Terrestrial Ecosystem Research Network

Strategic Plan & Key Activities

2023 - 2028

tern
Ecosystem Research Infrastructure

NCRIS
National Research Infrastructure for Australia
An Australian Government Initiative

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Contents

Through the National Collaborative Research Infrastructure Strategy (NCRIS) grant scheme, the Terrestrial Ecosystem Research Network ("TERN Australia") has become Australia's fundamental enabling infrastructure for long-term ecosystem observing, driving research that answers questions about the causes and the consequences of changing ecosystems at local and national scales, for encouraging scientific collaboration and integration, and for guiding policy-makers as they respond to environmental opportunity and challenge.

Introduction

Australian Ecosystem Science

Research on Australia's complex terrestrial and coastal ecosystems[1] is essential for understanding where, how and why Australia's environment changes over time and the scale at which change occurs. The Terrestrial Ecosystem Research Network, now more commonly referred to as TERN Australia, was established to deliver the macroscale infrastructure needed to support such research. TERN Australia is a continental scale, long term environmental monitoring capability, providing data, tools, samples, protocols, and models that help researchers detect change, assess trends early to support mitigation and adaptation strategies, and predict cumulative impacts of development.

Insights into the interactions within and between the many components of Australia's ecosystems are vital for developing management policies that ensure sustainable use of our ecosystems and maintenance of the services they provide. The integrity and resilience of ecological systems has impact across large regions of the globe and beyond geopolitical borders, adding urgency to the need for continuity of data from TERN's multi-scale, integrated observatory to support world leading research and Earth System models aimed at tackling environment and climate change challenges at the same pace and pattern in which they occur.

Ecosystem science and management require the collection and integration of information from multiple scientific disciplines concerned with the atmosphere, weather and climate, vegetation, soils, fauna, streams, rivers and coasts. TERN is providing the network of people and infrastructure to address these information needs, so that the world's ecosystem scientists can more easily work together and share and build on past findings (Fig. 1).

Additional to its field Observatory, TERN is fulfilling a critical role in the Australian research community and for Australian policy makers through its continuing support for the development and operation of a long-term, collaborative ecosystem research network, in association with local, state and national government monitoring programs. The ecosystem research environment covers a multifaceted and diverse range of activities, producing a wide array of environmental information that, but for the National Research Infrastructure initiative, would not be available to the broader research community. Through the development of a connected ecosystem research community, combined with formal recognition of data sharing as a research impact measure and the TERN Data Discovery Portal, TERN plays a key role in the harmonisation and standardised management of data at a national level, providing linkages between researchers in different disciplines and with the broader research community and providing information to inform evidence-based policy (Fig. 2).

TERN was created in 2009 with funding from a National Collaborative Research Infrastructure Strategy grant (NCRIS). Following several renewals of the grant, it has Australian Government funding until June 2028. Co-contribution of cash has been made from time to time from the state governments of Queensland, Western Australia, South Australia and New South Wales.

TERN's contribution to ecosystem science is achieved through collaboration with, and in-kind contributions from, Australian universities, CSIRO, the broader ecosystem science communities, and similar networks around the world. Principal among its operating partners are the University of Queensland, University of Adelaide, James Cook University and CSIRO.

1 TERN has adopted as its definition of an ecosystem the total living and non-living factors present in a particular area and the net result of all interactions among these components. Further, TERN recognises that ecosystem boundaries are naturally dynamic – that is, they are often indistinct and overlapping, can be large or small, short term or long term, and natural or artificial.

Part 1. Strategy

1.1 Vision

TERN advances ecosystem science and contributes to sustainable management of Australia's environment.

1.2 Mission

TERN is Australia's ecosystem monitoring network. We build relationships and infrastructure to enable long-term, standardised collection of data and samples from across the continent. We store and openly share these resources to support terrestrial and coastal ecosystem science and environmental management. TERN infrastructure, skills, data and samples are crucial to protecting Australia's biodiversity and achieving a net zero future.

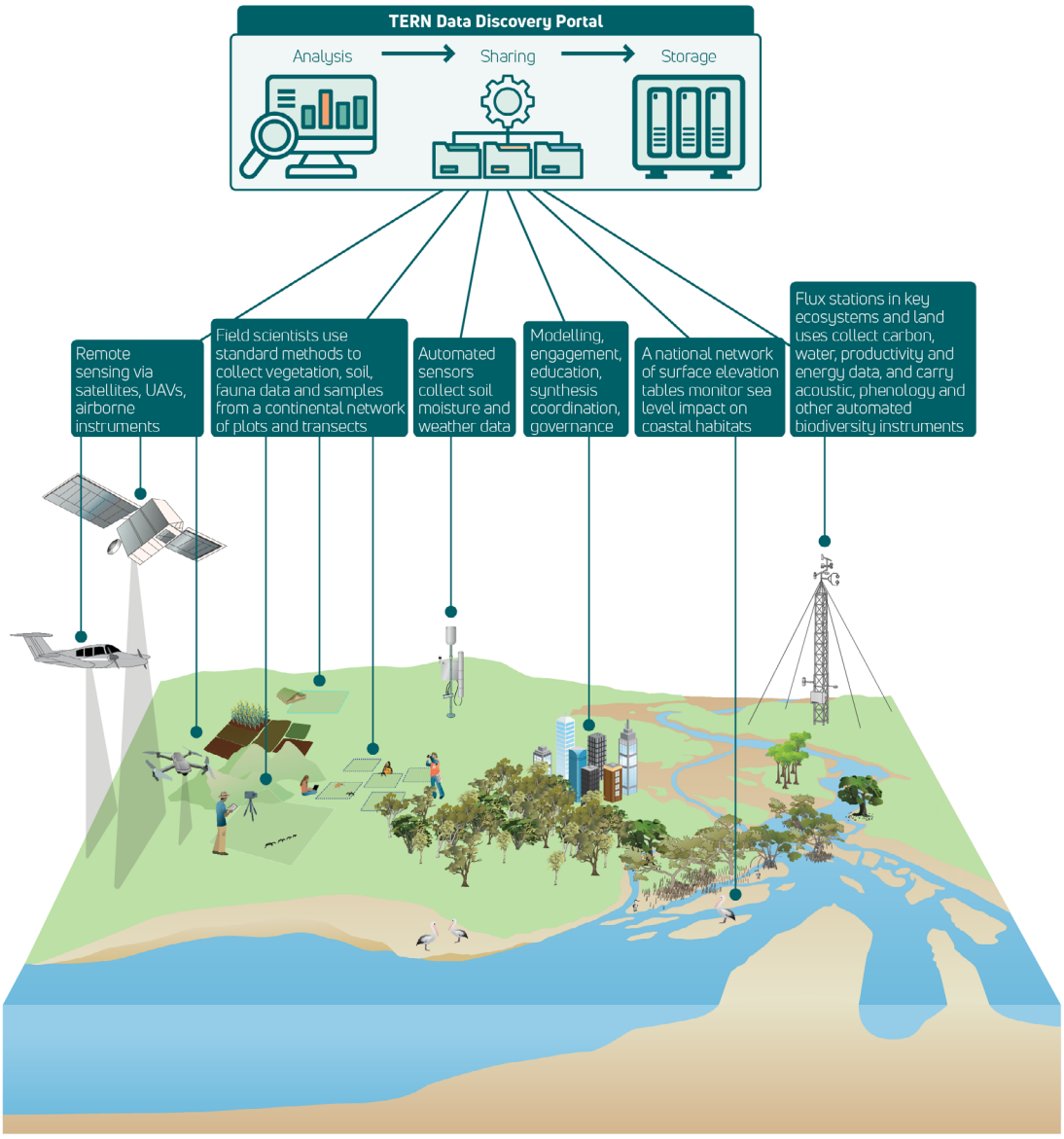


Fig. 1. TERN's monitoring, mapping, modelling and open access multi-scale measurements facilitate collaborative research.

1.2.1 Goals

In the journey towards achieving its mission, TERN has 4 major goals.

- **Enhance Ecosystem Monitoring**: strengthen and expand TERN's observational infrastructure, data collection, and analysis capabilities.
- **Enable Collaborative Research**: foster partnerships across disciplines, institutions, and sectors to address complex environmental challenges.
- **Support Decision-Making**: provide accessible, reliable data and knowledge to inform policy, management, and conservation efforts.
- **Promote Innovation**: drive innovation in ecosystem science, technology, and methodologies.

1.2.2 Key Strategies

Five strategies are crucial to the successful delivery of TERN's mission during 2023-28.

- **Infrastructure Enhancement**: investing in cutting-edge monitoring infrastructure, including terrestrial, coastal, and remote sensing networks.
- **Data Integration and Accessibility**: extending standardised data protocols, enhancing data sharing, and improving accessibility for researchers, policymakers, and the public.
- **Capacity Building**: supporting training, education, and skill development for ecosystem scientists and practitioners.
- **Stakeholder Engagement**: collaborating with government agencies, industry, Indigenous communities, and NGOs to facilitate alignment of research with real-world needs.
- **Research Translation**: translating scientific findings into actionable insights for land management, conservation, and climate adaptation.

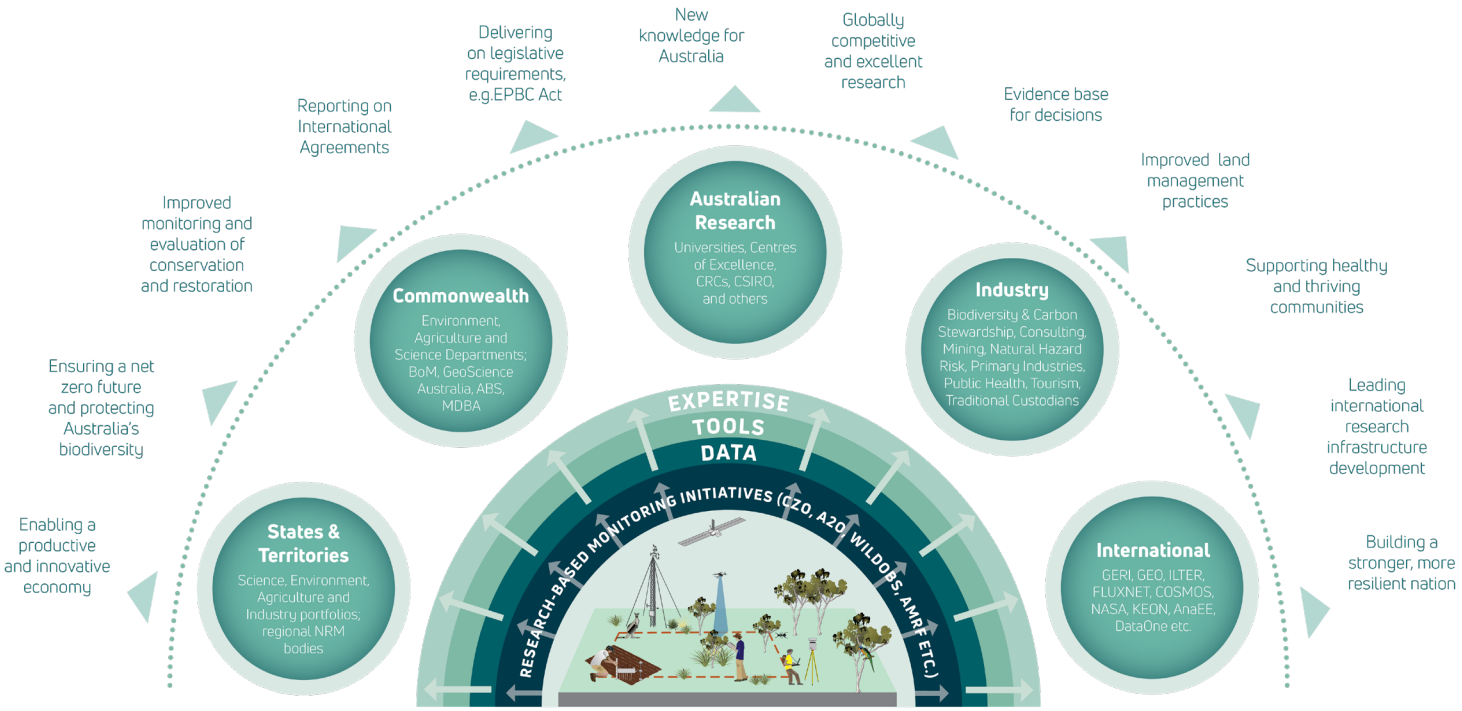


Fig. 2. TERN's mission is enabled by the linkages TERN facilitates between researchers in different disciplines and data from its monitoring network which then provide the information and tools necessary for business and evidence-based policy at local, state, national and global levels

1.3 Strategic Analysis

To frame the scope of TERN activities and ensure its research infrastructure is a catalyst for positive change in the planning and coordination of ecosystem research, TERN considers the 9 Principles shown in Fig. 3 during its investment decision-making. TERN's Principles were developed and refined over time in consultation with the Australian ecosystem community.

Part of National Research Infrastructure

TERN invests to provide best value for money, quality assured, national research infrastructure that is integrated, interconnected and where appropriate, consolidated with other NRI and environmental agency projects to streamline services for users.

Commercialisation and Industry support

TERN's standardised monitoring protocols, quality assured data systems and data exchange standards underpin environmental accounting and market schemes such as biodiversity and carbon offset

Indigenous Knowledge

TERN provides support to a new direction in knowledge creation related to the Australian environment, based on Aboriginal- and Torres Strait Islander-led approaches to understanding and managing Land and Sea Country.

Supporting research

TERN ensures its foundational data and information products are attractive and useful for fundamental ecosystem science research as well for applied ecosystem science questions

Decision-making opportunities

TERN makes its quality data and information, and collaborative synthetic products efficiently available for decision-makers for evaluating, modelling and predicting the status and trajectory of Australia's ecosystem

Outreach and engagement

TERN engages with industry and raises awareness with national and international collaborators and end users of research to ensure optimal utilisation of its research infrastructure and products.

National ecosystem monitoring system

Complementing and integrating with environmental monitoring conducted by other agencies and NRIs, TERN's work is directed towards the long-term task of monitoring terrestrial ecosystems, and providing a safe, trusted repository for long term data.

Scaleability - time and space

TERN measures parameters operating at vastly differing scales of space and time, to enable concurrent assessments at multiple scales, and to support upscaling and downscaling for modelling and prediction from local to global

Skills, training and education

TERN educates the current and next generation of ecologists in how to use TERN tools and data so that they may better understand complex ecological systems and their associated changes and apply this integrated knowledge to societal needs

Fig. 3. TERN's conceptual framework is comprised of 9 Principles

1.3.1 Key Success Factors

Through a strategic national approach based on its 9 *Principles*, TERN is continuing to strengthen its infrastructure and promote the collaborative behaviours critical to implementing a successful sustainable terrestrial and coastal ecosystem observational network. TERN looks to the following characteristics as measures of its success in sustaining TERN's long-term ecosystem research network.

Key component	Identified need
People	People with appropriate skills, knowledge and experience to develop and run long-term observational and integration programs are an essential component of any long-term ecosystem observation and analysis network. TERN is developing this capacity for Australia through its ongoing training, education, protocols, employment and career opportunities.
Co-operation	TERN plays an essential stewardship role in fostering and supporting co-operation between research institutions, community groups, private companies, local, state and national agencies across Australia and internationally.
Funding	Long-term (>5 years) observation and science projects require funding that recognises that the required 'infrastructure' includes skilled people, accumulated knowledge, operational costs and equipment (including both hardware and soft-ware). To build on NCRIS investments, TERN investigates future core funding opportunities and collaborations that will sustain the network in providing long-term preservation and open access for ecosystem data.
Co-investment	Engagement between state and territory agencies, researchers and the Australian government provides the synergies to allow the TERN program to continue. TERN seeks to catalyse cash and in-kind co-investment across the large number of beneficiaries of better ecosystem observations and more accessible long-term data sets, that will in turn improve the functionality and financial sustainability of the network.
Long-term research[2]	TERN promotes the outputs and impacts of long-term ecosystem research (e.g., publications) while also building awareness among government and other agencies that realistically, it may take years to decades for researchers to detect and/or confirm a significant change in an environmental process. In support of demonstrating the need for research using long-term data, TERN aligns its long-term data collection and preservation programs to the key tasks of government agencies and the resources for which they are responsible.

2 Long term refers to activities running over at least a 10-year period

1.3.2 Risks

TERN operates within a challenging logistical and operational environment, with a range of risks to be managed.

- Maintenance of the integrity of TERN in achieving the goals associated with terrestrial and coastal ecosystem observing at a national scale.
- Meeting the current and future data access and retrievability needs of ecosystem science users in a technologically changing world.
- Shifting needs and priorities of the terrestrial and coastal ecosystem research communities.
- Commitment of operating partners to TERN.
- Viability of some operating platforms in the light of externalities. Examples of the latter include adverse weather events, cost escalation, and loss of critical technical staff.

These risks occur at two levels, at the project level of TERN as a whole and at the operating partner level related to the acquisition, deployment and operation of the infrastructure.

Management of these risks and others that emerge are informed by the strengths and weaknesses listed below and the opportunities that will help TERN remain agile under changing circumstances. TERN's risks and mitigation processes are reviewed regularly in TERN's annual business planning and reporting processes.

1.3.3 TERN's Strengths, Weaknesses and Opportunities

Major Strengths	Opportunities
Focal point for coordination of previous disparate research communities across institutional and government levels.	Development of large-scale and long-term whole of 'community' infrastructure and research funding requests to advance a national ecosystem research capacity (e.g., CoastRI; freshwater ecosystems).
Multiple discipline coverage with strong internal support within disciplines and recognition of need to link across disciplines to address key ecosystem science and management questions.	In-kind support of problem-focused large-scale and long-term research funding proposals with direct link to essential state and continental scale ecosystem management problems (e.g., agricultural net zero).
Strong operational and strategic links to cognate NCRIS environmental observation and data projects, particularly through the National Earth & Environmental Science Facilities Forum (NEESSF)	Development of shared resources across monitoring platforms and institutions for delivering integrated national scale long-term infrastructure support (e.g., data and modelling).
Links to local, state and national environmental management agencies requiring access to long-term environmental science data and knowledge.	Establishment of sustainable base-level funding for operation and maintenance of monitoring platforms and data preservation in the longer term (e.g., industry and philanthropic equity partnerships)
Member of the Global Ecosystem Research Infrastructure, providing access to international infrastructure expertise.	Support for emerging regional initiatives such as the Oceania Biodiversity Observation Network (OceaniaBON) to facilitate interdisciplinary macrosystem research and fill gaps in data essential for validating, integrating and advancing Earth System models

Major Weakness	Management Response
Ad hoc support for Aboriginal and Torres Strait Islander-led approaches to understanding and managing Land and Sea Country.	Consultation with Aboriginal and Torres Strait Islander community representatives on what constitutes success with respect to future partnerships and co-design. Enforcement of TERN's relevant Principle when allocating funds for research infrastructure activities.
Dependence on one-to-one relationships and lack of robust institutional-level engagement and support from partners and key ecosystem science agencies and scientists.	Operating partners take a more proactive role within their institutions for promoting the benefits to researchers of their involvement in NCRIS and TERN.
No funding after current NCRIS.	Provide impact evidence to the Department of Education in support of its business case to Government.
Aging workforce and no career-oriented replacements.	Develop meaningful certification courses with transferable knowledge and skills and methods for recognising attainment of skills and for attracting and retaining research infrastructure staff
Time needed to build long-term national data sets suitable for State of Environment (SoE) Reporting	Maintain efforts to build and visualise time-series data sets on a national scale and also develop regional and local case studies suited for SoE reporting to indicate more localised trends and impacts of disturbance.
Insufficient skilled resources to support industry engagement and necessary data value-add activities for successful translation	Train and mentor existing data-related staff and re-prioritise their work to allow time for translation activities.
Under-representation of fauna in monitoring	In the first instance. focus faunal taxa monitoring on those that are easy to sample directly (e.g., ants), and mammals (camera traps) and birds (acoustic recordings).

1.4 TERN's Contribution to National Priorities

TERN's activities during its 2023-2028 funding cycle aim to maximise research excellence, translation and societal impact and are guided by several Australian Government policies and acts. A key influence is Australia's National Science and Research Priorities (Fig. 4).

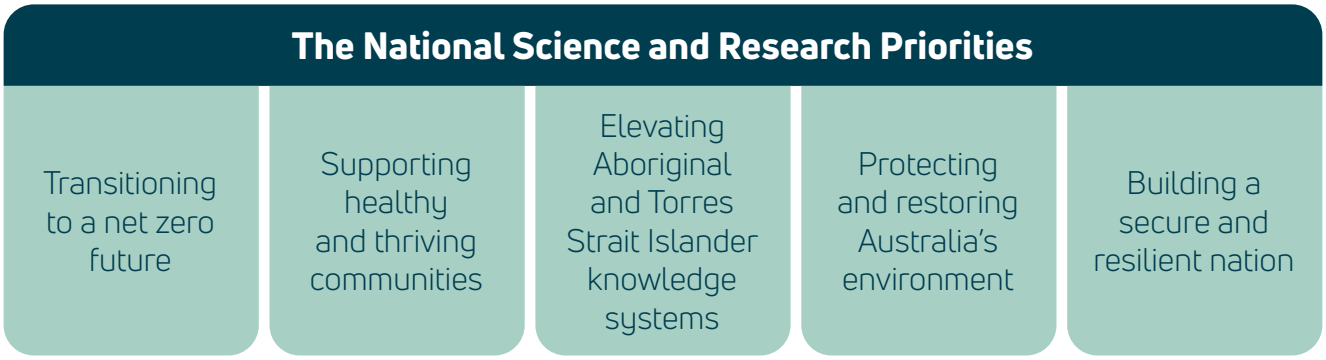


Fig. 4. TERN's activities support all 5 priorities but especially Priorities 1, 3 and 4

Additionally, there are many Australian Government acts and initiatives, that provide context and purpose to the TERN infrastructure and data collection in the areas of addressing climate change, protecting the environment, biodiversity and heritage and managing Australia's water resources. Some examples are listed below.

- Environment Protection and Biodiversity Conservation Act 1999
- Australia's Strategy for Nature 2019-2030
- Natural Heritage Trust of Australia Act 1997
- Nature Positive (Environment Protection Australia) Bill 2024
- 2023 review of the Carbon Credits (Carbon Farming Initiative) Act
- Aboriginal and Torres Strait Islander Heritage Protection Act 1984
- Threatened Species Action Plan 2022-2032
- Net Zero 2050 plan
- 2035 Emissions Reduction Targets
- Greenhouse and Energy Minimum Standards Act 2012
- National Water Initiative (NWI)
- Commonwealth Biosecurity 2030
- National Climate Resilience and Adaptation Strategy
- 2021 National Research Infrastructure Roadmap
- 30 by 30 Roadmap
- National Environmental Science Programme (NESP)
- State of Environment Reporting
- National Statement on Climate Change and Agriculture

1.5 Questions about Ecosystems

Perhaps the most significant characteristic of our planet is that it is constantly changing. The ceaseless processes of growth and decay, erosion and deposition, precipitation and evaporation are driven by diurnal, lunar, seasonal, and annual cycles, irregularly punctuated by disturbances. Everything changes with time; some changes just take more time than others. Knowledge of where and how changes are occurring can contribute to an understanding of why they occur and, possibly, how the extent of change can be managed.

TERN has been set up to systematically collect and analyse environmental data to help to tackle unanswered questions about biodiversity loss, climate change impacts, and sustainable resource management, and ultimately inform decisions for the benefit of current and future generations. Some key questions addressed by TERN's ecosystem community in collecting and/or analysing, integrating and synthesising ecosystem data are as follows.

How are Australia's ecosystems changing over time?

What is the impact of management interventions on Australian ecosystems and ecosystem processes?

What is the impact of climate change on terrestrial ecosystem functioning?

How is the spatial distribution of Australian plant and animal species changing and are some becoming extinct?

How are introduced plant and animal species affecting native species?

What are the current stocks (biodiversity and carbon) of some of Australia's key ecosystems

Part 2. Activities

2.1 Activities Beyond 2023

TERN's 2023-28 Activities see it retaining and extending the successful Observatory and Data focussed capability implemented under its previous Strategic Framework 2016-25. This structure allows TERN to strongly contribute to the Environment and Climate challenge of the 2021 Research Infrastructure Roadmap. TERN has responded to the Australian Government's Nature Positive initiatives (2022) by establishing a modelling and synthesis capability to better support prediction. Additionally, it has extended its monitoring to include coastal vegetated habitats, Australia's High Country, the Critical Zone, and those impacted by agricultural land use. Cutting across all Activities are TERN's international and Indigenous engagement activities and a commitment to facilitate translation from its outputs. TERN is undertaking 4 key Activities through its network of partners and collaborators (Fig. 5).

Fig. 5. TERN key Activities 2023-28

Core Activities

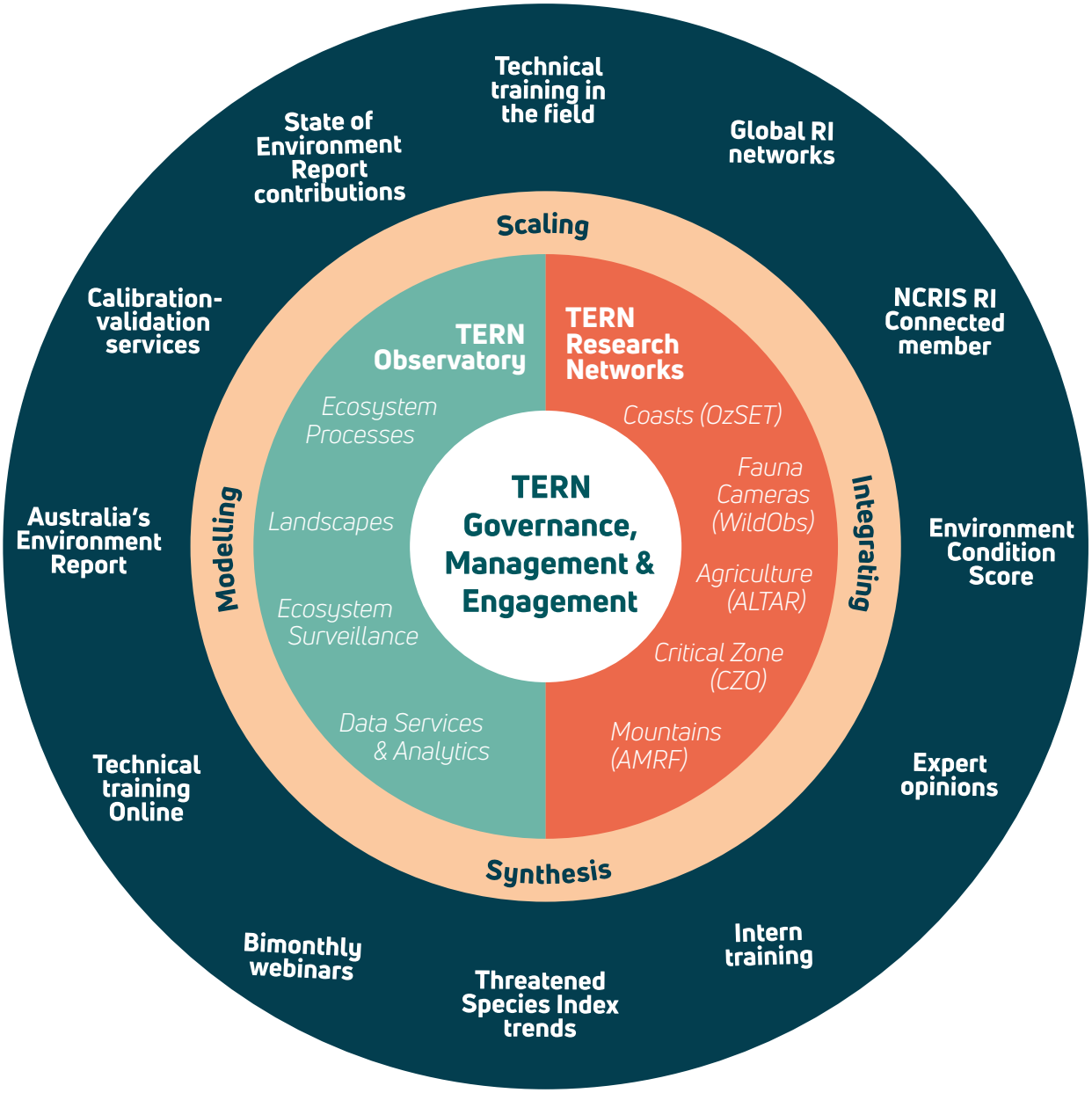
Activity 1 - Provide Continental, Regional and Local Scale Ecosystem Observation Data
Operate Australia's terrestrial and coastal ecosystem observatory and make the data and samples openly and freely available.

Activity 2 - Undertake Modelling and Synthesis
Enable development of, reliable multi-scale knowledge products and models.

Activity 3 - Engagement, Education, Training, Skills and Outreach
Facilitate collaboration, codesign and uptake of TERN data & innovative use of TERN infrastructure and services nationally and internationally.

Activity 4 - Governance and Management
Manage TERN as a collaboration between the University of Queensland, Australian universities, CSIRO and international partners. Set TERN's strategic intent with guidance from an Advisory Board and independent Science Advisory Committee.

2.2 From Activities to Impacts



By implementing this strategic plan in undertaking the 2023-28 Activities, TERN aims to contribute significantly to understanding and managing Australia's diverse natural and managed ecosystems.

We at TERN acknowledge the Traditional Custodians throughout Australia, New Zealand and all nations. We honour their profound connections to land, water, biodiversity and culture and pay our respects to their Elders past, present and emerging.

TERN is enabled by NCRIS. Our work is a result of collaborative partnerships with many universities and institutions.

To find out more please go to **tern.org.au**.

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