



# ENVIRONMENT, PLANNING AND SUSTAINABLE DEVELOPMENT DIRECTORATE

## SCIENCE PLAN 2020–25

A model for knowledge generation and delivery to guide sustainability



This Plan fulfils the requirements of the Biodiversity Research and Monitoring Program, a notifiable instrument under the [Nature Conservation Act 2014](#).

ACT Conservator Flora and Fauna  
Ian Walker

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# ACKNOWLEDGEMENT

*Yuma*

*Dhawura Nguna Dhawura Ngunnawal*

*Ngunnawalwari dhawurawari*

*Nginggada Dindi yindumaralidjinyin*


*Dhawura Ngunnawal yindumaralidjinyin*

*Hello*

*This is Ngunnawal Country*

*We always respect Elders, male and female*

*We always respect Ngunnawal Country*



We acknowledge the Traditional Custodians of the ACT, the Ngunnawal people. We recognise the special relationship and connection that Ngunnawal people have with this Country. Ngunnawal people are a thriving community whose life and culture are intrinsically connected to this land in a way that is core to their physical and spiritual wellbeing, their cultural practices, law/lore, songlines and stories. Ngunnawal people have maintained a tangible and intangible cultural, social, environmental, spiritual and economic connection to these lands and waters for thousands of years.



# VISION

Robust science underpins and guides adaptive management for conservation, sustainability and liveability in the ACT









# CONTEXT

In collaboration with many partners, the Environment Division of the Environment, Planning and Sustainable Development Directorate (EPSDD) **aims to lead environmental conservation, liveability and sustainability in the ACT**. The Division has responsibility for a wide range of policies and programs related to the environment, nature conservation, forest and rural land management, environment protection, bushfire management, biosecurity, heritage and water.

EPSDD's vision is '**Shaping Canberra's Future**'. EPSDD administers the Territory Plan and is responsible for environment, spatial planning, climate change, planning approvals and sustainable urban design. It administers a range of legislation, including the [Planning and Development Act 2007](#), the [Nature Conservation Act 2014](#), Climate Change and [Greenhouse Reduction Act 2010](#), [Environment Protection Act 1997](#), the [Water Resources Act 2007](#), [Fisheries Act 2000](#) and the [Heritage Act 2004](#). It also has responsibility for delivering elements of the [Emergencies Act 2004](#), including managing EPSDD lands consistent with the Strategic Bushfire Management Plan.

The Environment Division aims for a **strong evidence base** to underpin the work of EPSDD, delivered in a responsive, targeted and timely way to enable adaptive management. While scientific knowledge should **inform** all policies, decisions and management approaches, it cannot **prescribe** these, as they must take into account broader values and risk appetites. We further recognise the importance of the Ngunnawal people's cultural knowledge and practices, and their ongoing engagement, for the conservation and management of lands managed by EPSDD.

As society changes and evolves, **research and knowledge needs have grown in diversity and quantity**. This has led to an expansion of research and monitoring effort. A framework for coordination, prioritisation, and information exchange is now required.

**Research funding is becoming ever-more contested and competitive**, whether sourced from internal or external sources.

**Degradation of our natural environment is accelerating**. A growing population, urban intensification and sprawl, industrial level use of chemicals, water resource development, spread of invasive plants and animals, ecological fragmentation and disruption, bushfire and climate change are all reducing the capacity of our ecosystem to continue to deliver the environmental services on which we all depend. Delivering on research and knowledge needs across all these threat vectors is beyond the capacity of the ACT Government alone, raising the need for government research efforts to be based on careful prioritisation, and enhanced and strategic partnerships.

**Citizen science is increasingly important** as acceptance grows regarding use of multiple data sources, and new technologies enable good science to be designed, produced, proofed and analysed using citizen (volunteer) input. Its impact goes far beyond generation of knowledge to engagement, education and building community support for conservation and sustainability.





# VALUE PROPOSITION

EPSDD Environment Division's Science Plan aims to clarify and justify its science investment, highlight its research and monitoring priorities to potential partners, and provide a framework to support the ongoing development and use of a strong scientific evidence base to underpin the work we do and the decisions we make. It establishes the structure for a coordinated and strategic approach to identifying, funding and delivering science-based knowledge to maximise its relevance, cost-effectiveness and impact.

This Plan fulfils the requirements of the Biodiversity Research and Monitoring Program, a notifiable instrument under the [Nature Conservation Act 2014](#) (para 24-26).







# PRINCIPLES

The following principles underpin this Plan:

## RELEVANCE

Our scientific work is responsive to strategic and policy imperatives, targets management needs, focuses on work with clear potential for application, and anticipates future knowledge demands. Knowledge users are closely involved in conception, design and review of research and monitoring, and priorities are flexible and evolve over time.

## COLLABORATION

Our scientific efforts are multiplied and maximised through effective and catalytic partnerships with stakeholders, including research institutions, community conservation/ naturalist groups, agencies in other jurisdictions, and other relevant entities.

## QUALITY

Scientific work is carefully and rigorously designed to generate robust findings, with independent scrutiny of research and monitoring initiatives encouraged.

## INNOVATION

We draw on and develop new technologies, approaches, methodologies and thinking to generate, convey and apply the knowledge we need.

## RESPECT FOR NGUNNAWAL PEOPLE

We respect and support the rights, knowledge and aspirations of Ngunnaawal people in the planning and implementation of scientific work.

## COMMUNICATION

Our collective scientific knowledge is widely communicated within and beyond government, to non-experts and the broader community, to enhance understanding and acceptance.







# ACTION AREAS

## 1. AUTHORITATIVE SCIENCE ADVICE

A key role for scientific personnel across the Environment Division is to provide clear, up-to-date, reliable and timely advice to policy, planning, decision-making and management processes. This requires the maintenance of a well-qualified professional staff with the ability to keep their expertise current and reliable, and track relevant scientific developments, technical insights and management approaches nationally and internationally.

### Goals

- 1.1 Scientific staff are contemporary experts and provide reliable and timely advice
- 1.2 Scientific staff are supported to maintain professional expertise and continue professional development, through e.g. enabling their access to scientific literature, linkages with scientific institutions, participation in relevant scientific conferences, and receipt of relevant training.







## 2. TARGETED, WELL-DESIGNED RESEARCH AND MONITORING

EPSDD staff carry out a wide range of research and monitoring activities with a wide range of collaborators.

For the purposes of this plan, monitoring refers to any systematic data collection effort that tracks a variable related to the environment or environmental management over time.

Research here refers to systematic question-focused investigations to increase understanding of environment-related phenomena, variables and processes. Broadly, the major “entry points” for Environment Division research include systems: understanding how an ecosystem or species functions, in order to predict changes or guide management responses; interventions: understanding the feasibility, efficacy, impacts or implementation of a conservation or management approach; and threats: understanding threatening processes or pressures on systems and ecological values.

There is a substantial zone of overlap between research and monitoring: some research involves monitoring, and some monitoring enables research questions to be addressed. However, research also involves other approaches (including theoretical or experimental work), while a monitoring effort may involve collection of data without the framing or exploration of any research questions (e.g. tracking visitor numbers or ecosystem condition over time), generally known as surveillance monitoring. Which category a monitoring effort falls into is a function of how the data are used – for instance, a surveillance monitoring dataset can subsequently be analysed to address research questions. The usefulness and impact of monitoring efforts can be enhanced by (re)designing them carefully to answer relevant research questions, and by interrogating existing datasets to address such questions.

Monitoring, in turn, plays different roles. Some monitoring is carried out in order to directly inform management interventions and approaches, including monitoring undertaken as part of a highly structured and regularly repeated adaptive management cycle, such as annual grassy layer condition assessments and kangaroo counts to guide kangaroo management. Some monitoring, however, takes place with no clear management target – the information produced is not applied in practice (e.g. long-term monitoring of the ACT-endemic *Brindabella* orchid). Monitoring that is not producing information used in decision-making and management should be minimised and should be carefully scrutinised to ensure it has sound justification; such a justification could include it being legislatively mandated, or because a change in ecosystem condition beyond a threshold would trigger a management response (even if the specific response is not clear in advance).

The quality of research is fostered by enhancing the level of critical independent review at early stages of project development, and by publication of research outputs in peer-reviewed journals. This also serves to build trust within our end users.

While the Division has strong natural science capacity, addressing key knowledge gaps increasingly require social science and economics expertise.

Collaborative work with the Ngunnawal people assists them to fulfil their cultural rights in the management of Country; recognises the intrinsic value this has to their physical and spiritual wellbeing, cultural practices, songlines, law/lore and economic participation; and opens up new avenues for application of Ngunnawal cultural knowledge for management and conservation outcomes.



## Goals

- 2.1 All monitoring programs are scientifically robust, targeted and efficient; and collect the most appropriate data to evaluate and guide management actions
- 2.2 Monitoring efforts are designed in ways that enable relevant research questions to be addressed, and existing monitoring datasets are used to address relevant research questions
- 2.3 Research is relevant, robust, subject to independent critical scrutiny, co-developed with user groups, and results wherever possible in peer-reviewed publication of research findings
- 2.4 Citizen science collaborations are enhanced and strengthened
- 2.5 The social science and economics expertise within the Division is increased
- 2.6 Nggunawal people are widely consulted with and engaged in research and monitoring efforts, and understanding is increased of how Nggunawal cultural knowledge and practices can contribute to achieving EPSDD's conservation and management priorities, and how integrating Nggunawal cultural knowledge and practices with formal scientific knowledge and practices can generate fresh understanding to advise and guide management.
- 2.7 Research and monitoring priorities and outcomes have high visibility, in a variety of appropriate forms, within and beyond Government to maximise opportunities for collaboration and the impact of our work on biodiversity conservation, sustainability and liveability.



Stuart Rae, Little Eagle Working Group



### 3. EMBED ADAPTIVE MANAGEMENT ACROSS EPSDD

Adaptive management is “learning by doing”: it is a structured, iterative management approach that generates knowledge, and enables learning from the outcomes of management approaches. EPSDD seeks to promote a culture of adaptive management, and aims to embed a “Plan-Do-Review” framework across its operations (Figure 1a). Each of these steps should be based on robust evidence – the provision of which is dependent on all the focus areas outlined in this Plan.

The CEMP – the Conservation Effectiveness Management Program – is a key element in generating the knowledge to enable adaptive and evidence-based management. The CEMP is an overarching ecosystem condition monitoring framework for the ACT that links monitoring data on management activities with outputs (generally delivered through annual plans) through to outcomes, generally linked to our strategic goals (Figure 1b). This enables an assessment of the efficacy of management actions, identification of knowledge gaps, and the prioritisation of future research. Through consolidating information on ecosystem condition and increasing accessibility of this information across ACT Government, the CEMP aims to provide a data-rich decision support tool to inform strategic planning and assist management in conserving ecological values within the ACT.

#### Goals

- 3.1 The science, policy and implementation teams across the Environment Division are “interoperable”, delivering joined-up strategic, evidence-based and adaptive management
- 3.2 CEMP provides a coordinated, systematic, and robust biodiversity monitoring program across all ecosystem types in the ACT, which can detect changes in ecosystem condition within the ACT, evaluate the effectiveness of management actions in achieving conservation outcomes, and provide evidence to support decisionmaking
- 3.3 CEMP is mainstreamed across the Division, and its outputs are translated into strategic, statutory and operational planning
- 3.4 Systems and tools that enable and support adaptive management are widely adopted, including online databases, apps and dashboards that facilitate data visualisation and use.

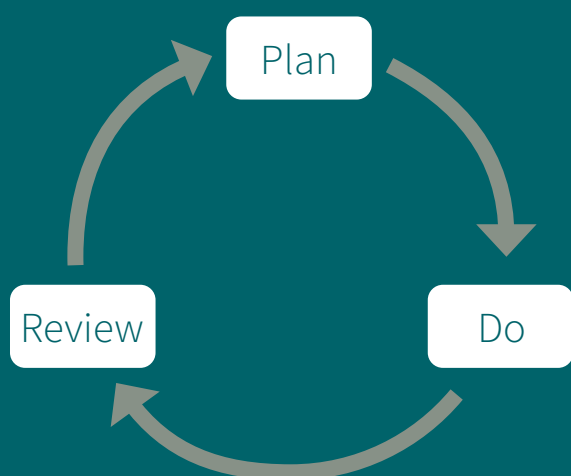


Figure 1a) The “Plan-Do-Review” cycle. The Science Plan sits in the centre of this circle, seeking to ensure each step in this cycle can draw on robust and relevant science-based knowledge.



Figure 1b) The monitoring pyramid. Understanding management effectiveness – the “Review” stage – requires integrated monitoring across the levels from activities up to outcomes.



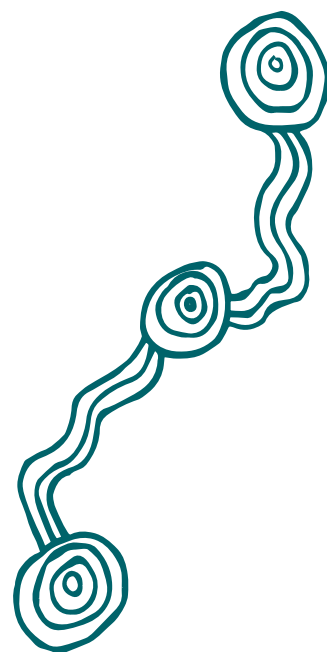


## 4. THOUGHT LEADERSHIP

The world is changing rapidly across social, cultural, economic, technological and ecological dimensions, often with a scientific underpinning or driver. The need exists to anticipate emerging or novel issues, explore their implications, and catalyse broad-based thinking and action to address them.

### Goals

- 4.1 Processes and events held across ACT Government and beyond stimulate scientifically informed debate, creative exploration and the generation of management responses to high-impact emerging issues, including climate change adaptation.





## 5. DATA CUSTODIANSHIP AND CURATION

The findability, quality and accessibility of data are critical to their practical impact. Data are currently generated by and held by an array of teams across EPSDD, with few coordinated protocols for data accessibility, governance and management. Locating and accessing data is frequently challenging, and progress toward implementation of the ACT's Open Data Policy is fragmented. Use of innovative approaches to data visualisation and access such as apps and dashboards is accelerating.

Research findings and how they are applied in EPSDD policy and operations are two key elements of knowledge for management. Historically, this information has been captured in reports and in the heads of experienced officers. However, internationally, research findings are being captured in 'knowledge-bases' (cf. databases) that make it possible to rapidly compare the findings from many studies—or to conduct thorough meta-analyses—to inform decision making. Further, management knowledge is being 'captured' and re-used in models (such as NARCLIM, Source, MUSIC).

### Goals

- 5.1 Data governance processes and culture that foster the importance of data curation, accessibility and transparency established in the Division
- 5.2 Innovation and best practice technology for capture, processing and storage of data, collaboration, and interactive visualisation and investigation of results are widely adopted
- 5.3 Workflows that address full adaptive management cycles and strategic objectives beyond data capture and storage are adopted; such as streamlined analysis and data-driven visualisation portals to inform decision-making, policy, and review of management actions
- 5.4 Data generated by the Division is accessible and catalogued, for government, research institutions and the public, in line with the ACT's Open Data Policy
- 5.5 The use of knowledge-bases to capture and re-use research findings is actively explored
- 5.6 Management knowledge is imported into models that are used to support decision-making by EPSDD/others.





# RESEARCH AND MONITORING THEMES

## 1. CLIMATE CHANGE

### Strategic Objective:

Updated climate change projections are available for the ACT, through the NSW and ACT Regional Climate Modelling (NARClIM) Project partnership, with clearly understood implications; frameworks available to assess and manage risks; and government, industry and the community are supported in assessing policy and management options to mitigate and adapt.

### Knowledge needs and gaps:

- Revised climate projections for the Territory
- Understanding of impacts on natural and built environments at a management scale
- Climate adaptation pathways for urban and rural societal sectors
- Identification and prediction of changes in:
  - » ecosystem function, resilience, and ecosystem service provision
  - » fire regimes
  - » distribution and threat status of species and communities
  - » the invasiveness of plant and animals
  - » ecosystem processor species (e.g. pollinators, soil disturbers and decomposers)
  - » soils, including soil carbon
  - » the resilience of species and communities to climate change
- Identification of climate refugia and climate connectivity
- Re-conceptualised conservation goals and prioritised conservation actions in a rapidly changing climate.







## 2. ECOSYSTEM PROCESSES AND RESILIENCE

### Strategic objective:

Improved understanding of ecosystem processes that drive ecological change and identification of opportunities to build and maintain resilience.

### Knowledge needs and gaps:

- Characterisation of appropriate fire and water flow regimes to meet terrestrial and aquatic management goals
- Effective approaches for restoring connectivity in rural and urban environments for improving resilience
- Effective approaches for catchment and local-scale restoration for improvement in water quality and quantity and aquatic ecosystem condition
- Understanding of soil processes and the impacts of their disruption.

## 3. SPECIES AND COMMUNITY ECOLOGY

### Strategic objective:

Innovative research to improve the understanding of the genetics and ecology of high-priority species and ecological communities, as a basis for informing and evaluating management and policy.

### Knowledge needs and gaps:

- Distribution, abundance and conservation status of ecological communities and species (including invertebrates)
- Fundamental ecological dynamics and processes of high-priority species and communities to inform adaptive management
- Understanding of how current management practices affect priority species and communities
- Identification of interventions that promote ecosystem resilience and generate broad biodiversity benefits
- Identification and exploration of captive breeding, genetic management, and reintroduction techniques to safeguard genetic diversity, promote threatened species conservation, and restore lost species from the landscape
- Identification of effective land, aquatic, and ecological community restoration techniques.

## 4. THREATS

### Strategic objective:

Improved understanding of key current and future threats (beyond climate change) to the ACT's environment, agriculture and liveability, in order to inform effective management responses.

### Knowledge needs and gaps:

- Increased understanding of bushfire impacts and the effectiveness of interventions for post-fire recovery
- Increased understanding of impacts of climate change-related changes in bushfire on ecological values, including identification of key fire refugia under likely climate scenarios
- Improved capability to predict and respond to plant invasion pathways
- Effective invasive plant management practices to improve environmental, economic and social values
- Innovative and cost-effective native and introduced herbivore management techniques to protect environmental, economic and social values
- Improved understanding of the ecosystem impacts of invasive predators and other animals, to inform appropriate management actions
- Improved awareness of development-related threatening processes (e.g. environmental contamination, habitat loss and fragmentation)
- Improved understanding of the impacts of specific human behaviours on ecological systems
- Assessment of economic impost of 'on farm' environmental threat management and implications for broader biodiversity values.





## 5. URBAN SUSTAINABILITY AND WELLBEING

### Strategic objective:

Knowledge established to maintain or enhance biodiversity values across the urban setting and the interface with reserves, and clarify the contributions of nature/biodiversity to the wellbeing of Canberra's citizens.

### Knowledge needs and gaps:

- Identification of biodiversity hotspots in urban environments
- Establishment of an integrated, comprehensive and scientifically informed vision for Canberra's development that maintains or enhances conservation outcomes
- Understanding of design and planning features for homes, gardens, parks, waterways and suburbs that increase wildlife benefit through the provision of habitat or connectivity
- Improved understanding of the extent and impacts of urban intensification, urban sprawl and urban infrastructure on biodiversity and human-wildlife conflicts, and the efficacy of approaches in reducing impacts
- Enhanced understanding of the relationship between nature conservation and community wellbeing, and how conservation contributes to achievement of the ACT's wellbeing targets
- Cost/benefit analyses of achieving biodiversity sensitive urban design
- Understanding patterns, trends, motivations for and experiences of park visitation; and identifying acceptable levels of ecosystem change due to visitor impact.
- Understanding the barriers to and benefits of changing specific human behaviours from the perspective of relevant social groups
- Understanding the efficacy and cost-effectiveness of specific behaviour-change interventions







## 6. RURAL LANDS

### Strategic objective:

Improved understanding of approaches to support ACT Rural Landholders to be productive and environmentally sustainable.

### Knowledge gaps and needs:

- Improved knowledge on systems of sustainable agriculture, grazing and livestock management; niche/alternative industries and certification; and integrated pest management
- Approaches for maintenance and enhancement of on-farm biodiversity, soil health, water quality/supply
- Social and economic research on factors affecting landholders' engagement in sustainable production activities
- Knowledge to support on-farm climate mitigation and adaptation.

## 7. FIRE MANAGEMENT

### Strategic objectives:

Knowledge and evidence base generated to guide fire management practices that balance the need to protect human life and property with other land management objectives, particularly conservation of environmental and heritage values, in a changing climate.

### Knowledge needs and gaps:

- Improved capability to predict fire behaviour to reduce risks to human life, property and ecological values
- Improved understanding of post-fire water quality risks
- Improved understanding of the effects of fire-suppressant chemicals on biodiversity and how best to apply them during fire management actions to minimise risks
- Increased understanding of ecological impacts of prescribed burning regimes to inform fire management programs
- Spatial modelling capability for exploring strategic fuel management options that optimise bushfire risk and environmental outcomes
- Greater understanding of long-term fuel dynamics of ACT ecosystems in response to prescribed burning
- Greater understanding of aspirations of Ngannawal peoples regarding burning as a management tool, including incorporation of cultural knowledge and techniques.



## 8. WATER

### Strategic objectives:

Knowledge and evidence developed to support the maintenance of water quality and quantity into a warmer and drier future.

### Knowledge needs and gaps:

- Projected scenarios for water flows and impacts on water bodies in the ACT
- Water quality dynamics within the ACT waterways, including nutrient movements in urban ponds, wetlands and lakes
- Possible management interventions in these waterways (e.g. transformation of current water bodies to wetlands; restrictions on chemical fertilisers; mandatory pre-treatment zones for stormwater runoff as part of development applications) and their efficacy at achieving objectives
- Improved understanding of the impacts of specific human behaviours on water quality and the efficacy and cost effectiveness of possible behaviour-change interventions
- Understanding of the effectiveness of the ACT's environmental flow guidelines and potential improvements, including with respect to needs of aquatic species and communities
- Understanding interactions between terrestrial land management practices (e.g. total grazing pressure), soil processes, and water management
- Assessment of the requirements for environmental flows from upstream of the ACT e.g. Tantangara releases to the Upper Murrumbidgee River, including proposed changes under the Snowy licence and Snowy Hydro 2.0
- Emerging technologies to reduce pollutant load
- Regional approaches to catchment management/ research.



## 9. SOILS

### Strategic objectives:

Knowledge and evidence developed to maintain and improve soil quality into a warmer and drier future through management interventions.

### Knowledge needs and gaps:

- Projections on soil quality, soil moisture, hydrology, erosion and nutrient cycling under a warming and drying climate, and implications for agricultural productivity and ecosystem functioning
- Better understanding of how soil condition on rural lands, and its response to drought, compares to soils on conservation estate
- Knowledge on soil biodiversity across the landscape
- Understanding of the areas and soil types that can benefit the most from conservation and management interventions
- Improved understanding of most effective management interventions to preserve and improve soil quality and productivity, including under hotter and drier conditions
- Improved understanding of management practices to prevent or restore areas of significant soil erosion, nitrification, or contamination.

## 10. PLANTATIONS, CARBON AND BIODIVERSITY MANAGEMENT

### Strategic objective:

Knowledge base established for effective carbon capture in the landscape, particularly through plantations, and managing plantations to enhance biodiversity values.

### Knowledge needs and gaps:

- Exploration of impact of management approaches, such as native vegetation corridors, on biodiversity in and around pine plantations
- Understanding of effective approaches for carbon capture in ACT context
- Identification of future planting requirements and determination of offset capacity
- Investigation of means to align reforestation for carbon offsets and biodiversity conservation objectives
- Development of new forms of carbon sequestration for submission to the Clean Energy Regulator for consideration for funding





# 11. ECOSYSTEM SERVICES AND ENVIRONMENTAL ACCOUNTING

## Strategic objectives:

The economic contribution of ecosystem services to the ACT is better understood, including to guide investment in the protection and management of ecosystem services, and the utility and appropriate use of environmental accounting in the ACT context is assessed.

## Knowledge needs and gaps:

- Water
  - » Understanding of what savings are made by ensuring water quality at source is high compared to the cost of treating water after extraction
- Forests and woodlands (including urban forests)
  - » Assessment of the contribution of forests and woodlands to the liveability of Canberra (e.g. air quality, moderation of temperature)
  - » Establishment of method to provide a monetary value (and cost benefit analysis) to benefits provided by trees across their lifetime
  - » Understanding of whether retention of mature trees and urban open space improves the value of adjacent blocks
  - » Understanding of how the economic and social benefits of ACT pine plantations balance with their impact on ecosystem services (e.g. water yield and quality)
- Health, wellbeing and amenity
  - » Knowledge on the benefits provided by reserves to the community (health, wellbeing and/or amenity), and why
- Environmental accounting
  - » Appropriate valuation methods for biodiversity and conservation in the ACT, and understanding on how they can inform EPSDD decision making
  - » Assessment of how much members of the ACT community are willing to pay for conservation.





# IMPLEMENTING THE PLAN

## SCIENCE GOVERNANCE

The Conservation Research Branch will lead the process to develop a governance structure to: coordinate research across the Environment Division; propose topics for investigation; ensure use of best practice research methodology; strengthen and streamline the link between research and management; provide best available evidence and advice to policy and management planning; guide the development of partnerships to ensure they further prioritise areas of research; and promote effective communication of research findings.

Advice and input from the ACT Scientific Committee, Commissioner for Environment and Sustainability, and the Climate Change Council will inform and strengthen our planning, management and research directions.

This 5-year Science Plan will be supplemented by an annual set of more specific scientific priorities, developed collectively by the Environment Division science team through annual joint science review, planning and prioritisation days.

## EPSDD SCIENCE PLATFORM

One essential element of delivering coordinated scientific activities is to have a comprehensive and up to date central information source. Accompanying this Strategy will be web-based interface page called the EPSDD Science Platform, which:

- Identifies/articulates research needs
- Keeps an up to date directory of who is doing what across the ACT Government in monitoring and research
- Provides a network to raise awareness on emerging issues/science
- Helps create a community of practice
- Helps identify opportunities/synergies in coordinated research (within and beyond government)
- Provides information on funding cycles and opportunities
- Centralises sources of information, publications and fact sheets
- Provides updates on research programs, publications, upcoming meetings, and other relevant information.













