
NEW ZEALAND'S
BIOLOGICAL
HERITAGE
Ngā Koiora
Tuku Iho
National
SCIENCE
Challenges
Ngā Rākau Taketake
Surge Investment for Myrtle Rust and Kauri Dieback

1. STRATEGIC SCIENCE INVESTMENT FUND - PROGRAMMES

NGĀ RĀKAU TAKETAKE*

	Indicative annual funding	Total [for 3 years]
Kauri dieback	Year 1 (part) $ 450,000 Year 2 $ 5,500,000 Year 3 $ 1,500,000 Year 4 (part) $ 1,300,000	**$8,750,000** (AVERAGE $2,916,700 p.a)
Myrtle Rust	Year 1 (part) $ 50,000 Year 2 $ 1,750,000 Year 3 $ 1,500,000 Year 4 (part) $ 1,700,000	**$5,000,000** (AVERAGE $1,666,700 p.a)
		$13,750,000

INTRODUCTION

In a letter dated 5 October 2018, the Ministry for Business, Innovation and Employment (MBIE) indicated that the Minister of Research Science and Innovation, the Hon. Dr Megan Woods, had allocated additional funding of $13.75 million for kauri dieback (KDB) and myrtle rust (MR) research. This funding is to be provided as an initial 'surge' investment over three years, with $8.75 million allocated to KDB research, and $5 million to MR research.

The surge funding will be administered through the New Zealand's Biological Heritage National Science Challenge, *Ngā koiora tuku iho*, as a SSIF Platform. MBIE has indicated that any new investment via the SSIF Platform must:

- Align with the Challenge's 2019-2024 Strategy, and specifically the Impacts and Strategic Outcomes proposed in the Strategy;
- Align with research priorities identified by the kauri dieback and myrtle rust Strategic Science Advisory Groups (SSAGs); and
- Apply the Challenge's prioritisation processes to decide on priority areas for research investment, given that currently-identified research needs exceed funding available at this time.

It is expected that MPI, DOC, SSAGs, Māori and other key stakeholders will have input into decisions about the Platform's Strategic Outcomes and research directions.

The Challenge's 2019-2024 Strategy focusses on coordination of Challenge investment, aligned research (conducted by relevant Challenge Parties), operational research, and community initiatives as an **innovation system** to achieve its objective of significant and rapid progress in the fight against myrtle rust and kauri dieback. To support this Platform, Challenge investment is explicitly targeted towards providing the coordination, cohesion, and focus required – drawing together a range of existing and future investments – to achieve 3-year Intermediate Outcomes for KDB and MR.

***Ngā rākau taketake** talks to the historical connections Māori, and New Zealanders, have with our kauri and myrtaceae trees. Taketake talks to the permanence of that relationship. This platform aims to protect and restore that relationship and connection.*

Acronyms

BHNSC	New Zealand's Biological Heritage National Science Challenge (also known as BioHeritage)
DOC	Department of Conservation
ISAP	BioHeritage International Science Advisory Panel
KDB	Kauri Dieback
KDP	Kauri Dieback Programme
KM	BioHeritage Kāhui Māori
MBIE	Ministry for Business, Innovation and Employment
MR	Myrtle Rust
MM	Mātauranga Māori
SLG	BioHeritage Science Leadership Group
SSAG	Strategic Science Advisory Group (MPI-led and managed)
SSIF	Strategic Science Investment Fund
SO	Strategic Outcome
VM	Vision Mātauranga

PLATFORM: Ngā rākau taketake

Strategic Intent

By 2021 **Ngā rākau taketake** has delivered science, data and solutions enabling Aotearoa New Zealand to more effectively:

- Apply a 'systems' approach to the development and application of a suite of new surveillance and detection tools to map, forecast spread, and control KDB and MR;
- Ensure the wider sector works together to save iconic taonga species under threat from KDB and MR;
- Increase Māori-centered research, kaupapa Māori and research involving Māori, and apply Mātauranga Māori-derived solutions to enhance resilience of forest ecosystems subject to KDB and MR;
- Engage with and empower agencies and communities to increase protection for our ngahere (forests) for future generations.

In achieving the above outcomes by 2021, **Ngā rākau taketake** will also have effectively:

- Grown capability in areas of expertise vital to the management of KDB and MR as well as related forest biodiversity;
- Developed and/or strengthened essential new high priority international and domestic research collaborations for KDB and MR, and other priority plant pathogens; and
- Demonstrated new ways of prioritizing science effort and working collaboratively across a wide range of organisations.

Science direction

This SSIF Platform is considered as "surge funding" and provides one mechanism for implementation of science plans for KDB and MR that have been developed via MPI. It will also invest in and align with research by agencies undertaking adaptive management of KDB/MR (e.g. Kauri Dieback Programme - the new entity tasked to implement the proposed National Pest Management Plan for KDB), as well as augment any future public science investment (such as new MBIE Smart Ideas/Endeavour funded programmes) and private-sector investments.

At a strategic level, key areas of focus for the "surge funding" will include:

- Validation of a suite of tools to efficiently and accurately map the spread of KDB and MR – research with potential for immediate benefits for management of these diseases;
- Empowerment of communities/stakeholders to map and monitor the distribution of the two diseases and their impacts;
- Generation of new knowledge to establish areas of longer-term strategic science leading to development of novel management tools and solutions; and
- Development of new understanding of the human dimensions of forest health management[1], recognising that social-ecological 'systems' research is crucial to achieving greater impact in the long term.

This focus reflects an urgent need for high throughput rapid detection and surveillance tools to enable agencies and communities to collaborate to determine the presence or absence of KDB and MR, and to establish ecological baselines for monitoring the long-term ecosystem effects of these two plant pathogens in a 'proof of freedom' framework. Determining presence or absence of infection is an

[1] Urquhart, J., Marzano, M., & Potter, C. 2018. Introducing the Human Dimensions of Forest and Tree Health. The Human Dimensions of Forest and Tree Health, 1–20. doi:10.1007/978-3-319-76956-1_1.

essential building block to inform management strategies and for protection of uninfected forests.

Approach

Principles and processes detailed in the BioHeritage Challenge 2019-2024 Strategy will underpin science investment decisions, and pathways to impact, for this SSIF Platform. The Platform will enable the Challenge to optimize coordinated national effort in KDB/MR research by:

- Maintaining a **strategic perspective across all relevant investments** (while not seeking to 'control' the direction of investments), thereby identifying gaps where investment is needed;
- Ensuring **coordinated national effort is informed by all priority setting initiatives**, e.g. SSAG processes, relevant sector strategy documents, Māori priorities, etc. The science plans for KDB (completed) and plan for MR (currently under development) provide a foundation from which to inform Challenge investment in kauri dieback and myrtle rust research;
- **Taking a "whole-system" view** across the entire innovation pathway, with interdependencies between people and kauri/myrtaceae clearly articulated. Nationally, investments need to encompass all stages of effort from generation of new ideas or tools through to achievement of impact. Such investments should come from a range of sources and sectors (e.g. SSIF funding, university research, current contestable funding pools, and operational research), leading to new forest health management practices being implemented across publicly and privately-owned forest resources;
- Facilitating **inclusion of independent initiatives** so they become part of a coordinated national effort, even if funded from other sources;
- Using the flexibility of the SSIF platform to **purposefully balance** urgent and immediate deliverables (identified for example in the KDB/MR science plans) against the need to invest in research to deliver long-term impact, or to adapt rapidly in response to disruptions (e.g. major spread or disease incursion) as opportunities arise;
- **Capturing and using key learnings** and knowledge from holistic research on other plant diseases, including managed incursions in other countries;
- **Applying "right team" principles at the outset**, with a focus on inclusion (where needed) of new participants who bring fresh perspectives and passion to the mission, as well as those who bring a healthy combination of Te Ao Māori and western science;
- Investing in **Mātauranga Māori-led solutions** – and resourcing them adequately – in acknowledgement that to date there has been a relative under-investment in uncovering indigenous ecological knowledge despite clear demonstration of the benefits of this approach in other BioHeritage Challenge investments;
- Ensuring current investments and outcomes of previous investments are **open, transparent and publicly available** (with due regard to commercially sensitive information). Full transparency is needed to prevent duplication of research effort and ensure investment is directly targeted to high priority research. To this end, the Challenge will endeavour to ensure **a minimum of 95%** of the surge investment (via this SSIF Platform) will be spent on science and research (including Mātauranga Māori). This will require the Challenge to support administrative costs associated with running the SSIF platform within the existing Challenge budget where practicable; and
- **Capturing and sharing the learnings of the research** on KDB and MR to assist in future-proofing and building resilience in New Zealand's biosecurity system (a key goal of Biosecurity 2025).

Ensuring research alignment - kauri dieback investment

The 2018 Kauri Dieback Science Plan was developed to integrate existing knowledge, and to prioritise investment to save kauri and its associated biota. The plan identifies six underpinning research themes: surveillance, detection, diagnostics, and pathways; biology of host(s) and pathogen(s); ecosystem impacts and interactions; Te Ao Māori; building public/community engagement and social licence; and control and management. These research themes align strongly with the Challenge's Strategic Outcomes (see Impacts section) and with the need to take a "systems view" when prioritising research on KDB.

The six themes in the KDB plan contain 21 priority outcomes that are required to save kauri ecosystems and provide robust long-term management of KDB. The plan also identifies key activities needed for its implementation, all of which align with intended activities under the SSIF Platform. These include: connection, alignment, and participation in partnership with Māori and a wide range of end-users; collaborative research; robust science; and strengthening of international linkages and collaborations.

While some priorities in the KDB Science Plan have been completed and others are underway, many have not yet commenced. In addition, the high level KDB research stocktake collated by MPI and the Challenge has highlighted the disparate and fragmented nature of KDB research currently underway or completed. Further, a previous independent review of knowledge and science progress in kauri dieback identified many critical knowledge gaps which have seriously impeded the protection of kauri ecosystems as well as basic understanding and management of the disease (Black and Dickie 2016). The science plan and review constitute the logical starting point for ongoing research prioritisation and alignment of effort.

Ensuring research alignment - myrtle rust investment

As with KDB, there is a need for a "whole of system" approach to address the problem of myrtle rust. Experience with MR will also inform management of other future invasive wind-borne plant pathogens. The MR Strategic Science Advisory Group was established in 2017 to support the development of a prioritised research programme and provide a coordination point for the diverse range of groups with interest in this area. The SSAG has identified intermediate, medium and longer-term priority areas for MR research which are currently being developed into the Myrtle Rust Science Plan. The most recent draft (22nd March 2019) lays out priorities around the following five themes: 1) Surveillance, monitoring and impacts; 2) Epidemiology, Ecosystems and Resilience; 3) Te Ao Māori; 4) Socioeconomic complexity and consequences; and 5) Disease control and management. Similar to the KD science plan, the finalised MR science plan will provide for ongoing research prioritisation and alignment of effort.

In addition to the urgent need for surveillance and monitoring of ecosystem impacts, knowledge gaps include how existing tools can be applied in the New Zealand environment, particularly with respect to feasibility and implications of large-scale use, and the cultural and social acceptability of using pesticides in sensitive ecosystems and urban environments. Additional management tools are needed that can be used in a range of contexts including by land-owners, plant producers (nurseries), communities etc.

1. Impact

Planning for impact

Indicative research priority areas needed to achieve impact are summarized in Table 1. These priority areas build on the science plans from the two SSAGs; further prioritisation will be needed to identify the Intermediate Outcomes for this investment. Challenge processes will be used to bring together a strategic scoping group that will facilitate collaborative co-design of outcomes by key researchers and stakeholders. This is a necessary first step to ensure optimal outcomes in terms of research and implementation and also meets MBIE's expectation that investment processes for the SSIF platform align with the Challenge's principles and processes.

At time of writing, expressions of interest for scoping the Platform Plan have been sought; a scoping group will be selected in early February 2019 and in place no later than 1 March. The first task for the SSIF scoping group will be to rapidly complete and review the stocktake of all KDB and MR research and map the work against a co-innovation pathway and timeline to impact. This builds on science stocktakes undertaken by KDB and MR SSAGs but will go a step further by determining the current status of research, ease of data access, horizon timeframe, and stage of implementation. This review is essential as it will directly inform which priority research areas identified by the KD/MR Strategic Science Plans require immediate funding from the new SSIF investment, what is already funded and pending delivery, and what research areas are low priority and/or require future leveraging and additional funding through aligned investment sources.

Because the surge investment is for an initial three-year period, the Challenge will prioritise immediate investment in science needed to expedite rapid progress in areas of greatest need, as determined by the scoping group and in consultation with key stakeholders. This may be achieved, for example, by funding a collaborative project between researchers currently separately engaged on development of detection systems. Greater collaboration and use of collective know-how will facilitate more rapid validation and widespread uptake of optimized detection techniques. The SSIF investment provides a new opportunity to stimulate integrative innovation in plant disease management that is not currently being achieved through other investment mechanisms in the New Zealand innovation system.

We also recognise the need to invest in science that will establish a fundamental basis for longer-term strategic research that may subsequently be funded through a range of mechanisms. Some proposed research priorities (e.g. from Strategic Science Plans) have aspirational goals over a medium-long (10-30 year) time frame but will likely have important implications for the future of New Zealand's kauri and myrtaceae, so it will be important to identify key research areas and invest in some highly strategic research elements with long-term effects or benefits at a national scale.

The research plan and priorities will be discussed annually with MBIE and reviewed by the BioHeritage International Science Advisory Panel (ISAP) and/or other international reviewers, and the Challenge's Kāhui Māori (KM).

Aligned investment to expedite and increase impact

We anticipate SSIF funding will be leveraged against a range of funding sources, with an anticipated minimum alignment from other investments of at least 1:1 (preferably 2:1) to achieve the impacts needed. Challenge leaders engage regularly with teams proposing to submit aligned KDB/MR research proposals into upcoming science funding cycles (e.g. Endeavour) to build connections, integration and alignment within the science innovation system. We anticipate that research priority areas will continue to evolve through the SSIF contract period, in response to research breakthroughs within the SSIF funded research and/or aligned research programmes, or as new opportunities arise (e.g. investments from new sources such as Endeavour/Marsden Fund or commercial initiatives). A communication and collaboration plan will ensure all researchers and stakeholders are fully engaged

and focused throughout the three-year investment period (Appendix 1) and ensure a much more highly connected and cohesive process to incorporate and integrate all new developments throughout New Zealand innovation system than currently exists.

Alignment with BioHeritage Challenge's 2019-2024 Strategy

This SSIF Platform aligns directly with the Challenge's three Impact areas:

1. **Whakamana** (Empower) – people understand the life-giving role of forest ecosystems, and are inspired to take action to protect them;
2. **Tiaki** (Protect) – we have the tools and the knowledge to protect our forests from myrtle rust and kauri dieback; and
3. **Whakahou** (Restore) – we understand the interdependencies between people and forest ecosystems, and use this 'whole system' knowledge in our interventions to combat kauri dieback and myrtle rust.

Alignment with SSAG priorities

The alignment between the Challenge's impact areas to the SSAG's priorities and research themes of the KDB and MR plans is outlined in Table 1. Plans for regular interactions between the SSAGs and Ngā rākau taketake have already been tabled at the last SSAG meeting on 4 February 2019. Alignment is supported by participation of SSAG member Lindsay Bulman in the recently established Challenge scoping groups for KDB and MR. Further alignment is also achieved through SSAG membership of Challenge KM Chair Glenice Paine and and Ngā rākau taketake co-leader Nick Waipara on SSAGs, with Challenge Director Māori also acting as an observer on SSAGs. Relationships will also be built via the Knowledge Brokers assigned to the SSIF Platform (in progress).

Proposed impacts and research priorities for SSIF Platform

The research areas in the following table are indicative: they are intended for development into detailed research plans and budget. These priority areas have been identified based on the KDB strategic science plan, as well as the draft MR science plan (March 2019). Mātauranga Māori solutions and Kaupapa Māori methodologies are a key component of all Impacts and research priorities listed in the table.

These priorities are supported by key research organisations (and leading researchers), Challenge Parties, end-user groups, and Māori. However, refinement of the innovation pathway is needed to identify the science to deliver Intermediate Outcomes that will be achieved by this investment.

Table 1: <u>Indicative</u> Research Priority Areas

KAURI DIEBACK IMPACT	SSIF Research priority areas, 2019-2021	KDB science plan alignment	Key industry or end-user partner[1]	Potential key research collaborators[2]	$,000 contribution[2] (ex GST per year)	
					SSIF	Co-funding
Saving Kauri	Improving protection of kauri forest and management of KDB through research to:	Theme no.	MPI DOC Iwi and Māori biosecurity practitioners NZ Plant Producers Regional Councils Rural landowners Forestry sector Urban landowners NGOs and community groups Commercial agri-businesses	MPI Victoria University Scion Plant & Food Research Iwi, hapū and Māori knowledge holders DOC Biological Heritage NSC (non-surge funding) Lincoln University Manaaki Whenua University of Auckland Massey University Lincoln University / Bio-Protection Research Centre International research collaborators		$2,000,000
	1) Identify and validate tools for faster high/throughput detection and diagnostics to allow mapping of presence of disease at landscape scale	Theme 1 Theme 4			800	
	2) Optimise collection, collation and analysis of surveillance data to inform science and management	Theme 1 Theme 4			480	
	3) Identify novel solutions for management of KDB	Theme 4 Theme 6			936	
	4) Increase public/ community engagement in responding to KDB	Theme 5			300	
	5) Incorporate cultural dimensions of forest health and MM into forest protection and restoration	Theme 3 Theme 4			400	
					$2,916,700	**$2,000,000**

MYRTLE RUST IMPACT	SSIF Research priority areas, 2019-2021	MR draft science plan alignment[4]	Key industry or end-user partner	Potential key research collaborators	$,000 contribution (ex GST per year)	
					SSIF	Co-funding[5]
Protecting Taonga myrtaceae	Minimising impacts of Myrtle rust through research to:	MR plan Theme No.	MPI DOC Iwi and Māori biosecurity practitioners NZ Plant Producers	MPI Scion Plant & Food Research Iwi and Māori knowledge holders		
	1) Deliver an effective surveillance system building on current and novel tools	Theme 1			500	500

	2) Identify novel solutions for management of MR	Theme 5 (Theme 3)	NZ Apiculture Regional Councils Rural landowners Forestry sector Urban landowners NGOs and community groups Commercial agri-businesses	DOC Biological Heritage NSC (non-surge funding) Manaaki Whenua Universities	217	1,600
	3) Increase public/ community engagement in responding to MR	Theme 4			150	150
	4) Incorporate MM into protection and maintaining resilience of taonga Myrtaceae	Theme 3 (Theme 2)			800	250
					$1,666,700	**$2,500,000**

[1] See Appendix 1 for a detailed list of stakeholders.
[2] Potential partners/collaborators; selection will depend on the nature of individual projects.
[3] Indicative based on current knowledge, likely to change as the research innovation pathways are mapped in detail by the strategic scoping group.
[4] Myrtle Rust Science Plan (22nd March 2019)
[5] To be aligned with specific research priorities with Manaaki Whenua (MW) MBIE 'Beyond Myrtle Rust' programme – Formal agreement pending between BHNSC and MW.

2. Excellence

Science excellence will be ensured by:

Backing the right teams. The Challenge is strongly focused on selecting the right teams from the outset, including fostering development of new inter- and trans-disciplinary research teams. We will be supporting individuals and teams with a strong track record of science excellence and impact delivery. We will also be seeking to include early career researchers, and others with relevant expertise who align with the values outlined in the Challenge's 2019-2024 Strategy.

Leveraging international expertise. NZ MR researchers are already well linked with international expertise in Australia, South Africa, Hawaii, and South America. Additional collaborations will be developed to address capability and knowledge gaps. We will seek new international collaborators with systems thinking, and expertise in host-pathogen systems most relevant to KDB/MR, e.g.: researchers working on Sudden Oak death in North America (e.g. USDA; Forest Service; Universities); emerging tree diseases in Europe (Forest Health Commission, Dept. for Environment Food & Rural Affairs, CABI); multidisciplinary EU researchers working within the Pest Organisms Threatening Europe programme, experts working on juniper phytophthora at Forest Research in Scotland; and Australian *Phytophthora* diebacks (CSIRO; DWG; Universities).

Management and planning for research adoption and impact. SSIF and aligned research will be structured to optimise adoption through early engagement with end-users and stakeholders to ensure a pathway to impact - the 'innovation pathway'. The flexibility offered by SSIF funding ensures that research plans, methodologies and implementation strategies can be adapted as priorities change and new opportunities emerge (see next paragraph).

Effective, streamlined project management and review will ensure the Platform remains on track to deliver highly relevant research that can be readily scaled out and implemented by end-users to enable practical and meaningful change in forest health management. Robust, quality assurance processes include peer and external review of plans and outputs by our Challenge ISAP, Kāhui Māori, and other international reviewers. Streamlined project management processes will allow adaption of research direction as required, through robust decision-making around stop-go points.

New measures of excellence. The Challenge takes a broad view of 'excellence' that encompasses current metrics of science excellence but extends these given the integrative and aspirational nature of Challenge research. Priorities articulated in the KDB and MR science plans involve interdisciplinary research, mixed knowledge systems, and strong cultural dimensions and the SSIF Platform will expedite development of 'novel' metrics of science excellence.

Mātauranga Māori. A critical aspect of science excellence in NZ is inclusion of Mātauranga Māori (MM) alongside other scientific methods and knowledge bases. A kuapapa of 'Iwi Ko Tahi Tatoa' where two entities are brought together as one, maintains the mana of MM. Progress will be assessed using metrics emerging from indigenous research worldwide. Kaupapa Māori-led research is also prioritised in Te Ao Māori themes within the KDB and MR strategic science plans. MM is already a strategic priority for the BioHeritage Challenge, and this priority is reflected in existing KPIs. We will build on these in development of KPI measures for the SSIF Platform. Building on preliminary research

partially developed within Tranche 1 of BioHeritage and supported by the Tangata Whenua Roopu, a kaupapa Māori research initiative led by kaumātua and kaitiaki has shown that Mātauranga, specifically a rongoā based solution, has potential to treat KDB. Early investment will used to accelerate and scale up trials of the rongoā approach. Accelerating this promising research is part of our commitment to achieve science excellence and impact through inclusion of Mātauranga Māori and gives effect VM.

3. Horizons and co-funding/leverage

The stock-takes of KDB and MR research that have been undertaken have highlighted extremely fragmented and discontinuous investment, which significantly reduces New Zealand's overall ability to deliver impact in this area. Research is being undertaken by many organisations and is funded by various mechanisms, ranging from operational research projects in MPI to highly focused TEC-funded PhD projects that are shedding new light on the KDB pathogen. Most involve important research, but further analysis of current research investments is urgently needed in order to provide clarity about the relative proportion of investment in generating new ideas, developing emerging ideas, or leveraging proven ideas (Horizons 1-3).

Once the rapid research stocktake of priority areas is completed, the Challenge will be able to provide an accurate and up-to-date portrayal of research effort and spend, which will in turn support open discussion and decision making around investments on KDB and MR. Adding value to existing investments and leveraging funding to enable new investments will be the strategic emphasis for the SSIF Platform as it will be the most effective way of maximizing value from this 'surge' investment; however, investment in the deep science to generate new ideas will also form a part of the overall investment strategy.

Once the full research landscape (including all aligned funding) has been mapped along a pathway to impact (the co-innovation pathway in Challenge terminology), we intend to fully utilise the flexibility provided by the SSIF platform to bolster research effort in areas of greatest need across the research horizons, and to leverage the SSIF Platform to encourage new investment, to deliver the greatest impact and benefit to help combat the spread and impact of KDB and MR.

Given the need for rapid progress by 2021, the SSIF Platform will focus proportionately greater SSIF investment into H2-H3 research for both pathogens. This focus reflects the urgent need for high throughput rapid detection and surveillance tools to enable agencies and communities to collaborate to determine the presence or absence of KDB and MR in order to develop a 'proof of freedom' framework and monitor long-term ecosystem impacts – essential to inform management strategies and protect uninfected forests.

Pending the outcome of the scoping of Intermediate Outcomes for the SSIF Platform, we expect that a smaller proportion of investment will be focused on H1 research on MR, as some solutions already exist and it is anticipated that fundamental knowledge gaps on MR pathobiology will be undertaken within the recently funded ($13M) MBIE-funded programme *Beyond Myrtle Rust: Towards ecosystem resilience*. As there are not yet any solutions for KDB, investment in H1 research on KDB is warranted. We are aware of two small university research programmes that are delivering potentially important results in terms of KDB pathogen biology and management. Subject to approval through Challenge processes and peer review, research effort in these H1 projects will be expedited by early investment.

The Challenge's ability to increase and align co-funding and research effort is contingent on how widely it is recognized and trusted by stakeholders. In collaboration with Te Tira Whakamātaki, the Challenge has made significant progress in building trust with key Māori stakeholders and the SSIF platform provides further opportunity to support Māori to meet their aspirations in terms of leadership and contribution to the battle against KDB and MR. Transparency around management

and impartial allocation of SSIF funding will be essential in building wider trust in the research community and beyond, such that existing tensions between research providers diminish and allow resources and effort to coalesce into a truly collaborative national and international effort.

4. Investing in people

The BioHeritage Challenge strategy relies on an intervention logic approach that ensures that essential partnerships in place among researchers, technologists and innovators, Māori, government agencies, industry, and the public to co-design solutions and to maximise adoption and scale out of new approaches. We place strong emphasis on explicit identification of key resources and capabilities from the full spectrum of research providers and capability within New Zealand and in the international science community.

Investing in and developing inter- and trans-disciplinary research teams. Delivery of impacts will require coordination and excellence across a wider range of disciplines than traditional science disciplines like plant pathology, molecular diagnostics, etc. Likely additional skill sets that will be needed in this Platform include additional plant pathology capability, social science, psychology, policy and legal expertise, kaupapa Māori, citizen science, communications, modelling, and project management. Gaps in expertise within the research teams will be identified and addressed during early scoping of the Platform. The Challenge parties have already identified relevant capabilities within their own organisations which will assist in the assembly of cross organizational multi-disciplinary teams.

Developing new capability. To date the Challenge has successfully built new capability and capacity in Tranche 1 by supporting PhD students, postdocs/early-career researchers, and summer students, providing emerging researchers with opportunities to be mentored across institutional boundaries including by staff in end user agencies. In the SSIF Platform we intend to build on this success by opening up new opportunities for leadership and co-sharing of roles, and by targeting early-career and Māori researchers, as well as those from a diverse range of relevant career pathways (i.e. science communication, project management).

Opportunities for embedding staff in end user agencies will be identified to allow upskilling of emerging researchers and increase understanding of the challenges of scaling out science solutions. Skill gaps will be identified early to allow necessary recruitment by participating organisations; preliminary scoping suggests a need for quantitative ecologists to determine the relative roles of environmental vs biological drivers on complex soil, forest, and human ecosystem dynamics.

Development of new capability and increased participation within the KDB/MR co-innovation pathway also supports implementation of Ko Tātou Biosecurity 2025, which aims to build a biosecurity team of 4.7 million New Zealanders who are aware of and building resilience in our biosecurity system.

Building Māori capability and capacity. Given the strong cultural connections that Māori have with our forests, we will be investing in Kaupapa Māori research, Māori-centered research and research involving Māori to build much needed Māori capability and capacity. We will be proactive in engaging with and supporting Māori scientists with experience in relevant skills through provision of dedicated mentoring and career development. However, given an acknowledged shortage of capacity, we will also be continuing our alternative successful approach of bringing knowledge holders into the science projects in culturally acceptable ways to work with and educate researchers in kaitiakitanga and

Mātauranga Māori. Resourcing in Mātauranga Māori through Kaupapa Māori led research is prioritised highly within both Te Ao Māori themes of the KDB and MR strategic science plans. The early investment to accelerate a promising Kaupapa Māori led research solution for KDB exemplifies how we plan build in Māori capability and capacity (Page 12).

5. Vision Mātauranga (VM)

During their engagement with current programmes and planning for further work on KDB and MR, Māori have been clear that they expect the Crown, councils, scientists, research institutes, and communities to collaborate with tangata whenua to protect and save their taonga species and forests from ill health, decline and extinction. This SSIF platform will recognise and give effect to the following priorities listed within Te Ao Māori themes of the KDB and MR strategic science plans: 1) recognising the unique role Māori have as Treaty partners with the Crown; 2) enabling Māori to honour/fulfil their role as kaitiaki (guardians) and Tangata Whenua (people of the land); 3) Māori and their Mātauranga are utilised to measure forest health, to treat and manage the diseases, with the ultimate aim being to eliminate disease impacts of kauri dieback and myrtle rust; and 4) Mātauranga knowledge holders are empowered to develop solutions for forest management.

Progress of VM across the SSIF platform will be assessed using metrics emerging from indigenous research worldwide. Approaches to best practice in collection and management of Indigenous Knowledge developed over the past 5 years will be adopted to ensure safety, recognition and inclusion for all Māori researchers and Tangata Whenua knowledge holders contributing to this research. This approach was endorsed by independent review of the Challenge in 2018. Kaupapa Māori led research has also been prioritised in Te Ao Māori themes within the KDB and MR strategic science plans.

This SSIF platform specifically aims to embrace Te Ao Māori throughout, because of the value of taonga kauri and myrtaceae to Māori. We also embrace the mission statement of the Vision Mātauranga policy: '*To unlock the innovation potential of Māori knowledge, resources and people to assist New Zealanders to create a better future*'.

Mātauranga Māori priorities will be delivered within the SSIF platform through five VM based strategic outcomes (which also align with SSAG plans):

1: A Treaty partnership is evident throughout the research programme, and Māori are participating at all levels including co-design and investment;

2: Māori willingly engage because they have trust and confidence in the research programme through co-design and kaupapa Māori led research components;

3: Māori understand what KDB and MR are and how they are being dealt with, and non-Māori understand the role and importance of Māori and Mātauranga in the research programme.

4: The mauri or hauora of kauri and myrtle ecosystems is protected. An example case study is determining the role rāhui (forest closures) play in healing the ngahere (forest), and

5: Mātauranga Māori created solutions for the restoration of kauri and myrtaceae and management of kauri dieback and myrtle rust are available at a national, regional or local rohe scale.

We will build on the successful role of our Kāhui Māori (KM) to help guide and ensure the SSIF Platform adds value through integration of Mātauranga Māori and Te Ao Māori. Our KM will review the proposed priority Mātauranga Māori and VM research themes as well as monitoring effectiveness of, and providing feedback on partnerships, equity and inclusion of Māori-centred research, kaupapa Māori and research involving Māori. To further promote co-design with Māori and kaupapa Māori research, all investments will aim for an average of "4" on the VM scale[1] (as adopted by the

BioHeritage Challenge) by 2022 and will draw heavily on the Māori-centered KPIs already agreed as part of the BioHeritage Māori strategy.

[1] http://www.biologicalheritage.nz/about/vision-matauranga (Hyperlink to Vision Mātauranga Classification scale)

6. Domestic and international collaboration

Domestic collaboration

During development of this document, Challenge parties[1] reiterated a willingness to collaborate to achieve the jointly agreed impacts. Adherence to these commitments at senior levels in participating organisations will assist in reducing competition between organisations. Further, our framework provides a mechanism for other knowledge holders and relevant expertise across a diverse range of individuals and institutions to contribute complementary effort and skills along the innovation pathway. The Challenge process currently underway to identify individuals willing to collaborate in the scoping groups to co-design of BioHeritage's Strategic Outcomes will assist in identifying additional researchers with skills to offer this platform.

Many national research organisations and agencies (e.g. the 'Kauri Dieback Programme' have previously and/or are currently actively engaged in various research initiatives focused on reducing the impact of KDB and MR, with additional entities proposed to play a role in this in the future. This SSIF platform aims to increase the level of cooperation and collaboration among these teams and organisations by, for example:

- Use of epidemiological and other (e.g. Bayesian) modelling to prioritise areas where cross organisational teams can work together to address unfunded key science priorities – an example of collaboration leading to additionality;
- Bringing together new teams to ground truth and validate detection and surveillance techniques;
- Resourcing integration of current datasets and application of modelling to identify additional research priorities and inform/guide identification of potential ecosystem interventions;
- Identifying opportunities for greater Māori participation and leadership;
- Supporting fellowships (or secondments) to stimulate new thinking, approaches or collaborations during short visits between organisations.
- **(**Appendix 1: Collaborators and Stakeholders**)

International collaboration

The Challenge uses a strategic approach to building international linkages that ensure science excellence, contribute to global research effort and build New Zealand and Challenge profiles internationally. Tree diseases have emerged as a global issue in recent years and New Zealand has an opportunity to contribute significantly/lead the way in integration of traditional knowledge in management of these, often catastrophic, losses in biodiversity. There is significant potential to expedite progress by leveraging additional international expertise in priority areas, including innovations to define, recognise and protect plant and soil health resilience as well as early detection tools to enhance detection of plant pathogens. Potential collaborations are outlined in Section 2 ('Excellence – leveraging international expertise') on p. 11.

Mātauranga Māori and international collaboration

Building new and strengthening existing international linkages between Māori researchers and kaitiaki with international indigenous practitioners and researchers managing plant diseases and protecting plant health will also enhance knowledge and expertise within the platform. In particular we will explore how indigenous communities' knowledge in Australia, Pacific, Asia and North America

have been applied to interpreting forest health and protection. In Australia indigenous plant health interpreters have improved early detection and management of invasive soil-borne *Phytophthora* species which have also been observed and recorded by kaitiaki and kaumātua in Aotearoa. Our Kāhui Māori will assist with the building and facilitation of collaborations between Māori and international indigenous researchers, as will the indigenous representatives on our ISAP.

[1] http://www.biologicalheritage.nz/about/parties

7. Nationally Significant Databases and Collections

Database/Collections	**SSIF Programmes support** [$ per year, excl GST]
Facilitation of data commons, database integration, access to soil libraries, herbarium specimens, isolate collections and other relevant collections (e.g. seedbank germplasm*)	TBC

The Challenge will play a lead role of facilitation and integration of databases and collections pertinent to kauri dieback and myrtle rust research. It is our intention that all current investments will be open, transparent and publicly available, so a research-based KD/MR database will be coordinated and underpinned with the incorporation of BioHeritage policies of data sharing/availability of results from this SSIF Platform. The research database will be strategically linked to the Biosphere Data Commons initiative to ensure greater value and access from current and new KDB/MR data and collections.

An additional strategic facilitation role will be needed to ensure any relevant collections (e.g. *seed germplasm banks) are supported with research elements that may address key knowledge gaps (e.g. methods to ensure New Zealand's unique taonga seeds are stored correctly to ensure survival and future proof against local extinctions) whilst maintaining cultural sensitivities, access, provenance and ownership of taonga biological materials. The Challenge has already collaborated with Te Tira Whakamātaki to leverage international expertise in seed-banking initiatives which included development of culturally appropriate seed-banking options underpinned with mana whenua ownership agreements in response to myrtle rust.

8. National Science Challenges

The BioHeritage Challenge currently funds three projects focused directly on KDB and MR (see Table below); these projects conclude in June 2019. All have made significant progress including elements that are 'world first' breakthroughs towards developing new tools and strategies for the management of KDB and MR. All three are directly aligned with the outcomes of this platform plan. Tranche 1 also supported two additional projects which are delivering relevant knowledge, co-design with Māori, and progress towards management implementation and surveillance, elements of which may expedite progress towards SSIF impacts. Elements of current Challenge investments may be considered for SSIF funding and/or Tranche 2 support from the Challenge, but BioHeritage Strategic Outcome development processes currently being implemented in the Challenge (described in detail in the BioHeritage Strategy) will be used in impartial development of the SSIF research plan to ensure a "level playing field" and encourage new research directions and initiatives from a wide range of organisations and researchers.

Tranche 1 kauri dieback and myrtle rust related projects 2014-2019:

NSC	Project
New Zealand's Biological Heritage	Protecting kauri ecosystems (Victoria University; $0.103M in 2017/18) Identifying mechanisms of spread of KDB pathogen through soil. Mātauranga Māori solutions for management of disease.
New Zealand's Biological Heritage	Kauri Rescue (Plant & Food Research; $0.334M in 2017/18). Community driven research with citizen scientists treating and monitoring KDB. Social science.
New Zealand's Biological Heritage	Māori solutions to biosecurity threats to taonga species' (Plant & Food Research; $0.16M in 2017/18). Building knowledge around preparedness and surveillance particularly Māori communities using myrtle rust as the exemplar
New Zealand's Biological Heritage	Blending Māori knowledge with research for better results (Lincoln University; $50k investment specifically in KDB in 2018/19). Kaumātua led case studies to protect biodiversity knowledge – one on Mātauranga (specifically rongoā) of relevance to KDB.
New Zealand's Biological Heritage	General surveillance framework for biosecurity incursions (Scion)

Other National Science Challenges will need to be consulted as to how they can contribute to this Platform. For example, it is expected that climate change research in the Deep South Challenge, and development of novel technologies in the Science for Technological Innovation Challenge will align with this Platform. We will consult with them during the scoping process.

2. *Template for key actions or initiatives*

KEY ACTIONS OR INITIATIVES

1. Strategic Intent

Key actions or initiatives:		Due by:
1	SSIF Platform scoping group established and terms of reference agreed	March 2019
2	Work with key SSAG representatives to ensure SSIF Platform investment aligns strongly with KDB and MR science plans; ongoing regular discussion with SSAGs	May 2019 and ongoing
3	Research landscape mapping and prioritization completed and made publicly available	June 2019
4	Research priorities for myrtle rust and kauri dieback reviewed by stakeholders in an appropriate forum e.g., annual workshop	Annual

2. Impact

Key actions or initiatives:		Due by:
1	Co-innovation pathway for implementation of KDB/MR research is mapped with key stakeholders	May 2019
2	Communication plan developed	May 2019
3	Clear statement of what success looks like for **Ngā rākau taketake** agreed	Aug 2019
4	Stakeholder review of progress towards "success" and plan adjustment completed and communicated	Annual

3. Excellence

Key actions or initiatives:		Due by:
1	Metrics capturing excellence through co-innovation pathway identified and developed, including kaupapa Māori research, research involving Māori, and inclusion of Mātauranga Māori	June 2020

4. Horizons and co-funding/leverage

Key actions or initiatives:		Due by:
1	Leverage/complementarity opportunities with Manaaki Whenua Myrtle Rust Endeavour project and future new public and private sector investments aligned with **Ngā rākau taketake** identified	2019; annually thereafter
2	Research gaps identified and communicated to research providers/funders to enhance potential relevance of aligned funding	June 2019

5. Investing in people

Key actions or initiatives:		Due by:
1	One research associate or postdoc, with systems modelling and/or	Dec 2019

	epidemiological modelling skills, appointed to 'connect' research data from previously disparate investment areas	
2	Ensure alignment of **Ngā rākau taketake** with annual capability planning in relevant CRIs and other organisations	June 2020

6. Vision Mātauranga

Key actions or initiatives:		**Due by:**
1	Hui or appropriate consultation held to ensure IP arrangements meet Māori expectations for management of indigenous data or knowledge	June 2019
2	Identify and resource appropriate Māori peer-reviewers for the proposed co-innovation pathway and SSIF investments	June 2019
3	Ensure adequate representation by Māori (particularly KDB and MR mana whenua) during development of Te Ao Māori/Kaupapa Māori led research priorities along the innovation pathway, through appropriate forums such as wānanga/hui	Annually

7. Domestic and international collaboration

Key actions or initiatives:		**Due by:**
1	Systems established and communicated by which researchers, stakeholders and the NZ public have open and transparent access and/or knowledge of research results, data and collection materials from this SSIF investment, and are incentivised to ensure that aligned investments are similarly transparent	Oct 2019
2	Relevant international expertise for both peer-review and/or collaboration identified by scoping group in consultation with key stakeholders	June 2019

3. *Proposed KPIs* (to be agreed after contracting)

KEY PERFORMANCE AREAS AND MEASURES

Preliminary Key Performance Indicators (KPIs) are proposed below. These KPIs will be finalised by a **scoping group** developed to oversee the SSIF Platform investment and delivery. KPIs are suitably high-level in order to achieve economies of scale and to maintain a culture of flexibility yet deliver timely progress within three years. During development of the innovation pathway, potential barriers to delivery will be identified and plans to overcome these clearly articulated.

KPIs will be externally peer reviewed by the BioHeritage ISAP and Kāhui Māori (and/or relevant peer-reviewers).

The Challenge Governance Group and Kāhui Māori are keen to maintain a focus on delivering impact via the **Ngā Rākau Taketake** SSIF investment. To that end, the metrics in the KPI table are aimed at delivering on the four areas of strategic focus outlined in Section 1, namely:

- Validation of a suite of tools to efficiently and accurately map the spread of KDB and MR;
- Empowerment of communities/stakeholders to map the distribution of the two diseases;
- Generation of new knowledge to establish areas of longer-term strategic science; and
- Development of new understanding of the human dimensions of forest health management.

Case studies, surveys, publications, and collaborations listed in the KPIs below will thus be targeted primarily towards these four focus areas.

SSIF PERFORMANCE AREAS	TARGET	DATE
Strategic Intent		
Impact		
Science excellence		
Horizons and co-funding/Leverage		
Investing in People		
Vision Mātauranga		
Domestic and international collaboration		

4. ***Executive Summary***

Surge funding:

The Government has allocated additional funding of $13.75 million for kauri dieback (KDB) and myrtle rust (MR) research. This funding is to be provided as an initial 'surge' investment over three years, with $8.75 million allocated to KDB research, and $5 million to MR research.

The surge funding will be administered through the New Zealand's Biological Heritage National Science Challenge, Ngā koiora tuku iho, as a SSIF Platform. MBIE has indicated that any new investment via the SSIF Platform must align with both the BioHeritage Challenge's 2019-2024 Strategy, including the Impacts and Strategic Outcomes proposed in the Strategy and the research priorities identified by the kauri dieback and myrtle rust Strategic Science Advisory Groups (SSAGs).

Strategic Intent:

This Platform is based on "surge funding" which reflects the urgent need for rapid progress to be made in development of tools and management strategies for KDB and MR. BioHeritage Clhallenge's processes will be used to decide on priority areas for research investment given that currently-identified research needs exceed funding available at this time. Research prioritization will build on work undertaken by the SSAGs and a wide range of stakeholders. Proposed new research will also build on previous and current effort. Greater national coordination of research effort will expedite better outcomes for KDB and MR.

Impact:

By 2021 **Ngā rākau taketake** has delivered science, data and solutions enabling Aoteroa New Zealand to more effectively:

- Apply a 'systems' approach to the development and application of a suite of new surveillance and detection tools to map, forecast spread, and control KDB and MR and inform ecological baselines for long-term ecosystem management;
- Ensure the wider sector works together to save iconic taonga species under threat from KDB and MR;
- Increase Māori-centered research, kaupapa Māori and research involving Māori, and apply Mātauranga Māori-derived solutions to enhance resilience of forest ecosystems subject to KDB and MR;
- Engage with and empower communities to protect and restore our ngahere for future generations;
- Use new ways of prioritise science effort and work collaboratively across a wide range of organisations.

Impacts will be achieved through:

- **Science excellence**: supporting and enhancing collaboration between high performing researchers and teams with a proven track record in delivery of science on KDB and MR;
- Giving effect to **Vision Mātauranga**: empowering and unlocking the innovation potential of Māori knowledge, resources and people to save kauri and protect myrtaceae.
- **Horizons and co-funding leverage**: growing investment in generating new ideas and seeking to align current and future investments in KDB/MR research to increase their value in terms

of delivery of positive outcomes for protection of NZ taonga forest species.

- **Increased domestic and international collaboration**: Identifying, developing and/or strengthening essential new high priority international and domestic research collaborations to expedite development of new tools and management strategies for KDB and MR;
- **Investing in people**: Growing capability in areas of expertise vital to the management of KDB and MR as well as related forest biodiversity and biosecurity; supporting development of new capability (including emerging researchers and Māori) needed for scientific research, implementation of research outcomes and community engagement.

5. ***Public Statement***

Public statement
Strategic Science Investment Strategic Science Investment Fund [SSIF] funding supports longer term underpinning infrastructure and programmes of mission-led science critical to the future of New Zealand's economy, environment and wellbeing. The *New Zealand's Biological Heritage* National Science Challenge *Ngā koiora tuku iho* has received a three-year SSIF investment of $13.75 million for research to address kauri dieback and myrtle rust. A science platform is a combination of people, facilities, information and knowledge that provides a particular, ongoing science and innovation capability for New Zealand.
Description Contact: For further information on this SSIF investment contact director@biologicalheritage.nz

6. *IP Management Plan*

Intellectual property will be managed in line with the existing Biological Heritage National Science Challenge IP management plan. The majority of the research from the surge investment will be intended for fully open application to provide greatest public benefit. To ensure timely implementation and uptake of research findings, it is essential that Māori and other key stakeholders/end-users involved with the research are able to freely engage with, adopt and make use of research findings. That said, it is acknowledged that some research may result in commercially applicable IP.

Existing BioHeritage NSC Challenge Parties have agreed to an IP management plan that seeks to maximise the benefit of project IP for New Zealand, gives due consideration to open-access principles, and acknowledges and respects Mātauranga Māori. Other parties who may seek to be part of the surge investment research will be required to adopt the IP plan. Key elements of the IP plan include:

- Challenge Project IP shall be dealt with in the best interests of New Zealand.
- Where Challenge Project IP does not have any expected future commercial application, Parties will provide open access to relevant Project information to the public.
- Pre-existing IP will remain the property of the owner who shares it for research purposes.
- Cultural IP (Mātauranga Māori) treated as proprietary, which is contributed or developed as a result of collaboration with Māori, remains, as appropriate, in iwi, hapū or whānau ownership.
- Where a Challenge Project seeks to use such Mātauranga Māori, the Parties involved in that Project will consult with relevant iwi, hapū or whānau to reach kotahitanga (consensus) on how the IP is to be used in the Project.
- Challenge Project IP arising from a research project will be owned by the Party or Parties that create(s) it, and they will be responsible for protecting, managing and commercialising that IP.
- Jointly-created Challenge Project IP suitable for commercialisation will be assigned to one Managing Party through a process of agreement of all the Parties involved in its creation. The Managing Party will be responsible for protecting, managing and commercialising that Challenge Project IP and sharing revenue with the joint creators as agreed.
- The IP owner of any Challenge Project IP not suitable for commercialisation will provide a non-exclusive, royalty-free licence to other Parties, as relevant, for the purpose of undertaking research or educational purposes related to the Challenge.

Appendix 1: Surge SSIF Platform Plan Collaboration Table

List of key stakeholders for collaboration and communication*
(*including to date, but not limited to those entities listed below)

Key Stakeholders & Collaborators
MBIE
DOC
MPI
MFE
Regional Councils - Kauri Dieback
Northland
Auckland
Waikato
Bay of Plenty
Regional councils and Unitary Authorities - Myrtle Rust
Northland
Auckland Council
Waikato
Bay of Plenty
Taranaki
Gisborne District
Hawke's Bay
Manawatu-Wanganui
Greater Wellington
West Coast
Environment Canterbury
Otago
Environment Southland
Gisborne District
Marlborough District

Tasman District
Nelson City
Chatham Islands

Kauri Dieback Programme
Governance Group
Tangata Whenua Roopu
Planning and Intelligence Team
Engagement and Comms
Operations Programme
Accelerating Protection for Kauri Programme
Kauri SSAG
Entity/Agency to implement Proposed National Pest Management Plan (to be confirmed?)

Myrtle Rust Response/LTM
Myrtle Rust Long-Term Strategy Governance
Governance Group
Technical Advisory Group
Myrtle Rust Long-Term Strategy Working Party
Myrtle Rust SSAG

CRIs
AgResearch
ESR
Scion
GNS Science
Manaaki Whenua - Landcare Research
NIWA
Plant and Food Research

Universities

AUT
Lincoln
Massey
Otago
Auckland
Canterbury
Waikato
Victoria
Other Research Entities
Cawthron Institute
Unitec
Science for Technological Innovation (SFTI) Challenge
Ngā Pae O Te Māramatanga CoRE
Bio-Protection Research Centre CoRE
B3 (Better Border Biosecurity)
Kauri Rescue
Royal Society Te Apārangi
Māori Groups/Ropu
Te Tira Whakamātaki
Iwi Chairs & Iwi Rūnanga Trust Boards
Hapū
Independent Māori Statutory Board-
Kaitaiki Regional technicians
Ngāti Tamaoho
Te Kawerau a Maki
Tūpuna Maunga o Tāmaki Makaurau Authority
Waipoua Trust (Te Roroa)
FOMA (Federation of Māori Authorities)
Key Community Stakeholders / Industry
Tree Council

Kauri Project
Forest & Bird
Waitakere Ranges Protection Society
Friends of Regional Parks
QEII Trust
NZ Walking Access Commission
NZ Plant Producers Inc
Apiculture NZ
Kaipātiki Trust
Kauri 2000 - Coromandel Forum
New Zealand Forest Owners Association
Reconnecting Northland
Botanic Gardens Association of New Zealand (BGANZ)
Office of PCE (Parliamentary Commissioner for Environment)
Kiwifruit Vine Health
Landcare Trust