

Environmental Trust  
**Coastal Rivers and Estuaries Project:  
Proposed Investment Strategy (Final)**  
July 2021



Natural Resources Commission

## Acknowledgement of Country

The Natural Resource Commission acknowledges and pays respect to all the Traditional Owners and their Nations in the area. The Commission recognises and acknowledges that the Traditional Owners have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. We value and respect their knowledge of natural resource management and their contributions of earlier generations, including the Elders.

## Acknowledgements

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- Dr Peter Scanes (chair) Department of Planning, Industry and Environment (DPIE)
- Mr Bruce Coates DPIE
- Ms Santina Camroux DPIE
- Ms Leah Andrews DPIE
- Professor Max Finlayson Charles Sturt University
- Mr Kyran Crane Coffs Harbour City Council
- Mr Gerard Tuckerman MidCoast Council
- Mr Joe Thompson Hunter Local Land Services
- Associate Professor William Glamore University of NSW
- Dr Ian Wright Western Sydney University

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## List of acronyms

DPI	NSW Department of Primary Industries
DPIE	NSW Department of Planning, Industry and Environment
EES	Environment, Energy and Science Group in DPIE
LLS	Local Land Services
MEMS	Marine Estate Management Strategy
MER	Monitoring, evaluation and reporting

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Cover photo: Little Run Creek, Tapin Tops National Park. Courtesy of John Spencer, DPIE

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## Executive summary

The Environmental Trust (the Trust) approved an investigation into the health of coastal rivers in November 2018 and engaged the Natural Resources Commission (the Commission) to undertake this research. The Commission has developed a potential investment strategy for the Trust's consideration as part of this research. This strategy was endorsed by the Advisory Group at their meeting on 24 September 2020.

The Commission recommends that the Trust adopts the strategy, which would focus the Trust's investment to build the resilience of coastal rivers and estuaries to climate change impacts.

### **Building resilience - long-term, future focussed investment**

The Trust asked the Commission to provide strategic recommendations to guide the prioritisation of investment in NSW coastal river and estuary health, building on existing knowledge, data and evaluations. We found the Trust has a significant opportunity to better coordinate, understand, leverage and effectively target their investment.

Climate change is driving major changes in our environment and is a key threat to the health of coastal catchments in New South Wales. Understanding and addressing these changes is essential if investments are to have optimal impact on the health of coastal rivers and estuaries.

The Commission has designed the strategy to address this threat and model a best practice approach to achieve and demonstrate long-term outcomes. This will address significant gaps in the current knowledge base and demonstrate what works and how to do it successfully.

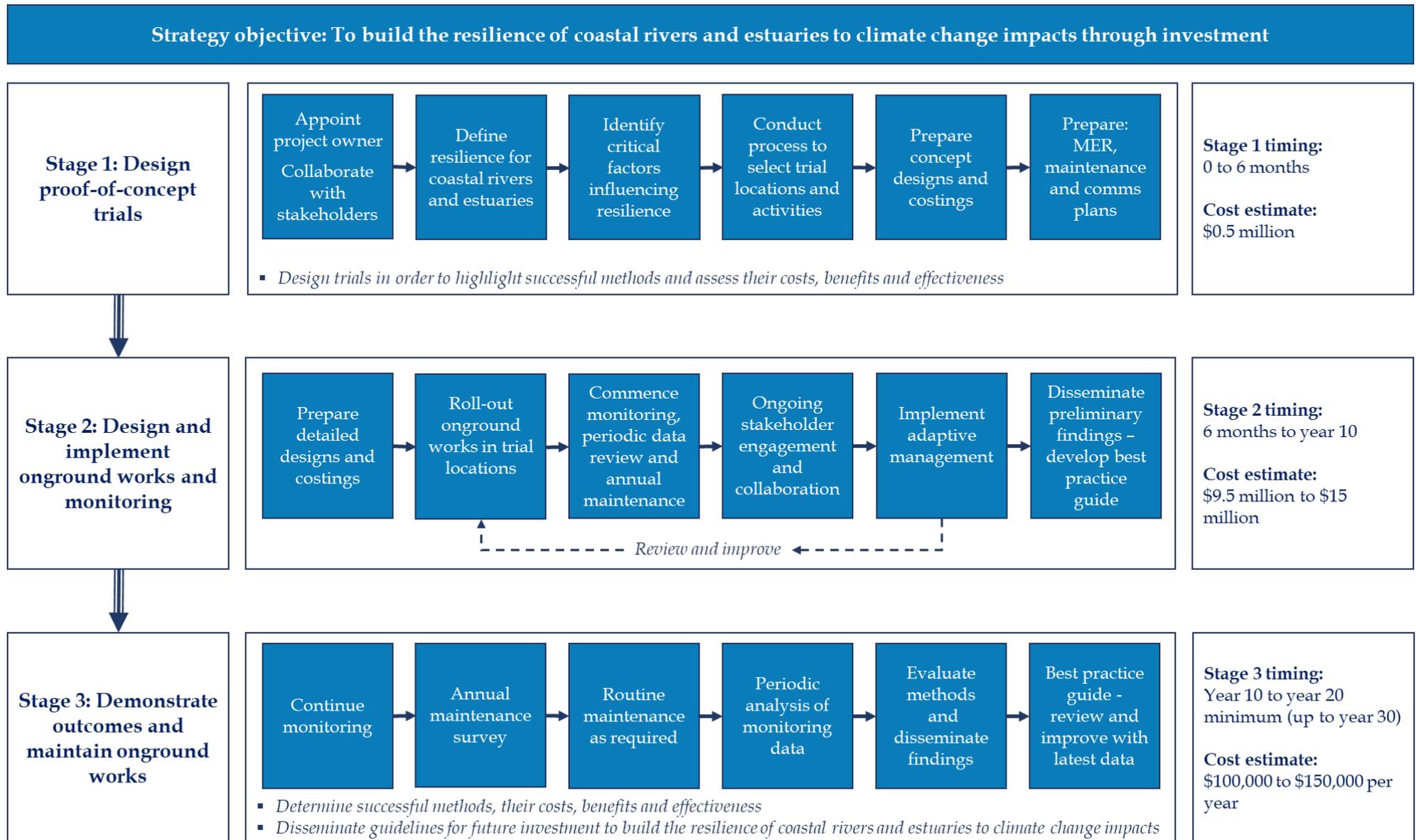
The strategy provides a roadmap for the Trust to consider, to enhance their long-term investment approach and acknowledges that making meaningful change to improve catchment health requires time. It tackles the limitations of short-term funding by prioritising long-term planning, good governance, project maintenance, monitoring and evaluation. It couples this with a dissemination strategy to engage investment partners and transfer learnings. It will guide actions that will provide:

- robust evidence of environmental outcomes and how onground works have built resilience
- effective evaluations that demonstrate successful actions and transferable findings
- longevity of outcomes through maintaining onground works
- a substantially improved knowledge base for all stakeholders in coastal catchment health
- enhanced leveraging opportunities and sharing of learnings to maximise outcomes.

The strategy is based on findings from extensive literature and data review, consultation with key stakeholders, consideration of best practice approaches to project governance and monitoring, and guidance and advice from the Advisory Group.

### **The strategy**

The strategy proposes proof-of-concept trials to be implemented in three stages (**Figure E1**).



**Figure E1: The strategy**

The proof-of-concept trials will test appropriate methods to build resilience in coastal catchments at the catchment or sub-catchment scale. Evidence will be collected to assess costs, benefits and effectiveness, and highlight successful methods. The findings will be used to determine best practice approaches that can be transferred and applied elsewhere and will be made available to coastal catchment managers and stakeholders. The focus will be to develop a best practice guide to build the resilience of coastal catchments to climate change impacts. This will effectively form the next generation approach for investment by all stakeholders in the health of coastal rivers and estuaries.

The estimated costs for the Trust to implement the strategy are \$10 to \$15 million over ten years, with further ongoing costs for another 10 to 20 years of between \$100,000 to \$150,000 per year (plus inflation). Co-investment from other stakeholders is also anticipated.

### **Key success factors**

To succeed, the proof-of-concept trials require a custom-made investment approach. Key success factors include:

- designing the trials to address known issues in the business-as-usual approach
- adopting best practice program and project governance, which includes delivery via a single lead organisation in partnership with relevant stakeholders
- ensuring genuine stakeholder collaboration and co-design
- leveraging outcomes from partnerships
- prioritising long-term, fit-for-purpose monitoring and evaluation
- prioritising long-term maintenance of onground works.

### **Report structure**

- **Chapter 1 - The Strategy - building resilience to climate change impacts**  
This chapter outlines the three-stages in the proof-of-concept trials, from concept to detailed design, through to implementation and demonstrating outcomes.
- **Chapter 2 - Success factors for implementation**  
This chapter outlines key success factors required to meet the strategy objective and demonstrate outcomes. The elements discussed form the basis of a custom-made, best practice investment approach to support strategy delivery.
- **Appendix 1** outlines how the strategy was developed, and the role of the Advisory Group, established by the Trust to advise and support the project.
- **Appendix 2** presents the key findings from the project.

# 1 The strategy - building resilience to climate change impacts

This chapter provides more detail on the strategy. It outlines the strategy objective and why it is important, how the strategy addresses the risks the Commission has identified, and key assumptions made. The chapter then concludes with the detail on the three strategy stages.

Background information on how the strategy was developed is provided in **Appendix 1**.

## 1.1 Strategy objective

**To build coastal rivers and estuaries resilience to climate change impacts through investment**

Climate change is driving major changes in our environment and is a key threat to the health of coastal catchments. There is new evidence that climate change is impacting our estuarine systems, warming and acidifying them much faster than global oceanic and atmospheric models predict.<sup>1</sup> Freshwater ecosystems are reportedly sensitive to minor climatic shifts, and modelling of freshwater species in NSW suggests at least a third of species looked at will lose more than half their range under climate change.<sup>2</sup>

Climate change will have significant impacts on coastal rivers and estuaries, including:

- changes to hydrology and hydrogeology, including flooding, low flows and run-off change affecting riparian stability, species composition and structure of ecosystems
- increased water temperature and acidity affecting water quality and aquatic biodiversity
- sea level rise causing increased tidal inundation and landward advance of tidal limits affecting ecosystems and riparian stability
- increased frequencies of bushfires creating catchment disturbance and ash laden sediment runoff affecting water quality.

Adapt NSW is the NSW Government portal for climate projections, impacts and adaptation.<sup>3</sup> While it contains much useful information, there is limited advice on how to mitigate or plan for predicted impacts, nor is it specific to changes occurring in estuaries and rivers. This strategy will address these limitations and focus on actions to build the resilience of coastal estuaries and rivers to climate change impacts through investment. The key benefits of this focus include:

- addresses one of the key threats to coastal rivers and estuaries
- is proactive and future focused
- helps narrow the potentially wide range of investments under the original objective, which was 'maximising coastal river and estuary ecosystem health from investment'

<sup>1</sup> Scanes, E., Scanes, P.R., and Ross, P.M. (2020), Climate change rapidly warms and acidifies Australian estuaries. *Nature Communication* 11, 1803. Available at <https://doi.org/10.1038/s41467-020-15550-z>

<sup>2</sup> Bush, A. and Hoskins, A.J., (2017), Does dispersal capacity matter for freshwater biodiversity under climate change? *Freshwater Biology* 62-2, available at <https://doi.org/10.1111/fwb.12874>

<sup>3</sup> State of NSW (n.d.) *Adapt NSW Understanding and adapting to climate change in New South Wales*, webpage available at <https://climatechange.environment.nsw.gov.au/>

- addresses a potential gap in funding
- supports the long-term objective from the NSW Climate Change Policy Framework<sup>4</sup> to make NSW more resilient to climate change
- aligns with and complements the Marine Estate Management Strategy (MEMS)<sup>5</sup> initiative – planning for climate change.

## 1.2 Risks addressed by the strategy

The Commission's research, stakeholder interviews and consultation with the Advisory Group, identified recurring issues for programs designed to improve the health of coastal rivers and estuaries. These issues result in these programs being unable to achieve or demonstrate their intended outcomes. Contributing factors identified by the Commission include:

- lack of whole-of-catchment approach
- institutional change has resulted in no one agency in NSW being responsible for catchment management
- lack of resourcing means less capacity for community based natural resource management
- the need for buy-in by all stakeholders, but this is not always attempted or attained
- lack of policy, regulation, or compliance for land and water management
- the impact of the works is comparatively small compared to the natural variability in the targeted health indicator (i.e. it is difficult to determine what impact the works have had).

At a project scale, common problems affecting the success of rehabilitation works include:

- projects often address symptoms of the problem rather than the causes
- management actions are not always implemented in the right combinations or at locations that would optimise benefits
- decision-making is commonly ad hoc and planned at too local a scale.<sup>6</sup>

While these recurring issues do not apply to all catchment investments, they sit within an all too common investment approach to fund onground works but not the long-term monitoring and evaluation to demonstrate environmental outcomes from the investment. Catchments are complex systems with multiple, interconnected and sometimes not well understood factors influencing their health. For onground works, at least 10 to 20 years of appropriate monitoring data are generally needed for trend assessment and evaluation of impact. Similarly, regular maintenance surveys and routine maintenance activities to maintain completed onground works are often not prioritised by investors.

Despite significant investment in improving the health of coastal rivers and estuaries over time, the Commission found there are no or limited evaluations that demonstrate the environmental outcomes that have been achieved. This means we cannot access the full potential knowledge

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<sup>4</sup> State of NSW and Office of Environment and Heritage (2016), *NSW Climate Change Policy Framework*, Sydney, Australia.

<sup>5</sup> State of NSW and Department of Industry (2018), *NSW Marine Estate Management Strategy 2018-2028*, published by the NSW Marine Estate Management Authority.

<sup>6</sup> Hermoso, V., Pantus, F., Olley, J., Linke, S., Mugodo, J. and Lea, P., (2015), Prioritising catchment rehabilitation for multi objective management: an application from SE-Queensland, Australia, in *Ecological Modelling*, 316, 168-175.

from past projects as we do not know what has worked, continues to work or what knowledge might be transferable to another catchment.

Stakeholders are reporting declining health in coastal rivers and estuaries.<sup>7</sup> Despite this, an overarching trend of declining health is not readily apparent from available and comparable state-wide datasets.

For example, State of the Environment reporting from 2003 to 2018 shows that coastal catchment health and trends are variable – some rivers and estuaries are in good health, some poor, some show changes over time, and others are stable. While there appears to be a disconnect between what stakeholders observe and what monitoring shows us, the monitoring data used to inform these ratings are variable in scale, frequency and coverage. Over time different indicators have been used and reporting has changed, making trends difficult to establish. This means that whole of catchment health status and trends cannot readily be determined. Further, it highlights that state-wide monitoring datasets should not be solely relied on to demonstrate the outcomes from investment.

Even though there is not a readily apparent, declining trend in coastal catchment health, there are significant threats impacting coastal rivers and estuaries. These threats include agricultural runoff, urban stormwater discharge, vegetation loss, water use and regulation, and climate change.

Where possible, the strategy has been designed to address these issues and associated risks.

### 1.3 Key assumptions

The key assumptions underpinning the proposed investment strategy are:

- the timeframe over which the Trust will fund onground works is limited to 10 years
- the Trust and/or an investment partner will fund monitoring and evaluation, routine maintenance of onground works and dissemination of findings beyond the initial 10 years, for a further 10 to 20 years
- non-routine maintenance may also require funding in the event of a large flood for example, and this is not captured in the costs included in this strategy
- the costs included in this strategy are:
  - indicative only and will need to be confirmed through detailed design and costing
  - for the Trust only and additional funds or in-kind contributions are expected to be leveraged from other stakeholders
- three trial locations are anticipated, and this will be confirmed during the detailed design and costing process
- each trial will be a sub-catchment or catchment that is of a significant and optimal scale to enable observation of the outcomes and effectiveness of works
- monitoring will include control catchments (i.e. catchments where no onground works are to be undertaken that are monitored for the purpose of comparison)

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<sup>7</sup> Environmental Trust stakeholder consultation 2017, for new major projects prospectus 2018-2020.

- priority onground works will have the most immediate needs and quickest return on investment
- strategy implementation will be consistent with success factors (**Chapter 2**).

## 1.4 Strategy stages

To deliver the strategy, implementation in three stages is proposed:

- **Stage 1:** set up proof-of-concept trials
- **Stage 2:** design and implement onground works and monitoring
- **Stage 3:** demonstrate outcomes and maintain onground works.

Each stage is described in the following sub-sections. The timing, estimated costs and key outputs are shown in **Figure E1**.

### Stage 1: Set up proof-of-concept trials

Stage 1 will prepare, plan and cost the early designs for the proof-of-concept trials. The intent of the trials is to test different onground methods to build resilience to climate change in coastal catchments and use the findings to help determine best practice approaches that can be transferred and applied as a result. The trials will be used to highlight successful methods and assess their costs, benefits and effectiveness. The design stage will identify where and what onground works will be targeted to achieve the strategy objective.

#### Stage 1 outputs:

- **Agreed definition of 'resilience':** understanding and defining what resilience to climate change impacts means for coastal rivers and estuaries as complex adapting systems – recognising that catchments have different physical and ecological characteristics and that resilience for one catchment may mean something else in another. The output will be an agreed definition for resilience in this context and will require collaboration with key stakeholders and recognition of catchments as complex, dynamic, socio-ecological systems.
- **Understand critical factors influencing resilience:** this will work within the agreed definition of resilience and examine the critical factors that influence it. This may include:
  - understanding key elements of a catchment system (e.g. aquatic biodiversity, riparian biodiversity, soil stability, water quality, flow regimes) and how those elements contribute to the overall resilience of the system
  - understanding what we can do to build the resilience of key at risk elements to make a difference for the overall system resilience
  - considering the scale of climate change impacts over 20 years may be difficult to discern from natural climate variability and the ability to observe impacts from onground works within this variability may be difficult
- **Desktop review of existing climate change knowledge, data and its relevance:** using readily available information, such as the Adapt NSW portal, this review will examine:
  - the predicted climate change impacts for each coastal catchment or region

- data or information available to assess the resilience status, threats and risks for coastal catchments, and the gaps in knowledge or programs
- actions to build resilience for coastal rivers and estuaries and how this may vary based on different catchment types
- if identified, targeted research to address material gaps in climate change resilience knowledge required to support strategy implementation.
- **Select trial locations:** The selection process should ensure a deliberate process with experts and representatives from estuaries and coastal rivers. Selection criteria will be developed and used to select the locations for the proof-of-concept trials to ensure the catchments or sub-catchments selected have the best conditions and characteristics for success. This will include consideration of catchment meta-types or representative catchments to ensure that the trial locations selected will provide transferable findings to like-catchments. Other considerations could include cost-benefit analysis, catchment condition and the likelihood of change. Criteria will also be used to inform the most appropriate methods to apply in selected catchments or sub-catchments, and where those methods should be applied.
- **Concept designs and costing for trials:** concept designs for an anticipated three trials will be prepared and costed, addressing relevant risks in **section 1.2** and using the information gathered in earlier tasks under this stage. The onground works will be designed to demonstrate how resilience to climate change impacts can be improved.

The design process will address:

- the most appropriate location and types of actions for building resilience and maximising return on investment
- the optimal scale of works to enable observation of change and resilience outcomes
- the most appropriate methods and where they would best be applied within the catchment or sub-catchment to improve resilience
- the current catchment health status and trends
- inclusion of representative catchment types to enable transferability of findings, methods and process to other like catchments in the future
- consideration of the trial location if it is a sub-catchment and its relationship to and influence on the whole catchment
- design of the long-term monitoring, maintenance and evaluation required in the selected trial locations to support demonstration of outcomes and adaptive management, including the use of control sites (i.e. monitoring in catchments where no onground works have been conducted)
- complementarity of the proposed trials with other catchment programs or monitoring to avoid duplication or support leveraging opportunities
- technical feasibility
- stakeholder involvement, including landholders

- as a minimum, the requirements set out in *Good Practices in Riparian Rehabilitation – Benchmarks for Environmental Trust Funded Projects*.<sup>8</sup>
- **Setting up success factors for implementation:** this will include establishing project governance and stakeholder collaboration, adaptive management, and leveraging opportunities, including working with academic institutions for collaborative research. A communications plan that outlines the dissemination of findings over the life of the project will be prepared, as well as the monitoring, evaluation and reporting (MER) plan, and the long-term maintenance plan. Key success factors that need to be addressed to support strategy delivery are outlined in **Chapter 2**.
- **Project owner appointed:** critical to the success of the proposed investment strategy will be to appoint the project owner; that is, a single lead organisation with responsibility and decision-making power to deliver the strategy. If warranted, the single lead coordinating body could appoint different local partners to assist delivery of each trial.

## Stage 2: Design and implement onground works and monitoring

Stage 2 will complete detailed designs and costings, and then implement the proof-of-concept trials. The onground works for the trials are expected to take multiple years to complete, dependent on the scale of the designs and other factors that may influence roll out.

Monitoring will commence along with adaptive management to support implementation. Targeted stakeholder communication and engagement should start and be a regular feature during the implementation phase.

### Stage 2 outputs:

- **detailed designs and costings** for the trials
- **works** delivered in three trial locations
- **early monitoring data** and analysis
- **adaptive management** of trial approaches if monitoring suggests scope for improvement
- **stakeholder communications** in trial locations that are regular and fit-for-purpose
- **annual progress reports** and other implementation requirements
- **preliminary best practice guide** to build the resilience of coastal catchments, which will be progressively updated over time with new data and evaluation findings.

## Stage 3: Demonstrate outcomes and maintain onground works

Stage 3 will disseminate and update the best practice guide. Key to this will be regular analysis of monitoring data and findings from the three trials. This will include evaluating and quantifying the environmental return on investment from each trial to highlight successful methods and assess their costs, benefits and effectiveness. Providing a best practice guide for future investment, and providing transferable findings, will enable leveraging of further investment and upscaling of resilience building actions.

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<sup>8</sup> DPIE and Natural Resources Commission (unpublished), *Good practices in riparian rehabilitation – benchmarks for Environmental Trust funded projects*.

Stage 3 will demonstrate, through monitoring of the proof-of-concept trials, the benefits of building resilience to climate change impacts.

Periodic evaluations of monitoring data will be undertaken at five yearly intervals (or as identified in the MER plan). The key evaluation question that this stage will answer is 'Did works improve resilience in a cost-effective way?'.

The evaluations will also address the transferability of the findings to other projects in similar locations or of similar approach and consider the cost efficiencies possible through adopting the approach. The findings could be used as a proof-of-concept to leverage further investment in similar projects, including from non-government sources if benefits to the private sector as well as the environment and community can be demonstrated.

The trials will need to be monitored for at least 10 years after completion of the works, with monitoring for up to 20 years or more optimal. This length of monitoring is required to demonstrate the quantifiable benefits and outcomes attributable to the proof-of-concept trials. The reasons why a long-term approach is needed are explained in **Section 2.4**.

### Stage 3 outputs

- **monitoring data** from onground trials collected for a minimum of 10 years to demonstrate the benefits gained and cost-effectiveness of the works to improve resilience
- **annual maintenance survey and remedial works** to maintain the onground works
- **best practice guide** for investment to build the resilience of coastal rivers and estuaries to climate change impacts (periodic updates)
- **transferable methodology and processes** for establishing and implementing outcomes-based monitoring at the start of a project
- **supporting analysis** conducted periodically to show the status and trends in relation to resilience outcomes in each catchment or sub-catchment trial area
- **final project report/evaluation and final best practice guide** at the conclusion of Stage 3.

## 2 Success factors for implementation

This chapter outlines success factors for implementation. These factors are drawn from the Commission's findings,<sup>9</sup> consideration of relevant best practice approaches, and stakeholder advice. Addressing these factors and the risks in the business-as-usual approach (**section 1.2**), will allow the full benefits of the strategy to be realised. Without them, the strategy will not succeed.

### 2.1 Adopt best practice program and project governance

To be successful, a program of this scale and complexity requires a best practice approach to implementation, achieved through careful design of program and project governance.

The Commission has provided recent advice to the Trust on program level governance under the Major Projects program review.<sup>10</sup> For example, program governance and accountability measures should align with Australian standards for grants management, have a documented strategy and program logic, have clearly documented objectives and risk management, and address any areas for improvement highlighted in this recent review. There are many resources that can help guide best practice program governance.<sup>11</sup>

In addition to adopting best practice program governance, the strategy will require careful design of project level governance. Ideally the proof-of-concept trials should be delivered by a single lead organisation in partnership with relevant core stakeholders.

The project governance structure should establish the lead organisation with autonomous decision-making ability. The lead organisation's capacity needs to match the scale and complexity of the program. An adequately resourced secretariat for the lead organisation is essential. A stakeholder advisory group should also be established with representation from all trial areas, relevant authorities, funding bodies, and core stakeholders, with terms of reference to guide their involvement.

The strategy will require the following principles for establishing an effective project governance structure to be addressed:<sup>12,13</sup>

- identify a single point of accountability – the project owner
- clarify roles and responsibilities, including delegations for financial and other decisions
- recognise that service delivery ownership determines project ownership

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<sup>9</sup> Natural Resources Commission (2020), *Summary Paper 2 – Coastal Rivers and Estuaries Project – Investment Proposals*.

<sup>10</sup> Natural Resources Commission (2019), *Environmental Trust Major Projects program review, Final report*.

<sup>11</sup> Resources to guide program governance include:

Department of Finance (2017) *Commonwealth Grants Rules and Guidelines 2017*, Commonwealth of Australia. Available at: <https://www.finance.gov.au/resource-management/grants/>

Commonwealth of Australia (2013) *Implementing better practices grants administration: Better Practice Guide*

Natural Resources Commission (2012) *Standard for quality natural resource management*. Available at:

<https://www.nrc.nsw.gov.au/nrm-standard-and-targets>.

NSW Premier and Cabinet (2010) *Good practice guide to grants administration*. Available at:

<https://www.dpc.nsw.gov.au/assets/memos-circulars/61978f08e5/101117-Good-Practice-Guide-Nov-2010-Revision.pdf>

<sup>12</sup> Garland, R., (2009), *Project Governance: A Practical Guide to Effective Project Decision Making*, available online at <https://epdf.pub/project-governance-a-practical-guide-to-effective-project-decision-making.html>

<sup>13</sup> Natural Resources Commission (2015), *Performance Standard for Local Land Services*.

- ensure separation of stakeholder management and project decision-making
- ensure separation of project governance and organisational governance structures
- clarify investor requirements, including for reporting
- initiate self-assessment performance and compliance monitoring mechanisms
- clarify financial management and reporting.

## 2.2 Stakeholder collaboration and co-design

Core stakeholders should be involved in co-design and implementation.

The lead organisation responsible for implementing the strategy should establish stakeholder collaboration forums in each trial location. Relevant stakeholders should be involved in co-design and subsequent implementation of the trials (e.g. via the stakeholder advisory group).

Along with NSW Government agencies, core stakeholders include:

- local councils
- community and landholders
- industry (farmers, water users, water managers)
- Aboriginal groups.

Successful implementation of the trials will also require building trust with the community and involving them from an early stage. This goes beyond communication and reporting of the program and should extend to capacity building and awareness raising for community, industry and government. This will help to ensure that the strategy is not implemented in isolation and that the outcomes and lessons learned are available for others.

## 2.3 Leverage outcomes from partnerships

The proof-of-concept trials will require long-term monitoring, maintenance and evaluation to ensure they are successful, achieve the intended outcomes and realise the full benefits of the investment in onground works. The Trust should apply its standard approach to leveraging funding to cover all three strategy stages, and also seek new and innovative leveraging outcomes over the life of the project.

The Commission has identified the following existing leveraging opportunities:

- **Research organisations** – there is considerable work being conducted on climate change and catchment resilience in NSW and across Australia by research organisations. These organisations include University of Wollongong, Macquarie University, University of NSW, The University of Sydney, Southern Cross University, Griffith University, the CSIRO Climate Science Centre and others.
- **Marine Estate Management Strategy** – Initiative 3: Planning for climate change aims to increase understanding and knowledge of how climate change will affect the marine estate (which includes estuaries). It includes enhancing mapping to identify vegetation communities at risk from sea level rise and monitoring climate change impacts to fill knowledge gaps and inform future management actions. Further, under Initiative 1, there

is also a significant program to prioritise sea level rise impacts in estuaries plus a range of catchment monitoring tasks that are relevant.

- **Coastal Management Program** – where plans have been completed by local government, data and information about climate change threats and planned mitigation actions could be used.
- **NSW Government Climate Change Research Hub** - have launched a guide for assessing climate change in estuaries. The guide is in eight parts and is designed to empower planning authorities, local councils and businesses to make informed decisions about our harbours, ports and estuaries in a rapidly changing climate
- **Adapt NSW** – web portal for data and information about climate change in NSW and at the regional scale. This includes use and interpretation of NARClIM data, groundwater recharge and surface water runoff mapping, rainfall erosivity mapping, urban heat mapping, soil carbon, pH and macro-nutrients mapping
- **NSW Biodiversity Conservation Trust** – invests to maximise biodiversity conservation outcomes and support private land conservation. The Biodiversity Conservation Trust identifies climate change as one of the main pressures threatening listed species and ecological communities, and biodiversity in general. They identify the importance of prioritising and investing in coastal riparian areas to increase ecosystem resilience to the effects of climate change by connecting protected areas and providing pathways for the movement of species.

Additional leveraging opportunities should also be explored if the Board adopt this strategy, including relevant Australian Government programs offered from time to time, and community based, philanthropic or financial opportunities. Contemporary approaches to leverage investment should also be explored by the lead organisation. For example, using social media campaigns or an online fundraising platform such as Go Fund Me.<sup>14</sup>

The lead organisation appointed as the project owner should be tasked with and incentivised to maximise leveraging opportunities throughout all three stages of strategy implementation.

## 2.4 Prioritise monitoring, evaluation and maintenance

A funding model that can extend beyond ten years is critical for strategy implementation. Long-term and flexible funding would allow for certainty in project leadership, monitoring, maintenance and evaluation. These elements are critical for assessing outcomes and disseminating findings.

The strategy will not achieve the objective or be able to demonstrate outcomes without long-term monitoring, evaluation and maintenance beyond the completion of onground works. Monitoring and data capture, evaluation and reporting should follow best practice approaches,<sup>15</sup> and could build on work under the Marine Estate Management Strategy.<sup>16</sup>

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<sup>14</sup> 'Go Fund Me' is an online fundraising website providing a platform for individuals or organisations to raise money through donations from crowdfunding. More information is available at: <https://www.gofundme.com/>

<sup>15</sup> Natural Resources Commission (2012), *Review of NSW resource condition monitoring, evaluation and reporting*.

<sup>16</sup> Aither (2019), *Integrated monitoring and evaluation framework for the Marine Integrated Monitoring Program, NSW Marine Estate Management Strategy, a live Framework prepared for NSW Department of Primary Industries*. Available online at: [https://www.marine.nsw.gov.au/\\_data/assets/pdf\\_file/0004/1193296/MIMP-Framework.pdf](https://www.marine.nsw.gov.au/_data/assets/pdf_file/0004/1193296/MIMP-Framework.pdf)

The strategy will require these activities to be prioritised and funded by the Trust and/or a co-investor to enable the Trust to:

- assess the costs, benefits and effectiveness of trialled methods - what works, where and why
- quantify environmental outcomes and impacts from onground works
- showcase best practice and develop a best practice guide for other investors to follow
- address a significant gap in our understanding of environmental outcomes associated with onground works in catchments
- understand how we can build resilience to climate change impacts and share the transferable knowledge gained with other coastal catchment stakeholders.

While it may be possible to use or build upon existing State or regional monitoring, additional fit-for-purpose monitoring will be required to analyse the proof-of-concept trials. This should include monitoring of control sites.

A maintenance plan for the strategy should be developed. This should include annual surveys of completed onground works to ensure the works remain in good condition (for example, not overruled with weeds in the case of revegetation). Any issues should be addressed through routine maintenance actions implemented in a timely fashion.

The Commission recommends that a minimum of 10 years and ideally up to 20 years of funding be provided for this by the Trust or a co-investor beyond the completion of onground works.

Our initial estimates for the cost of annual monitoring and data checking, annual surveys of onground works, routine maintenance activities, and periodic evaluations is estimated to be \$100,000 to \$150,000 per year. This figure will need to be confirmed during the detailed design phase and inflation should be factored into forward estimates for the life of the program.

The lead organisation will need to commit to resourcing and involvement for up to 20 years, and possibly longer.

The Commission recognises the inherent difficulties in delivering long-term programs. Given this, the Trust will need to carefully review and select the lead organisation. The Trust could consider existing private, public and community entities, or allow the market to determine potential lead organisations capable of delivering the strategy. Alternatively, the Trust could form a specialist entity to deliver the strategy.

If a delivery lead cannot be found for the strategy, the work could be broken down into key components and stage, with different organisations targeted for delivering the associated outputs.

For example, to successfully deliver Stage 1 would require a delivery lead with strong project design, research and collaboration credentials, who could bring together expertise in climate change, resilience, stakeholder collaboration and co-design, monitoring and catchment works.

## Appendix 1: How the strategy was developed

### Background to the Coastal Rivers and Estuaries Project

This proposed investment strategy is the final deliverable under the Coastal Rivers and Estuaries Project.

In 2017, the Trust held workshops with more than 50 stakeholders and completed a desktop literature review to identify priority issues for inclusion in their 2018-2020 Prospectus for new major projects. This process identified the declining health of coastal rivers, wetlands and estuaries as a high priority for funding.

To facilitate continual improvement in how the Trust might invest in coastal rivers and estuaries, and implement investment actions as effectively as possible, the Trust asked the Commission to undertake the Coastal Rivers and Estuaries Project. The relevant project aims were to:

- improve the knowledge and understanding of past and present health, threats, stressors, management and funding for coastal rivers and wetlands
- evaluate lessons learned, the barriers and enablers for success, governance models and innovative approaches
- provide strategic recommendations to guide prioritisation of investment into NSW coastal river and estuary health.

The Commission has developed this proposed investment strategy based on the findings from extensive literature and data review, consultation with more than 25 key stakeholders, a targeted workshop, and guidance and advice from an Advisory Group established by the Trust. The Advisory Group role and membership is discussed in the following sub-section.

The Commission's key findings and their implications for the investment strategy are presented in **Appendix 2**. The working papers prepared by the Commission over the course of the project provide detailed information on these findings, who was consulted, the literature and data reviewed, and other matters considered. These are available on request and include:

- Summary Paper 1 – Key Findings
- Summary Paper 1A - Riparian rehabilitation good practice benchmarks
- Summary Paper 2 – Investment Proposals.

### Expertise, experience and advice provided by the Advisory Group

The Advisory Group was established by the Trust under terms of reference for this project. The members are listed in **Table A1.1**, noting that not all were available for the project duration. The group's role was to participate in Advisory Group meetings and work collaboratively to provide:

- strategic advice
- academic expertise and contribution to the research findings
- sources of secondary research and grey literature as well as key contacts for stakeholder consultation and advice for dissemination

- endorsement / advice on the appropriateness of findings, recommendations or strategies developed following project research and in-depth analysis of why past approaches have not resulted in improved river and wetland health.

Four Advisory Group meetings were held over the course of the project. Out-of-session advice and clarification was also sought from the Advisory Group or specific members.

**Table A1.1: Members of the Trust’s Advisory Group**

Member	Organisation
Dr Peter Scanes (Chair)	Senior Team Leader, Estuary and Catchments Science, DPIE
Mr Bruce Coates	Manager, Coast Estuary and Floods, DPIE
Ms Santina Camroux	Acting Director Resilient Places, DPIE
Ms Leah Andrews	Senior Team Leader – Coast, Estuary and Flood Grants, DPIE
Professor Max Finlayson	Research Director, Charles Sturt University
Mr Kyran Crane	Coast and Environment Officer, Coffs Harbour City Council
Mr Gerard Tuckerman	Manager Natural Systems, MidCoast Council
Mr Joe Thompson	Manager Healthy Landscapes, Hunter Local Land Services
Associate Professor William Glamore	School of Civil and Environmental Engineering and the Water Research Laboratory, University of NSW
Dr Ian Wright	Senior Lecturer Science, Western Sydney University

### Strategy definition of coastal rivers and estuaries

Coastal catchments are treated holistically in this strategy. That is, one part of the catchment system should not be considered in isolation of the other parts.

Coastal catchments can be split into two connected landscape systems based on the tidal limit: the freshwater component and the tide and saltwater influenced component. ‘Coastal rivers’ is used to refer to the freshwater portion of coastal catchments upstream of the tidal limit, which is taken as the highest astronomical tide. ‘Estuaries’ is used to refer to the catchment portion downstream from the tidal limit. Estuaries extend laterally to include saltmarshes and mangroves that can be inundated by tides as well as coastal wetlands and intermittently closed and open lakes and lagoons. There are 184 estuaries along the NSW coast.<sup>17</sup>

Coastal rivers and estuaries in NSW include all waterways east of the Great Dividing Range (**Figure A1.1**). While most catchments east of the Divide outflow to NSW marine waters, the Snowy and Genoa river catchments outflow to the Victorian coast.

<sup>17</sup> Roper, T., Creese, B., Scanes, P., Stephens, K., Williams, R., Dela-Cruz, J., Coade, G., Coates, B. and Fraser, M., (2011), *Assessing the condition of estuaries and coastal lake ecosystems in NSW*. Monitoring, evaluation and reporting program, State of the Catchments 2010 – Technical Report Series: Estuaries and Coastal Lakes, Office of Environment and Heritage, Sydney.



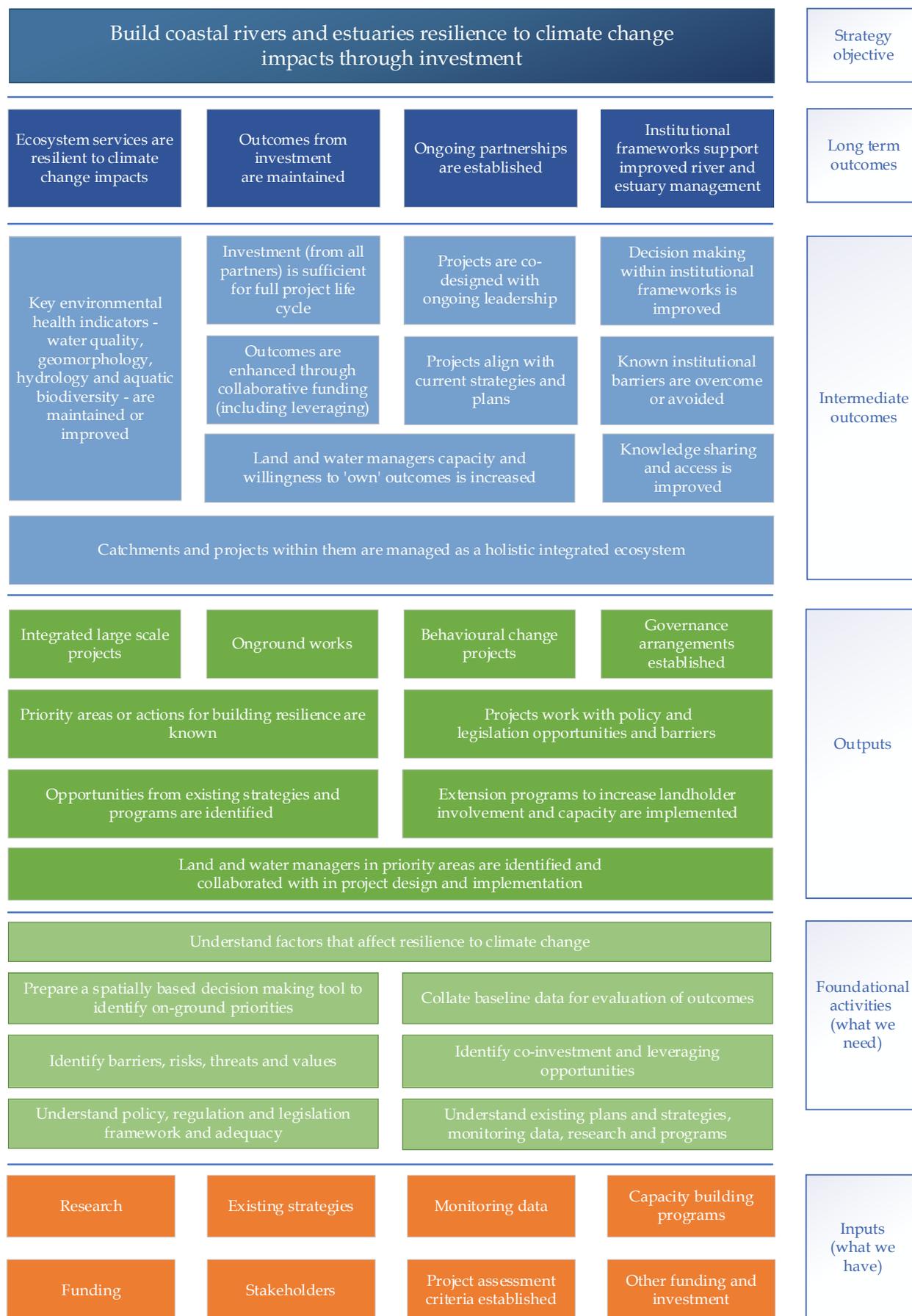
**Figure A1.1: NSW coastal catchments covered by this investment strategy**

### **Building the strategy logic, identifying options and assessing proposals**

Using the findings from the initial research and consultation (**Appendix 2**), the Commission developed an early strategy logic. The logic was used to consider potential investment proposals as it identifies foundational activities, which are the essential building blocks for achieving the outputs, which in turn will deliver the outcomes and the strategy objective.

The findings and logic were presented at a workshop with stakeholders and the Advisory Group. This workshop was critical in the development process, as it led to the narrowing of the investment strategy objective to focus on resilience to climate change impacts. The subsequent, refined strategy logic is presented in **Figure A1.2**.

The workshop discussions also resulted in several broad investment proposals being identified to address knowledge gaps or target priority areas and issues aligned to the strategy logic. The Commission further developed the proposals and assessed them against criteria, which included alignment with the Trust objects and a suite of considerations, which, when combined, were designed to assess value for money. The assessed proposals were presented to the Advisory Group, unsupported proposals were cut, and supported proposals refined and consolidated into the preferred approach presented in this strategy.



**Figure A1.2: Investment strategy logic to build resilience to climate change impacts**

## Appendix 2: Findings of the Coastal Rivers and Estuaries Project

Table A2.1: Key findings and investment considerations

Group	Finding	Consideration for investment strategy	Where it can be applied
Data availability	<p>The impacts to ecosystem health are being measured using two main rating systems:</p> <ul style="list-style-type: none"> <li>river condition index – includes indicators for geomorphology, hydrological regimes and aquatic biodiversity</li> <li>estuary health index – includes indicators for water quality and aquatic biodiversity</li> </ul> <p>The monitoring used to inform these ratings uses different indicators and is variable in scale, frequency and coverage which did not enable a whole of catchment health status or trend to be determined</p> <p>Available data did not show an overall state-wide declining trend, rather that catchment health is variable. There is significant variation of condition and threat across catchments and within rivers.</p>	<p>Strategic long-term monitoring, evaluation and reporting of coastal systems to demonstrate response to changes and enable adaptive management of coastal rivers and estuaries is needed</p> <p>To improve river and estuary data, consistent, fit-for-purpose monitoring and data collection that aligns with state-wide data programs should be a requirement under the intended program</p> <p>Given the variability of catchment health it is difficult to establish a State-wide trend. It is also difficult to generalise catchment health, especially for large catchments which can give different results depending on what scale the assessment is at. We need to acknowledge this variability and evaluate the most critical threatening factors.</p>	<p>May need co-investment to achieve</p> <p>Trust project criteria</p> <p>Proposal (or part of) for investment strategy</p>
Threats	<p>Coastal rivers and estuaries ecosystem health can be measured by its water quality, hydrology, geomorphology and biodiversity. These are all impacted by the threats below in inter-related and multiple ways</p> <p>The threats creating stress on coastal rivers and estuaries are:</p> <ul style="list-style-type: none"> <li>agricultural runoff</li> <li>urban stormwater</li> <li>vegetation loss</li> <li>water use and regulation</li> <li>climate change and variability</li> <li>entrance management</li> <li>recreation</li> </ul>	<p>The aim should be to address the threat which is causing the stressor (agent of change), rather than the stressor itself</p> <p>In many cases a threat cannot be removed (e.g. urbanisation, agriculture or climate change). So, the best approach is to adapt, ensuring the environment can continue to provide ecosystem services</p>	<p>Trust project criteria</p> <p>Proposal for investment strategy (or part of)</p>

Group	Finding	Consideration for investment strategy	Where it can be applied
<p>Status and trends</p>	<p>There was a broad correlation between catchments with lower health ratings and the level of urbanisation and/or agricultural practices</p> <p>Whilst the reporting indicates moderate but stable overall condition, expert opinion is that water quality is declining but river geomorphology is generally improving over the last 40-50 years</p> <p>River condition as reported in 2018 was moderate for NSW overall. At the regional scale it was:</p> <ul style="list-style-type: none"> <li>▪ good to very good for the south coast</li> <li>▪ good for central and north coast</li> <li>▪ moderate for the far north coast and Hunter River</li> <li>▪ poor for the Sydney coast / Georges River</li> </ul> <p>Estuary health as reported in 2018 was moderate for NSW overall consisting of:</p> <ul style="list-style-type: none"> <li>▪ poor or very poor grades for urbanised catchments in the central region</li> <li>▪ poor scores for several developed or agricultural catchments of the north and south coast</li> <li>▪ moderate to good health for the remainder with some showing improvement such as Wallamba River, Myall Broadwater, Durras and Nadgee Lakes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Very good areas should be protected and/or maintained</li> <li>▪ Moderate to good condition regional areas at risk from emerging threats and stressors should be a priority for rehabilitation or strategic monitoring and maintenance activities</li> <li>▪ Areas within those regions contributing the most threat to a system should be a priority for rehabilitation or mitigation</li> <li>▪ Poor to very poor areas where threats are significant and ongoing could be discounted or even excluded from investment priorities</li> <li>▪ Rehabilitation should not aim to restore back to a point in time as that is unrealistic to achieve; recognise the system may have changed and work with it</li> </ul>	<p>Trust investment program design (specific to an onground investment program)</p>
	<p>A study of data taken over 12 years from estuarine rivers, lakes, lagoons and creeks in NSW shows on average a 2.16 degrees Celsius temperature increase, about 0.2 degrees Celsius each year which is an order of magnitude greater than the rate of the oceans and atmosphere. Acidification of estuaries was also increasing by 0.09 pH units a year. Variable changes to the salinity of estuary systems were reported: creeks and lagoons became less saline while river salinity increased<sup>18</sup></p>	<ul style="list-style-type: none"> <li>▪ These outputs provide foundational understanding to improve models used to determine the impacts of climate change on ecosystems and human communities in coastal areas.<sup>19</sup></li> <li>▪ The accelerated rise in temperature highlights that individual traits of any estuary need to be considered in the context of regional climate trends</li> </ul>	<p>Proposal for investment strategy</p>

<sup>18</sup> Scanes E, Scanes PR and Ross PM (2020), Climate change rapidly warms and acidifies Australian estuaries. *Nature Communication* 11, 1803. Available at <https://doi.org/10.1038/s41467-020-15550-z>

<sup>19</sup> Ibid

Group	Finding	Consideration for investment strategy	Where it can be applied
Roles and responsibilities	<ul style="list-style-type: none"> <li>▪ There are a few key agencies who have a major role in funding and managing coastal rivers and estuaries. The Department of Planning, Industry and Environment (DPIE) encompasses Environment, Energy and Science and DPIE Water. The new Department of Regional NSW includes Local Land Services (LLS) and the Department of Primary Industries (DPI) Fisheries. Local government and the Marine Estate Management Authority are also key managers of coastal rivers and estuaries.</li> <li>▪ Community and landholder involvement are essential for on-going ownership of projects</li> <li>▪ Building and sustaining trust in the organisation coordinating the project is important. Changes to government agencies and even local government amalgamations have impacted the availability of resources, advice and engagement</li> </ul>	<ul style="list-style-type: none"> <li>▪ Projects should be linked to strategic management plans, such as: LLS Strategic Plans, Coastal Management Programs, Marine Estate Management Strategy (MEMS) Implementation Plan, or land use plans and strategies such as local strategic planning statements or regional strategies</li> <li>▪ Projects should be co-designed and then co-delivered where possible (including with Traditional Owners, local communities and policy makers)</li> <li>▪ Traditional water knowledge is an essential resource to use when planning and implementing projects<sup>20</sup></li> </ul>	Trust project criteria
Funding programs	<ul style="list-style-type: none"> <li>▪ The MEMS implementation funding and the Coastal Management Programs being developed by local government and co-funded by the Department of Planning, Industry and Environment's Coastal and Estuary grants are investing significant resources and funding in estuaries management and improvement.</li> <li>▪ There is also some funding through Local Land Services devolved grants, DPI Fisheries Habitat Action Grants, Biodiversity Conservation Trust agreements or the Trust's Restoration and Rehabilitation grants. However, projects funded under these programs are typically short-term and not targeted or coordinated to specifically address coastal rivers</li> </ul>	<ul style="list-style-type: none"> <li>▪ The investment strategy should focus on coastal rivers and complement existing estuary (and other catchment) funding where possible</li> <li>▪ It is also important to consider how this program could complement existing funding (e.g. through fewer long-term / large-scale investments or targeted gap filling smaller scale works) as a critical aspect of program design</li> </ul>	Trust investment program design  Could also inform the focus of the investment proposals
Interventions	<ul style="list-style-type: none"> <li>▪ There is little evaluation of long-term success of projects. No evaluations were found for the regional scale projects reviewed in this paper</li> </ul>	<ul style="list-style-type: none"> <li>▪ Past project evaluations to establish outcomes achieved (or not) could be</li> </ul>	Proposal for investment strategy

<sup>20</sup> Bradley Moggridge, Aboriginal Cultural Values and Knowledge - Fire and Water presentation, Rivers on Fire RiverTalk online seminar, 22 April 2020.

Group	Finding	Consideration for investment strategy	Where it can be applied
		<p>considered as a research project</p> <ul style="list-style-type: none"> <li>Establish an online open access project database with evaluations and learnings</li> </ul>	
Governance and policy	<ul style="list-style-type: none"> <li>Coastal rivers and estuaries should be managed as whole-of-catchment systems, with clear governance arrangements for the management of the system</li> <li>Project governance should vest autonomous decision-making with a streamlined project committee of core stakeholders led by a single project owner. The project committee's capacity should match the scale and complexity of the project and should enable effective communication with other stakeholders.</li> <li>Independent funding streams such as levies aimed at catchment and/or waterway health are important to support project secretariat functions and long term-projects.</li> <li>Lack of regulation and policy to address threats to coastal rivers and estuaries, such as agricultural runoff, or a willingness to implement them was one of the biggest issues raised in stakeholder interviews</li> </ul>	<ul style="list-style-type: none"> <li>Project planning should be the responsibility of one lead organisation with adequate resources to coordinate the project over the long-term (beyond project funding timeframes) and to collaborate with all relevant stakeholders</li> <li>Target investment where land use stressors are being addressed through other programs, such as capacity building or awareness raising</li> <li>Whilst regulation is beyond the scope of the Trust to address, it is important context for designing an investment program or informing a prioritisation framework</li> </ul>	<p>Trust project criteria</p> <p>Trust investment program design</p>