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***Embracing our Coastal Lifestyle:*** *Connecting our experiences with the future*

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# Abstracts

## (Alphabetical by presenting author surname)

# Science communication in the Victorian Coastal Monitoring Program

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Communicating and delivering knowledge products on coastal change is just as important as the information itself. However, the end-user community is greatly varied. The information and data needs of beach-goers and property owners differs greatly from that of contractors, local land managers and researchers. As such, developing multiple methods of science communication is critical to ensure uptake and appropriate use of coastal data.

The Victorian Coastal Monitoring Program (VCMP) tackles this challenge with a multi-levelled approach. We manage a wave buoy network, extensive timeseries of drone data and shoreline change, and deliver complex information through data portals for both raw and processed data visualisation and dissemination. We also involve the community in the collection and monitoring of the coast though the Citizen Science drone program and CoastSnap data points. We ensure the data collected by the community is visible to that community, providing valuable feedback and demonstrating the products of their efforts, while also providing valuable information to land managers and contractors. We provide a diversity of reports and summaries drawing on the collective data, and present general trends in plain English and using colour-coding systems to depict coastal change.

This presentation will showcase the various methods of science communication in coastal monitoring delivered through the VCMP, and the learnings and opportunities for advancing our approach to communicating with impact.

# Gold Coast Beaches Resilience Scheme

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The Gold Coast Beaches Resilience Scheme represents a strategic, phased approach to addressing long-term coastal challenges on one of Australia's most dynamic and high-value coastlines. This initiative seeks to ensure the sustainability of the City's beaches against escalating pressures from coastal erosion, rising sea levels, climate change and population increase. The project's foundation was built on a series of early studies, including a comprehensive literature review, the development of a community engagement framework, sand source and supply investigations, a beaches economic valuation, and ecological monitoring. These efforts provided a robust understanding of the current coastal system and informed subsequent project phases.

Phase 1 focused on assessing the current situation, particularly the sand budget and sediment dynamics, establishing a data-driven baseline to guide future management strategies. In Phase 2, the Scheme transitioned to options analysis and resilience planning, exploring adaptive measures and assessing their feasibility under various climate and usage scenarios. This iterative process was supported by a diverse panel of subject matter experts (SME), comprising national and international leaders in coastal management, ensuring global insights were integrated into local solutions.

A key deliverable of the Scheme is the development of the new Shoreline Erosion Management Plan, which builds on the findings and recommendations from these studies and phases. Preliminary results underscore the importance of collaborative, evidence-based coastal planning to enhance resilience and ensure the Gold Coast's iconic beaches continue to provide ecological, economic, and social value. This presentation will discuss the methodologies, preliminary outcomes, and innovative approaches that define the Gold Coast Beaches Resilience Scheme, showcasing it as a model for integrated coastal management.

# Sea Level Rise Adaptation Policies: A review of barriers, drivers, and enablers

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Coastal cities around the world are experiencing increased environmental challenges due to rapid urbanisation and rising sea levels caused by climate change. Sea Level Rise (SLR) has impacts such as flooding, coastal erosion, and saltwater intrusion into freshwater supplies, posing increased risks to urban infrastructure, ecosystems and communities. While adaptation strategies are becoming increasingly essential to build resilience to the impacts of SLR, the approaches taken vary significantly across the world.

This paper focuses on coastal adaptation policymaking and planning, aiming to understand the differing levels of climate adaptation policies in coastal cities and why some places have more advanced plans and policies than others. This paper reviews the barriers, enablers and drivers influencing the development of adaptation policies and plans for coastal cities in response to SLR, while also analysing the different approaches taken by different countries.

Sea level rise is a serious concern for coastal cities; however, response on the ground has been limited. The findings show that the sea level rise is major long-term challenge with significant impacts across environmental, built environment, economic, and social dimensions. Coastal cities, particularly in low-lying areas, are most vulnerable to the impacts of SLR. The review finds that while adaptation strategies such as protection, accommodation, and retreat are being implemented, they vary widely in their application and effectiveness across different regions. There are significant barriers to effective adaptation, including governance challenges, financial limitations, and community resistance, particularly to strategies such as managed retreat.

# Strengthening coastal biosecurity: protecting ecosystems, industries, and communities for a resilient future

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Coastal communities thrive on the rich natural resources and unique lifestyles shaped by their proximity to the ocean. From vibrant marine ecosystems to bustling fisheries, aquaculture, and tourism industries, the health of our coastal environments is central to our economic, cultural, and social well-being. However, these ecosystems face mounting challenges from biosecurity threats, including invasive species, marine pests, and the spread of aquatic diseases, which can compromise biodiversity, industry sustainability, and community livelihoods.

As we navigate towards a more sustainable and resilient coastal future, it is critical to integrate biosecurity measures across all facets of coastal management. By learning from past experiences, leveraging emerging research, and fostering collaboration among stakeholders—including fishers, aquaculture operators, recreational boaters, Indigenous custodians, policymakers, and community groups—we can strengthen biosecurity practices to safeguard coastal environments.

Education and engagement play a pivotal role in empowering coastal communities to actively participate in marine biosecurity initiatives. Enhancing awareness, promoting early detection, and fostering local stewardship will be key to mitigating risks and ensuring the long-term viability of coastal industries. Additionally, interdisciplinary approaches that incorporate policy insights, innovative engineering solutions, and nature-based strategies will further enhance coastal adaptation and resilience.

This presentation will explore case studies that highlight both the opportunities and challenges in advancing coastal biosecurity. Through real-world examples, we will examine how collaborative efforts, community-driven initiatives, and policy interventions can contribute to more effective and coordinated biosecurity management. By embracing an integrated approach, we can protect our coastal heritage while supporting a thriving blue economy for future generations.

# Local Shrubby Samphire Recovery Plan

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Between 2014 and 2017 significant dieback events occurred that affected the population of shrubby samphire across southern Australia. A long-lived and important habitat-creating species, the shrubby samphire occurs in coastal temperate saltmarsh around southern Australia.

The slender-billed thornbill (also known as Samphire thornbill) is a little brown bird classed as vulnerable under the *EPBC Act* and also under the *National Parks and Wildlife Act 1972*. Monitoring has shown the samphire thornbill is heavily reliant on the shrubby samphire where it nests.

Work is underway on a Local Recovery Plan for the Shrubby Samphire. To inform the plan, a small investigation within the soil study highlighted how understanding the range of astronomical and meteorological drivers, in addition to global sea level rise, can provide insights into loss of inundation-sensitive species in saltmarsh.

'Species flickering' is a stress/recovery cycling that may indicate species that are most immediately at risk of extinction. The die-off events between 2014 and 2017 may be a sign of species flickering and this plan sees a small window of opportunity for action to maximise retreat opportunities and improved management of sites in the upper Gulf St Vincent area.

# A tern for the better: First Nation collaborations to protect small terns

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Populations of Fairy and Little Terns are experiencing major declines across south-eastern Australia. Human activities, habitat loss and introduced predators are driving declines. Large coastal breeding colonies are now scarce and many historical breeding sites deserted. While Fairy Terns are listed nationally as Vulnerable, Little Terns are pending listing as Vulnerable. Management interventions are critical to mitigating threats, particularly from human recreation in their coastal beach, estuarine and island habitats.

In South Australia, two colonies of breeding Fairy Terns are the focus of conservation efforts: 1) an offshore island near Adelaide and 2) the Murray Mouth spit, Coorong National Park. Due to the logistical challenges of working offshore, the need to engage a variety of stakeholders is required to successfully monitor and manage these sites. Training of local participants to monitor breeding success outcomes is critical to understanding the health of sites. Working with Traditional Owners on Sea Country has led to amazing initiatives with Ngarrindjeri monitoring and protecting the colony from offroad vehicles.

In Queensland, Little Tern monitoring is supported by the Reef Integrated Monitoring and Reporting program and undertaken by BirdLife, Mandubarra and Mungalla indigenous rangers, National Parks, Cassowary and Hinchinbrook Councils and volunteers across many small colonies between Cairns and Townsville and at Bustard Bay. The colonies are small and many are under threat from quadbikes. Management actions have included temporary fencing/signage, education events and focused compliance activities. A collaborative approach is essential to improving breeding success of a dispersed population breeding in highly-disturbed areas and where tenures and responsibilities can be unclear as coastal sand spits and islands shift from year to year.

# Engineering positive outcomes for mangroves

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Coastal developments regularly impact coastal habitats such as mangroves. In recent decades legislative changes have tried to mitigate the impacts, with everything from simple exclusion, offsets or paying for offsets. Unfortunately, despite the best intentions, the outcomes both in terms of project delivery and habitat protection are often far from positive. During project delivery many things can be done to improve outcomes but implementing parties need to have the freedom to use multiple ways to deliver offsets.

Ecosystems that dominate in the intertidal and near shore zones are adaptive and capable colonizers, due to the dynamic nature of coastal systems. Mangroves are a particularly aggressive example of this. With an appreciation of what the natural systems need to succeed engineering design can be used to assist nature in achieving positive outcomes.

This paper explores how we can better approach managing coastal and near shore habitat impacts and how our legislative approach both from an engineering and approvals perspective could be improved. It is hoped that a more nuanced approach to approvals and an appreciation of how the environmental outcomes can be included more rational engineering and decision making will facilitate better outcomes. This will be done exploring a few case studies and discussion of issues with our current planning approach.
Particular focus will be given to:

- What works, or doesn't, with habitat rehabilitation and expansion.
- The role of nature based solutions and working with nature in project success.
- Key issues with current planning approach and how this could be improved.

# Optimising tide predictions for Australia: an ensemble satellite Earth Observation approach

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Accurate insights into sea level dynamics from tide modelling is crucial for coastal science. Global ocean tide models play an important role in hind- and future-casting tide predictions and gap-filling sparse tide gauge observations, making them an important input for coastal workflows. However, existing tide models vary greatly in local performance, particularly in dynamic and complex coastal regions where accurate tide predictions are both the most challenging, and the most critical.

Earth Observation (EO) data from altimetry satellites has been previously used to identify optimal tide models in challenging regions. New altimetry products specifically improve performance in nearshore regions. However, tidal dynamics at the coastline can vary significantly from deeper waters, making it difficult to extrapolate model selection from offshore altimetry observations. There is a critical need to supplement altimetry-based approaches with new scalable techniques for identifying optimal tide models at the coastline itself.

We present a novel satellite EO-based ensemble tide modelling approach that leverages local model performance to optimize tide predictions. We combine sea levels from satellite altimetry with an innovative Landsat and Sentinel-2 remote sensing method to directly compare the performance of 10 leading global tide models. We rank the performance of every tide model at any coastal location, developing an EO-guided “ensemble” tide model that combines multiple models into a single optimised output. Applying this approach at a continental scale across Australia's diverse tidal environments, we demonstrate its superiority over any individual global ocean tide model when compared to observed tide gauge data.

Our approach runs efficiently at scale and is suitable for large-scale coastal science applications that require accurate tide modelling across data sparse and poorly modelled coastal regions. The approach underpins the newly released Digital Earth Australia Intertidal product suite which maps the 3D shape of Australia’s intertidal zone using petabytes of EO data.

# Coastal conservation on the Sunshine Coast, QLD

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Sunshine Coast Council (SCC) is a coastal council in South-East Queensland with a rapidly growing population predicted to exceed 540,000 by 2046. Much of the population growth is projected along the coast in the urban growth corridor between Caloundra and Maroochydore. With approximately 60 km of coastline, two large estuaries, and multiple intermittently closed and open lakes and lagoons (ICOLLS), coastal conservation programs are essential to manage and protect fragile ecosystems while allowing for recreation and tourism to flourish.

Sustainable coastal conservation programs depend on effective environmental stewardship to care for and use the environment for positive ecological and social outcomes. They integrate scientific evidence with community expectations to reconcile recreational activities with the protection of fragile coastal ecosystems and threatened species.

SCC's coastal conservation programs are guided by the Environment and Liveability Strategy (1) and include conservation plans for threatened species, citizen science programs, volunteer programs, and community education programs. Fostering environmental stewardship by actively involving the community into conservation programs is invaluable for successful conservation outcomes in an urban environment.

The result of these programs is high engagement of the local community in our coastal conservation programs. Over 200 citizen scientists participate in the marine turtle monitoring program, over 1000 volunteers annually support beach clean-ups, and more than 7000 students and members of the community visit our mobile education centre, the Coastal Discovery Van, annually. Research collaborations with local universities further our understanding of local ecological processes and directly inform SCC's coastal conservation programs.

As a result, access to the natural environment and conservation of beaches and foreshores regularly rate highly in Living on the Sunshine Coast surveys (2), and there is generally wide support and interest in SCC's coastal conservation programs.

References:
(1) https://els.sunshinecoast.qld.gov.au/
(2) https://www.sunshinecoast.qld.gov.au/experience-sunshine-coast/statistics-and-maps/living-on-the-sunshine-coast

# Changing communities and changing coasts: CoastAdapt community engagement 8 years on

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CoastAdapt community engagement materials were developed in 2017 to support coastal councils to engage with their communities over changing coasts. Widely used and highly valued, the original manual was developed by a team of experts and based on a systematic review of communication academic and grey literature.

in 2024, a review by an expert panel revealed a number of significant changes in communication landscape over that time.

1. Many coastal councils have completed at least one round of coastal hazard mapping and adaptation planning with their communities. But also, many communities have experienced adverse effects of coastal hazards and have a heightened interest in coastal planning. This collective effort has elevated the coastal conversation from managing coastal erosion and set it within the broader context of global climate change.
2. Staff with coastal management expertise are in high demand and there is a need to provide updated materials and ongoing training and/or consultant support to engage with council staff, whatever their entry point.
3. There is inertia in moving from planning to identifying (palatable) adaptation options and then moving to implementing them.
4. A renewed effort is required to engage with communities, to plan for, and implement local coastal adaptation strategies. But there also needs to be broader community conversations about transition and transform of coastal communities.

With these shifts in mind, we worked with consultants and council staffs to produce the new version of the CoastAdapt community engagement manual with refreshed materials that provide guidance for coastal councils to engage their community effectively and to create opportunity for positive long-term change.

# Greenmount Headland: Balancing engineering and natural landscapes in a high stakes environment

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Greenmount Headland is a key landmark on the Gold Coast, offering stunning views of Snapper Rocks and the northern coastline. Its proximity to the airport and its role in hosting global events make it culturally, environmentally, and economically important. Any development here must preserve the region's heritage and future potential.

Much of the Gold Coast's infrastructure dates back to the 1970s, when the area's beaches gained popularity. With many of these assets nearing the end of their lifespan, the city is focusing on their renewal with an emphasis on resilience and sustainability. Thoughtful management is essential to preserving the coastal lifestyle, balancing past experiences with future challenges.

The infrastructure at Greenmount Headland, including walkways, platforms, and showers, faces significant issues such as geotechnical instability, stormwater runoff, and growing visitation. Initially focused on replacing two aging platforms, the project evolved into a broader revitalization of the entire headland, aligned with the theme of embracing coastal lifestyles through resilience and emerging knowledge.

The project involved multiple meetings, site visits, concept revisions, and community engagement. By navigating logistics, regulatory requirements, and local values, the design now addresses both the functional needs of the space and its cultural significance to the community.

Incorporating nature-based strategies and community input, the new boardwalk will revitalise Rainbow Bay and strengthen the community's connection to this iconic landmark. The project reflects coastal adaptation, resilience, and the importance of local knowledge. It serves as a model for integrating ecological and cultural needs, ensuring a balanced future for Greenmount and the surrounding coastline.

# Urban development and environmental impacts of land reclamation in Can Gio coastal area, Southern Vietnam

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Vinhomes Long Beach Can Gio, situated approximately 50 km southeast of Ho Chi Minh City, Vietnam, is one of the most ambitious land reclamation projects globally. Once completed, it aims to provide luxury residential housing for over 230,000 people and attract up to 10 million tourists annually. This study examines the key engineering challenges and evaluates the potential environmental impacts of the artificial headland on coastal hydrodynamics, sediment dynamics, and water quality. A multi-disciplinary methodology, combining field measurements, laboratory analyses, and advanced numerical modeling, is employed to assess the consequences of extensive dredging, reclamation, and the construction of encroachment structures. Results indicate that the artificial headland causes substantial disruption to longshore currents, altering sediment transport patterns along the coastline. Seasonal wave heights are predicted to increase by 8–12% due to the presence of the engineered structures. However, the impacts on water quality within the mesotidal zone are found to be minimal, highlighting the importance of strategic mitigation measures in balancing large-scale development with environmental sustainability.

# Adapting to the Bribie Island breakthrough - Jellicoe Street, Golden Beach

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Following the breakthrough at Bribie Island adjacent to Golden Beach in early 2022, the tidal range and wave conditions within the Pumicestone Passage changed almost overnight. This resulted in more frequent 'nuisance flooding' of low-lying areas, impacts to existing infrastructure designed for an estuarine environment, and increased erosion throughout Golden Beach which is ongoing. The entire system is in a state of dynamic change, with the community looking to council for solutions. One such solution was a new seawall at Jellicoe Street, designed for the changed conditions, future SLR projections, and incorporating nature-based solutions.

# Beneficial reuse of dredge spoil: The NSW Marine Estate Strategy in action

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In 2022, Transport for NSW (TfNSW) proposed maintenance dredging of the upper Swansea Channel, a key maritime asset for Lake Macquarie's coastal communities. A major challenge was finding a suitable site for dredge material placement. Elizabeth Island, a 5-hectare sand island with a mix of native vegetation and invasive bitou bush, was identified. The island had previously been modified by dredge material placement. A key environmental risk was disrupting the breeding of the endangered Little Tern, which had occasionally been recorded on the island, typically after sand placement. By applying past experience, it was determined that the dredge material could enhance Little Tern breeding habitat and help control the invasive bitou bush.

Dredging was conducted by TfNSW in late 2023 and mid-2024 under strict environmental controls and a detailed shorebird management plan. In November 2023, the first Little Terns arrived, with eight mating pairs nesting on the dredge material and 12 chicks recorded by January 2024. During the 2024/25 breeding season, over 20 mating pairs nested, resulting in more than 50 chicks.

This project builds on past lessons, innovation, and effective coastal resource management, showing that balancing social, cultural, environmental, and economic values under the NSW Marine Estate Management strategy can be achieved. It also demonstrates that 100% beneficial reuse of dredge spoil is possible and can contribute to increasing the resilience of estuarine ecosystems.

# But how severe is the threat of erosion? Assessments from NSW estuaries

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Bank erosion along estuaries destabilises riparian habitats, alters channel morphology, degrades water quality and threatens infrastructure. Bank erosion has been an issue in many Australian estuaries for over a century, requiring targeted management for long-term estuarine stability. The extent of bank protection works in NSW estuaries varies widely depending on historical land use and development pressures, with some areas extensively reinforced to mitigate the threat of erosion. Often, these threats have been assessed through field inspections and community concerns, but systematic, data-driven analyses remain limited. To assess the severity and spatial variability of estuarine bank erosion, field surveys have been integrated with volumetric analyses at key high-erosion sites as part of the NSW Estuary Asset Protection Program (NEAP Program), as part of the Riparian Stabilisation Package co-funded by the Australian and NSW Governments under the Disaster Recovery Funding Arrangements and managed by the NSW Department of Primary Industries and Regional Development – Fisheries, Repeat high-resolution terrain data have been used to quantify bank retreat rates and sediment yields over the past decade, providing critical insights into erosion dynamics across different systems. Comparisons between field-based erosion severity assessments and volumetric analyses reveal strong alignment in many cases, yet key discrepancies highlight the complexity of estuarine hydrodynamics. Some sites exhibiting visible signs of severe erosion showed minimal long-term retreat or sediment loss, while others classified as only moderate erosion had yielded substantial sediment volumes, likely reflecting relaxation times between erosion events and delayed responses captured through field assessments. By integrating these analytical approaches, a more comprehensive understanding of estuarine erosion processes can be achieved, supporting informed management and targeted intervention strategies.

# A comparison of State Coastal Management Programs in Australia

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Approximately 85 percent of Australians live in the coastal region. Coupled with rapid population growth and increasing development pressure, climate change impacts such as rising sea levels and the increasing intensity of storms and cyclones pose growing risks to Australia's lifestyle, environment, and economy. The level of vulnerability and risk is well-known; however, action to date has been limited by all levels of government. Previous research indicates that in the absence of guidance and financial and technical support from higher levels of government adaptation at the local level remains patchy. In response, several states developed programs in the last decade to assist local governments and communities in developing coastal management and adaptation plans. In 2016 Queensland state government launched the *QCoast2100 Program* which funds coastal local governments to prepare Coastal Hazard Adaptation Strategies (CHAS). Similarly, New South Wales government funds local Coastal Management Programs (CMP) through the *NSW Government Coastal and Estuary Grants Program*. Western Australian Government committed $33.5 million over five years from 2021-26 to the *CoastWA Program* which supports planning, managing and adapting to the impacts of coastal hazards to ensure sustainable land use and development on the coast for the long-term. In 2022 Victoria launched its *Resilient Coast – Adapting for 2100+ Program* which provides a statewide approach and grants for development of adaptation plans or projects. *South Australia Climate Ready Coasts program* is developing Coastal Hazard Adaptation Planning Guidelines for the state and will start funding projects in 2025. This project aims to compare these four state programs in terms of level of support and guidance they provide and identify their weaknesses and strengths and lessons they can learn from each other.

# Who pays? Emerging possibilities for resourcing managed retreat

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The increasing impacts of climate change require more proactive adaptation options. Managed retreat, the strategic and pre-emptive withdrawal of settlements and infrastructure from hazardous zones, is now being considered in an increasing number of contexts and locations. Its implementation, however, faces numerous and complex challenges, not least of which is the issue of resource acquisition and allocation. This challenge is confounded by logistical, capacity, political, and equity issues. The failure to consider these issues can undermine implementation efforts and may even derail actions altogether. This paper aims to promote discussion about how to ensure the implementation and resourcing of effective, efficient, and appropriate managed retreat. The study reviews how resources can be mobilised from private and public sectors to motivate this through product and policy innovation. Both sectors struggle with the long term and uncertain impacts of climate change and the ramifications of how to determine where residual risk lays, leaving them looking at each other for solutions and resourcing. Local and regional governments, often responsible for planning and land use, are usually the most resource constrained, but also saddled with climate adaptation responsibility. Local governments can be exemplary borrowers, collectors of taxes, and provider of services and act in collective interest given their role as planning authorities. However, there is limited capacity in the public sector to administer innovative resourcing schemes. The private sector, when provided the right incentives, can provide significant scale, flexibility, and dynamism to enable managed retreat, although there are also significant barriers to action at the likely scale required. As the frequency, extent, and magnitude of climate-related risks combine and compound, policymakers and planners will be left with fewer options for at-risk areas. They will need to mobilise the resources of communities and the private and public sectors to adapt.

# Stability of rock armoured structures in shallow water

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Conventional rubble mound structures such as breakwaters, seawalls, and revetments are the most common type of coastal structures worldwide used to protect harbour basins and hinterlands from wave action. One important aspect of their design is structural stability where the required armour size (weight) of the front slope needs to be determined. Several semi-empirical formulas have been developed for this purpose. These formulas have evolved over time, and are semi-empirical based on small-scale laboratory experiments where incident wave and structure characteristics are varied. However, these formulas are mostly validated for deep water conditions, while coastal structures are commonly located in shallow waters. Hence, some limited studies have recently focused on shallow water conditions and provided some formulas. Nevertheless, these formulas have not been examined thoroughly.

This paper aims to investigate the performances of these formulas both qualitatively and quantitatively. Besides, their accuracies and range of applications will be discussed. To achieve this, publicly available data sets obtained from laboratory experiments are used. Van der Meer et al. (2024), Etemad-Shahidi et al. (2020) and some other recent formulas for slope stability will be discussed. It will be shown that the recent formulas based on the spectral wave height and period are superior to those based on the significant wave height and mean wave period. Finally, a design formula to consider uncertainty and some hints are provided for practitioners.
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# Optimising storm surge response with a Tropical Cyclone Decision Support System

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Storm surge, the most life-threatening aspect of a tropical cyclone, poses a complex forecasting challenge due to the significant uncertainties associated with the cyclone's path, local bathymetry, cyclone characteristics, and the dynamic interaction with astronomical tides. The timeframes for forecasts and evacuations do not align; evacuation planning often requires forecast information earlier than it is currently available.

The Stormsurge project, funded by the Queensland Reconstruction Authority (QRA), Griffith University and Department of the Environment, Tourism, Science and Innovation (DETSI) represents a collaborative effort involving Griffith University, DETSI, Geoscience Australia (GA), Queensland Police Service (QPS) and the Bureau of Meteorology (BOM).

The primary objective of the QSurge Flood Model decision support system is to address the needs of emergency management stakeholders by developing an advanced, high-resolution, deterministic storm surge inundation tool for Queensland. Designed to support emergency managers, it will assist in making informed decisions regarding evacuations while also enhancing existing capabilities through advanced inundation modeling. The QSurge Flood Model system is intended for use across Australia but currently focuses on the Queensland coast, with particular attention to high-risk areas from Cooktown to the Whitsundays and the Gulf of Carpentaria, including major population centers such as Townsville, Cairns, and South East Queensland.

As a decision-support tool, QSurge Flood Model is not intended for real-time operational storm tide forecasting but rather to assist emergency managers in assessing storm tide risks, even with uncertainties in cyclone landfall timing and location.

# Here now be dragons… rewilding coastal dragons

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Adelaide's coastal habitats have been dramatically changed and fragmented by development and historical sand loss. This impacted the distribution of a range of coastal species, including Painted Dragons and other small lizard species, which disappeared from coastal sites. Dragons are now restricted to a few isolated remnant populations on Adelaide's Lefevre Peninsula. This species has not been recorded on Adelaide's coast south of its current distribution for over 60 years. Over the last few decades, a collaborative effort by local councils, Department for Environment, Green Adelaide, and coastal community groups has reinstated coastal sand dune habitat, through sand replenishment and revegetation. Increased beach widths and dune habitat provides an opportunity to re-wild painted dragons to where they had disappeared. Studies assessed current dragon populations, suitable habitat and works to improve reptile habitat and feasibility of translocating Painted Dragons. Painted Dragons prefer stable hind dunes with a cover of around fifty percent shrubs and a patchwork of open space and low weed densities. They prefer a scattering of fallen timber for perching and basking. Some areas need further restoration, to remove dense weed populations, address the overplanting with large shrub species and increase the mosaic of open space. Following wildlife ethics, translocation, and landholder approvals, the first capture and release of dragons occurred to restored coastal dunes in early 2024. This included capture of lizards from an area proposed for development. Only juveniles were taken and "soft released" into temporary pens. Within a week lizards gained significant weight and established burrows, and the pens were removed allowing the dragons to free range. Post release monitoring in spring 2024 indicated survival of several individuals and mating activity. A maternal burrow was found in early 2025. Further translocations will occur in early 2025 as part of a multi-year rewilding plan.

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# Variability of beach profile morphotypes in estuaries and bays under different hydrodynamics

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Beaches in estuaries and bays (BEBs) are considered low-energy environments. Compared to wave-dominated open coastlines, research on BEBs is relatively limited. Previous studies have shown that slope alone does not adequately explain BEB morphodynamics; instead, the shape of the beach profile plays a critical role. However, most prior research was qualitative, relying on visual assessments. In this study, we apply a novel quantitative morphometric index Gazi et al. (in preparation) to classify the shape of BEB profiles. Our objective is to test this index in two contrasting tidal regimes: microtidal and mesotidal. We analyzed four BEBs in the Pittwater Estuary (microtidal, Sydney, Australia) and four in the Ría de Vigo (mesotidal, Spain). Beach profile data were collected from 2016 to the present in Pittwater and from 2019 to 2022 in Vigo using Real-Time Kinematic Global Navigation Satellite System (RTK-GNSS) surveys. The Profile Morphotype Index (Γ) developed by Gazi et al. (in preparation) categorizes profiles into ten morphotypes, ranging from Concave (Γ = -1.000) to Convex (Γ = +1.000). This method quantifies the distribution of key segments of the upper beach profile, offering a more objective classification. Our results show clear site-specific variations in morphotypes due to differences in tidal range, fetch, bay entrance proximity, and beach orientation. In mesotidal environments, Concave-Convex morphotypes are prevalent, while Convex morphotypes (Γ = +1.000) dominate closer to bay entrances, transitioning to Concave morphotypes (Γ = -1.000) farther inland. Additionally, storm profiles exhibit lower Γ values than non-storm profiles. Remarkably, 99% of surveyed profiles were successfully classified using this index. This study highlights significant spatial and temporal variability in BEB morphotypes across tidal settings, demonstrating the utility of the Profile Morphotype Index (Γ) as a robust tool for future global BEB classification and morphodynamic studies.

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# A new coastal fortification technology

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[2]BASF Australia, Southbank, VIC

Sea levels have increased almost a quarter of a metre since 1880. The rate of increase today is more than twice the rate of the 20th century. Because the rate is now 3.4mm per year, we can expect another quarter of a metre sea level rise in the next 25 years.

Global warming is also increasing storm strength. Bigger storms generate stronger winds that produce bigger waves. Waves in deeper water have more energy than waves in shallow water. The inevitable result is increased erosion of coastlines, changed geomorphologies, more dynamic coastal environments, increased risk to coastal infrastructure and nightmare planning scenarios for local governments.

There is an increasing need to protect coastlines from erosion, however, we've learned that hard engineering structures do not absorb wave energy as a beach does.

Revetments with Elastocoast® are an innovative and proven coastal protection system. A 2-component polymer matrix creates an open-pored structure that absorbs the destructive energy of wave run-up, reducing wave action erosion. This extremely effective coastal protection system can be applied to prepared walls, breakwaters, and other marine and freshwater shorelines. The result is an extremely strong and durable barrier against waves and high water.

BASF's Elastocoast® can make use of use of surface aggregates of smaller sizes (20 to 60 mm). This quickly yields considerable savings in the cost of construction materials, transport and processing. The Elastocoast® surface also creates new habitat for intertidal marine organisms. A block placed on the seabed results in the restoration of plant life after a year.

"The main advantage of Elastocoast® is the structure's permeability compared to other revetments. Its higher porosity helps to distribute wave energy, reduce wave impact on the revetment and hence mitigate its destructive potential."

Prof. Dr.-Ing. Hocine Oumeraci, TU Braunschweig, Leichtweiß Institute for Hydraulic Engineering

References:
London Underground Pty Ltd, Melbourne. VIC
BASF Australia, Southbank. VIC.

# Manly Lagoon dissolved oxygen – Don't mix it up!

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Manly Lagoon is an estuary located in a highly developed catchment in Manly, NSW. The lagoon has a history of poor water quality, threatening the ecological and social values it provides. Of particular concern are the low dissolved oxygen (DO) concentrations within the lagoon. Healthy aquatic life generally requires DO levels between 6 and 9 mg/L (ANZECC and ARMCANZ, 2000). However, DO levels at the lagoon are only within these values 25% of the time (Tucker et al., 2023). Low DO could also lead to the release of nutrients from sediments into the lagoon's water, further reducing the water quality and overall health of the system.

In an estuary, oxygen is typically introduced at the surface through wind-induced mixing and diffuses down through the water. The oxygen is then consumed by biological and chemical processes, called the biochemical oxygen demand (BOD). The BOD includes the sediment oxygen demand (SOD) and some additional demand from the water column. This typically results in DO concentrations changing with depth; concentrations are higher at the surface where oxygen is introduced, and lower at the bottom where oxygen is consumed. Density stratification (driven by temperature or salinity differences) can also affect the change in DO with depth. In cases with a large SOD, stratification can prevent the high demand from consuming the oxygen at the surface, potentially allowing higher DO in the surface layer when stratified.

One option to address low dissolved oxygen is to artificially aerate the waterbody. This is typically done by mixing the waterbody, bringing low dissolved oxygen water to the surface where it can be reaerated. This paper details field investigations measuring the SOD at Manly Lagoon and assessing the suitability of artificial aeration. The importance of understanding density stratification and the potential for aeration to worsen DO is also discussed.

References:

Australian and New Zealand Environment and Conservation Council (ANZECC) & Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), 2000. Australian and New Zealand Guidelines for Fresh and Marine Water Quality

Tucker, T. A., Rayner, D. S. and Harrison, A. J., 2023. Manly Lagoon: Review of environmental processes. UNSW Water Research Laboratory, Technical Report 2021/23, Manly Vale, Australia.

# Surfing Infrastructure Masterplan (SIM)

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Surfing is a globally celebrated sport that continues to grow in both participation and cultural significance, yet there is a clear divide between the provision of government funded infrastructure to facilitate surfing, as opposed to that of other sports. This relatively lower investment is attributed to several factors:

1. Reliance on natural assets to surf (i.e., surf breaks at beaches)
2. Historical technological immaturity of artificial surf infrastructure (e.g., wave pools, deep water standing waves)

The Surfing Infrastructure Masterplan (SIM) is a world first initiative which aims to establish a 25-year vision for the development of surfing-related infrastructure on the Gold Coast—one of the world's most iconic surfing destinations. The SIM underscores the importance of investment in surfing infrastructure to accommodate growth in surfing, foster nature based tourism offerings and support sustainable and resilient coastal environments and address coastal resilience.

The SIM's objectives are:

1. to assess current and future demand on the Gold Coast's surf breaks
2. to identify and prioritise transformational infrastructure projects, and to create a roadmap for enhancing the social, economic, environmental, and cultural value of surfing.

The SIM seeks to support the recreational surfer community, the broader surfing ecosystem and strengthen the Gold Coast's reputation as a global leader in the management of surf amenity. Future projects under consideration include artificial surf reefs, deep-water standing waves, land-based wave pools, and infrastructure that extends surfing opportunities beyond daylight hours.
By highlighting the need for long-term vision and investment, the SIM will explore the critical role that well-planned surfing infrastructure can play in supporting surfing's social, economic, environmental and cultural contribution to the Gold Coast.

# Alternative options for coastal asset monitoring and inspection through iPhone LiDAR technology

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Local councils face ongoing challenges in managing coastal assets, where the high cost of survey-grade equipment, specialised labour, and the need for rapid reporting create significant barriers to efficient asset management. While drone capture methods have demonstrated potential for asset monitoring, regulatory frameworks limit their use in several cases requiring alternative, ground based methods.

This paper presents a case study on the use of LiDAR technology built into iPhones for asset inspections. The technology offers fast, high-resolution, low-cost, and user-friendly capabilities, making it accessible for non-specialised field technicians. With ongoing dilapidation of coastal assets over time and, particularly after storm events, there is a pressing need for ongoing monitoring to ensure public safety, especially in high-traffic areas.

In this case study, monthly monitoring was undertaken after a seawall had failed post-storm. Due to the nature of the failure, continuous monitoring was necessary to assess the condition of the structure and to manage safety risks until a permanent repair solution could be implemented. To facilitate this, five transects were set up across the affected area, and monthly LiDAR scans were performed. Both visual and quantitative analyses were conducted to track changes in the seawall's condition over time. Manual measurements were also taken to benchmark the LiDAR results. This data allowed for the identification of areas in need of immediate attention, ensuring that public safety was maintained while a more permanent solution was developed.

Although the methodology has limitations, particularly when applied to larger areas where curvature effects can impact the accuracy of 3D models, it proved highly effective in monitoring smaller, defined sections. This case study highlights the value of LiDAR technology in providing an accessible, low-cost solution for ongoing asset monitoring and safety assessments, offering a practical tool for local councils managing coastal infrastructure in dynamic and high-risk environments.

# Storm tide modelling of the cyclones in the Gulf of Carpentaria

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The Gulf of Carpentaria is highly susceptible to cyclone activity. In this study, a two-dimensional unstructured mesh was developed using Mike21 mesh generator to cover the Gulf of Carpentaria and its surrounding areas. This model aims to assist emergency managers in assessing storm tide risks, even in the face of uncertainties regarding cyclone landfall timing and location.

The model was setup using FM module of Mike21 and forced by cyclonic wind and pressure fields, as well as tidal boundary conditions. The wind and pressure fields were generated using different analytical models, such as the Young and Holland models. The most suitable model was selected based on a comparison with wind data recorded by several synoptic stations along the coast of the Gulf of Carpentaria during multiple cyclone events.

For tidal boundary conditions, data were sourced from the global tide model of the MIKE 21 Toolbox (with a resolution of 0.125 degrees), Maritime Safety Queensland, and time series generated using tidal constituents.

The model was run for several cyclone events, and the resulting storm tides were compared with measurements from multiple tidal gauges in the Gulf of Carpentaria. The comparison showed that the model is well-calibrated and can serve as a foundation for a storm surge warning system in the region.

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# Putting a dollar value on coastal adaptation actions – lessons and insights

**M Gough**[1], S Leck[1]
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Australia's coastline faces escalating risks from erosion, inundation, and storm surges, with climate change accelerating these challenges. The costs of inaction are significant, yet investment in adaptation is still limited. Demonstrating the dollar value of adaptation measures can increase funding and investment in adaptation. Sound economic analysis can also improve decision-making for adaptation. This presentation draws on lessons and insights from recent work assessing the economic costs and benefits of coastal adaptation measures in Western Australia.

Economic analysis of coastal adaptation measures is still relatively under used in decision-making, particularly compared to standard infrastructure investments. There are also specific challenges relating to data quality and availability, understanding the base case, and accounting for the long time frames over which benefits may occur. This presentation discusses some of the benefits of economic analysis approaches, and where they have been successfully applied and used in decision-making, reflects on the remaining challenges and issues, and recommends how these challenges can be overcome.

Economic tools allow decision-makers to compare adaptation options such as protection, accommodation, and managed retreat, weighing their long-term socio-economic benefits and the costs of investment. Our economic analysis of coastal adaptation actions has highlighted some important issues. In particular, the results of the analysis demonstrate the importance and value of adaptive pathways, and the importance of timing for investment in delivering net benefits for communities. Our analysis has also shown the value of nature-based solutions and the importance of soft measures that maintain recreation and ecosystem services, even in areas with high value properties. Our work has also demonstrated that the value of some adaptation options are much harder to quantify than others, for example managed retreat, but this does not always mean other options are better for the community.

# The Future of South Australian recreational jetties

**A Gray**[1]
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South Australia currently has approx. 76 recreational jetties, all are owned by the State Government with half of those jetties leased to local Councils. South Australians love their jetties, local communities and visitors relate to these assets as vital to the culture of our coastal environment.

State Government leasing arrangements include the transfer of management/maintenance obligations. A number of these recreational jetties are now either fully or partially closed due to poor condition, a result of years of underinvestment in maintenance combined with recent severe weather & storm impacts.

The future of these assets are now at a cross road – the State Government doesn't want responsibility and small regional councils simply cant afford to renew or replace them.

This presentation will provide a case study of the history of SA jetties, recent community surveys and sentiment, historical and current State and Local Government negotiations and the opportunities & challenges that these assets pose to smaller regional communities going forward (under the spectre of rising sea levels and increased severity of storm events).

# Drawing a line in the sand – Whitsunday shoreline benchmarking

**S Hardy**[1], L Ferris[1]
[1]Whitsunday Regional Council, Airlie Beach, QLD

The Whitsunday coastline in Central Queensland is impacted by cyclones and coastal storms that cause periodic coastal erosion. Following seasonal coastal erosion events, the council is often requested by the community to “fix” coastal erosion and restore the coastal dune profile. Some of the usual solutions to coastal erosion have been the use of sand nourishment and sand scraping. However, the Council previously did not have a good coastal data set or decision making system to assist with dune restoration decisions.

In 2022, the Whitsunday Regional Council completed its Coastal Hazard Adaptation Strategy (CHAS) which identified the need to develop a method of monitoring short term and long term coastal erosion and provide data to support coastal dune restoration decisions. In 2023, the Council developed its “Urban shoreline benching project”. The aim of the shoreline bench marking project was to use LiDAR (Light Detection and Ranging) to capture the topography of 12 urban foreshore areas from 20m in-land to the low tide mark. The LiDAR data captures the coastal geomorphology at 0.1m vertical resolution. The LiDAR data was then used to assist in determining the 2023 shoreline. The shoreline for the benchmarking project was determined to be at the base of the coastal dune. The base of the coastal dune was chosen to be the “shoreline” for monitoring because this geomorphological feature can be determined from LiDAR and also identified in the field. The result of the Whitsunday shoreline bench marking project is essentially a digital line in the sand to monitor short term and long term coastal erosion. The data can also be used to support coastal restoration actions and costs if specific sand loss triggers are exceeded. The Whitsunday Council now has better data to manage its response to coastal erosion events and manage community expectations.

# Sea level rise in estuaries – the risk of rising low tides

**A Harrison**[1], K Waddington[1], T Tucker[1], W Glamore[1]
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Most of Australia's population lives, works and plays within reach of one of our estuaries. Since European settlement, the floodplains along the banks of our coastal waterways have been modified substantially with the construction of extensive drainage systems to reduce inundation times, maximising dryland agriculture and to facilitate the lifestyle we now enjoy. These systems, which often include drainage channels accompanied by one-way floodgate structures, were installed within the tidal reaches of estuaries. Subsequently, their ongoing function is vulnerable to sea level rise.

While many studies focus on the impacts of tidal inundation resulting from increasing high tide levels due to sea level rise, this work highlights that changes in water levels across the entire tidal range will significantly affect present-day drainage in floodplain areas. In estuaries where one-way floodgates sit within the tidal range, they enable drainage to low tide levels, while preventing tidal inundation at high tide. Present-day low tide water levels in estuaries already restrict surface water drainage in the lowest lying areas of coastal floodplains. A substantial land area behind floodgates in NSW estuaries is within the present-day tidal range (approximately below 1 m AHD). As sea levels rise, an increasing portion of these areas will be below the low tide water level and even floodgates won't be effective to prevent prolonged inundation. This will change how we can use these areas, and planning for this future needs to start now.

This study presents the methods and outcomes of an assessment which determined the risk of sea level rise on floodplain drainage for seven major coastal floodplains in NSW. The findings resonate with agricultural coastal floodplains across Australia, and underscores the need for proactive management of these environments in the future.

# Optimising the Tweed Sand Bypassing Operating Model

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Tweed Sand Bypassing (TSB) is a joint initiative of the State Governments of New South Wales and Queensland. On 1 October 2024, Transport for NSW (TfNSW) became directly responsible for operations and maintenance on behalf of both Governments. Direct responsibility has improved visibility and flexibility over day-to-day operations of the system, enabling operational efficiencies to be investigated and implemented while continuing to achieve TSB's legislated objectives.

A significant milestone of the transition was the implementation of a management system, including an updated Environmental Management Plan (EMP) and revised environmental monitoring program. The program retains key long-term monitoring activities, however the updated EMP and extensive stakeholder engagement has initiated opportunities to streamline monitoring requirements and target monitoring efficiencies through technological innovation, partnerships and responsiveness to emerging environmental challenges.

TfNSW operations have facilitated flexible decision-making processes that have already provided better outcomes for the community and the environment. For example, direct management of the Duranbah nourishment campaign in November 2024 was undertaken in close consultation with stakeholders while considering daily metocean conditions and shoreline trends. This ensured minimal impact to southern Gold Coast beaches while still restoring amenity to Duranbah. Ongoing sand pumping operations, dredging, monitoring and asset management all benefit from the new operating model.

Annual maintenance dredging of the Tweed River entrance will continue as a key activity to achieve TSB's entrance management objectives. TfNSW are now responsible for engaging a dredging contractor which will allow for direct management and communication during dredge campaigns. Benefits of this arrangement include consideration of multi-year contracts, removal and placement design flexibility, outcome driven programming and scheduling, and the ability to respond to changing bathymetric conditions during a campaign.

It is envisaged that better integration of monitoring and analysis with site operations will be possible, ensuring TSB's strategic priority of continual improvement is achieved.

# Is Australia's oldest coastal legislation still effective?

**N Harvey**[1]
[1]University of Adelaide, Adelaide, SA

Australia has no national coastal legislation, but four Australian states have their own specific legislation. Three states have replaced their coastal legislation in the last 20 years, however, the South Australian *Coast Protection Act, 1972* has been virtually unchanged since its inception over 50 years ago. It is now the oldest piece of coastal management legislation in Australia, notwithstanding several attempts to update and reform it. This paper discusses why coastal legislative reform has been so difficult in South Australia.

There have been major changes to coastal policy and planning in South Australia over the last 50 years but no significant change to coastal legislation. One reason is that most head-powers for coastal management in South Australia reside in development control regulations and planning legislation. Three successive pieces of planning legislation have been introduced and subsequently amended, the *Planning Act 1982*, the *Development Act, 1993*, the *Planning, Development and Infrastructure Act, 2016.* In practice, coastal management functions have adapted to these changes along with the introduction of new coastal-related pieces of legislation dealing with issues such as native vegetation, natural resource management and environmental protection.

There have been numerous calls to reform South Australian coastal legislation. In 1992, the Minister for Environment and Planning commissioned a review of the *Coast Protection Act* to recommend changes to the Act. In 2007, the South Australian Parliament's Environment, Resources and Development Committee (ERDC) held an inquiry into coastal development and recommended revision or replacement of the Act. Recently in 2021 the ERDC held another broad coastal inquiry which again recommended reform of the Act. So far not much has happened.

This paper discusses the current effectiveness of South Australia's Coast Protection Act in the context of 50 years of failed attempts at coastal legislative reform and numerous coastal policy and planning changes.

# Natural Capital Accounting – driving innovation in marine and coastal management

E Francis[1], **L Howes[1]**
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Nature provides us with goods and ecosystem services such as clean air, fresh water and food. Natural capital accounting, also known as environmental economic accounting, is a framework for integrating environmental and economic data to better understand environmental assets. The framework helps to describe ecosystem changes and associated impacts to our well-being and the economy, and more broadly allows nature to be considered in decision making, leading to enhanced environmental value, resilience and sustainable use.

The creation of a natural capital account for the Great Ocean Road region is a fundamental tool to support the Great Ocean Road Coast and Parks Authority in actualising its significant transformation agenda. Established 1 December 2020, the Coast and Parks Authority represents the future of marine and coastal public land administration in Victoria. The Coast and Parks Authority aims to drive innovative advancement in coastal and marine management through full integration of quadruple bottom line protection principles to protect, enhance and manage public land.

To meet its transformation agenda, the Coast and Parks Authority must fully actualise the benefits of the natural capital account through systematic integration across all business sectors. Given this is a novel approach within the organisation, and more broadly within marine and coastal management across Australia, the Coast and Parks Authority has prioritised significant resource investment since 2023 to build knowledge and capability. This presentation will focus on articulating our ‘road map’ approach aimed at generating material improvement over the next 3-5 years in areas including, but not limited to, service delivery, monitoring and reporting of conservation activities, strategic, operational and regional planning and science communication.

Sharing key learnings represents an opportunity to shape a collective conversation around the benefits and challenges of embedding a natural capital approach to drive innovation in marine and coastal management.

# Innovative Coastal Management: The role of pilot projects in resilience

**A Jackson[1],** A Salyer[1], B Corbett[1], Z Lindenberg[1], M Mulcahy[1], S King[1]
[1]International Coastal Management, Gold Coast, QLD

Pilot projects have been pivotal in advancing coastal resilience, providing a testing ground for innovative solutions to address the challenges of dynamic coastal environments and a changing climate. While not all pilot projects achieve their desired outcomes, every initiative contributes invaluable lessons that drive ongoing development and strengthen industry knowledge, ensuring coastal management keeps pace with rapidly evolving conditions. The Gold Coast, Queensland, has long been a global hub for pioneering pilot projects. Early initiatives, such as the Kirra Groyne project in the 1970s, introduced sand-filled geocontainers for erosion control. While initial efforts required refinement, they paved the way for widespread adoption in remote and resourceconstrained locations like Pacific Island nations. Similarly, the Narrowneck artificial multi-purpose reef set a precedent for integrating coastal protection with recreational and ecological benefits, though its dual objectives required significant design iteration to balance effectiveness. Pilot testing nearshore nourishment strategies was another transformative milestone. By strategically placing sand in the nearshore zone, these projects enhanced sediment supply, dissipated wave energy, and reduced storm impacts. Despite early uncertainties, these pilots validated a long-term strategy now embraced on the Gold Coast and replicated in coastal communities worldwide. More recently, the pilot approach pioneered in Queensland has been adopted in Southern California, where lessons from Queensland's coastal resilience framework are shaping innovative projects. The "Living Speed Bumps" concept, currently in development, draws directly from Queensland’s integration of naturebased solutions and engineered interventions, emphasizing adaptability to local conditions and stakeholder engagement. The iterative and adaptive nature of pilot projects underscores their importance. Even when outcomes fall short, the lessons learned fuel innovation, refine approaches, and build resilience. This paper explores Queensland’s legacy of pilot-driven coastal resilience and its global influence, highlighting the critical role of experimentation, community involvement, and engineering ingenuity in safeguarding coastlines amid rapid environmental change.

# Modelling tidal flow reengagement and mangrove nutrient uptake

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[2]City of Gold Coast, Gold Coast, QLD

Southeast Queensland is one of Australia's fastest-growing regions, facing the challenge of managing urban expansion while protecting coastal and waterway ecosystems. There are currently many pressures on the southeast Queensland waters, but most importantly the impact of increasing populations on water quality. This paper highlights a case study from the Gold Coast demonstrating how re-engaging tidal flows and restoring mangrove habitats can serve as effective nature-based solutions for water quality improvement.

The City of Gold Coast is exploring alternative management options within its waterways to improve water quality. One such opportunity exists along the Pimpama River, where tidal flows can be reintroduced to areas with restricted intertidal connectivity due to historical drainage modifications. This intervention would support mangrove regeneration and provide additional nutrient uptake and water quality improvement.

Initially a desktop analysis was conducted to estimate the potential nutrient uptake based on predicted inundation areas and nitrogen uptake literature values for mangroves. This approach was then refined using a three-dimensional biogeochemical model. This involved modelling the tidal reengagement and calculating the potential nutrient reductions within the estuary and overall water quality improvement.

This paper will outline the methodologies underpinning this project and discusses the benefits of using a three-dimensional model to assess changes to water quality. It will also describe the process of scoping, evaluating, and implementing these solutions and detailing other potential applications.

# Urban dunes as a coastal defence: Lessons from Queensland's shorelines

A Jackson[1], B Corbet[1], Z Lindenberg[1], M Mulcahy[1], **S King[1]**, A Salyer[1]
[1]International Coastal Management, Gold Coast, QLD

Coastal dunes play a crucial role in maintaining the stability and resilience of beach systems, dynamically adjusting to wave energy and sediment transport. However, urbanisation and coastal infrastructure often disrupt these natural processes, leading to significant dune erosion and loss. Effective urban dune management is essential to mitigate these impacts and enhance coastal resilience. This study evaluates the effectiveness of compact urban dunes through crossshore storm cut modeling, complemented by real-world examples of long-term dune systems that successfully integrate with natural processes. The modeling results indicate that urban dunes, when properly designed, exhibit increased resilience and reduced storm cut compared to unmanaged dunes. Furthermore, the use of sand-trapping fences significantly enhances the efficiency of urban dune systems, demonstrating key differences from their wider, unconstrained natural counterparts. Over the past five decades, urban dune creation and management have evolved with the support of comprehensive, cost-effective methods and town planning policies. These strategies have facilitated the transfer of millions of cubic meters of sand from inactive back dunes to active beach and dune environments. The policies developed categorize dunes into non-urban, urban, minor public areas, and major public areas, each with specific intent, provisions, and guidelines for activity, land use, and vegetation management. This structured approach has not only provided a sustainable sand reservoir but has also fostered native dune vegetation, aiding in natural recovery post-storm events. The findings confirm that well-managed urban dune systems enhance resilience to coastal hazards while maintaining a balance between development and environmental preservation. Case studies illustrate successful nature-based strategies that integrate urban dunes into coastal landscapes, demonstrating their viability as a long-term solution for sustainable coastal management in urban settings.

# Wonder Reef Dive Attraction - a prototype for Blue Futures

**K Konings**[1]
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The City of Gold Coast has created a one-of-a-kind asset which provides environmental, recreational and commercial benefits. Wonder Reef sets a new bar for ecotourism experiences, creating significant habitat for our magnificent marine life and a wondrous dive experience. Wonder Reef is the world's first buoyant artificial dive attraction and represents an innovative fusion of art, science and engineering design.

The reef consists of 9 giant buoyant reef sculptures, which have already become home to hundreds of different marine life species including lobsters, octopus, tropical fish, turtles, and giant gropers. The kinetic nature of the reef sculptures allows them to move with the energy of the ocean, like a giant kelp forest. Spacing between the reefs and vertical upwelling attracts marine flora and fauna to provide an intriguing dive experience.

The overall aim of this poster presentation is to demonstrate that while there are competing demand for environmental, recreational, community and commercial uses for our oceans, we can create unique places where these demands do not have to compete but can live and work together in cooperation. The presentation will then provide a visual summary of the design, construction and installation phases. This section will also dive into the strategies which have been developed to ensure Wonder Reefs success now and into the future.

The presentation demonstrate how Wonder Reef has evolved from a blank canvass to a thriving and sustainable marine environment. This will include information on the ecological, recreational, commercial and overall benefit to the Gold Coast community.

Wonder Reef has been created with the natural environment in mind and will inspire a greater appreciation of the environment as it evolves into a significant new marine habitat. Hopefully this presentation with inspire attendees to look beyond traditional methods and create a unique blue future of their own.

# Making effective use of consultants in coastal adaptation planning

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[2]BMT, QLD
[3]Sustainable Human Environments Griffith University, QLD

Coastal councils are planning for coastal hazards in efforts to improve coastal resilience. This planning is hyperlocal and complex, requiring expertise that includes community engagement, coastal engineering, environmental science, social science, economics, and climate modelling. For many local governments, especially smaller ones with few staff, this is beyond already constrained capacity and resources. When funded by government programs, they undertake this planning through professional consultancies that execute all or some of these phases of planning. Consultants can offer specialised expertise essential for developing adaptative adaptation strategies. But does this always occur?

In this paper, we reflect on the strengths and weaknesses of the widespread use of consultants examined through data collection and analysis in two projects.

1. Development of guidance (delivered through the decision support platform CoastAdapt.com.au) based on qualitative interviews with consultants involved in coastal planning mostly in Queensland and Victoria. The resource offers guidance, checklists and templates on how to gain internal support, prepare a brief, select a consultant, avoid common pitfalls and manage and evaluate the project.

2. Evaluation of Queensland's QCoast$_{2100}$ program which funded local governments to prepare Coastal Hazard Adaptation Strategies. All local governments, large and small, used consultants. The project included 47 semi-structured interviews with consultants, local government officers, program managers, and expert panel members who reviewed the completed strategies.

We conclude that consultants need to be selected and managed carefully to obtain the benefits of their expertise. Pragmatically, councils can benefit from guidance on how prepare for and manage the consultancy process and consultants can be more conscious of supporting capacity building and learning in councils. We suggest how this can be managed more effectively across jurisdictions. We also reflect more theoretically on the role and implications of privatised advice for coastal resilience.

# Managing shoreline erosion along a 320 km coastline: where to start?

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Beaches within the Mackay Local Government Area (LGA) in Queensland are dealing with ongoing or recurring erosion, each addressed through site-specific management plans, including fourteen Local Coastal Plans and five local Shoreline Erosion Management Plans (SEMPs). With climate change and urban expansion adding pressure, the Mackay Regional Council is now seeking a more integrated approach through the creation of an LGA-wide SEMP. This plan is set to complement Council's Coastal Hazard Adaptation Strategy (CHAS).

Crafting a robust SEMP for the Mackay coastline is a real challenge, given the complex coastal processes and the unique social and economic features along this extensive stretch. The coastline, which extends from Cape Palmerston National Park to the O'Connell River, features sandy beaches, intertidal flats, and rocky headlands, each influenced by unique wave patterns, sediment supply, and topographic factors.

While coastal monitoring data is scarce, this first stage of developing an LGA-wide SEMP aims to establish a detailed understanding of the physical context of the Mackay coastline. It identifies key coastal processes, the region's sand budget and sand transport pathways through interrogating a multitude of historic and recent data scraped together from a range of public sources. This allows dividing the coastline into distinct sediment-sharing sub-regions, each with unique sand transport dynamics, which are used to delineate Coastal Management Units (CMUs). These CMUs are further divided into sub-units based on shared sediment transport pathways and exposure to coastal processes, to guide identification of sustainable erosion management and protection strategies in phase 2 of the SEMP development.

To assist Council manage shoreline erosion and where necessary, protect constructed essential public infrastructure over the next 20 years, identifying priority areas for coastal management actions for such an extensive coastline is imperative. This prioritisation is vital for efficient allocation of resources and planning effective erosion management strategies.

# Kingscliff Beach – will five decades of research and planning *really* help manage future risks?

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Due to its important location just south of the Queensland border, the Tweed coast and Kingscliff locality have been the subject of extensive coastal research, planning and management for over 50 years. From the seminal 1970 Delft Hydraulics Laboratory report into coastal erosion on the Gold Coast to the 2025 Tweed coastal hazard assessment by Bluecoast, this region has been well studied.

Supported by legislated, grant-funded, and practical assistance from the NSW Government, Tweed Shire has actively engaged in coastal zone planning and management for several decades. Kingscliff, like many coastal communities, has experienced significant erosion events resulting in the loss of infrastructure and amenity, followed by periods of recovery and various management interventions – some good, some bad and some just plain ugly.

This paper will touch on the role of decision-making driven by community pressures in an environment of limited resources and funding. Kingscliff foreshore has been subject to a range of engineered (and non-engineered) protection structures and strategies, the success or otherwise of these will be reviewed. The importance of Federal and State Government grant funding to support Local Governments in implementing well developed and fit for purpose risk management solutions cannot be understated.

Historical and current management actions will be looked in the context of what lies ahead. The latest coastal hazard projections look out to 2120 and there is a greater level of maturity in our understanding of environmental, social, and cultural values. What have we learned from the past and what are the implications for future risk management strategies?

# Overcoming human-wildlife conflict for sustainable recovery of beach-nesting birds in coastal Australia

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The struggle faced by Australia's beach-nesting birds is one of the best examples of human-wildlife conflict. These highly camouflaged birds attempt to breed in habitats used heavily for human recreation. Their unique behaviours make them highly susceptible to human disturbance.

As the human population increases and use of public open spaces intensifies, identifying threatened species recovery solutions that are adopted and sustainable across thousands of kilometres of coastline poses a considerable challenge. For wildlife inhabiting high human interface environments, the only way to reduce the loss of biodiversity is to gain collaboration and cooperation of individuals, organisations, and key stakeholders to act on the drivers for its loss.

BirdLife Australia's Beach-nesting Bird Program has invested 19 years in developing and implementing conservation actions to mitigate human-based threats, with citizen science and collaborative partnerships with coastal managers as the foundations for sustainable recovery. Solutions are evidence-based and integrate social science insights around barriers to behaviour change. A coexistence approach to sharing beach habitats is built on three key elements: on-ground protection of breeding sites; investment in behaviour change, and; supportive legislative regulations coupled with compliance patrols. Alongside on-ground efforts, scientists have been undertaking research to overcome key knowledge gaps to guide adaptive management. Population data combined with breeding success monitoring reveals an overall positive outlook for multiple populations of beach-nesters. However, threats at some sites continue to escalate, including weed infestations and both introduced and superabundant native predators, transforming these to breeding sinks. While we make progress with the most immediate of threats, we need to commit to a long-term strategy for coastal rehabilitation to build resilience in populations.

# Erosion in the Lake Illawarra entrance channel

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Lake Illawarra is an estuary on the south coast of NSW, consisting of a large lake of 36 $km^2$ which is connected to the ocean via a 2,000 m long entrance channel. Historically, the lake was an intermittently closed and open lake or lagoon (ICOLL), however, following community action in the 1990s and early 2000s regarding poor lake water quality, the entrance was connected to the ocean with the construction of entrance training walls in 2007, resulting in a permanently open entrance. Since the entrance was trained, significant changes have occurred to the hydrodynamics of the system. Increased conveyance has resulted in increased erosion, which results in a larger channel, further increasing conveyance and erosion in a positive feedback loop. The tidal range in the lake has increased by 7 mm/year since 2007, and several assets, including Windang Bridge, are threatened by the erosion. Modelling has been undertaken to assess the effectiveness of several intervention options, including weirs and groynes, with the aim of reducing the tidal range in the lake. Results show that a reduction in tidal range to 2007 levels is achievable through several alternatives, however the hydrodynamics of the system will significantly impacted.

# Shoreline Mangrove Offset Project – the journey from concept to reality

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[3]Griffith University, Brisbane, QLD

The Shoreline Mangrove Offset Project (SMOP) entails the construction of a bespoke 10ha mangrove and saltmarsh system on the bank of the Logan River in Redland Bay. The purpose of this project is to deliver a nutrient 'offset' for a parallel 15,000 person sewage plant being constructed to treat wastewater from the Stockland owned Shoreline urban development project to ensure that water quality levels in the Logan River and Moreton Bay are protected as the development proceeds. This is the first time that such an activity has been undertaken at this scale in Queensland, if not Australia.

This paper will describe the 'journey' taken from concept development/ideation, through State and Local Government approvals, construction and in the very near future the first delivery of treated effluent to the system.

An Australian Research Council (ARC) linkage project which has been awarded to a Griffith University led team to study this system over a 4-year period will also be described.

# State of the art – bathymetric technologies for coastal applications

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This paper explores the suite of tools available to provide bathymetry information to coastal engineering and related professionals and in particular the suitability of those tools for various applications, and known limitations.

Today many different tools are available for collection of bathymetry data, and each has particular strengths and weaknesses in terms of data density, speed of data collection per unit area, accuracy and cost.

The technologies reviewed include

- Satellite derived bathymetry
- Photogrammetry
- LIDAR
- Single beam
- Conventional multibeam echosounder (MBES)
- Interferometric
- Hybrid systems

Potential application of these technologies include flood modelling and object detection, sediment transport modelling/ monitoring, navigation channel maintenance monitoring/ dredging, infrastructure development, seagrass mapping, climate change impacts and many others.

Typically the lowest cost technologies provide are the least accurate, and the highest accuracy are the highest cost, so the identification of the most cost effective technology for each application is of importance in order to best leverage investment in bathymetry data for maximum economic benefit in outcomes for the community, developers and for future generation.

The paper tabulates the advantages and disadvantages of each technology for the applications noted and key factors to be considered by coastal practitioners to identify the optimum data source for a particular coastal problem.

# Accepted development can provide a self-assessable toolbox of authorisations for restoration

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There are well-established reasons to protect the values of coastal ecosystems. More recently, there is an identified need for government organisations to help overcome unintended governance barriers to restoration activities seeking to mend damaged ecosystems, for example, by restoring tidal flows and shellfish reefs (Waltham, et.al., 2024).

Queensland planning legislation provides an *accepted* category of development for self-assessable authorisations. Where works comply with requirements, an assessable development application with fees does not apply. Fisheries Queensland is reviewing two accepted development codes that can provide time and cost saving solutions for these types of fish habitat remediations. This presentation will discuss examples of proposed restorative work-types and provide an update on the reviews of these Accepted Development Requirements (ADRs).

Feedback and experience from the past seven years of *Planning Act 2016* pre-lodgement advice and development assessment for works that impact on marine plants or fish passage in waterways has been analysed and used to inform the updates proposed to the ADRs. This includes more than: 3,000 pre-lodgements, 8,800 accepted and 1,670 assessable developments. Proposed new accepted development work-types for restoration projects that involve barriers to fish passage in waterways and impacts on marine plants have been drafted to inform engagement involving key stakeholders. Each draft ADR includes a set, or toolbox, of work-types to provide such authorisations. These continue to protect existing environmental values and authorise temporary impacts for works that will lead to net benefits.

These new accepted work-types can also help developers identify ways they can mitigate or minimise unavoidable impacts to gain approvals with greater certainty. Finding solutions for proponents of both development and restoration that sit within existing authorisation systems avoids new costs in government service delivery and helps to keep resources focussed on delivery of outcomes, rather than on the development or augmentation of systems.

References:
Waltham NJ, Saunders MI, Morris R, Bell-James J, Bishop MJ, Bugnot AB, Connell S, Drew G, Fischer M, Glamore W, Jones A, McAfee D, McCormack PC, Mayer-Pinto M, Prahalad V, Shumway N, Swearer S, Wawryk A (2024). Identifying and overcoming barriers to marine and coastal habitat restoration and nature based solutions in Australia – Project summary. Report to the National Environmental Science Program. James Cook University.

# Numerical modelling of complex coastal morphology

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[2]Haskoning, Newcastle, NSW

Coastal processes are inherently complex and challenging to quantify due to the interplay of various natural (highly variable) and anthropogenic factors. Anthropogenic change, such as coastal structures and dredging, can significantly alter processes that influence coastal morphology. Numerical modelling is often employed as a tool to understand these changes and predict impacts on morphology. The complexity of coastal environments requires consideration of multiple key processes. When misunderstood, the application of the wrong tool/model can lead to impacts being incorrectly defined and consequently, adverse outcomes.

This paper presents the approach adopted by Royal HaskoningDHV (RHDHV) to understand the intricate coastal morphology at two sites: Cape Ferguson, QLD (RHDHV, 2022a) and Coffs Harbour, NSW (RHDHV, 2022b), and address where siltation had led to significant challenges.

A critical first step was to develop a conceptual understanding of sediment transport at each site using multiple lines of evidence approach (e.g., a combination of hydrographic, met-ocean surveys, literature review, and engineering judgment). Key processes were identified, and appropriate modelling software was selected to simulate representative conditions. In the case of Cape Ferguson, multiple modelling tools were required.

SWASH, LITPACK and measured currents were utilised to model the sediment transport dynamics at Cape Ferguson. Rigorous analysis ensured that the simulated conditions accurately represented the significant factors driving morphological change. For Coffs Harbour only SWASH was required. The combined use of these modelling tools and relevant analysis provided a comprehensive understanding of the sediment transport mechanisms.

The outcomes include the development of conceptual sediment transport models for Cape Ferguson and Coffs Harbour. These models provide valuable insights for developing solutions to address siltation challenges, optimising sand management strategies, and refining the design of coastal structures. The studies underscore the importance of integrating; coastal processes expertise, multiple modelling approaches, and analysis, to effectively tackle complex coastal morphology challenges.

References

RHDHV (2022a), AIMS Marine Facility Morphology Assessment, prepared for AIMS.
RHDHV (2022b), Numerical Simulations of Surf Zone Dynamics – Coffs Harbour Boat Ramp Upgrade. Prepared for Transport for NSW.

# Mapping the frequency of coastal storm-tide flood years

**J O'Grady**[1], H Bloustein[2]
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As sea-level rise (SLR) accelerates, tidal nuisance inundation, or "sunny day flooding," is becoming a chronic issue in low-lying coastal areas. Once considered occasional disruptions, these events are now persistent threats to coastal paths and streets (Hanslow et al., 2023). Beyond tidal flooding, extreme storm-tide events—caused by the convergence of major storm surges and high tides—pose an increasing risk of catastrophic inundation to coastal buildings and infrastructure. Traditionally defined as 100-year events with a 1% annual exceedance probability (AEP), these storm-tides are projected to become more frequent and severe due to SLR. The threshold for chronic coastal inundation remains uncertain, often described in terms of recurrence over decades but ultimately dependent on the adaptive capacity of affected systems.

This NESP ESCC hub study examines the changing nature of storm-tide flooding across 20 Torres Strait islands over two 30-year periods: the past (1995–2024) and the future (2025–2054). Using open-access geospatial data sources, such as digital elevation models (DEMs), we map projected inundation frequencies and use OpenStreetMap and satellite imagery to highlight areas likely to experience significant increases in flood risk. The map overlays indicate the number of years in which water levels are expected to exceed the DEM, providing insights into flood frequency and potential hotspots of chronic inundation. However, this approach is constrained by data availability.

Validation and calibration remain preliminary, relying on historical flood records from a limited number of known hotspot locations (1981–2020) to align water level and DEM datums. Further work is needed to incorporate local knowledge and refine elevation models across the 20 Torres Strait islands. Despite its limitations, this research lays the foundation for identifying vulnerable areas and informing future adaptation strategies. Further validation and community engagement are required before this research can be used for planning, policy, or navigation

# Impacts of storm group sequence on initial beach profiles

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[3]Coastal and Marine Research Centre, Griffith University, Gold Coast campus, QLD

Projected changes in the frequency and intensity of extreme storms have been well-documented. While individual storms can cause significant beach erosion, impacting coastal communities and infrastructure, the compounded effects of closely spaced storm events, without providing sufficient recovery time for the beach, can intensify these impacts. This study aims to quantify the total beach erosion caused by a measured storm group and explore the influence of storm sequence on the eroded volume. A morphological numerical model was used to investigate the response of three distinct initial beach profiles to a series of four storms. By rearranging the storm order in simulations, the effect of storm group sequence on cumulative erosion was assessed. Results indicated that beach erosion persisted unless the wave power of a storm was approximately 75% lower than the preceding storm. Furthermore, the relationship between total water level and erosion rate was found to be inversely proportional when the beach retained more than 80% of its pre-storm volume. This relationship switched to direct proportionality when the volume fell below this threshold. These findings underscore the importance of storm order and pre-storm beach volume in determining erosion outcomes, providing key insights for enhancing coastal resilience in the face of increasing storm intensity and frequency.

# ‘Creating space’: coming together for a wholistic approach to guide ‘retreat’ implementation

**E Patterson**[1], P Bicknell[1], E Hodson[1]
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Over the last 30 years Victoria has continued to develop clear policy to support decision makers in managing the impacts of climate change (like sea level rise leading to erosion and inundation) on the important values of the coast.

An integral element of these policies for adaptation planning (set out in the *Marine and Coastal Policy 2020,* and *Victoria’s Resilient Coast–Adapting to 2100+* framework/guideline) is the use of a pathway approach and consideration of adaptation actions in a specific order e.g. non-intervention, avoid, nature-based methods, accommodate, retreat and protect.

While coastal managers and decision makers are becoming more practiced at broadly applying the pathway, the ‘retreat’ action (where we need to create space and ‘move out of the way’ so the coastline can realign itself), is difficult to do well. It can be challenging to articulate how it can happen, (the who, what, how, when), communicate the long term benefits (rather than being seen as ‘giving up’), perceived as expensive (although in the long run be good value for money), hard to gain solid commitment from the government/community, and land use planning tools and instruments are not ‘fit for purpose’ to easily relocate assets and transition land uses.

Given the challenges are multi-disciplinary (planning, financial, political, land use, engagement), the best solution for developing improved guidance and support for applying the ‘retreat’ action is to use a multi-disciplinary approach.

This presentation and innovative session is an opportunity for people with a range of skills, disciplines and experiences, to come together for a facilitated discussion on what is working well to implement ‘retreat’ actions, what are the challenges and barriers faced, what are the gaps in our systems/processes, and what are the opportunities and a pathway forward to develop policies, tools and programs to support effective retreat actions.

References:
State of Victoria Department of Land, Water and Planning 2020, Marine and Coastal Policy 2020.
State of Victoria Department of Energy, Environment and Climate Action 2023, Victoria’s Resilient Coast- Adapting to 2100 + (framework and guidelines).

# The SLSC location quandary – is a specific planning policy needed?

**N Patterson**[1]
[1]Haskoning, Newcastle, NSW

Surf Life Saving Club (SLSC) buildings exist on every populated beach on the east coast. The function of the SLSC building is to provide vantage, equipment storage, first aid facilities and meeting/training areas for professional and volunteer lifesavers and nippers to enable them to provide lifesaving support for the local and visiting community and keep our beaches safe for all users.

To provide this function, the SLSC infrastructure inherently needs to be in close proximity to the beach and have adequate vehicular and pedestrian beach access. The dilemma arises when the SLSC infrastructure is within the immediate coastal erosion hazard zone and either requires protection, or relocation.

Despite the value of the SLSC function to the community, the protection of an existing building may not be consistent with other desirable values for the coastline such as preservation of the environment and natural aesthetics and beach width and amenity. This is where the quandary arises as there is often resistance to the relocation of a SLSC building further landward.

The opportunity to relocate a SLSC building is rare requiring several stars to align: when the building nearing the end of its design life or has been damaged due to its exposure and requires replacement, and a Coastal Management Program is being undertaken. This might occur approximately every 40-to-50-years.

This paper explores the challenges of meeting the current coastal management legislation requirements for SLSC buildings specifically.

Does the solution lie in a revised legislative framework for SLSC buildings specifically or does the community need to accept the need for relocation of SLSC buildings whenever this is a feasible option? Or does the form and function of SLSC buildings need updating?

A number of cases will be outlined providing examples where SLSC buildings have been protected, relocated, or neither and the various consequences.

# Designing climate adaptation legislation for Aotearoa New Zealand

**R Peart**[1]
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Aotearoa New Zealand faces an enormous challenge in successfully adapting to climate change. Due to the geography of the country, and location of most settlements on flood plains or along the coast, sea level rise and more frequent and severe weather events will threaten thousands of homes and entire communities. Māori communities will be particularly affected.

In 2020, the New Zealand government committed to progressing new law to address the complex and distinctive issues associated with managed retreat such as funding, compensation, land acquisition, liability and insurance.

This paper reviews the current adaptation challenges facing the country and progress on developing new legislation. It then explores design considerations for new law including defining the overarching purpose and principles applying to managed retreat, the assessment of climate risks, applying stronger development controls in high risk areas, developing and implementing local adaptation plans, acquiring at-risk properties and managing the physical relocation process.

The paper concludes with an evaluation of prospective new institutional and funding models including a managed retreat compensation scheme, a National Adaptation Fund and a National Adaptation Agency.

References:
Peart R, 2024, Design recommendations for a Climate Adaptation Act, Environmental Defence Society, Auckland

# Benefits, challenges and lessons learned of establishing Drone Monitoring Program

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[2]Department of Transport, Fremantle, WA

The Peron Naturaliste Partnership has been working with the WA Government, Department of Transport to pilot a coastal monitoring program of at-risk coastal areas in the Cape Peron to Cape Naturaliste region of SW Western Australia. The project ultimately aims to generate high-resolution imagery and digital elevation data of the intra-annual changes. This high-resolution Digital Elevation Model data will identify sediment volume change and shoreline response to extreme events and sea level change. This information will be fundamental to making more informed coastal planning and management decisions.

This program also aims to establish strong working relationships between the varying levels of government and with traditional owners, who are supporting the delivery of this program.

There are numerous benefits of developing and establishing a project of this kind, from the provision of valuable coastal data to building the involvement of traditional owners and the capacity of local governments to effectively manage coastal areas. But there has been a number of challenges in establishing this program, such as legal, liability and insurance issues of utilizing drones, challenges in formalizing working agreements and meeting the training needs of Aboriginal Rangers. This presentation provides an overview of these challenges, and the lessons learned in establishing a regional drone monitoring program.

# Cape to Cape Resilience Project: Implementing Victoria's first regional coastal adaptation plan

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[2]Alluvium Consulting Australia, East Melbourne, VIC

Inverloch is a coastal town located on the dynamic shoreline of Anderson Inlet, Bass Coast in south Gippsland, Victoria. Since 2012, it has experienced some of the most vigorous erosion on Victoria's coast, losing over 70m of beach and dune on some parts of the foreshore.

These dramatic changes catalysed the formation of the Inverloch Regional and Strategic Partnership (RaSP) in 2020. A collaboration between ten coastal management bodies and Traditional Owners, the RaSP has worked with community, stakeholders and consultants to develop Victoria's first regional coastal adaptation plan, the Cape to Cape Resilience Plan. The plan has been testing and refining the Victoria's Resilient Coast: Adapting to 2100+ guidelines and framework and feeding back to the community of practice.

In August 2024, the draft Cape to Cape Resilience Plan was released for formal public consultation. This coincided with some of the largest and most damaging coastal storms seen in Victoria in the last decade, eroding around 50,000m3 of sand off Inverloch Surf Beach in a few days. This storm event generated a wave of public interest, leading to extension of the consultation period to allow for additional feedback and targeted engagement.

The comprehensive Plan provides adaptation pathways out to 2100 and supports funding applications to implement adaptation actions. The project was awarded $3.3 million under the Australia Government's Coastal and Estuarine Risk Mitigation Grant Program in 2022 to undertake on-ground implementation works at Inverloch, guided by the adaptation pathways in the plan.

The first tranche of on-ground works is now underway, with a large-scale dune reconstruction and beach nourishment program at Inverloch Surf Beach scheduled to commence in Spring 2025. This paper provides an overview of the Cape to Cape Resilience Plan and the opportunities and challenges ahead in implementing the adaptation actions on this highly valued, dynamic coastline.

References:
DEECA 2024. Draft Cape to Cape Resilience Plan. Department of Energy, Environment and Climate Action.
DEECA 2023. Victoria's Resilient Coast – Adapting for 2100+ framework and guidelines. Report by the Department of Energy, Environment and Climate Action.

# Mapping elevation and change in Australia's complex coastal environments with satellite imagery

R Bishop-Taylor[1], **C Phillips**[1], S Sagar[1], V Newey[1]
[1]Geoscience Australia, Canberra, ACT

Data describing the 3D shape of our coastal zone is critical for mapping vulnerable coastal ecosystems and patterns of coastal change over time. However, this data is expensive and challenging to obtain at scale using drone or aerial survey methods and forms a "missing link" between land-based elevation and marine bathymetric datasets. Freely available imagery from earth observation satellites represents a powerful alternative for mapping coastal zones across large regions and through time. Previous applications for coastal elevation mapping have been restricted to low resolution and single timesteps, limiting their ability to map highly complex and constantly changing coastal environments.

Here, we introduce Digital Earth Australia (DEA) Intertidal, a novel product suite released in 2024 that delivers multi-temporal snapshots of Australia's entire intertidal zone from 2016 to the present. DEA Intertidal includes models of intertidal elevation, exposure and a suite of other supporting data layers. Developed iteratively and in collaboration with expert stakeholders, we were able to identify issues such as localised scaling offsets in an early version of the elevation model. This led to the development of a novel ensemble tide-modelling approach and pixel-level quantitative uncertainty whose accuracy varied predictably with coastal complexity. Feedback on the mapped extent of intertidal areas led to improvements in the extents product and user requirements dictated the temporal and spatial resolution of the final datasets. Users and stakeholders generously provided extensive validation datasets which were highly correlated to elevation values in DEA Intertidal.

The annual 2025 update to the data suite now includes DEA Intertidal Extents, a categorical classifier, used for basic mapping of terrain type in coastal areas. It also includes a series of Observational Attribute layers, used to support users to understand biases inherent when using sun-synchronous satellite data to understand tidal dynamics.

# Designing for boat generated waves and sea in estuaries

**R Plain**[1]
[1]Moffatt and Nichol, Brisbane, QLD

Coastal and maritime structures are generally designed to withstand ocean swell and sea (or wind waves). Seas (or wind waves) are short-period waves generated locally by wind shear across the water surface. Swell represents wind-generated waves that have travelled out of the generating area.

Coastal wave height records approximately follow the Rayleigh distribution. Typically, only condensed information is reported for sea and swell waves, including either significant wave height (Hs) or spectral wave height (Hm0).

A third type of waves, which is important to consider in estuaries and closed waters, are boat generated waves (termed wake or wash). Boats generate wake patterns that consist of many waves of varying height and period. The formation and size of the waves are governed by:

- submerged shape of the vessel's hull, length and displacement;
- vessel speed; and,
- water depth.

Certain types of vessels, including tow sport vessels and high speed catamaran ferries, generate destructive and high energy wave forms, due to either the wave height and/or period.

In contrast to naturally-occurring sea and swell, boat generated waves are characterised by short event duration and a broad spectral spread of wave parameters that do not lend themselves to the application of conventional statistical methods (Macfarlane, 2012). Furthermore, consideration of the return period for a design event is often meaningless when the same vessels are repeatedly operating on the waterway.

To complicate matters, various wave forms are superimposed. In estuaries, beyond the extent of swell penetration, seas and boat generated waves are superimposed resulting in complex and frequently occurring waves that may lead to:

- fatigue loading of structures;
- foreshore erosion; and/or,
- damage to coastal protection works.

This presentation will examine the current methods to predict seas and boat generated waves in estuaries and discuss implications for design of structures.

References:
Macfarlane, G.J., (2012), Marine vessel wave wake: focus on vessel operations within sheltered waterways, June.

# Balancing modern recreational boating needs with community feel by reimagining wave screens

**A Pomeroy**[1,2], M Penman[1], A Dean[1], N Burmeister[1]
[1]FSC Range, Richmond, VIC
[2]University of Melbourne, Parkville, VIC

St Leonards is a relatively small coastal community, known for its boating and seaside lifestyle. It is also the location of the St Leonards Boat Ramp where the penetration of waves into the launch area from multiple directions had long been a concern of various stakeholders. Whilst various options had previously been considered, the need to balance modern boating infrastructure with the 'look and feel' of the coastal community had mostly been overlooked. Indeed, such conflicts regularly occur along much of the Australian coast.

The new concept (which was recently constructed) took inspiration from wave-screening methods rarely considered today. Indeed, there was a need to return to basic physics coupled with high resolution numerical modelling using state of the art tools to develop a design tuned to the specific location. This approach led to a design that looked much like the previous coastal structure while providing for the contemporary needs of boating today. Communicating this was a key challenge for this project with the need to establish the confidence of key stakeholder groups that in many ways were in direct conflict with each other. Further, how proposed design would be sympathetic to the look and feel of the area, would respect the coastal processes and marine values, while addressing the concerns and needs of the boating community needed to be communicated. This involved a comprehensive community engagement approach using several different methods. Core to each of these methods was the communication of scientific and engineering principles in an accessible way.

In this presentation an overview of the design development, how innovative materials were adopted to increase the resilience of the facility, as well as the methods used to bring the community along the journey and to build confidence for all stakeholders in the design solution will be discussed.

# Using AI to navigate the planning and approvals process for coastal works

**N Prentice**[1]
[1]UPRS – Urban Places, Regional Spaces Pty Ltd, Brisbane, QLD

Unless you are a planner or work in the approvals or permits space, understanding what coastal works trigger an approval is complicated. The consequence of getting the initial advice related to approval can be significant – through extended time delays, the need for rectification works and the threat of infringement action.

In Queensland, coastal works are regulated under the *Coastal Protection and Management Act 1995* (Qld) and *Planning Act 2016* (Qld), and works are assessed against the provisions of the State Planning Policy.

The development assessment process and approvals for certain tidal and operational works in the coastal zone can be categorises as:

- excluded works of a minor or inconsequential nature;
- accepted development; and
- coastal development that is triggered for assessment.

Determining what works can be undertaken as excluded works versus accepted development versus assessable development requires an applicant to be familiar with the relevant legislation and assessment criteria. Technical advice and planning guidance can be challenging, especially in the face of time-critical works and the need to make rapid (and legally compliant) decisions.

To assist Council's we sought to develop an innovative, user-friendly AI-driven application to simplify this otherwise complicated process. Users navigate their way through a 'question-answer' style chat bot that allows coastal works to be assessed against the relevant assessment criteria under the Act.

# Enabling practical action: Victorian State of the Marine and Coastal Environment Report

**S Rawlings**[1]
[1]Director, Science and Reporting, Victorian Commissioner for Environmental Sustainability, Melbourne, VIC

The Victorian State of the Marine and Coastal Environment (SMCE) 2024 Report is scheduled to be completed in early 2025. The Report is authorised by Victorian legislative reform in 2018 that empowers Victoria's independent environmental reporter, the Commissioner for Environmental Sustainability, to acquire data from government agencies and issue a report with recommendations. The Victorian Government must respond to the recommendations within twelve months.

The recommendations of the SMCE Report aim to focus effort to achieve better outcomes for Victoria's marine and coastal environment by enabling practical action and leveraging the legislative and policy frameworks established under the reform. The challenge for all Victorians is to take full advantage of the potential of the marine and coastal legislation and policy, and to continually strive for a whole-of-system approach to guide action and lead to biodiversity and social outcomes that are meaningful and are consistent with Traditional Owner Sea Country aspirations.

Many of the pressures on our coasts, bays, estuaries, lakes and ocean are linked to activities on land. Therefore, management and regulatory actions that connect activities in our catchments to benefits for Victoria's marine and coastal environment are critical. So too is the need for strong action to mitigate, adapt and protect our marine and coastal environments and communities against the effects of climate change. While our coasts and nature are a drawcard for visitors and a valuable tourism asset, a holistic and coordinated approach to tourism and visitor management can limit negative environmental and social impacts while improving education and the goal of Victorians valuing nature and the state's diverse flora and fauna.

# Tasmania's statutory State Coastal Policy faces its sternest test after 29 years

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A recent application for a 500m jetty on Robbins Island in Tasmania's NW ran against provisions in the State Coastal Policy that prohibit development on actively mobile landforms. This has re-awoken Tasmanian Government awareness of the Policy which has sat without active implementation for well over a decade. The major political parties in Tasmania and development interests are bent on weakening the Policy provisions that have helped protect coastal ecosystems from inappropriate development for three decades. The Policy is, "binding on the Crown in all its capacities", and all coastal zone planning and management is required to be consistent with its provisions.

This presentation will summarise and illustrate the history of the State Coastal Policy since 1996, and assess current moves to weaken its key provisions through legislation and a statutory review. ACS members in Tasmania are actively partnering a broad spectrum of interests to defend and intentionally improve the Policy and its implementation.

# Selecting beach profiles for storm erosion modelling from 60 years of data

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Modelling the magnitude of coastal erosion expected across a range of storm events at different return intervals allows coastal managers to plan for risks to development located behind sandy beaches. In addition to the wave height and other characteristics of the storm itself, the volume of sediment eroded during a given storm depends strongly on the initial state of the beach prior to the storm. On the Gold Coast, where beach surveys have been undertaken for nearly 60 years and more than 100 survey dates are available at many transects, a large envelope of variability in the beach and nearshore profile has been recorded. However, models used to simulate coastal erosion from storms are complex and have slow compute times, so running them for many combinations of storm conditions for every possible beach profile is unfeasible.

To capture the range of observed profile variability within a limited number of individual profiles, statistical techniques were used to group similar profiles into 'clusters' and extract a representative profile from each one to use in subsequent modelling. Three different clustering methods – k-means clustering, the maximum dissimilarity algorithm, and a combination of both – were tested, and the optimal technique and number of clusters identified. Although these techniques are purely statistical and do not consider the underlying processes that drive profile variability, subsequent analysis of the resulting clusters confirmed that the groups broadly represent beach states that are characteristic of different periods over the 60-year survey program, such as before and after nourishments. In addition to underpinning subsequent storm erosion modelling, these profile clusters portray the temporal variability in the beaches of the Gold Coast, including the effect of management interventions on profile shape over the past six decades.

# Fish Habitat Area (FHA) Revocation – When policy and practicality don't align

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Fish Habitat Areas (FHAs) are areas protected from physical disturbance associated with coastal development and declared under Queensland's *Fisheries Act 1994*. Declaration of FHAs aims to ensure the sustainability of fisheries by protecting selected inshore and estuarine fish habitats.

FHAs are classified as management A and management B areas, and while there are differences in the level of protection afforded by each, there are a limited set of prescribed development purposes for which development approval can be sought.

An operational policy has been in place under the *Fisheries Act 1994* since around 2001 (updated in 2015) requiring extensive stakeholder engagement prior to the declaration of a FHA. However, there are legacy issues associated with declaration of FHAs under now repealed legislation (*Fisheries Act 1976)* which did not require the same level of consultation with stakeholders within and adjacent to the prospective declaration area.

This presentation provides a case study on the planned partial revocation of the Bowling Green Bay FHA to allow the ongoing operation of the Australian Institute of Marine Science (AIMS) headquarters at Cape Cleveland. Constructed in 1976, approximately 13 years prior to the declaration of the Bowling Green Bay FHA, the AIMS wharf is currently inaccessible due to siltation in the historically deep wharf basin. Reinstatement of this capability is critical to AIMS current and future operations.

Dredging within the FHA is prohibited because it is not a prescribed development purpose. Accordingly, the only way forward from an approvals perspective is the partial revocation of the Bowling Green Bay FHA which would allow the works to be considered against the regulatory framework. As this is a novel process and unknown to many practitioners, this presentation will provide an overview of the FHA revocation process timeframes, with specific reference to the circumstances around the AIMS wharf.

# Overcoming barriers of coastal Nature Based Solutions

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Coastal nature-based solutions (NBS) are rapidly gaining interest to mitigate shoreline erosion whilst offering co-benefits due to habitat creation, flood mitigation and climate change adaptation. This interest has supported their inclusion within the majority of coastal management plans as a low-cost alternative to hard defences. However, they have low implementation rates in Queensland.

Two initiatives were undertaken in 2024 to help support the ongoing implementation of coastal NBS. The first has been a series of one-day training programmes, with over 100 people attending ten workshops in regions including Douglas, Cairns, Hinchinbrook, Cassowary, Townsville, Livingstone, Redlands, and Gold Coast. Data collected throughout the training included feedback from practitioners on the topics most needed to support the implementation of NBS; from planning, engineering, working with nature, hazard management, and better understanding of benefits. Secondly, a joint research programme was undertaken between the Southern Cross University and the Wageningen University (The Netherlands), with researchers visiting Australia. Practitioner surveys were sent to Queensland Councils with respondents ranking barriers to the implementation of coastal NBS, with the top barriers being a lack of technical guidelines. Subsequent interviews held with local government staff further explored these barriers, which identified environmental vandalism by residents, uncertainty in performance and protection, the lack of standardised design guidelines and high permit costs further holding back their implementation.

This practitioner data can now be used to support more training initiatives for local governments, planned to be run throughout 2025 and 2026.

# Potential for Sand Backpass Systems in Tropical Queensland

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Beaches in tropical Queensland are dynamic systems, with sand moving alongshore under trade winds, offshore during storms, and can be redistributed back onto the shoreline in the months and years following an erosion event. Due to Longshore Sediment Transport (LST) sand does not always return to the same beach after a storm, which can lead Councils towards a management approach such as beach nourishment, implementation of groynes, or construction of hard defences. As an alternative approach, sand back passing can be considered, a concept of collecting sand after it has passed a beach, which is returned via a nourishment method (typically trucks or pipelines).

The $QCoast_{2100}$ supported an investigation undertaken by the Cassowary Coast Regional Council to develop a methodology that can be used through tropical Queensland to assess suitability of a site for a sand backpass system. The approach includes five steps which includes:

1. A coastal processes review;
2. Geotechnical investigation;
3. Analysis of constraints;
4. Modelling to consider system viability;
5. Site recommendations.

This approach has been used to conduct a sand backpass feasibility assessment for South Mission Beach (SMB) and Flying Fish Point (FFP). The assessment adds additional context, datasets, resources, costing information, and guidance into the framework that can be shared with other Councils to support their assessment. This includes information on socio-economic decisions, supported by the Infrastructure Australia (2021) guide to multi-criteria analysis.

References:
Infrastructure Australia (2021) guide to multi-criteria analysis - technical guide of the assessment framework

# Towards continental scale coastal ecosystem mapping in Australia utilising Earth Observation data

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Australia's coastal ecosystems, including mangroves, seagrass, tidal flats, and saltmarshes are vital to a range of environmental, cultural and economic values. Monitoring these ecosystems is essential for a range of activities relating to management and conservation, environmental economic accounting, carbon sequestration, and ecosystem services provisioning. The project discussed in this talk aims to enhance the capacity for monitoring these coastal ecosystems using a long-term Earth observation based approach implemented on Digital Earth Australia (DEA) infrastructure.

The project has 5 primary objectives:

1. Build and curate a new Australia-wide training data library for mangroves, saltmarsh, tidal flats and intertidal seagrass
2. Integrate and build on existing Landsat 8 and Sentinel-2 based workflows for the various ecosystems into a single multi-ecosystem model
3. Develop a machine learning framework on DEA
4. Design a mapping workflow capable of annual mapping – for all of Australia – of mangroves, saltmarsh, tidal flats and intertidal seagrass
5. Support current efforts towards national ecosystem extent and condition accounting and state of the environment reporting

The developed framework will aid in better understanding and managing of mangroves, intertidal seagrass, tidal flats, and saltmarshes, which up until this point have been mapped at varying spatial, thematic and temporal resolutions, and with varying capacity for ongoing monitoring.

The version of the Coastal Ecosystem Map (CEM) presented here is in its second iteration, after integration of insights obtained from a targeted stakeholder feedback initiative aimed at leveraging knowledge from the vast number of coastal mapping initiatives taking place at a state and localised level. We discuss the improvements implemented in this current version which underpins the February 2025 round of Ocean Environmental Economic Accounts being completed by the Commonwealth Government and identify the challenges and opportunities for continuous improvement that remain as we look to publish the product later in 2025.

# Developing multi-hazard risk and resilience climate services using machine learning. A case study in Northern NSW

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Despite the urgent need for adopting comprehensive multi-hazard risk assessments and resilience-building measures, current climate risk approaches predominantly rely on single hazard, static models. These models often fail to capture the complex spatial and temporal dynamics of multiple hazards and the interconnected responses of human and environmental systems. This project, addresses this critical gap by integrating advanced machine learning and artificial intelligence into climate services, specifically designed for enhancing multi-hazard risk assessment and adaptation strategies. By harnessing a range of machine learning techniques for image processing, reinforcement learning, and multi-agent large language models (LLMs)— this project aims to dynamically analyse and predict risk interactions involving floods, coastal storms, and other hazards. Through a pilot testing in Northern New South Wales, Australia, the project demonstrates how machine learning can transform heterogeneous data into actionable insights. These insights support timely decision-making for risk management, mitigation, and adaptation strategies tailored specifically to public authorities and private stakeholders, offering a scalable, efficient, and adaptable framework for next-generation climate services.

References:
Gallina, V., et al. (2016). A review of multi-risk methodologies for natural hazards: Consequences and challenges for a climate change impact assessment. Journal of Environmental Management, 168, 123-132.
Zennaro, F., et al. (2021). Exploring machine learning potential for climate change risk assessment. Earth-Science Reviews, 220, 103752.

# Coastal hazard adaptation in Queensland: QCoast2100 10 years on

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[2]Local Government Association of Queensland, Newstead, QLD

The Queensland government recognises that mitigating and adapting to climate change is an important consideration for planning at all levels and have reflected this in Planning legislation and State Planning Policy. Assessments in 2015 identified that climate change was projected to significantly worsen coastal hazards. The government responded by providing $12 million for local governments, to support the requirement to consider coastal hazards including the effects of climate change in their planning and development assessment frameworks by funding the development of Coastal Hazard Adaptation Strategies. The QCoast2100 grant funding program was commenced in 2015 to deliver this commitment.

10 years on the program has engaged with 95% of all coastal local governments providing the outcomes of either completing a CHAS, being well advanced in completing a CHAS or having undertaken an assessment to determine if a CHAS is needed.

This presentation discusses the expansion of the QCoast2100 program over recent years, and a shift to funding works and actions recommended in the CHAS' and the increased ability of councils to leverage funding from other sources for coastal hazard adaptation.

Key features of the program going forward are the promotion of nature-based solutions to maintain the coastal processes and environmental values; the engagement and support for First Nation communities to understand the coastal hazard threats to their community and culture; and the continuation of a knowledge sharing model to democratize the learning and experience of the councils participating in the QCoast2100 program.

# Temporary solutions, lasting resilience: the role of sunset clauses in Climate-Adapted Planning

**R Sharp**[1]
[1]Water Technology, Brisbane, QLD

A sunset clause is a vital adaptation planning tool, enabling temporary development approvals within Queensland's planning framework, allowing for flexible responses to climate change impacts. Under the **Planning Act 2016** (Qld), sunset clauses can be used to grant provisional development rights for a limited time, with the understanding that these approvals will expire unless reassessed. This mechanism is particularly useful in climate adaptation, as it allows development to proceed in the short term while preserving the option to reassess land use in the face of evolving climate data and environmental conditions.

Specifically, Section 87 of the **Planning Act 2016** allows for the imposition of time-limited conditions on development approvals, providing a clear legal basis for sunset clauses. This provision ensures that developments subject to temporary approvals are revisited, allowing planning authorities to adapt decisions based on the latest climate science, weather patterns, and environmental conditions. Additionally, **Section 59** allows for the modification of planning instruments to respond to changing circumstances, supporting the use of sunset clauses to effectively address the uncertainties posed by climate change.

Examples of sunset clauses in other Australian states illustrate their broader applicability. In **Victoria**, the **Planning and Environment Act 1987** allows for time-bound permits, particularly in areas prone to bushfire risks and other climate hazards, where conditions may be reassessed based on new environmental data or climate projections. Similarly, in **South Australia**, the **Planning, Development and Infrastructure Act 2016** provides for time-limited approvals, particularly in coastal areas where sea-level rise and flood risks may warrant temporary development decisions.

In practice, the use of sunset clauses under the Planning Act 2016 can help mitigate risks such as flooding, extreme weather, or coastal erosion by limiting the scope and duration of potentially unsustainable developments. By facilitating a more adaptive planning approach, sunset clauses within Queensland's planning legislation offer a pragmatic solution to managing the uncertain and evolving impacts of climate change, balancing short-term needs with long-term environmental resilience.

Drawing on site scale development application examples in both Queensland and Victoria, this presentation highlights the need for an adaptive management approach to infill development that facilitates the needs of today and ensures that development is flexible and responsive to future climate challenges.

# The do's and don'ts of disaster relocation: lessons in managed retreat and community resilience

N Poole[1], **R Sharp[1]**
[1]Water Technology, Brisbane QLD

Managed retreat involves the purposeful, coordinated movement of people and buildings away from risks. How is this achieved? Landswap and buyback programs have been implemented with various levels of success, but almost always post natural disaster. The perceived success or otherwise of these programs depends on a range of factors such as:

- Strong and decisive leadership,
- community centred approach,
- genuine ongoing community consultation
- momentum needs to be maintained as timeframes can often blow out because of red tape.
- simplicity in policy making
- continuity and consistency of staff so that communities can build relationships and thereby a sense of security.
- great communication and positive media that shows initiative, is consistent, open and understandable.

Councils are best placed to manage landswaps and buy backs with funding from state and federal governments. Local communities should be consulted in a meaningful way which is usually best managed by local government who have a stake in retaining the relocated community affected by natural disaster. It is essential that procurement of suitable land needs to be embarked upon early in the program if the goal of the recovery program includes the ability to retain the community.

Using lived experience of successful relocation programs, we will present how taking a proactive approach to relocation can mean the difference between perceived success or otherwise. Proactive approach for example, could mean LGAs identifying potential land prior to any natural disaster, and either acquiring or taking out an option over the land to enable landswaps and buybacks to move forward in a timely manner.

# Designing coastal protection works for future adaptation: A design framework

**J Stewart**[1]
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Designing for future adaptation 'up-front' allows coastal protection works to meet current-day needs but ensures viable pathways for adaptation to meet future needs. This requires consideration of 'non-stationary' environmental loading conditions, such as projected sea level rise, as part of the design. This paper presents a design framework intended to facilitate a consistent methodology for considering such loading conditions and 'up-front' planned adaptation of protection works within their design life. A design reliability approach underpins the framework, combined with projections of future environmental forcing conditions (i.e. water levels, waves, etc.) and acceptable performance criteria. The paper presents the proposed framework, an example of how the framework can be applied, and its application to a real-world project in Moreton Bay.

# Five years of 'tide to tip': industry-led cleanups driving marine stewardship

**L Stoltenberg**[1]
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Plastic pollution is ubiquitous in the marine environment. Recent research published by CSIRO has identified that three-quarters of rubbish found on our coastline is plastic, and most of it is of Australian origin[1]. In the face of changing climate, increasing plastic pollution, and other threats to our marine and coastal environments, one response from community and conservation organisations alike has been clean-up events, mainly in the form of beach clean-ups. Under the umbrella of the well-known movement of Clean Up Australia, 10,686 clean-ups have been registered in 2023 alone[2]. The seafood industry, recognising its responsibility as marine stewards, has stepped forward with many clean-ups being industry-led. One such program, led by the NSW oyster industry, and coordinated by OceanWatch Australia, is now running in its fifth year, and had back-to-back success. Commonly known as “Tide to Tip”, this annual program has seen the removal of 47.5 tonnes of rubbish from our estuaries and waterways across the state. A total of 86 clean-ups with close to 1000 volunteers and numerous partner organisations have since taken place. These clean-ups differ from regular beach cleans in that they go to often inaccessible places within mangroves and islands by utilising oyster punts for transport and local knowledge of rubbish aggregation points from oyster farmers. Addressing the impacts of pollution, these clean-ups not only contribute to the health of our waterways, but also help build social license, increase the capacity of marine stewardship, citizen science, and monitoring, foster networks and connections between industry and community, and increase ocean literacy and community awareness of marine litter and oyster farming more generally. This presentation will give an overview of the evolution of these clean-ups, highlight the lessons and learnings, and provide a reflection and forecast into where to from here with coastal clean-ups and marine debris.

References

[1]Hardesty, B. D., Lawson, TJ, van der Verlde, T. Lansdell, M., and Wilcox, C (2016). Estimating quantities and sources of marine debris at a continental scale. Frontiers in Ecology and the Environment. 15(1): 18-25.

[2]Boettcher and Moon (2023). Clean Up Australia Litter Report FY23 (https://irp.cdn-website.com/ed061800/files/uploaded/CleanUpAustralia-LitterReportFY23-FINAL.pdf)

# Nature based strategies for terminal erosion

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Silverleaves is located on the Northwestern coast of Phillip Island, Victoria. Terminal erosion, scour, and shoreline reorientation has occurred here and in recent years these impacts have accelerated, causing recession of up to 8 m/year. The upstream coastline is heavily modified by coastal protection structures (groynes and revetments), which have shaped this shoreline and influence both sediment transport and shoreline dynamics. Beyond the site, the shoreline is softer with dunes and vegetation dominate the landscape.

Significant concerns were raised by the Community about the observed erosion. Whilst a range of perspectives have been proposed on how this should be addressed, it was also highlighted that there was a need for a solution that balanced technical effectiveness with the local site character and ecosystem values. A coastal processes study revealed sediment bypassing and enhancing sand scour were contributing to the increased erosion rate recently observed. Thus there was a clear need to develop an unconventional adaptation options for the location.

Community engagement guided the adaptation planning process, providing valuable site history as well as community priorities and values. Nature based methods proved a favourable option for the area. The final strategy involved minor alignments to nearby revetment, a test section of supported littoral vegetation and downstream dune reconstruction. This approach was designed to mitigate erosive flow patterns and reduce incident waves to stabilise the shoreline, whilst providing benefits such as enhanced beach amenity, habitat creation, and accommodation space for vegetation to adapt and migrate with rising sea levels, enhancing the resiliency of the entire Silverleaves coastline.

This presentation will discuss how the processes driving a terminal erosion problem were characterized, the nature based strategies considered and ultimately how the final option was selected noting the strong interest by the community in how this problem would be managed.

# Banking on data: can 2000km of estuary mapping improve estuary decision making?

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Estuaries are critical ecological interfaces between freshwater and marine systems, highly sensitive to anthropogenic modifications that alter hydrodynamics, water quality, and ecosystem function. In NSW, estuary management has been a government priority for over 30 years, balancing ecological, economic, and social values. However, limited or outdated data on riverbank condition remains a key challenge in many systems. Bank erosion directly impacts estuarine stability, influencing sediment dynamics, water quality, and habitat integrity. Without comprehensive assessments, effective management and mitigation of these impacts remain constrained. Over the past 12 months comprehensive on-ground assessments have been conducted across ten major estuaries along the NSW coast. These have been commissioned under the NSW Estuary Asset Protection Program (NEAP Program), part of the Riparian Stabilisation Package, co-funded by the Australian and NSW Governments under Disaster Recovery Funding Arrangements, managed by the NSW Department of Primary Industries and Regional Development – Fisheries. The assessments provide high-resolution data on erosion severity, riparian vegetation condition, and bank protection effectiveness. Over 100 attributes were recorded along the navigable length of each system, producing one of Australia's most comprehensive and current empirical datasets on estuary bank condition. The dataset is collected, analysed, and presented through a user-friendly spatial platform, ensuring integration with the NSW Fisheries Decision Support Tool for Bank Erosion Management. River reaches are delineated based on variations in erosion severity, riparian vegetation condition, or existing bank protection measures, with segment lengths typically ranging from 20-200m in length. For many estuaries, these data establish a crucial baseline for monitoring long-term changes. Findings reveal distinct erosion dynamics across systems, with key insights at both broad (catchment) and localised scales. Critical information is presented on erosion hotspots and trends, sediment contribution and erosion drivers. This dataset enables targeted site prioritisation to enhance flood resilience, protect estuarine assets, and improve water quality, bank stability, and riparian vegetation health. The results support a coordinated, system-wide approach to estuary management and restoration planning.

# National Estuary Program - a way forward

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The majority of Australians live in urban or periurban centres within close proximity to estuaries. Yet history has shown us that since the colonial period we have not just abused environmental assets but managed to pollute waterways with toxic substances. Although state governments over time have taken steps to mitigate such abuse, it continues and more than likely will worsen as population grows. Climate change in its various forms will exacerbate deterioration in condition as will the input of new contaminants to add to influx of pollutants that feed into or lie within the nation's waterways. Recognition of risks to society and ecosystems is called for at a national level involving an integrated catchment approach to identifying and managing sources of contaminants as well as understanding the implications of climate change especially sea level rise on drainage efficiency. This requires a legislative-supported National Estuary Program similar to that which has been in operation as a partnership between federal and state governments in the USA.

# Coastal impact of wave energy converters: emerging trends

**J Thompson[1]**, G Vieira da Silva[1], N Cartwright[1], A Etemad-Shahidi[1]
[1]Griffith University, Gold Coast, QLD

Global surface temperatures continue to rise through emissions of greenhouse gases from unsustainable energy use (IPCC, 2023). Energy from ocean waves is a promising renewable power source to reduce fossil fuel emissions because of its relatively high predictability and large resource with an annual average of approximately 280 GW along the continental shelf of Australia (Gunn and Stock-Williams, 2012). Through the removal of wave energy for power production, wave energy converters (WECs) can influence the wave field and induce changes to the ocean currents. The coastal impact of these WECs has been the focus of many studies in recent years. Some studies have utilised wave tanks to measure wave field changes at model scale, whereas others have implemented modern numerical modelling techniques to simulate the effect of WECs on coastal dynamics at full scale. With rapid growth in this field of research, a review was considered critical to developing a better understanding of the coastal impact of WECs and inform coastal managers. This study adopts a systematic literature review approach to identify and quantify the emerging research trends. The emerging trends are then used to highlight areas for future research and help coastal managers to understand the potential benefits and risks of deploying WECs in coastal waters.

References:
IPCC, 2023. *Summary for Policymakers*. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34.
Gunn, K., Stock-Williams, C., 2012. *Quantifying the global wave power resource*. Renewable Energy 44, 296–304.

# Planning for change – community engagement on tidal inundation

**J Vickers**[1]
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Sea Level Rise-driven tidal inundation is one of seven coastal hazards Local Governments must consider in their coastal hazard planning under the NSW Coastal Management Act 2016. It poses an extreme risk in Tweed Shire as identified by Council's 2023 Climate Change Risk Assessment and is projected to affect over 2000 properties during a king tide event by 2050. Tweed Shire Council (TSC) has mapped the probable extent of the hazard and is exploring integration of these maps into the land use planning framework. Before commencing works to update the planning framework, Council will undertake an extensive community engagement campaign. As a developing coastal hazard in Tweed, community engagement will be integral to ensure effective strategic land use planning for tidal inundation. By fostering collaboration, inclusivity, and mutual understanding, it will ensure plans are not only technically sound but also socially accepted, equitable, and resilient in the face of evolving climate risks. This presentation provides a brief overview of TSC's approach to community engagement regarding tidal inundation, which includes: 1. Education campaign: Provide educational material and resources to build community awareness of the hazard, how and why it happens, and some of the key impacts/challenges associated with it. Host platform for discussion and questions. 2. Information campaign: Provide information identifying locally specific impacts (affected: properties, land uses, buildings, floodplain infrastructure [drains & gates], vegetation communities). Host online discussion forum and community conversations/focus groups. 3. Consultation: Provide information and opportunity for feedback regarding integration of tidal inundation maps into the land use planning framework. Information to include: impact on planning proposals (e.g. zoning change), land use permissibility, exempt and complying development, and relationship to other existing planning controls.

# Longshore sediment transport under climate change on the Gold Coast

**G Vieira da Silva[1]**, D Strauss[1], T Murray[1], F Alvarez[2], M Hemer[3], A Meucci[4], O Repina[1]
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[4]University of Melbourne, Parkville, VIC

Changes in longshore sediment transport (LST) driven by changes in wave climate will impact coastal dynamics. While wave climate projections are available, they often exhibit biases and uncertainty when comparing different models and successive generations of these projections. This study presents LST projections for the end of the 21st century under high-emission scenarios on the Gold Coast (Vieira da Silva et al., 2024).

The objectives of this work are to: (1) estimate future changes in LST on the Gold Coast, (2) compare projections from two iterations of the Coupled Model Intercomparison Project (CMIP), and (3) assess LST derived from both original CMIP datasets and bias-corrected wave climates from the same sources. To achieve this, we modeled LST changes using Delft3D, calibrated against sand bypassing data.

Both CMIP5- and CMIP6-derived LST models project a future reduction in LST on the Gold Coast. CMIP6-derived results exhibit half the uncertainty of CMIP5, with lower spreading among ensemble members. Additionally, under high-emission scenarios, CMIP6 suggests double the reduction in LST compared to CMIP5. Bias correction improved wave climate projections, including extremes, thereby reducing uncertainty between ensemble members. This, in turn, narrowed the spread of LST model ensembles by 20% for CMIP5 and 10% for CMIP6, though it did not significantly alter the projected ensemble mean. The projected LST reduction is linked to changes in the balance between modal and extreme waves from different directions.

This presentation will highlight the importance of bias-corrected wave climate data in estimating LST changes. Furthermore, it demonstrates how improvements in CMIP iterations reduced uncertainty of the wave climates, ultimately providing more robust LST projections. These findings have practical implications for coastal management and should be considered in future planning.

Reference:
Vieira da Silva, G., Strauss, D., Murray, T., Alvarez, F., Hemer, M., Meucci, A., Repina, O., 2024 Longshore sediment transport under climate change - A comparison between CMIP5 and CMIP6-derived forcings and the use of wave climate bias correction. *ESS Open Archive* . December 27, 2024.

# Gold Coast Beaches Resilience Scheme: sand budget and base case projections

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The Gold Coast Beaches Resilience Scheme is a landmark initiative by the City of Gold Coast, designed to enhance the long-term resilience of the region's ocean beaches. The scheme's first phase focuses on assessing baseline conditions, developing objectives, and defining a base case scenario, which serves as a benchmark for future coastal management strategies. A critical component of this assessment is the contemporary coastal sand budget, which provides key insights into sediment dynamics along the 52 km open coastline. The sand budget analysis evaluates sand movement, sources, and sinks, incorporating littoral drift, onshore supply, and existing management practices such as sand bypassing at the Tweed River and Gold Coast Seaway. Findings reveal spatial variability in sediment distribution, with sand accretion occurring in some areas, while northern beaches—particularly north of Surfers Paradise—experience progressive erosion. This understanding underpins the base case assessment, which models expected coastal conditions in the absence of major intervention.

The base case projects beach width, sand volume, and erosion risk under future scenarios, considering ongoing management actions such as minor beach nourishment, creek dredging, and seawall certification. Results suggest that by 2050, many beaches—including Burleigh Heads, Main Beach, and The Spit—will fall below desired width thresholds, with further narrowing expected under sea-level rise. The study emphasizes the need for a minimum sand buffer to protect the A-line seawall and coastal assets, highlighting challenges posed by uncertified seawall sections, which, at current certification rates, may take until 2091 to complete.

These findings establish the foundation for the Resilience Scheme's objectives, which prioritize maintaining beach widths, ensuring sufficient sand reserves, and achieving full seawall certification by 2050. The study underscores the urgency of proactive coastal management to sustain beach resilience amid climate change and growing population pressures.

# Co-designing Blue Carbon Projects with Yuwi Traditional Custodians – Cape Palmerston

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The Yuwi Country Blue Carbon Wetland Restoration Project is developed and delivered in partnership with the Yuwi Aboriginal Corporation (Traditional Custodians) and Greening Australia. The Project is assessing through co-design a range of potential blue carbon sites with a view to creating a project pipeline for implementation. The Cape Palmerston wetland has been selected through this process for restoration, including the reinstatement of tidal flows through bund removal. Detailed on-ground assessment and design, cultural and environmental assessments and the development of a restoration plan developed to guide the long-term site restoration.

The Project brings a range of technical experts and land managers, including hydrodynamic modelling of the wetland hydrology (James Cook University), soil experts (Acid Sulphate Soil assessment), ecologists to understand the impact of potential works, and Queensland Parks and Wildlife and Yuwi as the land managers and traditional custodians. On-country field investigations include Yuwi indigenous Rangers working along-side technical experts to integrate western scientific knowledge with traditional knowledge, including culturally important species and areas of cultural significance.

Yuwi people are employed directly through the project as a dedicated project coordinator, working alongside Greening Australia building skills to independently manage projects beyond the current opportunity. A dedicated Yuwi indigenous ranger and trainee are undertaking site assessments and on-ground works along-side technical experts. The broader Yuwi Community, including Elders and Knowledge Holders, are sharing knowledge through on Country community sessions (up to six on-country sessions) and an established Project Reference Group (decision makers from the Yuwi community). The Project is also facilitating the pathway for joint management of National Parks Land, with QPWS The project aligns and supports the implementation of the Yuwi Healthy Country Plan.

The presentation will be co-presented sharing the experience and process from Yuwi Traditional Custodians and Greening Australia who have partnered to deliver the project.

# Rocky Reef Recovery: Assessing long-term ecological response of a nearshore reef community.

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Kirra Reef is a rocky reef outcrop in the southern Gold Coast. The nearshore location exposes the reef community to naturally shifting sands that cover and expose parts of the reef depending on prevailing conditions. The Tweed Sand Bypassing project was established to maintain a navigable entrance to the Tweed River, while restoring and maintaining the northward sand drift to the southern Gold Coast. Monitoring at Kirra Reef has been done to meet the environmental obligations of the project and assess the influence of changes sand transport on marine communities. The preliminary dredge placements between 1995-2001, along with the (legislated) oversupply of sand to replenish eroded beaches in the southern Gold Coast and the relatively calm metocean conditions throughout the early 2000s, culminated in the burial of Kirra Reef in 2007 and 2008. In 2009, a series of storms along with an adjustment in the quantity of sand delivered via the sand bypass resulted in redistribution of sand and exhumation of Kirra Reef. Over time, the trajectory of recovery and ecological succession of benthic communities has been a little “rocky” relative to comparative reef communities. Following exhumation, the community was colonised quickly by foliose and turf forming algae. As the extent of reef steadily increased and the frequency of disturbance declined, benthic fauna started to take hold. Fast forward to today, a time where the extent of reef has largely stabilised, Kirra Reef now supports a more mature benthic community with a high diversity of marine fauna. While the composition of the community generally remains unique relative to other reef communities nearby, long-term monitoring has enhanced our understanding of the trajectory of ecological succession and demonstrated suitable and ecologically relevant timeframes to measure the response of reef communities to disturbance, while also allowing alignment with the legislated objectives of the Tweed Sand Bypassing project.

# Multi-disciplinary, operational, online system for monitoring and managing coastal change and resilience

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## Background:

Understanding and managing complex coastal processes between land, sea and human communities is of primary concern at all levels of government, industry and the broader society. Frequent, high-quality spatial information across the coastal zone is required to monitor, manage and predict coastal change and associated hazards. However, such data are seldom available, being typically beyond the capability and/or budget of stakeholders and agencies to acquire and manage. Combining recent advances in remote sensing, data analytics and environmental modeling with in situ data streams, cloud-based processing and delivery systems offers a means of tackling these challenges in a timely, fit-for-purpose and affordable manner.

## COASTS:

COASTS (Coastal Change Observation and Analytics (multi-) Scale (multi-) Technology System) is an integrated solution developed through the collaboration of the Sunshine Coast University, the University of Queensland and EOMAP for Noosa Council, Queensland, Australia. The principle of this system is to bring together several technologies, data sources, and disciplines in order to cost-effectively derive and deliver information and tools for managing coastal resilience, coastal hazards and beach safety. The main components of this system are: earth observation (EO) data, drone data, tidal and seastate data from in situ buoys, numerical modelling, physics- and AI-based analytics, together with cloud-based portal technology. The includes offers 1) multi-scale (historical and ongoing) bathymetry and turbidity maps and multi-scale terrestrial topography from satellite and drone imagery respectively 2) numerical simulations of shallow seabed change, wave height and direction with associated forecasts for erosion and deposition levels; 4) spatially explicit coastal hazard datasets and predictive models based on analytics algorithms and 5) a fit-for purpose coastal information portal for effective discovery and analysis of the captured data, derived information and predictive models. We will present this operational system, together with the benefits for timely and cost-effective coastal management and decision making.

# Woorim Beach sand back-passing system evolution: insights from comprehensive monitoring and modelling

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This study assesses the performance of a trial sand back-passing system at Woorim Beach, southeast of Bribie Island, implemented by the City of Moreton Bay (CMB) since 2019, and examines its potential for long-term coastal erosion management. The system pumps sand from the southern beach to the northern area to mitigate chronic coastal erosion. The study, divided into two phases, consists of Stage 1 to analyze captured data (particularly trial data from 2019–2023) and Stage 2 to employ a comprehensive modeling framework to resolve complex coastal processes and simulate the long-term performance of four management strategies: Do Nothing as the base strategy, Back-passing, Nearshore Nourishment (3-yearly), and Nearshore Nourishment (5-yearly). The performance of each strategy was examined by developing key performance indicators (KPIs), including coastal protection, recreational amenity, environmental enhancement, adaptability, and cost-effectiveness. The results showed that Woorim Beach is expected to erode without intervention, with the back-passing system offering limited benefits, especially in the southern sections. The nearshore nourishment options, particularly the 5-yearly strategy, demonstrated more immediate positive effects, including increased beach volume and no erosion. These options offered greater flexibility and proved more cost-effective compared to the back-passing system. The study concludes that the long-term use of the sand back-passing system is not recommended due to limited benefits and potential erosion impacts on southern Woorim Beach. Periodic nearshore nourishment with externally sourced sediment is recommended as the preferred long-term solution. The study also suggests continued monitoring and refinement of nourishment volumes and placement strategies for optimal coastal management.

# Three barriers to long-term strategic adaptation

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Strategic coastal adaptation planning has been progressing across Australia for over a decade. There is now a diversity of state-tailored frameworks, guidelines, funding support and data products available to assist land managers to plan for coastal change with a long-term view (2100+).

In Victoria, we are 4+ years down the path of active adaptation planning following recent (2018 – 2020) legislative and policy reform. Across the State there are 30+ co-funded strategic adaptation projects underway, and guidance (DEECA 2023) is increasingly embedded into business-as-usual planning. An active community of practice and new technical resources continue to support implementation, and our adaptation program has received recognition at state and national levels.

Nationally there is a growing body of climate science, economics and data products that advance our understanding of long-term coastal change. The benefits of proactive coastal adaptation are clear at local and regional scales – including economic benefits (inc. avoided damages), safeguarding coastal communities and ecosystems, and streamlining economic growth and development to the best locations.

While the adaptation guidance and technical resources are robust, navigating the practical barriers to strategic planning remains an ongoing challenge for land managers. In Victoria, several challenges (also common nationally) include: 1. Appetite across agencies and communities (inc. capacity, shift from fix-on-fail approaches, varying priorities and approvals), 2. Engagement with communities on long-term needs (inc. shift from immediate to futures thinking), and 3. Ownership of long-term actions (inc. implementation complexities and uncertainties).

We showcase these barriers using practical stories from adaptation planning projects in Victoria (including Gippsland, Port Phillip Bay and the Great Ocean Road), and highlight strategies employed to overcome barriers, and where there continues to be a need for new approaches.

References:
DEECA 2023. Victoria's Resilient Coast – Adapting for 2100+ framework and guidelines. Report by the Department of Energy, Environment and Climate Action.