

Coastal hazards under sea-level rise

Coastal Overwash Snapshot

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Acknowledgement of Country

Department of Climate Change, Energy, the Environment and Water acknowledges the Traditional Custodians of the lands where we work and live. We pay our respects to Elders past and present and emerging.

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About this snapshot

This snapshot summarises projected changes in coastal overwash hazards along the New South Wales coastline, based on the latest sea-level rise trajectories.

Projected changes in coastal overwash draw on multiple data sources, including tide gauge records, the [NSW Nearshore Wave Tool](#), and site-specific beach profile data. Together, these inputs inform advanced hazard modelling that simulates the combined effects of wave runup, tides, storm surge, and sea-level rise, providing a consistent, state-wide assessment of potential overwash locations along the New South Wales (NSW) coast.

Projected impacts of coastal overwash are represented through assessments at 100-metre spaced transects along the coastline. Information from 546 open-coast sandy beaches is included, representing over 800 kilometres of sandy shoreline projected to be exposed to overwash under future sea-level rise scenarios. The distribution of overwash locations is presented for the baseline year 2020 and the future time horizons of 2050, 2100, and 2150, under sea-level rise projections aligned with Shared Socioeconomic Pathways (SSPs).

This snapshot provides a high-level overview, with more detailed information available in a technical report (NSW Coastal Erosion and Inundation Hazards and Exposure Assessment Technical Report, 2025ⁱ) and through the Future Climate and Adaptation Hub on the [SEED Data Portal](#). This assessment provides the foundation for coordinated, strategic action, helping to prioritise investment, plan infrastructure resilience, or protect cultural heritage and communities at risk.

Coastal overwash
was assessed over
800km of sandy
shoreline.

Understanding coastal overwash

Coastal overwash occurs when multiple factors combine to raise coastal water levels above the protective features along the back of a beachⁱⁱ – such as dunes, cliffs, structures, or entrances to intermittently closed and open lakes or lagoons (ICOLLs). When this happens, waves can overtop these features and inundate areas and assets that are normally protected.

Along the NSW coast, overwash most commonly occurs during storms, when tide, storm surge, and especially wave runup combine to elevate total water levels (Figure 1). Wave runup is usually the largest contributor to extreme water levels because tidal ranges are relatively modest (about 1.5–2 m) and the narrow, steep continental shelf limits storm surge to typically less than approximately 0.5 m.

Coastal overwash occurs when several factors combine to raise coastal water levels above the natural or built protective features at the back of a beach



Open-coast inundation from overwash can be rapid and severe. When waves exceed the height of back-beach features, water can move landward quickly, inundating areas behind these features and causing significant localised damage (Figure 2). Although overwash-induced inundation is usually short-lived, it can be deep and forceful, posing risks to people, property, and infrastructure.

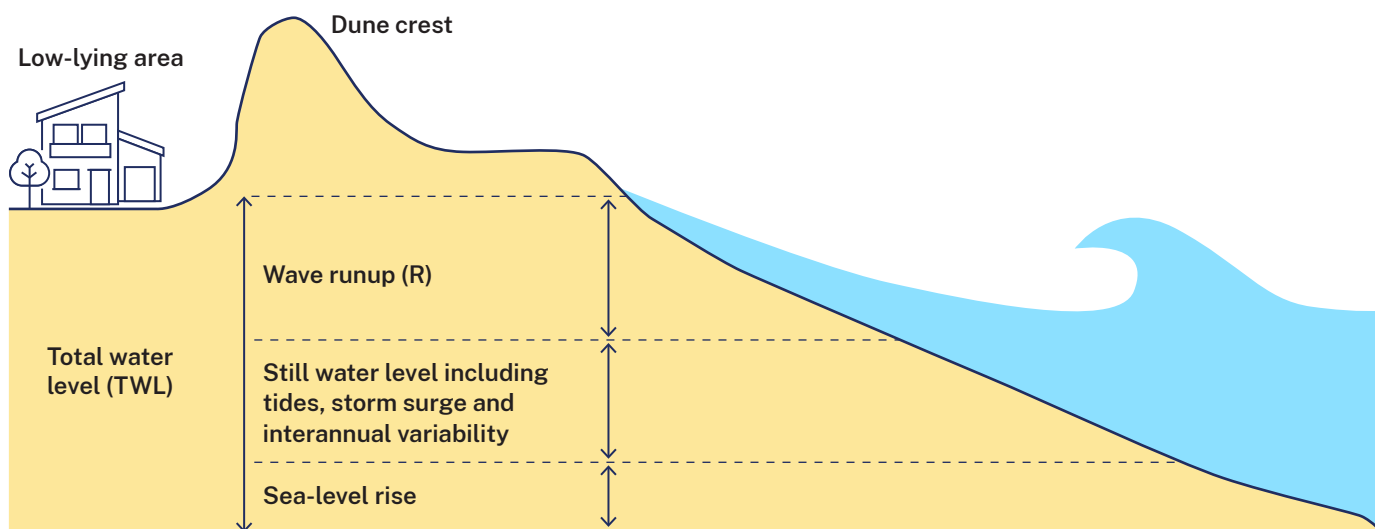


Figure 1: Cross-section of a beach illustrating the surf zone and back-beach area, including a dune. Other potential back-beach features include cliffs, built structures, and entrances to ICOLLs. The diagram also shows the components that contribute to the total water level (TWL).

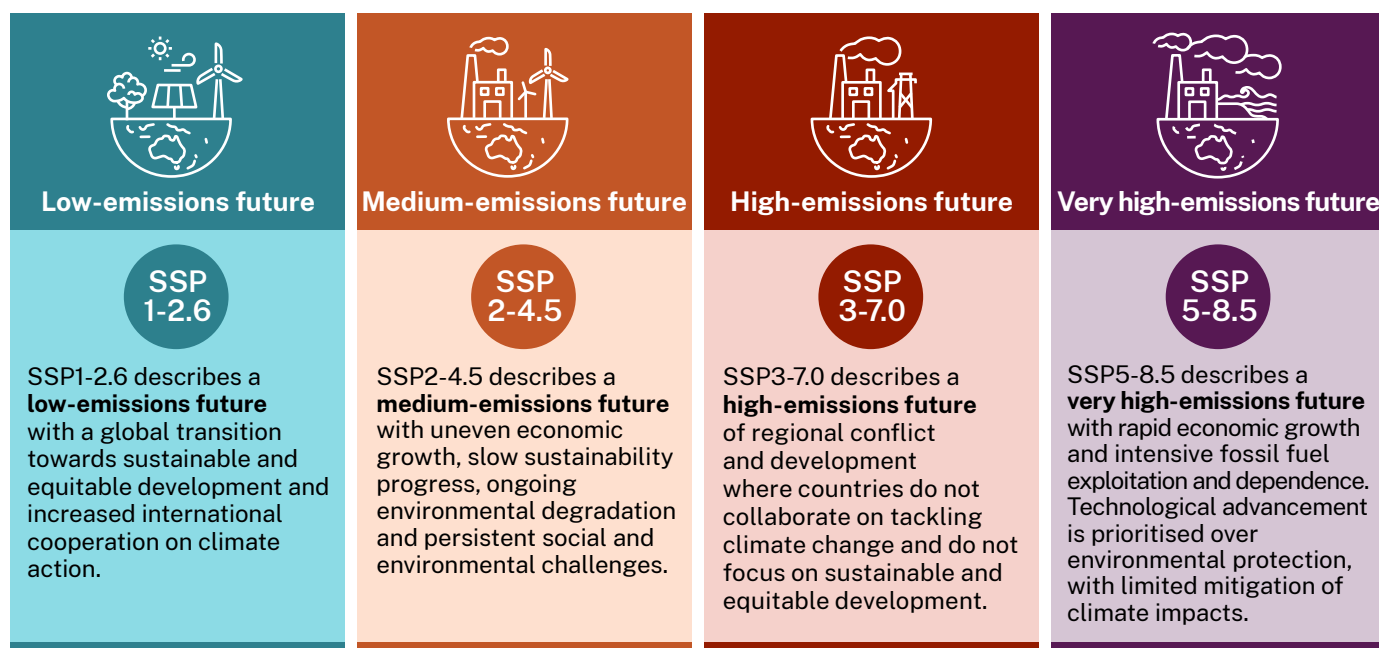


Figure 2 Examples of damage from coastal overwash at Terrigal Beach, NSW. This includes (left) damage to the Clan Motel adjacent to Terrigal Lagoon following the June 2016 east coast low, and (right) damage to the surf club roller doors at Terrigal after the same event.

Shared Socioeconomic Pathways

The coastal overwash modelling in this snapshot is based on the latest emissions and SSP scenarios adopted in the Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report (2021).

The SSPs describe plausible future trajectories of greenhouse gas emissions and associated socioeconomic factors such as population growth, economic development, education, urbanisation, and land use change.



Sea-level rise

Sea levels are rising and are projected to have a major impact on coastal communities in NSW over coming decades. At the State's baseline sea-level monitoring station at Port Kemblaⁱⁱⁱ, average sea level has been rising at a rate of approximately 3.7 mm/year with approximately 12 cm of sea-level rise since 1991^{iv}. Regardless of future emissions trajectories, sea-level rise will continue for centuries to millennia due to the long-term response of the deep ocean and ice sheets to past and ongoing warming^{v,vi}.

Sea level along the NSW coastline is projected to continue rising under all emissions scenarios, with only minor spatial variation. Slightly higher rates of rise are projected toward the north.

This assessment presents modelled projections under low-, medium-, and high-emissions scenarios, with an additional very high-emissions scenario (SSP5-8.5) included to capture high-consequence futures.

Further information on emissions scenarios is available on [AdaptNSW](#).

Port Kembla is projected to experience increases in sea level of 0.23–0.56 m under SSP1-2.6, 0.37–0.73 m under SSP2-4.5, 0.50–0.91 m under SSP3-7.0, and 0.59–1.04 m under SSP5-8.5 by 2100, relative to the 1995–2014 baseline period (Table 1 and Figure 3).

The 'likely' range of sea-level rise projected for Port Kembla relative to a 1995-2014 baseline from the IPCC's Sixth Assessment Report is presented for context to the coastal hazard modelling. The IPCC defines the 'likely' range as the 17th to 83rd percentile of modelled outcomes, representing a 66% confidence interval – meaning there is a two-thirds chance that sea-level rise will fall within this range, based on current knowledge.

Table 1: Projected increase in sea-level rise at Port Kembla (in cm) as per NASA Sea Level Projection Tool^{vii}.

Year	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
2050	17 (11–24)	19 (13–26)	21 (16–28)	23 (17–30)
2100	37 (23–56)	52 (37–73)	67 (50–91)	77 (59–104)
2150	58 (33–93)	87 (58–129)	118 (83–165)	134 (94–192)

The bold number is the median. Underneath the median is the ‘likely’ (17th–83rd percentile) range of sea-level rise.

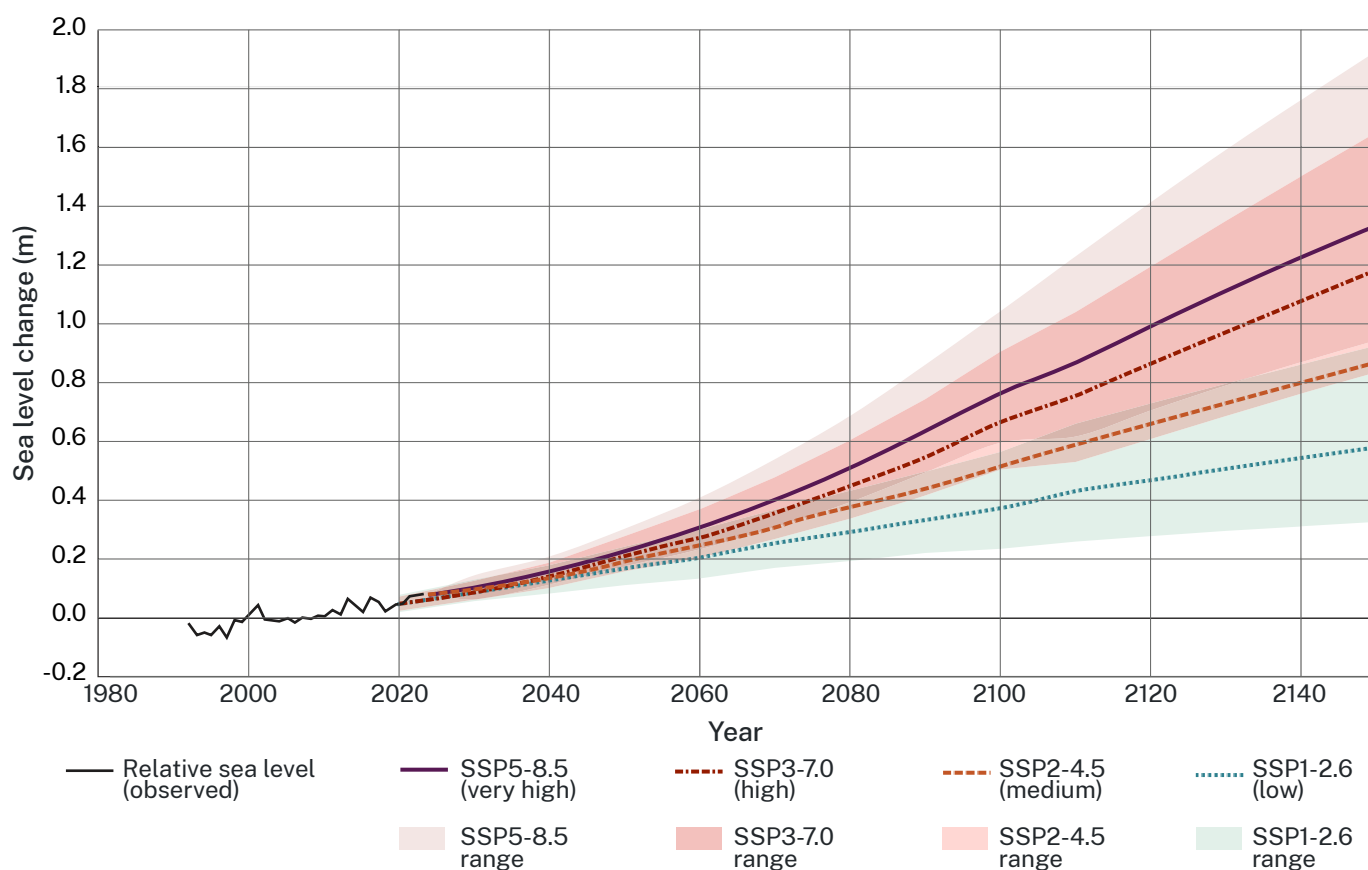


Figure 3: Median sea-level rise trajectories for Port Kembla out to 2150 (solid lines) and their associated likely ranges (shading) representing the 17th–83rd percentile for the low-emissions scenario SSP1-2.6, medium-emissions scenario SSP2-4.5, high-emissions scenario SSP3-7.0, and very high-emissions scenario SSP5-8.5. Projected increases are relative to a 1995–2014 baseline^{viii}.

Modelling coastal overwash

Coastal overwash modelling was undertaken using a probabilistic approach that simulates the combined effects of wave runup, tides, storm surge, and sea-level rise, covering more than 800 km of NSW sandy coastline. Historical simulations of total water level were undertaken using tide gauge data, the [NSW Nearshore Wave Tool](#), and site-specific data on beach profiles to provide a probabilistic distribution of current overwash likelihood.

Due to the high variability of wave conditions and spatial differences in back-beach features, it is not possible to precisely predict flow pathways or localised wave impacts during overwash events. Accordingly, the state-wide assessment does not map coastal inundation extents but instead compares total water level statistics with back-beach elevations to determine overwash likelihood.

For each future sea-level rise scenario and each decade, the hazard modelling was repeated a few hundred times with varying input values, generating a distribution of projections for coastal overwash likelihood within the combined range of uncertainty for annual exceedance probability (AEP) levels.

Outputs were expressed as percentiles (e.g., the 83rd percentile indicates that 83% of projections fall below that value for a given AEP and scenario) (Figure 4). A classification scheme was then applied to facilitate interpretation of results (for details, see next section).

The year 2020 was selected as the baseline period to maximise the use of observed coastal and water level data in NSW and to align with the sea-level rise projections adopted from the IPCC Sixth Assessment Report.

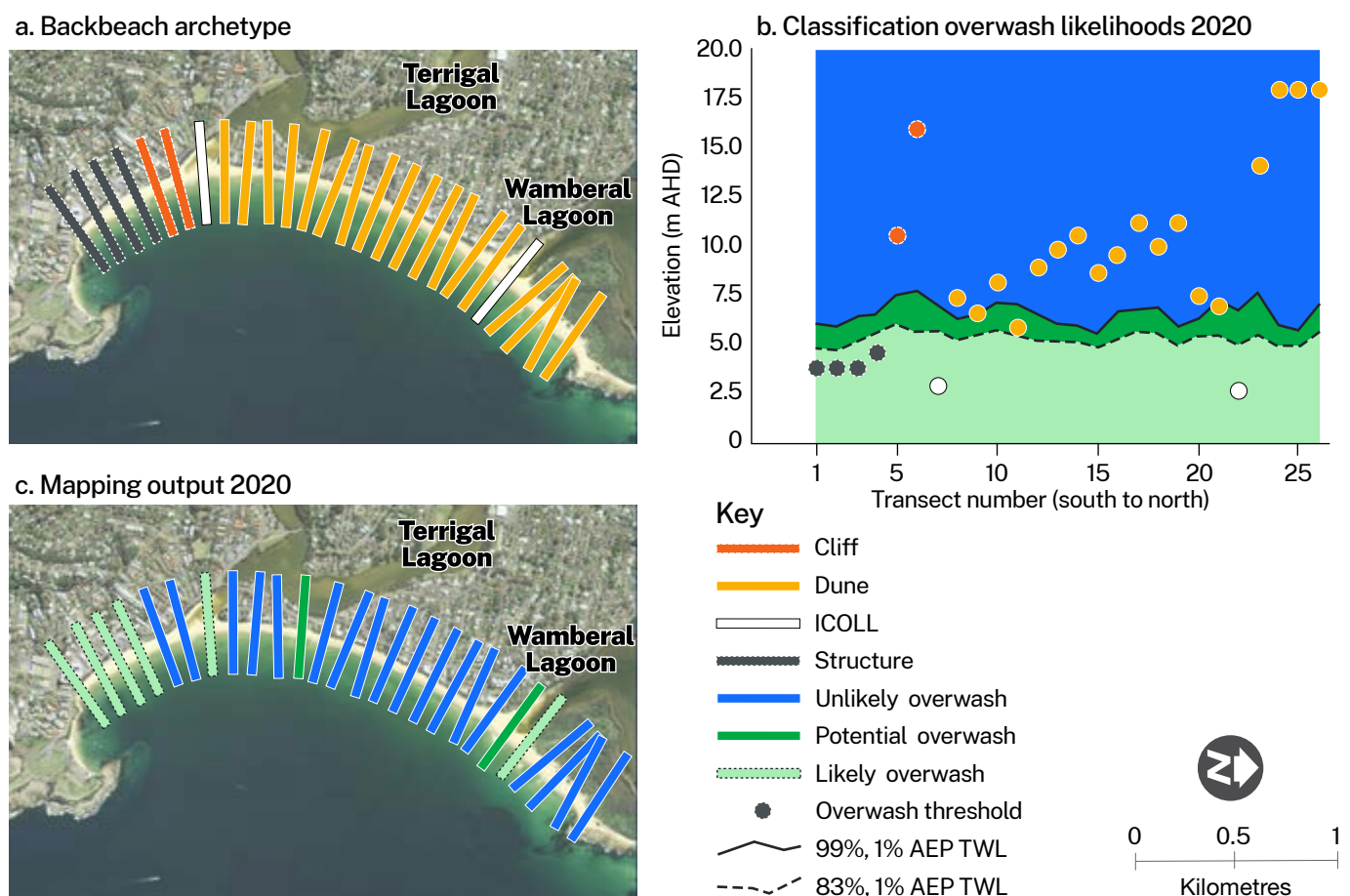


Figure 4 Local scale example of 83rd and 99th percentiles of the distribution for current 1% AEP TWL classed as coastal overwash likelihoods at Wamberal-Terrigal Beach transects by (a) backbeach archetype, (b) different overwash likelihoods (based on elevations), and (c) mapping of current overwash likelihoods.

Classifying coastal overwash likelihoods

To classify present and future coastal overwash, percentiles from the distribution of modelled total water levels (TWLs) for the nominated present-day AEP levels were compared with local back-beach overwash thresholds. These comparisons were used to assign each location to one of three likelihood categories. In this classification:

- The upper limit of the likely total water level range (83rd percentile) represents likely overwash conditions.
- The range between the 83rd and 99th percentiles represents potential overwash conditions.
- The 99th percentile marks the threshold beyond which overwash becomes unlikely.

Unless otherwise specified, results presented in this snapshot are predominantly based on the likelihood of overwash corresponding to 1% AEP. Figure 5 illustrates this classification using the distribution of 1% AEP total water levels for both present-day and future sea-level rise conditions. Rising sea levels shift these distributions, increasing the likelihood that more back-beach features will be overtopped in future (Figure 5).

There are inherent limitations in modelling coastal overwash under sea-level rise scenarios. Sources of uncertainty include the trajectory of future sea-level rise, variability in storm-driven wave conditions, and changes in the elevation and morphology of dunes, back-beach structures, and built assets. Additional uncertainty arises from the limitations of existing coastal response models and the unpredictability of future land use and infrastructure development.

The probabilistic approach adopted helps address these uncertainties, ensuring that the full range of plausible outcomes for coastal hazard is captured and can be incorporated into risk assessments and adaptation planning.

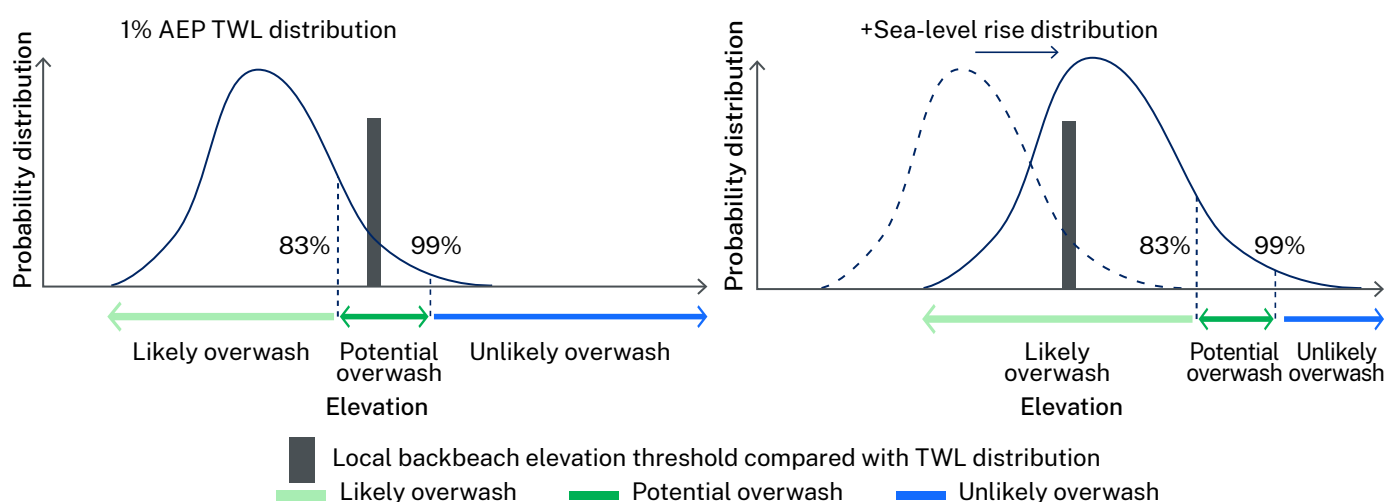


Figure 5 The distribution of the 1% AEP TWL is used to define the overwash likelihoods based on percentiles and local backbeach overwash thresholds. The coastal overwash likelihood in this conceptual example shifts from potential overwash in the present-day to likely overwash in the future under sea-level rise.



Projected coastal overwash in New South Wales

Coastal overwash is projected to increase

Coastal overwash is projected to reach thresholds for likely overwash more frequently in the future across the sandy coastline of NSW, particularly under higher-emissions scenarios. Under present-day (baseline) conditions for a 1% AEP total water level condition:

- Approximately 89% (~773 km) of the NSW sandy coastline is unlikely to experience overwash
- Approximately 5% (~40 km) of the NSW sandy coastline has the potential to experience overwash
- Approximately 6% (~51 km) of the NSW sandy coastline is likely to experience overwash

Coastal overwash is projected to increase under all sea-level rise scenarios (Table 2 and Figure 6). While the overall risk grows across all scenarios, the expansion in hazard remains relatively moderate due to the presence of natural coastal defences such as dunes and cliffs, which provide localised protection against overtopping.

Table 2 Projected coastal overwash likelihoods for the sandy coastline of NSW in 2050, 2100 and 2150 - percentage (%) and length (km) of coastline are provided below.

2050

Percentage and length of sandy coastline	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Unlikely Overwash	88% (766 km)	88% (764 km)	88% (764 km)	88% (763 km)
Potential Overwash	5% (42 km)	5% (43 km)	5% (43 km)	5% (44 km)
Likely Overwash	7% (57 km)	7% (58 km)	7% (58 km)	7% (58 km)

2100

Percentage and length of sandy coastline	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Unlikely Overwash	86% (747 km)	85% (735 km)	84% (721 km)	82% (710 km)
Potential Overwash	6% (52 km)	7% (58 km)	7% (63 km)	8% (68 km)
Likely Overwash	8% (66 km)	8% (72 km)	9% (81 km)	10% (87 km)

2150

Percentage and length of sandy coastline	SSP1-2.6	SSP2-4.5	SSP3-7.0	SSP5-8.5
Unlikely Overwash	82% (707 km)	77% (672 km)	73% (624 km)	68% (584 km)
Potential Overwash	9% (76 km)	11% (93 km)	13% (117 km)	16% (140 km)
Likely Overwash	9% (82 km)	12% (100 km)	14% (124 km)	16% (141 km)

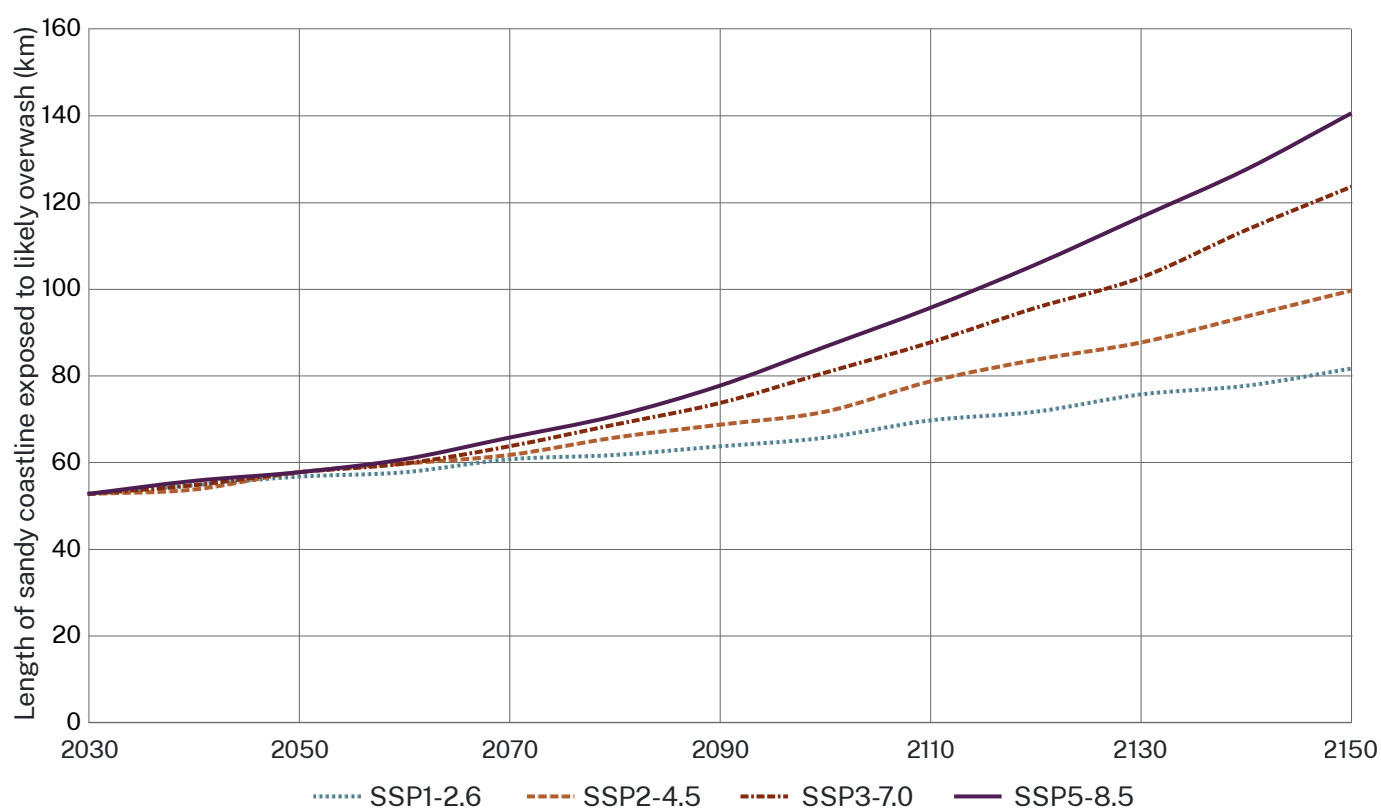


Figure 6 The state-wide total length (km) of sandy coastline projected to be exposed to likely coastal overwash for 1% AEP total water level conditions under different SSPs.



Regional breakdown of coastal overwash

Regional statistics for coastal overwash are grouped under the Australian Sediment Compartments framework^{viii}, which delineates nine distinct compartments characterised by regionally linked coastal processes and geomorphology. These compartments are the North Coast, Northern Rivers, Mid-North Coast, Port Stephens, Central Coast, Sydney, Illawarra, Shoalhaven, and South Coast. They are separated by major features such as headlands, river mouths, or significant changes in coastline orientation.

The coastal overwash statistics represent the total length of coastline within each region that is exposed to likely overwash conditions. At present (2020 baseline), the South Coast and Port Stephens exhibit the greatest exposure to overwash (Table 3). Regional differences primarily reflect variations in back-beach elevation and archetype, beach slope, and local total water levels.

For instance, northern regions such as the North Coast generally have flatter beach slopes associated with finer-grained sands, while beaches further south tend to have steeper slopes due to coarser sand. For a given wave energy, steeper slopes produce higher wave runup and greater total water levels, increasing the likelihood of overwash.

The total water level magnitudes for 1% AEP vary from about 3 m to 5 m AHD in the north and from approximately 4 m to 7 m AHD in southern compartments, depending on the percentile level. These results suggest that low-lying back-beach areas with elevations up to around 7 m AHD may be overtopped during extreme storm events.

Coastal overwash hazard is projected to increase in areas with low back-beach elevations, especially near ICOLL entrances and in locations with built structures such as sea walls (Figure 7). For instance, southern regions typically contain more ICOLLs, while central regions tend to have more built infrastructure, both of which influence future overwash patterns.

Overall, while coastal overwash is projected to increase over time, the rate of change is expected to remain relatively moderate in the near term, providing time to implement effective adaptation measures. The [NSW Coastal Management Framework](#) is the primary way that coastal hazards are managed in NSW, with local councils playing a key role in preparing coastal management programs that identify local issues and outline actions to address them.

Table 3 Length of sandy coastline (km) exposed to likely coastal overwash at 1% AEP total water level condition for the baseline period (2020) under a low-emissions scenario.

North Coast	Northern Rivers	Mid-North Coast	Port Stephens	Central Coast	Sydney	Illawarra	Shoalhaven	South Coast
2.0	5.4	2.4	7.8	3.2	3.7	5.2	2.8	18.6



Thresholds are based on the total length (%) of NSW sandy coastline projected to be exposed to likely coastal overwash for 1% AEP total water level conditions under a high-emissions scenario in 2100.

Figure 7 Projected likely coastal overwash for the NSW sandy coastline in 2050 and 2100 (in percentage and km length) under a high-emissions scenario.



Climate action and information

Climate action

This coastal overwash snapshot highlights both current hazard levels and the projected changes under various sea-level rise scenarios. The stark differences between emissions scenarios highlight the need for global action to reduce greenhouse gas emissions, and specifically for NSW to meet its legislated Net Zero emissions reduction target by 2050. Avoiding the more severe outcomes associated with high emissions scenarios depends on timely and sustained mitigation action.

Equally important is the prioritisation of adaptation strategies to manage both existing and future coastal overwash risks. Highly developed and vulnerable areas identified as at risk should be prioritised for early adaptation planning and investment. As hazard is projected to accelerate over time, proactive adaptation now provides an opportunity to strengthen resilience and ensure that communities can adapt effectively and equitably.

Detailed guidance (including options) on managing coastal hazards is included in the [Coastal Management Manual](#), which recognises that coastal risk management decisions need to consider local circumstances, including the vulnerability of development and local social, economic and environmental factors.

Information

Coastal hazard projections are delivered with support from the NSW Reconstruction Authority and the Commonwealth Government through the Disaster Risk Reduction Fund. Detailed information on the methods and applications of the hazard projections can be found in the technical report¹. The projection dataset for coastal overwash is available on the [SEED Data Portal](#). This comprehensive range of future scenarios ensures that decision-makers can plan for likely outcomes while also preparing for less probable, high consequence events.

This snapshot summarises key headline findings for projected coastal overwash, as part of the NSW Coastal Erosion and Inundation Assessment 2025. The assessment forms part of the NSW Government's commitment to 'publish regularly updated and improved local level climate change projections' under Action 3 of the [NSW Climate Change Adaptation Strategy](#).

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