# Planning Urban and Coastal Development, Infrastructure, and Services in Australia


Lead authors: Ryan J Lowe [1], Pascal Perez[2,3], Daniel Ierodiaconou[4], Rebecca Zitoun[5]

Core authors: Ben S Hague[6], Xiao Hua Wang[7], William Glamore[8], Graziela Miot da Silva[9], Mariana Mayer-Pinto[8], Rebecca L Morris[3], Luke Twomey[10], Jennifer Jenkins[11], Madeleine Hooper[12]

Contributing authors: David A Griffin[13], Scott Smithers[14], Arnold van Rooijen [1], Melanie Bishop[15], Ana Vila-Concejo[16], Carmen E Elrick-Barr [1,17], Capri D Joliffe[18], Kristen Splinter[8], Kathrine Dafforn[15], Jana Mrazova[19], Salman S Khan[13], Marzieh H Derkani[1], Abbie A Rogers[1], Jeff Hansen [1], Stephen Swearer [1], Greg Williams[20], Alex Babanin [3], Jonathan Barratt [21]

Reviewing authors: Alan Stokes[22], Miles Parsons[23], Martina Doblin[24], and Suzanne Fosbery[25]

1. The University of Western Australia
2. Australian Urban Research Infrastructure Network
3. University of Melbourne
4. Deakin University
5. Integrated Marine Observing System
6. Bureau of Meteorology
7. UNSW Canberra
8. UNSW Sydney
9. Flinders University
10. Western Australia Marine Science Institution
11. Infrastructure Australia
12. GHD
13. CSIRO
14. James Cook University
15. Macquarie University
16. The University of Sydney
17. University of the Sunshine Coast
18. JASCO Applied Science
19. Frankston City Council
20. RPS Group
21. CelsiusPro
22. Australian Coastal Council
23. Australian Institute of Marine Science
24. Sydney Institute of Marine Science
25. Ports Australia

NATIONAL MARINE SCIENCE COMMITTEE


## Abstract

Australia's coastal regions are critical to the nation's economy, livelihoods, culture, and resilience, yet face mounting challenges from climate change, population growth, and urbanisation. This paper presents a national strategy to improve the sustainability and resilience of urban and coastal development, infrastructure, and services through integrated, science-based approaches. It emphasises the need to strengthen Australia's coastal observations, modelling capabilities, and planning frameworks to better connect open ocean, nearshore, and land-based environments. Key initiatives include expanding national coastal research infrastructure; enhancing real-time monitoring and forecasting; strengthening the national workforce; integrating climate risk into statutory planning; establishing a cross-jurisdictional data portal; and creating a national coordination body to unify coastal research, planning, and management efforts across jurisdictions.

The paper highlights critical gaps in understanding coastal processes, extreme events, climate vulnerabilities, ecosystem responses, socio-economic factors, land use planning, and coastal engineering, especially through nature-based approaches. It stresses cross-disciplinary collaboration and shared infrastructure to enhance connections among research, industry, and communities, and accelerate technology development and implementation. Strengthening partnerships among researchers, government, industry, and local communities (including a focus on supporting Aboriginal and Torres Strait Islander leadership and knowledge systems) will guide best practices, foster innovation, and help Australia lead international efforts to enhance coastal resilience.

To achieve transformative progress, the paper proposes a national strategy with a vision for resilient, inclusive, and sustainable coastal futures by 2035. This approach is expected to reduce coastal risk exposure, improve infrastructure reliability, enhance community resilience, protect ecosystems and cultural heritage, and support sustainable development. It aims to drive coordinated action, support long-term science and infrastructure investment, and position Australia as a global leader in coastal adaptation and innovation.


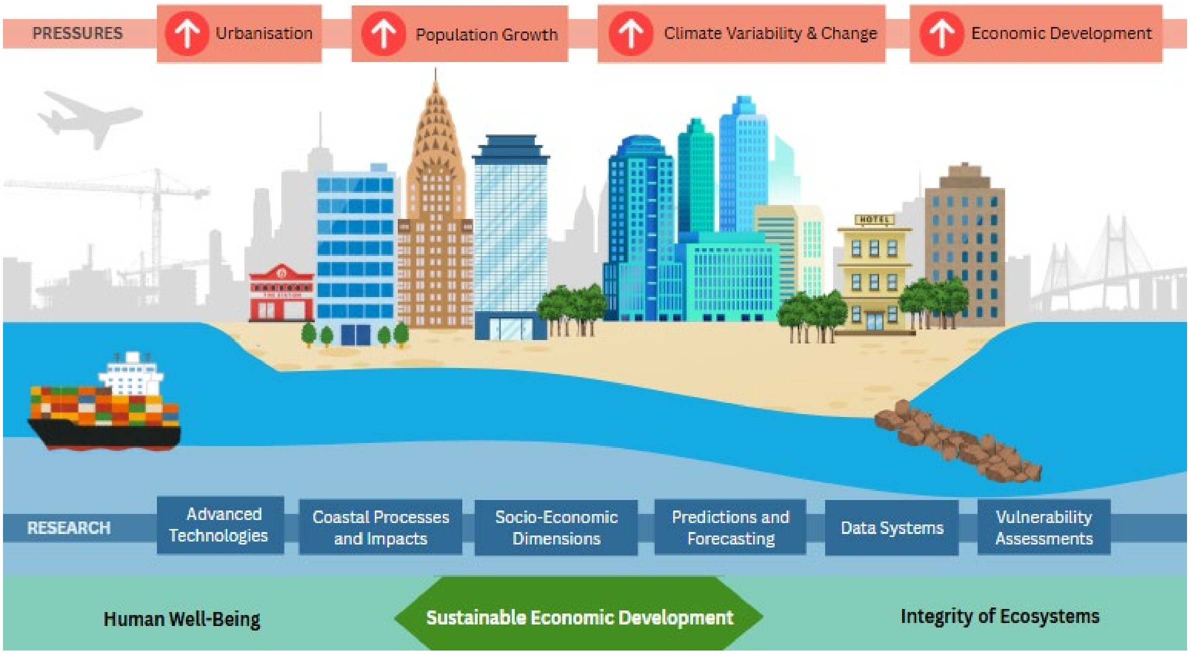


***Figure 1:*** *Schematic overview of significant pressures on coastal environments and infrastructure, the scientific research domains required to address them, and the outcomes these efforts support: human well-being, sustainable economic development, and ecosystem integrity.*

## 1. Relevance - societal benefits

As an island nation with almost 70,000 km of coastline, Australia's identity and prosperity are closely linked to its coasts. Over 85% of the population lives within 50 kilometres of the ocean, utilising the coasts for recreation, livelihoods, and well-being. Australia's marine industries currently contribute an estimated AUD $80 billion annually to the economy, with coastal tourism alone supporting over 450,000 jobs [1]. Additionally, Australian ports play a crucial role in international trade, handling approximately 99% of the nation's trade by volume. This activity alone generates AUD $264 billion annually and sustains around 700,000 jobs nationwide [2].

Looking forward, an estimated 274,000 existing homes, and more than 33,000 kilometres of road infrastructure, 8,600 commercial buildings, 6,200 light industrial buildings, and 1,500 km of rail lines and tramways may be affected by rising sea levels and stronger storms by 2100, with asset exposure exceeding AUD $226 billion [3]. The recently released *Australia's National Climate Risk Assessment 2025* [4] highlights the scale of escalating risks facing coastal communities and infrastructure. It projects that by 2030, if populations remain at current levels, approximately 597,000 Australians will be directly exposed to coastal hazards, rising to more than 1.5 million people by 2050. The report emphasises that sea level rise and increased storm activity will not only damage property and infrastructure, but also amplify household cost-of-living pressures through rising insurance premiums, underinsurance, and loss of asset values, particularly in low-lying coastal settlements and urban centres. Additionally, approximately one-third of Australia's cultural, recreational facilities, and open spaces are at high risk from climate-related impacts [5]. These figures do not include the new infrastructure required to support Australia's growing coastal population and economy, nor the potential threats to values such as cultural heritage, natural habitats, social cohesion, and community well-being, which can be difficult to quantify at a regional and/or national scale. The role of ocean accounting in this context is explored in detail in the **Ocean Accounting White Paper**.

Critical infrastructure, including ports, airports, water treatment facilities, energy networks, and transportation corridors, is particularly vulnerable to coastal hazards. Ensuring that such infrastructure is designed or upgraded to be climate-resilient is essential for sustainable coastal development. Ports, for example, are central to Australia's trade and economy, and their transformation into "Green Ports" offers a clear illustration of how climate-resilient infrastructure can both reduce risks and enable long-term national prosperity [6]. While coastal-based communities and industries will experience the most immediate impacts, the effects will be felt nationwide, given the foundational role of coastal infrastructure in enabling supply chains and delivering essential services. Strategic planning and adaptation are hence crucial for mitigating these risks and ensuring that infrastructure supports economic activity, public safety, and national resilience. Given Australia's geography and extensive coastline, coastal zones are also integral to sovereignty and strategic defence, underscoring their role in safeguarding national interests (as explored further in the **Maintaining Sovereignty, Securing, and Defending Australia White Paper**).

Coastal ecosystems hold inherent value as dynamic, living systems that support biodiversity, sustain ecological processes, buffer against coastal hazards, sustain cultural and recreational connections, and provide essential ecosystem services that underpin the health of both land and sea environments. Many Australians depend on the coastal ocean for their health, livelihoods, and quality of life, and the broader community places significant value on the continued existence of these environments. These ecosystems also hold deep cultural and spiritual significance for Aboriginal and Torres Strait Islander peoples, whose enduring connection to Sea Country is central to cultural practice, stewardship, and identity. As climate and development pressures intensify, it is crucial to strike a balance between urban and coastal development and the need to preserve the environmental, socio-cultural, and economic values of these ecosystems.

The concentration of human activity and infrastructure near the coast creates challenges as urban centres and associated services expand, driven in part by Australia's growing population. Responding to climate change and coastal hazards, therefore, requires a careful balance between enabling sustainable development and protecting the environments and ecosystems that society depends on (Figure 2). As coastal development intensifies, integrated planning is necessary to support economic and population growth while safeguarding ecosystems, cultural connections, and long-term community well-being. These outcomes align with the goals of Australia's Sustainable Ocean Plan, which seeks to embed climate action and sustainable development into ocean and coastal decision-making. Proactive adaptation also presents opportunities to stimulate innovation and create new industries and jobs.

At the same time, decisions must be made on how to sustainably manage ageing infrastructure, while minimising environmental impacts and avoiding legacy issues; for example, addressing poorly planned development and upgrading coastal protection structures to withstand rising sea levels through remediation, redesign, or managed retreat. Addressing these interconnected challenges requires a strategic, integrated, and solutions-focused approach to marine and coastal science in Australia. This involves building a stronger evidence base on coastal processes and their relationship to offshore ocean conditions, leveraging high-quality data and modelling, and fostering collaboration across disciplines, sectors, and jurisdictions. Science must be co-developed with industry, coastal planners, Traditional Custodians, communities, and all levels of government to ensure it addresses real-world needs, informs decision-making, and accelerates the development of practical, scalable solutions.

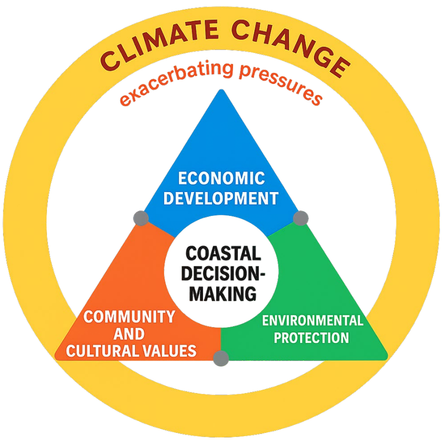


***Figure 2:*** *Coastal decision-making sits at the intersection of economic development, environmental protection, and community and cultural values. Climate change acts as an overarching pressure that exacerbates the trade-offs and challenges across these domains, underscoring the need for integrated and science-based approaches to coastal planning and adaptation.*

A coordinated national effort guided by science and knowledge is crucial for informing evidence-based decisions and delivering pragmatic, long-term solutions. Integrated planning, as detailed in the **Integrated Ocean Management & Resource Allocation and Management White Paper,** must be further supported by strategic investment and a shared commitment to effectively applying data and science. This approach is expected to:

- Promote healthier, safer, and more resilient coastal communities and environments that are better equipped to manage risks (including cumulative and slow-onset climate impacts) and recover from extreme events.
- Achieve a balance between infrastructure development and ecosystem health to support sustainable environmental and economic outcomes.
- Empower Aboriginal and Torres Strait Islander peoples in stewardship and self-determination by advancing research and management developed and led by the Traditional Custodians of Sea Country.

- Improve asset performance and reduce long-term costs.
- Improve certainty for coastal industries through improved forecasting and regulation.
- Demonstrate Australian leadership in developing best practice in science-informed coastal management and fostering knowledge exchange and regional adaptation partnerships with other neighbouring coastal nations across the Indo-Pacific and beyond.

This paper sets out a national framework to guide the sustainable development and climate adaptation of coastal regions. It emphasises scientific innovation and integrated planning aligned with national goals for resilience, equity, and economic prosperity. Success will be demonstrated not only by reduced exposure and improved service reliability but also by thriving coastal communities, sustained cultural connections, and ecosystems that continue to deliver benefits for generations.

## 2. Current state of the science or R&D

Australia's coastal zones are at the frontline of rapid environmental change, population growth, economic development, and strategic defence, underscoring their critical importance to national resilience and security. The scientific and research foundations that support planning and management in these areas are robust in some domains, but fragmented or underdeveloped in others. This section provides a summary of the current landscape of science, research, and development (R&D) in Australia related to urban and coastal development, infrastructure, and services. It includes critical assessments of strengths, weaknesses, and future opportunities to enhance knowledge and innovation.

### Overview of existing scientific research activities and key institutions

Scientific research in coastal and urban development in Australia covers a broad range of disciplines, including physical sciences (e.g., oceanography, chemistry, geosciences), biological sciences (e.g., ecology, marine biology), social sciences (e.g., economics, policy and law, human geography, urban planning, Indigenous knowledge, ocean literacy), and engineering and technology (e.g., infrastructure design, technology development, logistics, navigation and supply chains). These activities often cross disciplinary boundaries, with many projects integrating physical, biological, social sciences, and engineering approaches, and increasingly being driven by the perspectives of industry and government, to tackle complex coastal and urban challenges.

- Universities: Australian universities are foundational to coastal and urban science, providing leadership in fundamental and applied research across disciplines. Universities across Australia host specialist knowledge hubs in areas such as oceanography, marine biology, marine and coastal geosciences, urban planning, coastal/port/environmental engineering, climate systems, environmental economics, policy and law, and marine social-ecological systems, often working in collaboration with government, industry, and through international networks. State-based consortia such as the Sydney Institute of Marine Science (SIMS) and the Western Australian Marine Science Institution (WAMSI) also aim to coordinate marine research across universities. While SIMS operates as a multi-institutional organisation supporting shared infrastructure and collaborative research in New South Wales, WAMSI functions as a policy-aligned science coordination body in Western Australia. Despite differing structures, both help to facilitate cross-university collaboration aligned with strategic priorities.
- Government Agencies: Both Commonwealth and State-level agencies conduct applied science and environmental monitoring to support coastal planning and management. The Commonwealth Scientific and Industrial Research Organisation (CSIRO) leads national research on coastal and marine processes, infrastructure, and the impacts of climate change. The Australian Institute of Marine Science (AIMS) plays a leading national role in research into tropical marine environments and coordinates major national initiatives (e.g., long-term

monitoring programs). The Bureau of Meteorology (BoM) provides operational weather, oceanographic, and climate forecasting tools that underpin coastal hazard assessments. Geoscience Australia (GA) supports the mapping of coastal hazards and risk assessments. The Australian Bureau of Statistics (ABS) provides regular snapshots of the Australian population and economy, with a particular emphasis on urban and coastal areas. The Bureau of Infrastructure and Transport Research Economics (BITRE) is an Australian Government agency that provides economic analysis, research, and statistics on infrastructure, transport, and cities to inform policy development and enhance public understanding. State governments contribute through activities such as coastal hazard assessments, environmental monitoring, and applied research conducted by science teams embedded within environment, planning, and primary industries departments. Local governments also play a growing role in implementing coastal monitoring programs, land-use planning, and community engagement, often in partnership with State agencies and research institutions. The Intergovernmental Coastal Hazards Working Group (ICHWG) promotes a coordinated national approach to managing coastal hazards, including erosion and inundation, and comprises representatives from the Australian Local Government Association, as well as state, territory, and Commonwealth governments.

- <u>Industry and Non-Governmental Organisations (NGOs):</u> Coastal-related R&D is also driven by industry sectors in areas such as engineering, maritime operations, environmental consulting, and infrastructure development. Industry consultants often collaborate with researchers to support site-specific projects and develop effective coastal environmental management strategies. NGOs (including professional associations and industry bodies) also contribute to science translation, community engagement, and advocacy. For example, Ports Australia and the Australian Logistics Council (ALC) are key industry peak bodies that leverage their members' resources (including data) to support commissioned research and policy advocacy. PIANC-ANZ (a national section of the World Association for Waterborne Transport Infrastructure) plays a leading role in developing and disseminating best-practice guidance and knowledge transfer for sustainable and resilient maritime infrastructure. Similarly, the Australian Coastal Society (ACS) contributes to cross-sector knowledge sharing and national dialogue on coastal management and science. The Australian Coastal Councils Association (ACCA) plays a key national role in supporting local governments along Australia's coast, including advocating for coastal councils, particularly on climate change, erosion, infrastructure pressures, and legal risks; commissioning research and policy development to support sustainable coastal planning; and facilitating national collaboration between all tiers of government.
- <u>National Research Programs and Research Infrastructure:</u> Cross-sector research programs, such as the National Environmental Science Program (NESP) and Australia's Cooperative Research Centres (CRCs), support applied research on coastal resilience, urban infrastructure, and sustainable coastal development. In addition, key research infrastructure initiatives supported through the National Collaborative Research Infrastructure Strategy (NCRIS) provide essential digital, observational, modelling, and data infrastructure, which support informed decision-making for coastal development, planning, and risk management. While these NCRIS facilities have mainly operated independently, the proposed Coastal Research Infrastructure (CoastRI) initiative will establish a coordinated approach across 13 NCRIS facilities to enhance coastal research infrastructure, supporting observations and modelling. This coordinated approach along the whole value chain of coastal observations will enable Australia to better address coastal challenges and seize emerging opportunities through a more integrated and strategic effort.

Collectively, these diverse institutions, programs, initiatives, and centres contribute to a dynamic and evolving research ecosystem in Australia. However, further collaboration and national coordination among sectors, programs, and jurisdictions are critical to avoid duplication and inefficiencies, while also supporting innovation, addressing cross-cutting challenges, and delivering actionable science for coastal and urban resilience.

## Geographic emphases

Research in Australia reflects the extraordinary environmental and socio-economic diversity of its coastal and estuarine environments. These include, for example, wave-dominated shorelines along the south coast, extensive tropical estuaries and coral reef systems in the north, sheltered embayments in the west, and densely populated harbours and estuaries in the east. This spatial variation demands context-specific approaches to scientific investigation, infrastructure planning, and coastal governance.

Scientific research along Australia’s coastline has historically focused on areas near urban centres (particularly capital cities) and sites with established infrastructure, often driven by government funding priorities, accessibility, and proximity to research institutions. However, this distribution does not reflect the full range of current and future coastal development pressures. In many remote regions, such as northwestern Australia, northern Queensland, and eastern Tasmania, large-scale industrial developments associated with the resource sector (e.g., mining, oil and gas, salt production, and emerging offshore wind energy) and aquaculture continue to expand. This growth is driving demand for new coastal infrastructure, such as ports, jetties, processing and export facilities, human settlements, and access roads, in ecologically sensitive and data-poor regions. These developments often occur in areas with limited baseline data or sustained scientific monitoring, creating risks for both environmental outcomes and infrastructure planning. Remote, tropical, and Indigenous-managed coastal regions are also ecologically and culturally significant, and they are increasingly receiving attention in national coastal research agendas. Further expanding the geographic reach of coastal science is crucial to support evidence-based planning and regulation, ensure equitable access to data and tools, and establish consistent national baselines that accurately reflect the full diversity and vulnerability of Australia's coastal zones.

Nevertheless, the research landscape is currently shifting to better support coastal development planning and risk management across Australia. Recent policy developments—including the Australian Government’s Nature Positive Plan (2022), the National Biodiversity Strategy to 2030, the expansion of the national ‘blue carbon’ science program, and the development of the National Climate Adaptation and Resilience Strategy—have placed renewed focus on the importance of understanding and managing tropical and remote coastal regions. These areas are increasingly recognised not only for their cultural and climate mitigation value, but also as emerging frontiers for infrastructure, tourism, and regional development. At the same time, advances in Earth observation and remote sensing technologies are enabling more consistent and scalable environmental monitoring across these previously underserved regions. In parallel, Indigenous-led Sea Country monitoring initiatives are gaining formal support through programs such as the Indigenous Ranger Program. These developments signal a growing recognition of the ecological, cultural, and climate mitigation value of Australia’s northern and remote coasts, as well as the need for place-based, collaborative approaches to their management.

Technological developments are also rapidly transforming coastal and urban development planning and associated research. Innovations in remote sensing, such as satellite monitoring, spatial science, and AI-driven data analysis and machine learning, combined with increasing affordability, miniaturisation, and open-source availability of oceanographic and environmental instrumentation and software, are making coastal studies more data-rich and actionable than ever before. These tools enhance our capacity to monitor and manage complex coastal systems across spatial and temporal scales, supporting more informed infrastructure, urban planning, and risk mitigation efforts. National initiatives, such as the Reef 2050 Integrated Monitoring and Reporting Program (RIMReP) and the Marine and Coastal Hub of NESP, as well as partnerships through the Northern Australia Environmental Resources Hub, are also expanding capacity in currently data-poor regions.

Moving forward, sustained investment in regional science and closer partnerships with industry will be essential to ensuring balanced national coverage, supporting local decision-making, and enabling Australia's coastal research sector to lead internationally in addressing climate adaptation across a full spectrum of environmental, economic, and cultural contexts. Aligning science investment with areas of emerging industrial activity, particularly in remote regions, will be critical to ensuring that infrastructure development is supported by robust evidence and aligned with long-term sustainability goals.

## Scientific strengths and current capabilities

Australia has many globally recognised strengths in scientific domains that are critical to supporting sustainable and climate-resilient coastal and urban development, infrastructure, and services (Figure 3):

- Coastal and estuary hydrodynamics and morphodynamics: Australia is a global leader in understanding the physical processes of coastal systems spanning estuaries to open coasts. In estuarine environments**,** research has advanced knowledge of circulation dynamics, tidal asymmetry, sediment transport pathways, and turbidity maximum zones, especially in the context of large, urbanised estuaries. These studies have significantly improved the understanding of how estuarine systems respond to changing riverine and oceanic conditions. For more open coast systems**,** Australian research has advanced knowledge of nearshore and inner-shelf processes, shoreline change, and the evolution of features such as sandy beaches, flood-tide deltas, and coral reef islands. This knowledge is applied in coastal engineering and planning, providing evidence-based support for shoreline management.
- Coastal hazard projections and assessment: Australia has developed and applied advanced methods to assess exposure and vulnerability to coastal hazards, including erosion, inundation, storm surge, and compound flooding. The focus includes hazards from both short-term extreme weather events and longer-term changes driven by climate and geomorphic processes (such as catchment runoff and shoreline evolution). The research sector has developed innovative risk assessment methodologies, modelling tools, and applied hazard mapping that are widely used for disaster risk assessment, statutory planning, and infrastructure design. High-resolution coastal risk maps, shoreline change analyses, and coastal inundation models continue to support decision-making across jurisdictions.
- Coastal adaptation and planning: Research has supported the design and implementation of scenario-based adaptation tools, dynamic planning frameworks, and innovative solutions for coastal adaptation. New methods for evaluating adaptation trade-offs are being developed, utilising economic decision-support tools to facilitate an integrated assessment of economic, social, and environmental values in identifying effective adaptation solutions. The integration of hazard forecasts into statutory planning, zoning, and infrastructure design is progressing, with several jurisdictions adopting guidelines developed through partnerships among academia, government, and the private sector. Research is being conducted to identify barriers to transformative adaptation, review coastal policy, and understand the factors that drive resilience in coastal communities, to inform improvements to governance. Australia has a unique opportunity to learn from international experiences and strengthen its coastal zone governance by aligning recent advances with global efforts to address coastal climate change and adaptation.
- Coastal water quality and marine heatwave impacts: Significant progress has been made in understanding nutrient cycling, eutrophication, sediment-water interactions, and microbial processes in estuarine systems. Long-term studies in urbanised catchments, such as those in the Swan-Canning (WA), Hawkesbury-Nepean (NSW), and Brisbane River (Qld) systems, have provided valuable insights into water quality dynamics and management responses. Research has also contributed to the development of improved approaches for environmental impact assessment, particularly for coastal infrastructure developments such as dredging, port

expansions, and reclamation projects. Australia also plays a key role in global blue carbon research, particularly in quantifying carbon sequestration in mangroves, salt marshes, seagrasses, and kelp forests. In parallel, Australia has developed globally recognised expertise in understanding and predicting marine heatwaves and their consequences for coastal and marine ecosystems. Research has documented the ecological, economic, and social impacts of extreme warming events, including coral bleaching, seagrass die-offs, and disruptions to fisheries and aquaculture. Monitoring programs and modelling efforts have improved the ability to forecast and manage these risks, positioning Australia as a global leader in marine heatwave science and its application to coastal management.

- Climate and sea-level rise projections: Australian research contributes to globally benchmarked projections of long-term drivers of change, including sea-level rise, storm surge statistics, and shifts in climate extremes. This work supports an understanding of how large-scale climate systems influence Australia's coasts and underpins future scenarios used in planning. State and Local governments increasingly use downscaled climate and ocean models to assess risks to assets, ecosystems, and communities. Australian researchers have also developed databases, based on satellite observations and hindcast properties, for metocean conditions in Australian coastal waters, thereby strengthening the capacity to monitor long-term changes.
- Coastal restoration, nature-based interventions, and eco-engineering: Nature-based solutions encompass a wide range of interventions, from ecological restoration of natural habitats to enhance coastal protection, to hybrid approaches (such as living shorelines) and eco-engineering. Australia is a global leader in research that links ecological and engineering principles to mitigate the impacts of infrastructure without compromising its primary purpose (e.g., coastal protection). With some coastal cities in Australia having more than 50% of their shorelines modified by infrastructure, Australia also has a long history of leading research to mitigate the environmental impacts of infrastructure and urban development on coastal environments.

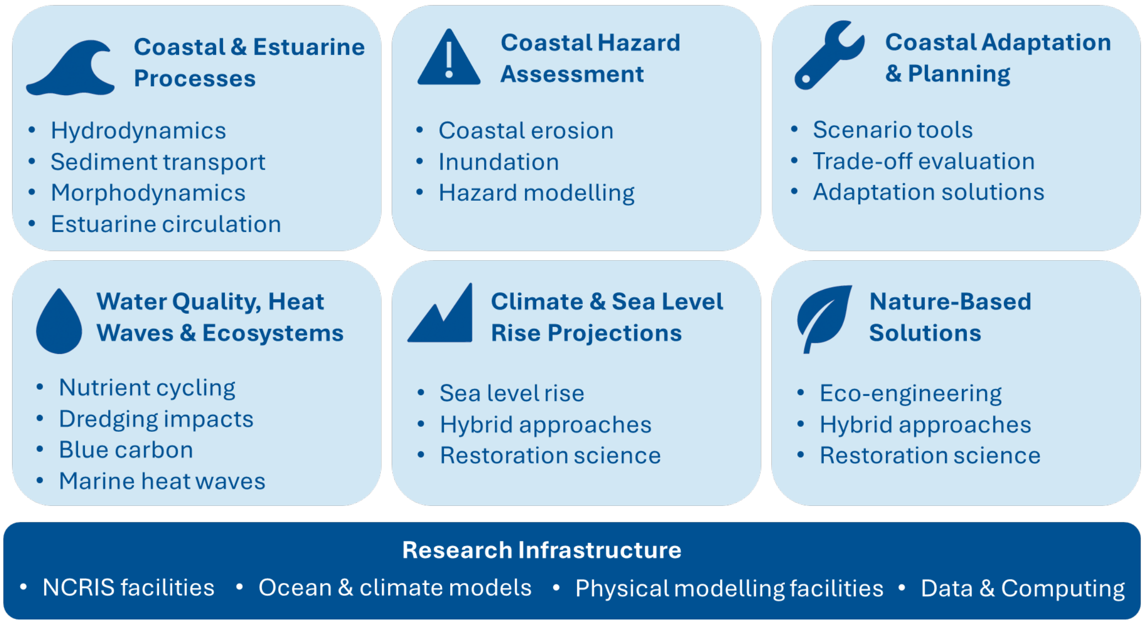


***Figure 3:** Australia's scientific strengths span coastal processes, hazards, adaptation, ecosystems, and research infrastructure, providing a strong base for climate-resilient coastal planning.*

## Funding landscape and infrastructure availability

Support for coastal and urban development R&D in Australia is provided by a mix of university, government, industry, and philanthropic funding sources. The Australian Research Council (ARC) provides significant funding for fundamental and applied research, primarily through its Discovery and Linkage programs. However, since ARC grants are mainly restricted to universities, the flexibility to directly fund partners in government or industry is limited**.** This limitation can be a barrier to delivering truly collaborative research projects that span universities, government agencies, and industry, particularly when partners outside academia are unable to receive direct funding.

Commonwealth agencies, such as CSIRO, AIMS, BoM, and GA, provide substantial support aligned with national priorities, including climate resilience and environmental management. An example is the Australian Climate Service (ACS), a part of which has supported the development of national sea level, wind-wave, and coastal hazard modelling products to deliver fit-for-purpose information for various applications, including coastal and estuarine flooding and erosion risk. State government agencies fund regionally focused research, often aimed at informing planning and regulation.

National programs, such as NESP and the Disaster Ready Fund, promote cross-sector collaboration and the integration of science into decision-making. Industry often contributes short-term, targeted research funding focused on operational outcomes.

Philanthropic investment is growing in Australia, particularly in areas related to marine conservation, habitat restoration, and blue carbon research. Still, it remains relatively limited in scale relative to many other developed countries.

Australia's research infrastructure is extensive, but uneven in terms of accessibility and coordination. NCRIS supports key national platforms, including the Integrated Marine Observing System (IMOS), the Terrestrial Ecosystem Research Network (TERN), the Australian Urban Research Infrastructure Network (AURIN), Australian Research Data Commons (ARDC), AuScope, Australian Community Climate and Earth System Simulator (ACCESS-NRI), and supercomputing centres like the National Computational Infrastructure (NCI) and Pawsey. These provide critical capabilities in data collection, modelling, data management, and analysis. However, many regional and industry-operated assets remain under-recognised, limiting visibility of national capacity and capability. An example of nationally significant digital infrastructure is Digital Earth Australia (DEA) that uses satellite data to map, monitor, and analyse environmental changes across Australia over time. This includes DEA Coastlines, which combines satellite data with tidal modelling to provide annual shoreline positions and long-term rates of change along the entire Australian coastline. This product enables national-scale monitoring of erosion and accretion hotspots and supports planning and management at multiple scales.

To address gaps at the land-sea interface, the proposed CoastRI initiative would provide coordinated infrastructure, modelling commons, and facilitate data aggregation and integration to support interdisciplinary coastal research. As part of NCRIS, it would strengthen collaboration across universities, government, industry, and Traditional Custodians of Sea Country. CoastRI's explicit focus on integration across the land–sea interface is designed to reduce duplication and provide a nationally coordinated approach to support both coastal research and the broad needs of stakeholders.

University-based infrastructure provides nationally significant capabilities to support coastal research and innovation. These include physical modelling laboratories (e.g., wave flume and basin test facilities); coastal field stations and observatories; research vessels and mobile monitoring platforms; and instrumentation for hydrodynamics, sediment transport, and water quality. While these assets are distributed across institutions, coordination and visibility remain limited, particularly in supporting integrated land-sea research. Industry-operated assets, such as testbeds and coastal monitoring systems, also support applied research, though they are often regionally specific and under-recognised as part of the broader R&D ecosystem. For further details on Australia's research infrastructure, refer to the **National Marine Research Infrastructure White Paper.** Without more substantial investment and coordination, Australia risks under-utilising these assets; conversely, with adequate support, the nation could establish a world-leading, integrated coastal research capability.

## Limitations and gaps

Australia's scientific system is underpinned by world-class expertise but faces persistent structural limitations that undermine its ability to support integrated coastal and urban development (Figure 4). These limitations span disciplines, institutions, and the science-policy interface. They are compounded by spatial and temporal imbalances in data availability and research continuity, data accessibility, as well as limited capacity to retain and apply knowledge across institutions over time. Translating robust science into infrastructure design, planning policy, and decision-making remains a key challenge. Addressing these gaps will be crucial to achieving a more cohesive and nationally coordinated approach to climate-resilient coastal development. The following outlines several of the most pressing limitations and gaps requiring attention.


***Figure 4:*** *Disciplinary enablers, systemic challenges, and knowledge gaps that must be addressed to achieve sustainable and resilient coastal development.*

- <u>Fragmented governance, jurisdiction, and data integration:</u> Limited coordination across institutions, programs, and jurisdictions results in duplicated effort and difficulty synthesising multi-source data into usable, decision-relevant knowledge. Access to comprehensive data held by the private sector is often restricted, limiting the ability to integrate the best available knowledge into research that supports broader coastal and marine assessments. In addition, the division of responsibilities between Commonwealth, State, and Territory governments under the Offshore Constitutional Settlement creates barriers to nationally integrated management of coastal and offshore environments. Revisiting aspects of this framework may be necessary to enable clearer coordination across levels of government.

- Limited integration of science and policy: While Australia has a robust scientific capacity, its translation into policy is often difficult, delayed, or underutilised. This limited integration is often due to institutional inertia, a lack of incentives, and inadequate enabling legislation.
- Inadequate integration of built and natural systems: While natural processes are well-studied, integration with urban infrastructure systems, planning models, and socio-economic feedback remains weak. This integration requires the joint consideration of marine, coastal, and catchment processes when identifying and forecasting hazards. There is no national plan for integrating nature into coastal development, nor are there technical guidelines for how to do it.
- Inadequate planning for long-term climate risks: Adaptation planning faces challenges from uncertainty in long-term climate scenarios, limited legal and policy mechanisms, and insufficient resources for implementation. Barriers include unresolved jurisdictional responsibilities and legal questions around erosion, accretion, and rolling easements under existing property law. *Australia's National Climate Risk Assessment 2025* [5] further underscores these concerns by documenting how legacy planning decisions and current development trajectories risk locking in future exposure of settlements to coastal hazards. It emphasises that escalation of risks in one system is highly likely to have cascading impacts across other sectors and services, highlighting the systemic nature of coastal vulnerability and the urgent need for integrated long-term planning.
- Lack of a coherent national plan for legacy infrastructure: Australia currently lacks a coordinated national approach to addressing legacy infrastructure, leading to challenges in managing aging assets (for example, seawalls, ports, roads) and ensuring their long-term sustainability in the context of climate change and environmental impacts
- Under-resourced remote science and monitoring: Northern Australia and remote southern coasts generally lack adequate coastal data and sustained research across physical, ecological, and socio-economic domains. This lack of data is a critical gap given the scale of coastal infrastructure supporting expanding industries such as mining, gas, aquaculture, energy, and tourism. Consequently, ports and shore-based facilities are often developed in data-poor regions, increasing environmental and regulatory risks. Addressing this requires investment in research infrastructure as well as better coordination with industry, local communities, and citizen science initiatives to expand data collection in cost-effective and collaborative ways. Examples of positive steps include Indigenous Ranger Programs and citizen science networks, which demonstrate scalable models for filling monitoring gaps.
- Disjointed funding and investment mechanisms: Current funding arrangements are not well-integrated, limiting the ability to pool resources across sectors for large-scale collaborative initiatives. A transparent, integrated framework that aligns capability with needs and is visible to all stakeholders (research, engineering, industry, regulators, Indigenous groups, and NGOs) would provide clearer direction for investment and help identify priority areas for government and industry support.

Under current trajectories, Australia risks falling short of its potential to deliver climate-resilient, sustainable urban and coastal development. Key challenges include uncertain long-term funding, cultivation of a skilled workforce, talent and retention, lagging integration of science into policy and design standards, and socio-economic barriers to implementing effective adaptation strategies. Public awareness and education (i.e., ocean and coastal literacy) on coastal vulnerability and adaptation options also remain low, further limiting support for proactive investment and activities. When communities are unaware of coastal risks and the range of adaptation options, they are less likely to adopt critical measures such as taxpayer investment, policy reform, or nature-based alternatives. This lack of coastal literacy erodes the social licence needed for transformative action and constrains the political and financial momentum required to implement effective long-term strategies. Overcoming these limitations will be essential if Australia is to achieve its 2035 vision for resilient, inclusive, and sustainable coastal futures.

## 3. Knowledge and disciplinary requirements

### Key knowledge gaps

Addressing Australia's coastal challenges requires a deep understanding of coastal systems, improved technologies, and more integrated science to inform decision-making frameworks. To achieve this vision, key priorities must include integrating climate and disaster risk, as well as ecological values, into coastal land-use and infrastructure planning; advancing Indigenous-led management and research; promoting scenario-based infrastructure investment; and ensuring that actions are grounded in funded, interdisciplinary, and forward-looking science. Addressing these priorities represents a generational opportunity to build resilient, inclusive, and thriving coastal futures for all Australians. Critically, closing these knowledge and capability gaps will require cross-disciplinary approaches that span Aboriginal and Torres Strait Islander peoples' indigenous knowledge systems, physical and biological sciences, engineering, socio-economics, and governance (Table 1). The following ten knowledge and capability gaps outline the critical limitations in current understanding, tools, and practices, explain why they must be addressed, and propose solutions through collaborative, cross-disciplinary efforts (Figure 4). Note that these gaps are not presented in any particular order of priority.

*Table 1: Key disciplines essential to urban and coastal development, infrastructure, and services—why they are critical and how they contribute to building national capability.*

| Discipline | Why It's Needed | Key Contributions | National Capability Alignment |
|---|---|---|---|
| **Social Sciences and Human Geography** | Understand community values, behaviours, and vulnerability | Participatory planning, social impact assessments, risk perception, and equity frameworks | Community engagement, adaptive governance, inclusive policy design |
| **Economics** | Evaluate trade-offs, costs, values, and distributional effects of adaptation strategies | Ecosystem service valuation, cost-benefit analysis, economic resilience modelling, and market-based policy design | Investment prioritisation, efficient resource allocation |
| **Policy and Governance** | Navigate regulatory complexity and inter-jurisdictional challenges | Institutional analysis, policy innovation, and governance of shared resources | Coherent national frameworks, cross-sectoral coordination |
| **Engineering** | Design and implement robust adaptation and infrastructure strategies | Coastal protection structures, hybrid solutions, and performance modelling under future climate conditions | Infrastructure resilience, nature-based solutions |
| **Technology & Data Science** | Harness advanced tools and technology for monitoring, modelling, and decision support | Remote sensing, AI/ML, digital twins, and spatial data integration | National monitoring and modelling platforms, predictive analytics |
| **Indigenous Knowledge Systems** | Incorporate place-based, intergenerational stewardship | Seasonal calendars, cultural indicators, and traditional management practices | Indigenous-led governance, cultural continuity in planning |

| | | | |
|---|---|---|---|
| **Law and Planning** | Implement science and adaptation pathways through formal planning instruments | Land use regulation, managed retreat frameworks, and legal rights and obligations | Climate-smart development regulation, enabling legislative frameworks |
| **Ecology** | Understand ecosystem function and responses to coastal development pressures. Design and implement robust ecosystem-based adaptation and infrastructure strategies | Ecosystem monitoring, restoration science, biodiversity modelling, and resilience assessment | Coastal ecosystem-based management and resilience, nature-based solutions |
| **Chemistry** | Understand biogeochemical processes that drive water quality, ecosystem health, and climate feedbacks | Nutrient and carbon cycling, contaminant fate and transport, ocean acidification impacts, and analytical methods for pollutants and water chemistry | Water quality monitoring, blue carbon accounting, pollution control, and ecosystem health assessment |
| **Oceanography and Geosciences** | Understand the fundamental processes that control coastal systems | Geological controls in ecosystems, hydrodynamics, coastal evolution, morphological changes, morphodynamics, and eco-morphodynamics | Coastal conservation, coastal behaviour at multiple time and spatial scales (from microscopic/instantaneous, to thousands of km and geological time frames), numerical modelling, NbS |

**1. Understanding coastal physical processes at planning-relevant scales**

Gap: Current understanding of nearshore hydrodynamics, sediment dynamics, and morphological change remains limited at the spatial and temporal scales needed to assess local coastal impacts such as erosion, inundation, and landform evolution. This limitation constrains the ability to inform land-use planning, infrastructure design, and adaptation under changing climate conditions.
Need: High-resolution, long-term monitoring of coastal dynamics and development of coupled wave-hydrodynamic and sediment transport models that can simulate morphological changes across event (storm) to decadal timeframes, both historically and under future climate scenarios. There is also a growing need to incorporate joint-probability modelling of coastal, catchment, and groundwater interactions to assess coastal hazard impacts, as well as to develop downscaled regional climate models.
How: Expand national observation networks into the nearshore environment using cost-effective technologies. Invest in model development supported by high-performance computing and foster interdisciplinary collaboration among all marine and coastal researchers and practitioners, including engineers, oceanographers, geomorphologists, climate scientists, biologists, and data scientists.

**2. Quantifying climate change impacts and vulnerability**

Gap: Although national climate projections are available, their resolution—typically between 50–250 km for global models and around 10–50 km for regional models—is too coarse to resolve the fine-scale coastal processes and features needed for local impact assessments, such as estuaries, beaches, ports, and urban coastal zones. Critically, these projections often overlook a range of processes (e.g., ocean currents, storm surges, sea level rise, and groundwater dynamics), including their interactions, which can significantly alter risk evaluations at coastal scales.

Need: Downscaled regional climate models tailored to coastal variables, and integrated vulnerability assessments incorporating physical exposure, system sensitivity, and adaptive capacity. Decision-making support also requires operational pathways that translate projections into adaptation actions.
How: Establish a national operational oceanographic and geohazard forecasting capability with a coastal focus. Develop best practices, standards, and datasets for vulnerability analysis to support interdisciplinary research that links climate science with engineering, ecology, and the social sciences. Tools should support adaptive planning and scenario testing while incorporating Australia's built environment and infrastructure.

**3. Assessing and optimising adaptation strategies (grey vs. green)**

Gap: There is limited empirical evidence on the long-term performance, cost-effectiveness, and co-benefits of adaptation approaches, especially nature-based solutions (NbS) such as dune revegetation, artificial reefs, and mangrove and shellfish restoration. Compared to conventional engineering structures, such as seawalls and breakwaters, there are notable gaps in scientific understanding, modelling tools, and technical guidelines to support the design, implementation, and long-term evaluation of NbS across diverse coastal environments. Currently, the lack of scientific understanding and design guidelines continues to limit the mainstream adoption of NbS by practitioners.
Need: Comparative evaluation and life-cycle assessment frameworks that quantify protective benefits, ecological outcomes, and social acceptability across different adaptation strategies. Such frameworks must also consider long-term ecosystem persistence and socio-economic performance to inform permitting and investment decisions.
How: Establish national and State-based pilot and demonstration projects with robust monitoring and adaptive management frameworks. Fund interdisciplinary research spanning engineering, ecology, geomorphology, economics, and governance to generate basic science behind NbS, empirical evidence, and design guidelines for when they are needed. Include investment in national databases to track the extent and condition of NbS projects over time, which extends beyond engineering performance metrics to capture social, economic, cultural, and environmental co-benefits. Developing nationally-coordinated testing facilities (e.g., wave basins and flumes) and virtual simulation workspaces would enable users across Australia to explore adaptation options and standardise approaches to NbS.

**4. Understanding, monitoring, and predicting ecosystem responses**

Gap: Coastal ecosystems are increasingly exposed to multiple, cumulative stressors acting over short-term (e.g., dredging) and long-term (climate change) timescales. Yet, our ability to predict how ecosystems will respond to disturbances generally remains weak and fragmented. Interactions among these stressors remain also poorly understood, making it difficult to predict responses and increasing the urgency of addressing cumulative impacts. These knowledge gaps limit opportunities to inform ecosystem repair, restoration, and the viability of nature-based approaches.
Need: Integrated physical-biological models that enhance our understanding of the key processes in each system, including how hydrodynamics and sediment transport control ecosystem health. These models will link environmental drivers to ecosystem health, resilience, and connectivity. There is also a need to develop scalable, cost-effective restoration techniques that can enhance adaptive capacity (refer to **Coastal and Marine Ecosystem Restoration and Repair White Paper)**. Research must also address the trade-offs between ecosystem protection and the development of coastal and port infrastructure to align environmental, social, and economic objectives. Scalable, cost-effective restoration techniques are needed to support adaptation and long-term ecosystem services.
How: Strengthen multidisciplinary ecosystem monitoring by integrating national coastal observing systems at priority coastal sites. Support fundamental research to establish baselines and track ecological responses to development and management interventions. Invest in technologies such as eDNA and metagenomics for rapid species assessment, remote sensing, and AI-enabled modelling tools to detect early signs of ecosystem change. In parallel, build out national databases of coastal

ecosystem condition and extent. Support collaboration initiatives with industry and community partners to enhance monitoring coverage and improve data flow to decision-makers.

**5. Integrating socio-economic dimensions**

Gap: Coastal management research often fails to adequately incorporate human dimensions, including social vulnerability, risk perception, behavioural responses to hazards, and the valuation of non-market ecosystem services. Without integrating these elements, adaptation strategies risk being socially unacceptable, inequitable, or overly focused on the financial bottom line of decisions. Public acceptance of adaptation measures, including visual and amenity impacts, will also be crucial to implementation, necessitating structured consultation with diverse communities and Traditional Owners regarding future options. As the climate becomes more unpredictable, many coastal communities and industries face growing risks from storms, flooding, and other environmental hazards. Traditional insurance often fails to provide fast or adequate support, especially in fast-moving or difficult-to-verify loss scenarios. These limitations in traditional insurance leaves many coastal communities and industry sectors without the protection they need to recover and adapt.
Need: Embedding socio-economic analysis at the outset of research and planning programs, with robust stakeholder engagement, participatory approaches, and assessments of distributional impacts and adaptive behaviours and preferences; and enabling explicit inclusion of multiple stakeholders' social and cultural values throughout planning and decision-making processes. Socio-economic monitoring should be conducted in parallel with ecological and engineering assessments to capture co-benefits and trade-offs. There is also a need to develop new types of insurance, such as those that are parametric (or index-based) linked to specific extreme weather or ocean conditions, to help fill the protection gaps in the marine sector. These tools should reflect the unique risks faced by coastal industries and be made accessible to vulnerable regions and communities.
How: Fund interdisciplinary teams combining economists, sociologists, human geographers, behavioural and legal scientists, and Traditional Custodians of Sea Country. Co-design and develop tools that capture diverse social values, behaviours, and economic trade-offs, tailored for coastal contexts. Support national data infrastructure for tracking socio-economic change alongside environmental indicators. Establish targeted programs to apply Australia's extensive marine data archives to the design and deployment of parametric insurance products. These efforts should include collaboration with the insurance sector, government, and marine industries to develop scalable, transparent, and context-sensitive financial tools for coastal risk management.

**6. Developing advanced technologies**

Gap: Existing monitoring infrastructure is typically costly, fragmented, and poorly suited to the complex and dynamic nature of Australia's coastal environments. Processing, managing, and interpreting the resulting large datasets remains a significant barrier, in part due to the lack of consistent and standardised data and metadata. Development and testing of low Technology Readiness Level (TRL) instrumentation remains challenging to fund.
Need: Deployment of autonomous monitoring platforms (e.g., drones, unpiloted surface and underwater vehicles), smart sensors, and AI/ML-enabled remote sensing, coupled with digital twin technologies to simulate coastal system behaviour.
How: Support targeted R&D for new sensor technologies, algorithms, robotics, and real-time data analytics. Fund fundamental research that provides the parameterisation needed for algorithms and digital twins. Pilot integrated, scalable technology platforms in diverse coastal settings, and align efforts with national digital infrastructure strategies to maximise data value and utility.

**7. Enhancing data systems and knowledge translation**

Gap: Fragmented, inaccessible, and poorly standardised data across jurisdictions, sectors, and research domains hinder effective coastal science, planning, and policy-making. Different sectors hold many critical datasets with limited interoperability and inconsistent metadata. Research outputs are

also often not translated into decision-ready formats. Scientific findings are not consistently converted into accessible tools, policy guidance, or planning instruments.
Need: A national, federated coastal data infrastructure aligned with FAIR (Findable, Accessible, Interoperable, Reusable) and CARE (Collective Benefit, Authority to Control, Responsibility, and Ethics) principles, complemented by targeted knowledge translation initiatives that produce accessible, actionable information.
How: Expand and enhance existing platforms (e.g., Australian Ocean Data Network (AODN)) with dedicated coastal data modules and decision-support tools. Encourage or require the sharing of industry data where appropriate, including through Environmental Impact Assessments or licensing conditions. Establish data sharing approaches and technology, supported by the Australian Research Data Commons (ARDC), to provide a relevant framework for bringing together cross-jurisdictional data, private and public data custodians, and commercial and sensitive data into a trusted, transactional digital infrastructure. Support the development of end-user-focused products through co-design, and invest in knowledge brokering capabilities embedded within projects and institutions.

**8. Valuing and integrating aboriginal and Torres Strait Islander peoples' Indigenous knowledge for co-led coastal stewardship**

Gap: The Indigenous knowledge systems and cultural values of Aboriginal and Torres Strait Islander peoples remain underrepresented in coastal science, management, coastal development planning, service delivery, and governance processes. This results in missed opportunities for holistic stewardship and adaptive management rooted in deep, place-based understanding. Coastal development that overlooks Traditional Knowledge may inadvertently compromise cultural heritage, ecosystem health, and long-term community wellbeing.
Need: Coastal development and ecosystem management must be informed by frameworks that respect and embed Traditional Knowledge systems, uphold land and sea rights, and support Traditional Custodian leadership. This inclusion requires moving beyond consultation to co-governance and co-creation of knowledge, ensuring that Traditional Custodian voices shape the priorities, methods, and outcomes of coastal programs and infrastructure decisions.
How: Establish and sustain partnerships with Aboriginal and Torres Strait Islander peoples and ranger groups. Prioritise Indigenous-led research and stewardship programs, embed Traditional Knowledge holders in advisory and decision-making structures at all levels, and co-produce monitoring, adaptation, and conservation initiatives that track both ecological and cultural indicators of health, especially in regions undergoing or targeted for coastal development. Appropriately remunerate Traditional Custodian roles. Incorporate Traditional Knowledge Labels into data platforms to respect and acknowledge Traditional Knowledge systems, ensuring that cultural data is appropriately managed and shared. Develop mechanisms to align coastal development and ecosystem services with the aspirations of Aboriginal and Torres Strait Islander peoples, including cultural mapping and impact assessments, which can guide responsible infrastructure siting and land-use planning. Expand funding to support Aboriginal and Torres Strait Islander tertiary and higher degree students and strengthen university capacity to deliver culturally safe education by resourcing Indigenous academic, professional, and leadership roles.

**9. Predictive modelling to inform urban and coastal development**

Gap: Current urban and coastal planning frameworks are static, poorly integrated with dynamic coastal hazard projections, and do not adequately reflect the complex interactions between environmental and socio-economic systems. Furthermore, the Australian regional climate models do not account for urban features. As a consequence, we currently cannot predict the impact of climate change on urban climate, let alone coastal urban climate.
Need: Development of spatially explicit, scenario-based models that integrate climate change, land-use change, infrastructure vulnerabilities, and social dynamics to inform resilient development

pathways. Building such tools must start with end-user engagement to identify what decisions need what information, and at what level of accuracy, so that outputs are genuinely fit-for-purpose.
How: Build and operationalise integrated modelling platforms drawing on national monitoring data, digital twin technologies, and open-access design principles. Ensure planners and local decision-makers are supported through training and co-development of decision-support tools and modelling applications that are transparent, usable, and tailored to real-world processes. As a relevant example, to address our knowledge gap on urban climate, AURIN and ACCESS-NRI are leading an initiative to establish a National Digital Research Infrastructure and federate all enabling capabilities nationwide: the Australian Urban Climate Research Infrastructure (AUCRI).

**10. Embedding climate adaptation strategies into coastal decision-making**

Gap: Climate adaptation efforts are often short-term, reactive, fragmented, and inconsistently embedded into formal decision-making processes, leading to delays, maladaptation, and escalating future costs. Even well-developed strategies often face barriers if there is a limited understanding of coastal risk within the community or a lack of political will.
Need: Nationally consistent and proactive adaptation strategies, integrated into planning that encompasses a holistic view of coastal management, investment, and policy systems at all levels of government, informed by dynamic, forward-looking risk assessments. The growing emphasis on Scope 3 carbon emissions reporting, which includes indirect emissions across supply chains, construction, and operational impacts, is increasing the need for reliable data and monitoring systems within coastal infrastructure and development. As Australia moves toward mandatory climate-related financial disclosures, capturing these emissions will become critical for transparent, climate-aligned decision-making.
How: Align adaptation objectives between federal, state, and local governance systems. Transform governance systems to recognise the relationships between coastal hazards, adaptation responses, other pressures, and planning, enabling decision-making to focus on integrated coastal zone management. Adopt approaches such as Dynamic Adaptive Policy Pathways to guide flexible long-term planning. Integrate coastal hazard risks into land-use regulations, infrastructure funding frameworks, and national performance reporting. Review and reform land use planning frameworks to ensure they effectively account for dynamic coastal processes, hazards, and climate-related uncertainties.

## 4. Infrastructure and capability needs

### Developing a skilled and multidisciplinary workforce

There is a recognised shortage of professionals with cross-disciplinary expertise spanning coastal engineering, geosciences, environmental science, oceanography, and data analytics. This need is becoming increasingly critical as scientific fields evolve with the adoption of emerging technologies such as autonomous observation systems, advanced numerical modelling, and machine learning for environmental prediction. Specialists who can integrate knowledge across disciplines are increasingly essential for addressing complex, multi-scale coastal challenges. For example, advancing NbS for coastal adaptation requires integrated expertise in coastal processes, engineering design, and ecology.

Education and capacity-building initiatives must be expanded and diversified, with a focus on training programs that bridge engineering, science, and technology, while also developing strong problem-solving skills. This effort requires not only specialised knowledge but also the ability to work across disciplines and apply effective communication and collaboration skills. Beyond foundational education, career pathways must be strengthened to ensure that emerging professionals can see long-term opportunities in research, industry, and government sectors. Expanding work-integrated learning initiatives, such as industry placements and internships, will better equip graduates with practical skills aligned to real-world coastal challenges. Joint positions for students and staff across universities, government agencies, and industry should also be promoted, as these roles can drive integration, data sharing, talent retention, and alignment of research with sector needs while sharing costs.

In addition, lifelong learning and professional development programs are crucial for enabling the existing workforce to upskill in emerging areas as technological advances transform the sector. Strengthening investment in this new generation of multidisciplinary experts will be essential to ensure Australia's capacity for delivering innovative and sustainable urban and coastal development projects.

## Growing coastal research and innovation infrastructure

Observational and modelling networks bridging the land-ocean interface represent a critical capability gap. Existing systems are fragmented, often operating in isolation without coordinated frameworks, which limits the ability to generate a comprehensive and predictive understanding of complex coastal processes. For example, terrestrial and marine monitoring programs are rarely integrated, resulting in gaps at the land–sea interface. In Australia, current efforts tend to focus on either terrestrial or marine domains, with limited integration across the transitional coastal zone where dynamic interactions are particularly pronounced. Enhanced integration across the land-sea interface is essential to support activities such as coastal hazard prediction, environmental management, and the design and monitoring of adaptation measures tailored to Australia's diverse coastal environments.

The currently proposed establishment of the CoastRI initiative is a significant and strategic step toward addressing some of these gaps, particularly those related to understanding coastal processes, enhancing coastal observations, and predictive modelling. CoastRI aims to deliver integrated, multi-scale observational and modelling platforms, combining land-based, coastal, and marine sensors with advanced coupled modelling frameworks. Its success depends on effective data integration and aggregation at a national scale, along with a standardised method to ensure consistency and reliability across diverse data sources. Tailored to Australia's diverse and dynamic coastal environments, this infrastructure will provide a critical backbone needed for research, decision support, and innovation in coastal resilience and sustainable development.

While some shared data frameworks exist among the industry, government, and research sectors, they are generally inadequate for addressing the scale and complexity of current challenges. Fragmented data ownership, inconsistent use of standardised protocols, and limited accessibility hinder the development of regional models and decision-support products. Long-term, near-real-time observational datasets are particularly scarce, yet essential for informed infrastructure design, environmental impact assessments, flexible construction approaches that can respond to changing coastal conditions over time, and lifecycle decommissioning of major coastal assets.

Investment in research infrastructure must also support technology development, engineering innovation, and commercialisation pathways. Facilities that enable controlled, large-scale testing of coastal protection infrastructure, nature-based and hybrid solutions, and eco-engineering innovations are needed. This infrastructure includes experimental (physical model) testing facilities and technology demonstration sites to bridge the gap between research concepts and real-world applications.

Improved data coordination, standardisation, aggregation, and accessibility must be a national priority. Establishing national data and model standards aligned with international best practices will support interoperability, enhance decision-making support, and ensure Australia's data assets are globally competitive.

## Strengthening national and international partnerships

Effective partnerships are essential for enhancing Australia's capabilities. Domestically, stronger integration across universities and government research agencies (Commonwealth and State) is needed to coordinate skills development, share knowledge and data, and leverage research infrastructure. Cross-sector collaboration should be incentivized through funding mechanisms that prioritize multi-institutional, multidisciplinary projects, including programs similar to Cooperative Research Centres (CRCs) or targeted grant schemes that mandate interdisciplinary collaboration between academia, government, and industry.

Internationally, partnerships such as the UN Decade's Ocean Cities program and the Practitioner Exchange for Effective Response to Sea Level Rise (PEERS) network offer valuable opportunities to share expertise, infrastructure, and training; however, funding constraints often limit collaboration. As a result, countries often undertake similar research efforts independently rather than through coordinated programs, which highlights the importance of coordinated international funding mechanisms and strategic alignment to promote global progress. Dedicated funding to support international engagement would also provide significant benefits, enabling Australia to play a greater role in international working groups and collaborative initiatives aimed at developing best-practice guidelines and advancing coastal resilience globally.

Australia also has a strategic opportunity to strengthen regional partnerships with neighbouring island and coastal nations across the Pacific, Indian Ocean, and Southeast Asia. Many of these countries face similar challenges in managing climate-exposed coastal infrastructure, urbanisation, and sea-level rise, while also grappling with limited data and institutional capacity. Collaboration can foster two-way learning in areas such as community-led adaptation, land–sea planning, NbS, and integration of Traditional Knowledge. These partnerships are also crucial to regional stability, as climate-related coastal pressures are increasingly intersecting with issues of defence, humanitarian response, and maritime security. Enhancing scientific and technical cooperation in the region, such as through joint research, training, and demonstration projects, would not only build shared resilience but also reinforce Australia's role as a trusted partner in promoting sustainable development and strategic engagement across the broader Indo-Pacific region.

A sustained, multidisciplinary research program, grounded in strong national and international partnerships, is needed to test and scale innovative eco-engineering approaches for coastal infrastructure in Australia. Overseas initiatives, such as Building with Nature (Europe) and Engineering with Nature (United States), demonstrate how collaboration across research institutions, industry, and government can accelerate the development of multifunctional coastal infrastructure that delivers coastal protection alongside co-benefits, including habitat restoration, carbon sequestration, and improved water quality. Applying this model in Australia through co-designed, large-scale field trials with end users and stakeholders would provide the performance evidence needed to inform regulatory frameworks, support innovation, and reduce risk in adopting nature-based and hybrid solutions.

These examples highlight how well-coordinated, multidisciplinary partnerships can drive innovation and deliver tangible benefits for coastal resilience. Similar collaborative models are also needed in other critical areas, including data integration and digital infrastructure, land–sea planning coordination, socio-economic risk modelling, legacy infrastructure management, and Indigenous-led coastal governance. Expanding partnership efforts across these domains will be key to ensuring coastal science and development efforts are robust, inclusive, and nationally integrated.

To sustain and scale these types of partnerships, Australia would benefit from establishing a dedicated national coastal body to coordinate efforts across jurisdictions and sectors. Such an entity could act as an enabler of collaboration, supporting joint monitoring programs, standardising workflows and policies, aligning research priorities, and facilitating interventions guided by best practice. This body could take the form of a statutory authority or coordinating agency, providing enduring institutional support. Given that the majority of Australia's population and infrastructure are located along the coast, and that coastal governance remains fragmented across local and state governments, a centralised and enduring institutional framework would provide more effective stewardship, ensure continuity, and support nationally consistent approaches to coastal science, adaptation, and planning. Establishing such an entity would unlock transformative opportunities for nationally integrated coastal resilience.

## *5.* Progress/Impact measurement

**Integration of relevant science into national and international frameworks**

Science supporting urban and coastal development in Australia already informs a range of national and international initiatives. At the national level, research outputs contribute to the *State of the Environment* reports, guide the *National Climate Resilience and Adaptation Strategy*, and underpin the Australian Disaster Resilience Knowledge Hub. Coastal science has also directly informed *Australia's National Climate Risk Assessment 2025* [5], which provides a baseline national analysis of climate-related risks. The assessment highlights coastal hazards as a priority domain requiring urgent adaptation responses, demonstrating how scientific evidence is already shaping national risk governance and resilience planning. These contributions also directly support Australia's Sustainable Ocean Plan, which emphasises climate action, knowledge integration, and sustainable development in national coastal and ocean management. Scientific data on nature-based shoreline protection methods is also compiled through platforms such as Living Shorelines Australia, which provides a repository of case studies, design guidelines, and research supporting the implementation of NbS for coastal resilience. Modelling tools developed through national programs are widely used in state coastal hazard mapping programs (e.g., Queensland's QCoast2100, New South Wales' Coastal Management Program, and Western Australia's Coastal Hazard Risk Management and Adaptation Planning (CHRMAP) framework).

Internationally, Australia's contributions support reporting against the *UN Sustainable Development Goals (SDGs)*, particularly SDG 13 (Climate Action) and SDG 14 (Life Below Water). Australia has also played a key role in developing the IUCN Green List, including the contribution of case studies, which provides a framework to evaluate progress under the Kunming-Montreal Biodiversity Framework—a global agreement aimed at halting and reversing biodiversity loss.

Broader uptake of the latest science remains a challenge. Many coastal councils cannot utilise the latest models or projections due to limited funding, lack of technical expertise, or insufficient staff capacity. Enhancing impact requires embedding scientific outputs into mandatory planning instruments, design standards, and funding eligibility criteria. A national initiative to align coastal resilience science with key statutory frameworks, such as the National Construction Code and Australian Infrastructure Audit, would help ensure science drives tangible outcomes. Strengthening partnerships with international frameworks, such as the Global Ocean Observing System (GOOS), particularly in expanding coastal observing capabilities, would also leverage Australia's role through the Integrated Marine Observing System (IMOS), which operates as a regional partner of GOOS, and collaborating with initiatives like Building with Nature (Europe), linked to the international Working with Nature initiative led by PIANC, and Engineering with Nature (USA), would further enhance global relevance and impact.

**Knowledge transfer to stakeholders and end users**

Current mechanisms for knowledge transfer in Australia include scientific publications, technical advisory committees, collaborative research hubs (e.g., the Marine and Coastal Hub of the NESP), and web-based platforms such as the AODN, Coastal Risk Australia, and *CoastAdapt*. Government agencies, such as CSIRO, GA, and BOM, frequently produce open-access decision-support tools.

However, research translation remains uneven. Research outputs are often too technical, not decision-ready, or poorly aligned with operational needs. Many local councils, infrastructure planners, and Indigenous custodians also lack user-friendly interfaces and the technical capacity to effectively utilise available data.

To improve knowledge transfer, future efforts must prioritise the co-design of research with stakeholders from project inception. Embedding knowledge brokers, science communicators, and digital platform developers within research teams can ensure outputs are accessible, timely, and tailored for decision-making contexts. To improve knowledge transfer and national consistency, Australia would benefit from establishing a national coastal coordination body (see Section 6), which in part helps to align coastal knowledge integration and translation. International models, such as the National Centers for Coastal Ocean Science (NCCOS) in the United States and the recently launched Coast-R Network in the United Kingdom, illustrate the value of such coordinated efforts in bridging research and real-world decision-making. In Australia, such a body would have a national coordination role, supporting the integration of research across jurisdictions, aligning state and local government adaptation planning with national science, and accelerating the adoption of research outputs into consistent standards, guidelines, and decision-making frameworks. It would provide a sustained mechanism to bridge research and practice, particularly supporting resource-constrained councils and fostering collaboration among Commonwealth, State, Traditional Custodians, and local stakeholders. Its authority and coordination role could be debated, but it should reflect the urgency of nationally consistent action.

## Proposed indicators of societal and scientific impact

Measuring the impact of coastal and urban development requires science to go beyond traditional measures of academic output, such as publications and other research-centric metrics. Proposed indicators should include:

- **Policy uptake**: Increase in the number of policies, planning instruments, or regulations that explicitly incorporate scientific outputs (e.g., inclusion of dynamic coastal hazard mapping in land-use planning schemes).
- **End-user adoption**: Increase in uptake of decision support tools, models, or guidelines by councils, agencies, or industry.
- **Societal resilience**: Reduction in vulnerability of coastal assets and communities, as measured through updated risk assessments aligned with scientific projections. Resilient communities can emerge either by minimising their exposure to adverse impacts or by enhancing their capacity to adapt to anticipated changes through strategies such as planned retreat.
- **Co-production and Indigenous engagement**: The number and quality of projects co-designed with Aboriginal and Torres Strait Islander peoples, and the integration of Indigenous knowledge into coastal management frameworks.
- **International recognition**: Citations in international guidelines (e.g., IPCC reports), invitations to global adaptation partnerships, working groups, task teams, and export of Australian-developed tools or methods.
- **Capacity building**: Number of trained coastal practitioners and early-career researchers engaged through integrated training initiatives and knowledge transfer programs.
- **Public awareness and coastal literacy**: Level of ocean and coastal literacy in the general population, measured through community surveys on knowledge, safety, and support for coastal adaptation.
- **Transparent decision-making**: Demonstrated articulation of trade-offs between financial and social costs and benefits of coastal management options in decision-making, enabling distribution of impacts across stakeholder groups to be identified.
- **Innovation and commercialisation:** Number of tools, technologies, or models developed, improved, or adopted by private sector partners, and evidence of new commercial applications of coastal science. Establishment of dedicated test beds to trial and validate

emerging solutions, and measurable improvements in the TRL of existing technologies as they progress towards implementation.

Regular tracking against these indicators, complemented by case studies of successful applications (e.g., managed retreat plans based on scientific hazard modelling), will provide accountability, ensure continuous improvement, and demonstrate progress toward national resilience goals.

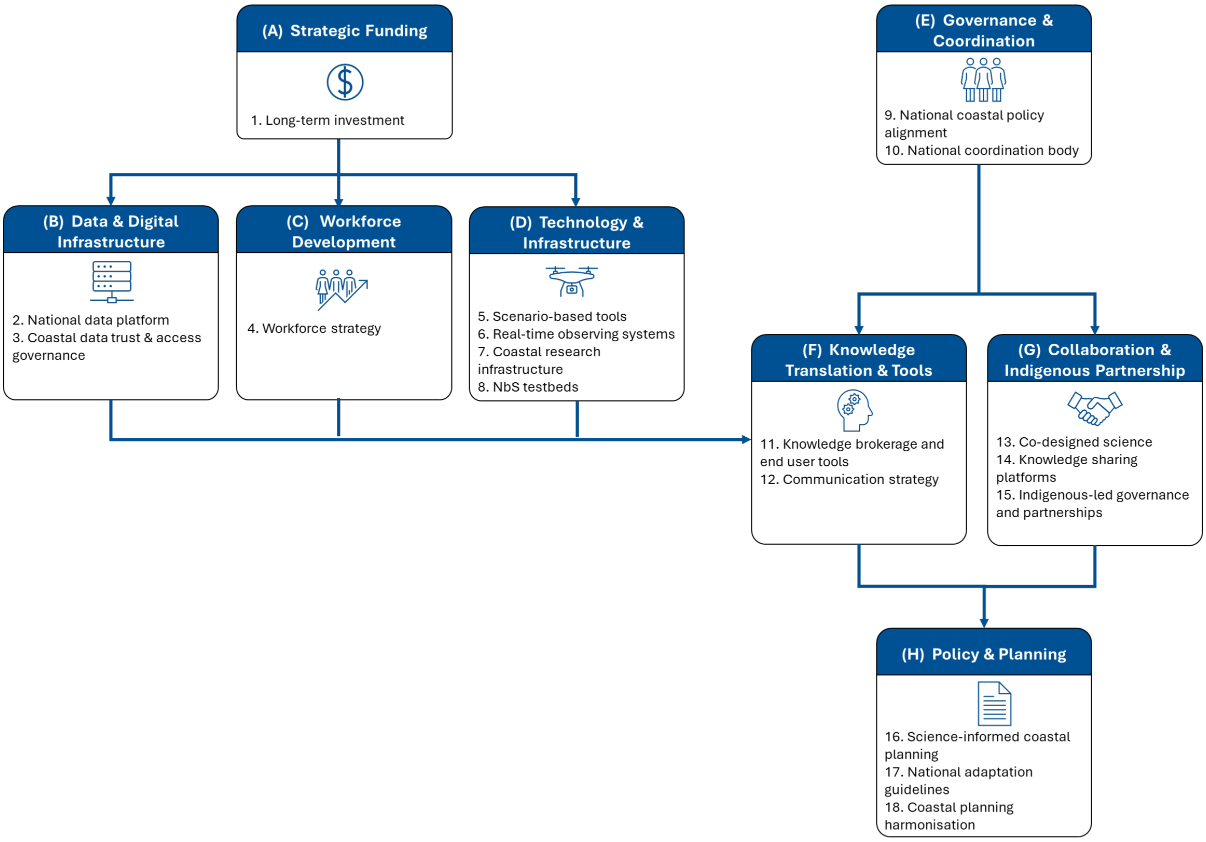


***Figure 5:*** *Interdependencies between national priorities (1–18) and systemic challenges (A–H) that underpin coastal science, planning, and adaptation*

## 6. Priorities and dependencies

Australia needs an integrated, mission-oriented national agenda that bridges coastal and marine science, infrastructure planning, policy, and urban development. This agenda must connect disciplines such as oceanography, engineering, ecology, geosciences, climate science, social sciences (economics, policy, and law), and urban planning, while operating across sectors and jurisdictions. It must also be guided by transparent and accountable processes to ensure trust, equity, and effectiveness across all levels of government, industry, and communities.

It must be adequately resourced to support both basic and applied science and be flexible enough to enable innovation in complex and uncertain policy settings. To support effective planning and development of Australia's coastal infrastructure, services, and communities, the agenda must directly link scientific and technical insight to decision-making at all levels of government and industry. This requirement includes incorporating social science perspectives on institutional and behavioural challenges and fostering co-design with communities.

Actions grounded in long-term observation, shaped by end-user needs, and focused on delivering practical outcomes are needed to drive meaningful transitions in how Australia sustainably manages human settlements, infrastructure, and ecosystems along its dynamic coastlines. With targeted reform and investment, Australia is well-positioned to become a global hub for innovation in adaptive coastal planning.

The following high-priority actions are grouped under eight systemic challenges (A–H) that currently constrain progress in planning, managing, and adapting Australia's coastal and urban environments. These challenges span scientific, institutional, policy, and infrastructure domains. Each challenge is followed by a set of actionable priorities (1-18) that are designed to catalyse meaningful, system-wide change (Figure 5). The priorities identified in this section are closely aligned with Australia's Sustainable Ocean Plan, which provides a national framework linking climate action, sustainable ocean development, and integrated knowledge systems.

**A – Insufficient, insecure, and misaligned funding:** Short-term, project-based funding models constrain the ability to invest in critical long-term research infrastructure, observation systems, model development, monitoring programs, and the retention of knowledge. Available funding programs are often discipline-based or limited in scope, with inadequate integration across sectors, regions, and long-term objectives. The absence of sustained investment undermines the generation of long-term (e.g., decadal) datasets, multi-disciplinary programs, and the capacity to build national centres of sustained expertise. Coordination of funding across Commonwealth, State, and local governments, together with industry, will also be critical to ensure efficiency and impact.

- ***Priority 1:*** *Establish a nationally coordinated, transparent, long-term funding model—led by the Commonwealth and supported by all levels of government—to drive transformative coastal research to guide future coastal development, infrastructure planning, climate adaptation, and service delivery across Australia.*

**B - Data gaps and access issues:** Australia's coastal and marine data landscape remains fragmented and inconsistently managed, with limited interoperability across systems and sectors. Metadata standards are often weak, data is frequently siloed, and access restrictions hinder collaboration and real-time decision-making. To support integrated planning and adaptive management, a federated, standardised national data architecture is essential, supported by strong governance and trusted cross-sector frameworks.

- ***Priority 2:*** *Establish a nationally-coordinated coastal data platform to enable federated governance, improve metadata standards, and facilitate collaboration across jurisdictions, sectors, and disciplines.*

- ***Priority 3:*** *Create and sustain a cross-sector coastal data trust to ensure efficient, transparent, and secure data sharing and stewardship among government, industry, academia, and communities.*

**C - Capacity and workforce limitations:** Australia faces persistent shortages of skilled professionals across the disciplines critical to coastal and urban resilience, including geosciences, engineering, environmental monitoring, ecological restoration, social sciences, and Indigenous knowledge systems. Workforce development is further constrained by short-term funding, limited cross-disciplinary training opportunities, and the absence of a national strategy to build and retain expertise aligned with future coastal challenges. Joint appointments across universities, government agencies, and industry should be encouraged to promote integration, data sharing, and alignment with workforce needs.

- ***Priority 4:*** *Establish a national workforce development program to train, attract, and retain skilled researchers, professionals, and knowledge brokers in coastal planning, infrastructure, climate adaptation, and community engagement, supported by cross-sector collaboration and long-term funding.*

**D - Technological and infrastructure gaps:** Australia lacks the integrated infrastructure needed to observe, model, and manage complex coastal dynamics. Nearshore sensors, long-term monitoring networks, and high-performance computing for modelling are limited in coverage and capability. Emerging technologies, such as autonomous platforms and AI-driven analytics, are currently underutilised. Opportunities exist to scale up the use of digital twins, drones, and other innovative platforms to enable real-time decision-making. Investment in coordinated, fit-for-purpose infrastructure is essential to enable real-time data collection, predictive modelling, and informed decision-making across the land–sea interface.

- ***Priority 5:*** *Develop and deploy scenario-based tools to support climate-resilient infrastructure and land-use planning in coastal regions.*
- ***Priority 6:*** *Expand near-real-time coastal observation and modelling systems via CoastRI to support forecasting, risk assessment, and adaptive management.*
- ***Priority 7:*** *Ensure sustained investment in national-scale coastal research infrastructure to support long-term science, innovation, and planning.*
- ***Priority 8:*** *Use Australia's diverse coastal environments as a testbed to pilot, evaluate, and export nature-based adaptation solutions.*

**E - Fragmented governance and institutional silos:** Coastal management in Australia is divided among numerous local, state, and Commonwealth agencies, often leading to inconsistent policies, duplicated efforts, and slow or uncoordinated responses. This fragmentation limits the effectiveness of adaptation strategies, creates barriers to investment, and reduces the efficiency of cross-sector collaboration. Addressing these challenges may also require reconsideration of the Offshore Constitutional Settlement, which continues to shape the division of responsibilities between Commonwealth and State governments for coastal and marine areas. Nationally consistent frameworks and sustained coordination mechanisms are crucial for streamlining planning, aligning policies, and facilitating integrated coastal management.

- ***Priority 9:*** *Harmonise coastal policies and regulatory approaches across jurisdictions to enable consistent planning, risk management, and adaptation outcomes.*
- ***Priority 10:*** *Establish a national coastal coordination body to align government, industry, research, and community efforts, harmonise policies across jurisdictions, and support the integration and translation of coastal knowledge into planning, policy, and practice.*

**F - Limited translation and uptake of science:** Research findings are often not translated into formats, tools, or processes that align with planning, policy, or community decision-making. Few mechanisms exist to synthesise and communicate scientific insights into operational guidance, and researchers are often not supported or incentivised to engage in this translation. Embedding knowledge brokers into programs is critical to ensure outputs are communicated effectively to decision-makers and communities. A national effort is needed to embed science into real-world applications through co-design, brokerage, and institutional coordination. Direct engagement with infrastructure, services, and planning sectors is also crucial to understanding the processes and tools they currently use for climate adaptation and to align new research with these frameworks.

- ***Priority 11:*** *Strengthen knowledge brokerage in coastal research programs by embedding dedicated brokers and communicators to co-design with end users and translate scientific outputs into decision-ready tools, guidance, and support.*
- ***Priority 12:*** *Develop and implement a national coastal science communication strategy to raise public awareness, build political and industry support, and empower communities in long-term coastal stewardship. This should include sustained support for NGOs and regional groups that enable community-led action, and the use of plain language, digital storytelling, and visualisation tools to make science accessible.*

**G - Limited cross-sector collaboration:** Effective collaboration between researchers, governments, industry, communities, and Indigenous organisations remains limited. Siloed institutions, uncoordinated priorities, and a lack of co-design mechanisms hinder innovation, reduce efficiency, and weaken social license for coastal decision-making. Stronger relationships, shared platforms, and inclusive leadership frameworks are needed to unlock the full value of cross-sector knowledge.

- ***Priority 13:*** *Embed co-design processes within research, planning, and infrastructure programs through sustained resourcing and facilitation.*
- ***Priority 14:*** *Establish cross-sector knowledge-sharing platforms to support collaboration, information flow, and joint problem-solving (e.g., Communities of Practice).*
- ***Priority 15:*** *Support and expand frameworks that enable Aboriginal and Torres Strait Islander peoples' leadership in Sea Country research, planning, and stewardship.*

**H - Regulatory and policy lag:** Australia's coastal planning and regulatory systems have not kept pace with emerging scientific knowledge or the escalating risks associated with climate change. Planning frameworks often rely on outdated hazard assessments, lack consistent triggers for adaptation, and are weakly integrated with scientific guidance. This regulatory inertia increases exposure of communities and infrastructure, impedes investment, and creates legal uncertainty. Reform is needed to integrate evidence-based science into planning systems and to facilitate proactive, nationally coordinated adaptation. Establishing nationally consistent planning thresholds, for example, sea-level rise and storm hazard benchmarks, would reduce fragmentation between jurisdictions and enable cohesive cross-boundary adaptation.

- ***Priority 16:*** *Improve integration of scientific data, modelling, and research into statutory planning, design codes, and policy development through improved translation mechanisms and cross-sector collaboration.*
- ***Priority 17:*** *Support implementation of coastal adaptation through a national funding program, consistent planning triggers, regulatory enforcement, and development of a national coastal hazards adaptation strategy.*
- ***Priority 18:*** *Harmonise planning and regulatory approaches across jurisdictions to ensure national consistency and efficiency.*

Figure 5 illustrates the interdependencies between the eight systemic challenges identified in this section. It highlights how foundational elements such as funding and governance enable capability, data infrastructure, and technology, which in turn support collaboration and knowledge translation, ultimately informing effective and adaptive policy development.

## Critical Timelines and Milestones

Australia should respond urgently to escalating pressures on coastal systems driven by both climate change and ongoing coastal development, consistent with the urgency highlighted in *Australia's National Climate Risk Assessment 2025* [5], which identifies sea level rise and coastal flooding and erosion as priority national risks with systemic economic and social consequences. Engagement with governments, industries, Aboriginal and Torres Strait Islander peoples' organisations, and communities through early co-design processes is essential to refine priorities and ensure research meets end-user needs [Priorities 13, 15]. Immediate actions (2026–2027) should establish a national coordination body that unites coastal research, planning, and management across sectors and jurisdictions [Priority 9]. This body would ensure efforts are strategically aligned to address nationally significant challenges, promote integration across disciplines, enhance standardisation, facilitate collaboration, and support cross-sector knowledge sharing [Priorities 2, 8, 14]. Securing long-term, dedicated funding is equally vital to support infrastructure development, monitoring, integrated modelling, workforce capacity, and innovation [Priorities 1, 4, 5, 7].

By 2027, near-real-time coastal observation networks spanning the land-sea interface should expand significantly, with deployments targeting priority regions [Priority 6]. This milestone is crucial for closing urgent data gaps in hazard forecasting and risk planning. A national high-resolution coastal mapping program should be underway, producing critical datasets for hazard assessment and adaptation planning [Priorities 2, 16]. Sites for large-scale experiments and field trials should be identified and operational [Priority 12]. Workforce development initiatives addressing coastal modelling, nature-based engineering, and interdisciplinary skills should be operational [Priority 4].

By 2029, Australia should pilot integrated coastal models combining physical, ecological, and socio-economic processes, and deploy user-focused decision-support tools for adaptation planning [Priorities 5, 11]. Long-term monitoring sites for NbS should be operational [Priority 12]. These steps will demonstrate proof of concept and provide evidence to inform planning guidelines.

By 2030–2032, a federated national coastal data infrastructure should be operational, providing access to key observational and modelling datasets [Priority 3]. Science-based, nationally consistent hazard and risk guidelines must be embedded within planning systems, supported by validated adaptation guidance informed by monitoring and modelling [Priorities 16, 17, 18]. Embedding these guidelines into statutory planning codes and infrastructure design standards will be crucial to mainstream adaptation across jurisdictions. Achieving this will require establishing and maintaining a strong social licence, ensuring community trust, engagement, and buy-in to support effective data translation into decision-making and planning [Priorities 10, 13, 15].

## Essential prerequisites and enablers

Several foundational prerequisites must be addressed early to enable progress. Long-term funding must be secured to support continuity in observations, modelling, technology development, and adaptation planning. A national coordination mechanism is crucial for guiding research priorities, promoting collaboration, and preventing duplication. Standardised, interoperable data formats and shared governance agreements must enable integrated national datasets.

The CoastRI initiative, if funded, will be a key enabler, delivering observational, experimental, and modelling platforms tailored to Australia’s diverse coastal environments. Early investments must expand monitoring stations, autonomous sensors, remote sensing, and coastal mapping to underpin adaptive decision-making. Critically, however, this investment in infrastructure needs to be matched by funding to support the use of these data streams in research, producing the necessary knowledge and outputs, as well as ensuring that data are in formats that different end-users will readily adopt.

Innovation hubs and common-user testing facilities (potentially linked to CoastRI) should foster collaboration between researchers, industry, governments, and Aboriginal and Torres Strait Islander peoples. Examples may include physical-modelling laboratories (e.g., wave flumes and basins), field test sites, and regional coastal observatories. These hubs would support prototyping, trialling, and scaling of next-generation nature-based solutions, hybrid infrastructure, and resilient urban coastal systems.

New and emerging approaches and technologies should be leveraged to enhance Australia's coastal adaptation capabilities. AI and Machine Learning applications offer transformative potential to improve predictive modelling, optimise adaptation pathways, and accelerate data analysis. Digital Twins of coastal regions, integrating real-time monitoring, advanced modelling, and scenario simulations, can guide adaptive planning and infrastructure investment. The expanded use of autonomous monitoring platforms, including USVs, AUVs, and drones, combined with advances in remote sensing, eDNA ecosystem monitoring, and other emerging and developing monitoring technologies (e.g., use of AI in acoustic and visual monitoring techniques), will provide the critical data and innovative tools needed to support sustainable and resilient coastal management.

In parallel, clear policy direction from the Commonwealth Government is needed to accelerate adaptation outcomes. This effort includes enabling frameworks and incentives to guide climate adaptation planning, support the adoption of NbS, and drive the assessment and renewal of existing coastal infrastructure. Agencies such as Infrastructure Australia could play a critical role in embedding coastal resilience into national infrastructure priorities and investment strategies.

Through coordinated investment in infrastructure and innovation, Australia can become a global leader in sustainable and resilient coastal development.

## Enhancing national connectivity and communication

Strengthening national connectivity is vital to maximise the impact of coastal science and adaptation. A National Coastal Forum, potentially linked to existing conferences such as the National Coast to Coast Conference (run by the Australian Coastal Society), Australian Coastal Councils Conference, or Australasian Coasts and Ports Conference, should provide an annual platform to align research, practice, and policy. This forum would coordinate research agendas, foster cross-sector collaboration, and promote nationally consistent approaches to coastal management.

Coordinated research to achieve national consistency in coastal planning will need to focus initially on how to transform coastal governance to remove silos, be inclusive, and facilitate integrated management. A national coastal knowledge platform is also recommended to provide integrated access to observational datasets, predictive models, adaptation tools, and case studies, ensuring outputs are accessible to researchers, planners, Traditional Custodians, industry stakeholders, and communities.

Strengthening knowledge brokerage will ensure research is translated into operational decisions. Brokers embedded within programs and agencies would synthesise outputs, facilitate co-design of decision-support tools, and link science to planning guidelines, engineering standards, and investment strategies.

Thematic national working groups, supported by peak bodies such as Engineers Australia, PIANC Australia-New Zealand, the Australian Marine Science Association, the Australasian Coastal Restoration Network, and the Australian Coastal Society, should drive targeted innovation in coastal modelling standards, NbS, and data interoperability.

Ultimately, a national coastal science communication strategy should be implemented to enhance public awareness, secure political and financial support, and empower local communities to engage in long-term coastal stewardship. The strategy should target not only public awareness but also political and industry audiences to secure sustained commitment. This effort will require more than communication alone, including sustained funding and institutional support for non-government organisations and regional groups, such as Natural Resource Management (NRM) bodies, that facilitate community-led action on the ground. Using plain language communication, digital storytelling, and visualisation tools will ensure science-driven coastal resilience efforts are widely understood and championed by communities.

Through coordinated national action, combining investment, innovation, and knowledge sharing, Australia can build a more future-ready coast that supports economic prosperity, cultural heritage, ecological health, and community well-being.

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