

An aerial photograph of the Cawthron Science Centre, a large facility with multiple buildings and parking lots, situated on a coastal plain. The center is bordered by a wide, light-colored sandy beach and the turquoise waters of the sea. To the right of the main building complex are several large, rectangular, light-blue ponds or reservoirs. The background features rolling green hills and distant mountain ranges under a bright blue sky with scattered white clouds. A dark blue semi-transparent overlay covers the upper left portion of the image, containing the title and logo.

Mai i ngā Maunga ki te Moana: The Cawthron *Science Plan*



Contents

Executive Summary.....	1
Preface.....	2
About This Science Plan.....	2
The Context for Cawthron's Science.....	3
The Opportunity Landscape.....	4
Science Missions.....	9
Transformational Science Platforms.....	16
Enablers for Knowledge Development and Impact.....	18
List of Acronyms.....	20

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Dr Cath McLeod, Chief Science Officer
cath.mcleod@cawthron.org.nz
www.cawthron.org.nz



Executive Summary

Cawthron's refreshed Science Plan, Mai i ngā Maunga ki te Moana, sets a clear pathway for amplifying our impact in Aotearoa New Zealand and the wider Pacific.

It focuses on advancing the sustainable use of marine and freshwater resources while delivering enduring environmental, economic, and community benefits. Grounded in more than a century of independent research and guided by our purpose Bold Science. Deep Care. Thriving Oceans, the Plan outlines solutions-focused science to drive progress toward resolution of the tripartite challenges of climate change, biodiversity loss, and food security.

The Plan recognises aquatic ecosystems as a foundation of community and environmental health, wellbeing, and prosperity, and responds to the currently complex national and international context which is shaped by environmental degradation, rising biosecurity and food safety risks, and shifting political, regulatory, and societal expectations. The Plan identifies the science that Cawthron can conduct which will make the greatest difference: regenerating and sustaining ecosystem health, enabling sustainable blue value creation within ecological limits, and reducing risks to people, ecosystems, and the economy through trusted monitoring, diagnostics, prediction, and decision support.

The Plan brings this focus to life through three Science Missions that reflect the interconnected environmental, social, and economic challenges facing Aotearoa New Zealand:

- **Mission 1: Supporting Thriving Ecosystems and Communities**
Enhancing Marine and Freshwater Environments.
 - **Mission 2: Sustainable Blue Growth**
Unlocking the Potential of Ocean and Freshwater Resources.
 - **Mission 3: Managing Risks**
Protecting People, Aquatic Environments, and the Economy from Threats.
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To extend our ambition beyond current programmes and deliver impact, the Plan identifies four long-term Transformational Science Platforms that cut across the missions:

- **Mountains-to-Sea: Te Taihu**
Restoring thriving aquatic systems.
- **Advancing Ecological Aquaculture**
Food within planetary limits.
- **Navigating Blue Climate Solutions**
Enabling safe, scalable, and nature-positive solutions for climate stability.
- **Oceans to Tables: Pacific Blue Foods**
Building Pacific led, climate-resilient aquatic food systems.

Successful delivery will be enabled by investment in people, capability, and research infrastructure. This includes strengthening training and career pathways, future-focused research infrastructure, data stewardship and digital decision support, responsible use of AI to accelerate insight, deeper partnerships across knowledge cultures, and a coordinated revenue and investment approach. Developed through a cross-Cawthron process and reviewed biennially, the Science Plan serves as an internal compass to align effort, collaborate at scale, and translate bold science into lasting outcomes.

Cawthron is well placed to deliver this Science Plan because our unique position in Aotearoa New Zealand's science landscape enables us to convene partners, integrate disciplines, and translate knowledge into action at pace.

In particular, our independence allows us to act as a trusted intermediary on sensitive issues; our breadth of in house expertise lets us tackle complex, interconnected challenges through integrated programmes; and our culturally grounded partnership approach supports genuine transdisciplinary solutions across knowledge systems.

Together, these strengths provide the foundation for delivering the missions, scaling impact through the transformational science platforms, and operationalising the Plan in practice.

Preface

Cawthron's science is grounded in more than a century of independent research, consulting and analytical testing.

Guided by our purpose *Bold Science. Deep Care. Thriving Oceans*, we are driven by the belief that healthy rivers, lakes, oceans and people are deeply interconnected. Our refreshed Science Plan builds on this belief and embodies the ambition to (a) advance the sustainable use of marine and freshwater resources and (b) deliver lasting benefits for the environment, the economy and our communities. Achieving both of these objectives will be challenging, but we believe Cawthron is well placed to balance these goals and provide the national and international leadership to achieve them.

Using our strengths across key science domains and crosscutting capabilities, the Plan strengthens our ability to deliver impactful, solutions-focused science at a time when it is urgently needed. It sharpens our collective attention, guiding where to direct our efforts to address climate change, biodiversity loss, and pollution as stress multipliers of the global planetary crisis. Most importantly, it calls on all of us to act - to lead, to collaborate, and to bring this Plan to life with purpose and momentum.

What the plan seeks to achieve

The Science Plan sets out a pathway for Cawthron to amplify its impact and advance its purpose of supporting thriving oceans and freshwater ecosystems. It provides an internal compass that guides where we dedicate our time, effort, and resources so our collective work drives meaningful change. By bringing people together around shared missions and transformational science platforms, the Plan fosters cohesion, collaboration, and opportunities for staff to step into leadership roles as part of a unified effort to deliver outcomes that matter for Aotearoa New Zealand.

How was the plan developed?

The Science Plan was developed through a cross-Cawthron process. Guided by Te Arahanga Āio and informed by broad staff input gathered through workshops, surveys, and written and verbal feedback, the Plan reflects a collective, organisation wide effort. To ensure it remains relevant, effective, and aligned with emerging priorities, it is reviewed on a biennial basis.

Who is our Science Plan for?

The Science Plan is for everyone at Cawthron. It is designed to guide and support all staff, including those that have support or enabling roles within the Institute, such as our Corporate Support, Commercial Development, and People and Capability teams. This Plan covers Cawthron's research and consulting activities; Cawthron Labs are developing their own goals and plan.



The Central Role of Aquatic Ecosystems in Aotearoa New Zealand

Aotearoa New Zealand is defined by water. Our identity, culture, economy, and wellbeing are inseparable from the health of our oceans, rivers, lakes, and wetlands. As an island nation with one of the largest ocean territories on Earth, and freshwater systems that underpin ecosystems and livelihoods from mountains-to-sea, the stewardship of aquatic environments is both **a national responsibility and a global opportunity**.

Cawthron's science is grounded in this watery reality. For more than a century, Cawthron has worked at the interface of people, water, food and aquatic ecosystems to develop knowledge, tools, and solutions that support thriving aquatic environments and the communities that depend on them. This Science Plan responds to the scale and urgency of challenges facing our aquatic systems, while setting out how Cawthron can accelerate progress with care through solutions-focused science.

The Importance of the Ocean

The ocean is Aotearoa New Zealand's largest natural asset. It covers 96 percent of our area of jurisdiction, supports biodiversity of global significance, regulates climate, and underpins major industries including fisheries, aquaculture, tourism, and maritime trade. The ocean also holds deep cultural importance for Māori and Pacific peoples, shaping identity, whakapapa, food systems, and relationships with place and communities.

Globally, oceans play a critical role in regulating the earth's climate, absorbing heat and carbon dioxide, cycling nutrients, and supporting food systems for billions of people. Healthy marine ecosystems provide resilience against climate impacts, support sustainable economic development, and contribute to human wellbeing in ways that are increasingly recognised but still undervalued.

For Aotearoa New Zealand, the opportunity is twofold: (1) to safeguard ocean health, and (2) to unlock high-value uses of marine resources that operate within ecological limits. Achieving this requires science that integrates ecological understanding with innovation, monitoring, and decision support, ensuring development is environmentally responsible and socially beneficial.

The Importance of Freshwater Systems

Freshwater systems, rivers, lakes, wetlands, and groundwater are the lifeblood of terrestrial and aquatic ecosystems. They sustain biodiversity, enable food production, supply drinking water, provide power, support recreation, and hold deep cultural significance. Freshwater systems connect land and sea, transporting nutrients and sediments across catchments and into estuaries and coastal environments.

In Aotearoa New Zealand, freshwater health is inseparable from land use, climate, and community wellbeing. Rivers and lakes shape regional identity and are central to mātauranga Māori, with strong connections to mahinga kai, kaitiakitanga, and intergenerational stewardship.

Protecting and restoring freshwater systems is, therefore, not only an environmental imperative, but a social and economic one. Science plays a critical role in understanding pressures on freshwater systems, identifying safe environmental limits, and supporting effective, inclusive decision-making that balances competing values and uses.





Challenges Facing Aquatic Systems in Aotearoa New Zealand

Despite their importance, Aotearoa New Zealand's aquatic systems are under increasing pressure. Decades of land use intensification, urbanisation, and infrastructure development have contributed to declining freshwater quality, habitat loss, and biodiversity decline. Many rivers, lakes, and wetlands have been degraded, with impacts that cascade from catchments to coastal ecosystems.

Marine environments face parallel challenges. Climate change is altering ocean temperatures, chemistry, and circulation, increasing the frequency and severity of marine heatwaves, harmful algal blooms, and marine pest and pathogen outbreaks. Coastal ecosystems are under enormous pressure from cumulative impacts associated with development, sedimentation, pollution, and emerging ocean uses.

These challenges are complex, interconnected, and dynamic. They span ecological, social, cultural, and economic dimensions, and cannot be addressed through single discipline nor short term approaches. There is an urgent need for integrated science that supports regeneration, enables sustainable development, manages risk, and builds resilience in the face of ongoing change. These environmental challenges are occurring alongside significant political, regulatory, and social change, further shaping how aquatic protection and resource development decisions are made in Aotearoa New Zealand.

Political and Social Context

Aquatic protection and resource development in Aotearoa New Zealand are shaped by a complex and contested political and social

landscape. The current Government in 2026 is strongly focused on economic growth, prioritising infrastructure delivery, aquaculture expansion, and faster consenting processes. Reforms such as the local government reform and Fast Track Approvals Act are intended to accelerate development but have raised concerns about reduced environmental scrutiny, cumulative impacts, and the treatment of local and cultural values.

At the same time, environmental funding has tightened, increasing pressure on councils, iwi, and communities to deliver protection and restoration outcomes. Aquaculture growth remains a national priority under MPI's 2035 goals, yet progress is constrained by competing coastal uses, consenting complexity, and ecological limits. Overlaying this are ongoing Treaty and Indigenous rights considerations, including Wai 262 and Māori settlement processes, reinforcing expectations for rangatiratanga and kaitiakitanga in aquatic decision-making.

The Opportunity Landscape Across Aquatic Systems

Aotearoa New Zealand's future is closely bound to the health, productivity, and stewardship of its aquatic systems. Our oceans, rivers, lakes, wetlands, and estuaries underpin biodiversity, food systems, cultural identity, community wellbeing, and economic prosperity. They also sit at the frontline of climate change, environmental degradation, and competing demands for use.

Taken together, these systems present a diverse and interconnected set of opportunities (Table 1), some well established, others emerging, and all dependent on strong science to ensure they are realised responsibly and within environmental limits. Understanding this opportunity landscape is essential for shaping where science effort is best focused, and where it can deliver the greatest long-term value for Aotearoa New Zealand and the wider Pacific (i.e. Te Moana nui a Kiwa).

Table 1: Aquatic Opportunity Landscape:
Where Science Can Make the Greatest Difference

Opportunity Area	Opportunity Potential	Primary Value Created	Primary Science Mission Link
Aquaculture (marine & freshwater)	High growth potential	Sustainable food, exports, jobs, bioactives	Sustainable Blue Growth
Bioactives & Bioproducts	High-value, low-footprint	Health, nutrition, advanced materials	Sustainable Blue Growth
Biosecurity, Mitigating Pests and Diseases	High avoided-cost value	Protection of ecosystems, industries, health	Managing Risks
Food Safety Risk Reduction	High avoided-cost value	Protection of ecosystems, industries, health	Managing Risks
Ecosystem Restoration & Regeneration	High community-value opportunity	Biodiversity, water quality, resilience	Supporting Thriving Ecosystems and Communities
Climate Adaptation and Water Security	Foundational, system-wide	Resilient ecosystems and communities	Supporting Thriving Ecosystems and Communities
Climate Regulation via Aquatic Systems	Globally significant	Climate mitigation, resilience	Supporting Thriving Ecosystems and Communities / Managing Risks
Environmental Monitoring & Data Systems	Enabling, high leverage	Decision-making, transparency, forecasting	All Missions
Natural Capital & Ecosystem Services	Growing policy relevance	Better planning, investment, governance	Supporting Thriving Ecosystems and Communities
Cultural Wellbeing and Community Stewardship	Enduring, system-wide	Cultural vitality, wellbeing, stewardship, social license	All missions
Tourism & Recreation	Mature / dependent on ecosystem health	Regional income, wellbeing, cultural connection	Supporting Thriving Ecosystems and Communities
Developing Sustainable Management Practices for Blue Resources	Multi sectoral (ports, irrigation, power, aqua etc), ongoing and enduring	Supports both environmental and economic prerogatives	All missions
Ocean-Based Energy Generation	Long-term growth, emerging	Low-carbon energy, infrastructure	Managing Risks
Wild Fisheries	Established / constrained	Food supply, regional economies, cultural value	Managing Risks
Marine Mining	Uncertain / contested	Potential resource value	Managing Risks

Established and Emerging Aquatic Sectors

Traditional aquatic sectors such as wild fisheries and tourism continue to play an important role in regional economies and national identity. However, many of these sectors are now constrained by ecological limits, social licence, and/or climate impacts. In these contexts, future value is less likely to come from increased extraction or intensity, and more from improved management, ecosystem regeneration, value addition, and resilience.

In contrast, aquaculture represents one of the most significant growth opportunities across marine and freshwater systems. With the right science, innovation, and governance, aquaculture has the potential to deliver very large amounts of nutritious food, bioactive products, and economic growth while operating within ecological limits.

The opportunity is not simply one of scale, but of transformation, shifting toward regenerative, climate-resilient systems that enhance ecosystem function and social outcomes alongside production. There is a critical need to understand, develop and continuously evaluate ecological limits to support regenerative approaches.

Aligned to aquaculture, bioactives and bioproducts derived from marine and freshwater organisms represent a high-value, low-footprint opportunity. These applications, spanning nutrition, health, materials, and industrial uses, can generate significant economic and societal value from relatively small biomass inputs, particularly when integrated with aquaculture, algae cultivation, and biotechnology innovation.

Other sectors, such as ocean-based energy generation and marine minerals, are often cited as future opportunities, but carry higher levels of uncertainty, risk, and debate. Existing sectors such as agriculture, forestry, hydropower and transport all utilise aquatic resources (e.g. irrigation) and impact aquatic ecosystems. These activities require particularly robust, independent science to inform decision-making, and enable better management of cumulative impacts. In these domains, the opportunity for science lies as much in risk reduction and stewardship as in enabling development.

Environmental and Nature-Positive Opportunities

Alongside sector based activities, there is a growing set of environmental and nature-positive opportunities that are increasingly recognised as central to long-term prosperity and wellbeing.

Ecosystem regeneration of rivers, lakes, wetlands, estuaries, and coastal environments, offers one of the most powerful opportunities to deliver multiple benefits. Healthy aquatic ecosystems support biodiversity, improve water quality, enhance fisheries productivity, buffer climate impacts, support livelihoods and wellbeing, and strengthen cultural and community connections to place.

Closely linked is the opportunity to better recognise and manage natural capital and ecosystem services. Aquatic systems provide services such as water purification, flood mitigation, carbon storage, habitat provision, and social and cultural value, yet these benefits are often undervalued or invisible in decision-making. Science that can measure, model, and communicate these services creates opportunities for better planning, investment, and governance.

Water security and climate adaptation represent another critical opportunity. As climate change intensifies, there is a growing need for integrated science that supports adaptive management of rivers, lakes, aquifers, and connected coastal systems. Protecting water quality and security is foundational for ecosystems, food systems, and communities, and is increasingly central to policy, iwi priorities, and regional resilience.

Biosecurity, disease prevention, and food safety risk management generate high returns on investment primarily by preventing losses rather than by increasing production. Early detection of pests, pathogens, and harmful algal blooms plus system level approaches to reduce or neutralise risks are essential to protect ecosystems, industries, and public health. In many cases, the benefits of effective risk management far exceed the returns from extractive activities.

Finally, environmental monitoring, data, and digital infrastructure can underpin and enable sustainable aquatic activity. Advances in sensors, molecular tools, modelling, and data platforms create opportunities for real-time insight, early warning, and adaptive management at scales previously not possible. These capabilities are increasingly exportable and position science as an enabler of transparency, trust, and accountability.

Supporting Community and Environmental Stewardship

Across Aotearoa New Zealand and the Pacific (Te Moana nui a Kiwa), aquatic environments are inseparable from identity, culture, wellbeing, and intergenerational responsibility. Rivers, lakes, coasts, and oceans are not only ecological systems or economic assets; they are places of meaning, underpinning whakapapa, mahinga kai, customary practice, community cohesion, and mental and spiritual wellbeing.

There is a growing opportunity for science to actively support cultural wellbeing and community-led stewardship, rather than treating these outcomes as secondary or indirect benefits. This includes science that:

- **Strengthens mātauranga Māori and Indigenous knowledge systems alongside western science;**
- **Supports iwi, hapū, and community leadership in aquatic management and restoration;**
- **Builds local capability to monitor, manage, and care for water bodies over the long-term; and**
- **Reconnects people with aquatic environments in ways that restore trust, agency, and wellbeing.**

This opportunity is increasingly recognised in policy, funding, and community expectations. It is also central to establishing and maintaining social licence, the durability of environmental outcomes, and the success of restoration, aquaculture, biosecurity, and climate adaptation initiatives.

From Opportunity to Focus: Shaping the Role of *Cawthron's Science*

Cawthron's Science Plan reflects a deliberate choice to concentrate effort where our science can make the greatest difference, by regenerating the ecological foundations of aquatic systems, enabling sustainable use within environmental limits, and reducing risks to people, ecosystems, and the economy. This focus recognises that the most enduring opportunities are those that take a systems approach, are inclusive and participatory, based on diverse knowledge, are ecosystem aligned, and capable of generating value without pressuring the environment.

At the core of this approach is a commitment to thriving aquatic ecosystems and communities. Healthy rivers, lakes, estuaries, and oceans underpin biodiversity, climate resilience, prosperity and wellbeing.

Cawthron is prioritising science that strengthens integrated monitoring, defines safe environmental limits, restores connectivity from ridgetop to reef, and delivers innovative, scalable regenerative and nature-based solutions across freshwater and marine environments.

Building on this foundation, Cawthron supports sustainable blue growth, particularly through the marine bioeconomy. Aquaculture, algae, and bioactive innovation offer the most immediate and scalable opportunities to grow value (NZ GDP) from aquatic systems through high-value, low impact pathways.



Science Mission 1



Supporting Thriving
*Ecosystems and
Communities*

Enhancing marine and
freshwater environments

Science Mission 2



Sustainable
Blue Growth

Unlocking the potential
of ocean and
freshwater resources

Science Mission 3



Managing
Risks

Protecting people, aquatic
environments, and the
economy from threats

MISSIONS SET STRATEGIC DIRECTION

TRANSFORMATIONAL SCIENCE PLATFORMS

(long-term platforms that deliver across missions)



Mountains-to-Sea
Te Tauihu

Restoring thriving aquatic
environments



Advancing Ecological
Aquaculture

Food within planetary
limits



Navigating *Blue
Climate* Solutions

Enabling safe, scalable,
and nature-positive
solutions for climate
stability



Oceans to Tables
Pacific Blue Foods

Building Pacific-led,
climate-resilient aquatic
food systems



Introducing Our Three *Science Missions*

To realise our purpose *Bold Science. Deep Care. Thriving Oceans*, we must channel our collective capability toward the areas where Cawthron can create the greatest impact. The refreshed Science Plan brings this focus to life through three major Science Missions, each representing a critical dimension of the environmental, social, and economic challenges facing Aotearoa New Zealand and beyond.

Mission 1: Supporting Thriving Ecosystems and Communities *Enhancing Marine and Freshwater Environments*

After more than a century of aquatic ecosystem degradation and biodiversity loss in Aotearoa New Zealand, there is a critical need for research-based solutions that protect and enhance our river, wetland, lake, estuary, and coastal ecosystems. By actively working with communities to rejuvenate aquatic ecosystems from mountains-to-sea, we will work towards flourishing aquatic environments that sustain our unique biodiversity and revitalise connections between communities and the environment. A key part of our work is to support industries to use aquatic resources more sustainably and to improve their management practices.

Mission 2: Sustainable Blue Growth *Unlocking the Potential of Ocean and Freshwater Resources*

Aotearoa New Zealand's ocean and freshwater bodies present vast opportunities to supply valuable resources while staying within environmental limits. The ocean, making up 96% of our area of jurisdiction but only 3% of GDP, is our largest untapped economic asset. By managing activities within ecological limits, Cawthron aims to advance sustainable aquaculture, transition to high-value and volume aquatic products, and support innovation in marine farming to unlock greater economic and societal benefits.

Mission 3: Managing Risks *Protecting People, Aquatic Environments, and the Economy from Threats*

This mission centres on identifying and mitigating biological, chemical, and ecological risks to communities, ecosystems, and industries. Key focus areas include: (a) developing systems and tools to manage aquatic pests and pathogens, (b) ensuring food safety through hazard identification and risk management, predicting and responding to harmful algal blooms and toxins, (c) understanding climate-driven threats to aquatic systems to build resilience and adaptive strategies for the future, and (d) identifying and reducing sociocultural, economic, and reputational risk.

Science Mission One:

Supporting Thriving Ecosystems and Communities

Enhancing Marine and Freshwater Environments

Context

Across Aotearoa New Zealand, ocean, lake, river, and coastal ecosystems are under sustained pressure from historical degradation and accelerating environmental change. Land use intensification, urban development, and infrastructure have reduced water quality, fragmented habitats, and weakened ecological connectivity between terrestrial and aquatic systems, with cumulative impacts evident in lakes, rivers, estuaries and nearshore marine environments.

Climate change is amplifying these pressures through warming waters, altered flow regimes, ocean acidification, and more frequent extreme events that further reduce ecosystem function and resilience. In many settings, increasing demands on aquatic environments are occurring without clearly defined safe environmental limits, robust indicators of ecosystem health, or integrated monitoring frameworks to support informed decision-making. While biological, pollutant and climate related risks, such as pests, pathogens, chemical contaminants, and harmful algal blooms, are addressed explicitly through Cawthron's Managing Risks mission, their impacts are tightly linked to underlying ecosystem conditions.

These challenges underscore the urgent need for mountains-to-sea science that strengthens integrated monitoring, identifies environmental limits as well as social baseline assessments, restores connectivity, and delivers innovative, scalable regenerative and nature-based solutions to rebuild healthy, thriving aquatic ecosystems. A key part of our work is to support industries to produce and use aquatic resources safely and sustainably.



Vision

A future of thriving aquatic ecosystems that sustain biodiversity and strengthen enduring connections between people, place, and water.

Actions (2026 – 2033)	Partners
1. Integrated Aquatic Monitoring and Indicators: Design and implement state-of-environment monitoring frameworks (including molecular tools), analysis and reporting processes (e.g. LAWA), and develop robust ecological indicators.	Central (MfE, EPA, DOC, StatsNZ) and regional government.
2. Expand Cawthron's Ocean Observing System with new sensors and sites enabling environment change monitoring and data-driven tools for managing risk and opportunity.	The Monterey Bay Aquarium Research Institute (MBARI); Oceanum; Regional councils.
3. Develop and apply models to assess and forecast environmental change from human activities and environmental stressors.	Oceanum; ESNZ.
4. Advance bio-physical connectivity and spatial planning tools to guide restoration, manage species/habitats, and support sustainable marine development and conservation.	Oceanum; Regional Councils; DOC.
5. Defining and implementing Safe Environmental Limits: Investigate and establish ecologically sound thresholds for pressures from activities such as aquaculture, agriculture, forestry, ports, wastewater discharges, and emerging ocean-based interventions (e.g. mCDR).	Central (MfE, EPA, DOC) and regional government; whānau/hapū/iwi.
6. Innovative Restoration and Nature-Based Solutions: Develop scalable, objective-based restoration approaches (knowledge and tools) for freshwater, coastal and offshore systems, quantify benefits of restoration, and explore synergistic uses of marine space for ecosystem enhancement.	Kotahitanga mo te Taiao; NZ port companies, industry (e.g. One Forty One Forestry), DOC; Regional Councils; environmental engineering firms; Catchment groups.
7. Understand the social and political perspectives of decision-making and facilitate agreed action plans for sustainable management, ecological restoration and conservation.	Regional councils; MfE; DOC.
8. Support, influence and develop practical solutions, evidence-based policy and decision-support tools that are used by government, Māori, councils, industry, and communities.	MfE; DOC; MPI; Taumata Arawai; Regional Councils; whānau/hapū/iwi.
9. Provide advice to assist with more sustainable management of aquatic resources.	Transport, energy, irrigation, agriculture, forestry, and aquaculture sectors.
10. Identify and celebrate efforts by individuals, whānau and community groups to enhance aquatic ecosystem health e.g. Cawthron Freshwater Champions	MfE; DOC; MPI; Landcare Trust; industry.

Science Mission Two:

Sustainable Blue Growth

Unlocking the Potential of Ocean and Freshwater Resources

Context

Aotearoa New Zealand's oceans and freshwater systems offer a major opportunity to generate long-term economic value while operating within environmental limits.

Global demand for sustainable aquatic food, high-value bioresources, and low carbon solutions is increasing, and aquaculture provides the clearest pathway to realise this opportunity at scale. However, unlocking sustainable blue growth requires a shift from commodity production toward regenerative, climate-resilient systems that integrate innovation across breeding, husbandry, health, monitoring, and technology.

By enabling aquaculture systems that are productive, resilient, and environmentally aligned, Cawthron can help grow value from aquatic resources while strengthening food security, wellbeing, regional prosperity, and social licence.



Vision

Unlocking a regenerative blue bioeconomy by advancing sustainable aquaculture, high-value aquatic products, and innovation that delivers enduring economic and societal benefit within environmental limits.

Actions (2026 – 2033)	Partners
1. Cohere a national aquaculture research platform and private public partnership fund.	NZ marine farming businesses; their industry bodies; MPI.
2. Enable shellfish hatchery development, innovation and application: Democratise mussel and oyster hatchery seed supply for commercial, iwi, and restoration stakeholders.	Current and future marine farming companies; restoration & environmental stakeholders, including iwi, DOC, regional councils and NGOs.
3. Co-design pathways to market for new aquatic species and products.	Aquaculture companies; Māori & Iwi partners, seafood, food and ingredient companies and processors; end-user & market shaping partners.
4. Domesticate new aquatic species to support aquaculture diversification (e.g. geoduck, kopakopa, flat oysters, scallops, seaweeds such as karengo, freshwater species).	Any aquaculture company interested in species diversification nationally and internationally; MPI; MBIE; whānau/hapū/iwi.
5. Develop high-value products from seaweed, microalgae, cyanobacteria, shellfish and other species including low-carbon food/feed products/ingredients. Develop and produce marine toxin standards.	Biotech companies, the nutraceutical & cosmetics industry. Novel food and feed producers. Analytical labs as well as medical institutes and pharmaceutical companies. In addition, likely several key academic institutes/universities.
6. Integrate climate and disease resilience approaches: Integrate breeding, physiology, nutrition to enable the growth of a climate-resilient aquaculture industry.	Universities; PROs; aquaculture companies; vaccine and feed producers.
7. Develop an ocean technology pipeline (e.g. sensor tech, field survey tech) to support data gathering for real-time marine farm management (and science group outcomes).	Aquaculture companies, nationally and internationally; offshore and marine renewable energy companies.
8. Develop new efficient and effective technologies for growing shellfish and seaweed in the coastal and offshore environment.	Marine farmers; engineering and technology firms; offshore infrastructure providers; iwi/Māori enterprises; relevant regulators.

Science Mission Three:

Managing Risks *Protecting People, Aquatic Environments, and the Economy from Threats*

Context

Aquatic systems in Aotearoa New Zealand face growing stress from anthropogenic pollution, biological hazards, climate change, and social risks, which threaten ecosystem health, public safety, and economic resilience.

Increased connectivity through trade (e.g. shipping), travel, intensified food production, and the increasing human population, heightens the likelihood that new pests, pathogens, chemical contaminants and other food safety hazards (e.g. harmful algae, microplastics) will arrive or emerge in Aotearoa New Zealand.

Climate change is amplifying these challenges through warming waters, altered ocean currents, and more frequent extreme weather events, increasing the incidence of harmful algal blooms, natural toxins, disease outbreaks in humans, mortality events in aquatic species, and the emergence of latent 'sleeper' pests. These risks have direct implications for aquaculture and fisheries, drinking water supplies, recreation (e.g. swimming and boating), and trade and market access. These issues fundamentally threaten ecosystem integrity and human health, and market access is a critical economic concern for Aotearoa New Zealand as a major net exporter of food.

The opportunity lies in shifting from reactive responses to hazard detection in the environment and foods, to proactive, science-led risk management approaches that harness advanced monitoring, diagnostics, prediction, and integrated frameworks to anticipate threats and to act swiftly and with purpose to stamp them out.

Mission three responds to the heightened risk environment we live in by strengthening biosecurity, food safety, and hazard management systems to protect people, aquatic environments, and the economy now and into the future.



Vision

Protecting people, aquatic ecosystems, and economic prosperity by anticipating and managing risks through trusted, science led solutions.

Actions (2026 – 2033)	Partners
1. Develop and implement fit-for-purpose methods to identify (and if possible, quantify) major hazards (e.g., pathogens, pests, chemicals, toxins, and other pollutants) in the food supply chain, aquatic products, and marine and freshwater ecosystems.	MPI; MfE; TWO; regional authorities; drinking water suppliers; maritime industries (aquaculture, fisheries, shipping, construction, minerals, energy); Iwi/hapū, Māori organisations; communities.
2. Continuously improve methods that Cawthron currently uses to detect hazards to ensure relevance of our commercial labs and research offerings.	
3. Develop and robustly validate surveillance systems that leverage and combine cutting-edge technologies, traditional technologies, and citizen science to accurately detect pests, diseases and other ecological threats and food safety hazards at scale and speed.	
4. Develop deep understanding of the origin, ecology, cause, properties, and fate of hazards of significance (e.g. microalgae, cyanobacteria, pathogenic bacteria, viruses, marine pests/diseases, plastics, chemicals).	
5. Evaluate the risk of various hazards (including climate) to humans, animals, plants and the environment, using accepted international approaches.	
6. Develop holistic risk mitigation strategies (technologies, tools, practices) that reduce the likelihood of marine pest and disease incursion and spread, the incidence of food safety hazards, and improve ecological and climate resilience.	
7. Develop readiness and response tools to stamp out risk or effectively manage them over the long-term. Position Aotearoa New Zealand as the world leader in active response and technology development to eradicate or suppress aquatic pests, pollutants, disease, and food safety threats.	
8. Develop and implement risk communication tools and processes that ensure expert advice provided to government, communities and industry is effective and understood.	
9. Develop and implement a community engagement programme that increases awareness and effectively expands the network of management and mitigation efforts for all aquatic threats.	
10. Strategic Risk Assessment for Ecosystem Stewardship: Advance ecological risk frameworks to support sustainable development, cumulative impact evaluation, adaptive management, and proactive ecosystem stewardship.	

Introducing Our Four *Transformational Science Platforms*

To realise ambition beyond our Core Missions where we already have significant traction and acumen, Cawthron has identified four Transformational Science Platforms. These are flagship, long-term (multi-decadal) science programmes that deliver across the Missions. We will provide thought leadership and invest deeply in these areas because they have the potential to deliver step change impact for aquatic ecosystems, communities and the blue economy globally. Through these initiatives, we will commit time and resources to building long-term partnerships and securing sustained support to translate science into meaningful outcomes. Where alignment, momentum or opportunity does not emerge over time, we will take a reflective and disciplined approach to reassess, learn and pivot – ensuring our efforts remain focused on where Cawthron can make the greatest difference.

Mountains-to-Sea: Te Taihu *Restoring Thriving Aquatic Systems*

We aim to protect and enhance aquatic ecosystems from mountains-to-sea in Te Taihu, through developing and implementing effective, innovative community-led restoration solutions. In doing this we aspire to create a scalable model that restores thriving habitats, boosts biodiversity, and supports productive fisheries and mahinga kai. Our vision is for abundance, and we believe that the ecological productivity of Te Taihu can be restored to provide for our community values. We will achieve this through piloting and implementing new aquatic restoration solutions, from mountains-to-sea, in partnership with iwi, the Department of Conservation, councils and community groups.

Advancing Ecological Aquaculture *Food within Planetary Limits*

Cawthron's Advancing Ecological Aquaculture Programme seeks to develop aquaculture systems that work within ecosystem limits while delivering resilient food production, environmental regeneration, and enduring social and cultural value. The programme applies ecological principles to design and manage aquaculture systems that go beyond food provision to enhance ecosystem function, climate resilience, and economic performance. Cawthron will achieve this through integrated land based, coastal and open ocean pilots, co-designed Living Labs with iwi, industry, and communities, and robust monitoring and accreditation frameworks that translate trusted ecological benefits into scalable practical tools and commercial success across Aotearoa New Zealand.

Navigating Blue Climate Solutions *Enabling safe, scalable, and nature-positive solutions for climate stability*

We aim to develop grounded and scientifically robust frameworks, tools and technologies for Aotearoa New Zealand and the Pacific to face climate change. This will support private and public stakeholders to identify coastal to inland water-related climate risks and to implement the most promising solutions to mitigate climate change and adapt to its consequences. We will use innovative approaches to develop and assess the effectiveness and limits of a wide range of options ranging from marine ecosystem restoration and CO2 removal to coastal adaptations along the protect-to-retreat continuum. We will build on our deep scientific understanding of natural and societal processes as well as on our international networks to help stakeholders differentiate between robust, long-term solution pathways and short-sighted fixes. We will also use our position as a trusted, independent institution to inform approaches proposed by external agencies.

Oceans to Tables: Pacific Blue Foods *Building Pacific-led, climate-resilient aquatic food systems*

Our aspiration is a long-term, Pacific-led, transdisciplinary partnership to transform aquatic food systems, building climate-resilient, nutritious and sustainable blue foods that restore coastal ecosystems while strengthening livelihoods, cultural wellbeing and economic resilience. The initiative brings together Aotearoa New Zealand's leading scientific expertise with regional agencies such as the Pacific Community, Pacific governments, and communities to co-design and implement integrated, place-based programmes. We aim to deliver safe and nutritious aquatic foods, support high-value product development and expand market access, restore aquatic ecosystems, enhance community-based capabilities, and enable locally led prosperity and resilience.



Table 2: Transformational Science Platform Summary

	Mission Alignment	Vision	Activities	Intended Impact
Mountains-to-Sea: Te Taihu	Mission 1: Supporting Thriving Ecosystems and Communities	Regenerating rivers, lakes, coasts, and ocean from mountains-to-sea to support thriving ecosystems and communities.	Integrated catchment-to-coast restoration, ecosystem monitoring, and community-led stewardship in Te Taihu.	Thriving freshwater and marine ecosystems with strengthened biodiversity, resilience, and enduring community stewardship.
Advancing Ecological Aquaculture	Mission 2: Sustainable Blue Growth	Delivering resilient, regenerative aquaculture systems within planetary limits.	Ecosystem-based aquaculture design, living-lab trials, breeding and systems innovation, and performance frameworks.	A sustainable blue economy enabled through low-impact, high-value aquaculture that supports food security and ecosystem health.
Navigating Blue Climate Solutions	Mission 3: Managing Risks (with Missions 1 & 2 crossover)	Enabling long-term and scalable solutions for climate mitigation and adaptation.	Innovative tools/approaches (e.g. modelling, targeted experiments, expert judgment) to assess and monitor the benefits and limits of blue carbon and adaptation options, and support the co-design of robust, long-term solution pathways.	Safe, sustainable, credible solutions to minimise climate risks to coastal and freshwater ecosystems and communities across Aotearoa New Zealand and the wider Pacific.
Oceans to Tables: Pacific Blue Foods	Mission 2: Sustainable Blue Growth (with Missions 1 & 3 crossover)	Building Pacific led, climate-resilient aquatic food systems that supports livelihoods and restores ecosystems.	Co-designed resilient aquaculture development, food safety, aquatic pests and diseases, coastal regeneration and regional capability building with Pacific partners.	Climate-resilient Pacific blue food systems that strengthen livelihoods, restore ecosystems and reduce climate and food security risk.

Enablers for Knowledge *Development and Impact*

Delivering this Science Plan depends on having the right capabilities, capacity, and infrastructure in place. This section outlines the key enablers required and where focus is needed to support successful implementation.

Training, Talent and Expertise

We invest in our people to build enduring scientific capability, resilience, and excellence. By strengthening career pathways for technicians and scientists and deliberately growing critical skills, we will ensure Cawthron is equipped to lead, adapt, and deliver impact now and into the future.

Action

- Develop a Cawthron-wide capability plan to identify priority skills, succession needs, and targeted investment in people (e.g. training initiatives) to support long-term scientific excellence and impact.

Lead

- People and Capability

Partnerships

Cawthron's impact is strengthened through deep partnerships that span knowledge cultures, disciplines, and communities. By working alongside Māori, Pacific, industry, education, and government partners, we aim to grow shared understanding of complex systems, embed ethical and reflective practice, and enable adaptive change. Through partnership based science, Cawthron seeks to be a nationally and internationally recognised exemplar – supporting our partners as leaders and stewards of aquatic systems.

Actions

- Deepen partnerships across knowledge cultures to strengthen shared understanding of complex systems and deliver collaborative, solutions-focused science.
- Co-design research with Māori partners, embedding Māori centric research practices and enabling Tangata Whenua to engage meaningfully in aquatic management and stewardship.
- Grow Māori led and Indigenous led scientific innovation by increasing Māori representation, capability, and leadership across Cawthron's science programmes.

- Establish a Knowledge Exchange Framework to connect global and local expertise with educators, students, whānau, industry, and Pacific communities, and to support shared learning and long-term capability building.

Lead

- Te Kahui Āio

Research Infrastructure

Delivering Cawthron's science ambitions requires fit-for-purpose, future focused infrastructure that enables excellence across marine, freshwater, and laboratory-based research. This includes *in situ* ocean-observing systems, research vessels, specialist laboratories, biocontainment facilities, and scalable digital and data infrastructure. Together, these assets underpin high quality science, real-time insight, collaboration, and the translation of knowledge into impact.

Action

- Develop a strategic framework for future marine, freshwater, and laboratory research infrastructure, identifying priority assets, investment pathways, and opportunities for shared, national scale infrastructure that strengthens long-term science delivery.

Lead

- Corporate Support

Artificial Intelligence

Artificial Intelligence (AI) is rapidly transforming the landscape of scientific research. For a science institute like Cawthron, AI offers powerful tools to analyse complex datasets, automate repetitive tasks, and reveal patterns that would be difficult or impossible to detect using traditional methods. By harnessing AI, we can accelerate discovery, improve the accuracy and reproducibility of our research, and generate deeper insights from marine, freshwater, and laboratory data. Additionally, AI enables real-time decision support, enhances predictive modelling, and supports the development of innovative digital tools, ultimately amplifying our scientific impact and contribution to environmental stewardship.

Action

- Understand and articulate the opportunities for AI to accelerate our scientific endeavours and impact, including identifying priority areas where AI can add value, building capability within our teams, and fostering collaborations to advance responsible and innovative AI adoption.

Lead

- Data Science

Data

Cawthron's science generates rapidly growing volumes of marine, freshwater, laboratory, and socio-environmental data through observing platforms, sampling programmes, survey programmes, analytical testing, modelling, and sensor networks.

To realise maximum value, these data must be intentionally governed, analytically robust, culturally grounded, and translated into decision-support and insight that directly enables environmental, social, and economic outcomes.

Our aspiration is to move from data as a by-product of science to data as a strategic organisational asset; one that underpins high-impact research, reusable digital products, trusted partnerships, and financially sustainable environmental intelligence.

Actions

- **Align to impact:** Define the purpose of Cawthron data and prioritise investments where they most directly support mission outcomes and decision-making.
- **Govern the assets:** Create and maintain an institute-wide inventory of core data assets, with clear stewardship/ownership, access rules, and Māori data governance embedded.

- **Enable reuse and delivery:** Build shared, standardised infrastructure and workflows (pipelines, QA/QC, interoperability) that turn data into reusable decision-support tools and products.

Lead

- Information Technology and Data Science

Funding and Investment

Delivering this Science Plan at pace will require accelerating revenue generation alongside more diversified and resilient funding sources. Cawthron will strengthen its revenue planning processes while expanding international partnerships and philanthropic investment, enabling us to sustain ambition, invest in capability, and deliver long-term impact beyond traditional funding models.

Action

- Develop and implement a coordinated revenue plan that aligns science ambition with commercial delivery, international growth, and philanthropic investment to support long-term sustainability and impact.

Lead

- Revenue Office and Science

Effective Implementation

To translate this Science Plan into action, we will develop a short implementation plan that sets out how the strategy will be operationalised, including clear priorities, roles and responsibilities, timelines, and the key decisions required. This plan will be developed collaboratively and will be supported by the Te Arahanga Āio team, ensuring strong integration across disciplines and knowledge systems, alignment with organisational governance, and a practical pathway from intent to measurable outcomes.

List of Acronyms

Acronym	Meaning
AI	Artificial Intelligence
CDR	Carbon Dioxide Removal
DOC	Department of Conservation
EEZ	Exclusive Economic Zone
EPA	Environmental Protection Authority
ESNZ	Earth Sciences New Zealand
GDP	Gross Domestic Product
HABs	Harmful Algal Blooms
LAWA	Land, Air, Water Aotearoa
MBARI	Monterey Bay Aquarium Research Institute
MBIE	Ministry of Business, Innovation and Employment

Acronym	Meaning
MfE	Ministry for the Environment
MPI	Ministry for Primary Industries
mCDR	Marine Carbon Dioxide Removal
NGO	Non-Governmental Organisation
NZ	New Zealand
PRO	Public Research Organisation
QA/QC	Quality Assurance / Quality Control
Stats NZ	Statistics New Zealand
TWO	Te Whatu Ora
Wai 262	Waitangi Tribunal Claim 262



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Deep Care.
Thriving Oceans.

