BRIBIE ISLAND EROSION AND BREAKTHROUGH

Independent expert review pursuant to the Terms of Reference

PART 3 – LONG TERM RECOMENDATIONS

Options & Recommendations

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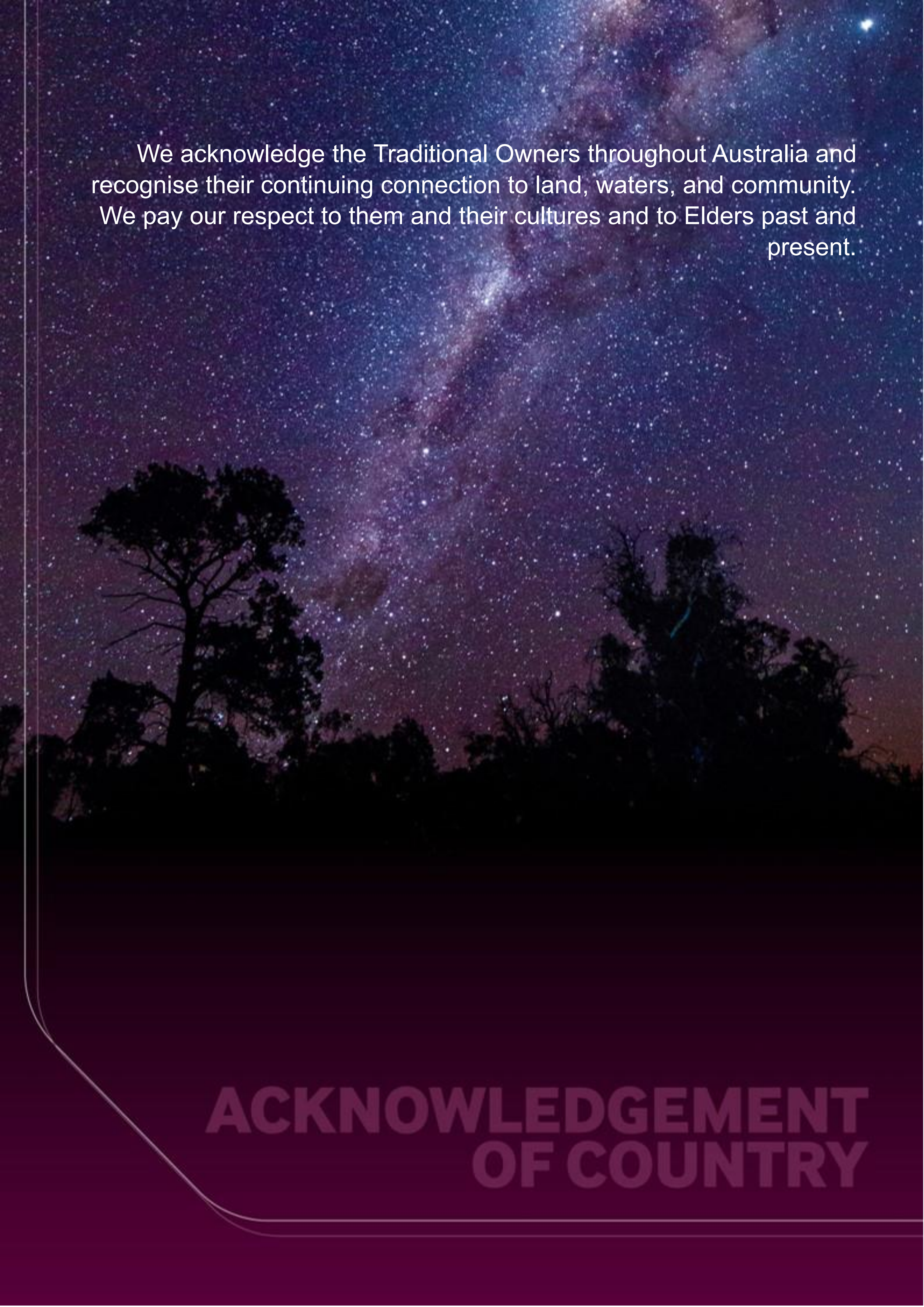
ACKNOWLEDGEMENT OF COUNTRY

We acknowledge the Traditional Owners throughout Australia and recognise their continuing connection to land, waters, and community. We pay our respect to them and their cultures and to Elders past and present.



PREFACE

This report, *Long-Term Recommendations*, forms the third instalment in a structured series of investigations aimed at addressing the evolving coastal challenges at Bribie Island and within the Pumicestone Passage system.

- **Part 1: Desktop Analysis** provided a detailed review of the historical scientific evidence and coastal processes that have shaped the region over time. It established a foundational understanding of the natural dynamics and historical shoreline evolution.
- **Part 2: Immediate Recommendations** identified key issues and developed urgent, short-term actions to mitigate the most pressing impacts resulting from the breakthrough events. It also laid the groundwork for future decision-making by piloting intervention techniques to gather insights critical for shaping longer-term strategies.
- **This Report: Long-Term Recommendations** now shifts the focus to proactive, forward-looking measures that aim to enhance the long-term resilience of the coastal system. It presents a suite of suggested actions, based on robust experience and proven methodologies, that could be taken to progressively stabilise, protect, and regenerate the area.

It is important to emphasise that this is not a design report. Rather, it proposes a framework of integrated solutions that can inform the next phases of planning, design, consultation, and approvals. The recommendations are grounded in practical expertise gained from similar projects in dynamic coastal environments and are aligned with the goals and values of the region which include environmental integrity, cultural respect, and functional sustainability.

We recognise that the regulatory, environmental, and governance frameworks involved are complex. Implementation will require careful coordination across agencies and communities, as well as clear pathways for zoning, permitting, and environmental management. While this report begins to explore those issues, they will be further reviewed in the following report.

Ultimately, the intent of this report is to transition the focus from reactive to proactive coastal management, offering practical, actionable recommendations. Shifting the idea of Bribie Island solely as a marine environmental asset to a key piece of the coastal management framework, worthy of strategic, long-term investment and adaptive management.

EXECUTIVE SUMMARY

This report presents a strategic recommendations framework to guide long-term coastal resilience planning and intervention for Bribie Island and the broader Pumicestone Passage region, following the significant geomorphic changes triggered by the 2022 breakthrough and the more recent post-Tropical Cyclone Alfred developments.

The aim of this report is not to provide finalised design solutions, but rather to propose a logical, goal-oriented set of recommendations that can be used to inform detailed design, consultation, and policy development. The report builds on insights from previous studies and urgent intervention assessments and establishes a forward-looking approach aligned with environmental values, coastal engineering best practices, and adaptive management principles.

This phase of work responds directly to the Terms of Reference for long-term solutions, specifically, to reduce risks to mainland and island infrastructure, restore environmental and hydrodynamic function within the Passage, and support navigation, ecological health, and coastal resilience. The overarching strategy centres on stabilising the system, mitigating further damage, and proactively guiding recovery and adaptation.

Context and Logic

The analysis recognises three key periods relative to the island's transformation:

1. **Pre-Breakthrough** - an already dynamic and eroding island system, with long-standing concerns around sea-level rise, sediment transport, navigation, and foreshore protection.
2. **Post-Breakthrough #1 (2022)** - marked by increased tidal range, wave energy, shoreline vulnerability, and altered hydrodynamics.
3. **Post-Tropical Cyclone Alfred Breakthroughs** - conditions now resemble open ocean influence, placing heightened pressure on infrastructure, ecosystems, and community assets.

With urgent works currently underway to transition the system from the third stage (Post-Tropical Cyclone Alfred) back toward the second stage (Post-Breakthrough #1), it is critical to move forward with the next phases of recommended actions. These will help further stabilise and improve conditions within the Passage. It must be acknowledged, however, that even the second stage was marked by significant impacts, including elevated tidal ranges and increased wave exposure. As such, the broader goal is not only to restore the system to its pre-breakthrough state, but to enhance it in ways that build resilience against future coastal pressures.

Here are the four key recommendations:

Recommendation 1 - Reinstate the Island / Close Breakthrough #1

Reinstating the breached section of Bribie Island is proposed as a critical early intervention. This involves a large-scale dredging and nourishment campaign, drawing material from identified sources (e.g., the filled Caloundra Bar,internal shoals and other sources), and restoring a target dune width and elevation (nominally 90m width and +5m AHD crest). Temporary measures, such as sand-filled geotextile containers, may be deployed to stabilise the island while vegetation re-establishes.

This approach is not a "return to the past," but rather a strategic reset to improve tidal conditions, reduce wave energy entering the Passage, and buy time for more permanent and robust solutions to be implemented. Reinstatement is the foundation upon which further enhancements and management will rely on.

Recommendation 2 - Enhance the Island and Pumicestone Passage for Improved Resilience

This recommendation outlines a package of ten integrated measures, collectively aimed at improving resilience, biodiversity, water quality, and sediment stability. These include multipurpose reefs, artificial headlands, buried walls, ecological restoration (e.g., oyster and mangrove rehabilitation), channel realignment, and dune buffers.

While each measure offers unique value, their combined effect provides layered defence and system-wide improvement. The full package represents a future vision for the area, but it is understood that these elements may be implemented in stages, guided by monitoring, feedback, and evolving priorities.

Recommendation 3 - Develop and Implement Long-Term Management Pathways

To ensure that reinstatement and enhancement efforts are sustained, a shift in mindset is needed - from viewing Bribie Island purely as a natural feature, to treating it as a managed coastal resilience asset. This involves defining long-term ownership, responsibility, and funding frameworks, and establishing protocols for adaptive maintenance (e.g., sediment nourishment, vegetation management, emergency response).

It also proposes the development of pre-approved operational zones, that would streamline maintenance works and reduce approval burdens in areas where proactive sediment management is required over the long term.

Recommendation 4 - Re-assess Environmental Zoning and Permitting

Implementing the above recommendations at scale will require significant reform and coordination within the regulatory framework. Much of the project area lies within marine park, national park, and recreation management zones, with varied levels of restriction on activities such as dredging, nourishment, and structural works.

This recommendation calls for a thorough review of zoning configurations and permitting pathways, with a focus on defining new approval categories, special management areas, or legislative changes that can enable necessary works while respecting environmental values.

Importantly, the urgent works currently being undertaken have been designed as a pilot approach, delivering immediate risk reduction while collecting data and insights to inform the feasibility, impacts, and permitting of more ambitious long-term strategies. This feedback loop will be essential to adaptive governance moving forward.

Final Takeaways

This report represents a practical, experience-driven pathway toward resilience. It acknowledges that no single solution will satisfy all stakeholders or operate without risk, but it presents a coherent, staged plan that aligns with observed system needs and community priorities.

The recommendations are high-level and conceptual in nature. They do not constitute final designs but provide a strategic basis for progressing to the next phase of coastal planning, including detailed design, environmental assessment, stakeholder consultation, and agency coordination.

Through ongoing implementation, monitoring, and adaptation, these recommendations aim to set a new standard for proactive coastal management in one of Australia’s most dynamic natural systems.

1 INTRODUCTION

This report represents the next phase in the ongoing response to the dynamic changes affecting Bribie Island and Pumicestone Passage. Building on the findings and recommendations of the previous report, *Urgent Solutions*, this stage focuses on identifying and assessing potential long-term solutions aimed at reducing future risk, improving coastal system resilience, and guiding strategic investment and management decisions.

1.1 Terms of Reference

The scope of this report is guided by the following item from the Terms of Reference:

To develop long-term recommendations that reduce the risk of further damage to the mainland foreshore, infrastructure, and waterways; preserve Bribie Island; and maintain safe navigation through Pumicestone Passage.

These long-term recommendations are intended to support decision-makers, asset managers, and communities in adapting to a rapidly evolving coastal environment, while also aligning with broader regional frameworks, such as the Sunshine Coast Council's Coastal Hazard Adaptation Strategy (CHAS) and its associated planning tools, including the Coastal Hazard Adaption Precinct Plan.

1.2 Understanding the Temporal Context

To fully understand the coastal changes and how to respond, it is essential to consider the timeline relative to the Bribie Island breakthroughs. We distinguish three key stages:

- **Pre-Breakthrough #1 (Before 2022)**
  Even before the initial breach, Bribie Island exhibited signs of instability. Parts of the island were in an erosive state, while others were accreting. There were long-standing community concerns about navigation challenges due to shifting sandbars and declining water quality (noted since at least the 1990s). Sea level rise was already a topical issue, with low-lying areas within the Passage seen as vulnerable under future projections.
- **Post-Breakthrough #1 (2022 - early 2025)**
  The first breakthrough significantly altered tidal exchange and hydrodynamic patterns in the Passage. Tidal ranges increased, leading to greater flushing and exposure, but also increased wave energy reaching Golden Beach and other vulnerable locations. These changes made clear that the existing systems were not well adapted to the new conditions.
- **Post-Tropical Cyclone Alfred Breakthroughs (March 2025 - present)**
  Cyclone Alfred triggered Breakthroughs #2 and #3, intensifying the already fragile coastal dynamics. Tidal levels in the Passage now mirror open ocean conditions, and wave impacts have increased again, placing further pressure on mainland assets and ecosystems. These latest changes bring an urgency to develop coordinated, longer-term strategies.

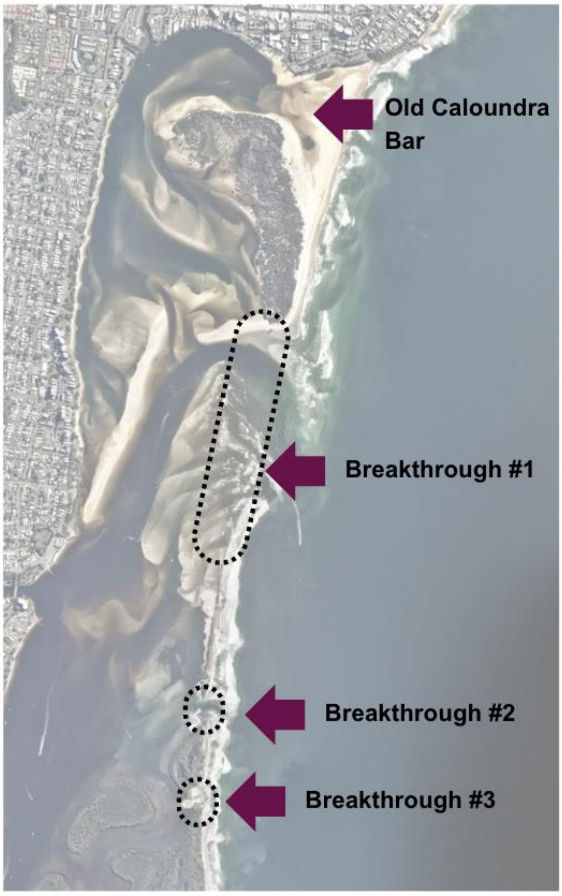


Figure 1: Location of Breakthroughs Relative the Old Caloundra Bar

1.3 Clarifying the Focus of this Report

This report centres specifically on the implications and potential responses to the Bribie Island breakthroughs. While many broader coastal matters are relevant, such as foreshore amenity, water quality, or regional coastal development, our analysis remains focused on the cascading effects of the breakthroughs and the viable options for mitigating those impacts. Not every coastal concern in the region falls within the remit of this review.

1.4 Revisiting Our Strategic Goals

As set out in the *Urgent Solutions* report, our primary goal was to create time and space for communities and authorities to plan, while implementing practical actions that reduce risk in the short term. These goals, developed through our internal assessment and consultation with technical working groups, are not exhaustive or universally accepted, but provide a functional foundation for this phase of the work.

Our objectives remain to:

- **Stabilise and manage tidal regimes**, ideally restoring conditions closer to those experienced before the initial breakthrough, while also building resilience to rising sea levels.
- **Ensure safe and functional use of the waterways**, particularly for recreation, navigation, and emergency response.
- **Increase the resilience of the Passage environment**, including ecological health, water quality, and biodiversity.
- **Reinforce the resilience of the island coastline**, reducing erosion and protecting both public and private assets.

Bribie Island, while valued for its environmental and cultural significance as a National Park, has also long functioned as a natural coastal barrier, playing a crucial role in regulating tidal flows and protecting inland communities and habitats. The feasibility of reinstating part or all of this protective function will be a key focus of the options explored.

1.5 On the Nature of "Long-Term Solutions"

It is essential to acknowledge that long-term does not mean permanent, nor does it mean free from uncertainty. The Bribie Island-Pumicestone Passage system is highly dynamic, subject to both local and global influences, including sea level rise, storm cycles, sediment budgets, and broader climatic shifts.

While some may suggest that the ultimate long-term solution is to reverse or slow sea level rise itself, this is a global challenge far beyond the scope of this project. Instead, our use of the term "long-term solutions" refers to practical, physical interventions, such as managed realignment, sediment placement, structural protection, or ecological engineering, that can help stabilise conditions for a meaningful duration (timeframes will be further discussed in this report), assuming effective maintenance and adaptive management.

1.6 Management, Maintenance, and Limitations

Any viable long-term approach must consider ongoing management and maintenance. Even the most technically sound or ecologically sensitive interventions will require regular assessment and adaptive response. Simply installing a solution will not suffice unless it is paired with a commitment to coordinated governance and responsive management.

The success of future actions will depend heavily on improved inter-agency coordination, flexible regulatory frameworks, and sustained community involvement.

2 BREAKTHROUGH LOCATION - KEEP IT, OR REVERT?

The emergence of the first breakthrough on northern Bribie Island in 2022 marked a significant shift in the region's coastal dynamics. This initial breach introduced a new tidal channel that altered water levels, wave energy distribution, sediment transport patterns, and the overall ecosystem within the Pumicestone Passage. While these effects were notable after the first breakthrough, they escalated substantially following Tropical Cyclone Alfred in 2025, which triggered two additional breaches, now referred to as Breakthrough #2 and Breakthrough #3.

2.1 Immediate Response - Context and Next Steps

Our previous recommendations focused on the closure of Breakthroughs #2 and #3, to restore the area to conditions like those seen post-Breakthrough #1 but prior to Cyclone Alfred. The aim was to lower tidal energy and wave pressure within the system and buy time for more extensive planning.

Now, with Breakthroughs #2 and #3 targeted for closure, two critical long-term pathways remain for consideration:

- **Retain Breakthrough #1** as the primary entrance and adapt systems around it; or
- **Close Breakthrough #1** and **re-establish the historical Caloundra Bar entrance**, reinstating Bribie Island as a continuous barrier.

Each pathway carries distinct implications for engineering feasibility, environmental outcomes, navigation, and coastal community safety.

2.2 Retaining Breakthrough #1 - Adapting Around the New Channel

It's important to note that, unlike the previous Caloundra entrance, which generally featured a fixed northern boundary along Caloundra and a more dynamic southern edge formed by Bribie Island, the current breakthrough has flexible and shifting boundaries on both sides. This dual-sided instability significantly increases variability in bar location, behaviour, and associated risks.

To maintain Breakthrough #1 in its current form, several challenges must be addressed. Notably, the foreshore behind Breakthrough #1 is already part of the Sunshine Coast Council's Coastal Hazard Adaptation Precinct Planning (CHAPP), with early-stage proposals including raised seawalls and engineered foreshore protections. However, these plans remain under development and are not ready for immediate implementation.

Key Considerations for Breakthrough #1

- Remaining island segments south of Breakthrough #1 are narrow and retreating, requiring substantial sand replenishment, this may get 'washed' into the breakthrough causing siltation.
- Increased wave energy and foreshore vulnerability. A wave break island or structure between Breakthrough #1 and Golden Beach would be needed, similar to the Gold Coast Seaway system, to absorb wave energy and reduce shoreline impacts.
    - These works would demand large sand volumes and hard coastal structures (e.g., training walls) to stabilise the entrance and protect the community.
- Because both sides of the breakthrough are dynamic, the entrance channel is prone to persistent infilling, resulting in unreliable navigation and a potential need for frequent, large-scale maintenance dredging, likely exceeding current approval limits.

2.2.1 Implementation Considerations

This approach would require complex modelling, extensive environmental assessment, and lengthy approval processes, potentially taking years before work could begin. In the meantime, the community and environment remain exposed to ongoing risks and degradation.

2.3 Reinstating Bribie Island and Reopening the Old Caloundra Bar

Alternatively, reinstating the island at Breakthrough #1 and reopening the Old Caloundra Bar could offer a more practical and immediate pathway to risk reduction.

This option presents the following benefits:

- Lower tidal levels and reduced wave energy within the Pumicestone Passage.
- Improved navigation and system flushing, with greater water quality and recreational access.
- Avoidance of complex engineering requirements to start, as this approach is based on recreating known, previous conditions.
- Faster implementation due to fewer unknowns and less need for extensive design or new approval pathways.
- Provides an interim coastal configuration that stabilises the region while long-term strategies are developed.

This strategy presents an opportunity to meet short-term and long-term goals, reducing strain on vulnerable systems, and buying time for broader consultation, design, and policy work.

2.4 Breakthrough/Bar Location Options

The following is a high-level pros and cons summary for the two options discussed above.

Table 1: Breakthrough/Bar Location Option Summary

Option	Description	Pros	Cons
Retain Breakthrough #1	Adapt to the current entrance location	• Leverages current conditions; • may align with future CHAPP infrastructure upgrades	• Does not significantly reduce tidal levels or wave energy; • introduces high maintenance dredging needs; • complex engineering and approvals required; • may not meet water quality or navigational goals
Reinstate Island & Reopen Old Caloundra Bar	Close Breakthrough #1 and restore former entrance	• Reduces tidal inflow and wave impact; restores more stable hydrodynamics; • known system response; supports navigability and ecological health	• Requires significant sand volumes; • interim measure requiring ongoing management

2.5 Recommendation - Close Breakthrough #1 and Reinstate the Old Caloundra Bar

While adapting to Breakthrough #1 may appear to offer continuity and avoid short-term disruption, it does not necessarily align with the broader goals of this project:

- It fails to reduce tidal levels or moderate wave exposure to the extent required to protect mainland infrastructure and public spaces.
- It risks escalating maintenance needs, particularly for dredging and sediment management.
- It introduces the need for structural components and approval hurdles that will delay meaningful impact.

By contrast, reinstating the island and reopening the historical entrance offers a pragmatic and lower-risk option. It is more consistent with the objectives to:

- Stabilise tidal regimes and wave conditions,
- Improve navigation and water quality,
- Protect critical coastal assets,
- And buy time for the development of fully integrated, long-term solutions.

In this context, restoring the system closer to its pre-breakthrough condition is not merely a return to the past, but a strategic step toward a more resilient and manageable future.

3 REINSTATEMENT - WHAT DOES THAT REALLY MEAN?

The idea of "reinstating" Bribie Island may sound simple: return the island to its former condition and reverse the impacts of recent breakthroughs. However, in a coastal system as dynamic, regulated, and ecologically sensitive as Pumicestone Passage, the reality is far more complex.

3.1 Reinstatement is a Matter of Time and Definition

Bribie Island has never been static. Its form, function, and stability have changed constantly in response to oceanic conditions, tidal regimes, and human influence. Therefore, reinstatement requires identifying a target state in time. Are we restoring the island to how it looked in 2020? 2010? 1980? Each period carried distinct morphological and ecological characteristics, and importantly, each came with vulnerabilities that need to be acknowledged.

For instance, even before the 2022 breakthrough, certain areas of the island were in an erosive state, while others were accreting. Sea level rise, storm activity, and sediment imbalances were already generating concern across the community. In this context, reinstatement is not a return to perfection, it's a pragmatic attempt to recreate a more stable baseline condition.

3.2 It's Not Just About Sand

When we talk about reinstating Bribie Island, we're not simply referring to sand placement. While sediment can be rapidly repositioned to re-form dune structures, this alone does not restore the island's function. Vegetation is critical, it stabilises dunes, reduces wind and wave erosion, and provides ecological value. However, vegetation takes years, even decades, to mature and re-establish its full stabilising influence.

This means that any reinstatement strategy will require interim stabilisation measures such as dune fencing, sacrificial buffers, or engineered structures to reduce vulnerability while natural systems recover. Without such measures, reinstated sand masses may quickly erode under storm pressure or high tide events before vegetation has a chance to anchor the system.

3.3 The Reinstatement Spectrum: Three Approaches

In evaluating reinstatement as a potential long-term solution, three conceptual pathways emerge. Each approach reflects a different level of commitment, intervention, and risk appetite.

3.3.1 Reinstatement with No Further Intervention

This option involves rebuilding the island - likely to a previous configuration, but without committing to any ongoing management or maintenance. Once reinstated, the system is left to evolve naturally, subject to the same forces that caused the original breach.

Purpose: Provide short-term relief from current conditions by restoring wave and tidal buffers, improving flushing and navigation, and buying time for further strategy development.

Implications: Based on historical erosion and storm patterns, such a reinstated island would likely breach again, possibly at a quicker rate than it had done previously, depending on future conditions. This approach would function as a tactical delay rather than a durable fix.

3.3.2 Reinstatement with Active Management

In this model, the island is reinstated, but unlike Option 1, it is actively managed over time. This includes but is not limited to regular beach nourishment, vegetation reinforcement and ongoing monitoring.

Key Acknowledgement: Even with active maintenance, the island remains vulnerable. Major storm events or cumulative erosion could still lead to overwash or breakthrough. Management can extend the island's lifespan and buffer critical assets but cannot fully eliminate risk.

Benefits: Adaptive and responsive. This approach provides flexibility and the opportunity to adjust strategies over time.

Challenges: Requires sustained funding, institutional coordination, and a dedicated maintenance program to be effective.

3.3.3 Reinstatement with Enhancement and Active Management

This approach takes the restoration concept further, combining reinstatement with engineered improvements to strengthen long-term resilience. This may include building dunes higher than historical crests (e.g. +5m AHD), integrating buried geotextile cores for storm resistance, or even shaping the island's profile for optimal hydrodynamic performance.

Objective: Not just to restore, but to future-proof. This model acknowledges that historical conditions may not be suitable in the face of climate change and increased storm intensity.

Benefits: Provides the most robust long-term solution with the potential to reduce future intervention needs.

Drawbacks: Higher capital cost, longer design timelines, and more complex approval pathways. May also be less "natural" in appearance or impact, requiring more careful stakeholder communication.

3.4 Pros and Cons Comparison

Table 2: Pros and Cons of Reinstatement Approaches

Reinstatement Strategy	Pros	Cons
1. Reinstatement Only	• Rapid implementation • Lower upfront costs • Easier approvals	• Short-term benefit only • Likely to breach again • No long-term resilience
2. Reinstatement + Active Management	• Adaptive to conditions • Supports ecological recovery • Moderate cost and complexity	• Still vulnerable to extreme events • Requires sustained management and coordination
3. Reinstatement + Enhancement + Active Management	• Best long-term durability • Aligns with resilience goals • May reduce future costs	• Higher capital costs • More complex approvals and design • May alter natural character

3.5 Recommendation - Reinstatement with Enhancement and Active Management for Increased Coastal Resilience

Reinstatement, while often perceived as a simple act of "putting the island back," is in reality a nuanced and complex undertaking. It encompasses not just sediment placement, but also the re-establishment of vegetation, the consideration of dynamic coastal processes, and a long-term commitment to maintenance and adaptation.

Of the three conceptual pathways explored:

- **Option 1** (Reinstate Only) offers short-term relief but leaves the system vulnerable to near-term re-breach.
- **Option 2** (Reinstate with Active Management) provides a more stable interim state but still relies on ongoing intervention without addressing the underlying vulnerabilities.
- **Option 3** (Reinstate with Enhancement and Active Management) goes further, recognising that reinstating Bribie Island as it once was, is not enough to meet future challenges. It proposes a proactive, resilience-focused approach that combines natural processes with targeted structural enhancements to better withstand future storm impacts, sea-level rise, and coastal erosion.

Based on the goals set out in this program - stabilising tidal regimes, improving safety and access, strengthening ecological resilience, and protecting mainland assets - Option 3 is our recommended pathway.

This enhanced reinstatement strategy not only addresses today's immediate pressures but also sets the foundation for long-term stability and sustainability. It reflects the need to act decisively now, while acknowledging the importance of building smarter, more robust systems that can evolve with a changing climate and coastline.

As future chapters in this report will explore, implementing Option 3 will require coordination, consultation, and careful design, but it offers the most strategic and forward-looking response to one of the region's most significant coastal challenges.

4 WHAT COULD BE DONE?

With urgent works underway, the question shifts from *whether* to act to *how* best to act. The breakthrough at Bribie Island and its acceleration following Tropical Cyclone Alfred has highlighted the risks of passive management in a dynamic and sensitive system. With momentum now in place to implement immediate interventions, the opportunity arises to shape a more strategic, future-focused response.

At International Coastal Management (ICM), our approach to coastal resilience is based on more than four decades of experience, both in Australia and globally. We apply a proven Integrated Coastal Resilience Framework that considers the coastal system as an interconnected whole, balancing ecological values, physical processes, and community needs.

4.1 The Three Pillars of Coastal Resilience

Effective long-term solutions require simultaneous consideration of the top of the beach, bottom of the beach, and sediment supply. While the Bribie Island system is highly complex and will require further detailed study, modelling, and design the underlying framework remains consistent and adaptable to evolving site conditions.

4.1.1 Top of the Beach - Dunes and Foreshore

This zone includes the dunes and dry sand areas above the high-water mark. It provides critical storm buffer capacity and habitat, and its integrity relies heavily on vegetation and sand stability.

Key approaches include:

- Nourishing the upper beaches and dunes
- Dune reshaping/management and native vegetation planting
- Structures to support or hold the top of beach (seawalls, headlands, groynes)

4.1.2 Bottom of the Beach - Intertidal and Subtidal Zone

These submerged areas are key to dissipating wave energy and controlling sediment transport. Since the breakthrough, these dynamics have shifted significantly.

Potential strategies:

- Submerged breakwaters or artificial reefs
- Seagrass or oyster reef restoration
- Nearshore nourishment (placing sand in subtidal zone) to build up sand bars

4.1.3 Sediment Supply - Movement and Balance

Sediment is the foundation of coastal form and function. The reconfiguration of Bribie Island has altered sediment pathways, leading to accretion in some areas and erosion in others.

Options may include:

- Strategic dredging of sand from within the Passage or from offshore sources
- Sediment budget analysis to identify deficits
- Sand backpassing or bypassing systems to restore natural movement

4.2 Beyond the Framework - A Multifunctional Toolbox

No single solution will be suitable for every challenge in this complex environment. Solutions must be context-specific, and may fall into one or more of the following categories:

- **Hard Engineering:** Seawalls, groynes, training walls, breakwaters

- **Soft Engineering:** Nourishment, dune planting, access control
- **Nature-Based Solutions:** Living shorelines, vegetated dunes, habitat restoration

The most effective responses will likely be **hybrid or multifunctional solutions**, designed to deliver ecological, protective, and amenity benefits simultaneously.

4.2.1 Material Considerations

The following table outlines several key materials commonly considered in coastal protection solutions; while not exhaustive, it highlights that most holistic, effective strategies will typically require a combination of materials tailored to site-specific conditions and performance objectives. Some key pros and cons of coastal structure materials are highlighted below.

Table 3: Key Pros and Cons of Materials

Material Type	Pros	Cons
Rock (e.g. armour stone)	• Long design life (50+ years) • High wave energy resistance • Readily accepted in approvals	• High cost for transport and placement • Requires significant storage space and logistics for works on remote island
Geotextile Sand Containers	• Flexible and adaptable • Lower supply cost • Useful for emergency or temporary works	• Less durable under high energy conditions • Susceptible to UV and vandalism • Maintenance required over time
Concrete (e.g. precast units, blocks)	• Customisable shapes for specific applications • Durable if marine-grade • Can be combined with habitat features	• Can degrade in marine environments without special mixes • Nonflexible, means subjected to cracking in dynamic environment • Visually stark unless well integrated
Wood (e.g. groynes, boardwalks)	• Natural aesthetic • Cost-effective if locally available in some regions • Easier permitting for small-scale uses	• Shorter lifespan due to rot, marine borers, and UV • Requires regular inspection and replacement • Limited load-bearing capacity
Hybrid Composites (e.g. fibre-reinforced polymers)	• High strength-to-weight ratio • Resistant to corrosion and marine degradation • Long lifespan with low maintenance	• Can be expensive and less widely available • Less field-tested for large-scale coastal structures • May require specialised installation

Our objective here is not to prescribe fixed designs but to open a discussion on potential solution pathways. Every proposed measure will need to be rigorously assessed for cost, feasibility, approvals, and community alignment.

4.3 Project Case Studies to Guide Long-Term Solutions

This section highlights selected ICM-led projects that are particularly relevant to the long-term goals for Bribie Island. While we acknowledge that other organisations have delivered valuable work in the region, time constraints have limited our ability to review all existing initiatives in detail. As such, we have drawn primarily on our own project portfolio, where we have direct insight into the design rationale, implementation challenges, and outcomes. These examples offer practical reference points for how similar strategies could be adapted to meet the objectives outlined in this report and the Terms of Reference.

4.3.1 ‘Soft’ Seawalls

Bribie Island Emergency SFGC Protection Works

Severe storm erosion at Boyd Street, Woorim, threatened a WWII bunker and nearby infrastructure. Emergency protection works using sand-filled geotextile containers (SFGCs) were rapidly designed and installed by ICM to stabilise the area while preserving heritage access.

Relevance to Bribie Island This project demonstrates how flexible, low-impact solutions like SFGCs can provide fast and effective shoreline protection, relevant for Bribie Island where urgent yet sensitive interventions may be required.

Figure 1: Left: Aerial Image of WW2 bunker protection (Google Earth, 2025), Middle: Cross-section image of WW2 bunker protection carried out by ICM (ICM, 2025), Right: Woorim Dune and Outfall Protection (ICM, 2025)

4.3.2 ‘Harder’ Seawalls

The Gold Coast A-Line Terminal Seawall

Established in the 1970s, the A-Line defines a consistent alignment for seawalls protecting coastal assets on the Gold Coast. ICM has been involved in the long-term design and upgrades of these structures, including flexible, resilient seawall systems designed to accommodate sea-level rise and future storm impacts.

Relevance to Bribie Island: The A-Line concept illustrates how terminal seawalls can serve as a last line of defence. While Bribie Island may not require structures as substantial, the principle of a buried or concealed seawall for future protection is directly applicable to its long-term resilience planning.

Source: Gold Coast City Council

Figure 2: Left: Cross-section of designed seawall A-line (CoGC, 2025), Middle: Construction of Seawall and post construction (ICM,2025), Right: Aerial image of Gold Coast, with A-line shown along main beach (CoGC, 2025)

Seabees Seawall - Bowen Golf Club

To address cyclone-driven erosion, ICM designed a modular seawall for the Bowen Golf Club using surplus Seabee units from Abbot Point. The solution included tailored structural elements and was constructed in 2017. Natural vegetation has since regrown over the wall, preserving the site's ecological and visual values.

Relevance to Bribie Island: This project demonstrates how durable coastal protection can be achieved using adaptable, low-visibility solutions. A similar buried or vegetated "terminal" seawall could provide discreet yet effective defence for Bribie Island, aligning with its natural character and long-term resilience needs.

Figure 3: Left: During construction utilising Seabee units, Middle: After construction, Right: Dune development post works (ICM, 2017)

4.3.3 Onshore and Nearshore Nourishment

Gold Coast Nearshore Nourishment

First trialled in the 1980s with key contributions from ICM founder Angus Jackson, nearshore nourishment involves placing sand just offshore to allow natural processes to rebuild beaches. This technique remains a cornerstone of the Gold Coast's coastal strategy and was recently applied following Cyclone Alfred.

Relevance to Bribie Island: While current zoning restricts its use near the Bribie breakthroughs, this proven method demonstrates how large-scale, nature-based nourishment can enhance coastal resilience. It presents a valuable long-term maintenance strategy for Bribie Island if regulatory pathways are refined.

Figure 4: Rainbowing into the Nearshore of Main beach, Gold Coast - post-cyclone Alfred 2025 (ICM,2025)

Woorim Beach Nourishment

In 2011, ICM conducted a comprehensive assessment of nourishment options for Woorim Beach, including historical review, sand volume modelling, and evaluation of sand recycling from Skirmish Point. The study addressed sediment quality, logistics, and cost comparisons for implementation. Ultimately, Nearshore Nourishment design was adopted and implemented.

Relevance to Bribie Island: This project highlights how targeted nourishment and sand recycling can support long-term erosion management. Similar strategies, particularly nearshore nourishment, could be integrated into Bribie Island's maintenance plans to enhance resilience and reduce future risk.

Figure 5: Photo of "Brisbane" rainbowing nourishment into the nearshore zone of Woorim beach

4.3.4 'Soft' Groynes to stabilise Entrance

Maroochydore Soft Groynes and Seawall

Between 2001–2003, ICM designed and delivered four groynes and a geotextile container seawall at Maroochydore to address severe erosion near the Cotton Tree Holiday Park and improve entrance stability for the Maroochy River. This project introduced custom 2.5 m³ sand-filled geotextile containers and prioritised community input, leading to the long-term retention of soft structures for beach usability. At the end of sand filled containers lifespan, the groynes were replaced rather than shifting to rock, under direction of public opinion..

Relevance to Bribie Island: The use of adaptable, soft engineering solutions offers a model for Bribie Island, particularly for managing entrance stability and reducing bar infill. The project also highlights how community-supported, flexible coastal infrastructure can align with resilience and amenity goals.

Figure 6: Left: Aerial image of Bribie entrance (Google Earth, 2025) Middle: Filling of Geobags (ICM, 2003), Right: Aerial image of Cotton Tree Holiday Park, Soft Groyne (ICM, 2025).

Elliot Heads 'Soft' River Entrance Training Wall

In 2006, ICM designed a 'soft' training wall for the Elliott Heads River Entrance using sand-filled geotextile containers, building on the success of similar works at Maroochydore. The structure helped to stabilised the river entrance while preserving a wide sand buffer and allowing natural coastal processes to continue.

Relevance to Bribie Island: This project demonstrates how low-impact, adaptable structures can effectively stabilise tidal entrances without heavily altering the environment. A similar approach could support Bribie Island's entrance management and navigation goals while aligning with ecological and visual sensitivity.

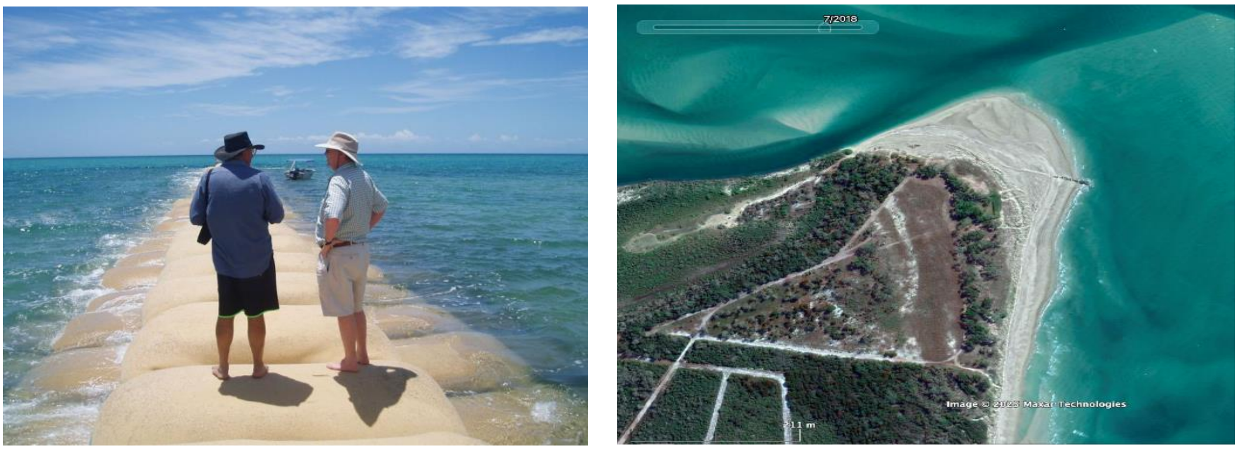


Figure 7: **Left: ICM performing post-construction inspection at Elliot heads (ICM, 2006), Right: Aerial Image of Elliot Heads soft river entrance training wall (Google Earth, 2025)**

4.3.5 Soft Groynes to stabilise inner channels

Munna Point Soft Groynes

ICM developed a soft engineering solution at Munna Point for Noosa Shire Council, addressing shoreline erosion within a Queensland Heritage Site. The project involved seven low-profile groynes using sand-filled geotextile containers and a custom mattress to minimise scour, supported by targeted dredging and nourishment to restore beach usability.

Relevance to Bribie Island: This project illustrates how adaptable, low-impact solutions can stabilise vulnerable shorelines while preserving cultural, environmental, and recreational values. A similar pilot approach at Bribie Island could support resilience goals while maintaining the area's low-key, natural character.

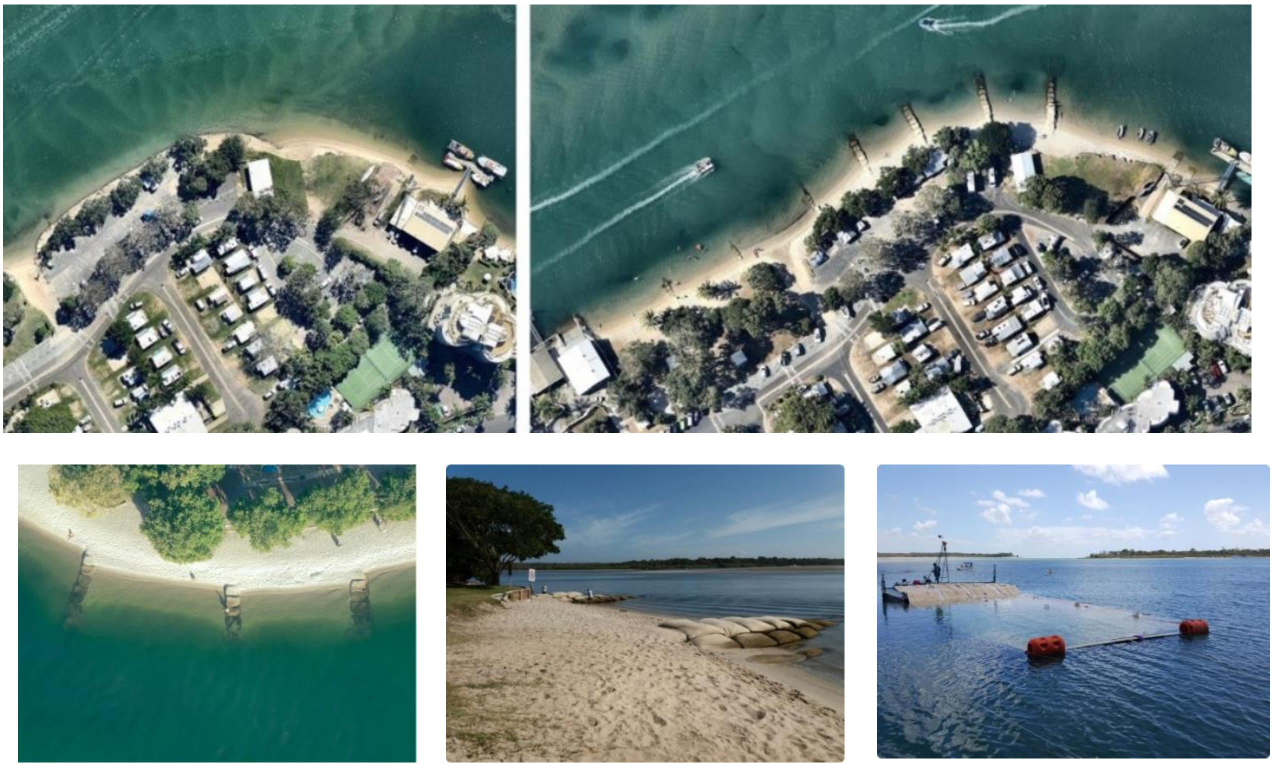


Figure 8: **Drone and land-based images of Munna Point, Noosa Heads, utilising geotextile containers as groyne heads to reduce scour risk, and retain sand (ICM, 2025).**

4.3.6 Closure / redirection of channel

Noosa River (Dog Beach) Erosion Protection Works

In response to severe shoreline retreat at Noosa River's Dog Beach, ICM developed and delivered an integrated erosion protection strategy for Sunshine Coast Regional Council. Works included a 160 m hybrid wall (sand-filled mega-containers and rock), training wall, submerged groyne, targeted dredging, and nourishment. In 2024, strategic sand bunds were also installed to further mitigate current-driven erosion.

Relevance to Bribie Island: This project highlights how soft and hybrid infrastructure, informed by detailed analysis and adaptive design, can effectively protect dynamic waterways. Similar strategies may be applicable to Bribie Island, particularly where sediment mobility and public amenity are key concerns.

Figure 9: Left: Aerial image of Noosa dog beach (Google Earth, 2024), Middle and Right: Drone images of sand being pumped from inner channel to create closure of nearshore channel (ICM, 2024)

4.3.7 Oyster Reefs

Noosa River Oyster Habitat Restoration Reefs

Queensland's first large-scale oyster reef restoration project, delivered by ICM for The Nature Conservancy, involved designing and constructing reefs across four sites within a developed estuary. Covering 2,300 m² of reef using rock and oyster shell, the project included habitat assessment, engineering design, impact approvals, and construction oversight.

Relevance to Bribie Island: This project demonstrates how nature-based reef structures can restore habitat and stabilise estuarine shorelines with minimal environmental impact. A similar approach could be applied along the sheltered side of Bribie Island to support ecological resilience and shoreline protection.

Figure 10: Left: Done image of new constructed Oyster reefs, Middle: Land based image of Oyster reefs, which help improve mangrove stabilisation and enhanced ecological impact, Right: Boat based image of Oyster reefs, indicating the view from canal users (ICM, 2024)

4.3.8 Coastal Dune Development

Gold Coast Coastal Dunes

Since the 1980s, ICM has led dune management on the Gold Coast, pioneering techniques like nourishment, fencing, and native vegetation planting. These efforts were formalised through enduring coastal policies and have continued through to present-day cyclone response and resilience planning.

Relevance to Bribie Island: This long-term, nature-based approach to dune stabilisation offers a model for Bribie Island's coastal enhancement. Incorporating dune rehabilitation into future works could provide critical erosion buffers while preserving the island's natural character and community values

Figure 11: Left and Middle: Urban Dunes in Main beach, Gold Coast pre cyclone Alfred, Right: Main Beach, Gold Coast post cyclone, showcasing the effectiveness and utilisation of coastal dune management (ICM, 2025)

4.3.9 Temporary Emergency Works

Surfers Paradise Hardstand Emergency Erosion Works

In response to Cyclone Alfred (2025), ICM supported the City of Gold Coast in mitigating scour risks along the Surfers Paradise Hardstand. Using storm erosion modelling and survey data, emergency geotextile works were implemented to protect infrastructure ahead of planned nourishment.

Relevance to Bribie Island: This project illustrates the value of scalable, rapid-response protection measures that can be adapted to short-term coastal threats. Similar emergency options could support Bribie Island during transitional phases between long-term interventions and active shoreline stabilisation.

4.3.10 Multipurpose Artificial Reef

Narrowneck Artificial Reef Renewal

Originally designed by ICM in 1999 as part of the Northern Gold Coast Beach Protection Strategy, the Narrowneck Reef was built using large geotextile containers to stabilise beaches, improve surf quality, and support marine habitat. ICM returned in 2017 to redesign and optimise the reef using advanced modelling and construction oversight.

Relevance to Bribie Island: This project exemplifies multifunctional coastal infrastructure, offering shoreline protection, ecological enhancement, and recreational benefits. A similar artificial reef could support Bribie Island's goals of resilience, low visual impact, and eco-tourism development.

Figure 12: Narrowneck Artificial Reef – aerial close-up, underwater, and aerial shoreline perspective

4.3.11 Training Walls & Sand Bypassing

Gold Coast Seaway

Constructed in the 1980s, the Gold Coast Seaway stabilised the Nerang River entrance with training walls and introduced a pioneering continuous sand bypassing system to preserve littoral drift. ICM's founder, Angus Jackson, played a leading role in its early development.

Relevance to Bribie Island: The Seaway showcases how large-scale engineered solutions can manage complex, dynamic systems. Its sand bypassing model offers insights for future long-term interventions in the Pumicestone Passage.

Figure 13: Left: Aerial Images taken of the Gold Coast Seaway pre trained groyne (ICM Archive), Middle, Post-Construction of Seaway (ICM, Archive), Right: Aerial Image of trained seaway (Google Earth, 2025)

Noosa Backpass / Bypass

Noosa Main Beach is influenced by the shifting Noosa River mouth, with sand naturally drifting south to north. In 2006, ICM supported the development and approvals of a sand backpass system, which moves around 30,000 m³ of sand annually southward to offset losses and maintain beach width.

Relevance to Bribie Island: The Noosa system demonstrates how strategic sand recycling can support long-term beach stability in dynamic estuarine environments. A similar backpassing or bypass approach may be viable for Bribie Island's nourishment and entrance management efforts.

Figure 14: **Aerial image of Noosa Backpass / Bypass System (small, dotted lines) (Jackson, 2023)**

4.3.12 Shore connected breakwaters

Holloways & Clifton Beach Erosion Management (Norther QLD)

ICM developed concept and detailed designs for shoreline protection at Holloways and Clifton Beaches in Cairns, where persistent erosion posed risks to parklands, roads, and public amenity. Through a comprehensive options assessment, including rock groynes, reefs, and geotextile structures, nearshore rock breakwaters were chosen as the most durable solution for the site's high wave exposure.

Relevance to Bribie Island: This project illustrates how the choice of materials, whether rock, geotextiles, or hybrids, must suit local conditions and resilience goals. While large breakwaters are often seen as rigid interventions, this example shows they can be designed at smaller, more agile scales to meet site-specific needs. Such adaptive design thinking may support a pilot approach for Bribie Island, where targeted, lower-impact structures could be trialled to enhance resilience without overcommitting to permanent, large-scale infrastructure.

Figure 15: **Land based images of Holloways & Clifton newly constructed breakwater, project has been considered largely successful (ICM 2025).**

4.4 High Level Options Review

The following pros and cons table presents high-level considerations for various coastal management solutions. It is important to note that not all solutions are created equal - design, location, construction quality, and maintenance all play a critical role in their success. For example, a well-designed and properly constructed seawall can offer effective protection, while a poorly executed one may fail and result in unintended erosion or damage to surrounding areas. These summaries are intended to support early-stage discussions.

Table 4: High level Options Review

Solution Type	Pros	Cons
Seawalls	• Can be effective against storm surge and sea level rise • Designs in progress under CHAPP • Long lifespan	• Can be high construction and maintenance costs • Can cause beach narrowing and reflect wave energy
Groynes & Artificial Headlands	• Groynes proven effectiveness at Golden Beach • Helps manage sediment transport • Can enhance dune stability	• May cause downdrift erosion if not properly designed • Visual and recreational impact
Breakwaters	• Can reduce wave energy offshore • Can protect vulnerable dune systems • Suitable for high-energy zones	• Requires complex modelling and assessment • Costly and may affect natural sediment dynamics
Artificial Reefs	• Supports marine biodiversity • May attenuate wave energy • Offers recreational benefits (diving, fishing)	• Less effective at controlling erosion alone • Needs careful placement to avoid unintended effects
Training Walls	• Can stabilise entrance channels • Helps control tidal and flow dynamics if actively managed	• Major environmental and hydrodynamic impacts • High capital cost and long lead time for approval
Dredging & Nourishment	• Already permitted (10,000m³/year) • 'Soft' solution with lower approval risk than harder solutions	• Temporary solution requiring repeat campaigns • Source location and transport logistics are critical
Dunes	• Natural coastal defence • Supports ecosystem services • Can be rapidly implemented with sand reserves	• Vulnerable to high-energy events without additional protection • Requires active maintenance and revegetation
Vegetation	• Stabilises dunes and sediment • Enhances biodiversity and visual amenity	• Susceptible to erosion from storms and overwash • Takes time to establish and needs ongoing management
Sand Pumping Systems	• Enables sediment redistribution without dredging • Could be part of a closed-cycle management system	• High setup cost and technical complexity • Requires financial feasibility assessment

5 LONG TERM RECOMMENDATIONS

5.1 Overview

Based on the analysis of historical context, current conditions, and projected coastal risks, this section outlines high-level recommendations to guide future planning and investment at Bribie Island and within Pumicestone Passage. These recommendations aim to transition from reactive measures to a proactive, resilient coastal management framework.

In summary, the long-term strategy consists of three core pillars:

- **Reinstate Bribie Island / Close Breakthrough #1** - Restore the physical barrier function of the island, aligned with pre-breakthrough conditions (a footprint from approximately 20 years ago), to mitigate tidal and wave exposure and improve system stability.
- **Enhance the Island and Pumicestone Passage for Improved Resilience** - Implement design improvements that strengthen the resilience of the reinstated landform and surrounding foreshore. This includes incorporating nature-based and hybrid engineering solutions to better withstand future conditions, including more frequent and severe storm events, ongoing sea-level rise, and changing sediment dynamics.
- **Develop and Implement Long-Term Management Pathways** - Establish a robust and adaptive management and maintenance strategy, with clearly defined responsibilities, monitoring protocols, and funding mechanisms. This should ensure that implemented works remain effective and responsive to future changes in the coastal system.
- **Re-assess Environmental Zoning and Permitting** - under the current frameworks, many of the recommendations above will not be possible, therefore re-assessing the boundaries and limitations of the existing framework is recommended, shifting the ability to proactively manage the area.

These long-term recommendations are intended to provide a framework for sustained coastal resilience, bridging the gap between immediate interventions and enduring protection of the environment, infrastructure, and communities that depend on the Passage.

5.2 Limitations of Recommendations

The recommendations outlined in this report propose large-scale interventions within a highly dynamic coastal environment, involving multiple stakeholders and intersecting interests. These recommendations are grounded in our practical experience addressing complex coastal challenges and are aligned with the goals established under the project's Terms of Reference.

We acknowledge that no single solution, or combination of solutions, will fully satisfy all stakeholders. Rather, these recommendations are intended to serve as a foundation for further discussion, detailed design, inter-agency coordination, and community engagement. While the options presented are based on approaches that have proven effective in similar contexts, they will require further technical analysis, environmental assessment, and feasibility testing to refine and implement appropriately.

5.3 Design Goals

The design objectives outlined in this report aim to guide future coastal management responses in a manner that is consistent with the unique character and values of Bribie Island, Pumicestone Passage, and the surrounding community. These objectives act as a foundational lens through which all proposed interventions, both structural and non-structural, should be evaluated and refined.

5.3.1 Local Values and Character

Bribie Island and the Pumicestone Passage are places of considerable cultural, environmental, and recreational significance. The local community places high value on:

- **Ecological Integrity** - Preserving the area's diverse habitats, including mangroves, seagrass beds, dune vegetation, and estuarine systems, which support rich biodiversity.

- **Cultural and Spiritual Connection** - Recognising and respecting the deep cultural ties First Nations people have to this Country and acknowledging the importance of meaningful inclusion and engagement.
- **Recreational Use** - Ensuring continued access for activities such as boating, fishing, kayaking, birdwatching, surfing, and beachgoing, all of which contribute to community well-being and the local economy.
- **Natural Aesthetics** - Maintaining the area's low-key, undeveloped character with minimal visual intrusion from large-scale built structures.

5.3.2 Design Goals

In alignment with these values, the following overarching goals have informed the development of all recommendations in this report:

- **Restore and Protect Natural Systems** - Re-establish geomorphic and ecological functions disrupted by the breakthroughs, including tidal exchange, sediment pathways, and vegetated dune systems.
- **Minimise Visual Impact** - Design interventions that integrate seamlessly with the natural landscape, avoiding overengineered or highly urbanised outcomes.
- **Support Resilient Recreation** - Maintain safe and sustainable access for navigation and leisure in ways that are adaptive to future change.
- **Enhance Long-Term Adaptability** - Develop solutions that can evolve in response to dynamic environmental conditions and ongoing community feedback, supported by monitoring and adaptive management.
- **Respect Cultural Heritage and Values** - Prioritise collaborative design approaches that embed cultural knowledge and aspirations into the planning and implementation process.

These design objectives will serve as an evaluative framework for assessing the suitability of future coastal resilience solutions, ensuring that the outcomes not only address technical challenges but reflect the place-based values of the region and its people.

5.3.3 An Eco-tourism/Research Hub

Eco-tourism is a growing industry, with increasing demand for low-impact, nature-based experiences. Reinstating Bribie Island and actively managing its mangrove and seagrass systems presents an opportunity to support initiatives such as guided mangrove kayak tours, walking tracks similar to those along the Golden Beach foreshore, environmental information centres, and even a research hub for monitoring and studying coastal ecosystems. These initiatives would not only promote education and cultural awareness but also create sustainable economic opportunities linked to the island's restored natural assets.

Figure 16: Right: Mangrove walking tracks on Golden Beach. Left: Kayak tours though mangroves.

5.4 Recommendation 1 - Reinstate Bribie Island / Close Breakthrough #1

In the previous report, *Figure 7* presented the mean annual coastal width of the Bribie Island section where Breakthrough #1 occurred, based on Digital Earth Australia (DEA) Coastline data. This dataset, beginning in

1987, illustrates that the shoreline has historically fluctuated between approximately 70 metres and 110 metres in width.

Notably, a consistent downward trend in coastal width began around 2003/2004, indicating a period of progressive narrowing leading up to the 2022 breakthrough event.

While this dataset does not capture shoreline changes prior to 1987, anecdotal and other photographic evidence suggests that the island has long been dynamic and responsive to shifting environmental conditions. As such, this data provides a useful, though high-level, starting point to inform a target reinstatement width. Based on this historical trend, a nominal target width of 90 metres has been adopted as a feasible benchmark for reinstatement in this location.

Although it might be tempting to propose reinstating the island to a more historical state, such as that seen in the 1950s or 1960s, substantial changes have occurred across the broader coastal and estuarine system since that time. Reverting to such a past state could create unintended disruption to the current-day balance of hydrodynamic and ecological processes.

Instead, selecting a reference period approximately 20 years ago offers a more realistic and practical target that balances the need for coastal protection with the goal of minimising system disruption. Importantly, this reinstatement is not viewed as a static solution; rather, it is intended as a foundation for ongoing active management, with flexibility to adapt as conditions and understanding evolve over time.

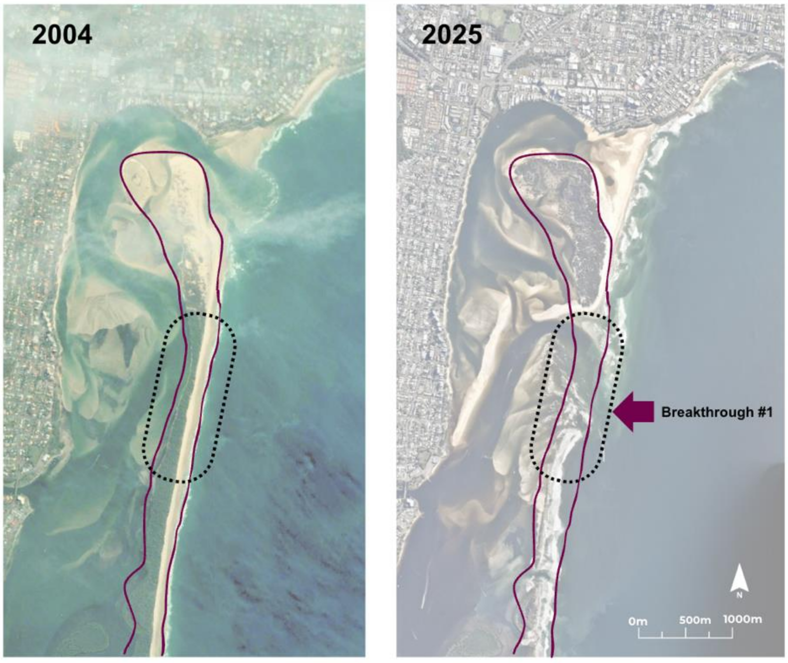


Figure 17: **Left: Google Earth Aerial image from 2004. Right: Nearmap Aerial Image from 2025 with the 2004 'island outline' overlayed.**

5.4.1 Design Considerations for the Reinstatement of Bribie Island

This recommendation proposes a large-scale dredging and nourishment campaign to reinstate Bribie Island in the vicinity of the original barrier position prior to Breakthrough #1. While this report does not provide detailed design specifications, preliminary analysis indicates that the volume of sand required for reinstatement is in the range of 2 to 2.5 million cubic metres (m^3). This involves reinstating the area at Breakthrough #1, along with additional sand placement to widen the shoreline to match its approximate 2004 condition, extending from the northern end of Breakthrough #1 to the southern end of Breakthrough #3.

5.4.1.1 Reinstatement Width and Height

Target Width: Based on DEA Coastline data, a target average width of **90 metres** is proposed, which reflects a mid-range value observed before the significant erosive trend post-2003. This balances feasibility with resilience.

Target Crest Height: A minimum frontal dune crest level of **+5.0 m AHD** is recommended to provide resistance to overwash during high tide and storm events. This level was shown to be sufficient during TC

Alfred; however minor increases may be warranted through adaptive testing. The remaining island could be at a +3.5m AHD (crest level.).

5.4.1.2 Sediment Source and Compatibility

Primary Sources:

- **Old Caloundra Bar:** Estimated to provide 600,000-800,000 m³ of compatible sand by dredging recently accreted material from the filled inlet.
- **Inner Breakthrough Sandbank:** Approximately 300,000 m³ could be sourced by removing material from the long sandy strip now acting as a wave break within the breakthrough.
- **Offshore Sand Sources:** Offshore sources will likely be required to make up the additional volume needed for full island reinstatement and ongoing system buffering.

  Potential sources may include:

  - Spitfire Channel
  - Proposed Port of Brisbane channel extension works, offering an opportunity for alignment and shared logistics.

  All offshore sand source options should be thoroughly assessed in terms of:

  - Environmental impact
  - Dredge accessibility and cost
  - Compatibility of material with Bribie Island's native sand
  - Regulatory and navigational constraints

Material Compatibility: All sand, whether from nearshore or offshore, must be analysed for grain size distribution, carbonate content, and ecological suitability to ensure performance and habitat protection.

Extraction Impacts: Any dredging works must be designed to avoid unintended disruption to seagrass beds, benthic habitats, or sediment transport systems, especially in marine park or Ramsar-listed areas.

5.4.1.3 Structural Support During Establishment

Temporary Structures: these may be required during the works (to be detailed in the design stage)

Geotextile Sand Containers (GSCs): To hold reinstated sand in place until vegetation is re-established.

Nourishment sacrificial berms: Constructed and replaced as needed to buffer short-term wave attack.

Access and Staging Areas: Logistical planning is needed for barge or amphibious vehicle access without further damaging sensitive environments.

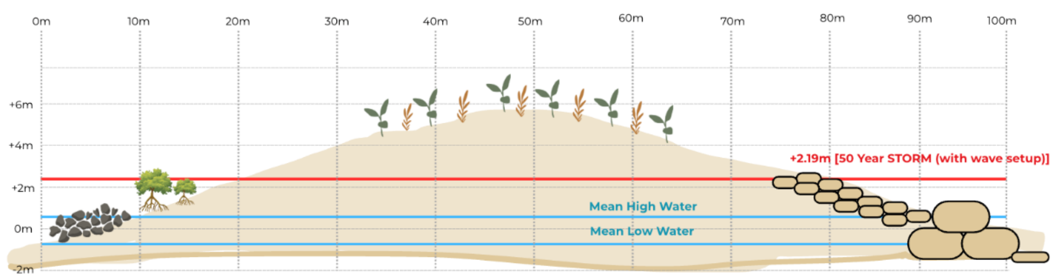


Figure 18: Schematic Typical Cross Section with example of Temporary Container Support (not to scale)

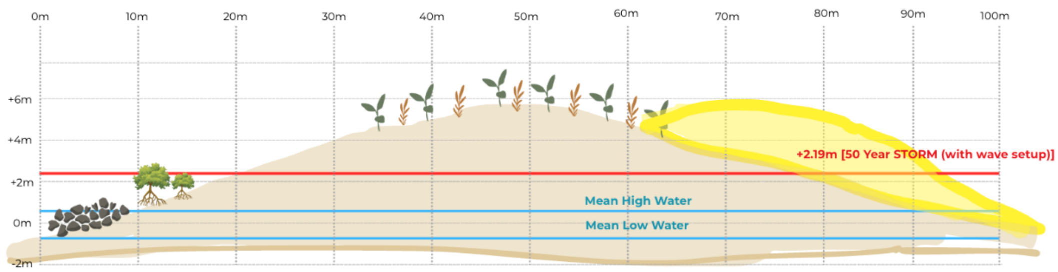


Figure 19: Schematic Typical Cross Section with example of Nourishment 'Buffer'/Sacrificial (not to scale)

5.4.1.4 Vegetation Strategy

Staged Replanting: Pioneer species like *Spinifex sericeus* and *Casuarina equisetifolia* for rapid stabilisation. Longer-term vegetation succession plans to encourage natural dune formation and biodiversity.

Irrigation and Monitoring: May be required in early phases, especially during dry seasons.

5.4.1.5 Construction and Dredging Methodology

Agile Implementation: On-site coastal engineers with real-time decision-making authority will be essential due to the dynamic environment.

Weather Contingency Planning: Detailed staging and buffer planning must consider seasonal cyclones and storm conditions.

Construction Timing: Optimal between April and September (outside cyclone season and migratory bird nesting periods).

5.4.1.6 Environmental and Cultural Heritage

Ecological Surveys: To avoid impacts on protected fauna and flora, especially turtles, shorebirds, and intertidal habitats.

Cultural Heritage: Early consultation with Traditional Owners is critical to identify and protect culturally significant sites.

5.4.1.7 Regulatory and Stakeholder Coordination

Approval Pathways: Likely to require a combination of state environmental approvals, marine park permits, and possibly EPBC referral.

Agency Engagement: Strong coordination with the Sunshine Coast Council, Queensland DES, marine park managers

Stakeholder Communication: Clear updates to the public about timing, access restrictions, and benefits.

5.4.1.8 Monitoring and Maintenance

Performance Monitoring: develop a monitoring plan

- Shoreline change via UAV and satellite imagery
- Vegetation cover and health
- Dune crest height and volume changes

Trigger Thresholds: Defined thresholds to prompt rapid nourishment or repair works if erosion exceeds expected performance.

Maintenance Plan: Set up periodic sand top-ups and vegetation replanting over a 5-10-year window.

5.4.1.9 Integration with Learnings from Urgent Works

The urgent works currently underway to close Breakthroughs #2 and #3 are expected to yield valuable insights into:

- Sediment movement patterns under present hydrodynamic conditions.
- The performance of soft and semi-soft structural measures (e.g., sacrificial dunes, geotextile tubes).
- Implementation constraints (e.g., working windows, contractor limitations).
- Environmental permitting bottlenecks.

These lessons should be directly integrated into the design and staging of the longer-term reinstatement, reducing risk and optimising the success of future phases.

5.5 Recommendation 2 - Enhance the Island and Pumicestone for Improved Resilience

This section presents a high-level conceptual strategy to build upon the urgent and reinstatement works by introducing integrated enhancement measures aimed at improving the long-term resilience of Bribie Island, the Pumicestone Passage, and adjacent foreshore environments. The goal is not only to repair damage and protect key assets but to proactively shape a more sustainable and adaptive coastal system - ecologically, socially, and economically.

These enhancement measures are inspired by a suite of proven techniques drawn from global best practice, many of which ICM has implemented successfully in similar dynamic environments throughout Queensland and internationally. While these solutions stem from our technical experience, we acknowledge that community feedback, agency engagement, and detailed site investigations will ultimately shape the final design and delivery pathway.

Importantly, this is not the only possible solution path**.** The ideas presented here are illustrative and intended to initiate discussion about what is achievable. These options will be subject to further analysis, environmental approvals, and co-design processes. Future community consultation will play a pivotal role in determining which concepts progress into final recommendations.

5.5.1 Framing the Opportunity

By enhancing Bribie Island and its coastal surrounds, we have a chance to future-proof the region against worsening climate pressures. This is not just about protecting what exists, it's about regenerating ecological systems, enhancing liveability, and improving navigational, recreational, and cultural values.

Enhancements should be considered in direct response to the goals set out earlier in this report:

- Stabilise and manage tidal regimes
- Maintain safe and functional waterways
- Support ecological health and water quality
- Reinforce the resilience of the island and foreshore assets

These goals reflect a long-term vision that goes beyond simply reinstating the island. Enhancing the system in a targeted, integrated way is essential to ensure long-term success and reduce future risk.

5.5.2 The Recommended Solutions Package

What might the outcome of implementing these solutions look like? The figures below show the before (now) and after (potential future).

Figure 20: Aerial images of existing condition [Google Earth, 2025] (left) and potential future (right)

Figure 21: Recommended future options using different elements from the 'toolkit' (ICM,2025)

Table 5: Recommended Solutions

No.	Potential Solution	Purpose
1	**Multipurpose Artificial Reef**	Reduces wave energy impacting the narrow section of Bribie Island, supports nearshore sand retention, creates recreational and habitat opportunities.
2	**Artificial Headlands**	Stabilises nourishment placed along the beach, slows longshore drift, and provides foundation for dune vegetation.
3	**Terminal (Buried) Wall**	A hidden final defence under the dunes, inspired by the Gold Coast A-line, to reduce catastrophic failure risk while allowing natural landscape expression.
4	**Inner Bank Widening with Oyster Reefs**	Builds broader, stable shoreline using redistributed sand, promotes mangrove establishment, and improves ecological resilience. Buffered sand bank along Fish Habitat edge/channel edge to provide additional shorebird bird habitat
5	**Soft Groynes for Entrance Management**	Low-impact groynes to help guide sediment transport and stabilise entrance flow, reducing channel infill.
6	**Re-open Caloundra Bar**	Removes infilled material to restore historic tidal flow and navigation; provides a large volume of sand for nourishment efforts. Technically would be a part of the reinstatement, however, there would be likely additional material to be removed beyond the reinstatement area only
7	**Inlet Sand Pump Station**	Manages sediment build-up and redistributes sand as needed to areas like the outer beach, similar to the Noosa River system.
8	**Channel Realignment**	Moves the main channel away from Golden Beach to reduce tidal pressure on the foreshore, creating space for dune recovery. Allowance for buffered sand bank along the Fish Habitat Area should be made to provide additional stability and reduce ‘meandering.
9	**Golden Beach Dune Buffering**	Builds in long-term erosion resilience by increasing space for dunes, potentially integrated with buried seawalls.
10	**Weir Upgrade**	Future consideration: regulates internal tidal flows, manages water levels, and supports long-term water quality and flood resilience.

5.5.2.1 Schematic Layout and Interactions

The following schematic diagram provides a conceptual illustration of how various elements from the solution toolkit may interact with one another and their surrounding environment as part of an integrated coastal resilience approach. It is intended for high-level visualisation only and does not represent detailed design or final layout.

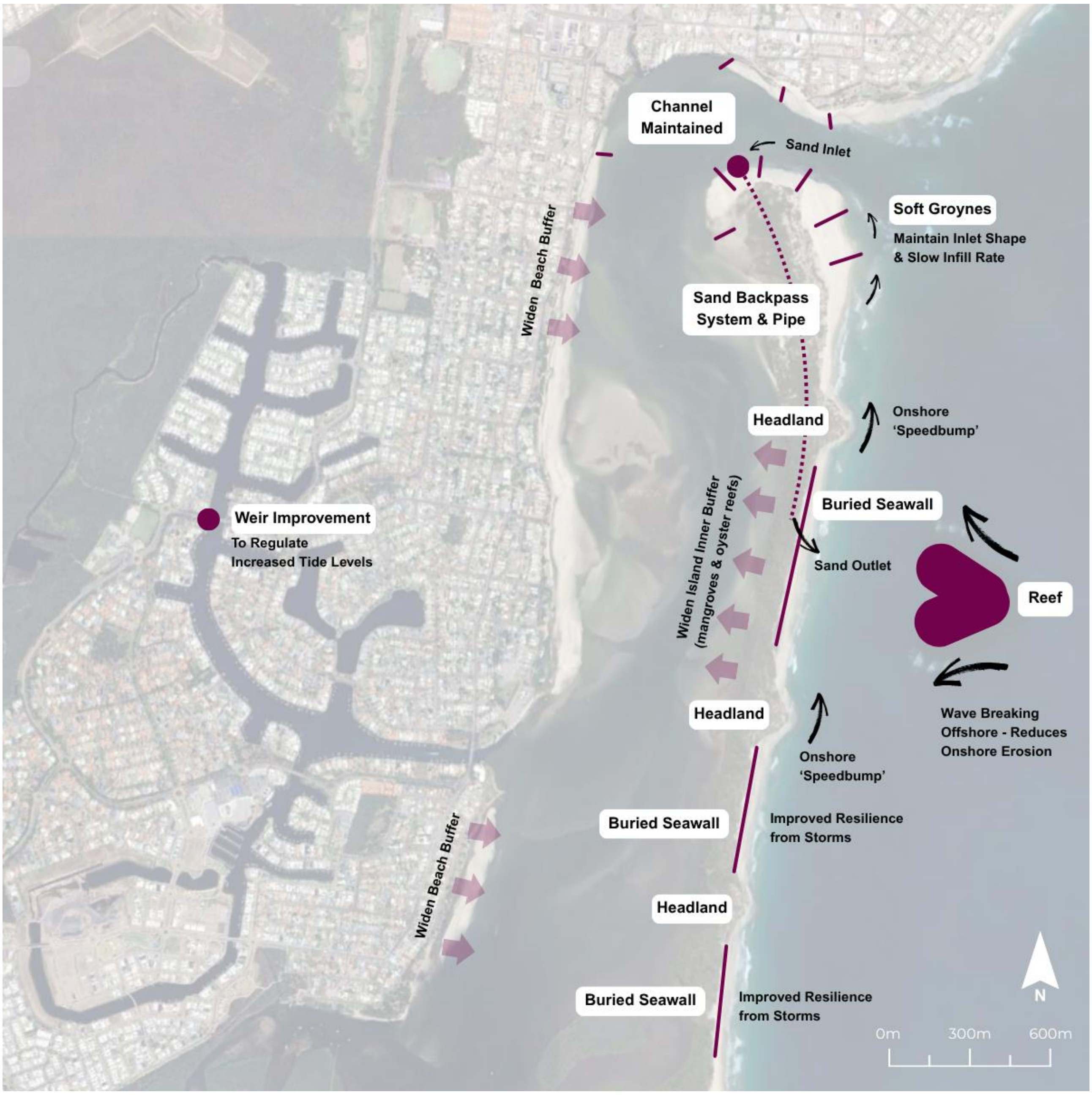


Figure 22: Schematic Layout of Potential Solutions

5.5.3 Resilience Building Elements Explained

5.5.3.1 Multipurpose Artificial Reef

Reasoning: Installed offshore, this reef diffuses incoming wave energy and encourages sediment deposition. It also provides habitats for marine life and recreational opportunities.

Pros: Multifunctional benefits; protects shoreline; enhances biodiversity.

Cons: Moderate construction complexity; may require approvals for marine structures.

Key Performance Indicators: Wave energy reduction, biodiversity increase

5.5.3.2 Artificial Headlands

Reasoning: These structures act as fixed points to retain nourished sand and slow sediment loss along the coast.

Pros: Supports dune growth; prolongs nourishment effectiveness.

Cons: May alter local sediment transport patterns; visual impact considerations.

Key Performance Indicators: Shoreline stability, sand retention rate

5.5.3.3 Terminal (Buried) Wall

Reasoning: Concealed under dunes, this measure acts as an emergency buffer in high-energy events.

Pros: Hidden from view; passive protection.

Cons: Costly if extensive; requires precise placement and design.

Key Performance Indicators: Structural integrity post-events, limit of erosion

5.5.3.4 Widened Inner Bank with Oyster and Mangrove Restoration

Reasoning: Increases resilience on the estuarine side by stabilising sediments and creating habitat.

Pros: Ecological enhancement; sediment retention.

Cons: Requires coordination with environmental agencies; time-intensive to establish

Key Performance Indicators: Mangrove/oyster growth rate, sediment retention and water quality

5.5.3.5 Soft Groynes at Entrance

Reasoning: Directs sediment transport at the entrance in a minimally invasive way to reduce the rate of the bar/opening infill

Pros: Adaptable design; low ecological impact.

Cons: Requires regular monitoring and adjustment.

Key Performance Indicators: Sediment drift control, entrance stability, structural performance/stability post storm event

5.5.3.6 Reopening the Caloundra Bar

Reasoning: Reinstates historic tidal flow, reducing tidal heights and flushing stagnation.

Pros: Improves system balance; provides nourishment material.

Cons: Major dredging activity; sensitive habitat impacts possible.

Key Performance Indicators: Tidal range reduction, water quality/flushing improvement in northern Passage

5.5.3.7 Sand Inlet Pump Station

Reasoning: Manages sediment buildup and redistributes it where needed.

Pros: Controlled sediment placement; supports adaptive management.

Cons: High capital and operational costs; needs constant management.

Key Performance Indicators: Sediment transfer efficiency, operational reliability

5.5.3.8 Main Channel Realignment

Reasoning: Shifts flow pathways offshore to reduce pressure on Golden Beach.

Pros: Improves foreshore conditions; natural buffer development.

Cons: Complex hydrodynamic modelling required; potentially high costs.

Key Performance Indicators: Wave exposure at Golden Beach, sediment deposition

5.5.3.9 Golden Beach Dune Buffer

Reasoning: Provides a protective buffer along urban foreshore, complementing other measures.

Pros: Natural resilience; space for adaptation.

Cons: Requires shifting the navigation channel; maintenance required.

Key Performance Indicators: Dune width, vegetation health

5.5.3.10 Weir Upgrade

Reasoning: Helps manage water levels inland as coastal dynamics change.

Pros: Improved flood control; long-term water management.

Cons: Still conceptual; long lead time for design and approvals.

Key Performance Indicators: Tidal regulation, upstream water levels

5.5.4 Integration, Sequencing, and Future Development

Each measure contributes to the broader coastal resilience goal but can be implemented independently or in phases. Sequencing could align with:

- Lessons from immediate and reinstatement works
- Available funding and project timelines
- Environmental permitting and consultation windows

5.5.5 The following phased pathway could be considered:

Short-Term (0-2 years): Implement Measures 1, 2, 3, and 6 in conjunction with reinstatement works

Medium-Term (2-5 years): Introduce Measures 4, 5, 7, and 9

Long-Term (5+ years): Evaluate Measures 8 and 10 based on future conditions

5.6 Recommendation 3 - Develop and Implement Long-Term Management Pathways

This recommendation focuses on establishing a durable, forward-looking management framework to support the success of the reinstatement and enhancement works proposed for Bribie Island and the Pumicestone Passage system. While the first two recommendations address structural and ecological resilience, this recommendation emphasises the governance, funding, and operational mechanisms required to ensure those efforts are maintained, adapted, and improved over time.

Key institutional questions remain unresolved, including:

- Who will be responsible for ongoing management?
- How will maintenance be triggered, funded, and executed?
- What approvals and planning instruments are needed for future works?

5.6.1 A Shift in Approach

A fundamental shift is needed in how Bribie Island and its surrounds are perceived, not as passive natural environments alone, but as active coastal management assets. Like seawalls, training walls, or groynes, the island plays a critical role in protecting shorelines, moderating tidal flows, and sustaining navigation channels. It is time to manage it with the same rigour and foresight as other coastal infrastructure.

To support this shift, we propose the development of pre-approved "blanket" nourishment and dredging zones, inspired by the successful nourishment box system used along the Gold Coast. These zones define spatial areas, onshore and offshore, where routine sediment management and minor works can be undertaken under existing approvals, significantly reducing red tape, response time, and the cost of reactive interventions. The creation of such spatial planning tools would:

- Provide certainty to managers and contractors about where and how works can occur.
- Simplify regulatory pathways for future nourishment, dredging, or minor adaptation works.
- Enable more agile, adaptive responses to changing coastal conditions.

In tandem, a formalised long-term management plan should be established, incorporating:

- Defined governance and custodianship across agencies.
- Secure and recurrent funding models, potentially through coastal levies, state support, or climate adaptation funding pools.
- Monitoring and adaptive triggers, clearly defined parameters (e.g., island width, vegetation cover, tidal range) that initiate action.
- Coordinated operational planning that aligns with regional strategies like the CHAPP and complements ongoing community initiatives.

To drive this forward, we recommend the formation of a multi-agency steering group, potentially including state government, Sunshine Coast Council, QPWS, and marine park representatives, to oversee planning, approvals, community engagement, and adaptive implementation.

Ultimately, the goal is to embed Bribie Island's resilience into the region's governance structure, ensuring its protection and function are not left to chance or reactive crisis management, but are part of a proactive, integrated coastal resilience system.

5.6.2 Holistic Review

As part of a holistic management approach, it will be essential that future governance frameworks consider not only forward-looking solutions but also historical and regional influences that continue to shape the Pumicestone Passage system. Several matters raised by the community warrant further review, including the presence and legacy of historical oyster reef leases. While the current focus of this report has been on the breakthrough events and associated morphological and hydrodynamic changes, available data suggests that these former leases did not play a significant role in causing the initial breakthrough. Nevertheless, further investigation into their historical footprint and any potential ongoing influence may provide useful insights into system-wide sediment behaviour and ecological interactions.

Additionally, the location and alignment of the shipping channel relative to Bribie Island warrants consideration in the broader context of sediment transport and navigation safety. Integrating these factors into long-term planning will require a comprehensive understanding of regional processes and cumulative impacts. Similarly, ongoing water quality issues highlight the importance of reviewing and potentially upgrading stormwater runoff systems throughout the adjacent urban catchments. Addressing these inputs will be vital for improving ecological health and sustaining the broader goals of water clarity, biodiversity, and system resilience.

These topics will be explored in greater detail in the next report of this series, where long-term management frameworks and coordinated adaptation pathways will be further developed to support sustainable outcomes for the Passage and its surrounding communities.

5.7 Recommendation 4 - Re-assess Environmental Zoning and Permitting

To implement the recommendations outlined in this report a re-assessment of existing environmental zoning and permitting frameworks will be essential.

Much of the subject area is located within highly protected zones, including the Moreton Bay Marine Park, Bribie Island National Park, and the Bribie Island Recreation Area, all managed by Queensland Parks and Wildlife Service (QPWS). Each of these areas is governed by specific regulations that significantly influence what types of activities and works can be carried out.

The current zoning under the Marine Parks (Moreton Bay) Zoning Plan 2019 includes:

- Habitat Protection (HP) zones, which allow for conditional permitting of activities such as sand nourishment and minor structural installations.
- Conservation Park (CP) zones, which are more restrictive and generally do not permit large-scale works without legislative amendments, such as re-zoning or the declaration of a major works area.

For national park areas, approvals must align with the Nature Conservation Act 1992, which generally prohibits infrastructure or restorative works unless a Special Management Area is declared. Similarly, any activity within the Bribie Island Recreation Area must comply with the Recreation Areas Management Act 2006, requiring written approvals depending on the land tenure and overlap with other protected zones.

In practice, this means that the scale and nature of the recommended works, particularly large-scale nourishment, the installation of structural coastal defences, and habitat interventions, may not be permissible under current zoning configurations. Where interventions intersect with sensitive zones like CP areas or national parks, new approval types and management categories will likely need to be established.

This could include:

- Legislative amendments to redefine or rezone areas;
- Declarations of major works or special management areas;
- Updates to marine park and recreation area boundaries or usage definitions.

Further complexity arises from the region's Ramsar-listed wetlands and associated obligations under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), where certain activities may be considered Controlled Actions requiring federal environmental assessment.

We acknowledge that many of the recommendations outlined, particularly those involving physical structures or sediment redistribution, have not yet undergone detailed environmental modelling or impact analysis. As such, the next stage of reporting will investigate potential regulatory pathways, explore the feasibility of new approval mechanisms, and identify ways to integrate stakeholder and agency input into the permitting process.

This work will be undertaken in coordination with QPWS and other regulatory bodies as part of the Technical Working Group, with the goal of ensuring that proposed actions not only meet engineering and resilience objectives but are also achievable within an environmentally responsible and legally compliant framework.

Note that further discussion around potential for approval pathways will be discussed in the following report.

Appendix A – Terms of Reference

Appendix B – Authors and Contributors

Authors

An audience deserves to know something about the author. This review is the product of a team ('we') represented by two companies, RPS and ICM. RPS was founded in 1970 by a passionate team of academics in Oxfordshire, United Kingdom, and has been operating in the Australia Asia Pacific region since 2003. RPS is part of Tetra Tech Inc, which was founded in 1966 to provide engineering services for waterways, harbours, and coastal areas in the United States. Tetra Tech operations are global and include ~30k employees, however, this review is largely the independent voice of one RPS employee, Brian McRae.

Brian's relevant experience to contribute to this review includes three decades managing coastal and environmental matters in California (Los Angeles, including initiatives related to the L.A. River and the Santa Monica Bay), New South Wales (Sydney's Northern Beaches) and Queensland (including managing the Gold Coast Seaway, Sand bypass system, and navigational channel network), as well as involvement throughout his career in disaster management. His perspective includes training as a naturalist, biologist, environmental planner, and public sector manager. He attributes key achievements in his career to a passion for improving 'systems', including the complex dynamics between ecosystems, governance, economy and, importantly, relationships.

RPS supported Brian with his contributions to this review in a number of ways. Notable support was provided by Brad Williams, Practice Leader - Place (Sunshine Coast), who contributed insight regarding local community dynamics and context. He brings more than 28 years' experience as an urban planner and development consultant, and a deep appreciation of the Sunshine Coast community and environs. His key experience and abilities stem from his direction of large master planned communities, complex urban development projects, emerging regional communities and the drafting of statutory planning instruments.

ICM originated on the Gold Coast and earned global recognition for leading approaches to coastal resilience that rely on nature-based engineering solutions. As a Gold Coast City Council engineer in the 1980s, ICM founder Angus Jackson contributed to the pioneering of this approach, which is founded on Queensland Government investigations in the 1970s ('Delft report') pursuant to coastal storm damages. The Gold Coast Seaway, the GC and Tweed sand bypass systems, and the management of the Gold Coast shoreline originate from this early initiative. ICM has a strong history of innovation in coastal and waterfront design and delivery of cost-effective solutions globally.

Aaron Salyer, Director and Coastal Engineer, partnered with Brian to direct this project, and led the efforts of the team from International Coastal Management (ICM). Aaron's focus is on leading efforts to protect and restore coastal ecosystems, and in particular enhancing community resilience to ocean hazards. Through innovative engineering, he aims to implement nature-based solutions that promote multifaceted benefits. His goal is to foster a profound shift in how society values and interacts with coastal environments, promoting sustainable development and marine conservation worldwide. Aaron is also an expert panellist for the United Nations Ocean Decade.

Contributors

The Department of State Development, Infrastructure and Planning provided invaluable assistance to facilitate the delivery of this review, including supporting RPS/ICM throughout to successfully apply an agile delivery methodology, including organising a Queensland Government Technical Working Group (**TWG**). A separate working group of Sunshine Coast Council officers with relevant subject matter expertise was formed and operated in parallel with the QG TWG. Both groups assisted with the identification of relevant sources, and through reviewing and commenting on draft outputs. Agencies represented include:

- Department of State Development Infrastructure and Planning
- Department of Premier and Cabinet
- Queensland Treasury
- Department of Environment, Tourism, Science and Industry
- Department of Primary Industries
- Department of Resources, Mining, Manufacturing and Regional Development
- Department of Transport and Main Roads, Maritime Safety Queensland
- Queensland Police, Marine Rescue Queensland
- Queensland Reconstruction Authority
- Sunshine Coast Council

Appendix C – Source list