The Aotearoa Circle

Mā te Kaitiakitanga ko te Tōnuitanga
Prosperity Through Guardianship

NATURAL INFRASTRUCTURE PLAN

Part 4D: Our Blue Economy

The economic dependencies and growth opportunities presented by natural infrastructure for Aotearoa New Zealand's blue economy

Contents

Introduction

Why investing in natural infrastructure matters

By recognising natural infrastructure as the productive infrastructure that it actually is, we can strengthen our economy, reduce risk, create jobs, and build a future we can proudly say we helped shape.

Aotearoa New Zealand's economy is intrinsically linked to the environment. With 70% of our exports reliant on natural resources, investing in resilience and natural capital is not a trade-off - it is a win-win.

That's why we believe our Natural Infrastructure Plan presents a 1 + 1 = 3 investment: it addresses today's challenges while building capacity for tomorrow.

It also points to the need for a shift in conversation beyond hard engineering solutions that may appear cheaper upfront, but often cost more over time in maintenance, repairs and lost co-benefits.

We understand why infrastructure matters. Roads move goods and services. Pipes deliver water and power. Bridges connect communities and enable commerce.

Natural infrastructure is less visible and therefore less valued. It exists in wetlands, native forests, dunes, rivers and floodplains. It quietly provides flood mitigation, water filtration, erosion control, carbon sequestration and temperature regulation without invoices, contracts or maintenance schedules.

Nature may be the most undervalued infrastructure asset we have. And because we undervalue it, we underinvest in it.

For too long, we have framed economic growth and environmental health as competing interests. This Plan demonstrates that we can - and must – achieve both. By doing so we can capitalise on the multiple benefits that investment in natural infrastructure offers - often with lower, long-term operating costs.

And as the New Zealand Infrastructure Commission Te Waihanga has identified, long-term strategy and planning are essential to guiding infrastructure investment and enhancing national resilience. This Plan adds a powerful tool to our infrastructure toolkit to support this.

Practical Actions

The Natural Infrastructure Plan has been developed through a coalition of 200+ contributors with over 10,000 combined hours of research, debate and collaboration. It reflects deep expertise and shared ambition.

What it is not is a list of aspirations. Instead, it provides practical actions from clear policy levers for government to significant opportunities for business, leadership and investment.

The plan also includes six case studies demonstrating the measurable benefits of incorporating nature-based solutions into infrastructure planning.

It encourages decision-makers to widen the lens through which infrastructure investments are assessed.

The Investment Decision Toolkit, for example, provides a structured way to evaluate natural infrastructure alongside traditional engineered solutions.

Public agencies, private companies and iwi can use these tools to compare options, assess long-term value and capture multiple co-benefits.

When making decisions that will shape infrastructure for decades, the greatest risk is not choosing the wrong option. The greatest risk is failing to consider all available options.

Natural infrastructure is not an environmental add-on. It is a credible, investable infrastructure asset.

By investing in natural infrastructure, we can reduce the risk in insurance, improve returns on investment, and know we will have enduring growth.

The question is no longer whether we can afford to invest in natural infrastructure.

It is whether we can afford not to.

Vicki Watson

Chief Executive
The Aotearoa Circle

About The Aotearoa Circle

The Aotearoa Circle, a unique leadership organisation, convenes public and private sector partners to tackle complex climate and nature challenges that threaten economic growth and future prosperity.

We know that our economy is intrinsically linked to our natural capital, yet it has been declining for decades.

That's why we have a mission and a deadline. If nature loss is not halted and reversed by 2035, Aotearoa New Zealand will reach a tipping point with lasting consequences for our economy, communities and global standing.

Our work considers pressing climate change and nature challenges facing our key sectors - from agriculture, energy and seafood to transport, finance, and tourism. We do this by delivering practical, cross-sector solutions that reduce risk, strengthen resilience, and ultimately aim to restore natural capital.

The Circle is guided by Guardians (our Board) and strengthened by future voices through our Rangatahi Advisory Panel (RAP) who actively participate in major workstreams, including the development of this plan.

Formed in 2019, our co-founder Sir Rob Fenwick stated at the time that, “Time is running out for the treasures of nature that we love, and it is worth using every last breath, all of our collective energy, to save our land and secure our future.”

Sir Rob’s vision continues to inspire and guide us each day.

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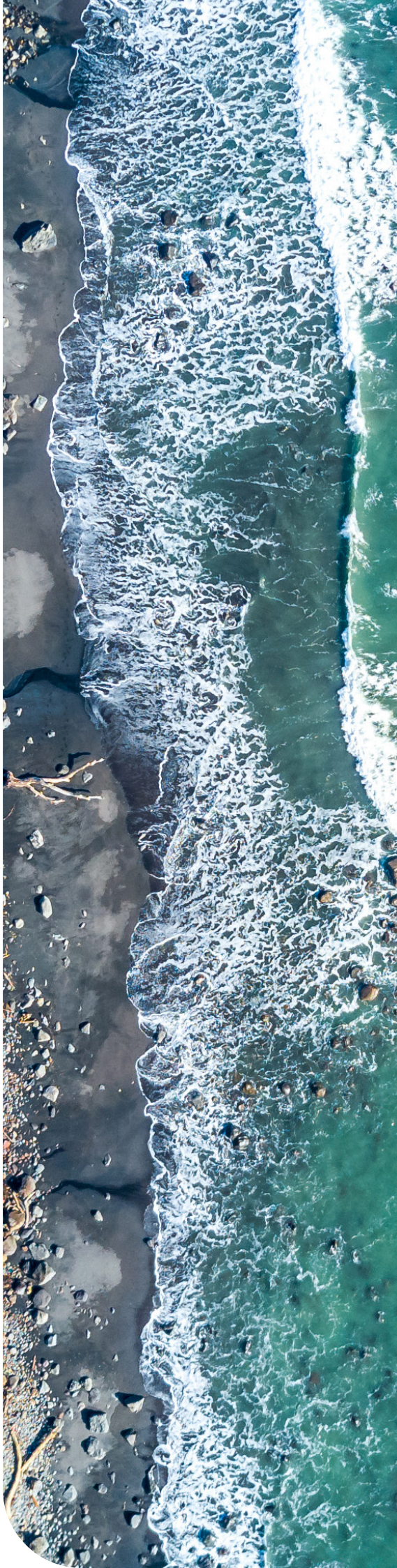
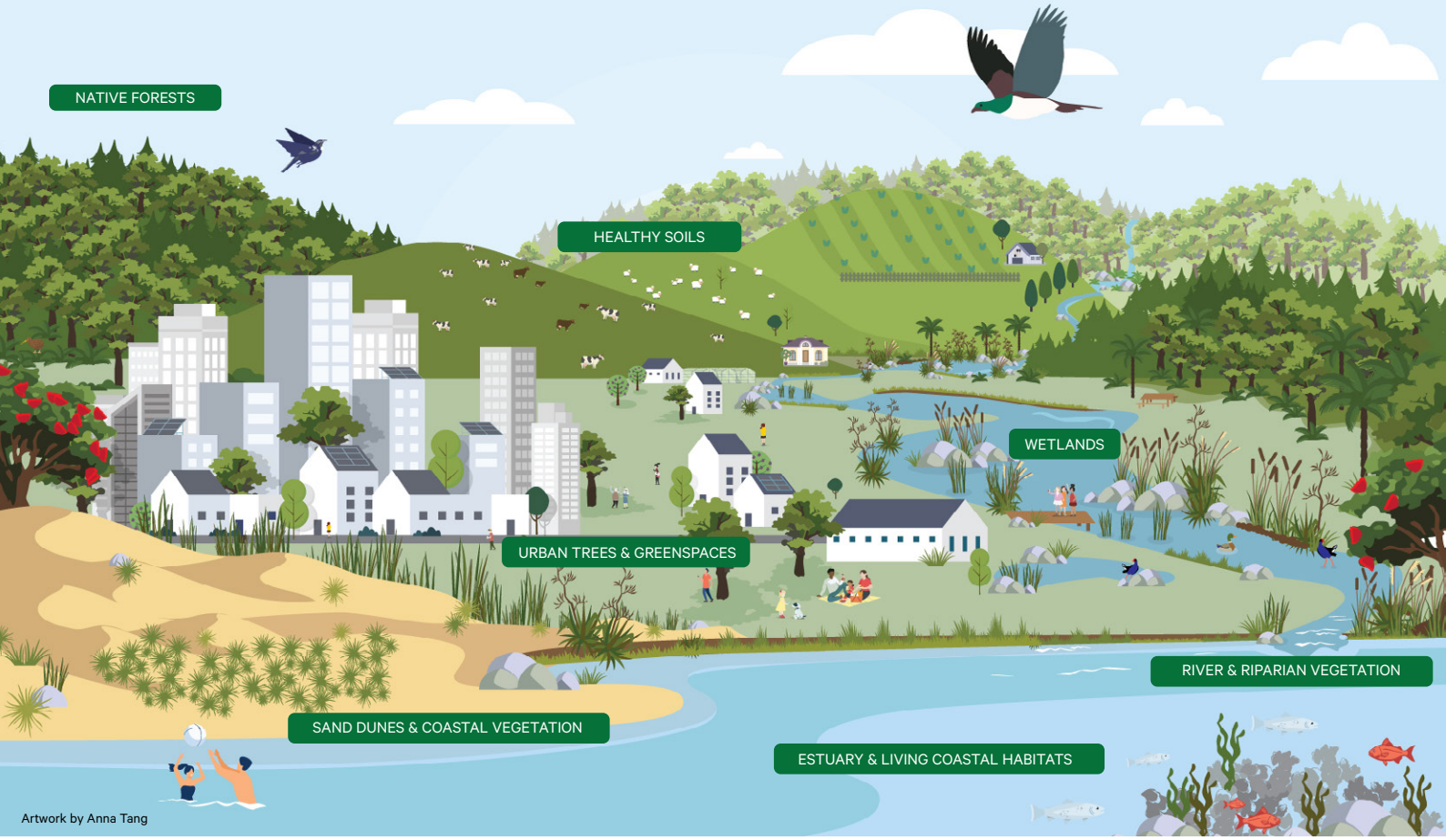


What is natural infrastructure?



NATURAL INFRASTRUCTURE	SERVICES IT PROVIDES
NATIVE FORESTS	• Stabilises slopes and reduces erosion and landslides • Regulates water (slows runoff, sustains baseflows, improves quality) • Habitat for native species; supports cultural values and recreation • Stores carbon over long timeframes; provides local cooling and shade
RIVER & RIPARIAN VEGETATION	• Filters sediment, nutrients and some pathogens before they reach waterways • Shades streams, lowering temperatures for aquatic life • Stabilises banks and reduces erosion • Provides habitat corridors for native species and inanga spawning areas
WETLANDS	• Temporarily store floodwaters and buffers stormwater • Retain water and supports drought resilience • Filter nutrients and contaminants, improving water quality • Sequester and stores carbon (notably peat systems) • Provide habitat and mahinga kai values
URBAN TREES & GREENSPACES	• Reduce urban heat and provide shade for people and places • Intercept rainfall and reduce stormwater runoff • Improve air quality and support urban biodiversity and wellbeing
SAND DUNES & COASTAL VEGETATION	• Trap and stabilise sand, reducing coastal erosion • Buffer storm surge and waves; enable natural shoreline adjustment • Provide habitat for coastal species and protect communities and assets inland
ESTUARY & LIVING COASTAL HABITATS	• Attenuate waves and help stabilise shorelines • Filter water, cycle nutrients and improve clarity • Store “blue carbon” in sediments and vegetation • Provide nursery habitat that supports fisheries and biodiversity
HEALTHY SOILS	• Provide the foundation for food production by cycling nutrients, retaining moisture and supporting fertile land • Reduce erosion and sediment loss when healthy, protecting waterways and downstream ecosystems • Help buffer flooding by absorbing, storing and slowly releasing water across the landscape • Filter contaminants and improve water quality before water reaches rivers, estuaries and aquifers • Store carbon and support soil biodiversity that underpins ecosystem resilience

Executive summary

Securing Aotearoa New Zealand's Blue Economy growth potential through strategic investment in natural infrastructure.

Aotearoa New Zealand's marine economy currently includes significant shipping, port, tourism, and seafood sectors (fishing and aquaculture). Today's marine economy contributes **$10billion annually** (3.9% of GDP), supports 70,000 jobs and is projected to achieve **$14billion in exports by 2035** should a deliberate Blue Economy transition be adopted[1].

Transitioning to a regenerative Blue Economy is a strategic ambition to take Aotearoa New Zealand beyond the current marine economy. This transition would provide enduring ocean health and community prosperity by fostering innovation, and resilient and responsible practices[2, 3].

The Blue Economy transition depends upon natural infrastructure for economic prosperity.

All marine economy sectors are vulnerable to environmental pressures such as climate change-induced marine heatwaves, increasingly severe and frequent storms and sedimentation, biosecurity risks, and sea-level rise[3, 4, 5]. Increased investment in traditional and natural infrastructure, technology, and workforce support is required to respond to these, and to enable emerging opportunities for transitioning to a Blue Economy.

A Blue Economy delivers strong and measurable economic returns.

The opportunities for increased economic value through greater investment in natural assets within the Blue Economy are clear. Global experiences show that **every dollar invested in marine natural infrastructure delivers 2 to 12 times in societal benefits through avoided damage, reduced operational costs, and enhanced productivity.** These benefits arise from limiting impacts such as trawling, dredging, and the accumulation of pollutants including microplastics[6, 7, 8]. Kelp forests generate significant value for fisheries on an annual per hectare basis, while also sequestering carbon dioxide[9]. The Hauraki Gulf provides ecosystem services that are annually valued at over $5 billion, with total natural assets estimated at between $40-100 billion[10]. For these and many more reasons, **strategic investment in natural infrastructure is not only socially and culturally important - it's an economic prerequisite.**

Fragmented governance structures create systemic risks and obscure opportunities for blue economic growth.

In Aotearoa New Zealand marine governance, legislation, policy and regulation occur across 14 agencies[11]. This creates inefficiencies for marine sector industries. Despite significant research such as the Sustainable Seas Science Challenge[12], the uptake of available knowledge to develop a Blue Economy for Aotearoa New Zealand has been limited. Data is also fragmented, meaning investments that deliver environmental outcomes are often undervalued when investment decisions are made.

Cross-sector collaboration is essential to unlock Blue Economy potential. Standards for identifying and valuing marine nature-positive activities are immature[13]. The absence of cross-sector coordination limits the opportunity to develop an aspirational national Blue Economy strategy and the associated governance reforms required to support it. Regional clusters such as Murihiku Regeneration (Southland) and the experience of Moananui (Nelson Tasman) have demonstrated that integrated, place-based approaches which are anchored in marine ecosystem health, iwi/Māori leadership, and shared data can rapidly unlock growth opportunities which individual sectors cannot achieve alone. These models show how coordinated investment in natural infrastructure, aligned policy frameworks, and collaborative planning can simultaneously reduce operational risks (from climate impacts, biosecurity threats, and market volatility) while creating new revenue streams and attracting transformative capital.

Attracting and mobilising new investment in marine sector innovation, research and development remains difficult due to inconsistent standards, complex governance arrangements, and projects that are often too small to draw meaningful capital[14].

A national strategy which enables cross-sector collaboration (i.e. modelled on successful regional clusters domestically and internationally) supported by streamlined marine governance would position Aotearoa New Zealand to capitalise on emerging Blue Economy opportunities at scale.

A national Blue Economy strategy is essential to unlock economic growth potential and manage systemic risks.

Aotearoa New Zealand's vast Exclusive Economic Zone (EEZ), our strategic location in the South Pacific, the richness of marine fauna and flora, and the many opportunities for regenerative Blue Economy development require a nationally coordinated, cross-sector strategy for shared knowledge, collaboration and innovation.

Against the background of large capital flows into "ocean clusters" internationally, i.e. where regional coordination of Blue Economy activities has attracted significant investment and rapid growth, the development of a national Blue Economy strategy is not discretionary but essential to position Aotearoa New Zealand competitively.

A successful national Blue Economy strategy would place Aotearoa New Zealand in a position to deliver its full economic, social and environmental promise by: enabling the Blue Economy to deliver measurable financial returns; guiding Blue Economy sectors to reduce systemic risks from climate impacts, biosecurity threats, and market volatility; support the streamlining of fragmented governance to lower business costs and attracting transformative investment; and charting a course to establish Aotearoa New Zealand as a global leader in sustainable ocean management.

Why natural infrastructure is fundamental to this national strategy?

Healthy marine ecosystems underpin all marine economy sectors. Degraded ecosystems increase operational costs, reduce productivity, weaken market access, and amplify vulnerability to climate change. Conversely, strategic investment in marine natural infrastructure including kelp forests, seagrass meadows, wetlands, and reef systems delivers cost savings through reduced dredging and operational expenses. It also strengthens climate resilience, supports market access for high-value exports, and enables new revenue streams through blue carbon and ecosystem service markets. Natural infrastructure is therefore not an environmental add-on but economic core infrastructure.

About this report

Purpose

This report, prepared in February 2026, outlines the key economic dependencies and growth opportunities presented by natural infrastructure as it pertains to one of Aotearoa New Zealand's key economic sectors.

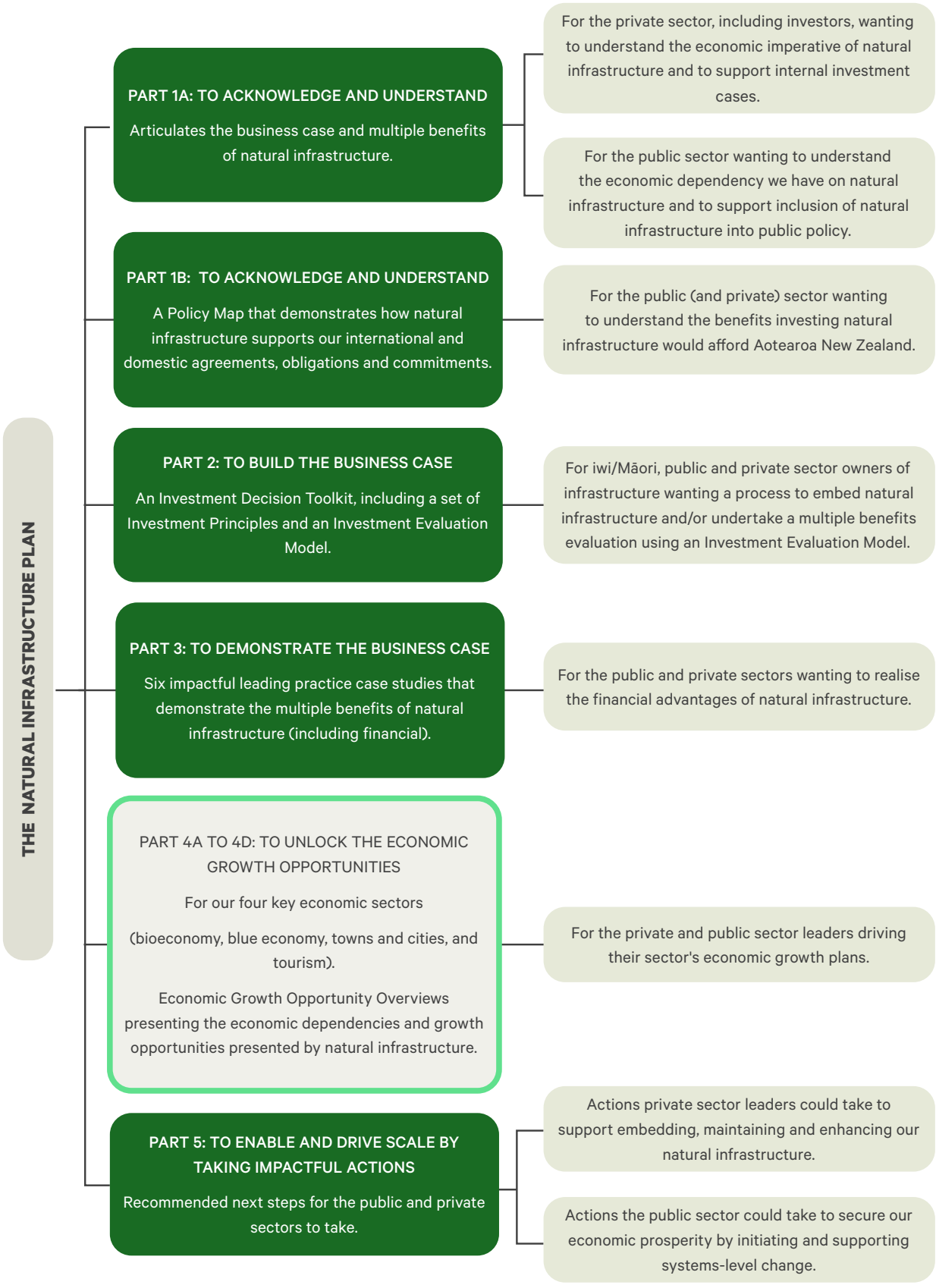
With our natural infrastructure being our most fundamental infrastructure, the purpose of this report is to outline, in a single document, the economic dependencies and growth opportunities presented by natural infrastructure.

This report has been prepared to support The Aotearoa Circle's Natural Infrastructure Plan (NIP).

Structure of the Natural Infrastructure Plan

The Natural Infrastructure Plan comprises several sections framed against the five objectives. Each has a specific purpose and intended audience.

Note: Parts 1B, 2, 3 and 4A-4D are available as separate PDFs to download.



Next steps

It is envisaged that sector leaders utilise this report when developing a national Blue Economy Growth Strategy.

It is also envisaged that this national growth strategy acknowledge and integrate the economic dependencies the sector has on natural infrastructure, and include plans to embed, maintain, and enhance our natural infrastructure.

To achieve enduring prosperity, and to realise economic growth opportunities, system-level changes are required. These systems-level changes, and other recommendations, are contained within the NIP.

A. Defining the Blue Economy

The marine economy encompasses all activities that depend on the ocean including fisheries, aquaculture, shipping, telecommunications, energy, tourism and government services[15].

The Blue Economy refers to these same activities undertaken in ways that generate economic value while actively improving ecological health, cultural wellbeing and social outcomes. Broadly internationally, the Blue Economy aims for the sustainable use of the ocean to promote economic growth, social wellbeing, and environmental health (both marine ecosystems and the broader physical environment), ensuring the ocean can be sustained and support humanity and economic activity well into the future[16, 17].

The Aotearoa New Zealand Sustainable Seas National Science Challenge defines the Blue Economy as[18]:

"Marine activities that generate economic value while contributing positively to ecological, cultural, and social well-being."

The Sustainable Seas Science Challenge Blue Economy definition is underpinned by the Challenges' Blue Economy Principles for Aotearoa New Zealand which guides how ocean-related economic activities can transition to a Blue Economy and effectively integrate economic growth with environmental performance, achieving ecological health, social wellbeing, and cultural integrity[19, 20]. Westpac NZ centralised these in their February 2025 Blue Economy report[21].

Natural infrastructure is central to this definition. Healthy marine ecosystems enable Blue Economy sectors by providing habitat, carbon sequestration, water filtration, coastal protection and biodiversity which supports fisheries, aquaculture, tourism and energy development.

Figure 1. Blue Economy Principles developed by the Sustainable Seas National Science Challenge (2023)

(i) What is 'In' a Blue Economy and What is 'Out'?

Global Blue Economy Definition and Sectors.

There is no single universally accepted global definition of the Blue Economy, but the World Bank, UN, OECD, EU and UNEP FI converge on a consistent framing:

The Blue Economy is the sustainable use of ocean, sea and coastal resources for economic growth, improved livelihoods and jobs, while preserving the health of marine ecosystems.

Critically, this distinguishes the Blue Economy from the broader ocean economy, thus not all ocean-linked economic activity qualifies as "blue," only that which aligns with ecological sustainability, climate goals, and social inclusion.

Sectors consistently treated as core to the Blue Economy (when managed sustainably) include:

- sustainable fisheries and aquaculture that avoid overfishing and protect habitats
- marine biotechnology and bioproducts
- coastal and marine tourism grounded in conservation and community benefit
- maritime transport and decarbonising shipping
- offshore renewable energy
- nature-based coastal protection and ecosystem services such as mangroves and seagrass
- circular economy and waste management solutions
- resilient coastal infrastructure that integrates natural systems.

Sectors increasingly treated as outside or only conditionally within the Blue Economy are those associated with high ecological impact unless demonstrating a clear, time-bound transition pathway.

Offshore oil and gas, and high-impact seabed mining, are now commonly excluded from blue finance taxonomies and policy frameworks. Unsustainable industrial fishing which is characterised by overfishing, illegal unreported and unregulated (IUU) fishing, high bycatch, or habitat destruction is explicitly inconsistent with Blue Economy principles. Mass tourism which degrades reefs, mangroves, or displaces communities, and coastal development that destroys key ecosystems through reclamation or hard-engineering, are similarly treated as ocean economy but not Blue Economy[22].

The practical distinction is this: activities must actively contribute to or be compatible with ocean health, decarbonisation, and equity to qualify as "blue."

The global trend decisively excludes extractive and destructive activities from credible Blue Economy frameworks, regardless of their scale or historical precedent in the ocean economy. For Aotearoa New Zealand, this provides a clear anchor: a national Blue Economy definition and supporting policy must build on the findings of the Sustainable Seas Science Challenge and explicitly align with this global direction, defining in-scope sectors around regeneration and nature-positive outcomes, and establishing transition timelines for activities currently outside the Blue Economy framework but still operating in New Zealand waters[23].

(ii) Iwi/Māori and the Blue Economy

The iwi/Māori economic contribution to Aotearoa New Zealand's GDP has grown from **$17 billion (6.5% of GDP) in 2018 to $32 billion (8.9% of GDP) in 2023[24].** The iwi/Māori economy's asset base has grown from **$69 billion in 2018 to $126 billion in 2023 and which is an 83% increase that exceeded the earlier NZTE projection of $100 billion by 2030[25].**

Within the wider iwi/Māori economy, the marine sector represents a strategic component with iwi/Māori collectives holding approximately $2.3 billion in fishing and aquaculture assets. Iwi/Māori own 47% of Aotearoa New Zealand's commercial fishing quota by value with significant additional investments in aquaculture and marine-related enterprises[26].

The iwi/Māori marine economy is important in aligning with whakapapa (ancestral connection), kaitiakitanga (guardianship), and tino rangatiratanga (self-determination)[27, 28].

For this economic sector, the Blue Economy includes activities such as the regeneration of ecosystems and kaitiakitanga i.e. place-based marine management anchored in mātauranga Māori (traditional knowledge)[29]. Many iwi/Māori are already investing in sustainable aquaculture, seaweed cultivation, and marine restoration as expressions of balancing the need to rely on income from ocean activities and kaitiakitanga [30, 31, 32].

The deep meaning to iwi/Māori of the ocean cannot be overstated given all modern iwi/Māori governance i.e. Rūnanga and Asset Holding Companies arose during the 1992 Māori Fisheries Settlement process[33]. Key elements of the Māori marine economy include significant commercial fisheries quota and aquaculture rights, the National Iwi Chairs Forum Marine Working Group, marine tourism and offshore wind development interests, customary fisheries, and many hapū-based coastal moana kaitiakitanga initiatives nationally[34, 35].

B. Summary of the marine economic national growth plans

Aotearoa New Zealand lacks a unifying national Blue Economy strategy which integrates environmental performance, natural infrastructure protection, and coordinated cross-sector investment[36].

Over the past 25 years, Aotearoa New Zealand has completed numerous marine sector reviews and produced multiple industry plans for aquaculture, fisheries, minerals, offshore energy and marine tourism.

Aotearoa New Zealand's current national marine sector industry plans include [37, 38, 39, 40, 41]:

- New Zealand Aquaculture Development Plan 2025-2030 (targeting $3 billion by 2035)
- National Fisheries Plans (under Fisheries 2030 framework)
- Offshore Renewable Energy Development (potential $12-94 billion GDP impact)
- Minerals Strategy and Seabed Mining Policy (targeting $3 billion exports by 2035)

Marine Tourism and Recreation Roadmap[42].

These plans reveal strong sector-specific ambition but also highlight the critical gap of a lack of a coherent national agenda for sustainable marine economic development and transition to a regenerative Blue Economy.

C. Scale of the investment opportunity and expected contribution to GDP

Aotearoa New Zealand possesses the 7th largest Exclusive Economic Zone in the world, 15 times larger than its land area, offering vast potential for blue economic development.

Given Aotearoa New Zealand's vast marine estate, a coordinated transition to a Blue Economy offers major growth potential. Despite relatively low current marine economic activity, there is strong innovation capacity that has yet to be fully resourced, alongside marine biodiversity spanning subtropical to subantarctic latitudes.

Strategic investment in emerging opportunities such as integrated multi-trophic and offshore aquaculture, marine bioresources, and offshore renewable energy could significantly increase export value, attract large-scale capital, create new jobs, and position Aotearoa New Zealand as a global leader in sustainable ocean management[43].

Realising this opportunity depends directly on the health of natural infrastructure. Degraded ecosystems increase costs, reduce productivity, and threaten our reputation and trade access under recent free trade agreements that increasingly require verified environmental performance[44, 45].

Transitioning to a Blue Economy is not only an economic imperative – it's a strategic positioning opportunity for Aotearoa New Zealand

Natural infrastructure sets the frame for how we compete in global markets, how we respond to climate and nature pressures, and how we create long term prosperity anchored in healthy marine ecosystems. This transition would enable Aotearoa New Zealand to meet rising offshore market expectations for low impact, traceable and regenerative production and ensure the ocean continues to underpin our economic identity and earning potential for future generations[46 47, 48, 49].

Current investment constraints limit Blue Economy realisation. Westpac NZ's report emphasised the Blue Economy growth opportunities for Aotearoa New Zealand. The scale and scope of the Blue Economy opportunity spans traditional marine industries and emerging sectors driven by technology and sustainability. Current ocean dependent industries contribute an estimated $7-$8 billion to GDP each year, and Westpac NZ notes this could increase to more than $10billion annually by 2035 with coordinated investment and innovation[44].

Three interconnected investment barriers prevent this transition:

- The lack of a coherent national Blue Economy Strategy means global investors face uncertainty about Aotearoa New Zealand's long-term direction, commitment to marine ecosystem health, and policy stability.
- Individual marine sector projects often operate at insufficient scale to attract institutional capital; projects remain fragmented across different sectors, regions, and ownership structures, making it difficult for investors to identify meaningful entry points or construct portfolios of complementary marine assets.
- Chronic underinvestment in the enabling infrastructure for Blue Economy transition particularly marine ecosystem restoration, governance reform, and establishing marine environmental monitoring systems means investors willing to take positions in Aotearoa New Zealand marine sectors face elevated operational costs, regulatory uncertainty, and reputational risks.

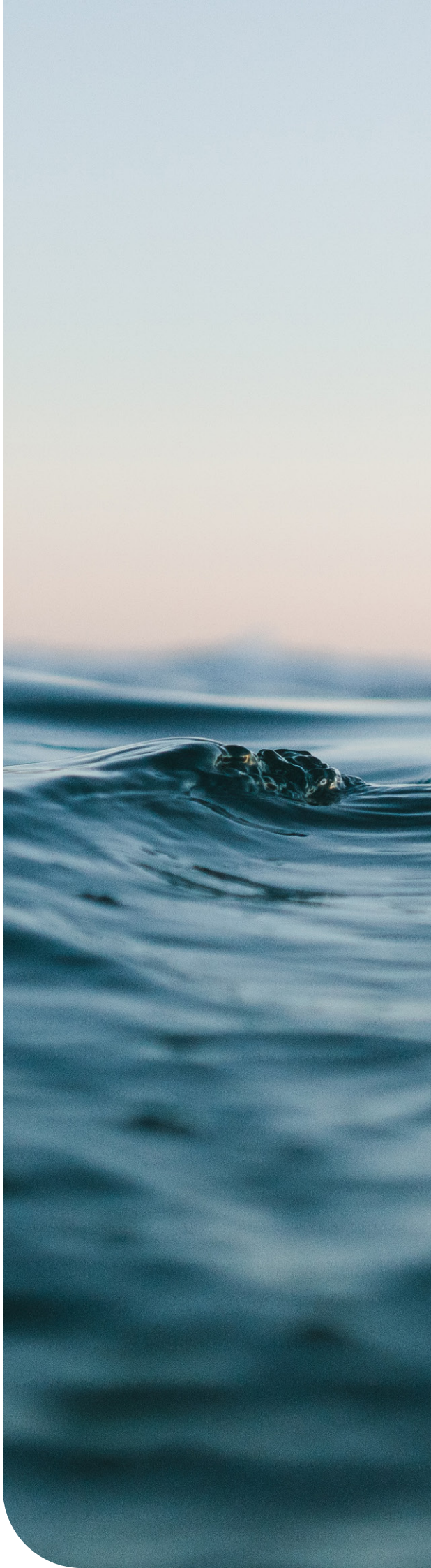
These three factors compound, creating self-reinforcing barriers i.e. without coordinated investment, sector scale remains insufficient; without scale, institutional investors stay on the sidelines; without capital inflows, the governance reforms and natural infrastructure investments required to de-risk the sector never materialise. This leaves existing marine industries struggling to secure sufficient investment to innovate and transition, while potential investors globally remain wary of deploying capital in Aotearoa New Zealand's marine sector.

The opportunity is substantial with broader OECD and Aotearoa New Zealand marine sector assessments indicating total Blue Economy value creation could reach $30–$40 billion annually for Aotearoa New Zealand by 2050 when including advanced aquaculture, marine biotechnology, marine

renewable energy and high value ecosystem services5. This represents tens of thousands of new high value jobs and a significant lift opportunity in export earnings. Integrating economic development with ecosystem-based marine management and te ao Māori principles positions Aotearoa New Zealand as a global leader in sustainable and prosperous ocean management. Breaking through the current investment barrier requires strategic investment, innovation, policy coherence across sectors, and a compelling national narrative that balances economic growth with responsible ocean use[50, 51, 52, 53].

Regional clusters such as **Moananui** in Nelson Tasman and Murihiku Regeneration in Southland quickly demonstrated the growth potential of place based Blue Economy development anchored in marine ecosystem health, iwi leadership and integrated regional planning[54]. **Murihiku Regeneration**, established by the four southernmost Ngāi Tahu runaka, provides a leading example of an integrated regional strategy that anchors sustainable aquaculture and seaweed farming in healthy natural infrastructure while aligning climate response through the Southland Murihiku Regional Energy Strategy 2022 to 2050[55]. This approach prioritises iwi leadership, mātauranga Māori, kaitiakitanga and intergenerational planning[56, 57].

These regional models illustrate the significant potential of collaboration in the Blue Economy, which could be unlocked on a large scale, if supported by a **national Blue Economy strategy**. The strategy would underpin the need for streamlined and efficient marine governance, legislation, policy and management, recognise marine natural infrastructure as core economic infrastructure and enable the information sharing, coordination and policy certainty needed to attract transformative investment.



D. Nature-related dependencies of Aotearoa New Zealand's marine economy

Our marine and Blue Economy must acknowledge, and respond to, the underlying natural infrastructure dependencies.

(i) Economic dependencies of the marine and Blue Economy on natural infrastructure

Figure 2 shows that fisheries and aquaculture activities exhibit consistently exhibit High or Very High dependencies on natural infrastructure. underscoring how tightly the marine economy is bound to the condition of marine and coastal ecosystems. For details on how this data was determined, please refer to Appendix 2 of the main Natural Infrastructure Plan.

The figure shows that core production activities depend on stable coastal habitats, healthy estuaries, functioning riparian margins, predictable water quality and resilient marine vegetation such as kelp, seagrass and mangroves.

This pattern reinforces the section's central message: when these natural systems decline, the ability of the marine economy to produce, transport, and market high-value seafood becomes increasingly fragile. High natural dependencies across almost all activities demonstrate that productivity, biosecurity, market access and coastal protection are inseparable from the health of surrounding natural infrastructure, making ecosystem resilience a foundational requirement for long-term sector growth.

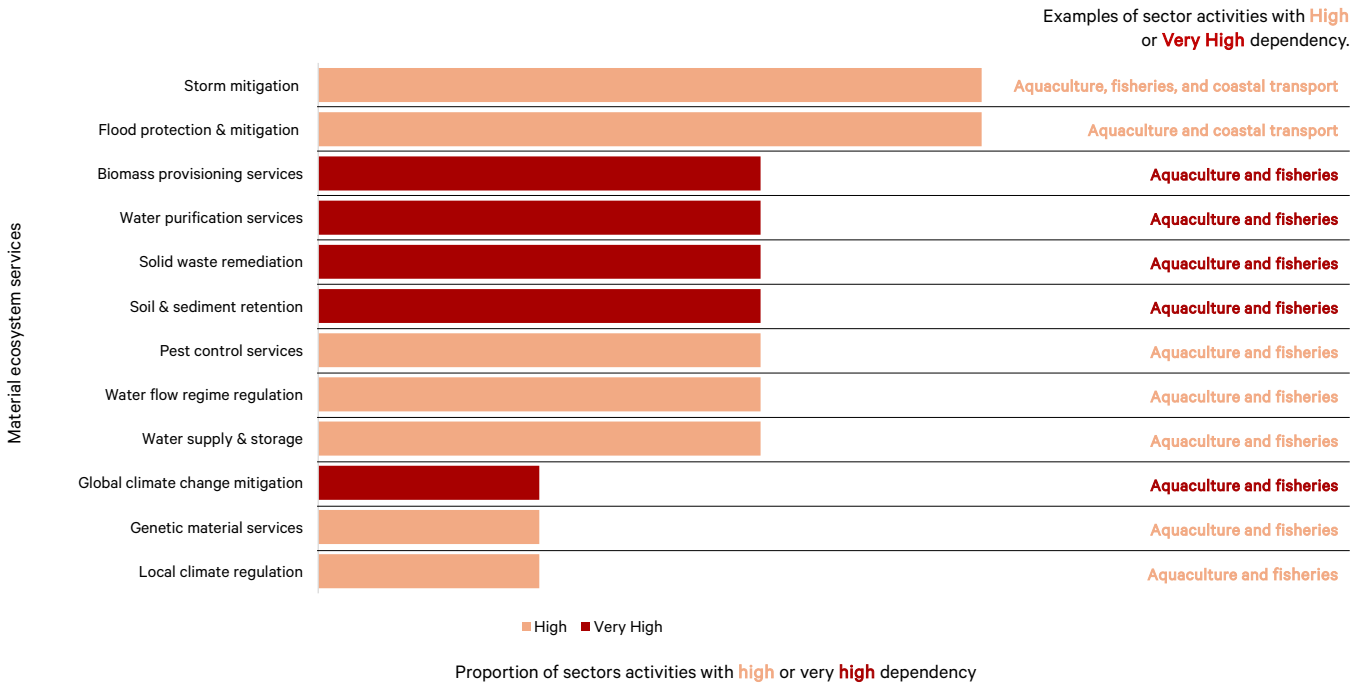


Figure 2: Examples of sector activities with High or Very High dependencies on natural infrastructure.

Table 1 outlines the range of natural infrastructure that the current major marine sector industries depend upon.

Table 1: Key economic activities and dependencies on natural infrastructure[58] [59].

MARINE SECTORS	NATURAL INFRASTRUCTURE DEPENDENCIES
Aquaculture: Sustainable farming of seafood including finfish, shellfish and seaweeds	• Healthy coastal and marine ecosystems (water quality, nutrient cycling) • Seagrass meadows and kelp forests (habitat and water filtration) • Mangroves and salt marshes (water quality, coastal protection) • Coral reefs (biodiversity, water quality) • Natural coastal processes (sediment dynamics, tidal flows)
Biotechnology: Research and development of pharmaceuticals, nutraceuticals and biomaterials derived from marine organisms	• Biogenic reefs (source of bioactive compounds) • Marine biodiversity (genetic resources) • Healthy marine ecosystems (species diversity for bioprospecting) • Coastal and deep-sea habitats (unique organisms)
Ocean Technology: Advanced ocean-related technology	• Baseline ocean health data (ecosystems for monitoring) • Marine ecosystems (testing grounds for technologies) and coastal habitats (deployment sites) • Natural ocean processes (understanding for innovation)
Energy: Harnessing wave, tidal and offshore wind energy	• Tidal systems and coastal dynamics (energy generation) • Seabed integrity (foundation stability) • Coastal ecosystems (minimal disruption required), wave and ocean currents (energy resource). wind patterns over ocean (offshore wind).
Port-related infrastructure:	• Coastal wetlands and mangroves (natural buffers, sedimentation management) • Seagrass beds (water quality, sediment stabilization), biogenic reefs (wave attenuation, coastal protection), natural sediment transport systems • Coastal ecosystems for integrated management.
Tourism and recreation: Eco-tourism, marine sports and cultural experiences	• Biogenic reefs (dive sites, biodiversity attractions), beaches and coastal dunes (recreation, protection), marine megafauna habitats (whale watching, marine experiences) • Mangroves and wetlands (ecotourism experiences) Marine Protected Areas (conservation estate)
Marine ecosystem services: Protection and restoration of marine habitats	• Mangroves (Carbon sequestration, coastal protection, nursery habitat) • Seagrass meadows (carbon storage, water filtration, habitat) • Salt marshes (carbon capture, coastal stabilization), biogenic reefs (biodiversity, wave energy reduction, tourism) • Coastal wetlands (water purification, flood control).

MARINE SECTORS	NATURAL INFRASTRUCTURE DEPENDENCIES
Marine engineering and infrastructure: Innovative infrastructure for aquaculture, energy and transport	• Natural coastal processes (sediment transport, tidal dynamics) • Seabed ecosystems (foundation stability) • Coastal habitats for hybrid solutions (green-grey infrastructure) • Marine biodiversity (ecological design considerations) • Biogenic reefs and oyster beds (inspiration for bio-enhanced structures).

Fisheries and aquaculture depend on healthy aquatic ecosystems

High-value seafood from fisheries and aquaculture depends on healthy marine ecosystems. These ecosystems provide wild fish, crustaceans, molluscs, seaweeds, and other valued marine flora and fauna. A healthy marine environment, including kelp and mangrove forests and seagrass meadows regulates marine species population dynamics, water temperature, and nutrient availability, supporting both primary food production and feedstock for fisheries, whether customary, commercial or recreational, and enables a successful aquaculture sector.

Protection from flooding and storm events is critical.

Riparian vegetation and coastal marine ecosystems such as kelp forests, mangroves, dunes, seagrass meadows, and sand bars provide coastal protection and river flood mitigation services and can protect urban environments and infrastructure.

Extreme weather events and coastal storm surges damage ports and other coastal infrastructure including for aquaculture. This was evidenced in the 23 January 2011 severe Auckland floods during a major storm. Flooding was 0.11 metres deeper and more extensive than another significant event in 1936, with houses inundated and roads closed. Most of the difference in peak water levels for these similarly sized storms can be attributed to a sea-level rise of 0.12 metres since 1936[60].

Weather events also introduce sediments and pollutants into aquatic ecosystems. As these events become more frequent and intense with climate change, our economic dependency on natural infrastructure will increase.

Marine economy activities are also dependent on ecosystem services provided higher up in coastal catchments. Ecosystem and landscape features that maintain sediments, reduce erosion, treat nutrients in storm water runoff, and regulate local climates are important for managing adverse effects before they enter the marine environment.

Without investment in natural infrastructure, Blue Economy development will stall[61].

Healthy ecosystems underpin productivity in fisheries, aquaculture, tourism, and coastal protection[62]. Degraded ecosystems reduce fish habitat, increase sedimentation costs, weaken coastal protection, elevate insurance risk, impact water quality and diminish biodiversity essential for economic activity. Conversely, healthy kelp forests, shellfish beds, seagrass and wetlands reduce operational costs, support climate resilience and enable market access for high value exports.

Maintaining trade and market access is critical.

Market access increasingly depends on verified environmental performance. For example, the UK-New Zealand and EU-New Zealand free trade agreements (FTA) require demonstrated environmental sustainability as conditions of trade access and the UK FTA includes the Mauri of Marine Ecosystems (Article 22.9)[63]. Strategic investment in natural infrastructure is therefore not an environmental add-on but a fundamental prerequisite enabling and accelerating Blue Economy returns.

E. Nature-related impacts from Aotearoa New Zealand's marine economy

Increasing sea-surface temperatures, marine heat waves, ocean acidification, and changing currents[64] are impacting Aotearoa New Zealand's existing marine economy and are likely to continue to do so in coming decades.

(i) Impact drivers.

Figure 3 highlights that marine economic activities face High to Very High exposure to nature-related impact drivers, particularly those linked to sea and coastal water transport, aquaculture, and fisheries. For details on how this data was determined, please refer to Appendix 2 of the main Natural Infrastructure Plan.

The figure shows that climate-driven hazards such as storm surge, sea-level rise, coastal erosion, and marine heatwaves create concentrated risks for the sectors that rely most heavily on stable coastal environments and healthy marine ecosystems. These impacts act as stress multipliers: degrading habitats, disrupting transport networks, increasing contamination events, and raising operating costs across ports, vessels, farms, and processing facilities. The prevalence of High and Very High impact scores across almost all aquaculture and fisheries activities reinforces the section's core message that the Blue Economy's vulnerabilities are systemic rather than isolated. Without stronger natural infrastructure and more coherent governance, these compounding pressures will continue to undermine productivity, reliability, and investment confidence.

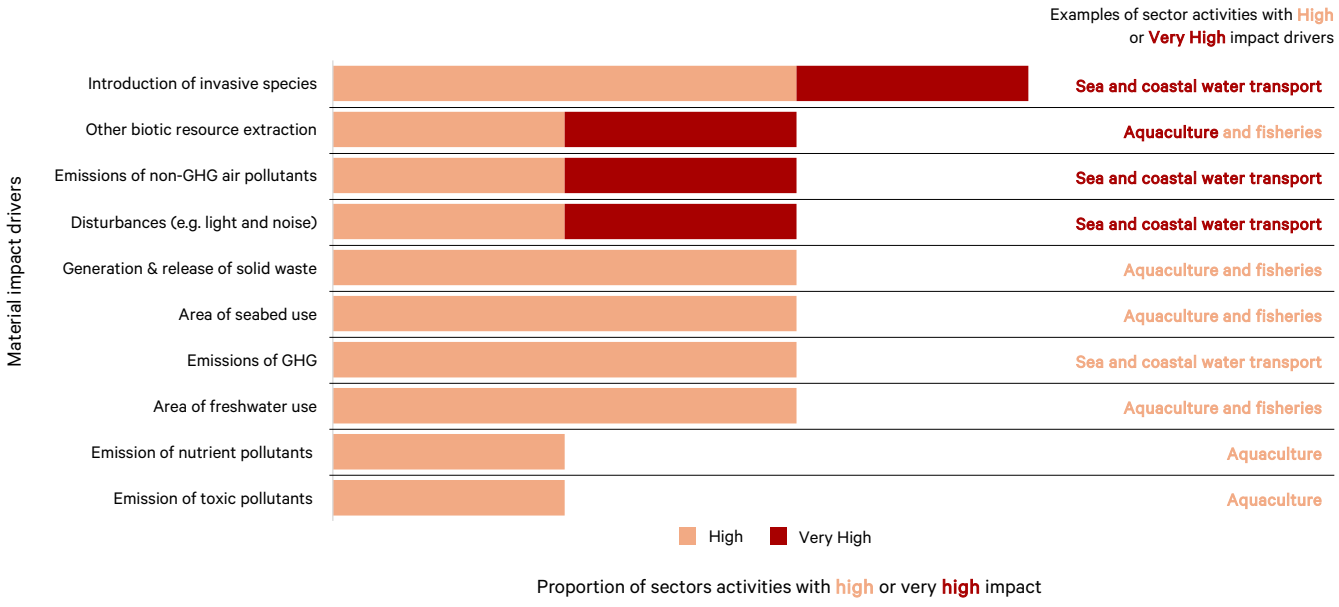


Figure 3: The marine and Blue Economy greatest impact drivers on natural infrastructure, with examples of sector activities with High or Very High impact drivers

Marine economy activities impact other biotic resources.

Marine fisheries impact marine ecosystems through unintended catch and overfishing threatening biodiversity[65]. A range of activities including trawling, dredging, laying submarine cables and other construction at sea disturbs the seabed which is a significant carbon store[66]. Along with threats to biodiversity risks, this benthic disturbance reduce marine ecosystem resilience. Bycatch continues to contribute to population decline and extinction risk of some protected species. Marine mammals such as Hector's dolphin and New Zealand sealions, seabirds, and some protected corals are often caught as commercial bycatch. In 2024-24, 15 Hectors' dolphin, 477 fur seals and sea lions, 2,225 seabirds, 6,704 kgs of protected coral were reported as bycatch in New Zealand waters[67].

Pollutants from land-based activities create heavy impacts.

Sedimentation naturally occurs through storm events and comes from terrestrial economic activity e.g. forestry and farming. Sediment, urban run-off and other pollutants enter streams and rivers, which flow into the ocean. These can cause high impacts on coastal natural assets and can spread out for kilometres beyond the initial river mouth or estuary, driven by tides, wind and currents. In the marine environment this alters habitats, reduces foraging opportunities, and smothers sensitive species such as kelp and pāua[68]. These impacts are being exacerbated by more frequent and severe extreme weather events due to climate change. A Natural Resource Sector Sustainable Business Council study of the decline of the Marlborough Sounds pāua fishery 2001-2014 estimated a $20 million dollar drop in pāua quota value in parallel with the marine environmental change there[69].

Marine economy activities and climate change increase the risks from invasive species.

Non-native marine species are being introduced continually to Aotearoa New Zealand waters, usually carried by ballast water or on the hulls of ships and recreational vessels. As of 2022, a total of 428 non-native marine species have been found in Aotearoa New Zealand waters, of which 62% of these have established populations. Additionally, Climate change increases the chance that established aquatic pests will spread further, reproduce faster, and have more severe adverse impacts on the Blue Economy. Higher water temperatures and marine heatwave events may also increase the risk of new invasive pests and diseases becoming established[70].

F. Natural infrastructure related challenges for moving towards a Blue Economy

Aotearoa New Zealand's ocean ecosystems face escalating pressures, creating interconnected challenges that undermine Blue Economy growth aspirations.

1. **Climate change** drives ocean warming, acidification, and intense marine heatwaves that disrupt fisheries and aquaculture by altering species migration patterns and survival conditions, facilitating invasive species spread and destabilizing fishery stocks[71] [72]. These climate impacts compound existing infrastructure challenges and rising sea levels and increased extreme weather events increase the risk of port disruption and potential relocation[73].
2. **Land-based disturbances** exacerbate ecosystem degradation significantly. Marine sedimentation from wetland reclamation, coastal construction, dredging, bottom trawling, and agricultural runoff reduces light penetration, smothers biomass, and, especially when combined with marine heatwaves, alters marine chemical composition, threatening native species survival and diminishing biodiversity[74]. The resulting degradation directly increases operational costs across all Blue Economy sectors; sedimented estuaries increase port dredging expenditures by millions of dollars annually while impairing aquaculture productivity[75]. Invasive caulerpa seaweed threatened over **$100 million in value** derived from fishing activities in the Hauraki Gulf and **$45 million in biodiversity value76 77.**
3. **Degraded seaweed forests** reduce fish populations, undermining fishing opportunities and revenue, and diminish tourism appeal and carbon sequestration capacity[78]. Sedimented estuaries increase infrastructure costs and reduce productivity across multiple sectors[79] [80]. Lost coastal wetlands eliminate protective services valued at billions of dollars, raise insurance premiums, and remove carbon sequestration potential. **Only 10% of Aotearoa New Zealand's original wetlands remain,** representing massive loss of natural coastal protection and nursery habitat although fortunately community-based, mana-whenua-led, and private landowner wetland restoration is beginning to turn this around[81].
4. **Marine governance and management could be rationalised:** As at least 13 reviews since 1998 attest, Aotearoa New Zealand's marine governance, policy, and management arena is overly complex with 25 statutes administered by 14 different agencies across seven spatial jurisdictions[82].

   For marine economy businesses, and other organisations, these governance and management arrangements are resource intensive, time consuming and inefficient to navigate. Additionally marine ecosystem data disaggregation and information gaps impede accountability and risk assessment, while fragmented governance, insufficient commercial scale and limited institutional capacity also deter investment[83].

   The Sustainable Seas National Science Challenge significantly improved the marine management research, information and knowledge base yet its findings are not being systematically applied in Aotearoa New Zealand.

   The United Kingdom, for example, over a decade, tackled the necessary comprehensive ocean governance reform in establishing the Marine Management Organisation. This has integrated both regulation and marine planning providing certainty for stakeholders and enabling ecosystem-based management[84].
5. **Simultaneous strengthening is required across traditional infrastructure, through improved monitoring, enforcement, information processing and analysis capability, as well as through investment in natural infrastructure restoration.** Efficiently addressing these challenges requires integrated approaches which restore marine ecosystems while building institutional capacity and physical assets capable of enforcing sustainable practices, monitoring environmental conditions, and enabling Blue Economy development[85]. Infrastructure investment alone cannot succeed without parallel ecosystem restoration, and restoration efforts will not be durable without supporting governance, operational capability and sustainable financing mechanisms[86].

G. Blue Economy growth opportunities presented by natural infrastructure

For Aotearoa New Zealand, marine-related natural infrastructure represents a combined climate action strategy, financial risk management mechanism, and economic development instrument that delivers environmental and social benefits alongside measurable financial returns[87].

Investing in marine natural infrastructure creates a strategic win-win for Aotearoa New Zealand, protecting and restoring ecosystems, responding to climate change while **increasing economic resilience and unlocking new revenue streams.**

1. **Natural infrastructure provides cost-effective coastal protection** as climate impacts intensify. Wetlands and coastal marine flora attenuate wave energy and reduce flooding risk, protecting infrastructure assets worth billions while reducing financial risk for insurers[88, 89]. Strategic investments in sedimentation reduction and sustainable fishing enable coastal seaweed and seagrass recovery, which functions as critical fisheries nurseries and carbon sinks.
2. **Natural infrastructure investment delivers multiple simultaneous benefits, including economic efficiency gains.** Restored wetlands eliminate pollutants and reduce port dredging costs by millions annually while supporting aquaculture operations[90, 91]. Healthy seagrass meadows support both fisheries productivity and carbon sequestration, enabling sectors to meet the sustainability credentials increasingly demanded by international markets. Restored natural infrastructure reduces financial risk, increases sectoral certainty, strengthens climate resilience, and enables sustainable economic growth [92, 93].

(i) The investment case for natural infrastructure

Marine natural infrastructure delivers measurable value across marine economy sectors. Wetlands and shellfish filter pollutants and process nutrients, reducing port dredging costs by millions annually while supporting aquaculture and tourism[94]. Blue carbon ecosystems create potential carbon and biodiversity credit revenue and support emissions reduction targets[95]. **Tourism, worth over $1.2billion annually, depends on pristine beaches, clear waters, and healthy marine life[96, 97 98, 99].**

The investment case for natural infrastructure is compelling and measurable. Every dollar invested in marine ecosystem restoration returns between $2 -$12 in societal benefits through avoided damage, reduced operational costs, and enhanced productivity.

Kelp forests generate fisheries value of $29,851 per ha yearly (Ha/yr) while sequestering 28-52 tonnes of CO^2 (Ha/yr). Blue carbon ecosystems sequester carbon at rates ten times greater than terrestrial forests, with kelp drawing down 28-52 tonnes of $CO^2{}_2$ per hectare annually, of which an estimated 11% may be sequestered for millennia via submarine canyons unique to Aotearoa New Zealand's geography, and at rates that are ten times greater than mature terrestrial forests.

The Hauraki Gulf ecosystem services are valued at over $5billion annually, with total natural assets estimated between **$40-100billion[100].**

Table 2: Marine natural infrastructure types and their economic values in Aotearoa New Zealand[101] [102] [103]

NATURAL INFRASTRUCTURE TYPE	KEY ECOSYSTEM SERVICE(S)	ECONOMIC VALUE ($/HA/YEAR)	EXAMPLE
Kelp Forests	Fisheries habitat, carbon sequestration (28-52 tCO^2/ha/yr), coastal protection	$29,851 fisheries value	Hauraki Gulf: 7.9M potential carbon value from current forests
Mussel Reefs	Water filtration, biodiversity habitat, coastal stabilization	2-4 times Return on Investment. Restoration investment reduces port dredging costs by millions annually	Pelorus Sound: 4-year research shows high survival rates, Hauraki Gulf 7 million mussels 2024
Coastal Wetlands	Carbon storage (4x terrestrial forests), flood protection, water purification	$625 million in avoided damage (Hurricane Sandy equivalent)	Pūkorokoro-Miranda: Blue carbon pilot site
Seagrass Meadows	Nursery habitat, water filtration, carbon storage	Part of $5 billion Hauraki Gulf ecosystem services	Multiple restoration sites in Te Tauihu region

H. Innovative examples of natural infrastructure in the current marine economy

1. Ports as natural infrastructure stewards.

Lyttelton Port Company is a leader within Aotearoa New Zealand's port sector in nature-related financial disclosures, investing an estimated $200,000 annually in biodiversity monitoring and reporting across Whakaraupō Harbour. Their assessment identified critical economic dependencies on harbour health for stormwater dilution, recreational access, and mahinga kai values, with degraded water quality potentially increasing operational costs by 15-20%[104].

The Port of Tauranga's living seawall initiative, co-funded with Tauranga Council at approximately $180,000, deploys 100 sea pods creating 36% more biodiversity than conventional seawalls, with monitoring by the University of Waikato showing successful colonisation by glass shrimp, cushion stars, and juvenile fish within 12 months[105].

The Port of Nelson's Living Filters trial, supported by $75,000 from the Government –funded Sustainable Seas National Science Challenge, suspended nearly 29,000 greenshell mussels from wharf structures, achieving 8-11mm growth in six weeks while filtering urban runoff from the Maitai River estuary[106]. Projected scaling could reduce port dredging costs by $1.2 million annually and improve water clarity by 30%, demonstrating that natural infrastructure delivers measurable financial returns through reduced maintenance and enhanced operational resilience[107].

2. The Hauraki Gulf - an integrated natural infrastructure asset.

The Hauraki Gulf/Te Moananui-ā-Toi now represents Aotearoa New Zealand's largest blended finance marine restoration initiative, mobilising $26million through combined government ($6million) and NEXT Foundation ($20million) funding[108, 109].

In parallel, in July 2024, Ngāti Manuhiri Settlement Trust deployed seven million kūtai (green-lipped mussels) into Kawau Bay as part of the Revive Our Gulf partnership, creating ecosystem services valued at $5 billion annually across the marine park[110, 111].

This natural infrastructure directly underpins $29.8million in commercial fishing, $292million in cruise tourism[112], and $83.3million in aquaculture revenue, with the Gulf's total natural assets delivering economic value of between $40-100billion[113, 114].

The Sea Change Tai Timu Tai Pari marine spatial plan[115], established through co-governance between mana whenua and government agencies, provides the institutional framework that coordinates these investments. The plan's implementation has delivered a 40% increase in marine protection coverage and established monitoring protocols tracking urchin removal success and kelp forest regeneration, demonstrating that integrated natural infrastructure management can simultaneously restore ecosystems and sustain economic outputs across multiple marine economy sectors[116, 117].

3. Iwi/Māori-led marine restoration as economic development.

Ngāti Whātua Ōrākei's Ōkahu Bay restoration demonstrates leadership in marine infrastructure management, deploying 60 tonnes of kūtai in November 2021 with co-investment from the hapū, the University of Auckland Institute of Marine Science, and The Nature Conservancy[118, 119]. This three-year experiment, monitoring survival on shell versus sediment substrates, targets restoration of pātaka kai values and generates scientific knowledge valued at $450,000 in research funding[120].

Ngāti Manuhiri's Kawau Bay mussel deployment integrates cultural tourism experiences with reef restoration, creating employment for six iwi members and attracting $120,000 in visitor revenue[121].

In Southland, **Murihiku Regeneration** coordinates the southernmost Ngāi Tahu rūnaka strategy combining aquaculture pathway development ($272million current annual value) with Greenwave Aotearoa seaweed pilot farms and energy transition planning. The region's emerging Blue Economy cluster targets billion-dollar industry potential within 20 years, with seaweed farming providing ecosystem services including carbon sequestration at 28-52 tCO^2/ha/year while diversifying beyond traditional fisheries[122].

Contact us

This report forms a key part of a wider Natural Infrastructure Plan.

For questions or additional information on the Natural Infrastructure Plan please reach out to The Aotearoa Circle.

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Appendix 1: Recommended next steps to support developing a Blue Economy strategy

Immediate timeframe (six months)

Map the opportunity, sector maturity and growth potential:

- ❑ Conduct a comprehensive mapping of marine economy sectors based on their maturity, policy needs and support, investment readiness, environmental and ecological challenges, and economic growth potential[123, 124, 125].
- ❑ Identify success stories (domestically and internationally), current barriers, and enabling conditions to guide strategic investment and policy development[126, 127].

Engage with all key actors in the current marine economy:

- ❑ Proactively involve stakeholders from sectors not currently well represented such as those working in marine minerals and non-living marine resource extraction, shipping, offshore energy production, and investment[128, 129]. Their inclusion will broaden the scope of opportunity, strengthen cross-sector collaboration, build capability and facilitate financing[130].

Convene a Blue Economy roundtable with the 'coalition of the willing':

- ❑ Establish a multi-stakeholder roundtable group to bring together Blue Economy business leaders, iwi representatives, scientists, innovators, policymakers, and financial experts.
- ❑ The group should build a compelling business case and develop a Blue Economy Strategy to secure government and private sector funding and buy-in to enable a sustained Blue Economy growth strategy[131, 132].

Short-term timeframe (12 months)

Attract seed fund early-stage coordination:

- ❑ Seek initial funding to establish a collaborative Aotearoa New Zealand Ocean Business Leaders[133]/Blue Economy Roundtable for a defined period and support short-term priority actions[134, 135, 136]. This funding should be co-sourced from government, corporate partners, iwi/Māori, philanthropy and importers, and potential international collaborators (e.g., Horizon Europe, global investors, philanthropy)[137].

Develop a national Blue Economy Strategy:

- ❑ Co-create with Blue Economy sectors, including those sectors that have strong iwi/Māori leadership, a comprehensive national strategy that outlines a pathway for Aotearoa New Zealand to grow blue prosperity while restoring marine ecosystems, enhancing climate resilience, and unlocking new forms of capital[138, 139]. This strategy should include narrative on the necessary policy and regulatory efficiencies and other enablers[140].

Heighten political attention regarding the opportunity and use this to attract investment:

- ❑ Leverage the Blue Economy Strategy and sector success stories to build a compelling investment narrative. This will help attract additional capital to scale up growth opportunities across sectors[141, 142, 143].

The Natural Infrastructure Plan, including its associated separate parts, have been prepared by The Aotearoa Circle in collaboration and consultation with Circle Partners and other key stakeholders to stimulate discussion, improve understanding and support consideration of nature as critical national infrastructure. The plan reflects the views at the time of publication and is intended for general information purposes only.

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The Aotearoa Circle

Mā te Kaitiakitanga ko te Tōnuitanga
Prosperity Through Guardianship

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