LEGISLATIVE ASSEMBLY
FOR THE AUSTRALIAN CAPITAL TERRITORY

STANDING COMMITTEE ON ENVIRONMENT AND TRANSPORT AND CITY SERVICES
Ms Suzanne Orr MLA (Chair), Miss Candice Burch MLA (Deputy Chair)
Ms Tara Cheyne MLA, Ms Nicole Lawder MLA

Submission Cover Sheet

Nature in Our City

Submission Number: 31

Date Authorised for Publication: 8 August 2018

CSIRO Submission 18/629

Nature in Our City: inquiry into the value of the natural environment to an urbanising Canberra.

ACT LA Standing Committee on Environment and Transport and City Services

June 2018

Enquiries should be addressed to:

Dr Natasha Herron
Executive Officer
CSIRO Land and Water
[redacted]

Main Submission Author:

Mr Guy Barnett
Principal Research Scientist
CSIRO Land and Water
[redacted]

Table of Contents

Executive Summary

CSIRO welcomes the opportunity to provide this submission to the inquiry into the value of natural environments in an urbanising Canberra. The following summarises key findings from CSIRO's research that provide insights that may help inform this inquiry:

- Urban green spaces provide a range of physical and mental health benefits. The health sector is increasingly recognising nature as a cost effective tool for planning healthy cities.
- Residential green spaces and parkland are important for mitigating urban heat in Canberra, which highlights the importance of increasing the extent of vegetation cover to maximise the cooling potential of green infrastructure and increasing urban resilience to climate change impacts.
- People are diverse in the way they appreciate and value different aspects of nature. They appreciate the types of species that are around them; the services they get from ecosystems such as shading, cooling and shelter to name a few; and the value they place on having nature in their daily lives through aesthetic and cultural appreciation.
- Natural infrastructure systems in urban areas can contribute to a 'sense of place' (incorporating the notions of identity, attachment and dependence), which can be used to anticipate community acceptance of land use planning decisions.
- Water Sensitive Urban Design (WSUD) features, such as urban wetlands, provide multiple benefits in managing the urban water cycle through conservation of drinking water, stormwater quality improvement, flood control, and landscape amenity. However, there are a lack of studies documenting the performance of WSUD approaches in different development contexts. Increased monitoring and validation of WSUD approaches would help inform decision making that accounts for all costs and benefits, and trade-offs.
- The natural values (species composition, ecological services, etc.) of grassy woodlands, the predominate ecosystems in and around Canberra, can be maintained provided that development thresholds are not crossed. Three key urban planning principles that will prevent thresholds being crossed are: 1) That areas of existing grassy woodlands in the best condition should be a priority for conservation management; 2) Land uses of high intensity that degrade the natural values of grassy woodlands need to be limited and significant areas of low intensity use and conservation-only use should dominate; and 3) Land uses of all intensities can have influences that spread beyond their boundaries so their spatial arrangement, wider footprint and interactions need to be considered.

The use of natural systems to provide services in urban areas remains relatively novel when compared to conventional approaches of urban infrastructure provision. A barrier to adoption of these approaches is that measurement and attribution of benefits from natural systems in cities is difficult as they transcend sectoral boundaries and involve complex interdependencies that can result in unintended consequences.

Introduction

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) welcomes the opportunity to provide a submission to the ACT Legislative Assembly Standing Committee on Environment and Transport and City Services on the value of natural environments in an urbanising Canberra.

CSIRO has diverse capabilities in social, economic, environmental, and engineering science and we bring together ecologists, economists, social scientists and built infrastructure researchers to study the role of natural systems in urban environments. CSIRO's research examines how natural systems or components of natural systems can be maintained or integrated into an increasingly urbanised landscape to provide ecosystem services that optimise both environmental and human well-being. This has included integrated assessments to understand how green spaces in urban landscapes can provide ecosystem services that mitigate projected climate change impacts.

Canberra is commonly referred to as the 'Bush Capital' as it is surrounded by an extensive system of nature reserves and open space. The genesis of Canberra as a planned city enabled a deliberate approach to incorporating nature in the city, with extensive tree plantings a feature of Canberra's early development.[1]

Vegetation modelling undertaken for Canberra shows that the woodland vegetation communities have been the most impacted since European settlement.[1] The importance of nature reserves and open space is recognised in the Territory Plan, which includes provisions for ensuring the environmental values of nature reserves are protected from development. The loss and degradation of natural environments in urban areas creates a disconnect between ecosystems and the communities that could potentially benefit from their services. As Canberra continues to develop, there is a need to ensure natural values are protected.

The following highlights findings from CSIRO's research that provides insights that may help inform the inquiry into the value of natural environments in an urbanising Canberra.

CSIRO response to the Terms of Reference

1. The level of public support for and satisfaction with amount and quality nature and natural environment areas in Canberra, particularly in urban areas.

No specific input.

2. The types of nature and natural environment areas within Canberra e.g. urban open spaces or bushland reserves and the existing and potential benefits and challenges they bring to Canberra's:

(a) Social amenity

Blue-green infrastructure systems in Canberra use natural systems to provide the ecological and amenity value associated with urban greening (e.g. trees, parks and gardens), while blue infrastructure (e.g. wetlands, bio-retention basins and rainwater tanks) also provide for water management that is aligned with principles of Water Sensitive Urban Design (WSUD). Integration of blue and green infrastructure can help to achieve multiple objectives, which include: urban heat mitigation, restoration of natural hydrology, improved water quality, and social amenity. These natural systems in urban areas can contribute to a 'sense of place' (incorporating the notions of identity, attachment and dependence), which can be used to predict community acceptance of land use planning decisions. Studies have shown that sense of place associated with natural systems is not just associated with people living in proximity to the location, but

can also extend more broadly to the overall urban area.[2] The policy implication is that social boundaries can extend beyond geographical or management boundaries of a place.

Urban green spaces provide a range of physical and mental health benefits, and the health sector is increasingly recognising nature as a cost effective tool for planning healthy cities.[3] If real progress is to be made in designing health-promoting green infrastructure, ecologists and health scientists must work more closely together to tease apart the causal mechanisms involved. Research has demonstrated that people who made long visits to green spaces had lower rates of depression and reduced blood pressure, and those who visited more frequently had greater social cohesion. Higher levels of physical activity were linked to both duration and frequency of green space visits. A dose-response analysis for depression and high blood pressure suggests that visits to outdoor green spaces of 30 minutes or more during the course of a week could reduce the population prevalence of these illnesses by up to 7% and 9% respectively. Given that the societal costs of depression alone in Australia are estimated at AUD$12.6 billion per annum, savings to public health budgets across all health outcomes could be immense.[4]

There is a lack of clear evidence about which elements of nature deliver which health outcomes.[4] Green spaces may promote physical activity first and foremost by providing free and readily accessible locations for active pastimes. A number of studies suggested that people who live in neighbourhoods with higher levels of green space undertake more (and sometimes more vigorous) physical activity such as cycling and walking. At the population level, higher amounts of green space within neighbourhoods have been found to correlate with reduced all-cause mortality and morbidity.[5] There is the need to better understand if the benefits of green space exposure and physical activity accrue separately, or synergistically. A better understanding of the links between urban environmental areas and health outcomes would help guide effective investment in green space provision and ecological enhancement.[5]

(b) Economic development

Research has shown that street trees provide a range of benefits to urban residents that are implicitly captured in the value of residential properties. Results from a study in Perth, which applied a spatial hedonic model, demonstrated that broad leaved trees on a street verge increases the median property price by more than $16,000.[6] These findings have implications for the planting and maintenance of trees on street verges, which have been shown to generate public and private benefits.[6] Similarly, in Perth the amenity benefits of urban wetlands were shown to increase the value of nearby houses.[7] The inclusion of a recreational index as well as spatial proximity is able to capture how individuals value environmental amenities around their homes based on the site's natural characteristics as well as recreational services.[8]

(c) Biodiversity; and/or

Research has shown that nature is valued in diverse ways by people, which is influenced by both the different types of relationships with nature and the different aspects that underpin how nature is valued. This was demonstrated for a Sydney case study that investigated options for managing a restricted and endangered ecological community in an urban setting.[9] It was found that the community valued the site in a wide range of ways connected to different aspects of its naturalness, which had implications when considering management options for restoration and managing climate change impacts. The factors that influence how people relate to and value nature include: ecosystem composition (identified species and the communities they connect to), ecosystem quality or function (services provided), and the value they place on having nature in their daily lives.[9] There is growing evidence that demonstrates the potential for the strength of an individual's connection to nature to affect their interaction with green space, which along with opportunity (proximity to parks) can help explain who uses urban parks and for what purpose.[10] The strength of a connection to nature is also important for the benefits people derive from private green space.[11] Also, people with a greater connection to nature tend to travel farther to access more vegetated parks.[12] This highlights the challenge for Canberra of fostering increased connection of the community to

nature through social and educational interventions. The challenge could become more difficult if urbanisation results in the loss of natural spaces, which means people have fewer opportunities to experience nature and develop connections with it.

Research on the spatial distribution of green infrastructure in Sydney investigated the influence of land use type, residential density and socio-economic advantage. The findings highlighted that urban densification can lead to a general loss of two important reservoirs of urban green infrastructure (public parkland and residential tree cover). Disadvantaged communities may have a greater reliance on public green infrastructure in the form of parkland due to a lack of private residential tree cover.[13] While, a study in Brisbane found that tree cover is higher in more socio-economically advantaged areas, with this socio-economic bias holding true for both public and private (residential) green space, with the latter providing the greatest contribution to tree cover in the urban area.[14] Therefore, in Canberra, greening efforts on private land could be important in ensuring equitable access to nature.

(d) Climate resilience

In 2017, CSIRO undertook analysis of satellite imagery to provide the ACT Government with digital maps that showed land surface temperatures and vegetation vigour for mornings and evenings in the summer of 2016-17 and for the winter of 2017. These maps were overlain with maps of vegetation cover, which were provided by the ACT Government.[15]

Key findings for the summer period included:

- Canberra has a surface urban heat island at night in built-up areas that is around 8 °C warmer, on average in summer, than surrounding rural areas. This difference largely results from the relatively slow night time release of heat that has been absorbed by buildings and pavements in urban areas during the day. This slow release of accumulated heat reduces night time cooling relief in summer.
- Warmer areas in summer, with above-average surface temperatures, are characterised by large expanses of impervious surface cover such as rooftops and paving, and few trees. This is common in commercial and industrial areas, carparks and new housing developments. Areas that have been cleared for development or have low, sparse, dry vegetation cover, such as grasses and pasture are also hotter during the day. Residential areas with above-average surface temperatures were characterised by little tree cover.
- Cooler areas in summer, with below average surface temperatures, typically have green vegetation, more tree cover, are irrigated or are near water. Areas shaded by trees, buildings or topography are also cooler. In rural areas, vegetation that has a higher proportion of tree canopy cover also tends to be cooler.
- Canberra's lakes maintain relatively stable temperatures throughout the day and night. This will provide cooling benefits on hot days when they are cooler than surrounding areas, but the benefit is likely reduced on still, hot, nights.

Considering the importance of residential green space and parkland in regulating urban temperatures it is important to understand how change in land use could affect local temperatures for urban residents. Areas with a higher proportion of tree cover tend to have lower surface temperatures (e.g. roads and roofs), while areas with greater land cover in the form of pavement and bare soil/dry grass generally have higher surface temperatures.[15] This highlights the importance of promoting certain landscape covers to maximise the cooling potential of green infrastructure and increase resilience to climate change impacts.[16]

3. Opportunities for Blue (water) and or Green (natural) Infrastructure in Canberra

(a) Functional requirements of blue-green infrastructure

The use of natural systems in cities to provide services such as stormwater management remains relatively novel, when compared to conventional approaches. The multi-functionality of some Water Sensitive Urban Design (WSUD) elements (e.g., flood mitigation, stormwater management, alternative water source, landscape amenity) can mean there are competing objectives. There are a lack of studies on the performance of WSUD approaches in different development contexts in achieving sustainability design objectives. Increased monitoring and validation of WSUD approaches would help address knowledge gaps. For example, the effectiveness of installing distributed WSUD assets at a household or street scale in existing urban development to address catchment objectives such as restoration of pre-development hydrology and improving water quality and ecosystem health in local waterways.[17]

CSIRO undertook an integrated assessment of stormwater harvesting options to help achieve the ACT's sustainable urban water management targets.[18] This study showed that stormwater harvesting opportunities have the potential to save up to 3 GL of drinking water demand in Canberra. This study has generated a considerable amount of new knowledge on the hydrological, financial, ecological and social (including stakeholder preferences) implications of stormwater harvesting in Canberra.[18]

(b) Cost and maintenance considerations of blue-green infrastructure

WSUD features, such as urban wetlands, provide multiple benefits in managing the urban water cycle through conservation of drinking water, stormwater quality improvement, flood control, and landscape amenity.[17] However, WSUD approaches remain relatively novel compared to conventional water management approaches, which means that in some areas the knowledge required to plan and maintain these natural systems is still developing. A post-implementation review of developments designed with WSUD approaches in Adelaide found that uncertainty around costs was an impediment for greater adoption of WSUD.[19] In many cases, the capital costs of sustainability initiatives, such as WSUD, have been funded under one-off grant opportunities that meant there was still the need to demonstrate a robust business case for WSUD approaches without subsidies. Also, in many cases the ongoing costs of operating and maintaining the WSUD features were not accounted for, which meant some local governments were reluctant to assume maintenance responsibility for WSUD assets due to uncertainties on the cost burden.[19]

Achieving the design intent of WSUD elements in restoring pre-development hydrology and water quality can be constrained by a lack of capacity in both the construction and operation of these approaches.[17] The paucity of WSUD system monitoring and performance assessment means there can be a lack of understanding of the required maintenance tasks and costs for WSUD approaches.[19]

Rainwater tanks to augment household water supply have been an important intervention in Australian cities to reduce pressure on potable water supply systems, while also reducing the impact of urbanisation on increased stormwater runoff. A physical inspection of rainwater tanks in Melbourne in 2014 found that approximately one third of tanks were on poor foundations, and that around 4% of pumps were broken. It was also found that most householders with rainwater tanks lacked adequate knowledge to correctly maintain their rainwater tank systems.[20] The results highlight the complexity of introducing a new type of infrastructure asset where distributed, privately owned and operated assets provide public benefits.[20]

(c) Amenity benefits

To understand community support and understanding of WSUD, CSIRO undertook interviews and focus groups with residents who lived in developments designed with WSUD.[17] Residents near wetlands seemed

generally aware of the cleansing function of reed beds, but the design intent of landscaped swales was not clear for residents. The amenity benefits of WSUD features, such as green space, recreational areas, community gardens, biodiversity and waterways, were perceived as supporting healthy outdoor activity and the building of social capital within the community. Those residents who were highly involved in the day to day management of WSUD features, or those who felt well informed and consulted, experienced a sense of pride in the green credentials of their development. This highlights the importance of community education and involvement to improve community acceptance of WSUD systems.[17]

(d) Conservation and biodiversity benefits

No specific input.

4. Managing the interface between the natural environment and urban areas particularly in regards to conserved environmental areas

In principle, biodiversity of grassy woodlands, and the ecological functioning of the landscape, can be maintained provided that critical upper limits to intensive development are upheld.[21-23] For the long-term viability of the most intact vegetation, it is important to maintain a landscape with an overall minimum amount of native vegetation. Three key urban planning principles emerge from these considerations:

1) The condition of existing grassy woodlands is important, with areas in best condition being a priority for conservation management.
2) Land uses of high intensity need to be balanced with significant areas of low intensity use across landscapes.
3) Land uses can have influences that spread beyond their boundaries so their arrangement across landscapes is important.

The vast majority of woodland fauna species are dependent on woodland that is in good-moderate condition and a minimum landscape representation of 30% grassy woodland is recommended as a level that would support healthy populations of mobile fauna, i.e. are able to move through non-habitat.[23]

5. Current policy or regulatory settings that impede the integration of the natural environment within optimal urban development and design.

No specific input.

6. Any other relevant matter.

No specific input.

Concluding remarks

Canberra faces pressures in managing urbanisation while still ensuring that natural areas and systems are appropriately value and protected. The CSIRO research summarised in this submission highlight the benefits provided by natural systems in our cities, including health benefits, landscape amenity, urban cooling, water cycle management, and enhancing local biodiversity. Consistent and accurate measurement of these ecosystem services will help ensure that their social, economic and environmental values can be reflected in future planning decisions. The purposeful use of natural systems to provide services in urban areas remains relatively novel when compared to conventional approaches to providing urban infrastructure.

A barrier to greater adoption of these approaches is that the measurement and attribution of benefits from natural systems in cities is difficult as they transcend traditional sectoral boundaries, and there are complex interdependencies that can result in unanticipated impacts from interventions.

References

1. MacKenzie, A.; Barnett, G. In *The bush capital—a complex urbanising landscape*, The Landscape Architect, IFLA Conference Papers, 2006; Citeseer: 2006.
2. Tapsuwan, S.; Leviston, Z.; Tucker, D., Community values and attitudes towards land use on the Gnangara Groundwater System: A Sense of Place study in Perth, Western Australia. *Landscape and Urban Planning* **2011,** *100*, (1), 24-34.
3. Shanahan, D. F.; Lin, B. B.; Bush, R.; Gaston, K. J.; Dean, J. H.; Barber, E.; Fuller, R. A., Toward Improved Public Health Outcomes From Urban Nature. *American Journal of Public Health* **2015,** *105*, (3), 470-477.
4. Shanahan, D. F.; Bush, R.; Gaston, K. J.; Lin, B. B.; Dean, J.; Barber, E.; Fuller, R. A., Health Benefits from Nature Experiences Depend on Dose. *Scientific Reports* **2016,** *6*, 28551.
5. Shanahan, D. F.; Franco, L.; Lin, B. B.; Gaston, K. J.; Fuller, R. A., The Benefits of Natural Environments for Physical Activity. *Sports Medicine* **2016,** *46*, (7), 989-995.
6. Pandit, R.; Polyakov, M.; Tapsuwan, S.; Moran, T., The effect of street trees on property value in Perth, Western Australia. *Landscape and Urban Planning* **2013,** *110*, 134-142.
7. Tapsuwan, S.; Ingram, G.; Burton, M.; Brennan, D., Capitalized amenity value of urban wetlands: a hedonic property price approach to urban wetlands in Perth, Western Australia*. *Australian Journal of Agricultural and Resource Economics* **2009,** *53*, (4), 527-545.
8. Tapsuwan, S.; MacDonald, D. H.; King, D.; Poudyal, N., A combined site proximity and recreation index approach to value natural amenities: An example from a natural resource management region of Murray-Darling Basin. *Journal of Environmental Management* **2012,** *94*, (1), 69-77.
9. Dunlop M.; Ryan P.; McGuinness S.; A., G. *Scoping climate-ready management of Eastern Suburbs Banksia Scrub in Queens Park, Sydney.*; CSIRO: Canberra, Australia, 2017.
10. Lin, B. B.; Fuller, R. A.; Bush, R.; Gaston, K. J.; Shanahan, D. F., Opportunity or Orientation? Who Uses Urban Parks and Why. *PLOS ONE* **2014,** *9*, (1), e87422.
11. Lin, B. B.; Gaston, K. J.; Fuller, R. A.; Wu, D.; Bush, R.; Shanahan, D. F., How green is your garden?: Urban form and socio-demographic factors influence yard vegetation, visitation, and ecosystem service benefits. *Landscape and Urban Planning* **2017,** *157*, 239-246.
12. Shanahan, D. F.; Lin, B. B.; Gaston, K. J.; Bush, R.; Fuller, R. A., What is the role of trees and remnant vegetation in attracting people to urban parks? *Landscape Ecology* **2015,** *30*, (1), 153-165.
13. Lin, B.; Meyers, J.; Barnett, G., Understanding the potential loss and inequities of green space distribution with urban densification. *Urban Forestry & Urban Greening* **2015,** *14*, (4), 952-958.
14. Shanahan, D. F.; Lin, B. B.; Gaston, K. J.; Bush, R.; Fuller, R. A., Socio-economic inequalities in access to nature on public and private lands: A case study from Brisbane, Australia. *Landscape and Urban Planning* **2014,** *130*, 14-23.
15. Meyers J; Devereux D; Van Niel T; G., B. *Mapping surface urban heat in Canberra*; CSIRO: Canberra, Australia, 2017.
16. Lin, B.; Meyers, J.; Beaty, R.; Barnett, G., Urban Green Infrastructure Impacts on Climate Regulation Services in Sydney, Australia. *Sustainability* **2016,** *8*, (8), 788.
17. Sharma, A.; Pezzaniti, D.; Myers, B.; Cook, S.; Tjandraatmadja, G.; Chacko, P.; Chavoshi, S.; Kemp, D.; Leonard, R.; Koth, B.; Walton, A., Water Sensitive Urban Design: An Investigation of Current Systems, Implementation Drivers, Community Perceptions and Potential to Supplement Urban Water Services. *Water* **2016,** *8*, (7), 272.
18. Maheepala, S.; Grant, A.; Schandl, H.; Oliver, R.; Blackmore, J. M.; al., E. *Canberra Integrated Waterways: feasibility study: report for ACT Territory and Municipal Services*; CSIRO, Water for a Healthy Country National Research Flagship,: Canberra, A.C.T, 2009.
19. Sharma, A. K.; Cook, S.; Tjandraatmadja, G.; Gregory, A., Impediments and constraints in the uptake of water sensitive urban design measures in greenfield and infill developments. *Water Science and Technology* **2012,** *65*, (2), 340-352.

20. Moglia, M.; Gan, K.; Delbridge, N.; Tjandraatmadja, G.; Gulizia, E. P.; Christopher;; Sharma, A.; Cook, S. In *Condition inspection of rainwater tanks in Melbourne*, 36th Hydrology and Water Resources Symposium: The art and science of water, Hobart, 2015; Engineers Australia: Hobart, 2015; pp 1413-1417.
21. Smith, F. P.; Prober, S. M.; House, A. P. N.; McIntyre, S., Maximizing retention of native biodiversity in Australian agricultural landscapes—The 10:20:40:30 guidelines. *Agriculture, Ecosystems & Environment* **2013,** *166*, 35-45.
22. McIntyre, S.; McIvor, J.; MacLeod, N., Principles for sustainable grazing in eucalypt woodlands: landscape-scale indicators and the search for thresholds. **2000**.
23. McIntyre, S.; McIvor, J. G.; Heard, K. M., *Managing and conserving grassy woodlands*. CSIRO PUBLISHING: 2004.