCC	Dependent on scale of works required (say $1 – 2m)	I.2	See 'A2' Option in Sect.5.4.4 of CZM Study report
I.5	Undertake detailed design, assessment, planning and works to relocate activities on Sewage Treatment Plant compound. There appears to be sufficient vacant land within the Plant to relocate activities within the site to allow retreat. There may also be bedrock at shallow depth that could provide further protection from erosion, which would be confirmed through a geotechnical investigation.	Bellambi Pt	1	Move activities as erosion impacts manifest	**WCC** to advise **SWC** of risks and encourage SWC to adopt this action, in consultation with WCC	Dependent on scale of works required (say $1 – 2m)	I.3	See 'PR2' Option in Sect.5.4.3 of CZM Study report
I.6	Undertake detailed design, assessment, planning and works to upgrade Bellambi Boat Harbour in current location to withstand impacts. The boatramp and associated carpark and revetment could be raised and upgraded over time, to ensure the structure remains viable for boat use with sea level rise and to continue to withstand wave overtopping and impacts during storms. Actions to preserve the Harbour additionally offer protection to the Sewage Treatment Plant behind.	Bellambi	1	As maintenance to revetment and boat ramp is required over time, or following storm damage	WCC	Dependent on scale of works required (say $1 – 2m)	I.2	See 'A2' Option in Sect.5.4.4 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- NSW Government Coastal Management Program or other recreational boating/maritime/leisure-based funding program
- Other State and Federal Government Grants (especially climate change adaptation and resilience building funds)
- Council's routine asset maintenance and works program

- New Council levies or increased land rates
- Sydney Water Corporation funding, and responsible for own infrastructure costs
- Contributions from other infrastructure owners / managers (e.g. SWC at Bellambi Boat Harbour)

7 MONITORING (M)

Description:

The approach generally adopted for management of risks to existing assets and infrastructure is to wait until the risks have materialised to a level that is no longer considered tolerable (i.e. it reaches a 'trigger' level) before acting. Monitoring of key indicators is therefore necessary in order to determine when the 'trigger' has been reached.

Beaches are expected to erode and accrete in response to individual storms or series of storm events, and intervening quiet periods. Superimposed on this erosion / accretion cycle, however, is expected to be a longer-term trend of shoreline recession, which is induced by projected sea level rise. Monitoring of beach profiles is necessary to determine beach response to storms, and also to identify any underlying recession signals.

Most triggers for action presented in this Implementation Action Plan relate to the proximity of the Zone of Reduced Foundation Capacity (ZRFC) to a structure. The ZRFC is important for structures, as erosion scarps in dune sands will slump to a more stable dune profile shortly after a storm event, which may impact upon the area landward behind the erosion scarp. This zone is determined based on the landward erosion position, the erosion scarp slope, the dune or land height and the back beach material. It is noted that the ZRFC defined in Cardno (2010) assumes the back beach comprises dune sands. While the back beach area may comprise materials of greater structural integrity (which may reduce the ZRFC extent), for simplicity of monitoring, calculation of the ZRFC should assume the back beach and dunes comprise sand.

Other monitoring is also recommended, relating to coastal processes and responses to catchment rainfall and ocean storm conditions, including coastal inundation.

Beach profile monitoring by BMT WBM

Monitoring is also important in the evaluation of the effectiveness of the Management Plan. As part of the monitoring, and as detailed further in Section 19, the risk evaluation process used to prioritise coastal risks should be repeated in the future to ensure that the highest priority risks always remain the focus of the CZMP.

Monitoring aims to help address a wide range of 'high' or 'extreme' risks across multiple beaches at the current timeframe. As such, all actions associated with the monitoring strategy take highest priority (i.e. Priority ranking '1')

Risks Addressed by Implementation of Strategy:

Monitoring will not address identified risks specifically. Instead, monitoring will support the implementation of other strategies, will be used to define triggers for future action, and will provide information for future analysis and re-evaluation of risks as climate change impacts manifest.

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
M.1	Monitor beach profile and distance of immediate impact zone and ZFRC from structural assets located behind the beach. Regular survey profiles should be established at approximately 100 metres along each beach, and adjacent to significant assets (e.g. seawalls, surf clubs, pavilions, cycleways, residences at risk).	All beaches, especially Thirroul Pool and Pavilion, Woonona (Beach Dr), and Sandon Point (Trinity Row)	1	2016/17, and minimum 6 months thereafter, and immediately after storm events	WCC	Staff time only (internal cost of about $20,000 per year)	Nil	See 'NR14' Option in Sect.5.4.1 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
M.2	Monitor lagoon / coastal creek entrance breakout level, frequency and berm height, as sea level rise (including recession) impacts upon the entrance configuration.	Stanwell Park (Hargraves & Stanwell Cks); Thirroul (Flanagans Ck); McCauleys (Hewitts & Tramway Cks); Sandon Pt (Slacky Ck); Bulli (Whartons and Collins Ck); Bellambi Gully; Bellambi Lagoon; Fairy Lagoon	1	Berm heights to be captured by beach profile monitoring	WCC	Staff time only	Nil	See 'NR14' Option in Sect.5.4.1 of CZM Study report
M.3	Monitor frequency, depth and spatial extents of coastal inundation events.	Priority locations include: Stanwell Park (Hargraves & Stanwell Creeks); Thirroul (Flanagans & Thomas Gibson Creeks), Bulli (Whartons Creek), Woonona, Bellambi Lagoon, and Fairy Lagoon.	1	Event-based monitoring	WCC	Staff time only	nil	See 'NR14' Option in Sect.5.4.1 of CZM Study report
M.4	Re-run risk assessment based on monitoring results and revise management response if risk level changes (i.e. increase or decrease in level of risk).	All beaches	1	After 5 – 10 years of monitoring	WCC	Staff time only, or minor sub-consultancy (up to $25,000)	M.1 – M.3	See 'NR14' Option in Sect.5.4.1 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- State Government Coastal Management Program (particularly for re-evaluation of risks in future)
- Council's routine monitoring and works program
- New Council levies or increased land rates
- Contributions from Sydney Water Corporation and other infrastructure owners / managers (where monitoring also determines on-going risks to non-Council assets and infrastructure)

8 OCEAN POOLS (P)


Bulli Ocean Pool

Description:

Wollongong is privileged to have a number of ocean pools along the coastline, which are mostly constructed on intertidal rock platforms. The pools are heritage listed as they date back to settlement of the Wollongong area. Given their age, they require reasonable annual maintenance to keep them functional. Bulli Pool is particularly vulnerable to sand build-up, and has required regular (~ 6 monthly) works to remove the sand from inside the pool.

Most pools are already overtopped during high tides, however, with future sea level rise, the pools will essentially become permanently submerged unless works are undertaken to raise the walls in line with future ocean levels. Given that the Wollongong Northern Beaches community is well served by no less than nine ocean pools, some rationalisation may be required in terms of future sea level rise accommodation works, with some pools raised and some pools abandoned.

Weighing into this decision is the current condition of each pool, and the ability of the structure to accommodate necessary structural modifications associated with raising of the walls.

Thirroul Pool is located behind the existing seawall in the middle of Thirroul Beach. It is possible for Thirroul Pool (and the heritage listed Thirroul Pavilion) to be relocated landward, further away from the existing and future potential erosion zone. An economic assessment carried out as part of the CZM Study (refer Appendix F of CZM Study) found that the amenity value of Thirroul Beach itself far outweighed the costs of relocating the structures further landward (Thirroul Pool, Pavilion etc).

Coledale, Austinmer, Bellambi and Towradgi are at 'high' or 'extreme' levels of risk at the current timeframe, and as such management of these pools takes highest priority (Priority level '1'). Those pools that won't reach 'high' or 'extreme' risks until 2050 or 2100 (e.g. Woonona Pool) are given a secondary priority (Priority level '2').

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Coalcliff Tidal Rock Pool (S end)	Medium	High	High	Bulli Pool	Medium	High	Extreme
Wombarra Rock Pool	Medium	Medium	High	Woonona Ocean Pool (Collins Pt)	Medium	High	Extreme
Coledale Rock Pool	High	Extreme	Extreme	Bellambi Pool	High	Extreme	Extreme
Austinmer Rock Pool	High	Extreme	Extreme	Towradgi Pool	High	Extreme	Extreme
Thirroul Pool (also heritage site)	High	Extreme	Extreme	Port Kembla Olympic Pool	High	Extreme	Extreme
Thirroul Pool office and amenities	High	Extreme	Extreme	Port Kembla Pool - Amenities/Kiosk/Lifeguard Tower	High	Extreme	Extreme
Thirroul Pool toilet	Medium	High	Extreme				
Thirroul Pool storage shed (large)	Medium	High	Extreme				
Thirroul Pool intake	High	Extreme	Extreme				

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
P.1	Undertake audit of all Ocean Pools in Wollongong LGA. The audit shall investigate the relative sensitivity of the pools to wave impacts and sea level rise, in addition to their current condition, maintenance regime, and community usage. Where necessary, future adaptation/modification should be identified (e.g. raise seaward parapet wall, modify inlet/outlet system etc.). The audit shall prioritise pools based on their ability to withstand hazard impacts versus maintenance regimes and other community needs.	Coalcliff Wombarra Coledale Austinmer Thirroul Bulli Woonona Bellambi Towradgi Port Kembla	1	2016/17 or as soon as practical	WCC	Staff time only	nil	See 'NR4' Option in Sect.5.4.1 of CZM Study report
P.2	Update / include ocean pools in Council's Asset Management Plan and, based on the outcomes of the audit, incorporate maintenance plans and priorities into forward works programs. If it is determined that Ocean Pool(s) cannot be progressively repaired to withstand wave and sea level rise impacts into the future, the pool(s) will need to be abandoned and slowly removed as they fail over time, and this should be contained in the Asset Management Plan. *Actions P.3 to P.5 apply if supported by the Asset Management Plan. Land status and management arrangements relevant to these actions will need to be clarified. It is highly likely that upgrades to existing infrastructure or new infrastructure may be sited, partly or fully on Crown Land. As a result, land owner consent and/or authorisation of the proposed works by way of Crown tenure/s is likely to be required in order to formalise the occupation of Crown Land and define ongoing maintenance responsibilities.*	As above	1	2016/17or as soon as possible after Action P.1	WCC	Staff time only	P.1	See 'NR4' Option in Sect.5.4.1 of CZM Study report
P.3	Undertake detailed design, assessment, planning and works to retrofit Ocean Pools in current locations to withstand impacts. The decision to progressively retrofit selected Ocean Pools over time to withstand wave and sea level rise impacts shall depend upon the suitability of pool condition for this purpose, based upon outcomes of Action P.1. It is likely Woonona Pool is more suitable to being maintained as the pool walls are already higher, buffering from sea level rise impacts.	Coalcliff Wombarra Coledale Austinmer Bulli Woonona Bellambi Towradgi	2 2 1 1 2 2 1 1	When damage to pool shell occurs OR the pool is being inundated at water levels lower than MSL OR as part of major asset refurbishment in accordance with the Asset Management Plan	WCC	Dependent on scale of works required (say $1 – 2m per pool)	P.2	See 'A2' Option in Sect.5.4.4 of CZM Study report
P.4	Undertake detailed design, assessment, planning and works to relocate Thirroul Pool outside of hazard zone. Consideration will need to be given to ensure that a relocated Thirroul Pool retains heritage character and value. (See also Action SC.6)	Thirroul	1	When monitoring shows that ZRFC measured from erosion escarpment threatens pool foundations OR when pool reaches end of functional life and requires major refurbishment in accordance with Asset Management Plan.	WCC	Dependent on scale of works required (say $2 – 4m)	P.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
P.5	Undertake detailed design, assessment, planning and works to raise Thirroul Pool intake. Thirroul Pool intake will be affected by inundation with sea level rise, and this impact will need to be accommodated (for example, raising the pipe line) if the structure cannot be relocated and the Pool is to be protected or retained in a	Thirroul	1	When Thirroul Pool undergoes major refurbishment / relocation as required OR when replacement / refurbishment of the Pool intake is required	WCC	Approximately $100,000	P.4 unless intake affected before pool	See 'A2' Option in Sect.5.4.4 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
	similar form to present.							
	Port Kembla Olympic Pool (+Amenities/Kiosk/Lifeguard Tower) – See Action S.9							

Relevant Programs and Possible Funding Opportunities:

- State and Federal Government Grants (especially climate change adaptation and resilience building funds)
- Council's routine asset maintenance and works program
- New Council levies or increased land rates
- Potential revenue generated from public entry to pool (Thirroul Pool only)

9 PRIVATE LAND ACQUISITION (PL)


Beachfront residence, northern end of Thirroul Beach

Description:

There are many private properties along the Wollongong Coastline that are potentially affected by existing and future coastal risks. Coastal inundation is considered a relatively low risk, as it is temporary and usually does not occur with destructive impacts. Storm erosion on the other hand is of much greater consequence, as loss of land or foundation capacity can completely destroy buildings and other assets located within the impact zone.

There are two existing residential dwellings that are at significant risk in the future from storm erosion, one located at Thirroul Beach, and the other located at McCauleys Beach. It is impractical to protect these individual properties without having significant impact on the overall beach amenity. These properties should therefore be returned to public ownership, and abandoned/sacrificed in the future as the beaches slowly recede.

Given the anticipated timeframe for impact, it is expected that these dwellings could continue to be occupied until erosion directly threatens their structural integrity. As such, they could be leased back so that residents can continue to enjoy the amenity they offer, and to help recover the costs of the market-priced acquisition.

Neither of the two properties are at 'high' or 'extreme' risk at the current timeframe, and as such, actions associated with this strategy are given a secondary priority (i.e. Priority Level '2').

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100
Thirroul: Existing Residences 1 ppty at centre of beach	Medium	High	Extreme
McCauleys: Existing Residences 1 ppty at N end of beach	Medium	Medium	High

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
PL.1	Voluntary buy back – lease back. Council to seek finance to acquire affected property, at market value, on a voluntary basis. Once under Council ownership, the property is then leased at market rates, as a way of recouping financial investment, until such time as the hazard impact is imminent. If the sale of the property is delayed significantly, then the market value of the property is likely to reduce due to the increasing coastal risks. Once the hazard impact is imminent, the property shall be demolished.	Thirroul – 1 property in middle of the beach	2	2016/17– consider options for financing of acquisition and commence consultation with landholder. Offer acquisition once funding becomes available. Arrange lease once under Council ownership. Terminate lease and demolish property when erosion impacts threaten building foundations or impacts are considered imminent (see Action M.1).	WCC	Current market value of property	Nil	See 'PR5' Option in Sect.5.4.3 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
PL.2	Voluntary acquisition. Council to seek finance to acquire affected property, at market value, on a voluntary basis. If the sale of the property is delayed significantly, then the market value of the property is likely to reduce due to the increasing coastal risks (thus incentive for private landholder to sell sooner). *This action is an alternative to PL.1 if lease-back is not possible (meaning that recouping of acquisition costs also not possible).*	Thirroul – 1 property in middle of the beach	2	If and when buy-back / lease-back option is determined to not be feasible, seek finance for voluntary acquisition. Offer acquisition once funding becomes available. *Property would be demolished upon acquisition. (see Action PL.5)*	WCC	Current market value of property	PL.1	See 'PR4' Option in Sect.5.4.3 of CZM Study report
PL.3	Voluntary buy back – lease back. Council to seek finance to acquire affected property, at market value, on a voluntary basis. Once under Council ownership, the property is then leased at market rates, as a way of recouping financial investment, until such time as the hazard impact is imminent. If the sale of the property is delayed significantly, then the market value of the property is likely to reduce due to the increasing coastal risks. Once the hazard impact is imminent, the property shall be demolished.	McCauleys Beach – 1 property at the northern end of the beach	2	2016/17 – consider options for financing of acquisition and commence consultation with landholder. Offer acquisition once funding becomes available. Arrange lease once under Council ownership. Terminate lease and demolish property when erosion impacts threaten building foundations or impacts are considered imminent (see Action M.1).	WCC	Current market value of property	nil	See 'PR5' Option in Sect.5.4.3 of CZM Study report
PL.4	Voluntary acquisition. Council to seek finance to acquire affected property, at market value, on a voluntary basis. If the sale of the property is delayed significantly, then the market value of the property is likely to reduce due to the increasing coastal risks (thus incentive for private landholder to sell sooner). *This action is an alternative to PL.3 if lease-back is not possible (meaning that recouping of acquisition costs also not possible).*	McCauleys Beach – 1 property at the northern end of the beach	2	If and when buy-back / lease-back option is determined to not be feasible, seek finance for voluntary acquisition. Offer acquisition once funding becomes available. *Property would be demolished upon acquisition. (see Action PL.5)*	WCC	Current market value of property	PL.3	See 'PR4' Option in Sect.5.4.3 of CZM Study report
PL.5	Demolish properties, following termination of any leasing arrangements (if Actions PL.1 and/or PL.3 were adopted)	Thirroul – 1 property in middle of the beach, and McCauleys Beach – 1 property at the northern end of the beach	2	Assuming properties are in public ownership, demolish property when monitoring shows that the ZRFC encroaches the building foundations.	WCC	Approx. $50,000	M.1 PL.1 or PL.2 and PL.3 or PL.4	See 'PR4 and PR5' Options in Sect.5.4.3 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- NSW Government Coastal Management Program
- NSW Government Coastal Lands Protection Scheme
- Other State or Federal Government Grants (especially climate change adaptation and resilience building funds)
- New Council levies or increased land rates
- Private financial institutions (e.g. banks) if lease-back arrangement can repay capital + interest.

10 ROADWAYS & PARKING (R)

Description:

Wollongong City is precariously positioned on the coastal plain that separates the Illawarra Escarpment from the Pacific Ocean. With distance north, the escarpment gets closer and closer to the coast, meaning that the coastal plain becomes narrower and narrower. Along the coastline, and particularly along the northern Wollongong Beaches, major and minor roads are positioned close to the coast. This culminates just north of Wollongong, wherein the coastal access road is perched hard against the sea cliffs, where the Illawarra Escarpment meets the ocean.

Lawrence Hargraves Drive is a major access road for the northern beaches, and is at risk of damage in the vicinity of Austinmer and Little Austinmer Beaches. Trinity Row at Sandon Point is also a major road positioned immediately behind the beach within the potential future erosion and recession zone. Other minor roads that mostly serve as access to local residences are also under threat at a number of locations along the coastline.

Where possible, roadways and parking should be relocated outside the areas of immediate coastal risk. Given the anticipated timeframe for impact, planning should commence now in earnest in order to reserve lands and access provisions for future road relocations.

No roadways are under an immediate intolerable risk (i.e. 'high' or 'extreme' level of risk), and therefore, aside from planning actions, all actions associated with management of roadways and parking are given secondary priority (i.e. Priority ranking '2').

Seacliff Bridge, north of Wollongong

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Sharkys: Austinmer Boat Harbour Car park	Medium	Medium	High	Sandon Point Local Roads: Trinity Row, Ursula St, Alroy St	Medium	Medium	High
Little Austinmer Lawrence Hargrave Drive (Major Coastal Road)	Medium	High	Extreme	Woonona Local Roads (Kurraba Rd)	Medium	Medium	High
Little Austinmer: local roads and carpark	Medium	Medium	High	Woonona Local Roads (Beach Drive, Liamina Ave, Robertson Rd, Dorrigo Ave)	Medium	Medium	High
Austinmer Lawrence Hargrave Drive (Major Coastal Road)	Medium	High	Extreme	Bellambi Beach Local access road along coastline to Bellambi Boat Harbour (does not service houses, but provides access to Pool and Harbour)	Medium	High	Extreme
Austinmer Beach access and car park	Medium	Medium	High	Towradgi Local Roads: Marine Parade (N end of beach)	Low	Medium	Medium

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
R.1	Undertake traffic assessments to determine the feasibility and costs associated with redirection of traffic compared with redesign/protection of roadways at risk of recession. The assessments would be carried out for those local roads and major roads (Lawrence Hargrave Drive) that may be affected by recession in the future. The assessment needs to consider the broader impacts of redirected traffic and feasibility of maintaining access to residences. Redirection options may also include purchase of land to construct a new roadway connection. Where redirection is unlikely due to road/traffic constraints, protection and /or accommodation options for the roadway shall be considered as part of the traffic assessments.	Little Austinmer Austinmer Sandon Point Woonona Bellambi Towradgi	1	2016/17 or as soon as practical	WCC	Staff time only or minor consultancy (say $25,000)	nil	See 'NR5' Option in Sect.5.4.1 of CZM Study report
R.2	Update local roads and major roads in Council's Asset Management Plan and, based on the outcomes of the traffic assessment, incorporate relocation/redirection and/or protection works into forward works programs. *Actions R.3 to R.7 apply if supported by the Asset Management Plan.*	As above	1	2016/17 or as soon as possible after R.1	WCC	Staff time only	R.1	See 'NR5' Option in Sect.5.4.1 of CZM Study report
R.3	Undertake detailed design, assessment, planning and works to relocate beach access road and carpark to beach.	Little Austinmer	2	When erosion impacts occur to roadway foundations	WCC	Less than $50,000	R.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
R.4	Undertake detailed design, assessment, planning and works to relocate Austinmer Boat Harbour carpark. As part of retaining a functioning boat harbour for the community, car parking facilities for boat users need to be retained. There is public open space landward of the current car park. Relocation to this site would need to be determined in conjunction with remodelling the harbour to remain functional with sea level rise inundation impacts (refer Action I.4).	Sharkys	2	When erosion or wave overtopping damages carpark such that it is not functional OR when Harbour is being redesigned	WCC	Less than $100,000	R.2	See 'PR2' Option in Sect.5.4.3 of CZM Study report
R.5	Undertake detailed design, assessment, planning and works to relocate roadway (Trinity Row). The ability to redirect traffic off Trinity Row will need to be confirmed through Action R.1. Residential access would be permitted, with through traffic directed elsewhere. The current roadway would be sacrificed to allow for planned retreat of the beach.	Sandon Point	2	when ZRFC from erosion escarpment encroaches upon Trinity Row	WCC	Approximately $500,000	R.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
R.6	Undertake detailed design, assessment, planning and works to relocate roadway (Kurraba Rd), based upon the outcomes of Action R.1. Access to residential properties must be retained.	Woonona	2	When ZRFC measured from erosion escarpment encroaches onto the roadway.	WCC	Approximately $500,000	R.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
R.8	Undertake detailed design, assessment, planning and works to relocate roadways (Beach Drive, Liamina Ave, Robertson Rd, Dorrigo Ave).	Woonona	2	When ZRFC measured from erosion escarpment encroaches onto the roadway.	WCC	Approximately $500,000	R.2 SP.3 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
R.7	Undertake detailed design, assessment, planning and works to relocate roadway (Marine Drive), as necessary. Marine Drive is currently at low risk, with impacts not expected for many years. Initiating plans to redirect the roadway at the present time assists future traffic planning. Access to residential properties will need to be maintained.	Towradgi	2	At scheduled time for asset maintenance OR when ZRFC measured from erosion escarpment encroaches onto building foundations or cabins, whichever is sooner	WCC	Less than $100,000	R.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
	See Action S.4 for: Austinmer Lawrence Hargrave Drive (Major Coastal Road) Austinmer Beach access and car park							
	Bellambi access road along coastline to Bellambi Boat Harbour – refer Action S.5							
	WIN Stadium carparking – refer Action RF.4.	City	2					

Relevant Programs and Possible Funding Opportunities:

- State and Federal Government Grants (especially climate change adaptation and resilience building funds)
- Council's routine asset maintenance and works program
- New Council levies or increased land rates

11 RECREATIONAL FACILITIES (RF)

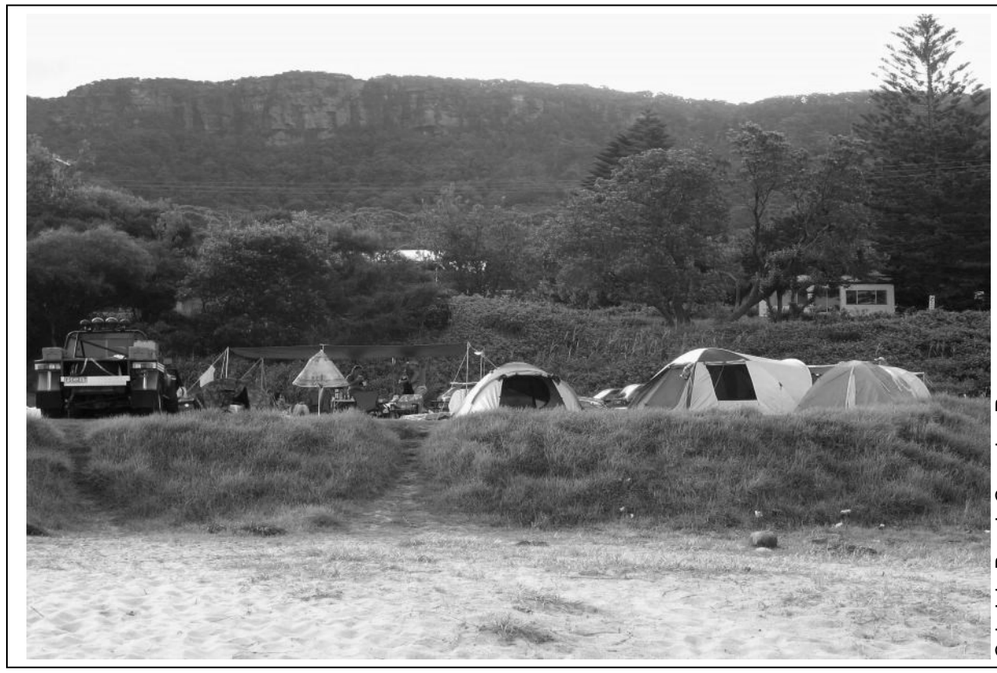
Description:

There are many formal and informal recreational facilities located along the Wollongong Coastline. These include beach accessways, playgrounds, seating, campgrounds and tourist parks, and the WIN football stadium (note the cycleway and other major assets and infrastructure have been discussed separately). Recreational facilities also includes parklands and reserves, which can allow for natural retreat of the beach at the sacrifice of some parkland, without significant overall reduction in the functionality of the park. Allowing this natural retreat of the beach is the key to retaining a sandy beach for public enjoyment, the environmental and the economic benefits associated with the beach.

Recreational facilities (stand alone or within parks) require on-going maintenance and periodic replacement as they approach the end of their design life. As part of the Asset Management process that guides maintenance and remediation of Council assets, these facilities should be repaired as required following storm events, with the longer-term objective of relocation away from the area of immediate coastal risk (for example, relocating tourist cabins or picnic tables within a tourist park or reserve, to allow retreat of the beach). Given the anticipated timeframe for major impact on these facilities, it is expected that progressive landward relocation can be easily achieved as part of future upgrades and replacements.

No specific recreational facilities are under an immediate intolerable risk (i.e. 'high' or 'extreme' level of risk), and therefore, most actions associated with management of recreational facilities are given secondary priority (i.e. Priority ranking '2'). The exception is the general maintenance and repair of existing minor facilities, such as beach access tracks, which is required after any major storm event, and as such, is given a Priority Level of '1'.

It is noted that there are a number of parks and reserves at low to medium risk to 2100. Based upon the low levels of risk, no specific action is required at the current time (indeed, some of these assets are affected by inundation, for which no action is likely to be taken). Should impacts to these parks and reserves occur earlier than anticipated, again, repair storm damage to minor recreational facilities, access tracks etc to maintain public safety would occur in accordance with the EASP.



Coledale Beach Camping Reserve

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Stanwell Park Recreation Area Park and Natural Area	Medium	Medium	High	McCauleys Beach Reserve	High	Extreme	Extreme
Coalcliff Beach Reserve Nature Area, Coalcliff Beach Reserve	Medium	Medium	High	Sandon Point Beach Reserve (not including Sandon Point Heritage area)	Medium	Medium	High
Coledale Beach Reserve	Medium	Medium	High	Bulli Beach Reserve, Ocean Park (Bulli Beach)	Medium	Medium	High
Coledale Beach Camping and Caravan Park	Medium	Medium	High	Bulli Tourist Park (caravan park)	Medium	Medium	High
Sharkys Beach Reserve	Medium	Medium	High	Woonona: Collins Point Reserve, Woonona Beach Reserve, Beach Drive Park	Medium	Medium	High
Little Austinmer Beach Reserve	Medium	Medium	High	Bellambi: Beach Drive Park, Bellambi Natural Area, Bellambi Point Reserve, Bellambi Pool Reserve	Medium	Medium	High
Austinmer Beach Reserve and Tuckermans Park	Medium	Medium	High	Stuart Park (on heritage list, local significance)	Medium	High	Extreme
Thirroul: Tingara Park	Medium	Medium	High	City Beach: Open space, parks including City Beach Foreshore	Medium	Medium	High
Heritage Site: Thirroul Beach Reserve (S of pool)	Medium	High	Extreme	City Beach: Football Ground (WIN Stadium) and Showground	High	Extreme	Extreme
McCauleys: Woodland Avenue Reserve, Corbett Ave Reserve, Sandon Point Reserve	Medium	Medium	High	Coniston: Wollongong Golf Course ** for inundation, this is only a very small section at far south end.	Medium	Medium	High

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
RF.1	Within the context of accepting loss (sacrifice) of park land to allow natural retreat of beaches into parklands behind, repair storm damage to minor recreational facilities, access tracks etc on an as-needed basis to maintain public safety. Where damage is extensive, consider abandoning and relocating assets and access as described in other actions.	Stanwell Park Coalcliff Coledale Sharkys Little Austinmer Austinmer Thirroul McCauleys Sandon Point Bulli Woonona Bellambi Bellambi Pt Corrimal Towradgi Fairy Meadow City Coniston Perkins	1	As needed following damaging erosion and/or inundation events	WCC, WCC in co-ordination with facilities owner for Golf Course land	Dependent on the degree and extent of storm damage. Assume damage would be relatively minor, else the facilities would be relocated and replaced	nil	See 'PR1' Option in Sect.5.4.3 of CZM Study report
RF.2	Physically relocate/reposition Bulli tourist cabins. Tourist cabins are typically low key structures that are relatively easily relocatable.	Bulli	2	When ZRFC measured from erosion escarpment encroaches onto cabins foundations	WCC	Less than $100,000	M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
RF.3	Undertake detailed design, assessment, planning and works to relocate WIN Stadium parking and ancillary buildings and minor football ground outside of hazard zone. There is potential to reconfigure the football ground landward to avoid hazards impacts. The actual WIN Stadium is currently at very low risk but parking and other small buildings adjacent would need to be relocated.	Coniston	2	When erosion escarpment encroaches on the assets	WCC to advise facilities owner of risk and encourage adoption of this action in consultation with WCC.	More than $500,000	M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
	Thirroul Beach Reserve – see Action S.1							
	Austinmer Beach Reserve and Tuckermans Park – see Action S.1 and Action S.4							
	Stuart Park (North Beach) – see Action S.8							

Relevant Programs and Possible Funding Opportunities:

- State and Federal Government Grants (especially climate change adaptation and resilience building funds)
- Council's routine asset maintenance and works program
- Funding of private works by private facilities owners

12 SEAWALLS & TRAINING WALLS (S)


Rockwall at southern end of Corrimal Beach

Description:

There are a few coastal structures located along the Wollongong Coastline that offer protection to land and assets behind the structures to varying degrees of assurance. These include seawalls at Austinmer Beach, Thirroul Beach, Bellambi Beach (behind Bellambi Pool), Bellambi Boat Harbour and boat ramp, North Beach (from Pavilion to the kiosk) and Perkins Beach (at Port Kembla Olympic Pool). There are reports of a possible structure at Scarborough Beach, however details are minimal. Note that there are also extensive seawalls and breakwater structures at Port Kembla Harbour, which are under the direct management responsibility of Port Kembla Port Corporation (PKPC), and as such, are excluded from this CZMP.

The condition of the existing seawalls is expected to be variable, especially for the older structures. Foundation conditions are largely unknown. Storms in 1974 depleted many beaches of sand, and exposed the foundation piles of the structure at Thirroul Beach. The structure at North Beach adjacent to the North Beach Pavilion is currently being replaced.

The Lake Illawarra Entrance training walls have been constructed recently in order to provide a more consistent water level within the lake (the prolonged drought conditions in the early 2000's resulted in lake levels falling more than half a metre below normal ocean levels, causing extensive die-off of algae and seagrass). Whilst the design of these walls considered future sea level rise, on-going maintenance of the structures will still be required as overtopping frequency increases. Raising of the walls may be considered necessary in the future to minimise on-going damage.

Management of seawalls and training walls that are at 'high' or 'extreme' levels of risk at the current timeframe takes highest priority (i.e. Priority ranking '1'), while actions to address 'high' or 'extreme' risks that won't materialise until 2050 or 2100 are given secondary priority (i.e. Priority ranking '2').

Under Section 55 of the Coastal Protection Act, 1979, seawalls may be partially or wholly funded by landholders that are additionally or wholly protected by the structure. In this case, WCC can lobby RMS, SWC and other private landholders for funding assistance, as proposed seawalls would additionally protect Lawrence Hargrave Drive (an RMS road), additionally and wholly protect Bellambi STP (SWC property) and private properties. Under Section 55, Council is permitted to apply a Coastal Protection Service Charge to such landholders to partially or wholly fund ongoing maintenance of the seawalls and offsite impacts.

Property Risk Categories (in accordance with the Coastal Protection Regulation, 2011) for private properties affected by erosion and recession; and Property Response Categories (in accordance with OEH, 2013) that outlines the potential for response in terms of protection works only for such private properties is listed in Appendix A. It is noted that this CZMP has adopted a far more detailed assessment of risk, and investigated many alternative actions additional to protection options. Thus, for Council's use, a summary table of recommended current and future actions for all private properties at risk to 2100 is given in Appendix A.

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Austinmer Beach				Thirroul cont.			
Austinmer Beach Reserve and Tuckermans Park	Medium	Medium	High	Existing Residences (8 ppty at S end of beach, plus 8 ppties for geotechnical hazards extending along headland to McCauleys)	Medium	High	Extreme
Austinmer Surf Club	Medium	High	Extreme	Bellambi			
Heritage Site: Norfolk Island Pines (backing entire beach)	Medium	Medium	High	Cycleway / Shared Pathway (S of Bellambi Gully entrance)	Medium	Medium	High
Austinmer changeroom & toilets	Low	Medium	Medium	Bellambi Pool Toilet Block	Low	Medium	Medium
Austinmer Boatshed	Low	Low	Low	Bellambi Pool car park	Low	Medium	Medium

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Austinmer War Memorial (Heritage Site)	High	Extreme	Extreme	Bellambi Beach Local access road along coastline to harbour (does not service houses)	Medium	High	Extreme
Lawrence Hargrave Drive (Major Coastal Road) at Austinmer	Medium	High	Extreme	Bellambi Point			
Austinmer beach access and car park	Medium	Medium	High	Stormwater outlets and pipes (adjacent to STP)	High	Extreme	Extreme
Stormwater outlets and pipes at Austinmer	High	Extreme	Extreme	Sewage Treatment Plant	High	Extreme	Extreme
Thirroul Beach				North Beach			
Thirroul Surf Club	High	Extreme	Extreme	Stuart Park (on heritage list, local significance)	Medium	High	Extreme
Thirroul Pool (also heritage site)	High	Extreme	Extreme	Public open space adjacent to Pavilion, Kiosk	Low	Medium	Medium
Thirroul Pool office and amenities	High	Extreme	Extreme	North Beach Surf Club	High	Extreme	Extreme
Thirroul Pool toilet	Medium	High	Extreme	Heritage Site: North Beach Kiosk	Low	Medium	High
Thirroul Pool storage shed (large)	Medium	High	Extreme	Cycleway / Shared Pathway (includes heritage railway cuttings and embankments)	Medium	High	Extreme
Heritage site: Thirroul Pavilion (being used as kiosk / restaurant) and residence	High	Extreme	Extreme	Stormwater outlets / pipes (adjacent to Pavilion)	High	Extreme	Extreme
Heritage Site: Thirroul Beach Reserve (S of pool)	Medium	High	Extreme	Perkins Beach			
Local Roads (Bath St)	Low	Medium	Medium	Port Kembla Olympic Pool	High	Extreme	Extreme
Beach access and car park (S end of Beach)	Low	Low	Medium	Port Kembla Pool - Amenities/Kiosk/Lifeguard Tower	High	Extreme	Extreme
Stormwater outlet to Flanagans Creek	Medium	High	High	Stormwater outlets & pipes (one adjacent to Port Kembla Pool)	High	Extreme	Extreme
Thomas Gibson Creek - Major stormwater outlet	High	Extreme	Extreme	Lake Illawarra Training Walls	High	Extreme	Extreme

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
S.1	Conduct audit (dilapidation survey) of existing seawall structures and training walls, to determine their current condition, effectiveness, expected functional life, and future potential to mitigate storm erosion and wave overtopping under higher sea levels. The audit should be used to guide subsequent decisions at the relevant beaches, including future replacement with seawall protection or "manage to fail" (planned retreat) options.	Scarborough Austinmer Thirroul Bellambi Bellambi Pt North Perkins Lake Illawarra Entrance	1	2016/17 Repeated on a 5 – 10yr cycle (or shorter for structures nearing the end of their functional life).	WCC	Staff time only, or minor consultancy (say $20,000)	nil	See 'NR2' Option in Sect.5.4.1 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
S.2	Update hazard estimates for 2010, 2050 and 2100 where relevant to account for existing seawall protection, and update this action list, as necessary, to account for condition (life) of existing seawalls	As above	1	2016/17 (as soon as practical following Action S.1).	WCC	Staff time only or consultant	S.1	See 'NR2' Option in Sect.5.4.1 of CZM Study report
S.3	Add seawalls and training walls to Council's Asset Management Plan, and based on the outcomes of the audit, incorporate remediation, maintenance and replacement works into forward works programs. *Actions S.4 to S.9 apply if supported by the Asset Management Plan. Land status and management arrangements relevant to these actions will need to be clarified. It is highly likely that upgrades to existing infrastructure or new infrastructure may be sited, partly or fully on Crown Land. As a result, land owner consent and/or authorisation of the proposed works by way of Crown tenure/s is likely to be required in order to formalise the occupation of Crown Land and define ongoing maintenance responsibilities.*	As above	1	2016/17 (as soon as practical following Action S.1).	WCC	Staff time only	S.1	See 'NR2' Option in Sect.5.4.1 of CZM Study report
S.4	Undertake detailed design, site investigations, approvals and works associated with repair or replacement of existing seawall along existing alignment, and associated beach nourishment. The design and approvals shall describe ongoing maintenance arrangements for any replacement structure and management of offsite impacts from the structure.	Austinmer	1	When end of functional life is reached (refer Action S.3) OR when wall is structurally damaged by storm event, whichever is sooner.	WCC **WCC** to advise **RMS** of risks and lobby for funding assistance, as this action additionally protects an RMS road.	Depending on scope of works. An entirely new wall may be up to $3.5m	S.3	See 'S1' Option in Sect.5.4.2 of CZM Study report
S.5	Undertake detailed design, site investigations, and approvals as necessary for maintenance and upgrading works of existing seawall along existing alignment, and extension of wall along shoreline section between Bellambi Boat Harbour and Pool. The upgrade design shall provide for protection from wave overtopping; and shall describe adequate arrangements for ongoing maintenance management of impacts from the structure. There is potentially bedrock below the site that could form suitable foundations e.g. between the Pool and Harbour along the roadway.	Bellambi, from Bellambi Gully entrance to Bellambi Pool, then to Bellambi Boat Harbour	2	On as needs basis for asset maintenance (refer Action A.3) or to repair storm damage (e.g. to roadway).	WCC **WCC** to advise **SWC** of risks and lobby for funding assistance, as this action additionally protects SWC assets and land.	Depending on scope of works. Indicative budget of $1m	S.3	See 'S2' Option in Sect.5.4.2 of CZM Study report
S.6	Undertake detailed design, site investigations, and approvals as necessary for maintenance and upgrading works of existing seawall along existing alignment. Specific provision of stormwater outlet required in design of upgrading. The upgrade design shall also describe ongoing maintenance arrangements and management of offsite impacts from the structure.	Bellambi Pt along the boundary of the Sewage Treatment Plant between Bellambi Lagoon and Bellambi Point	1	On as needs basis for asset maintenance (refer Action A.3) or to repair storm damage.	**WCC** to advise **SWC** of risks and lobby for whole or partial funding for this action that protects SWC assets and land.	Depending on scope of works. Indicative budget of $0.5m	S.3	See 'S2' Option in Sect.5.4.2 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
S.7	Undertake detailed design, site investigations, approvals and works associated with the construction of new seawall sections, to the south of North Beach Pavilion, and to north to replace the existing crib-lock wall. The seawall design shall provide for protection from wave overtopping. Design and approvals shall also describe ongoing maintenance arrangements and management of offsite impacts from the structure.	North Beach, (along cycleway to south of Pavilion and to north past existing SLSC, replacing existing crib-lock wall	1	2016/17: detailed designs and planning approvals. Construct crib-wall replacement section subject to audit outcomes (refer Action S.1) and works program (refer Action S.3). Construct section following next major storm erosion event.	WCC	Depending on scope of works, but expected to be in the order of $2 million	S.3	See 'S2' Option in Sect.5.4.2 of CZM Study report
S.8	Undertake detailed design, site investigations, approvals and works associated with the construction of a new seawall section along specified alignment to retain salient and Stuart Park. Design and approvals shall also describe ongoing maintenance arrangements and management of offsite impacts from the structure.	North Beach: short wall section along salient landward of nearshore reef at seaward edge of Stuart Park	2	When monitoring indicates commencement of ongoing recession at salient behind nearshore reef on North Beach.	WCC	Depending on scope of works, but expected to be in the order of $2 million	M.1	See 'S2' Option in Sect.5.4.2 of CZM Study report
S.9	Undertake detailed design, site investigations, and approvals as necessary for maintenance and upgrading works of existing seawall along existing alignment. Specific provision of stormwater outlet required in design of upgrading. The upgrade design shall also describe ongoing maintenance arrangements and management of offsite impacts from the structure.	Perkins (adjacent to Port Kembla Olympic Pool)	1	On as needs basis for asset maintenance (refer Action A.3) or to repair storm damage.	WCC	Depending on scope of works. Indicative budget of $0.5m	S.3	See 'S2' Option in Sect.5.4.2 of CZM Study report
S.10	DoI – Lands & Forestry maintain the Lake Illawarra training walls to ensure their ongoing stability and function. Note that all river training walls managed by DoI – Lands & Forestry are included in an asset management plan that includes regular inspections by qualified engineer.	Lake Illawarra Entrance	1	When end of functional life is reached (refer Action S.3) OR when wave breaking destabilises armour stone OR when frequency of overtopping presents significant risk to pedestrian and boating public.	DoI – Lands & Forestry	In the order of $1m for significant raising of training wall height.	S.3	See 'A2' Option in Sect.5.4.4 of CZM Study report
S.11	Undertake detailed design, site investigations, approvals and works associated with the construction of new seawall sections connecting along the headland from Thirroul to McCauleys Beach. The seawall design shall provide for protection from wave overtopping. Design and approvals shall also describe ongoing maintenance arrangements and management of offsite impacts from the structure. As the seawall only protects private property, in accordance with Section 55 of the *Coastal Protection Act 1979*, Council can require construction and ongoing maintenance to be funded by the private property owners.	Southern end of Thirroul to McCauleys headland, covering 16 properties, for both erosion (8 ppties) and geotechnical hazards (8 ppties).	2	Prior to redevelopment / upgrading of any development identified as "at risk" or when the Immediate Impact Zone (including foundation stability allowance) intersects existing buildings.	Private property owners are responsible for seawall construction and maintenance. Seawalls must be constructed on private land only, not public land. WCC responsible for development assessment.	Depending on scope of works. Indicative budget of $1m.	nil	See 'S2' Option in Sect.5.4.2 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- State and Federal Government Grants (especially climate change adaptation and resilience building funds)
- RMS funding (for on-going protection of Lawrence Hargrave Dr)
- Sydney Water Corporation funding (for on-going protection of STP directly through works on Bellambi Pt, and indirectly through works to protect roadway between Pool and Harbour)
- Council's routine asset maintenance and works program
- New Council levies or increased land rates

13 SURF CLUBS & PUBLIC BUILDINGS (SC)

Description:

Surf Club buildings are generally located immediately behind beaches to provide easy access for lifesaving crews and equipment, as well as commanding views over patrolled and unpatrolled sections of beach. This unfortunately means that the buildings are usually at risk of coastal inundation and storm erosion. With future sea level rise, many of the Surf Club buildings will also be at risk from shoreline recession.

The Surf Club buildings along the Wollongong coastline are in variable condition. City Beach Surf Club has recently been constructed, while there are plans in place for the imminent refurbishment of Sandon Point Surf Club building. A relocatable lifeguard structure is intended for Coledale, which would allow for the structure to be moved landward when beach conditions threaten to impact on the structure.

Other public buildings, such as Pavilions, Kiosks and amenities building are also at risk from current and future coastal erosion and shoreline recession. Relocation (i.e. rebuilding on a more landward site) at the end of their functional life is a viable option for many of these structures. A few of these structures are heritage-listed (e.g. Thirroul Pavilion, North Beach Pavilion, North Beach Kiosk), signifying their importance to the local community. Relocation of these structures to avoid loss and damage in the future may be a viable option.

Management of Surf Clubs and Public Buildings that are at 'high' or 'extreme' levels of risk at the current timeframe takes highest priority (i.e. Priority ranking '1'), while actions to address 'high' or 'extreme' risks that are not expected to materialise until 2050 or 2100 are given secondary priority (i.e. Priority ranking '2').

Sandon Point Surf Club

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Helensburgh / Stanwell Park SLSC	Medium	High	Extreme	Sandon Point Surf Club	High	Extreme	Extreme
Coalcliff Surf Club	Low	Medium	Medium	Bulli Surf Club	High	Extreme	Extreme
Coledale Surf Club	Low	Medium	Medium	Bulli Kiosk and residence	Medium	Medium	High
Coledale Beach Camping Reserve - Amenities Building	Low	Medium	Medium	Woonona Surf Club	Low	Medium	High
Austinmer Surf Club	Medium	High	Extreme	Bellambi Surf Club (affected by inundation)	Medium	High	Extreme
Austinmer Boatshed (affected by wave overtopping)	Medium	Medium	High	Corrimal Surf Club (affected by inundation)	Medium	Medium	High
Thirroul Surf Club	High	Extreme	Extreme	Fairy Meadow SLSC Lifeguard Tower	Low	Medium	Medium
Thirroul Pavilion (Heritage site: currently being used as kiosk / restaurant and residence)	High	Extreme	Extreme	North Beach Kiosk (Heritage Site)	Low	Medium	High
Thirroul: Former Quest House (heritage site) affected by inundation	Medium	High	Extreme				

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
SC.1	Conduct audit (dilapidation survey) of substantial public buildings (including Surf Clubs) to determine current condition, as well as site constraints for future redevelopment, including foundation capacity, and land availability to relocate the structures. Where the site is constrained, the audit shall identify the possibility of replacement with a relocatable structure. The outcomes of the audit shall specify for each asset the future action being "relocate", "redesign", "retrofit" or "relocatable". The audit shall also make note of suitable triggers for implementation of future action, and guide implementation of future works on these public structures.	Helensburgh Surf Club Coalcliff Surf Club Coledale Surf Club Coledale Camping Amenities Austinmer Boatshed Austinmer Surf Club Thirroul Surf Club Thirroul Pavilion Sandon Pt Surf Club Bulli Surf Club Bulli Kiosk Woonona Surf Club Bellambi Surf Club Corrimal Surf Club North Beach Kiosk North Beach Pavilion	1	2016/17 or as soon as practical	WCC	Staff time only, or minor consultancy (say $30,000)	nil	See 'NR3' Option in Sect.5.4.1 of CZM Study report
SC.2	Add public buildings (including Surf Clubs) to Council's Asset Management Plan, and based on the outcomes of the audit, incorporate remediation, maintenance and replacement works into forward works programs, with specific notification of "relocate", "redesign", "retrofit" or "relocatable". *Actions SC.3 to SC.17 apply if supported by the Asset Management Plan.*	As above	1	2016/17 (as soon as practical following Action SC.1)	WCC	Staff time only	SC.1	See 'NR3' Option in Sect.5.4.1 of CZM Study report
SC.3	Undertake detailed design, site investigations, and approvals as necessary to relocate and redesign Coledale SLSC to withstand coastal impacts, particularly inundation (the proposed relocatable lifeguard structure at Coledale reduces need to have clubhouse in close proximity to the shoreline, enabling relocation, subject to outcomes of SC.1)	Coledale	2	When monitoring shows that ZRFC measured from erosion escarpment threatens building foundations OR when building reaches end of functional life and requires major refurbishment.	WCC	More than $500,000	SC.2	See 'A3' Option in Sect.5.4.4 of CZM Study report
SC.4	Undertake detailed design, site investigations, and approvals as necessary to relocate Helensburgh / Stanwell Park SLSC outside of hazard zone. There are likely to be some site constraints (Norfolk Is Pine) that limit relocating the surf club (subject to audit – SC.1).	Stanwell Park	2	When monitoring shows that ZRFC measured from erosion escarpment threatens building foundations OR when building reaches end of functional life and requires major refurbishment. (within 20 years expected)	WCC	More than $500,000	SC.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
SC.5	Undertake detailed design, site investigations, and approvals as necessary to redesign or retrofit construction of Austinmer SLSC in current location to withstand coastal impacts, such as wave impacts and inundation. Design parameters for the structure (e.g foundation requirements) will be dependent upon the presence and condition of a seawall structure (refer Action S.4). Subject to outcomes of audit (Action SC.1), relocation of the SLSC is unlikely due to land constraints.	Austinmer	2	When monitoring shows that ZRFC measured from erosion escarpment threatens building foundations OR when building reaches end of functional life and requires major refurbishment. (within 20 years expected)	WCC	More than $500,000	SC.2 M.1	See 'A2' Option in Sect.5.4.4 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
SC.6	Undertake detailed design, site investigations, and approvals as necessary to relocate Thirroul Pavilion outside of hazard zone. Consideration will need to be given to ensure that a relocated Thirroul Pavilion retains heritage character and value (i.e. by physically moving existing structure).	Thirroul	1	When monitoring shows that ZRFC measured from erosion escarpment threatens building foundations OR when building reaches end of functional life and requires major refurbishment. (within 20 years expected)	WCC	More than $500,000	SC.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
SC.7	Undertake detailed design, site investigations, and approvals as necessary to relocate Thirroul SLSC outside of hazard zone (i.e. by constructing a new replacement structure).	Thirroul	1	When monitoring shows that ZRFC measured from erosion escarpment threatens building foundations OR when building reaches end of functional life and requires major refurbishment.	WCC	More than $1m	SC.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
SC.8	Undertake detailed design, site investigations, and approvals as necessary to relocate Bulli Surf Club and Kiosk. There is likely to be sufficient space for relocating the surf club and kiosk in the future (subject to audit – SC.1).	Bulli	1	When buildings reach end of functional life and require major refurbishment. (within 20 years expected)	WCC	More than $500,000	SC.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
SC.9	Undertake detailed design, site investigations, and approvals as necessary to relocate Woonona SLSC outside of hazard zone. There is likely to be sufficient space for relocating the surf club in the future (subject to audit – SC.1).	Woonona	2	When building reaches end of functional life and requires major refurbishment. (within 20 years expected)	WCC	More than $500,000	SC.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
SC.10	Undertake detailed design, site investigations, and approvals as necessary to redesign or retrofit construction of Bellambi Surf Club in current location to withstand wave inundation. Development controls (such as the Flood DCP) would constrain redesign in respect to still water inundation.	Bellambi	2	When building reaches end of functional life and requires major refurbishment. (within 20 years expected)	WCC	More than $200,000	SC.2 M.1	See 'A2' Option in Sect.5.4.4 of CZM Study report
SC.11	Undertake detailed design, site investigations, and approvals as necessary to redesign or retrofit construction of Corrimal Surf Club in current location to withstand inundation impacts. Development controls (such as the Flood DCP) would constrain redesign in respect to still water inundation.	Corrimal	2	When building reaches end of functional life and requires major refurbishment. (within 20 years expected)	WCC	More than $200,000	SC.2 M.1	See 'A2' Option in Sect.5.4.4 of CZM Study report
SC.12	Relocate lifeguard tower structure outside of hazard zone. The lifeguard tower is at low risk, and there is no immediate need for action. When impacts become imminent, the tower is a low key structure that will be easily relocatable.	Fairy Meadow	2	When monitoring shows that ZRFC measured from erosion escarpment encroaches onto structure foundations	WCC	Approx. $20,000	SC.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report
SC.13	Undertake detailed design, site investigations, and approvals as necessary to redesign or retrofit construction of the North Beach Kiosk structure in current location to withstand coastal impacts, such as wave erosion and inundation. The Kiosk structure could be retrofit during asset maintenance. Design parameters for the structure (e.g. foundation requirements) and possible future location will be dependent upon the presence and condition of a seawall structure (refer Action S.7).	North	2	When building requires significant maintenance OR when monitoring shows that ZRFC measured from erosion escarpment encroaches onto building foundations, whichever is sooner	WCC	More than $200,000	SC.2 M.1	See 'A2' Option in Sect.5.4.4 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
SC.14	Ensure re-development of Sandon Point Surf Club is designed to withstand wave inundation and coastal erosion impacts (e.g. suitable foundation capacity, floor levels, etc).	Sandon Point	1	Currently in progress	WCC	More than $ 1m	nil	See 'PR2' Option in Sect.5.4.3 of CZM Study report
SC.15	Undertake detailed design, site investigations, and approvals as necessary to redesign or retrofit Austinmer Boatshed in current location to withstand wave impacts and wave inundation. *Design parameters for the structure (e.g foundation requirements) will be dependent upon the presence and condition of a seawall structure (refer Action S.4).*	Austinmer	2	When monitoring shows that wave inundation frequency is greater than 1/month OR when building reaches end of functional life and requires major refurbishment. (within 20 years expected)	WCC	More than $500,000	SC.2 S.4 M.1	See 'A2' Option in Sect.5.4.4 of CZM Study report
SC.16	Undertake detailed design, site investigations, and approvals as necessary to retrofit the former Quest House in current location to withstand inundation impacts. Flood DCP provisions would provide guidance for requirements. May involve raising existing structure in current location.	Thirroul	2	At next major refurbishment of the heritage site (within 20 years expected)	WCC	More than $200,000	SC.2 M.1	See 'A2' Option in Sect.5.4.4 of CZM Study report
SC.17	Undertake detailed design, site investigations, and approvals as necessary to relocate Coalcliff SLSC outside of hazard zone. There is likely to be sufficient space for relocating the surf club in the future (subject to audit – SC.1). (Redesign with suitable foundations is a secondary option, if relocation is not possible). *Coalcliff is highly constrained by bedrock, making the need for the SLSC to remain in current location unlikely, because of retreat of the shoreline. Relocation of the SLSC would require reconfiguring of the access road and carpark – this would be required with a retreated shoreline in any case.*	Coalcliff	2	When building reaches end of functional life and requires major refurbishment.	WCC	More than $500,000	SC.2 M.1	See 'PR2' Option in Sect.5.4.3 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- State and Federal Government Grants (especially climate change adaptation and resilience building funds, or community infrastructure funds)
- Council's routine asset maintenance and works program
- New Council levies or increased land rates
- Revenue generated from hire or rental of public buildings and amenities (e.g. pavilions and kiosks)

14 FURTHER STUDIES & PLANS (SP)

Description:

While this CZMP has considered the impacts and risks of coastal processes, it is clear that risks can be amplified when coastal storms and inundation coincide with heavy rainfall and catchment-derived flooding. Consideration of future sea level rise is an important part of strategic flood planning.

There are a number of areas along the Wollongong Coastline where coastal inundation can combine with catchment flooding to exacerbate impacts and flood conditions. Further studies are required to investigate the likely flood levels and inundation extents under these conditions. Key areas needing investigation include Thirroul, where some 150 residences are potentially affected by coastal inundation, and Woonona, where up to 100 properties could be flooded through backwater inundation and wave overtopping of the coastal dunes.

Flooding and inundation of the narrow coastal plain along the Wollongong northern beaches is likely to have severe ramifications for traffic and access for emergency response crews, with Lawrence Hargrave Drive potentially affected. As such, an Emergency Response Plan should be developed in concert with Emergency Services (e.g. SES, NSW Police) and co-ordinated with the regional DISPLAN.

Some further studies and plans are required to help address 'high' or 'extreme' level of risk at the current timeframe, and as such, these take highest priority (i.e. Priority ranking '1'), while studies and plans to address 'high' or 'extreme' risks that won't materialise until 2050 or 2100 are given secondary priority (i.e. Priority ranking '2').

Emergency response during Brisbane floods (2011)

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Stanwell Park: Existing Residences (edge of 6 ppties at S end of beach next to Stanwell Ck)	Medium	High	Extreme	Thirroul: Existing Residences (151 cadastral parcels)	Medium	High	Extreme
Stanwell Park: Existing Residences (Edge of 13 ppties at upper reach of Stanwell Ck)	Medium	High	Extreme	McCauleys: Existing Residences (8 ppties at N end of beach)	Medium	High	Extreme
Stanwell Park: Vacant Land (Future Development) (edge of 4 ppties at S end of beach next to Stanwell Ck)	Low	Medium	High	Sandon Point: Existing Residences (adjacent to Slacky Creek; S end of beach off Blackall St)	Medium	High	Extreme
Stanwell Park: Kiosk (in Stanwell Park Recreation Area)	Medium	High	Extreme	Bulli Tourist Park (caravan park)	Medium	Medium	High
Stanwell Park: Reserve Dwelling	Medium	High	Extreme	Bulli: Existing Residences (adjacent to Whartons Creek & Stormwater System)	Medium	High	Extreme
Stanwell Park: Reserve Toilets	Medium	Medium	High	Existing Residences (19 at centre of beach)	Medium	Medium	High
Coledale Beach Camping and Caravan Park	Medium	Medium	High	Woonona: Existing Residences (80 along creek & stormwater alignments, centre of beach)	Medium	High	Extreme
Austinmer: Lawrence Hargrave Drive (Major Coastal Road)	Medium	High	Extreme	Bellambi: Bellambi SLSC and cycleways, next to Bellambi Gully	Medium	High	Extreme
Austinmer: Neighbourhood Business Centre (local shops)	Medium	Medium	High	Bellambi Point: Existing Residences (10 adjacent to Bellambi Lagoon)	Medium	Medium	High
Thirroul: Major Roads (Lawrence Hargrave Drive)	High	Extreme	Extreme	Corrimal: Existing Residences (37 adjacent to Towradgi Lagoon / Creek)	Medium	High	High
Thirroul: Local Roads (Bath St linking to the Esplanade, Henley St, Road reserve for Harbord & Ocean Sts)	Medium	High	Extreme	North Beach (Fairy Lagoon): Major roads (Pioneer Road)	Medium	High	High
				North Beach (Fairy Lagoon): Cycleway / Shared Pathway (adjacent to Squires Way)	Medium	Medium	High

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
SP.1	Develop interim flood emergency response and evacuation plans for roads and properties affected by coastal inundation outside of existing flood planning areas. This includes arterial roads, such as Lawrence Hargrave Drive. As flood studies are completed for these areas (refer Action SP.2), update flood emergency response plans with more considered floodplain management strategies.	Austinmer	2	2016/17 / Immediately	WCC	Staff time only or minor consultancy (say $25,000)	nil	See 'NR9' Option in Sect.5.4.1 of CZM Study report
		Thirroul (Lawrence Hargrave Drive, local roads, affected properties)	1					
		Sandon Point to Bulli Beach (Whartons Ck)	2					
		Woonona (Beach Dr, affected properties)	2					
		Bellambi Lagoon (local roads & properties).	2					
		Bellambi Gully (local roads, SLSC, cycleways).	2					
		Fairy Lagoon (Pioneer Rd, cycleway, Stuart Park access)	2					
SP.2	Update or commence flood studies at all catchments that are impacted by elevated ocean water levels in flood mapping and management. Update Flood Planning Areas and manage accordingly, such as through the NSW Government's Floodplain Risk Management process. Flood studies should consider combined catchment flooding and elevated oceanic water levels, including the latest sea level rise predictions. The combined flood modelling shall then by used to determine the level of risk from such hazards (i.e. clarify Flood Risk Precincts) and therefore the appropriate planning controls that should apply (i.e. based on WCC DCP Chapter E13).	Stanwell Park (Hargraves & Stanwell Creeks)	1	As soon as practical, with priority to areas where a significant number of private properties are potentially affected.	WCC	Depending on the scope and extents of flood areas (typically $40,000 - $80,000 per major catchment / floodplain)	nil	See 'NR10' Option in Sect.5.4.1 of CZM Study report
		Coledale (Carricks, Daly, Stockyard Creeks)	2					
		Austinmer	1					
		Thirroul (Flanagans & Thomas Gibson Creeks)	1					
		Bulli (Whartons Creek)	1					
		Woonona (Creek at Lighthorse Drive)	1					
		Bellambi Lagoon, Bellambi Gully	2					
		Fairy Lagoon	2					
		Update existing flood studies to include sea level rise and elevated oceanic water levels.	1					
SP.3	Undertake further investigations to determine an appropriate response to managing risks to both Council assets and 19 properties at risk by 2100 on Woonona Beach. Risks to private properties on Woonona Beach are not expected to materialise until 2100. However, services to the properties, in particular road access along Beach Drive, are likely to be affected well before 2100. Indeed the seaward edge of the road may be impacted by extreme storm erosion at present. Therefore, a decision is required at the present time regarding the response to managing the private properties, as this affects how the road and services shall be managed and vice versa. The key long term options available are: • construction of seawall protection, which would significantly alter the morphology and amenity of the beach; or	Woonona Beach	1	2016/17 / Immediately	WCC	Staff time only, or minor consultancy	R.2 (for Beach Drive) C.2 (for cylceway along beach) ST.2 (for outlet under Beach Drive)	See Section 6.11 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
	• acquisition of the 19 private properties and relocation of Council's assets, to allow the beach to retreat landward, preserving the sandy beach amenity for the greater community and environment. However, selecting one of these options for Woonona Beach is complicated by the following factors, and therefore requires further investigation through detailed studies: • ensuring ongoing services to the properties, such as road access, sewer, water and stormwater, all of which are likely to be affected well before the properties themselves • SWC in particular must be involved in the selection of a preferred management option for their sewer pipeline (that is seaward of the properties) that is considerate of Council, private properties owners and other beach users and stakeholders ; • the legal implications of current legislation, particularly the *Coastal Protection Act, 1979*, that may limit / constrain options for managing the private properties; and • the political will and financial assistance required for either of the options. Further details to be considered as part of this Action are outlined below							

<u>Further Details for SP.3 at Woonona</u>:

Beach	Aspects to be considered as part of further investigations
Woonona	As a seawall would additionally protect private property owners, Council may levy such owners for ongoing maintenance of the wall under the *Coastal Protection Act, 1979*. However, there is no mechanism to levy private owners for the capital cost of a seawall, which would be a significant upfront expense (> $5 milllion) for either private owners and / or Council. Seawall construction would significantly affect the character and amenity of the beach. With sea level rise, it will not be sustainable to maintain sand across the walled section of beach. Instead, the seawall would essentially form a headland, with adjacent beach sections retreating further landward. Current legislation requires minimal impacts and ongoing maintenance of beach amenity as a condition for new seawall construction, thus a seawall at Woonona may not be able to meet such requirements. Council may not need to protect its own assets, and this should be determined through Action R.2, Action C.2 and Action ST.2. A key consideration will also be the approach of SWC to managing its sewer pipeline, located seaward of the properties. Any decision by SWC will necessarily affect the approach taken by Council and also affect the private properties, and vice versa. Collaboration on an approach from the three parties is required. Council's roadways are largely provided for the residential properties and therefore are not required unless the properties are retained (indeed there is a possibility of provision of rear access to these properties). The cycleway and stormwater assets adjacent and below the road can be relocated. However, should Council choose to sacrifice and abandon its assets, services to the 19 private properties would be affected. Further, should Council abandon its own assets and permit private property owners to construct a seawall at their own expense, it is not possible to maintain access to the private properties without protecting Councils assets, and therefore any privately funded seawall would still need to be constructed on public land. This is inconsistent with current legislation, unless Council is a partner in construction of the option. Acquisition of the 19 properties and relocation of Council's assets would provide the best outcome for the beach environment and the larger number of nearby residents and other community users. This is because the assets and properties would be removed to allow the beach to retreat, therefore retaining a sandy beach amenity. The "buy back/ lease back" option would enable the private properties to be utilised until the roadway access is impacted to a level that it is no longer safe, enabling some recouping of costs for property purchase. However, there is currently no suitable or sufficient financial assistance for Council to undertake such an action, through mortgage arrangements or otherwise. That is, while mortgage repayments would be assisted by long term leasing of the properties, the initial deposit for property purchase and low interest loan arrangements require State or Federal government assistance. There is currently no arrangement or mechanism for Council to apply for such assistance. In considering acquisition and retreat as an option, the human impacts to the 19 property owners, and the potential for long term impacts to rear properties (i.e. well into the future when the front lots have been eroded) needs also to be considered. Should long term acquisition and retreat be the selected action, it is imperative that concerted community education be undertaken to ensure that the greater community understands the advantages to them from such an action (compared with seawall protection that favours the individual seafront owners protected because of the long term impacts on beach amenity discussed above).

<u>Relevant Programs and Possible Funding Opportunities</u>:

- NSW Government Grants (including the Floodplain Management Program)
- Federal and State Government Emergency Management Funding

15 STORMWATER (ST)

Description:

Catchment runoff from the Illawarra Escarpment and the coastal plain is all directed into the ocean through natural waterways and urban stormwater systems. There are a large number of stormwater outlets that discharge directly onto beaches along the Wollongong Coastline. As outlined previously, there is a small local hazard associated with erosion of sand at these stormwater outlets, however, these typically do not have major implications for broader beach erosion or shoreline recession.

The stormwater outlets themselves are structures that are at risk from coastal processes and hazards. Erosion around the structures can compromise their integrity, causing failure, while coastal inundation may create backwater effects along the stormwater system, or prevent effective drainage during heavy rains.

It is recommended that stormwater outlets be relocated landward wherever feasible, as part of Council's on-going stormwater maintenance and refurbishment program. Where it is not feasible for relocation, then stormwater outlets would need to be redesigned or retrofitted to withstand coastal impacts in the future, without compromising their function from a drainage perspective.

Management of stormwater assets that are at 'high' or 'extreme' level of risk at the current timeframe takes highest priority (i.e. Priority ranking '1'), while actions to address 'high' or 'extreme' risks to stormwater that won't materialise until 2050 or 2100 are given secondary priority (i.e. Priority ranking '2').

Outflow adjacent to Thirroul Pool

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Stanwell Park: Stormwater outlets and pipes (servicing upper reaches surrounding Stanwell Ck)	High	Extreme	Extreme	Woonona: Stormwater outlets and pipes (N end at Kurraba Rd)	High	Extreme	Extreme
Stanwell Park: Stormwater outlets and pipes (servicing across Stanwell Park adjacent to Kiosk and from N carpark to Hargraves Ck)	High	Extreme	Extreme	Woonona: Stormwater outlets and pipes (connecting line from Kurraba Rd to Beach Drive along beachfront)	High	Extreme	Extreme
Coalcliff: Stormwater outlet and pipe (S end of beach)	Low	Medium	High	Woonona: Stormwater outlets and pipes (along seaward edge of Beach Drive)	High	Extreme	Extreme
Scarborough / Wombarra: Stormwater outlets and pipes (3 at S end Wombarra Beach)	High	Extreme	Extreme	Bellambi: Stormwater outlets and pipes (adjacent to Bellambi Pool carpark)	High	Extreme	Extreme
Coledale: Stormwater outlets and pipes (1 at S end at Carrick Ck, 2 beach parallel at Dalys Ck)	High	Extreme	Extreme	Bellambi: Stormwater outlets and pipes (under Bellambi SLSC carpark)	High	Extreme	Extreme
Sharkys: Stormwater outlets and pipes	High	Extreme	Extreme	Bellambi Point: Stormwater outlets and pipes (adjacent to STP)	High	Extreme	Extreme
Little Austinmer : Stormwater outlets and pipes	High	Extreme	Extreme	Bellambi Point: Stormwater outlets and pipes (into Bellambi Lagoon)	High	Extreme	Extreme
Austinmer: Stormwater outlets and pipes	High	Extreme	Extreme	Corrimal: Stormwater outlets and pipes	High	Extreme	Extreme
Thirroul: Stormwater outlet to Flanagans Creek	Medium	High	High	Towradgi: Stormwater outlet / pipe (N end)	High	Extreme	Extreme
Thirroul: Stormwater outlets and pipes to upper Flanagans Ck catchment	High	Extreme	Extreme	North Beach: Stormwater outlets / pipes (at Lagoon entrance)	High	Extreme	Extreme
Thirroul: Thomas Gibson Creek - Major stormwater outlet	High	Extreme	Extreme	North Beach: Stormwater outlets / pipes (adjacent to Pavilion)	High	Extreme	Extreme
McCauleys: Stormwater outlets and pipes (N end of beach)	High	Extreme	Extreme	North Beach: Stormwater outlets / pipes (at Lagoon Restaurant)	High	Extreme	Extreme

Sandon Pt: Stormwater outlets and pipes (S end of beach)	High	Extreme	Extreme	Perkins: Stormwater outlets & pipes (one adjacent to Port Kembla Pool)	High	Extreme	Extreme
Sandon Pt: Stormwater outlets and pipes (Centre of beach)	High	Extreme	Extreme	Lake Illawarra: Stormwater outlets / pipes	Medium	High	High
Bulli: Stormwater outlets and pipes	High	Extreme	Extreme				

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
ST.1	Undertake stormwater asset audit and investigate appropriate design elements for stormwater infrastructure for periodic inundation with seawater and / or wave action and utilise as assets are replaced. The audit will identify where and when stormwater assets will be affected by wave attack and/or permanent inundation with sea level rise, to determine future conveyance capacity. The audit is also to determine functional lifespan of existing stormwater assets, noting that seawater is expected to yield shorter design life. For assets affected by erosion, simply withstanding wave attack may not be sufficient if erosion of land around the structure makes it impractical.	Stanwell Park Coalcliff Scarborough / Wonbarra Coledale Sharkys Little Austinmer Austinmer Thirroul McCauleys Sandon Pt Bulli Woonona Bellambi Bellambi Pt Towradgi Corrimal North Beach Perkins Lake Illawarra	1	2016/17 or as soon as practical	WCC	Staff time only, or minor consultancy (say $50,000)	nil	See 'NR7' Option in Sect.5.4.1 of CZM Study report
ST.2	Update stormwater assets in Council's Asset Management Plan, and based on the outcomes of the audit, incorporate remediation, maintenance, relocation and replacement works into forward works programs. *Actions ST.3 and ST.4 apply if supported by the Asset Management Plan.*	As above	1	2016/17 or as soon as possible after ST.1	WCC	Staff time only	ST.1	See 'NR7' Option in Sect.5.4.1 of CZM Study report
ST.3	Undertake detailed design, assessment, planning and works to relocate stormwater assets landward of hazard zone. Subject to confirmation by Action ST.1, it is likely that the outlets and pipes can be progressively removed and relocated landward as erosion occurs. However, the new outlets will also need to be designed to withstand inundation with sea level rise and wave overtopping. Relocation of outlet to Thomas Gibson Creek at Thirroul will be dependent upon outcomes of Action S.1	Coalcliff	2	When erosion or wave overtopping destabilises outlet OR when inundation frequency impedes effective conveyance of stormwater OR when asset replacement is required, whichever is sooner.	WCC	Dependent on size, siting and degree of relocation of the stormwater outlet. Typically less than $50,000 each.	ST.2	See 'PR2' Option in Sect.5.4.3 of CZM Study report
		Scarborough / Wombarra	1					
		Little Austinmer	1					
		Thirroul	1					
		McCauleys (N end of beach)	2					
		Sandon Pt	1					
		Bulli	2					

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
		Woonona	1					
		Towradgi (N end of beach)	2					
		North (Fairy Lagoon)	1					
ST.4	Undertake detailed design, assessment, planning and works to redesign or retrofit stormwater structures in current location to withstand impacts. In the first instance, stormwater assets should be relocated out of the hazard zone (refer ST.3), but for some locations this will not be practical or feasible. The outcomes of Action ST.1 shall guide suitable designs for ensuring conveyance of stormwater with more frequent inundation with sea level rise. *This provision will still be required for assets protected by seawalls (i.e. Austinmer; Bellambi adjacent to pool carpark; Bellambi Point adjacent to STP; and Perkins Beach adjacent to Port Kembla Pool)*	Stanwell Park	1	When erosion or wave overtopping destabilises outlet OR when inundation frequency impedes effective conveyance of stormwater OR when asset replacement is required, whichever is sooner.	WCC	Dependent on size, siting and degree of protection required at the stormwater outlet. Typically less than $50,000 each.	ST.2	See 'A2' Option in Sect.5.4.4 of CZM Study report
		Coledale	1					
		Sharkys (Austinmer Boat Harbour)	1					
		Austinmer	2					
		McCauleys	1					
		Sandon Pt (Trinity Row)	1					
		Bulli	1					
		Woonona (Lighthourse Dr Ck)	1					
		Bellambi (pool carpark)	1					
		Bellambi Pt (next to STP)	1					
		Corrimal	1					
		North Beach	1					
		Perkins	2					
		Lake Illawarra	2					

Relevant Programs and Possible Funding Opportunities:

- State and Federal Government Grants (especially climate change adaptation and resilience building funds)
- Council's routine asset maintenance and works program
- New Council levies or increased land rates

16 VEGETATION & HABITATS (V)

Description:

Although much of the Wollongong Coastline is developed, it still retains a number of pockets of vegetation that provide significant habitat value. Indeed there are several Endangered Ecological Communities (EEC) located within the Wollongong Coastal Zone.

The vegetated coastal dune systems also provide significant habitat value to coastal species. Significant efforts have been made over the past 30 years to vegetate and rehabilitate coastal dunes through Council's Dunecare program. This has effectively eliminated risks associated with sand drift, and has helped to secure healthy sand reserves along many of the beaches to act as a buffer against future storm erosion events.

Bitou bush and other invasive species are still problematic along the coast, meaning that Council's efforts in coastal dune rehabilitation will be on-going for many years to come. There are also local issues associated with dune vegetation, for example the monoculture of *Acacia sophorae* dominating dune vegetation at Woonona Beach (and other beaches) that is affecting beach amenity. The development of a Dune Management Strategy shall seek to address issues associated with weeds and dune vegetation species, to alleviate such local concerns. The sightline requirements of the surf clubs, particularly in those locations where lifeguard towers are not able to be provided, is also of key concern.

All beaches and beach dunes are under 'high' or 'extreme' risk at the current timeframe, and as such, dune revegetation works are given the highest priority (Priority Level '1'). With the exception of Bellambi Lagoon, other important habitats along the coastal zone are not under immediate risk ('high' or 'extreme' risks won't materialise until 2050 or 2100), and therefore are given a secondary priority (Priority Level '2').

Coastal Dune System, City Beach

Risks Addressed by Implementation of Strategy:

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Stanwell Park Beach	High	Extreme	Extreme	Bulli: Collins Creek	Medium	High	Extreme
Stanwell Park Coastal Dune Systems	High	Extreme	Extreme	Woonona Beach	High	Extreme	Extreme
Stanwell Park: Hargraves Creek	Medium	Medium	High	Woonona Coastal Dune Systems	High	Extreme	Extreme
Stanwell Park: Stanwell Creek	Medium	High	High	Woonona: Creek at Lighthorse Drive and adjacent habitat	Medium	Medium	High
Coalcliff Beach	High	Extreme	Extreme	Bellambi Beach	High	Extreme	Extreme
Coalcliff: Stoney Creek	Medium	Medium	High	Bellambi Beach Coastal Dune Systems	High	Extreme	Extreme
Scarborough and Wombarra Beaches	High	Extreme	Extreme	Bellambi Gully and adjacent habitat	Medium	High	Extreme
Scarborough / Wombarra: Small creek / drainage lines (S end and centre of Scarborough beach)	Low	Medium	Medium	Bellambi Point Beach	High	Extreme	Extreme
Scarborough Recreation Reserve, Jim Allen Oval Natural Area	Low	Medium	Medium	Bellambi Point Coastal Dune Systems	High	Extreme	Extreme
Coledale Beach	High	Extreme	Extreme	Heritage Site: Bellambi Lagoon and associated habitat	High	Extreme	Extreme
Coledale: Carricks Creek	Medium	High	Extreme	Corrimal Beach	High	Extreme	Extreme

	Risk Now	Risk at 2050	Risk at 2100		Risk Now	Risk at 2050	Risk at 2100
Coledale: Stockyard Creek	Medium	High	Extreme	Corrimal Coastal Dune Systems (Corrimal Beach Natural Area, Towradgi Park)	High	Extreme	Extreme
Coledale: Dalys Creek	Medium	Medium	High	Corrimal Beach: Towradgi Lagoon and adjacent EEC Habitat	Medium	High	Extreme
Coledale: EEC - Coastal Headland Banksia Scrub	Medium	Medium	High	Towradgi Beach	High	Extreme	Extreme
Sharkys Beach	High	Extreme	Extreme	Towradgi Coastal Dune Systems	High	Extreme	Extreme
Little Austinmer Beach	High	Extreme	Extreme	Towradgi Beach Reserve (dune vegetation)	Low	Low	Medium
Little Austinmer Coastal Dune Systems	High	Extreme	Extreme	Fairy Meadow Beach	High	Extreme	Extreme
Austinmer Beach	High	Extreme	Extreme	Fairy Meadow Coastal Dune Systems	High	Extreme	Extreme
Thirroul Beach	High	Extreme	Extreme	Fairy Lagoon and Habitat (part of Puckeys Estate lands)	Medium	High	Extreme
Thirroul: Tingara Park	Medium	Medium	High	North Beach	High	Extreme	Extreme
Thirroul: Flanagans Creek	Medium	Medium	High	North Beach: Stuart Park (on heritage list, local significance)	Medium	High	Extreme
Thirroul Coastal Dune System (small area adjacent to creek entrance)	High	Extreme	Extreme	City Beach	High	Extreme	Extreme
McCauleys Beach	High	Extreme	Extreme	Open space, parks including City Beach Foreshore, dune lands part of WIN Stadium Grounds	Medium	High	Extreme
McCauleys: Hewitts Creek	Medium	Medium	High	City Beach Coastal Dune Systems	Medium	Medium	High
McCauleys: Tramway Creek	Low	Medium	Medium	Coniston Beach	High	Extreme	Extreme
McCauleys Coastal Dune Systems (S end)	High	Extreme	Extreme	Coniston Coastal Dune Systems; dune lands part of Wollongong Golf Course	High	Extreme	Extreme
Sandon Point Beach	High	Extreme	Extreme	Fishermans Beach & MM Beach	High	Extreme	Extreme
Sandon Point: Slacky Creek	Medium	Medium	High	Perkins Beach, including Port Kembla Beach and Windang Beach	High	Extreme	Extreme
Sandon Pt Coastal Dune Systems (N end of beach)	High	Extreme	Extreme	Coastal Dune Systems: Pork Kembla Beach, Perkins Beach Reserve, Windang Beach	High	Extreme	Extreme
Bulli Beach	High	Extreme	Extreme	Lake Illawarra: EEC Swamp Oak Floodplain Forest	Medium	Medium	High
Bulli Coastal Dune Systems	High	Extreme	Extreme	Lake Illawarra: EEC Coastal Swamp Oak Forest	Low	Medium	Medium
Bulli: Whartons Creek	Medium	Medium	High				

Refer accompanying CZM Study for beach by beach assessment of erosion/recession risks and inundation risks

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
V.1	Prepare and implement an LGA-wide Dune Management Strategy that incorporates reviewing and enhancing existing dunecare programs, recruits new volunteers (including targeting SLSC members) and prioritised locations for dune vegetation and weed removal across the LGA and within individual beach compartments. Where existing dune vegetation is sufficient or substantial, the Dune Management Strategy shall focus on weeds and vermin removal, plant species diversity and vegetation height management, to ensure beach amenity values are not substantially degraded. For example, where monocultures of *Acacia sophorae* (or other species) are found, the Dune Management Strategy provides a mechanism for Council to introduce greater species diversity to reduce the proliferation of the species. Dune vegetation programs must be considerate of sightline requirements of all Surf Clubs in the LGA, such as detailed in Council's Draft Beach Sightline Strategy (2007). Liaison with SLSC and use of appropriate low-growing species across key sightlines is required (in some cases this may involve replacement of existing tall species with suitable low growing species). The Coastal Dune Management Manual (2001) shall also be a reference document for Council in developing and implementing the Dune Management Strategy. Dune vegetation works can be used as an opportunity to educate the community regarding the growth of dune volumes and value as beach protection. The increase of dune height which occurs as dune species capture sediments within the beach system additionally provides a higher barrier to mitigate wave overtopping effects.	All beaches and coastal dune systems along the Wollongong coastline	1	2016/17 or as soon as practical	WCC	Staff time only Costs for on-going dunecare works subject to funding availability	Nil	See 'DV' Option in Sect.5.4.2 of CZM Study report
V.2	Utilise Norfolk Island Pines in new coastal plantings by Council, as appropriate. This would ensure continued use of this plant as a marker of coastal settlement. Where possible, new plantings to replicate or replace perished or eroded trees should be sought, outside of hazard zones. This action recognises the cultural importance of Norfolk Island Pines in coastal development along the Wollongong Coastline.	All beaches (see Heritage strategy for listings), especially: • Coledale • Sharkys • Little Austinmer • Thirroul • Sandon Pt • North Beach	2	2016/17 / immediately	WCC	Staff time only	Nil	See 'NR12' Option in Sect.5.4.1 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
V.3	Undertake an audit of all EECs and important habitat areas within the hazard zones and implement buffers and rehabilitation as appropriate. This option would involve: • Identifying important flora/fauna species that, due to their limited distribution, will need to be translocated; • Prioritising rehabilitation requirements based upon the relative threat to distributions from coastal hazard impacts, to ensure lower risk distributions are protected and enhanced; and • Identifying areas that can be designated buffers around important habitats, to enable migration in response to hazard impacts, i.e. erosion and recession, as well as migration in response to sea level rise. The outcomes of the audit should feed into existing biodiversity strategies (e.g. *Illawarra Regional Biodiversity Strategy, 2010*). Hazards impacts investigated should include both permanent inundation as well as recession due to sea level rise.	All known EEC and important habitat areas, including parks, reserves and waterways at: • Stanwell Park (including Stanwell and Hargraves Creeks) • Coalcliff (including Stoney Creek) • Scarborough / Wombarra • Coledale (including Carricks, Daly and Stockyards Creeks) • Little Austinmer • Thirroul (including Flanagans Creek) • McCauleys (including Hewitts and Tramway Cks) • Sandon Pt (including Slacky Creek) • Bulli (including Whartons and Collins Creeks) • Woonona (inc. Creek at Lighthorse Drive) • Bellambi Gully & Lagoon • Towradgi Lagoon • Fairy Lagoon • North Beach • City Beach • Coniston Beach • Perkins Beach • Lake Illawarra foreshores	2*	2016/17 or as soon as practical	WCC	Staff time only or minor consultancy (say $40,000)	nil	See 'NR11' Option in Sect.5.4.1 of CZM Study report

* Bellambi Lagoon habitat is under intolerable risks at the current timeframe and as such should be given priority for assessment.

Relevant Programs and Possible Funding Opportunities:

- State and Federal Government Grants (especially climate change adaptation and resilience building funds)
- Department of Industry - Lands & Forestry (weed control / dune management)
- Council's annual dunecare and community education / participation programs
- New Council levies or increased land rates

17 WHOLE OF COUNCIL ACTIONS (W)

Description:

In the past, without a whole of LGA coastal hazards assessment or management plan, consideration of coastal hazards in Council decision making has been undertaken on an as needs basis. In some cases this has meant decisions are made prior to assessing risk from coastal hazards, then retrospectively designing the asset or infrastructure to cater for a hazards impact. Further, only one of the existing Community and Crown Lands Plans of Management (POMs) for coastal areas specifically note coastal hazards as an issue requiring consideration in planning new facilities, structures or uses of the land.

With a CZMP, including hazard lines, coastal risks can now be considered at the outset in Council decision making. From a whole of Council / LGA perspective, this is a crucial milestone, particularly as Council is the owner of key assets affected by coastal hazards, and can set the benchmark for private landholders and community in the coastal zone.

Listed below are over-arching actions that should be undertaken by Council to better incorporate coastal risk management into Council decision making processes.

Whole of Council Actions will address a range of intolerable risks, many of these being intolerable at the current timeframe. Although the level of risk differs from one beach to the next, the Whole of Council actions apply to Council's operations, strategic approach such as through the LEP, and so variously affect the approach to management for the whole coast. As such, the actions for preparing and implementing Whole of Council Actions take highest priority (i.e. Priority ranking '1').

Flagstaff Hill Looking to Wollongong Harbour and City

Risks Addressed by Implementation of Strategy:

All risks to existing recreational assets and land (including beaches), existing development and infrastructure and future development along the beaches variously within the Wollongong LGA.

Action List:

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
W.1	Conduct internal Council training to educate the different departments about coastal hazards and the coastal hazard lines, to support greater consideration of hazards in Council planning. The aim of internal education is two-fold. First, this allows better use of the existing hazard mapping in preparing decisions internally by Council, for example, in prioritising asset replacement or designing assets for hazard impacts. Second, it will facilitate explanation of the hazards to community by Councillors, particularly as planning and other actions may affect the general community. There is a need for better education within Council (and the general community, see below) regarding what the hazard lines mean and how they should be utilised and applied.	Relates to entire coastal zone	1	2016/17 or as soon as practical	WCC	Staff time only	Nil	See Sect.5.2 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
W.2	Preparation of Community & Crown Land Plans of Management and Masterplans In the past, decisions regarding facilities and works as described in such plans considered hazards once the decision to refurbish or construct a facility had been made from the Masterplan perspective. Now that hazard lines are available, the development of such plans should consider the hazard extents and timeframes prior to specifying actions within such plans. That is, depending on the expected life of a facility it may or may not be appropriate to construct within a 2050 hazard area. Once again, guidance as to appropriate timeframes for development is given in the Future Development section	All Community and Crown Lands	1	At next update to POMs and masterplans for Community and Crown Lands, i.e.: • Stanwell Park Reserve and Bald Hill Plan of Management August 2009 • Wollongong City Foreshore Plan of Management, January 2008 and Blue Mile Masterplan • Coledale Beach Plan of Management, June 2004 • Judbooley Parade, Windang Plan of Management, June 2008 • The Community Land of Wollongong Generic Plan of Management 2010	WCC DoI – Lands & Forestry	Staff time only	Nil, but preferably W.1	See Sect.5.2 of CZM Study report
W.3	Consideration of hazards and development controls for Council works not requiring development consent. Where development consent is required for a Council action, then the DCP controls apply. However, there are many works undertaken by Council where development consent is not required (for example, environmental management works under SEPP Infrastructure (2007)). In this case, there needs to be an internal process for taking consideration of coastal hazards constraints when undertaking exempt development by Council. Part of this will be through internal Council education (see below), however, a checklist or guideline should be prepared for internal Council use for exempt developments.	All Council works within the Wollongong coastal zone	1	At time of preparing REFs for Council works not requiring development consent.	WCC	Staff time only	Nil, but preferably W.1	See Sect.5.2 of CZM Study report
W.4	Prepare a foreshore building line for entire LGA based upon the existing hazard lines The foreshore building line would present the starting point from which setbacks for development can be drawn. This would be a key tool for use in managing future development and redevelopment in conjunction with a Coastal Management DCP (refer Action DC.1). The foreshore building line may be modified in the future in concert with implementation of specific management actions, such as construction of a seawall for a specific beach. For those beaches where seawall protection is being considered as an option, a recommended seawall alignment was mapped in the CZM Study. At all other locations, the immediate (2010) ZRFC line is recommended as an appropriate foreshore building line to be adopted by Council. The foreshore building line shall be adopted within the LEP and any future LEP review. The foreshore building line should be updated as and when coastal hazard zones are redefined as part of the revision of the CZMP (e.g. every 5 to 10 yrs). This will ensure that the foreshore building line progressively retreats in line with the impacts of sea level rise over time.	Entire LGA of Wollongong, to form part of LEP	1	2016/17 or as soon as practical	WCC	Staff time only.	Nil	See Sect.5.2 of CZM Study report

Ref.	Action	Beach Location(s)	Priority	Timing / Trigger	Responsibilities	Estimated Costs or Resources Reqd	Preceding Actions	Further Info.
W.5	Community Education for Resilience Building To support the implementation of this Plan, there will need to be ongoing community education about coastal risks. The risk approach is a valid way of expressing to community both likelihood and consequence from coastal hazards. This will assist community to make their own judgements regarding how they perceive the risk from coastal hazards, and make decisions regarding this risk over likely timeframes of impact. It is important that community begin to understand now the types of impacts relating to storms and how Council proposes to manage this, as well as how such risks may change with sea level rise. This action supports the overarching approach to implement "no regrets" options now and delay more difficult or costly options for when impacts are imminent. There may be many years before impacts eventuate, however, at that time, the community will be better prepared to accept and implement the action that has been signalled many years in advance within the CZMP.	At various locations across the LGA	1	2017, with ongoing repeats of community consultation every 2 years	WCC	Staff time only, with possibly minor consultancy assistance ($10,000 - $20,000)	Nil	See Sect.5.2 of CZM Study report
W.6	Consideration of coastal risk zones when reviewing land zones in the Wollongong Local Environment Plan This would allow for rezoning of land where appropriate to the level of risk from coastal hazards at the time that land zones are revised as part of a review of the Wollongong LEP. A key location that should be rezoned is Sharkys Park at Sharkys Beach. The land is zoned residential, but owned by Council, so can feasibly be rezoned to public recreation or environmental management without the need for compensation. This ensures the land is not considered for development at any time in the future, which is appropriate to the high level of risk to this land.	Wollongong LGA Sharkys Park – rezoned from residential to public recreation land	1	At the next LEP review (~ 5 – 10 yrs)	WCC	Staff time only	Nil	See Sect.5.2 of CZM Study report

Relevant Programs and Possible Funding Opportunities:

- Largely no external funding required, with actions to be undertaken by Council staff.
- State and Federal Government Grants (especially climate change adaptation and resilience building funds) for community and internal staff education actions

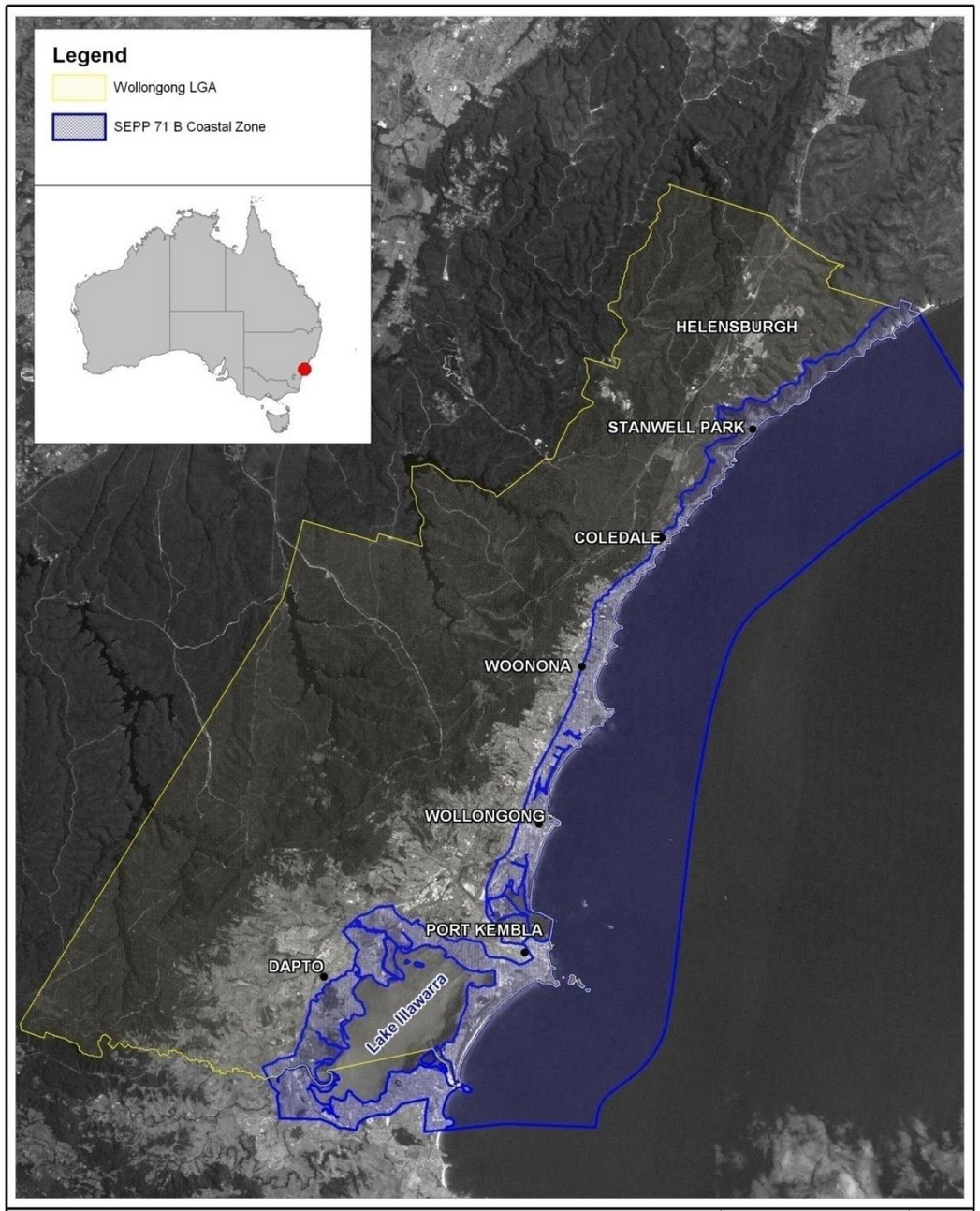
18 MAPS FOR INDIVIDUAL BEACHES

A series of maps is provided in Section 18, after the Implementation Schedules, to show the relevant locations for actions from the Management Strategies, where they can be feasibly shown, for each beach along the Wollongong Coastline (e.g. BM strategies are shown, DC strategies that apply to numerous assets are not shown).

The Coastal Erosion Hazard and Coastal Inundation Hazard areas on the strategy maps present the entire risk areas from present to 2100 (including the zone of reduced foundation capacity for the Erosion Hazard).

The Flood Hazard presents Council's Flood Planning Area, which is Council's known High to Low Flood Risk Precincts combined. The Flood Hazard relates to inundation due to catchment rainfall only, except at Lake Illawarra where the flood study investigated the combined impacts from catchment rainfall, 1 in 20 year ocean water levels and sea level rise. As specified by the Further Studies and Plans strategy, the most accurate estimation for potential inundation impact should consider the combined impact of catchment rainfall, ocean storm water levels and future sea level rise.

The Flood Hazard has been overlain on the Coastal Inundation Hazard on the maps to clearly portray those areas of backwater coastal inundation that are outside of existing Flood Planning Areas, and which require further action through this plan. Actions to address wave overtopping have been specified where required in this Plan, as this is a separate component of the Coastal Inundation Hazard that is not necessarily addressed by existing controls on Flood Precincts.



Title:
Stydy Area - Wollongong LGA Coastline

Drawing: 1-1
Rev: A

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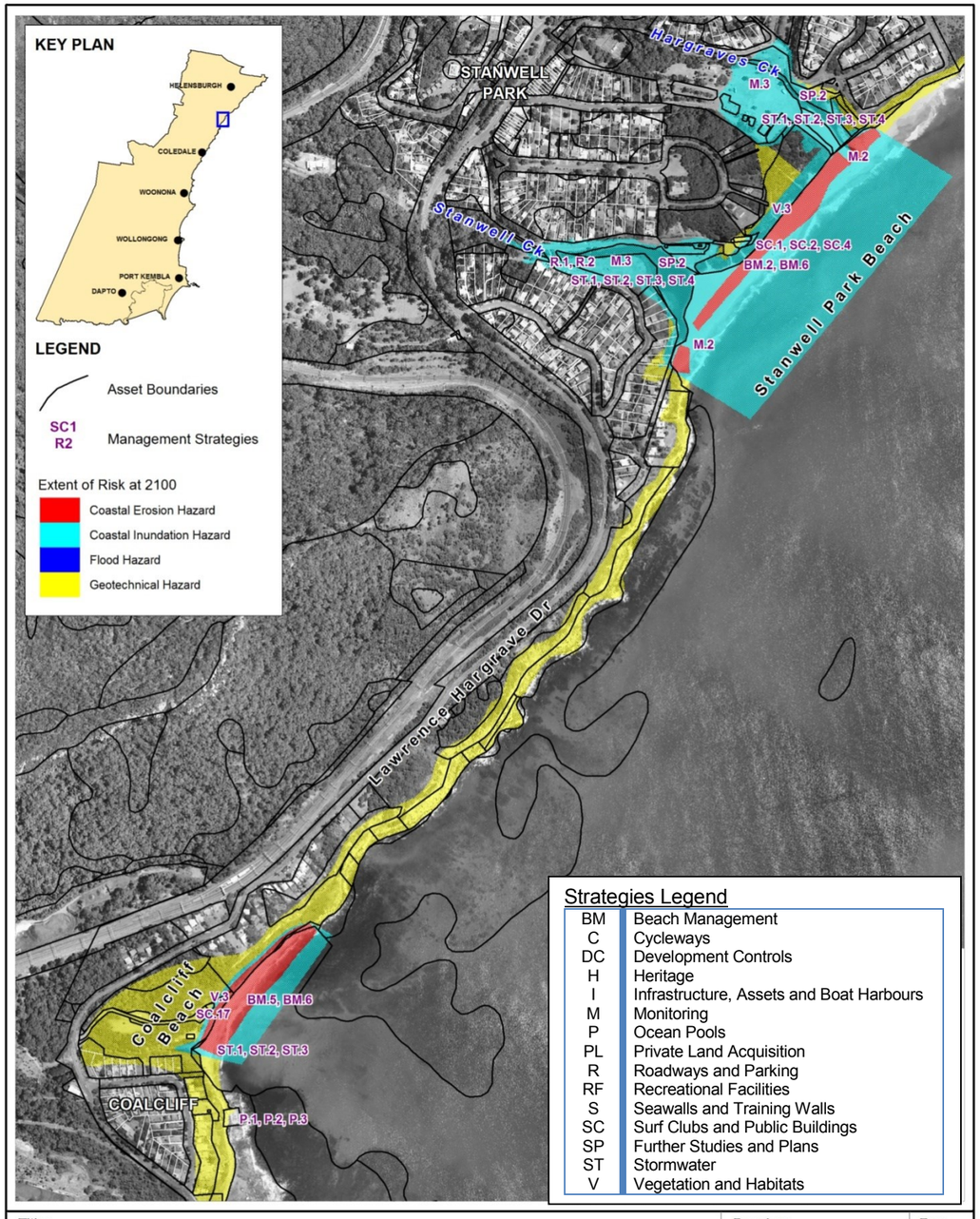

Title:
Management Strategies
Stanwell Park / Coalcliff

Drawing: **Map 1** Rev: **A**

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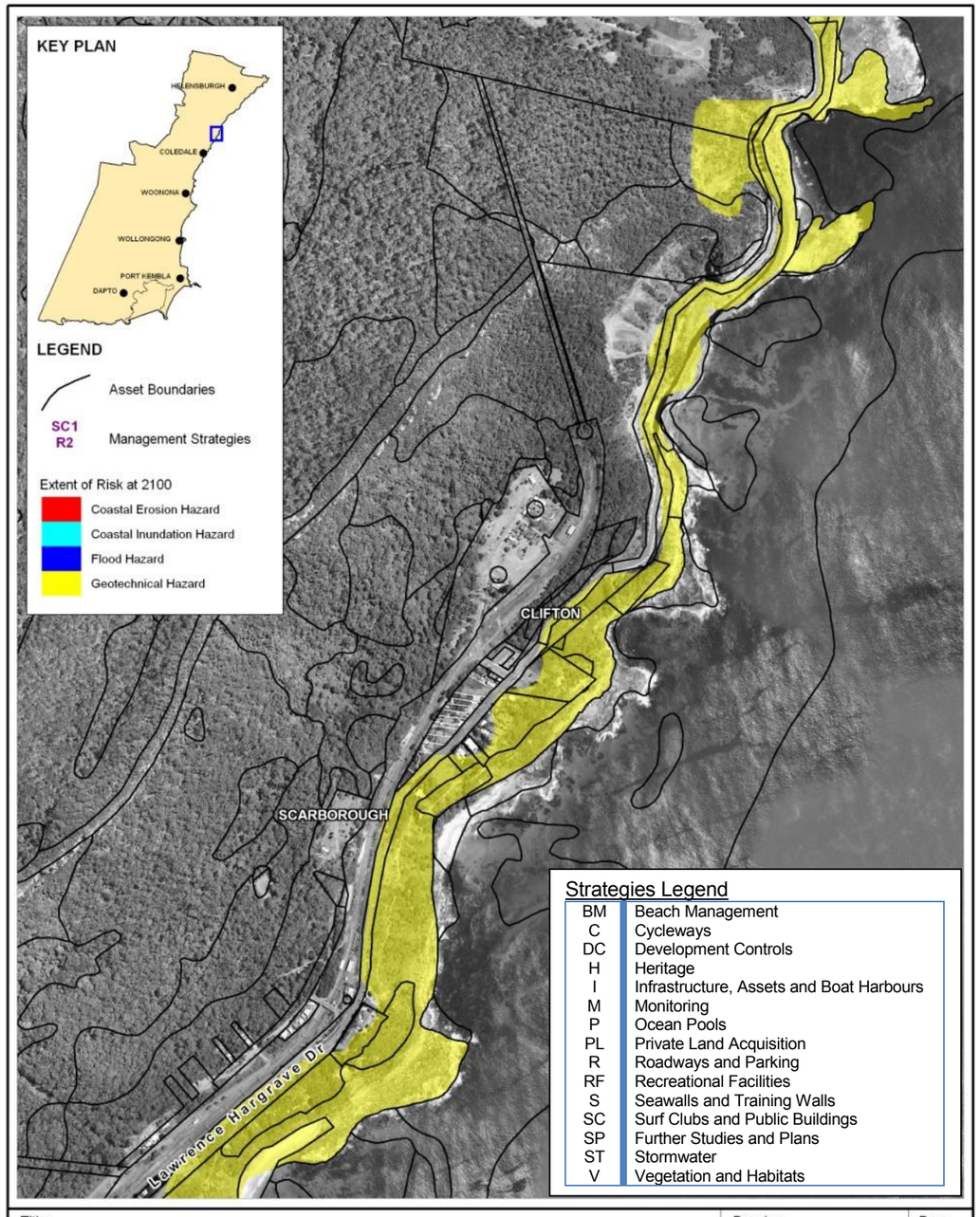

Title:
Management Strategies
Clifton / Scarborough

Drawing: **Map 2** Rev: **A**

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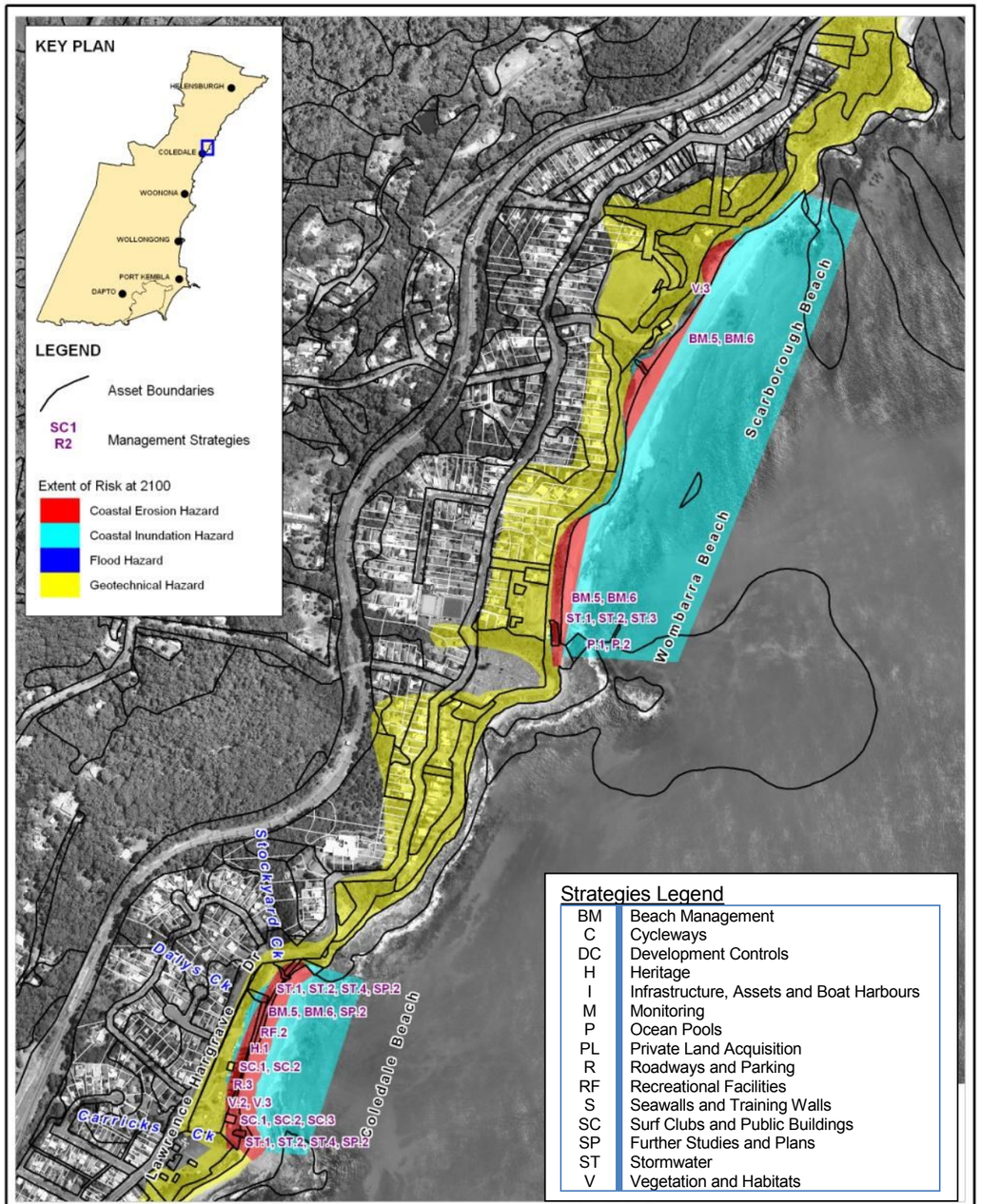

Title:
Management Strategies
Scarborough / Coledale

Drawing: **Map 3** Rev: **A**

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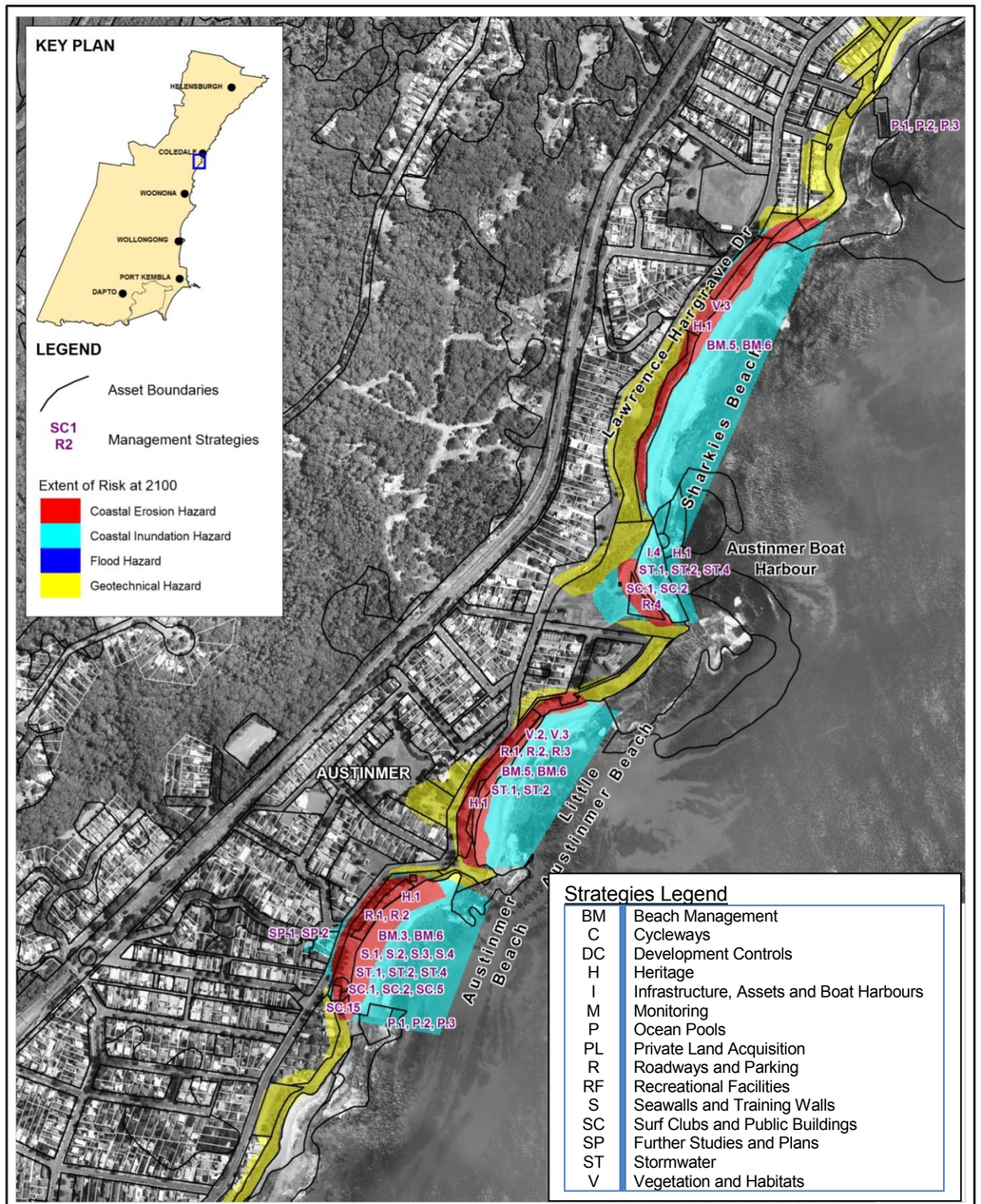

Title:
Management Strategies
Austinmer

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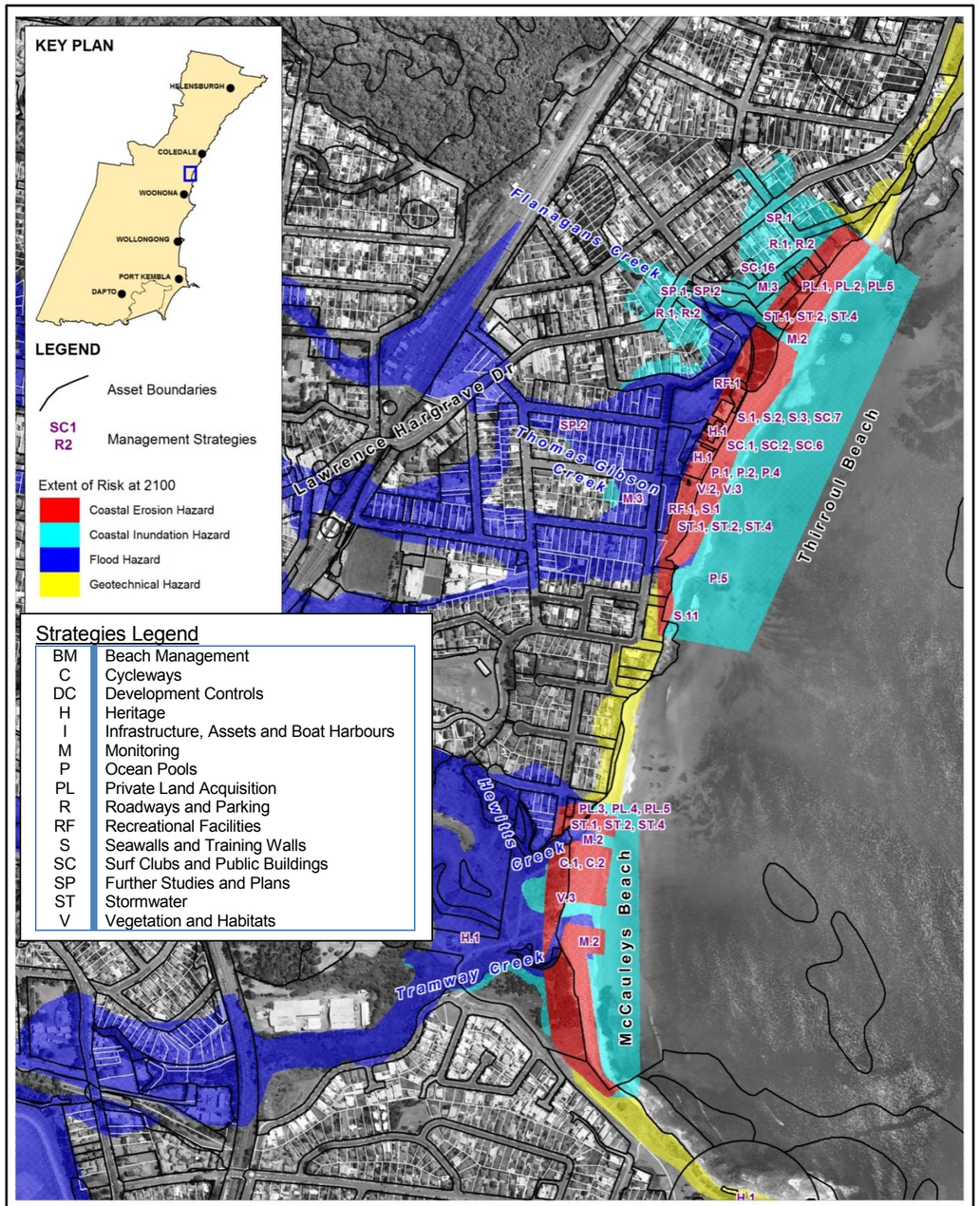

Title:
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Thirroul / McCauleys

Drawing: **Map 5** Rev: **A**

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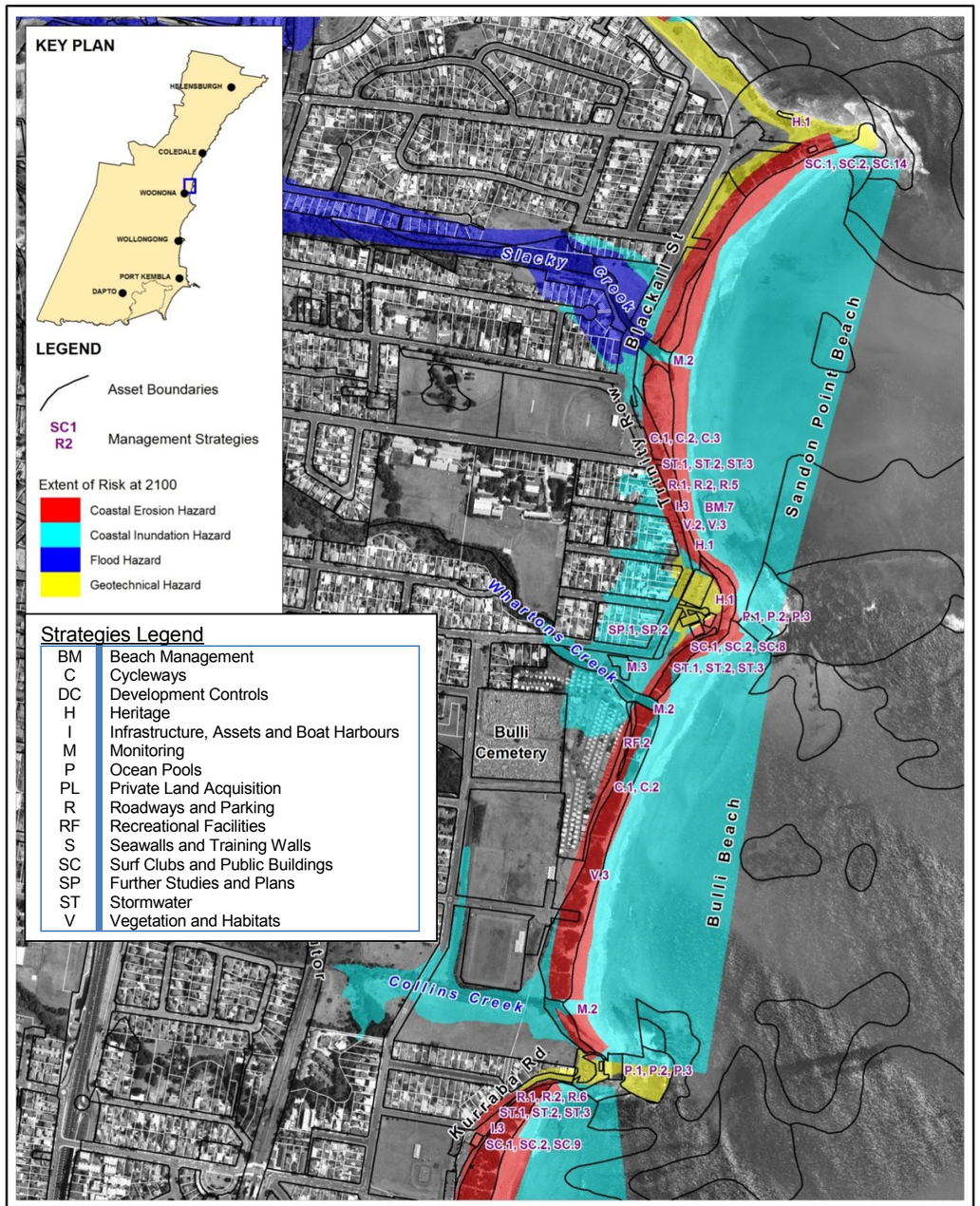

Title:
Management Strategies
Sandon / Bulli

Drawing: **Map 6** Rev: **A**

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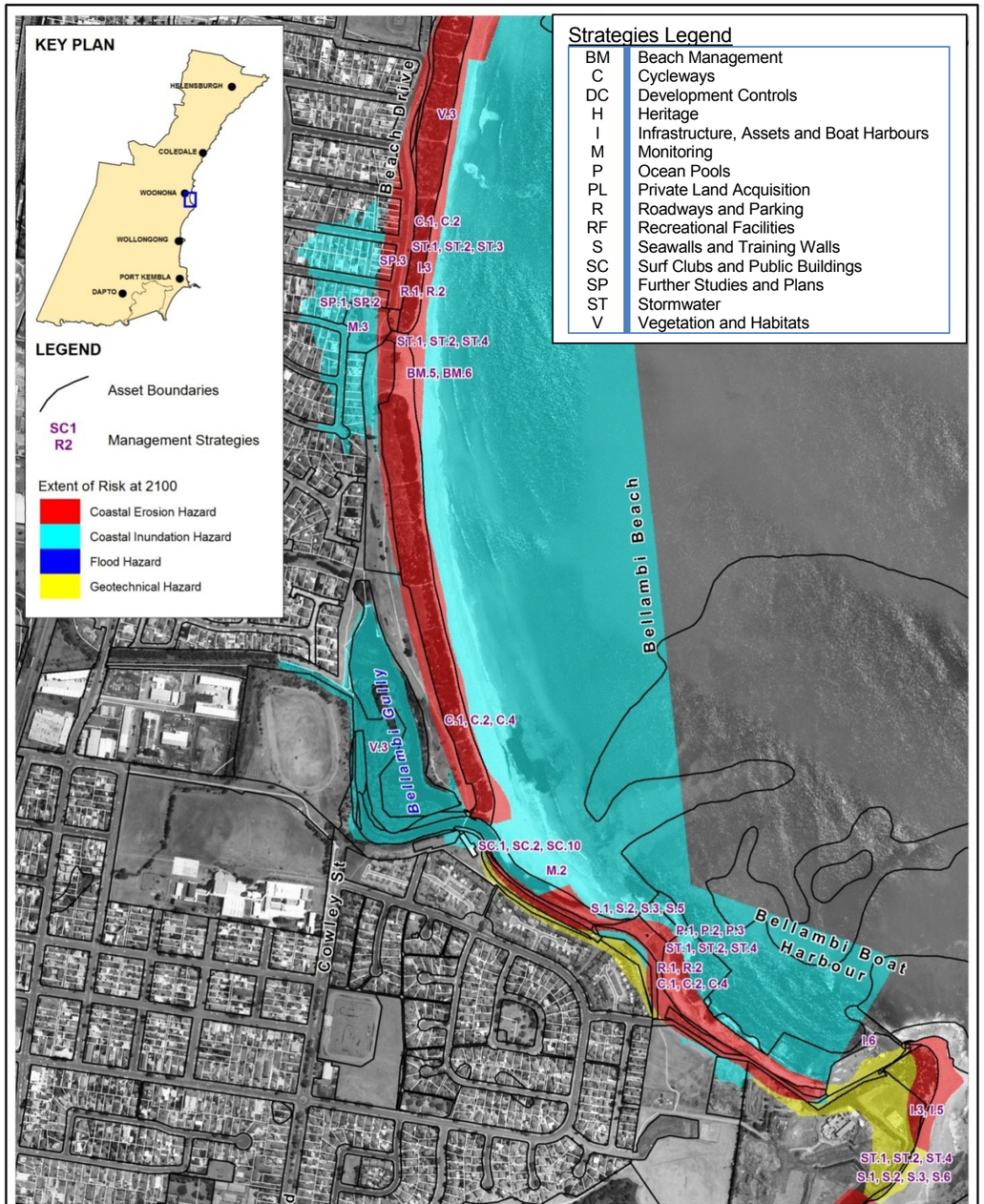

Title: **Management Strategies Woonona / Bellambi**		Drawing: **Map 7**	Rev: **A**
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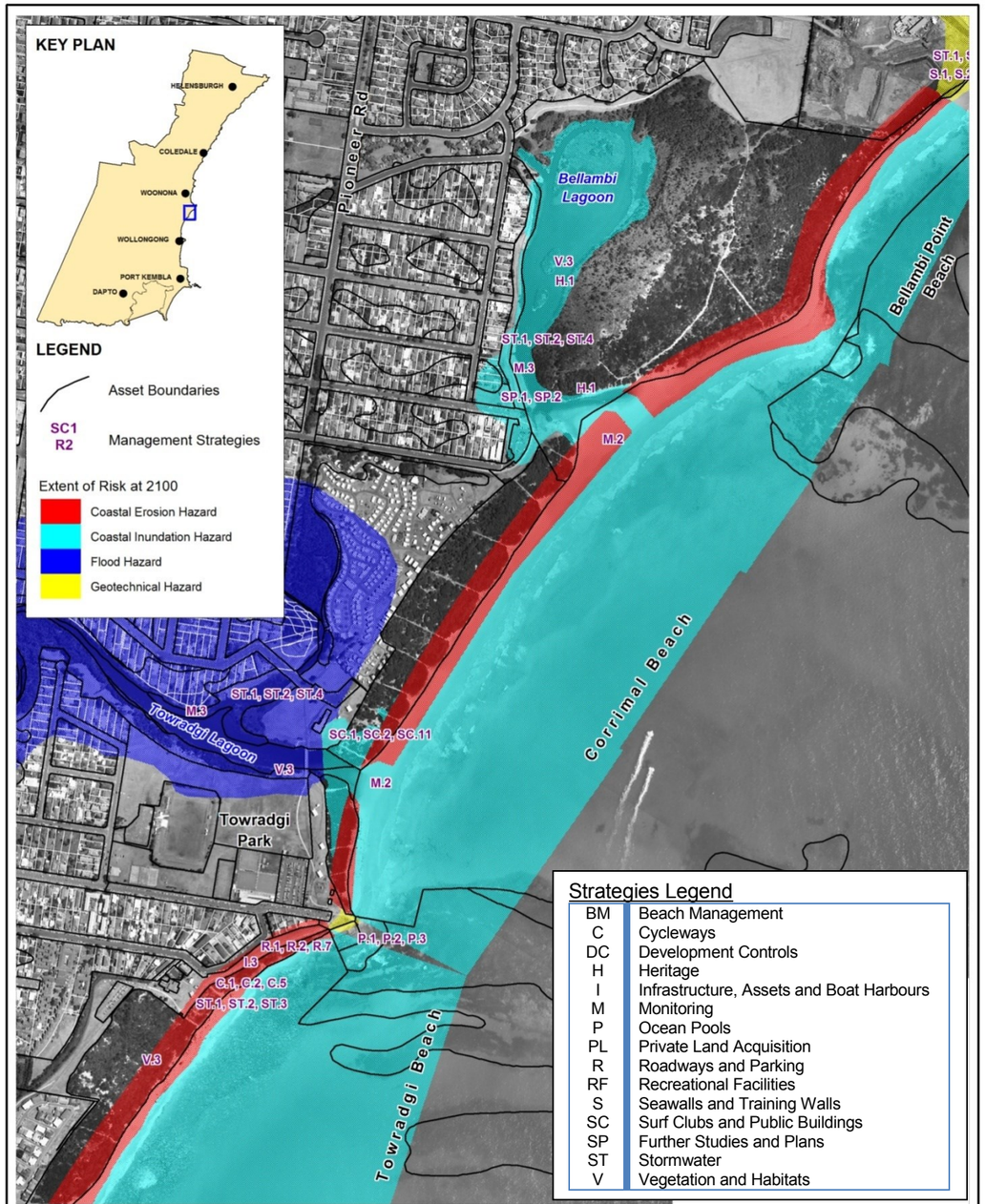

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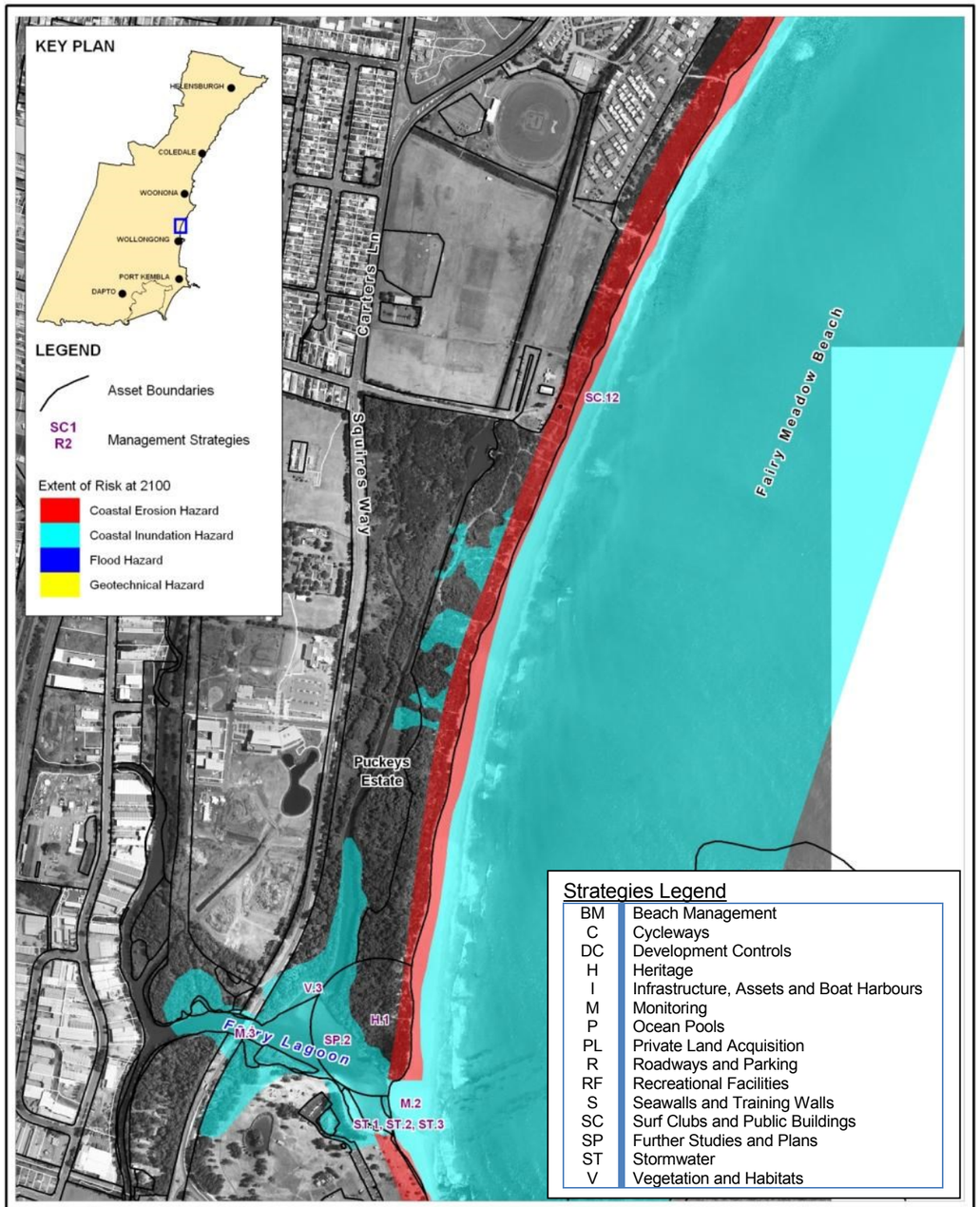

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Fairy Meadow

Drawing: **Map 9** Rev: **A**

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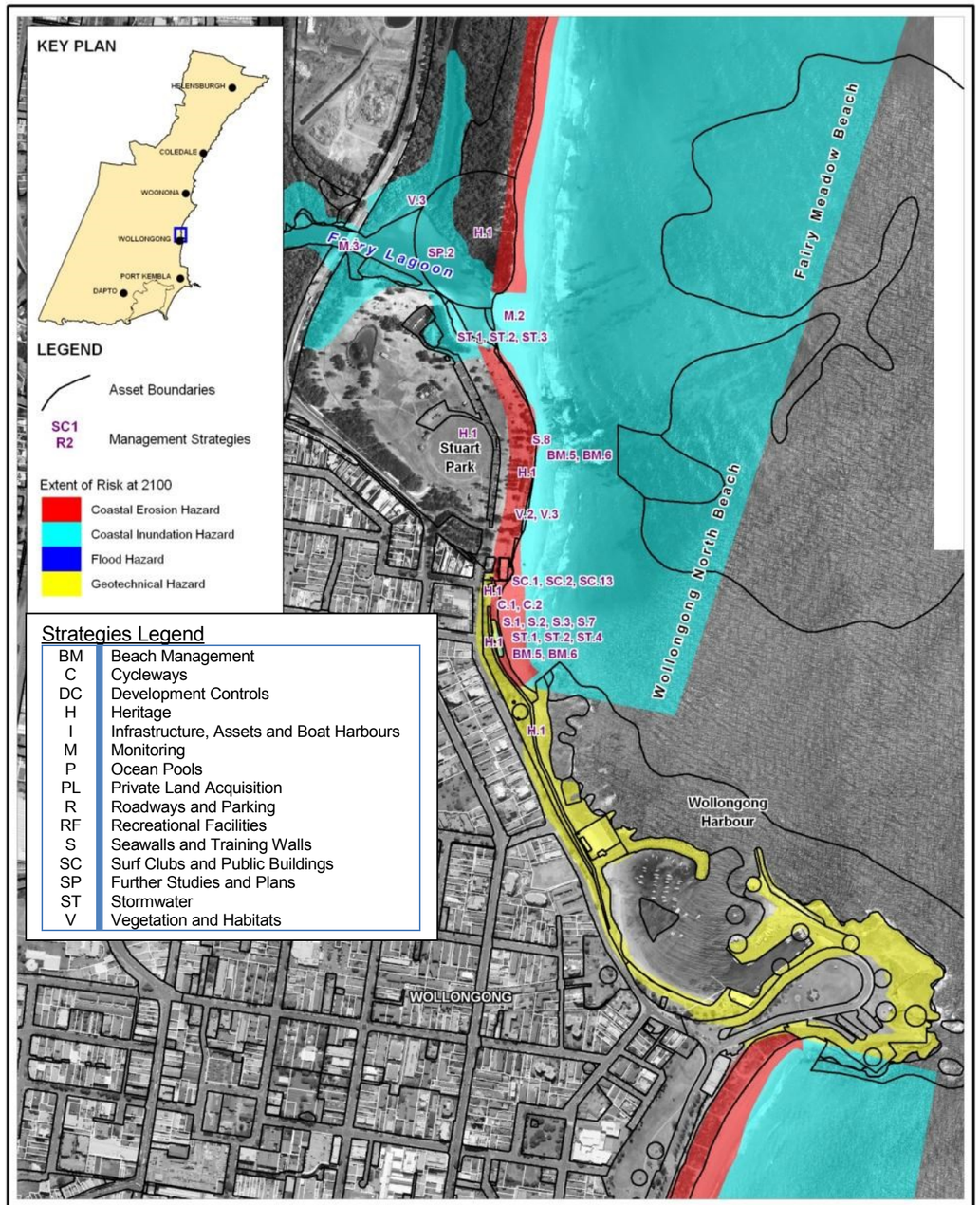

Title:
Management Strategies
Wollongong

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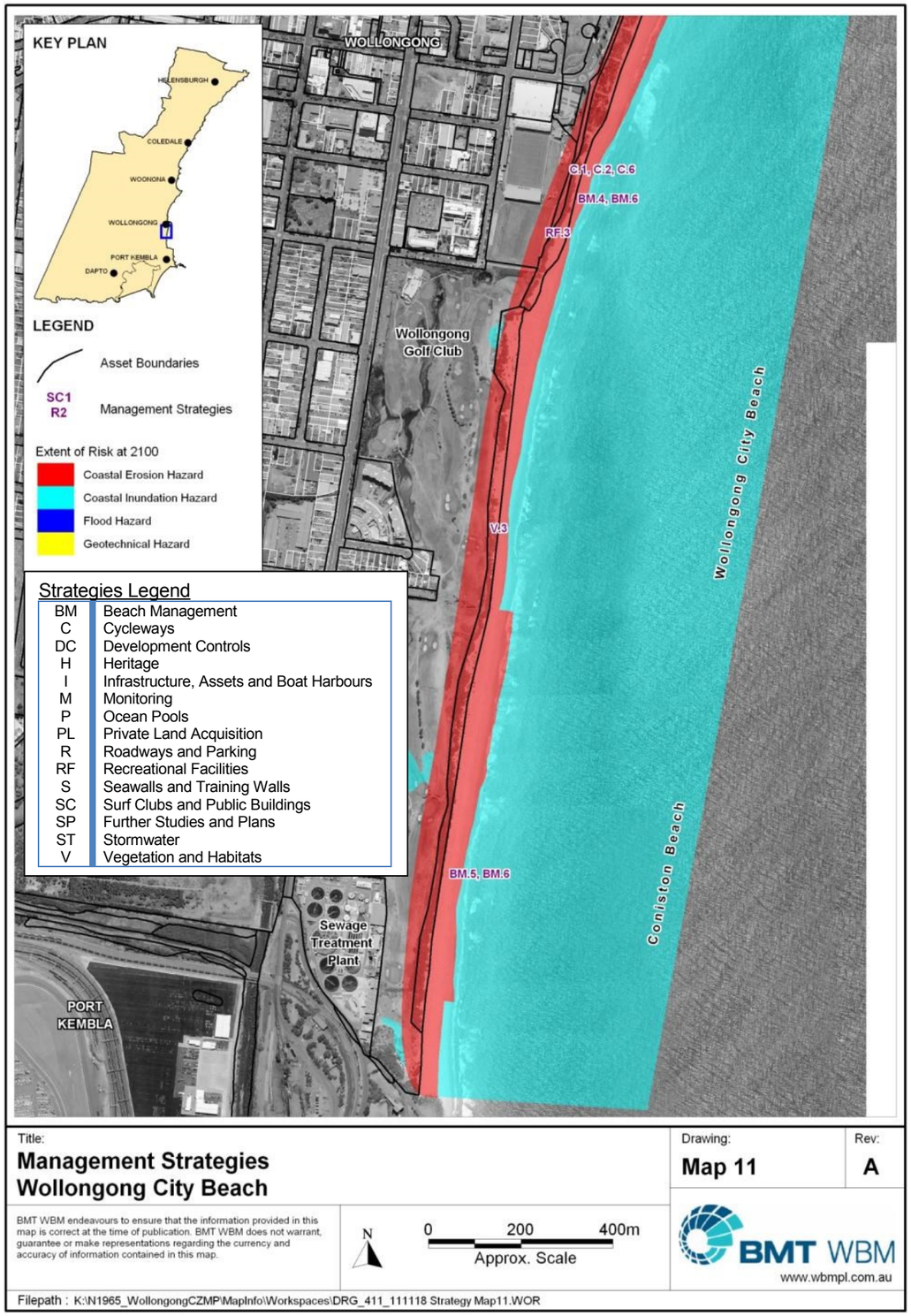

Title: **Management Strategies Wollongong City Beach**

Drawing: **Map 11** Rev: **A**

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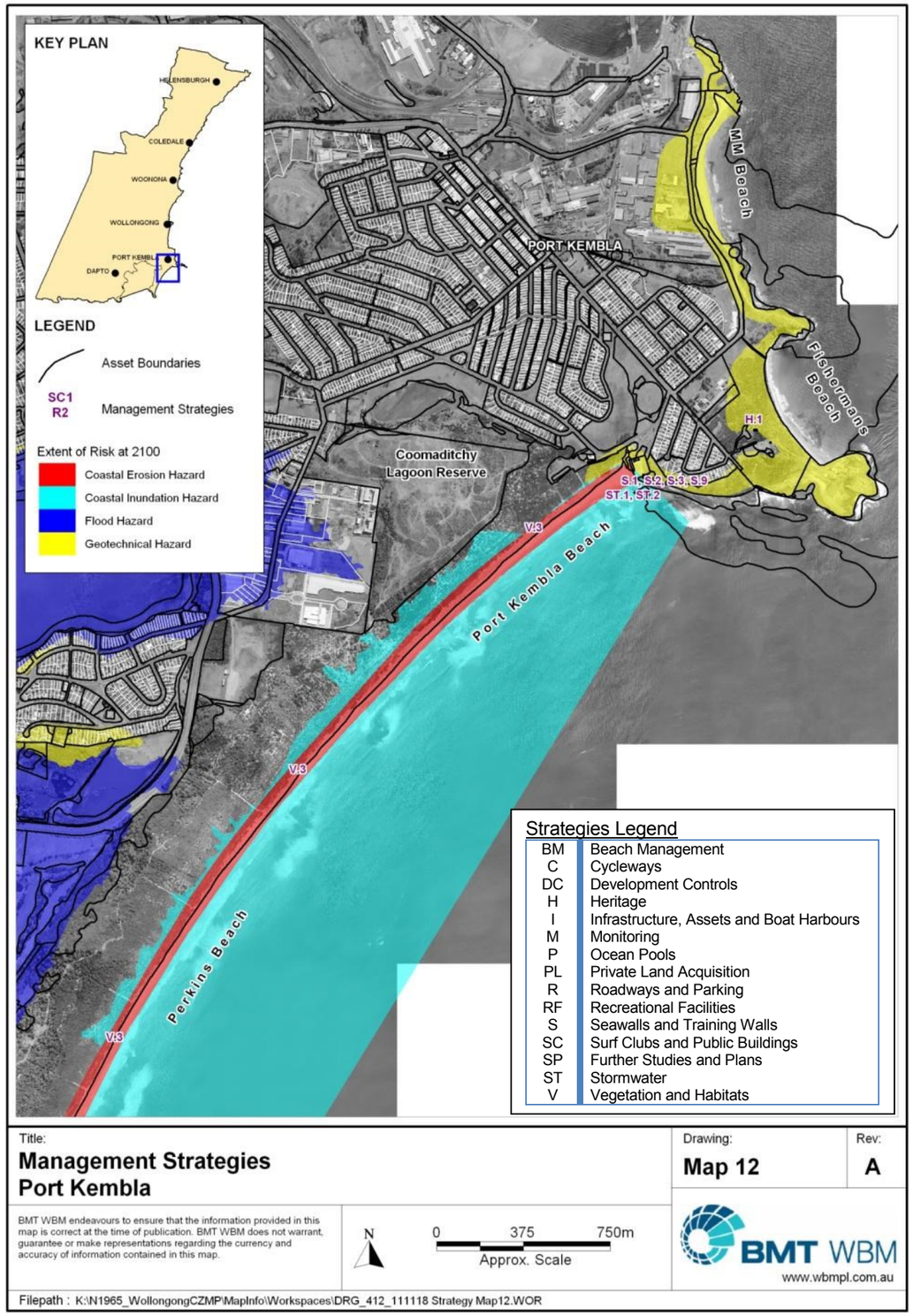

Title: **Management Strategies Port Kembla**

Drawing: **Map 12** Rev: **A**

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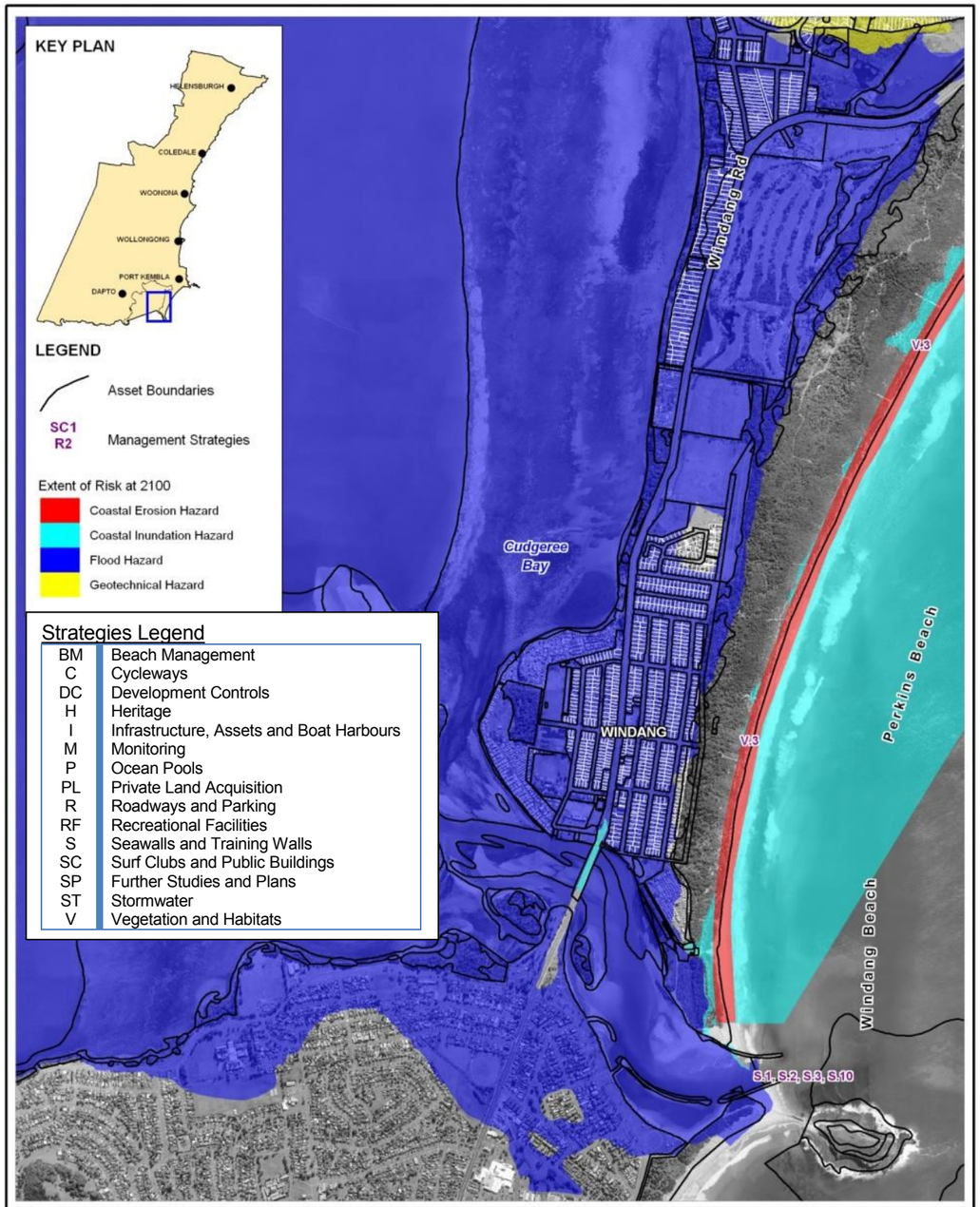

Title:
Management Strategies
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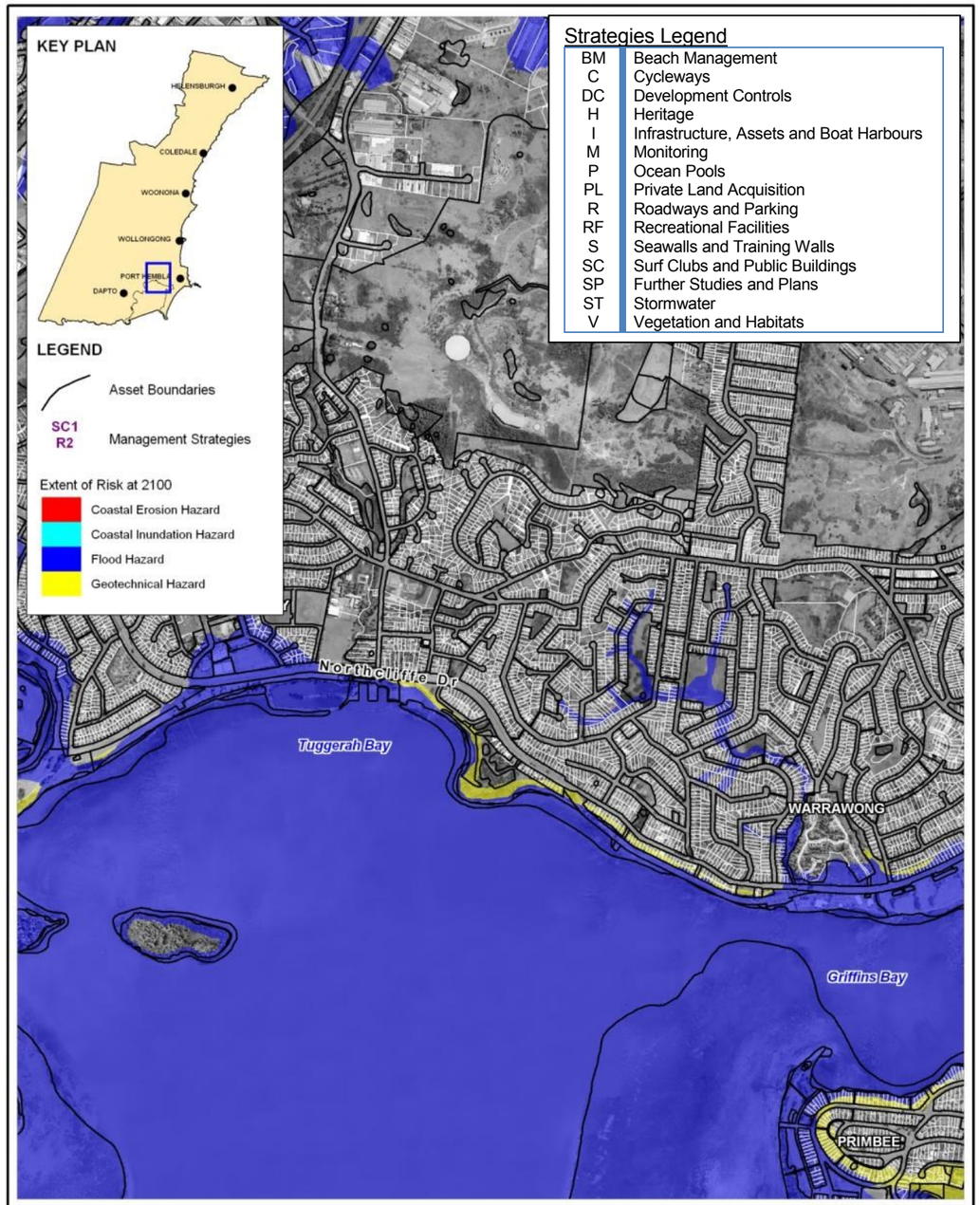

Title:
Management Strategies
Berkeley / Warrawong

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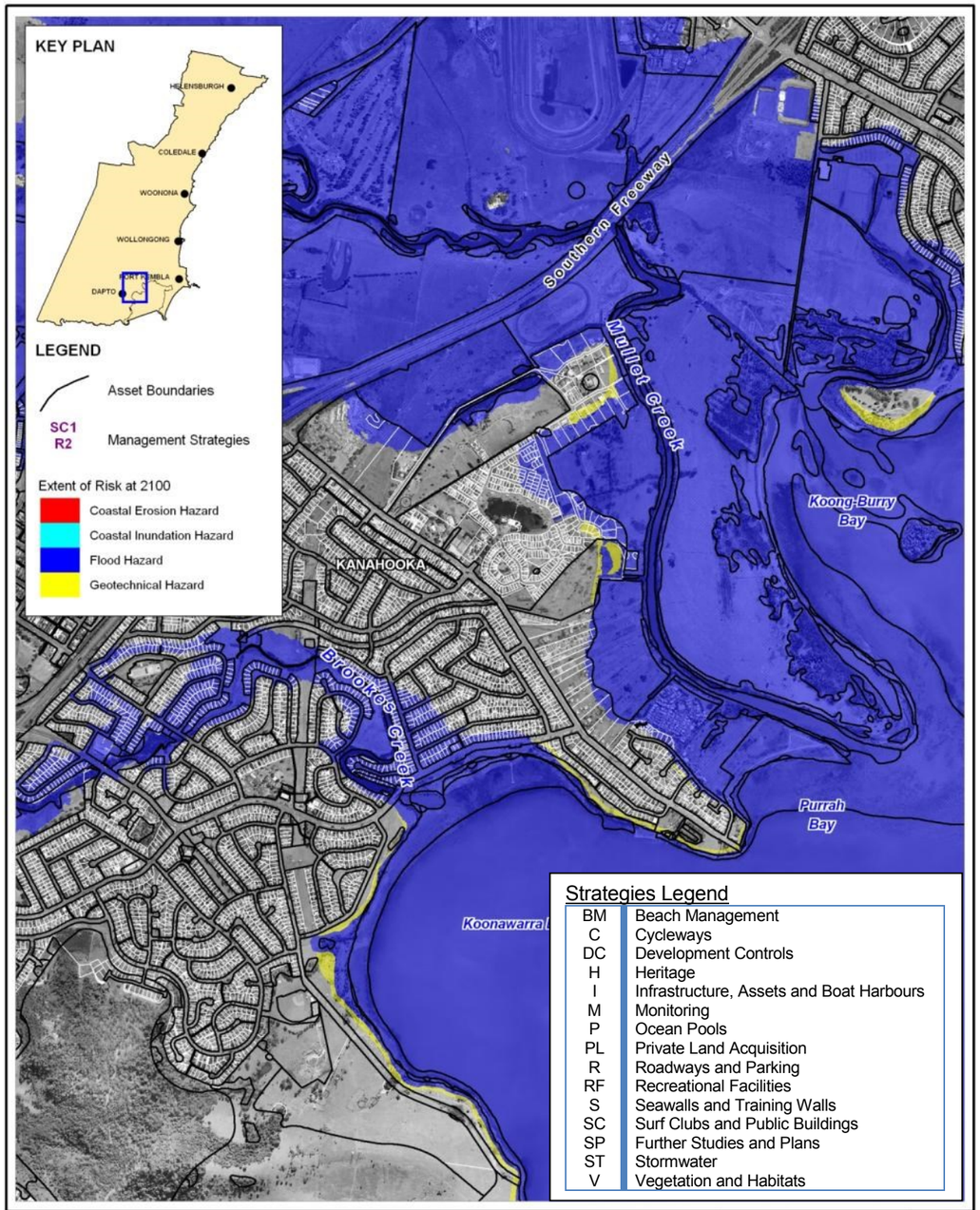

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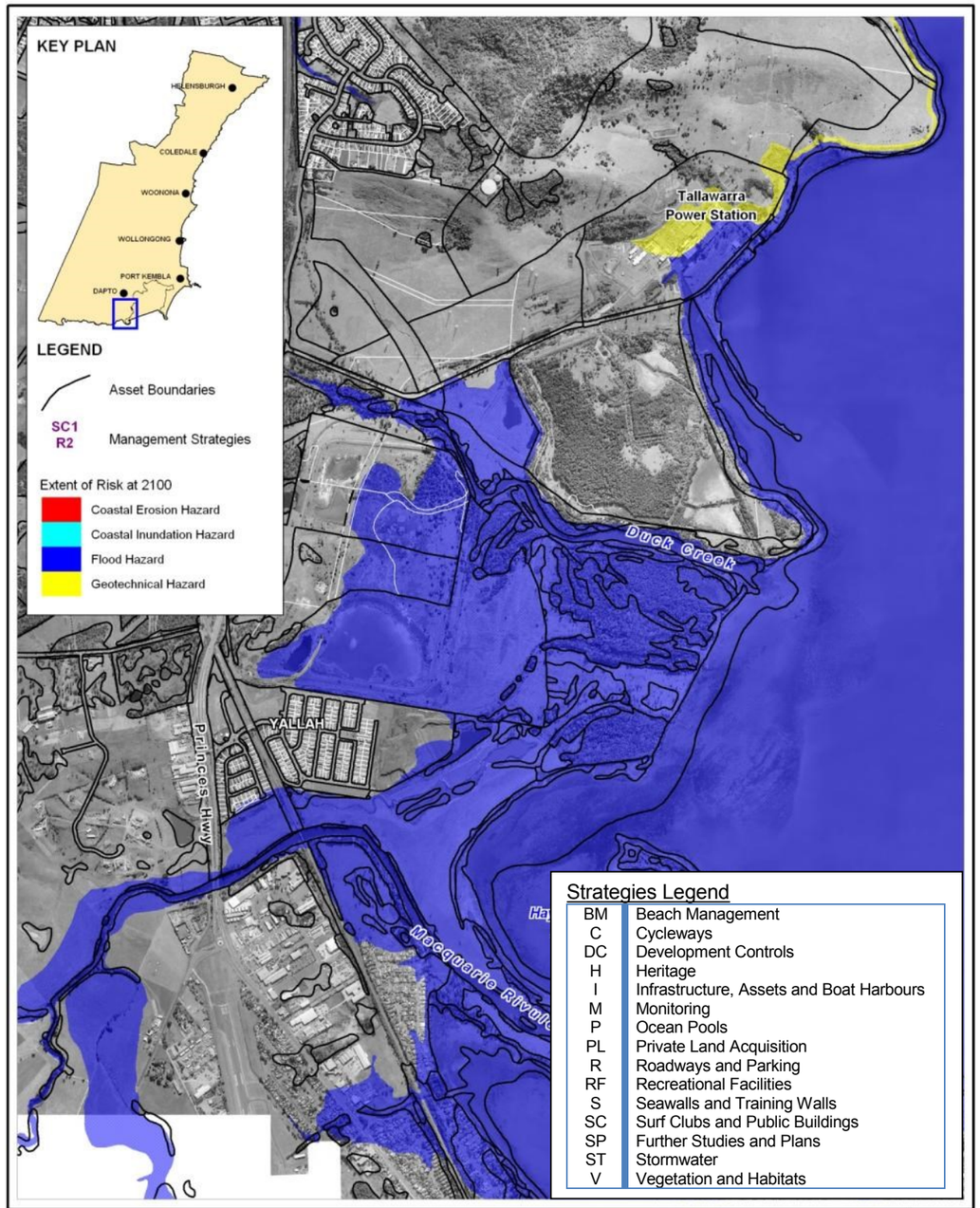

Title:
Management Strategies
Tallawarra

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19 EVALUATION AND REPORTING

19.1 Performance Evaluation

The Wollongong Coastal Zone Management Plan requires evaluation and reporting regarding its successful implementation, and thus the successful management of existing and future coastal risks. Where implementation performance is sub-optimal, contingencies should be emplaced to remedy the situation. A series of performance measures to assist in the evaluation process are discussed below.

19.1.1 Primary Performance Measures

The first set of performance measures should ascertain whether the strategies are actually being implemented or not in accordance with the timeframe and triggers designated in the Plan. As such, the primary performance measures are simply a *measure of action initiation*.

Organisations (mostly WCC) responsible for implementation will need to review the Plan carefully and ensure that adequate funding and resources are allocated to the various strategies and actions to ensure that the timeframe for implementation is achieved.

Specific questions to be answered as part of an evaluation process are:

- What strategies have actually been implemented (regardless of outcome – see Secondary Performance Measure)?
- What strategies are outstanding, and should have been implemented within this nominated timeframe?

If it is determined that the strategies are not being implemented in accordance with the nominated timeframe, then one or both of the following *contingencies* should be adopted:

- Determine the cause for the delay in implementation. If delays are funding based, then seek alternative sources of funding. If delays are resource-based, seek additional assistance from stakeholder agencies and/or consider using an external consultancy to coordinate implementation of the Plan; and
- Modify and update the Coastal Zone Management Plan to reflect a timeframe for implementation that is more achievable. The revised Plan would need to be endorsed by all relevant stakeholders and agencies responsible for implementation.

19.1.2 Secondary Performance Measures

The second set of performance measures are aimed at *measuring the overall outcomes of the Plan* in terms of actually managing and reducing the risks to the community associated with existing and future coastal hazards. That is, 'how has the Plan made a difference?'

The main mechanism for gauging whether the overall outcomes of the Plan have been achieved, or not, is to re-evaluate the risks through a follow-up risk reassessment process. As for the first risk assessment, consideration will need to be given to all relevant mechanisms in place that assist with managing future risks and increasing Council's and the community's resilience to a changing climate as associated coastline responses (including erosion, recession and ocean inundation).

The specific question to be answered here is:

- Have the identified risks been adequately managed / mitigated?

If, after a reasonable period of time it is determined that the risks have not been adequately managed/mitigated, then the following contingencies should be adopted:

- Carry out a formal review of the implemented management strategies, identifying possible avenues for increasing the effectiveness of the strategy in managing the risks along the coastline;
- Commence implementation of additional management strategies that may assist in meeting the objectives of the Coastal Zone Management Plan (possibly 'fast-tracking' some longer term strategies as necessary);
- Reconsider the objectives of the risk management. For example, accommodating future changes may no longer be feasible and an alternative approach of abandonment and planned retreat may be necessary. Any such changes to the Plan would need to be endorsed by the stakeholders and relevant government agencies, as well as the public.

19.2 Factors for Success

The success of the Wollongong Coastal Zone Management Plan can be improved by the following factors:

- Certification by the Minister and Adoption by Council;
- Broad stakeholder and community agreement on the overall Plan strategies and objectives for risk management;
- Understanding and agreement on implementation responsibilities and funding opportunities by Council and other government agencies, stakeholders and the general community;
- Commitment by organisations involved to dedicate appropriate time and resources to achieve the objectives and timeframe of the Plan; and
- Actively sourcing of appropriate resources and funds, through grants, user contributions, and in-kind commitments from the agencies, stakeholders and community.

A particularly important aspect is the acceptance and agreement by the local community. Without significant support and pressure by the local community, Council may find it difficult to prioritise coastal management works when considering the full range of Council assets and lands requiring attention in the future.

19.3 Plan Review

It is recommended that this Implementation Action Plan be reviewed annually, to determine progress with individual actions and strategies, while a broader audit and update be conducted every 5 years. The annual review should focus on funding, resources and barriers to implementation of the individual actions and strategies, whereas the 5 year audit should target re-evaluation of risks to determine progress with overall risk management and reduction. From the 5 year audit, changes can be made to the Plan to ensure the document remains current, and relevant to the changing landuse and community demands along the Wollongong Coastline.

20 REFERENCES

BMT WBM (2016) Wollongong Coastal Zone Management Study, prepared for Wollongong City Council by BMT WBM, Broadmeadow, NSW. (Companion document to this Implementation Action Plan)

Cardno (2010), Wollongong City Council Coastal Zone Study, prepared for Wollongong City Council by Cardno Lawson Treloar, June 2010.

GHD (2010), Report on Wollongong Coastal Study Geotechnical Assessment, Final Report, prepared for Cardno Lawson Treloar, June 2010.

OEH (2013), Guidelines for Preparing Coastal Zone Management Plans, July, 2013

21 ACRONYMS

CZM	Coastal Zone Management
CZMP	Coastal Zone Management Plan
DCP	Development Control Plan
DoI	Department of Industry
DISPLAN	Wollongong Local Disaster Action Plan
EEC	Endangered Ecological Community
FDCP	Flood Development Control Plan
GDCP	Geotechnical Development Control Plan
LEMC	Wollongong Local Emergency Management Cttee
LGA	Local Government Area
MSL	Mean Sea Level
NPW Act	NSW National Parks & Wildlife Act 1974
NPWS	National Parks & Wildlife Service (part of OEH)
OEH	NSW Office of Environment & Heritage
PKPC	Port Kembla Port Corporation
SES	State Emergency Service
SLSC	Surf Life Saving Club
STP	Sewage Treatment Plant
SWC	Sydney Water Corporation
RMS	Roads and Maritime Services
WCC	Wollongong City Council
ZRFC	Zone of Reduced Foundation Capacity

APPENDIX A: PROPERTY RISK AND RESPONSE CATEGORIES

DECCW (2010) and the Coastal Protection Regulation (2011) require the risk to properties to be specified according to the estimated timeframe for impact, i.e. current year, 2050 or 2100. The Coastal Protection Regulation (2011) indicates that the risk category and the year it was assessed be indicated on planning certificates under Section 149 of the Environmental Planning and Assessment Act, 1979. Risk Categories specified by the Coastal Protection Regulation (2011) are provided in Table 1 below.

In addition, DECCW (2010) advise that the intended response to the potential hazard impact be indicated within a CZMP (i.e., the intended response does not need to be attached to the Section 149 certificate). Response Categories specified by DECCW (2010) are provided in Table 2 below. Property risk and response categories of a format specified by DECCW (2010) and the Coastal Protection Regulation (2011) are provided herein.

It is noted that this Wollongong CZMP has provided considerably greater detail as to the likely risk to private property, and furthermore, has provided a range of suitable actions for such risks to private property that go far beyond structural protection options. For Council's use, a summary table of recommended current and future actions for all private properties at risk to 2100 is given in Table 4.

It is noted that the guidance provided by DECCW (2010) indicated the risk category need only refer to the coastal erosion and recession hazard (and not the coastal inundation hazard), and this is the approach taken to the list of properties provided in Table 3.

Table 1 Coastal Hazard Risk Category (NSW Government, 2011)

Risk Category	Intended public authority response
1	The land is, or is likely to be, adversely affected by the coastal hazard at the present time (**a current coastal hazard)**.
2	The land is not, and is not likely to be, adversely affected by the coastal hazard at the present time, but is likely to be adversely affected by the coastal hazard in the year 2050 (**a 2050 coastal hazard**).
3	the land is not, and is not likely to be, adversely affected by the coastal hazard at the present time or in the year 2050, but is likely to be adversely affected by the coastal hazard in the year 2100 (**a 2100 coastal hazard**)

Table 2 Coastal Hazard Response Category (DECCW, 2010)

Response Category	Intended public authority response
A	Coastal protection works are considered technically feasible and cost-effective funding is being sought for implementation
B	Coastal protection works are considered technically feasible but not cost effective for public funding – unlikely to be implemented by a public authority
C	Coastal protection works are not considered technically feasible – no intended public authority works

Table 3 Wollongong Risk and Response Categories

Parcel_Details	Suburb	Risk Category	Response Category	Comment
Lot 1 DP 948547	STANWELL PARK	3	C	Only 1 property in middle of beach; Sea wall in front of property will affect beach amenity in future
Lot 74 DP 7664	STANWELL PARK	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 73 DP 7664	STANWELL PARK	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 721 DP 1075403	STANWELL PARK	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 71 DP 7664	STANWELL PARK	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 1 DP 849241	STANWELL PARK	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 35 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 27 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 36 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 34 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 29 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot E DP 25596	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 30 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 33 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 31 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 32 DP 8450	COALCLIFF	1	C	Affected property at bottom of cliff and house at top. Impacts unlikely to reach residential building
Lot 3 DP 1119139	AUSTINMER	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 3 DP 206574	THIRROUL	1	C	In middle of beach; not advisable to protect; CZMP recommends acquisition
Lot 2 DP 508419	THIRROUL	1	B	CZMP provdes for protection
Lot B DP 421085	THIRROUL	1	B	CZMP provdes for protection
Lot 6 DP 5736	THIRROUL	1	B	CZMP provdes for protection
Lot 1 DP 508419	THIRROUL	1	B	CZMP provdes for protection
Lot 4 DP 5736	THIRROUL	1	B	CZMP provdes for protection
Lot 5 DP 5736	THIRROUL	1	B	CZMP provdes for protection

Table 3 continued Wollongong Risk and Response Categories

Parcel_Details	Suburb	Risk Category	Response Category	Comment
Lot 1 SP 12590	THIRROUL	1	C	In middle of beach; not advisable to protect; CZMP recommends acquisition
Lot 2 SP 12590	THIRROUL	1	C	In middle of beach; not advisable to protect; CZMP recommends acquisition
Lot 3 SP 12590	THIRROUL	1	C	In middle of beach; not advisable to protect; CZMP recommends acquisition
Lot 4 SP 12590	THIRROUL	1	C	In middle of beach; not advisable to protect; CZMP recommends acquisition
Lot 3 DP 5736	THIRROUL	1	B	CZMP provdes for protection
Lot A DP 421085	THIRROUL	1	B	CZMP provdes for protection
Lot 24 DP 7133	THIRROUL	2	C	Isolated property surrounded by public lands; not feasible to protect; CZMP recommends acquisition
Lot 37 DP 7525	BULLI	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 35 DP 7525	BULLI	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 102 DP 714032	BULLI	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 101 DP 714032	BULLI	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 36 DP 7525	BULLI	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 4 DP 201691	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 71 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 73 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 65 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 72 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 67 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 61 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 70 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 1 DP 825544	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 62 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 1 SP 57806	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 2 SP 57806	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 63 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 64 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 77 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 76 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 74 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 75 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 66 DP 12235	WOONONA	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 68 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 69 DP 12235	WOONONA	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 210 DP 13182	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 2 SP 13877	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 208 DP 13182	TOWRADGI	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 4 SP 13877	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 209 DP 13182	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 5 SP 13877	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 207 DP 13182	TOWRADGI	3	B	CZMP recommends monitoring and DCP implementation for now.
Lot 3 SP 13877	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 1 SP 13877	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.
Lot 6 SP 13877	TOWRADGI	2	B	CZMP recommends monitoring and DCP implementation for now.

Table 4 Summary of Recommended Future Action for Private Properties at Erosion and Recession Risk

This table provides a summary of the recommended future action for all private land found to be at low to extreme risk by 2100. In many cases only implementation of the proposed Coastal Management DCP is recommended at the current time, due either to the low level of risk to 2100, the physical location of building footprints compared with the hazard line estimate, and so on. In some cases, specific additional actions have been provided in this plan. Further details are given in the table below.

	Risk Now	Risk at 2050	Risk at 2100	Coastal DCP	FDCP	Recommended Future Strategy
Stanwell Park: Existing Residences (1 centre of beach)	Low	Medium	Medium	✓		Low risk, therefore no action required at present. Likely to be suitable for acquisition (e.g. PL.1/PL.2) and retreat in future, as only one property affected, to ensure beach amenity is retained.
Stanwell Park: Existing Residences (4 ppties S end)	Medium	Medium	High	✓		Building footprints are landward of 2100 hazard estimate, further action unlikely to be required. DCP controls will trigger geotechnical investigation for foundation capacity as properties are redeveloped, properties likely to be located near bedrock. Otherwise, recommend acquisition (e.g. PL.1/PL.2) and retreat in future.
Stanwell Park: Vacant Land (Future Development) (1 block at S end)	Low	Low	Medium	✓		Low to medium risk, no current action required. Suitable location for acquisition (e.g. PL.2) in future. .
Coalcliff: Existing Residences (10 ppties N end, but only affects edge of ppty below cliff (i.e. not the buildings)	Medium	Medium	High	✓		Hazard affects land within property boundaries at the base of cliffs, not the buildings. Further action unlikely to be required.
Vacant Land (Shark Park, currently zoned residential)	Medium	Medium	High	✓		Refer Action W.6, which recommends rezoning to public recreation
Little Austinmer: Existing Residences (1 at N end)	Low	Medium	Medium	✓		Future action dependent upon outcome to manage Lawrence Hargrave Drive.
Thirroul: Existing Residences 1 ppty at centre of beach	Medium	High	Extreme	✓		Refer Action PL.1/PL.2 & PL.5
Thirroul, McCauleys: Existing Residences (8 ppty at S end of beach, plus 8 ppties for geotechnical hazards extending along headland to McCauleys)	Medium	High	Extreme	✓		Refer Action S.11.
McCauleys: Existing Residences 1 ppty at N end of beach	Medium	Medium	High	✓	✓	Refer Action PL.3/PL.4 & PL.5
Sandon Point: Existing Residences (edge of 5 ppties at S end of beach)	Low	Medium	Medium	✓		Low risk at present, no action currently required. DCP will manage building setbacks as properties re-developed.
Woonona: Existing Residences (19 ppties at centre of beach)	Medium	Medium	High	✓		Refer Action SP.3
Towradgi: Existing Residences (3 ppties at N end)	Low	Medium	Medium	✓		Likely to be bedrock at depth to provide stable foundation. Geotechnical investigation would be triggered through DCP, mitigating risk.
Towradgi: Existing Residences (1 ppty at N end)	Medium	Medium	High	✓		Likely to be bedrock at depth to provide stable foundation. Geotechnical investigation would be triggered through DCP, mitigating risk.

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