Nature's resilience dividend:

How nature can strengthen Sydney's flood and coastal hazard resilience

Committee for Sydney

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Acknowledgements

Nature's Resilience Dividend was prepared by the Committee for Sydney, in partnership with AECOM and the Sydney Environment Institute, bringing together research insights and practitioner expertise. It draws on:

- A 2025 workshop with Greater Sydney practitioners, where barriers and enablers for Nature-based solutions were discussed.
- Stakeholder consultations with key experts to refine findings and ensure practical relevance.
- Policy analysis, case studies, and real-world examples, providing evidence-based recommendations for scaling up Nature-based solutions.

AECOM is the world's trusted infrastructure consulting firm, partnering with clients to solve the world's most complex challenges and build legacies for generations to come.

The Sydney Environment Institute is a globally recognised multidisciplinary environmental research institute tackling the climate and biodiversity crises.

This report was developed through the Committee for Sydney's Resilience Program. The Resilience Program is supported by Ausgrid, Endeavor Energy, Sydney Water, Suncorp, Resilient Sydney and AECOM, and focuses on:

- Identifying opportunities for innovation and economic growth for business, government, and the community in the transition to net zero.
- Determining where and how we invest to ensure system-level resilience and to reduce impacts on businesses and communities.
- Building on experience of extreme heat, flood, storms, and fires, to reduce direct risks to life, assets and productivity, now and into the future.

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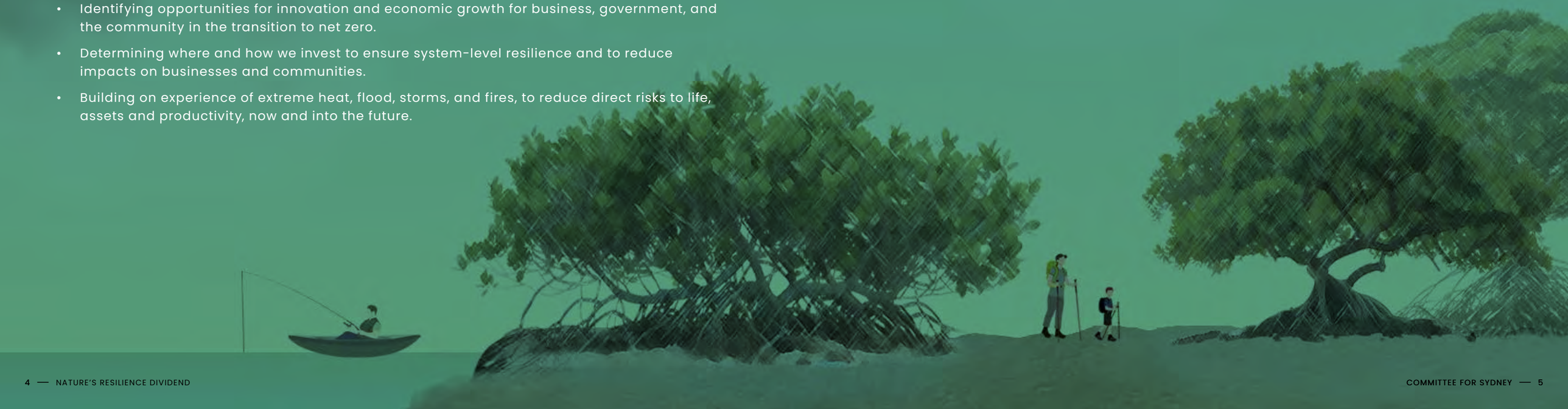
Building on research by Genevieve Wright, Sydney Environment Institute, 2024

Thank you to the following organisations for their generous contributions.

- AECOM Australia Pty Ltd
- Atelier Ten
- Aurecon Group
- Australian National University
- Bayside Council
- Blacktown City Council
- Blue Green Australia
- Campbelltown City Council
- City of Ryde
- City of Sydney
- CSIRO
- Endeavour Energy
- Ethos Urban
- Georges River Council
- Hassell
- Infrastructure NSW
- Ku-ring-gai Council
- Landcom
- Macquarie University
- Natural Hazards Research Australia
- NSW Department of Climate Change, Energy, Environment and Water
- NSW Department of Planning, Housing and Infrastructure
- NSW Reconstruction Authority
- Penrith City Council
- Royal Botanic Gardens and Domain Trust
- Suncorp Group
- Sydney Coastal Councils Group
- Sydney Environment Institute
- Sydney Water
- The University of Sydney
- Transport for NSW
- Transurban
- University of Technology Sydney
- Urbis
- Western Sydney University
- Willoughby City Council



Executive Summary

Image source: Sydney Park, Bioretention project: AECOM

Nature's Resilience Dividend explores how nature-based solutions can transform disaster risk reduction from a reactive, infrastructure-heavy approach to a proactive, adaptive system that delivers multiple benefits. Nature, when strategically integrated into urban planning and hazard management, provides a measurable "dividend" — reducing flood, tidal, and coastal inundation risks while enhancing ecological, social, cultural, and economic value.

Sydney faces escalating flood risks driven by rapid urbanisation, climate change, and ageing stormwater infrastructure. Traditional grey infrastructure alone cannot keep pace with these challenges. Global evidence shows that nature-based solutions — such as wetlands, mangroves, green corridors, and hybrid green-grey systems — often outperform conventional measures in reducing hazard impacts. Unlike engineered assets that depreciate, nature-based solutions grow in value over time, improving biodiversity, water quality, and community wellbeing. This is the essence of nature's resilience dividend: resilience that compounds.

The report highlights successful international and local case studies, from Auckland's Te Ara Awataha stream daylighting to Queensland's Blue Heart wetlands and New York's Big U coastal resilience project. These examples demonstrate that nature-based solutions can manage large-scale flood risks while delivering co-benefits such as cultural connection, employment, urban cooling, and enhanced public spaces.

For the first time NSW has a plan (the State Disaster Mitigation Plan) that specifically points to nature-based solutions as having a critical role to play in reducing natural hazard risk across the state. However, nature-based solutions are not yet "business as usual" in Sydney. Barriers include limited quantitative data on flood mitigation performance, complex valuation of co-benefits, fragmented governance, lack of recognition of nature as a financial asset, and short-term funding cycles disconnected from long-term returns. The NSW Flood Risk Management Guideline states that nature-based solutions have 'low value' impact in addressing anything other than small, frequent, local flooding. Overcoming these challenges requires systemic change.

The report sets out seven directions and 25 recommendations to unlock nature's resilience dividend, including:

Embedding nature-based solutions in all urban development and hazard planning ("Why not nature?")

Integrating Indigenous knowledge and place-based design into adaptation pathways

Refining valuation frameworks to capture full economic, social, and ecological benefits

Test, measure and scale nature-based solutions in metropolitan Sydney

Re-cast nature as a financial asset that delivers economic and wider benefits

Streamline planning approvals for complex nature-based solutions

Establishing governance and funding models that recognise nature as an asset and connect investment to long-term resilience.

By shifting from a narrow focus on engineered solutions to a holistic approach that starts with nature, Sydney can move from reactive flood management to proactive resilience. Nature's Resilience Dividend is not a metaphor - it's a measurable return on investment in resilience, and requires investment, leadership, collaboration, and mindset change to make nature-based solutions a core part of disaster risk reduction.

Summary of Recommendations

Directions	Key recommendations	Lead Agency
1. Ask 'Why not nature' in every urban development, stormwater management, flash flood risk and coastal defence project	a. Identify an NSW Government Department to champion the planning, integration and implementation of nature-based solutions for disaster risk reduction. b. Develop a nature-based solutions policy and practice guideline that shows how nature-based solutions can be integrated into policy, programs and projects to reduce flood risk. This framework should consider the full lifecycle of nature-based solutions, including implementation risks, policy levers and cost-benefit analysis to support informed decision-making. c. NSW DCCEEW to update flash flood, tidal and coastal inundation policy to recognise the catchment-scale role of nature in reducing flood risk, drawing on data and evaluation from existing projects in Greater Sydney and comparable locations, as identified through Recommendation [4].	**Lead:** NSW Reconstruction Authority / NSW Department of Climate Change Energy and Water
2. Ensure planning for natural hazard risk begins with nature, people, place and Indigenous knowledge	a. Integrate nature-based solutions into the development of place-based adaptation pathways and Disaster Adaptation Plan (DAP) business cases from inception. b. Utilise the regional coordinating roles established through the NSW Reconstruction Authority-led DAPs to facilitate design led nature-based solution planning, risk allocation and collaborative delivery across multiple agencies and councils, and with Traditional Owners. c. Build stakeholder capacity on how nature-based solutions bring co-benefits (biodiversity, recreation, water quality and flood mitigation)	**Lead:** NSW Reconstruction Authority
3. Refine methods for valuing economic, social and environmental benefits	a. Offer training or information sessions for local governments, state agencies, and consultants on applying the Framework for Valuing Green Infrastructure and Public Spaces in business cases. b. Make it easier to incorporate the full financial benefits of Nature-based solutions into decision-making processes by identifying best practise case studies and developing easy to use data and tools to expand the green infrastructure framework and knowledge base c. Develop a user-friendly version of NSW Valuing Green Infrastructure Framework for use in all publicly funded infrastructure projects, PPPs and appropriate contributions plans and developer agreements d. Reconsider how the discount rate applies to benefits associated with nature-based solutions that devalue longer-term benefits in cost-benefit analyses. e. Fund and enable simplified cost-benefit analyses and valuation methods to be used in accessing State Government grants and other funding. f. Commit to nature-based solutions projects being delivered as part of university research trials to build documentation of benefits	**Lead:** NSW Department of Planning Housing and Infrastructure

Summary of Recommendations

Directions	Key recommendations	Lead Agency
4. Test, measure and scale	a. Assign a State Government owner to commission, collate data and showcase examples of where valuing nature-based solutions have led to positive hazard risk reduction and other co-benefits. b. Use new and existing nature-based projects to generate real-world data on the effectiveness of nature-based solutions in place and over time (in partnership with Government, Universities, Schools, etc.) to ensure robust assessment. c. Use Disaster Adaptation Plans and other monitoring frameworks to demonstrate the risk reduction, economic, social, cultural and ecological benefits of nature-based solutions as part of adaptation pathways.	**Lead:** NSW Reconstruction Authority
5. Re-cast nature as a financial asset	a. Develop user friendly, clear and accessible methodologies for calculating the full social and economic value of Nature-based solutions so they can be properly accounted for in Council and State Government operational and delivery plans, asset registers, and during the development of business cases, contributions plans, developer agreements, Housing and Productivity Agreements etc b. Provide capacity-building programs for councils, including training and technical guidance on how to include trees and green infrastructure as assets. This could be delivered as part of a council micro-credentials program and delivered by specialist registered training organisations (RTOs). c. Fund/ Support/ Develop a program with Councils to shift to include trees and green infrastructure in their asset registers and asset management models, similar to roads and stormwater assets.	**Lead:** NSW Department of Planning Housing and Infrastructure

Summary of Recommendations

Directions	Key recommendations	Lead Agency
6. Streamline planning approvals for complex nature-based solutions	a. Include "Blue and green infrastructure" or as a State Significant Infrastructure category in Schedule 3 of the Planning Systems SEPP b. Increase investment and collaboration between state government, local governments, utilities and parkland managers to deliver the Sydney Green Grid.	**Lead:** NSW Department of Planning Housing and Infrastructure
7. Connect funding with longer term return on investment	a. Incorporate nature-based solutions in the proposed zoning and associated Contributions Plans for new greenfield urban development across Sydney b. Create a distinct multi-year project funding from the Disaster Ready Fund to enable urban nature-based approaches to support and enhance flood risk reduction (Capex and Opex) E.g. DRF Funding and Disaster Adaptation Plan (DAP). c. NSW Treasury to explore new funding opportunities by working with public and private sector investors. This could include green bonds, biodiversity credits and partnerships with insurers to unlock new sources of capital for nature-based solutions implementation. d. Explore sustainable funding models, including blue carbon markets, that incentivise nature-based solutions on public and private land and support long-term maintenance across multiple landowners. For example, landowners who incorporate green infrastructure on their land could be incentivised with reduced council rates. e. Incentivise property developers to incorporate blue and green infrastructure into large-scale infrastructure projects such as the Green Factor Tool approach identified within the Nature Positive Sydney report.	**Lead:** NSW Treasury

Why nature-based solutions and why now?

Sydneysiders increasingly face the risk of flooding, tidal and coastal inundation as demonstrated by recent events across the city.

The Hawkesbury Nepean Valley experienced major riverine flooding in 2021-22[1], resulting in loss of life, widespread evacuations and property damage. Overland flooding has impacted numerous suburbs, including Double Bay[2] (2024), Manly (2022)[3] and Camden[4] (2022), causing severe flash flooding during intense rainfall, with roads inundated, schools closed, and homes damaged. Coastal storms have impacted beachside housing and infrastructure in suburbs like Collaroy, where storm surge reached maximum wave heights as high as 18 metres during the East Coast Low in June 2016[5].

Managing flood, tidal and coastal risk in Sydney has a storied history. Long before colonisation, Aboriginal peoples in the Sydney basin, including the Darug and Gundungurra nations, relocated communities to manage changing river systems and sea level rise[6]. While direct documentation of Aboriginal flood management practices in the Sydney Basin is limited, evidence from other regions demonstrates that through deep cultural knowledge of Country, Aboriginal people practiced seasonal mobility, construction of weirs to manage floodwaters, elevated settlement patterns, and land management [7].

Post-colonisation, our flood management planning started in earnest in the 1980s, roughly two hundred years after we started urbanising Sydney. It's a reality that our flood management planning - from stormwater drainage to evacuation infrastructure - is always in catch-up mode. Every time we convert green space to housing or infrastructure, we reduce the landscape's absorptive capacity - the sponginess of the city. Less absorption means more water bouncing off our roofs and streets and finding its way towards the closest river or coastline through a network of drains, pipes and culverts.

Sydney risks falling further behind as climate change introduces more frequent and intense storms to our city[8]. The traditional flood management approach of trying to move stormwater downstream as quickly as possible[9] requires that the drainage infrastructure is designed to meet maximum rainfall (as opposed to flood events)[10] and assumes that our rivers and seas aren't already high and rising (which means that water backs up into coastal and riverine environments). Flash flooding in places like Double Bay and Manly has occurred during high tides when stormwater has nowhere to drain. But this risk is equally the case where stormwater pipes are overwhelmed and water backs up, causing flash flooding across the city.

In more progressive cities like Singapore, the Government has now realised that it can't build stormwater infrastructure to outrun increasingly intense rainfall events[11]. Like Singapore we can't design out the impact of flooding and coastal inundation, but we can do everything in our power to reduce the increasing risk. This must include nature-based solutions.

"Cities that rely on conventional flood mitigation… are like a person whose veins and arteries have hardened. Just as reduced blood flow causes heart attacks, blockages and overflows in urban drainage systems can have devastating knock-on effects." [12]
— Kongjian Yu, Landscape Architect

Nature based solutions to reduce the impact of natural hazards are not new.

Whilst the term 'nature-based solutions' has been around since the turn of the millennium, the concept behind it has been practiced by Indigenous peoples for tens of thousands of years through practices such as cool burning[13]. The NSW Reconstruction Authority defines nature-based solutions as[14]:

"…actions that work with nature to reduce natural hazard risk through protecting, preserving, restoring, and enhancing nature"

The modern practice is not new. The Boston Emerald Necklace was a nature-based solution conceived by Landscape Architect Frederick Law Olmstead in 1878 to address urban flooding, whilst solving emerging public health issues from stagnant water [15]. Closer to home, in Sydney Park, former brick pits that once provided the clay that gave Sydney's expanding suburbs their distinctive look have been transformed into a natural system that has been used to reduce flood risk, improve water quality and create ecological benefits and social amenity [16].

Today we plant and protect trees to provide shade and reduce urban heat.

We create parks and naturalise drainage corridors to absorb rainfall, reduce stormwater runoff and make the city more spongey.

We protect coastal regions, harbours, and estuarine foreshores by using mangroves, oyster reefs, wetlands and sand dunes.

And, increasingly, we're combining natural systems with engineered, hard infrastructure – using hybrid solutions like living sea walls, soil mounds, permeable paving, and rain gardens to manage water, reduce risk and restore ecological function.

Collectively, these approaches create a toolkit of practices that harness natural processes to enhance flood management and ecosystem benefits.

How? Nature slows water, increasing infiltration into the soil, storing water and maximising plant growth which makes more room for water storage. Creeks and rivers move slowly by meandering, encourage sedimentation which is good for ecologies that clean water and store it, like wetlands, oysters, and mangroves.

Sydney leads the world in many green endeavours, including using nature-based solutions to mitigate the growing challenge of urban heat risk[17] but on flooding, tidal and coastal inundation, we are still very traditional. Combined with land use planning and emergency management, flood risk management maintains a continued reliance on concrete engineering and pipes, potentially increasing our vulnerability to extreme weather. Long stretches of concrete pipes and channels increase the velocity of stormwater, removing the absorptive capacity of the land and increasing the volume and speed of discharge into river systems.

So why have we focused our attention and effort on this topic?

Sydney's flood risk is growing and changing

Sydney is growing – into greenfield areas, denser urban areas, and more established coastal suburbs – meaning more hard surfaces for water to run off and more stormwater to manage during those increasingly frequent and intense storm events[18].

Our flood risk is not static. Dynamic challenges include more development in areas prone to flood risk, changing flood risk due to climate change (more frequency and intensity of rainfall in wet periods), the development of previously absorptive upstream catchment areas, and the cumulative risk of intense rainfall and high tides (with runoff unable to drain, causing flash flooding) and rainfall overwhelming drainage infrastructure.

We have a very mature flood risk management framework here in Sydney, which local governments must follow in order to be provided limited legal liability for decisions "made or advice given as it relates to flood risk"[19]. This framework was developed after much of the city's urban form was already established. Meaning, flood management to date has largely focused on draining water quickly to rivers and the harbour, often overlooking the role that nature-based solutions can play. The NSW Flood Risk Management Guideline states that nature-based solutions have 'low value' impact in addressing anything other than small, frequent, local flooding[20], [1].

Channelised streams, such as Bow Bowing Creek in Campbelltown that have replaced natural with man-made stream beds, are often counterproductive when looked at from a community resilience perspective. Speeding up water flows by changing the direction and bed of the river can drastically reduce soil hydration, resulting in more extreme conditions when local trees stop evapotranspiration in high heat due to lack of moisture in their root system.

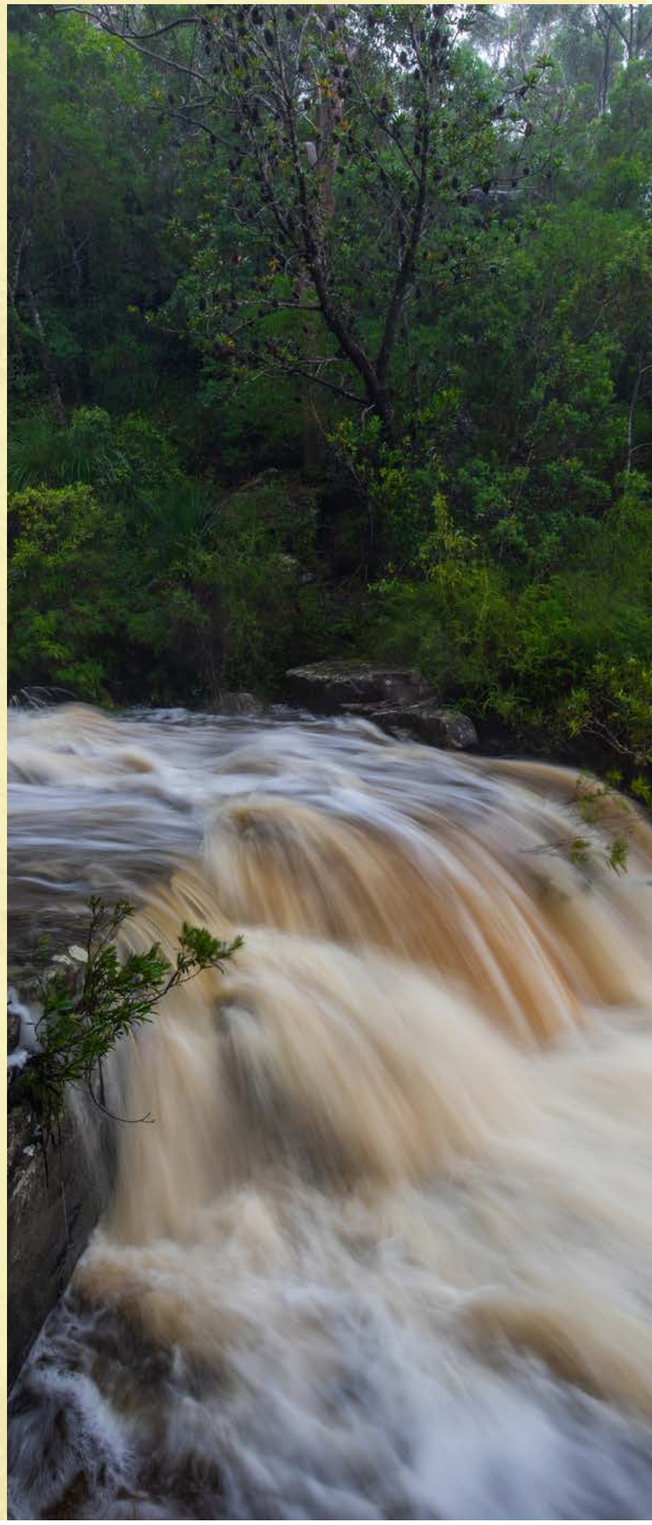
Stormwater detention and retention in built-up areas is a critical part of Sydney's water cycle, underpinning both flood management and the resilience of our communities. This is also an area where nature-based solutions have a vital role to play. Unlike engineered interventions that are often seen as fixed, one-off responses, nature-based approaches anticipate and adapt to change - just as nature itself does. They require ongoing care, maintenance and regeneration, but in return they deliver lasting value, reducing risk while enhancing the liveability and ecological health of our city.

1 As per reference above: "These measures [NBS] typically only deal with short duration, more frequent events and will have very limited benefit for the rarer events of importance in flood risk management."

One of the key barriers to accelerating the uptake of nature-based solutions in Sydney, along with limited space, is the limited applicable evidence demonstrating their effectiveness in managing large, infrequent flood events. While NSW's Flood Risk Management Framework acknowledges the value of nature-based solutions for more frequent, shorter-duration events, there is a perceived absence of strong, applicable evidence for rarer, larger floods [21]. This is less an issue of the effectiveness of nature-based solutions and more an issue that their effectiveness has not been properly documented.

Building greater confidence in these solutions will require stronger evidence and case studies - both international and local – that are clearly applicable to Sydney's geography and planning context and can provide governments with the assurance needed to support their adoption. In the meantime, there is a clear opportunity to prioritise their use in areas already experiencing flash flooding, as well as in greenfield developments, where nature-based approaches can be embedded early to complement traditional systems and reduce long-term risk.

So, what is changing in the NSW context?



NSW has introduced a State-wide plan that specifically backs in nature-based solutions

For the first time, NSW has a State Disaster Mitigation Plan (SDMP), and state-wide plan that specifically points to nature-based solutions as having a critical role in reducing natural hazard risk (State Disaster Mitigation Plan Action 22).

NSW Reconstruction Authority is responsible for developing Disaster Adaptation Plans in Sydney and across NSW that take a multi-hazard approach (bushfire, flood, extreme heat etc) and regional, place-based approach to reducing those risks[22]. The new disaster adaptation planning process – known as adaptive pathway planning - intends to consider (and potentially embed) nature-based solutions as one of the strategies to reduce flooding, coastal inundation and other hazard risks.

This new policy direction presents a significant opportunity to shift how we approach natural hazard risk management in NSW.

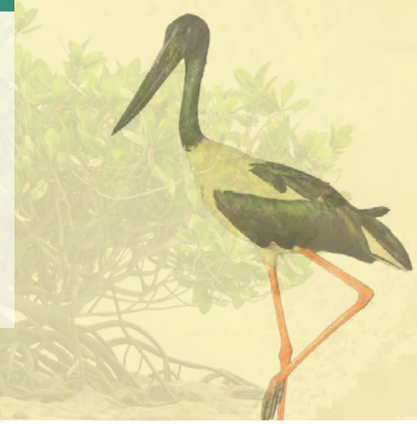
By considering the value of nature-based solutions within a broader multi-hazard and multi-benefit framework, the Disaster Adaptation Plan process may allow decision-makers to account for the multiple benefits of nature-based solutions within a place. Therefore, allowing for a consideration beyond the narrow evaluation of flood mitigation effectiveness alone. While nature-based solutions may not always be the most effective option for all flood events, their ability to deliver multiple co-benefits - such as enhanced biodiversity, urban cooling, improved water quality, and cultural and social value - means they can rank more highly in options assessments when these broader outcomes are considered, rather than flood management alone.

Furthermore, the regional and cross-agency nature of the Disaster Adaptation Plan process introduces new opportunities for more strategic and coordinated responses, such as managed retreat or land-use change, that are often challenging to achieve by a single council-led Floodplain Risk Management Plan.

So, what kind of evidence and real-world examples show that nature-based solutions work?

NSW State Disaster Mitigation Plan (SDMP)

The purpose of the SDMP is to set "… out the NSW Government's strategy to reduce the impact and cost of natural hazards on people, homes, livelihoods, infrastructure, and communities. It also sets out a plan of short and medium term actions required to address current challenges and strengthen State level policy and programs. Implementing these actions will support and guide the development of place-based Disaster Adaptation Plans (DAPs)."



Growing global and local evidence that nature-based solutions often outperform traditional flood risk management solutions (regardless of scale).

A global review of academic studies evaluating the effectiveness of nature-based interventions, found that nature-based solutions were often as or more effective than conventional approaches in addressing the adverse impacts of climate change on people[23]. A global comparison of the cost-effectiveness of nature-based and engineering solutions for hazard mitigation showed that 65% of studies found nature-based solutions more effective in reducing hazards, while 26% found them partially more effective [24]. The evidence shows that nature-based solutions can reduce flood risk in many scenarios relevant to metropolitan Sydney.

The reality is that in Australia and overseas, there are growing examples and evidence of nature being used to reduce hazard risk at scales far beyond what is considered here. This evidence needs to be tested here in metropolitan Sydney.

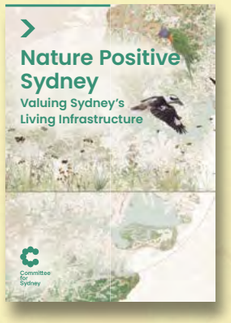
From New York to the Netherlands, New Zealand to New Orleans, and from Ningbo, China to Narooma here in NSW, exciting and innovative projects are demonstrating the direct benefits of nature-based solutions in reducing flood, tidal and inundation risk. They are further demonstrating the economic, social and environmental co-benefits that nature-based solutions can deliver.

"Nature-based solutions are cheap, effective and scalable, and can help governments address the growing challenges of climate change, biodiversity loss, increased frequency of extreme weather and natural hazards as well as other human-made environmental disasters."

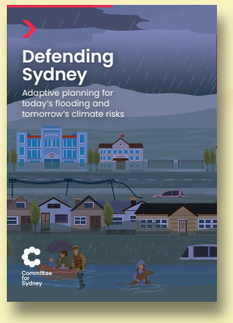
— The UN Office of Disaster Risk Reduction[25]

Nature based solutions are consistently raised by experts as part of the solution to building Sydney's resilience

This is not a new area of focus for the Committee for Sydney. The benefits of nature-based solutions in promoting mental and physical health, mitigating heat and flood risk, enhancing biodiversity, and supporting community continuity have been consistent themes.



The "Nature Positive Sydney" report highlights the importance of recognizing and funding Sydney's natural assets, such as parks, waterways, and urban forests, to enhance biodiversity and community well-being.



In "Defending Sydney," the Committee advocates for the use of natural systems, like wetlands and green spaces, to mitigate climate risks, including flooding and urban heat islands.

In "No Weak Links", the Committee identified that there is limited formal recognition of the role that trees, plants, parks and waterbodies (also known as nature-based solutions) in Sydney play in risk management and community continuity. Blue-green infrastructure - such as mangroves – are not considered critical infrastructure despite their key role in riparian and coastal protection.

The "Burning Money" report addresses the economic and health costs of heatwaves in Western Sydney, recommending embedding the impacts and economic costs of heatwaves into NSW Government decision making, including through the 2026 NSW Intergenerational Report (aggregate risk), and biennial departmental climate change impacts, risks and adaptation statements (enterprise risk disclosure).

If cities around the world are adopting nature-based solutions into their everyday flood management practices, how do we make nature business as usual?[26]

How are nature-based solutions reducing flooding, tidal and inundation risk around the world?

Nature-based solutions are being successfully implemented around the world to reduce the impacts of flooding, protect communities, and restore degraded ecosystems. From urban streams in New Zealand to floodplains in the United Kingdom and living shorelines in Australia, these projects show how nature can be harnessed to reduce a range of risks while delivering a wide range of co-benefits.

To understand how nature can be used to reduce inland and coastal flood risks, we reviewed a range of global case studies. This research was informed by interviews with private, state and local entities, drawing directly from the experiences of people who have been delivering these projects over the last few years. The five projects we examined, as outlined below, ranged from solely nature-based measures such as ecosystem restoration to hybrid measures that combine nature-based solutions with grey infrastructure and traditional flood management [27].

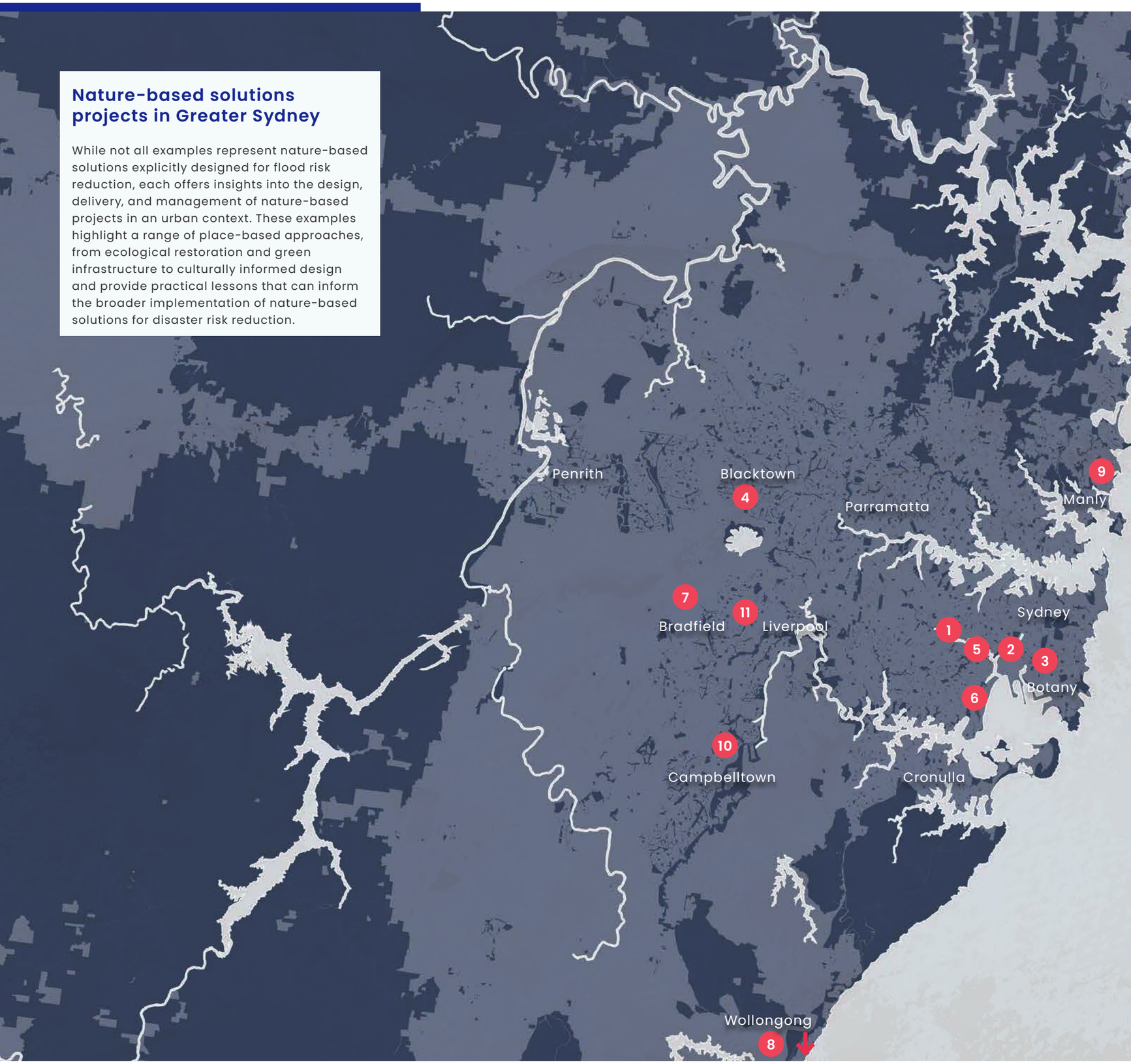
What the examples share is a clear understanding of local natural systems, changing flood risks, a willingness to engage across sectors and landholders, and a commitment to long-term outcomes. These examples provide valuable insights into what it takes to implement nature-based solutions at scale, and highlight the importance of strong governance, strategic planning, and meaningful community engagement - lessons that are directly relevant to the metropolitan Sydney context.

The insights drawn from these case studies have directly informed the findings outlined in the following sections. The insights are reflected in our summary of the six co-benefits of nature-based solutions for disaster risk reduction, the identification of five significant barriers preventing nature-based solutions from becoming a business-as-usual approach to flood risk management, and the key opportunities for change.

Nature-based solutions are not about a single approach to flooding, tidal or inundation risk. They are intentional, design thinking led, place based and always have multiple benefits.

Nature-based solutions projects in Greater Sydney

While not all examples represent nature-based solutions explicitly designed for flood risk reduction, each offers insights into the design, delivery, and management of nature-based projects in an urban context. These examples highlight a range of place-based approaches, from ecological restoration and green infrastructure to culturally informed design and provide practical lessons that can inform the broader implementation of nature-based solutions for disaster risk reduction.



Example projects

1. **Cooks River Naturalisation (Sydney Water)**
   Removed concrete banks, regraded slopes with sandstone, planted 100,000+ native species, restored wetlands/saltmarsh along ~1.1 km
2. **Sydney Park Water Re-use**
   Series of connected wetlands, cascades, spillways, stormwater harvesting infrastructure integrated into park landscapespecies, restored wetlands/ saltmarsh along ~1.1 km
3. **Raingarden Program (City of Sydney)**
   More than 2,300 m² of raingardens in streetscapes: terraced, offline, biofiltration design filtering stormwaterspecies, restored wetlands/saltmarsh along ~1.1 km
4. **Fairwater Estate (Blacktown City Council)**
   3.5 ha of wetlands, engineered ponds, riparian corridors, WSUD at precinct-scale; Natural detention, infiltration moderates flows, reduces flood peaks
5. **Cooks River to Iron Cove GreenWay project' (Inner West)**
   Ecological corridor with water-sensitive urban design features (rain gardens, bioswales, wetlands) along 5.5 km green corridor
6. **Kogarah North Precinct Public Domain Plan – nature-based solutions for future retrofit**
   Flood and overland flow study guiding future nature-based solutions retrofits in precinct plan
7. **Wianamatta Precinct Plans (Aerotropolis)**
   Regional WSUD approach: precinct-scale stormwater harvesting, wetlands, riparian corridors along South Creek
8. **Wetlands and Ponds (University of Wollongong)**
   Ponds and artificial wetlands for flood conveyance; Kooloobong pond and campus ponds/streams since 1970s, planted slopes for habitat and safety
9. **Wetland Retention Dee Why Lagoon**
   Similar to Botany wetlands: freshwater ecosystems for habitat, recreation and flood/ storage function
10. **Campbelltown Billabong**
    Natural billabong, wetlands, vegetated swales, riparian replanning
11. **Restoring the Waters (City of Fairfield)**
    Concrete removal, meandering creek, native planting, floodplain reconnection

CASE STUDY 1:

Blue Heart Sunshine Coast

LOCATION

Maroochydore, QLD, Australia

HAZARD RISK

Flooding

The Blue Heart project is a $35-million initiative led by local government aimed at enhancing flood storage capacity along the Maroochy River floodplain. Over the next 80 years, the project seeks to restore 5,000 hectares of land (wetlands, public reserves and agricultural land) to an estuarine wetland system.

The nature-based solution used is the removal of historic constructed tidal barriers to allow saltwater into the area, attracting mangrove and saltmarsh communities to grow naturally. Detailed modelling commissioned by Sunshine Coast Council shows that restoring wetlands and removing tidal barriers increases flood storage capacity and slows runoff during peak rainfall events, reducing flooding.

Key outcomes achieved to date include the Blue Heart becoming Australia's first blue carbon project under the Australian Carbon Credit Units Scheme. The project has involved extensive collaboration across a diverse range of public and private stakeholders, though it continues to face delays due to opposition from some private landholders and developers. Strong partnerships across government, industry, research institutions, Traditional Owners, and the community have been central to its progress and success.

Key lessons from this project that can be applied to projects in Greater Sydney include:

- Strategically aligning a project with key State and Federal priorities can help secure funding from all three levels of government, supporting the viability and longevity of nature-based solutions.
- Embedding cultural values from the outset improves project outcomes and social license. Collaboration with the Kabi Kabi people was particularly significant, providing cultural guidance, training, and heritage protection throughout the rewetting process. Indigenous rangers were employed to monitor and manage the site.
- Large-scale transition planning may require discontinuing maintenance of vulnerable roads and power infrastructure. This highlights the need for strong coordination and communication across multiple agencies when planning nature-based solutions in environments with mixed land uses.

CASE STUDY 2:

Wagonga Inlet Living Shoreline

LOCATION

Narooma, NSW, Australia

HAZARD RISK

Coastal erosion and tidal inundation

The Wagonga Inlet Living Shoreline (WILS) project in Narooma, NSW, was developed to address coastal erosion and increased tidal inundation along the foreshore.

Instead of rebuilding the existing rock wall, the project adopted a nature-based approach to restore three degraded ecological communities; saltmarsh, subtidal Angasi (flat oyster) reefs, and intertidal Sydney rock oyster reefs. These natural systems absorb wave energy, stabilise the shoreline, and provide habitat for marine life, while also improving water quality.

Key outcomes achieved to date include the establishment of NSW's first subtidal native oyster reef on the South Coast, early evidence of improved biodiversity with 15 fish species and sargassum seaweed observed, and significant community engagement. The project has delivered additional public benefits, including a new elevated boardwalk, jetty, and pontoon, and embedded Indigenous knowledge through partnerships with the Wagonga Local Aboriginal Land Council and the Joonga Land and Water Aboriginal Corporation. Local Indigenous crews helped plant vegetation, while NSW's only certified Indigenous dive crew monitored the subtidal reefs.

Key lessons from this project that can be applied to projects in Greater Sydney include:

- Nature-based solutions can be made more viable when integrated with infrastructure upgrades (e.g. boardwalks, pontoons), creating opportunities to attract broader funding sources.
- Close collaboration with Indigenous communities from the outset can embed cultural knowledge and values in the design, delivery and ongoing management of the project and create jobs on Country.
- Navigating planning and approvals for nature-based solutions requires clear coordination across multiple agencies, particularly when species and land responsibilities are fragmented.
- Personal relationships between agency staff can help bridge institutional barriers and support more integrated delivery.

CASE STUDY 3:

Te Ara Awataha

LOCATION

Auckland, New Zealand

HAZARD RISK

Flooding and storms

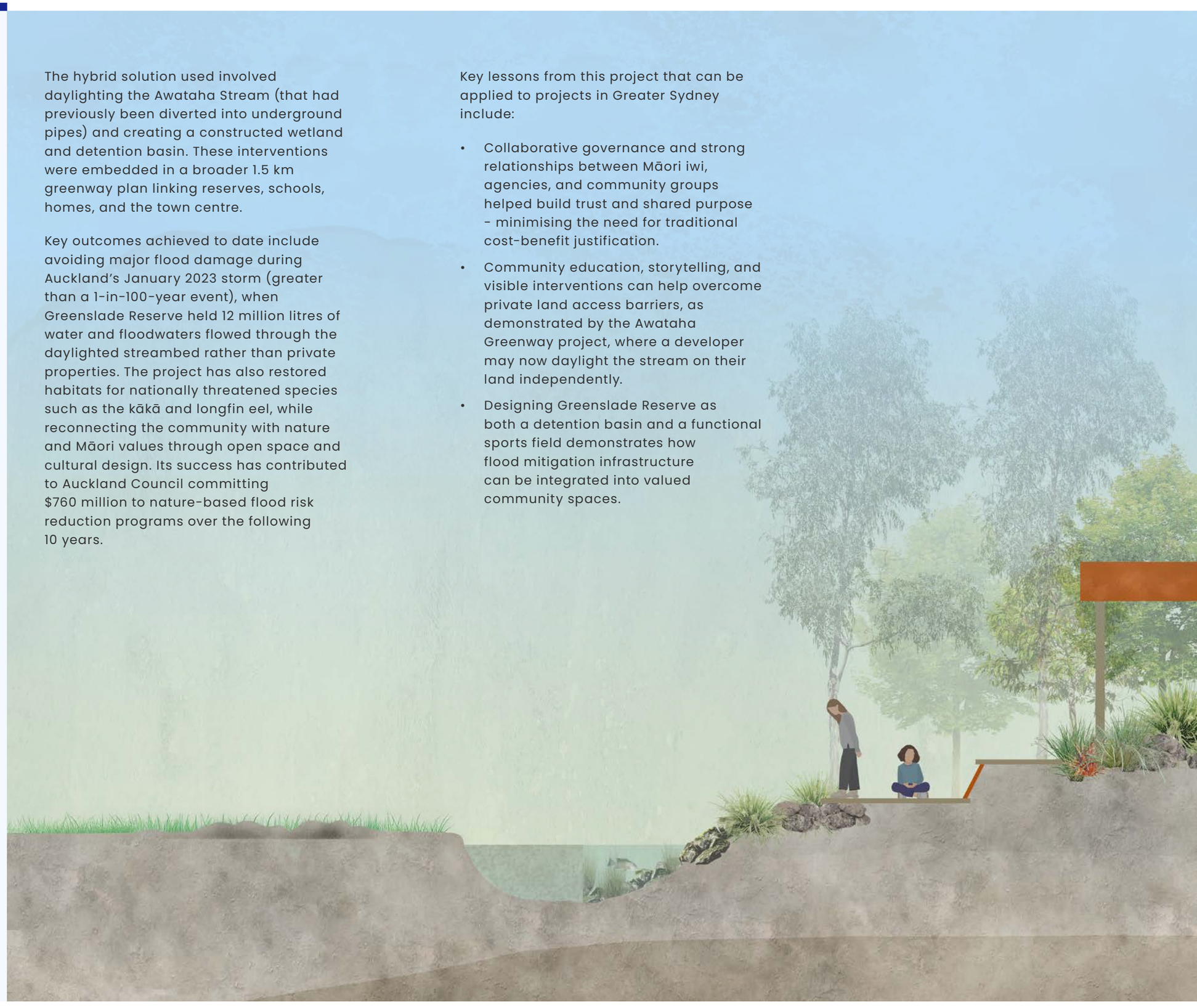
The Te Ara Awataha project is a river daylighting and wetland restoration initiative in Northcote, Auckland, developed to address flood risks impacting homes, roads, and public spaces in a growing urban area.

The hybrid solution used involved daylighting the Awataha Stream (that had previously been diverted into underground pipes) and creating a constructed wetland and detention basin. These interventions were embedded in a broader 1.5 km greenway plan linking reserves, schools, homes, and the town centre.

Key outcomes achieved to date include avoiding major flood damage during Auckland's January 2023 storm (greater than a 1-in-100-year event), when Greenslade Reserve held 12 million litres of water and floodwaters flowed through the daylighted streambed rather than private properties. The project has also restored habitats for nationally threatened species such as the kākā and longfin eel, while reconnecting the community with nature and Māori values through open space and cultural design. Its success has contributed to Auckland Council committing $760 million to nature-based flood risk reduction programs over the following 10 years.

Key lessons from this project that can be applied to projects in Greater Sydney include:

- Collaborative governance and strong relationships between Māori iwi, agencies, and community groups helped build trust and shared purpose - minimising the need for traditional cost-benefit justification.
- Community education, storytelling, and visible interventions can help overcome private land access barriers, as demonstrated by the Awataha Greenway project, where a developer may now daylight the stream on their land independently.
- Designing Greenslade Reserve as both a detention basin and a functional sports field demonstrates how flood mitigation infrastructure can be integrated into valued community spaces.



CASE STUDY 4:

Mansfield Sustainable Flood Resilience Project

LOCATION

Nottinghamshire, UK

HAZARD RISK

Flooding

The Mansfield Sustainable Flood Resilience Project aims to reduce flood risk across the entire town. Urban development had significantly reduced natural drainage, placing nearly 1,000 residents at high risk and leading to frequent combined sewage overflows into waterways.

The sustainable urban drainage approach embedded nature-based solutions across the 20,000 interventions including detention basins, bioswales, permeable pavements, and rain gardens - capable of storing more than 58 million litres of water.

Key outcomes achieved to date include successful performance of the urban drainage infrastructure during Storms Babet, Gerrit, and Ciaran (2023–2024), reducing flooding in known hotspots. The project has benefited over 90,000 residents by improving flood resilience, river health, and biodiversity while creating around 500 local skilled jobs. The UK Government has since mandated this Mansfield style approach for all new housing developments from 2024.

Key lessons from this project that can be applied to projects in Greater Sydney include:

- Government investment and supportive policy frameworks are critical to enabling large-scale nature-based solutions.
- Nature-based infrastructure can be integrated at scale in an urban environment to deliver both flood resilience and broader co-benefits.
- Strategic partnerships across government, design, and research organisations can enhance planning, delivery, and innovation.
- Community involvement in project design supporting the social license for the project.

CASE STUDY 5:

The Big U Coastal Resilience Project

LOCATION

Manhattan, New York, USA

HAZARD RISK

Flooding and storms

The Big U is a coastal resilience project in Lower Manhattan, developed in response to the devastation caused by Hurricane Sandy in 2012. The storm flooded 17% of the city, caused $19 billion in damages, and exposed major vulnerabilities in New York's coastal defences.

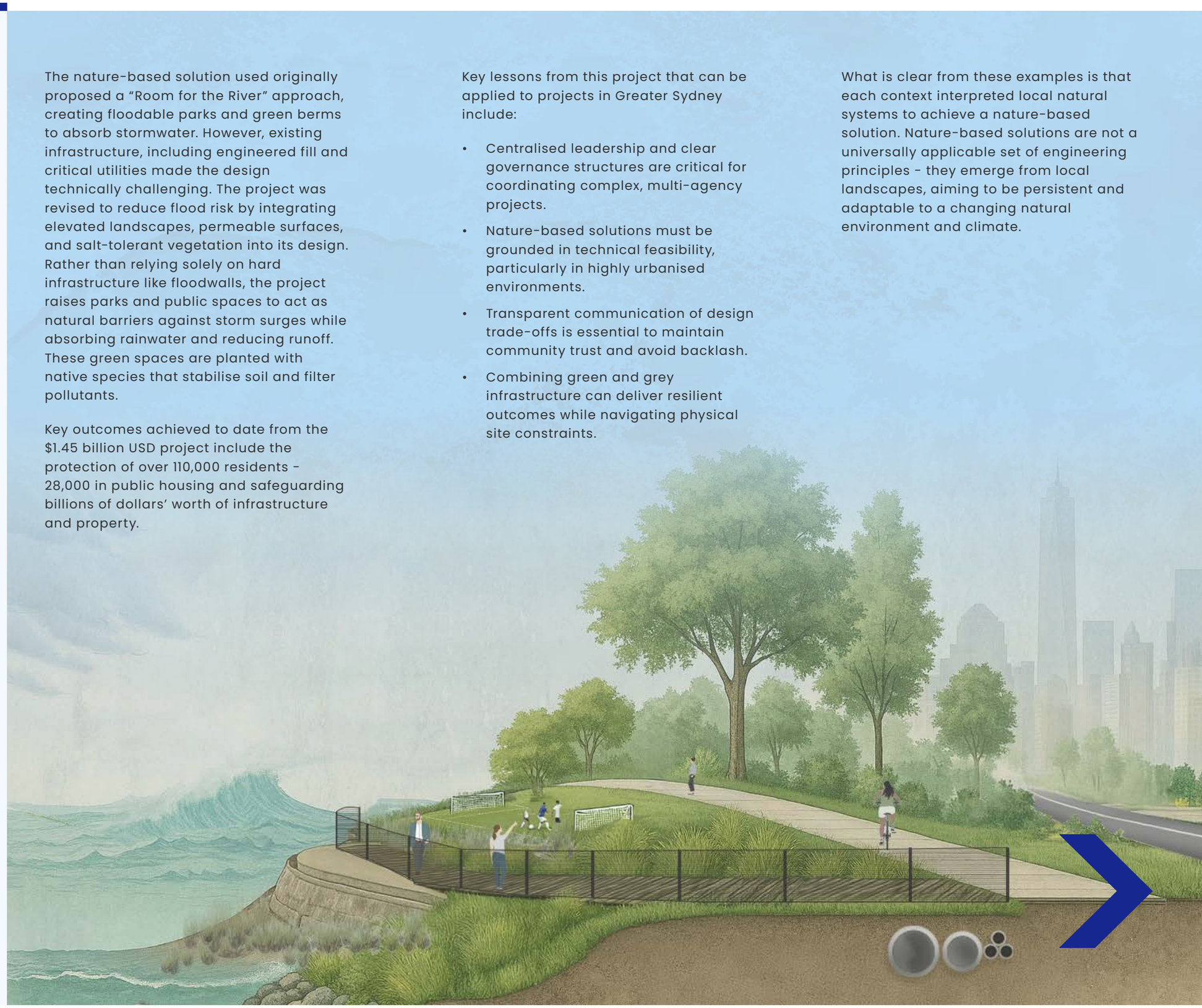
The nature-based solution used originally proposed a "Room for the River" approach, creating floodable parks and green berms to absorb stormwater. However, existing infrastructure, including engineered fill and critical utilities made the design technically challenging. The project was revised to reduce flood risk by integrating elevated landscapes, permeable surfaces, and salt-tolerant vegetation into its design. Rather than relying solely on hard infrastructure like floodwalls, the project raises parks and public spaces to act as natural barriers against storm surges while absorbing rainwater and reducing runoff. These green spaces are planted with native species that stabilise soil and filter pollutants.

Key outcomes achieved to date from the $1.45 billion USD project include the protection of over 110,000 residents - 28,000 in public housing and safeguarding billions of dollars' worth of infrastructure and property.

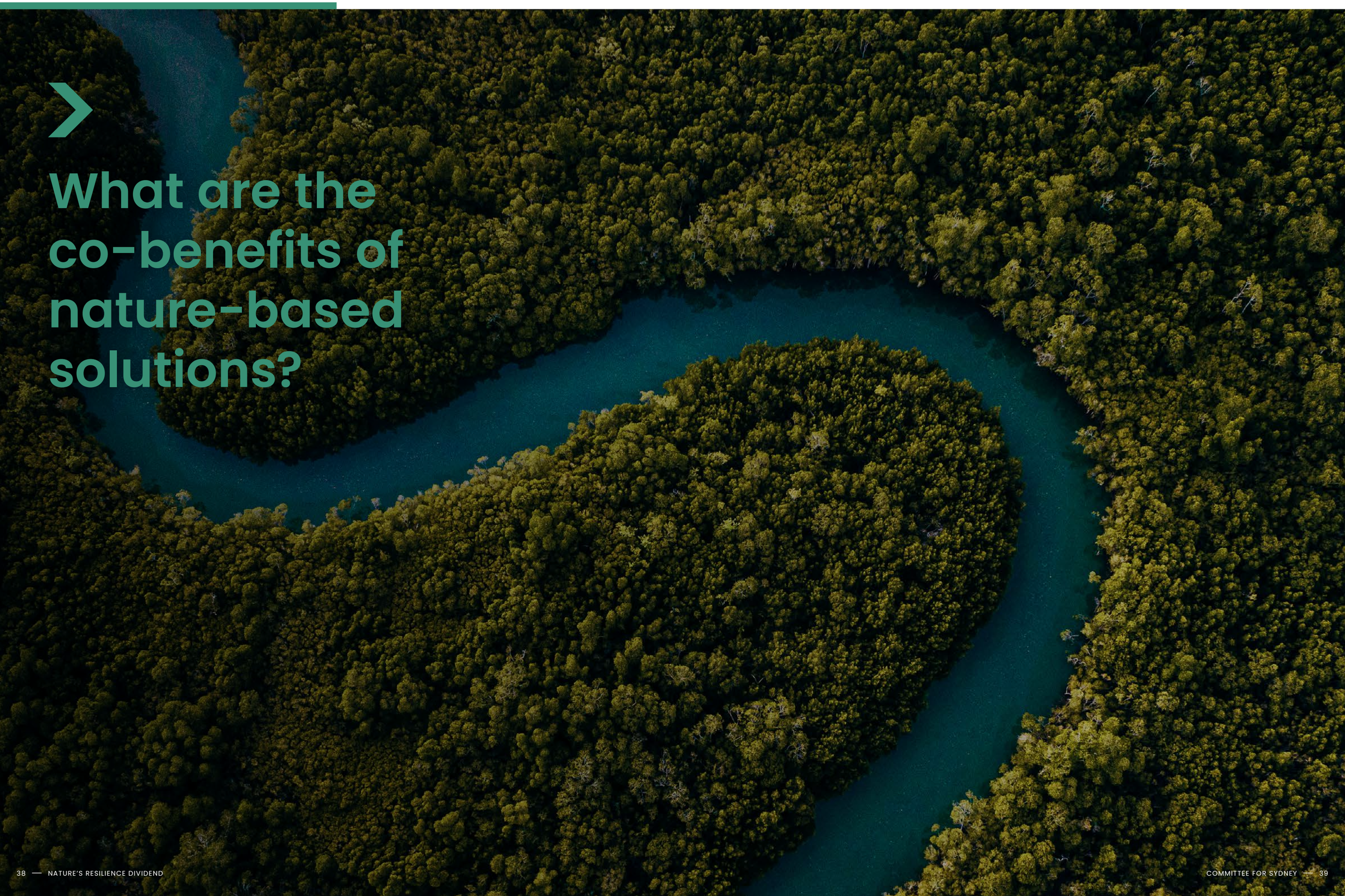
Key lessons from this project that can be applied to projects in Greater Sydney include:

- Centralised leadership and clear governance structures are critical for coordinating complex, multi-agency projects.
- Nature-based solutions must be grounded in technical feasibility, particularly in highly urbanised environments.
- Transparent communication of design trade-offs is essential to maintain community trust and avoid backlash.
- Combining green and grey infrastructure can deliver resilient outcomes while navigating physical site constraints.

What is clear from these examples is that each context interpreted local natural systems to achieve a nature-based solution. Nature-based solutions are not a universally applicable set of engineering principles - they emerge from local landscapes, aiming to be persistent and adaptable to a changing natural environment and climate.



What are the co-benefits of nature-based solutions?



Nature-based solutions do more than reduce flood, tidal and inundation risk—they create a wide range of environmental, social, cultural, and economic benefits.

What are the co-benefits of nature-based solutions?

These co-benefits are often not captured in traditional infrastructure or cost-benefit assessments. Not because the co-benefits exist, but because in a world where 'what gets measured gets managed', they are difficult to quantify or are considered secondary to core flood mitigation outcomes. However, growing evidence from real-world projects shows that these co-benefits are significant and should be valued more explicitly in decision-making.

Our research identified six co-benefits commonly delivered by nature-based solutions:

- Connection to Country and employment.
- Improved water quality.
- Habitat for native species and enhanced biodiversity.
- Community health and wellbeing
- Enhanced public infrastructure and connectivity.
- Reduced stormwater and wastewater overflows.

The following examples, drawing on case studies, highlight the range of co-benefits delivered by nature-based solutions - benefits that extend well beyond flood mitigation.

Connection to Country, community and employment

- **Blue Heart wetland restoration (QLD):** Partnered with the Kabi Kabi people to co-design the project, embed cultural values, and employ Indigenous rangers for wetland monitoring and management. A permanent ranger base was established to strengthen long-term connection to Country.
- **Wagonga Inlet living shoreline (NSW):** Co-designed with the Wagonga Local Aboriginal Land Council, featuring cultural artworks, native plantings, and Indigenous-led dive and restoration crews. Cultural knowledge was embedded across planning and delivery.
- **Te Ara Awataha stream daylighting (NZ):** Piloted the Take Mauri Take Hono framework, using Māori indicators of mauri (life force) such as water quality, biodiversity, community belonging, and cultural visibility to guide and assess project success.
- **Big U integrated waterfront resilience (New York City):** Community engagement was central to the project design process, with diverse Lower Manhattan communities contributing to locally tailored resilience and public space outcomes.

Improved water quality

- **Wagonga Inlet living shoreline (NSW):** Restored oyster reefs improve water quality by filtering pollutants; monitoring has recorded 15 fish species returning to the area.
- **Te Ara Awataha stream daylighting (NZ):** Stream restoration and wetland creation improved water quality, with mauri-based indicators tracking clarity and ecological health.
- **Mansfield Sustainable Flood Resilience (UK):** Distributed rain gardens and detention basins reduce stormwater pollutants entering urban waterways.
- **Blue Heart wetland restoration (QLD):** Wetland filters runoff before entering the Maroochy River, improving downstream water quality.
- **Big U integrated waterfront resilience (New York City):** The design includes bioswales and landscaped berms to absorb runoff and filter stormwater before it reaches the East River, improving water quality in a heavily urbanised environment.

Habitat for native species and enhanced biodiversity

- **Blue Heart wetland restoration (QLD):** Restoring 5,000 ha of estuarine wetland supports threatened species, migratory birds, and mangrove ecosystems that store carbon.
- **Te Ara Awataha stream daylighting (NZ):** Created a biodiverse green corridor supporting longfin eels and nationally threatened birds like the kākā.
- **Wagonga Inlet living shoreline (NSW):** Saltmarsh and reef restoration enhances estuarine habitats, attracting bird and marine life.

Community health and wellbeing

- **Te Ara Awataha stream daylighting (NZ):** Delivered a 1.5 km greenway linking homes, schools, and parks. Strengthened wellbeing through walkable green space and cultural design, with success indicators including community belonging and cultural visibility.
- **Mansfield Sustainable Flood Resilience (UK)**: Green infrastructure across the town improved amenity and liveability, while creating over 500 jobs and supporting mental wellbeing.
- **Big U integrated waterfront resilience (New York City):** Multi-functional public spaces, including elevated parks and shaded pathways, were co-designed to reduce urban heat island effects, enhance walkability, and provide safe spaces for recreation and social connection.

Enhanced public infrastructure and connectivity

- **Te Ara Awataha stream daylighting (NZ):** Integrated stormwater management with pedestrian paths and open space, linking key destinations through a green corridor.
- **Wagonga Inlet living shoreline (NSW):** Delivered elevated boardwalks, a jetty, and pontoon that provide recreational access while protecting shoreline habitat.
- **Big U integrated waterfront resilience (New York City):** The project reimagines flood protection infrastructure as community assets, including protective berms, floodwalls, and deployable barriers with open space, playgrounds, and pedestrian links across neighbourhoods.

Reduced stormwater and sewage overflows

- **Mansfield Sustainable Flood Resilience (UK):** Designed to store over 58 million litres of stormwater, relieving pressure on drainage infrastructure and reducing sewer overflows.
- **Te Ara Awataha stream daylighting (NZ):** Lowered Greenslade Reserve now acts as a detention basin; during the 2023 Auckland floods it stored 12 million litres of water, preventing inundation of nearby homes.
- **Big U integrated waterfront resilience (New York City):** Green infrastructure features like rain gardens and vegetated berms help manage intense rainfall events, reducing the burden on stormwater systems and limiting combined sewer overflow into the East River.

Recognising and accounting for these co-benefits is critical - it increases the likelihood that nature-based solutions will be prioritised during options assessment processes because the benefits are explicitly recognised, assessed, weighed against costs and ultimately integrated into mainstream disaster risk and flood risk planning.

Yet in considering the full spectrum of co-benefits, it's essential to recognise the role of social license and policy legitimacy—two outcomes that are increasingly critical in the delivery of public infrastructure. The six projects cited demonstrate that when communities are engaged early and meaningfully, and when benefits are clearly shared, support follows. These processes don't just build better places; they build trust. In a time when we need to be responding to both changing risk and secure social license to do so, the capacity to deliver policies that are not only technically sound but socially endorsed is a form of political legitimacy. This is clearly a value that sits outside the bounds of conventional cost-benefit analysis, but one that looms large in any serious risk assessment.

Why are nature-based solutions not business as usual in disaster risk reduction?

There are 5 key barriers to making nature-based solutions business as usual

If nature-based solutions have demonstrated the value they create, have proven to be effective at mitigating flood, tidal and inundation risk and have been implemented for decades, why are they not the default approach? What are the barriers to making nature-based solutions business as usual?

We know that the barriers aren't technical. There are examples from NSW and all over the world that show nature-based solutions – often as a hybrid solution with conventional measures - reduce flooding, tidal and inundation risk and deliver multiple co-benefits that are unavailable to traditional infrastructure solutions. We have seen examples from a range of scales – big cities to small, and large catchments to smaller coastal towns.

So, what is holding back the deployment of nature-based initiatives as a default solution for flood risk management?

This section of the report draws on insights from experts and practitioners across local government, state government agencies, academics, and infrastructure providers across metropolitan Sydney. It identifies five key barriers currently limiting the widespread adoption of nature-based solutions in flood risk management.

Barrier 1

There is a lack of quantitative data on flood and coastal disaster risk reduction benefits here in Greater Sydney.

Barrier 2

Emerging methods for valuing the economic, social and environment benefits of nature-based solutions are complex and under-utilised.

Barrier 3

There is no agency taking responsibility for owning design, approval and driving decisions about risk allocation, collaborative governance is needed to enable cross-boundary and inter-agency design and delivery.

Barrier 4

Nature is not considered a financial asset, meaning it is rarely included in asset management planning and funding.

Barrier 5

There is a disconnect between the short-term funding cycles and the longer-term return on investment nature delivers.

Barrier 1
Lack of quantitative data on flood and coastal disaster risk reduction benefits

When grey infrastructure is assessed – from levees and detention basins, to drains and channel improvements – we generally have well-established performance data [28]. That means, when modelling and assessing flood risk management options, we have a good understanding of their effectiveness. This creates performance certainty and reinforces grey infrastructure as a tried and tested infrastructure solution.

However, for nature-based measures, we heard there is less quantitative information about the flood mitigation benefits and co-benefits of different types of nature-based solutions – this is particularly the case at the catchment and floodplain scale (as opposed to urban scale). Part of the reason is that the effectiveness of nature-based solutions can vary depending on scale, geography, and intervention type. In addition, their effectiveness varies over time [29].

Nature-based solutions lack standardised evaluation methodologies. The lack of uniformity that comes with a place-based solution means that rarely are the benefits the same across different regions or projects. Without this information, it is difficult to develop consistent performance metrics for evaluation guidelines, making the quantification of the benefits challenging, particularly when comparing measures to traditional grey infrastructure.

Where has this barrier already been overcome?

The *Mansfield Sustainable Flood Resilience Project* in the UK is an example where quantitative data and modelling were used to demonstrate the effectiveness of nature-based solutions at scale. The project involved installing a town-wide network of rain gardens, bioswales, and detention basins, supported by detailed hydrological modelling that showed the system could store over 58 million litres of water and significantly reduce surface water flooding. This approach could be applied to projects in Sydney to build local evidence and better compare green and grey infrastructure options.

Barrier 2
Emerging methods of valuing the economic, social and environment benefits of nature-based solutions are complex and under-utilised

We have multiple methodologies, frameworks and tools in NSW for quantifying the costs and benefits of green infrastructure – leading the way in Australia. However current methodologies such as cost-benefit analysis are complex and are still in their early stages of application to projects that involve nature-based solutions.

NSW Treasury's Cost-Benefit Analysis (CBA) Guidelines include provisions for ecosystem valuation, allowing nature-based solutions to be recognised in infrastructure planning [30]. However, engagement as part of the development of this report identified that the guidelines for green infrastructure only measure reductions in cost savings associated with stormwater servicing, water filtration and water quality. It is also a challenge for our frameworks to capture the co-benefits if the quantifiable evidence is not yet there, and the benefits observed are not consistent across projects or places, and therefore not codifiable. (see Barrier 1).

Infrastructure planners and local governments across Sydney have reported that they often struggle to apply existing frameworks and guidelines due to a lack of capacity, awareness, limited flexibility of the metrics or the complexity of their application. The NSW Framework for Valuing Green Infrastructure and Public Spaces is one example of an approach that provides guidance on incorporating ecosystem services into business cases, yet the experience of applying it is beyond their reach[31].

Where has this barrier already been overcome?

While cost-benefit analyses are important, we cannot wait for every co-benefit to be fully quantified before justifying investment - especially when flood risks are escalating and the broader value of these projects is already widely understood. In the *Auckland Te Ara Awataha* project, for example, a cost-benefit analysis incorporating all the co-benefits was not required to secure support. Instead, strong partnerships with mana whenua, local schools, and the community created a shared understanding of the project's value. The co-benefits - flood mitigation, ecological restoration, cultural expression, and community wellbeing - were so clearly articulated and embedded in the design that decision-makers and stakeholders backed the project without needing formal economic justification.

Barrier 3
Risk allocation and collaborative governance is needed to enable cross-boundary and inter-agency design and delivery

Our governance structures in metropolitan Sydney are generally not aligned with natural catchment boundaries, complicating large-scale interventions across multiple jurisdictions, including public, private and government-owned land.

There is no mechanism, such as formal inter-agency agreements or guidelines, to clearly articulate how an equitable distribution of risk, cost, and benefit can be achieved for nature-based solutions projects that utilise public land or assets owned by multiple agencies, local governments, utilities, or other asset owners.

Although there are catchment-based flood studies, where neighbouring local governments collaborate to achieve flood risk management outcomes (e.g. Georges River), there are limited mechanisms that incentivise public and private landowners to support the implementation of large-scale nature-based solutions.

In NSW, local governments hold the primary responsibility for floodplain and coastal risk management, and move liability for flood risk to the State Government through local flood risk management plans. The State government (through NSW DCCEEW) provides technical and financial support through the Coastal and Floodplain Management Programs. The NSW Reconstruction Authority is responsible for overall hazard mitigation planning and investment across the state of NSW.

In short, no agency owns or promotes nature-based solutions, and there is no clear approval pathway for nature-based solution projects that would otherwise be considered 'State Significant' if it were a grey infrastructure project.

Where has this barrier already been overcome?

Sunshine Coast Council led collaboration with the Queensland Government, Unitywater, and the Kabi Kabi people, while also engaging agencies such as the Land Restoration Fund and Queensland Parks and Wildlife. Strong cross-sector partnerships - with universities, Indigenous ranger groups, and NGOs like The Nature Conservancy - helped secure funding, embed cultural values, and provide the technical and regulatory support needed to navigate complex approval processes and deliver a landmark blue carbon and flood resilience initiative.

The *Cooks River to Iron Cove GreenWay* project in Sydney is another example of navigating cross-boundary governance. Spanning multiple council areas, it required coordination across local governments, state agencies, and private landowners to deliver an integrated environmental, active travel and cultural corridor. Despite challenges and long time frames, it demonstrated how shared vision, and collaborative planning can overcome fragmented land ownership and jurisdictional barriers.

Barrier 4
Nature is not considered a financial asset

Traditional asset management frameworks in local governments tend to focus on built infrastructure, such as roads and pipes, and often overlook the flood resilience and economic, social and environmental value of trees, parks and other nature-based solutions.

There is limited technical guidance on how to measure and incorporate ecosystem services into financial planning and onto local government balance sheets or asset registers, leading to inconsistent application across Sydney.

Without recognition in asset registers, nature-based solutions that support stormwater absorption and reduce runoff are treated as discretionary expenses rather than core infrastructure investments, meaning funding for implementation and long-term maintenance is unpredictable.

The NSW Natural Capital Accounting Framework sets out to identify, value, and measure environmental assets, or natural capital, by recording baselines and changes in their extent, condition, and value. Yet despite its existence, policymakers and investors lack knowledge on how to integrate this approach to valuing nature-based solutions, therefore missing the opportunity to leverage the benefits.

Where has this barrier already been overcome?

There is evidence that this is changing. Councils like Willoughby have incorporated their 30,000 street trees on their asset register. This is an essential first step in the long term management, maintenance and replacement of trees as assets, in the same way that Council manages its hard infrastructure and evaluates and reports on the financial and community costs and benefits of its asset base over the medium to long term., City of Sydney and Campbelltown Council are two other examples of implementing this approach [32].

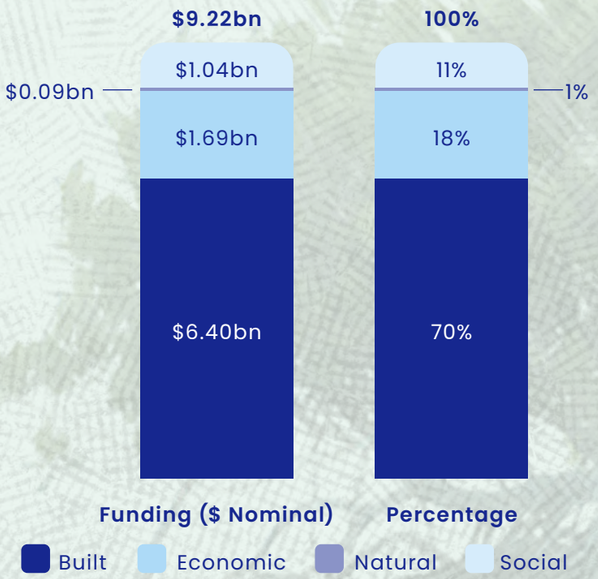
Barrier 5
Short term funding and long-term return on investment remain disconnected

We heard that currently, most nature-based solution projects rely on grant-based or post-disaster recovery funding, rather than long-term, ongoing financing mechanisms. There is limited funding for reducing flood, tidal and coastal inundation, meaning most funding is allocated to 'proven' traditional measures. Disaster funding tends to be reactive rather than proactive, often triggered by extreme weather events instead of supporting preventative and resilience-focused investments. The intent in NSW is that the Disaster Adaptation Planning processes can shift this approach.

In addition, as shown in figure below, only a very small portion of Commonwealth Disaster Ready Funding has supported projects in the 'natural' domain, with the vast majority directed toward built environment infrastructure [34].

Short-term grant cycles make it difficult to embed nature-based solutions in resilience planning and infrastructure programs, limiting their ability to contribute to flood risk reduction and long-term asset management, and to collect and build the evidence base for repeat or scaled up funding. Even when funding is available, it is often limited to the initial project implementation (Capex) and does not cover the ongoing maintenance costs (Opex) undermining the appetite for and effectiveness of nature-based solutions for the longer term.

Equally the benefits of nature-based solutions are often difficult to monetise, as the benefits could be avoided loss (damage to public or private assets), ecological enhancements (water quality improvements and re-establishment of protected species), and social benefits (enhanced cultural engagement or social connectedness). The lack of a revenue stream often means limited opportunities for co-investment by businesses, insurers, or developers.



Source: NEMA 2023e and Deloitte 2024. Notes: (1) DRFA funding is based on the time of expenditure. Figures have been rounded.

Figure 1: Commonwealth DRFA disaster reimbursement by domain: 2018-19 to 2022-23[33]

These challenges were confronted in the 'Colvin Review' of Commonwealth Government disaster resilience funding , and the 2025 Federal Disaster Ready Fund (DRF) Round 3 including a dedicated allocation of funding toward infrastructure (including nature-based solutions). However, this Disaster Ready funding round also includes a ramped-up requirement to produce a cost-benefit analysis as part of the funding proposal, which will make it harder for nature-based solutions to compete with traditional flood mitigation measures as noted above).

Where has this barrier already been overcome?

The success of the Te Ara Awataha stream project in Auckland has led to similar projects being designed by Auckland Council like the *Te Whakaoranga o te Puhinui* regeneration project[35] and the Council investing $760 million in the 10-year Making Space for Water Program which aims to prepare for floods and reduce flood risks in stormwater systems by foregrounded blue-green projects[36].

The first-phase Mansfield, UK, Sustainable Flood Resilience interventions were successfully tested during Storms Babet, Gerrit, and Ciaran (2023-2024), effectively alleviating flooding hotspots. Due to its success, water utility Severn Trent plans to incorporate these lessons into the next asset management period, aiming to create four 'urban catchments of the future' combining AI, nature-based, traditional, and community-focused water management.

Enabling nature-based solutions to reduce hazard risk

We know nature-based solutions can reduce flood, tidal and inundation risk and complement and enhance engineered flood modification measures, while delivering a range of additional economic, social and ecological co-benefits.

In Auckland and Mansfield, implemented nature-based solutions have exceeded expectations, and have attracted scaled up investments to similar projects being planned, funded and implemented across New Zealand and the UK. They have delivered the intended flood risk reduction benefits, but also so much more by starting with nature and community and culture, and designing solutions that work for the place, the people and the ecology.

In New York, the original BIG U project started with creating room for the river and community engagement. It ran into engineering challenges and morphed into a hybrid project, led by a new Ministry of Environment and Justice, that has pushed ahead with making the combined nature and traditional flood risk management solutions work.

In Narooma, NSW and Maroochydore, QLD these projects started with understanding how nature could better manage the changing risks to those locations and developed solutions based on indigenous knowledge that would grow and evolve over decades – increasing in value rather than depreciating like a traditional solution.

Here in Sydney, we have our own examples of how nature-based solutions in places like Sydney Park are working to reduce hazard risk and deliver ecological and community benefits, and the value of nature is being embedded in financial systems in local governments across the metropolitan area.

So how do we make nature-based solutions business as usual in reducing flood, tidal and inundation risk?

Recommendations:

The first step is leading with nature. We need to rethink how we integrate nature-based solutions into decision making. We take a fundamental view that we should start with nature-based solutions as the default approach that can be paired with other approaches, or at worst become a minor player. But, if nature is competing with established policy, process and lowest risk-based approaches, we will not see the kinds of progress that other parts of the world have developed and delivered.

Why?

- The status quo does not recognise the value of nature-based solutions in how we approach hazard risk reduction.
- There is no agency taking responsibility for the development and deployment of nature-based solutions, particularly taking a place-based design led approach that drives collaboration and decisions about sharing of risks, costs and benefits
- Nature based solutions don't currently have an enabling policy or planning framework to integrate these options into disaster risk reduction, or an owner or champion to prosecute their value across the hazard risk cycle and unlock the co-benefits.
- We don't have the sufficient local evidence that nature-based solutions can reduce flood, tidal and inundation risk and complement and enhance engineered flood modification measures.

This approach will need to be complemented by a series of policy, planning and investment changes set out in the following table of recommendations, but the shift in approach and mindset is the key to unlocking this opportunity.

The following 7 directions and 25 recommendations set out the path to realising nature's resilience dividend, and the agencies that are needed to lead and support this goal.

Direction 1:
Ask ‘Why not nature’ in every urban development, stormwater management, flash flood risk and coastal defence project

Why is this an issue

The status quo does not recognise the value of nature-based solutions in how we approach risk reduction for flooding, and tidal and coastal inundation.

We have global evidence that nature-based solutions can enhance and even be more effective than traditional flood management options[37] — now we need to localise this evidence and change mindsets and behaviour (and back that up with structural and systems change, and appropriate governance).

Multiple agencies play a role; however, no one agency takes responsibility for the development and deployment of nature-based solutions, particularly leading the charge and driving decisions about sharing of risks, costs and benefits.

Nature-based solutions don’t currently have an enabling policy or planning framework to integrate these options into disaster risk reduction, or an owner or champion to prosecute their value lead collaborative approaches across the hazard risk cycle.

How to resolve

1a. Identify an NSW Government Department to champion the planning, integration and implementation of nature-based solutions for disaster risk reduction.

1b. Develop a nature-based solutions policy and practice guideline that shows how nature-based solutions can be integrated into policy, programs and projects to reduce flood risk. This framework should consider the full lifecycle of nature-based solutions, including implementation risks, policy levers and cost-benefit analysis to support informed decision-making.

1c. NSW DCCEEW to update flash flood, tidal and coastal inundation policy to recognise the catchment-scale role of nature in reducing flood risk, drawing on data and evaluation from existing projects in Greater Sydney and comparable locations, as identified through Recommendation [4].

Implementers

Lead: NSW Reconstruction Authority / NSW Department of Climate Change Energy and Water

Support:

- NSW Department of Planning Housing and Infrastructure
- Local Government
- NSW Government Architect
- Insurers
- Infrastructure NSW
- NSW Public Works
- Sydney Water
- Sydney Catchment Authority

Direction 2:
Ensure planning for natural hazard risk begins with nature, people, place and Indigenous knowledge

Why is this an issue

Reducing natural hazard risk is as much a social and ecological challenge as a technical one.

Evidence from across the world shows that solutions need to be design led and place (or precinct) based, responding to the local ecology, culture, community and changing hazard risk. Typically, this will involve multiple landowners (public and private) and integration of Indigenous & non-indigenous perspectives into how landscapes work ecologically.

Nature-based solutions can respond to multi-hazard risk and recognise that disaster risk reduction and resilience need to incorporate social and cultural determinants of vulnerability that go beyond simplistic notions of spatial hazard exposure and asset damage.

How to resolve

2a. Integrate nature-based solutions into the development of place-based adaptation pathways and Disaster Adaptation Plan (DAP) business cases from inception.

2b. Utilise the regional coordinating roles established through the NSW Reconstruction Authority-led DAPs to facilitate design-led nature-based solution planning, risk allocation and collaborative delivery across multiple agencies and councils, and with Traditional Owners.

3b. Build stakeholder capacity on how nature-based solutions bring co-benefits (biodiversity, recreation, water quality and flood mitigation)

Implementers

Lead: NSW Reconstruction Authority

Support:

- NSW Department of Climate Change Energy and Water
- Greater Sydney Parklands Trust
- Utilities
- Local Government
- Universities
- Traditional Owners and Aboriginal Land Councils
- Owners of major public and private open space and land

Direction 3:
Refine methods for valuing economic, social and environmental benefits

Why is this an issue

The Framework for Valuing Green Infrastructure and Public Spaces has established a leading approach that meets NSW Treasury standards.

However, engagement has found that it remains too complicated for practitioners and industry and only includes limited benefits like stormwater reduction rather than the full value of nature.

While Cost-benefit Analyses (CBA) are a useful tool, the inherently place-based (local community, cultural and environmental) benefits of nature-based solutions mean that CBAs should not be the sole determining factor in whether a project should go ahead or not.

How to resolve

3a. Offer training or information sessions for local governments, state agencies, and consultants on applying the Framework for Valuing Green Infrastructure and Public Spaces in business cases.

3b. Make it easier to incorporate the full financial benefits of Nature-based solutions into decision-making processes by identifying best practise case studies and developing easy to use data and tools to expand the green infrastructure framework and knowledge base

3c. Develop a user-friendly version of NSW Valuing Green Infrastructure Framework for use in all publicly funded infrastructure projects, PPPs and appropriate contributions plans and developer agreements

3d. Reconsider how the discount rate applies to benefits associated with nature-based solutions that devalue longer-term benefits in cost-benefit analyses.

3e. Fund and enable simplified cost-benefit analyses and valuation methods to be used in accessing State Government grants and other funding.

3f. Commit to nature-based solutions projects being delivered as part of university research trials to build documentation of benefits

Implementers

Lead: NSW Department of Planning Housing and Infrastructure

Support:

- NSW Treasury
- NSW Reconstruction Authority
- NSW Department of Climate Change Energy and Water Regulators e.g. IPART
- Infrastructure NSW
- NSW Public Works
- Sydney Water,
- Sydney Catchment Authority

Direction 4:
Test, measure and scale

Why is this an issue

A NSW driven approach is needed to build the evidence basis for the effectiveness of nature-based solutions across the state.

Through a replicable evaluation process projects can measure and quantify the effectiveness of the interventions from an economic, socio-cultural and ecological perspective.

When sufficient evidence is available on the effectiveness of nature-based solutions as a risk mitigation option, relevant NSW Government policies and guidance can then be updated to reflect this.

How to resolve

4a. Assign a State Government owner to commission, collate data and showcase examples of where valuing nature-based solutions have led to positive hazard risk reduction and other co-benefits.

4b. Use new and existing nature-based projects to generate real-world data on the effectiveness of nature-based solutions in place and over time (in partnership with Government, Universities, Schools, etc.) to ensure robust assessment.

4c. Use Disaster Adaptation Plans and other monitoring frameworks to demonstrate the risk reduction, economic, social, cultural and ecological benefits of nature-based solutions as part of adaptation pathways.

Implementers

Lead: NSW Reconstruction Authority

Support:

- NSW Department of Climate Change Energy and Water
- NSW Department of Planning Housing and Infrastructure

Direction 5:
Re-cast nature as a financial asset

Why is this an issue

Nature is seen as a cost – something to maintain - rather than an asset that delivers economic, social and ecological benefits to the community and place.

Most Councils and State Agencies do not yet include nature as an asset in their asset management systems.

How to resolve

5a. Develop user friendly, clear and accessible methodologies for calculating the full social and economic value of Nature-based solutions so they can be properly accounted for in Council and State Government operational and delivery plans, asset registers, and during the development of business cases, contributions plans, developer agreements, Housing and Productivity Agreements etc

5b. Provide capacity-building programs for councils, including training and technical guidance on how to include trees and green infrastructure as assets. This could be delivered as part of a council micro-credentials program and delivered by specialist registered training organisations (RTOs).

5c. Fund/ Support/ Develop a program with Councils to shift to include trees and green infrastructure in their asset registers and asset management models, similar to roads and stormwater assets.

Implementers

Lead: NSW Department of Planning Housing and Infrastructure

Support:

- NSW Department of Climate Change Energy and Water
- NSW Reconstruction Authority
- Local Government
- Regulators e.g. IPART, EPA
- Local Government NSW
- Regional Organisations of Councils
- Professional associations
- Universities

Direction 6:
Streamline planning approvals for complex nature-based solutions

Why is this an issue

Nature based solutions can be equally complex to other linear infrastructure projects, but do not have the planning pathways to enable these complex projects to be considered efficiently.

NSW and Sydney need a planning pathway/ approval mechanism to enable complex multi-landowner nature-based solutions to support cross-boundary planning and require collaboration across councils, private landowners, and agencies to share risks, benefits and costs.

How to resolve

6a. Include “Blue and green infrastructure” or as a State Significant Infrastructure category in Schedule 3 of the Planning Systems SEPP

6b. Increase investment and collaboration between state government, local governments, utilities and parkland managers to deliver the Greater Sydney Green Grid.

Implementers

Lead: NSW Department of Planning Housing and Infrastructure

Support:

- NSW Reconstruction Authority
- NSW Department of Climate Change Energy and Water
- Greater Sydney Parklands Trust

Direction 7:
Connect funding with longer term return on investment

Why is this an issue

There is a need to incentivise implementation through clear funding pathways that reflect the complexity and establishment timeframes of nature-based solutions.

How to resolve

7a. Incorporate nature-based solutions in the proposed zoning and associated Contributions Plans for new greenfield urban development precincts across Greater Sydney

7b. Create a distinct multi-year project funding from the Disaster Ready Fund to enable urban nature-based approaches to support and enhance flood risk reduction (Capex and Opex) E.g. DRF Funding and Disaster Adaptation Plan (DAP) funding.

7c. NSW Treasury to explore new funding opportunities by working with public and private sector investors. This could include green bonds, blue carbon markets, and partnerships with insurers to unlock new sources of capital for nature-based solutions implementation. Pilot programs could be introduced to test these funding models including Biodiversity credits and nature repair market

7d. Explore sustainable funding models, including blue carbon markets, that incentivise nature-based solutions on public and private land and support long-term maintenance across multiple landowners. For example, landowners who incorporate green infrastructure on their land could be incentivised with reduced council rates.

7e. Incentivise developers to incorporate blue and green infrastructure into large-scale infrastructure projects such as the Green Factor Tool approach identified within the Nature Positive Sydney report.

Implementers

Lead: NSW Treasury

Support:

- NSW Department of Planning Housing and Infrastructure
- Resilient Sydney
- Local Government
- Sydney Catchment Authority
- IPART
- EPA
- Catchment and river groups

Glossary & References

Glossary of Terms

Term	Definition
adaptive pathway planning	A flexible planning approach that allows for adjustments over time as conditions change.
asset register	A list of assets owned by an organisation, including infrastructure and natural elements like trees.
bioswales	Landscape elements designed to concentrate and remove pollution from surface runoff water.
blue carbon	Carbon captured by the world's ocean and coastal ecosystems.
channelised streams	Streams that have been modified with man-made channels to control water flow.
co-benefits	Additional positive outcomes that occur alongside the main benefit of a project.
constructed wetland	A man-made wetland designed to treat stormwater and improve water quality.
cost-benefit analysis	A method to evaluate the total expected costs versus benefits of a project.
detention basin	A low area that temporarily holds stormwater to prevent flooding.
disaster adaptation plan	A strategy to reduce risks from natural hazards like floods and fires.
ecosystem services	Benefits provided by nature, such as clean water, air, and pollination.
evapotranspiration	The process by which water is transferred from land to the atmosphere by evaporation and plant transpiration.
green-grey systems	Infrastructure that combines natural elements with traditional engineering.
hybrid infrastructure	A mix of natural and built systems used to manage environmental challenges.
inundation	Flooding or submerging of land by water.
living seawalls	Structures that protect coastlines and support marine life.
natural capital	The world's stocks of natural assets including geology, soil, air, water and all living things.
nature-based solutions	Actions that work with nature to address environmental challenges.
permeable paving	Pavement that allows water to pass through, reducing runoff.
rain gardens	Planted areas that absorb rainwater and reduce flooding.
resilience	The capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow no matter what kinds of chronic stresses and acute shocks they experience.
resilience dividend	Nature, when strategically integrated into urban planning and hazard management, provides a measurable “dividend” — reducing flood, tidal, and coastal inundation risks while enhancing ecological, social, cultural, and economic value.
saltmarsh	Coastal wetlands flooded and drained by salt water brought in by the tides.
tidal barriers	Structures that control the flow of tidal water to prevent flooding.

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We would like to thank our Resilience Program Partners for supporting the Committee for Sydney's work to drive solutions to our most pressing resilience challenges.

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