

# Encouraging residents' stewardship of street trees in Canberra: Perspectives in the context of the ACT Government's *Street Forestry Program*

by

Ming Hui Choy

Submitted in partial fulfilment of the requirements for the degree of  
Bachelor of Environment and Sustainability (Honours)  
in the Fenner School of Environment and Society,  
Australian National University

July 2026



Australian  
National  
University

# Candidate's Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of the author's knowledge, it contains no material previously published or written by another person, except where due reference is made in the text.

Ming Hui Choy

Date: 28 Oct 2021

## Acknowledgements

I would like to take this chance to thank my supervisors, Peter and Beck, for their support and guidance throughout the entire year. No words can describe my gratitude for them, and I am extremely honoured to have been supervised by them both. Peter has provided tremendous support to me despite his hectic schedules, seeing me beyond that of a student, but as a person. As my first foray into social science research, Beck has been very patient with teaching me the ropes and piquing my interest in the area. I deeply cherish the conversations and interactions I had together with both Peter and Beck, and would not ask for another Honours experience.

Special thanks to the Urban Treescape team from the ACT Government for their cooperation and support throughout the year, for this research could not have been conducted without their assistance.

I would also like to thank my journal club family for their support and encouragements all this time. The journal papers they have shared, some of which made it into this dissertation, have helped me gain deeper insights into a broad range of topic areas. For that, they too deserve the credit for the completion of my dissertation.

A huge thank you to Nici, for taking on the role of our Honours convenor, and assisting us with our journey despite some challenges we faced with an abrupt lockdown. Huge respect for her ability to juggle her many responsibilities as well.

Lastly, I give thanks to my family for their support back home, and to my friends who never failed to be there for me when I needed them. You all made my journey worthwhile.

# Abstract

Urban forests are increasingly important as a ‘nature-based solution’ to climate change, and for the many other benefits they deliver to urban residents. Therefore, many cities globally are focusing on enhancing the extent and quality of their urban forests. Canberra, Australia’s capital city, introduced an *Urban Forest Strategy* in recognition of these issues. One of its goals is to engage residents in stewardship of street trees in their neighbourhoods, which requires a better understanding of residents’ perceptions and attitudes to these trees. Whilst there is some knowledge of these amongst Canberra residents, there are also gaps, particularly about residents’ willingness to play a stewardship role for urban trees. Furthermore, most literature situates urban tree stewardship in the context of organised neighbourhood groups, with less focus on individual stewardship. This thesis therefore explores Canberra residents’ attitudes and behaviours to stewardship of street trees in their neighbourhoods, in the context of an ACT Government pilot initiative, the *Street Forestry Program*, and considers the implications for such initiatives.

In April and May 2021, the *Street Forestry Program* conducted a survey of residents and pop-up consultations in six suburbs, and a webinar. I was able to draw on the survey results, undertake participant observations at consultations and the webinar, and conduct interviews with residents in two suburbs. Results suggest a widespread view that street trees are important, for a range of reasons: the top five were aesthetic, shading, biodiversity, carbon sequestration and erosion control. Around 70% of survey respondents reported that they engaged in stewardship behaviour, primarily watering trees and picking up branches and leaves; this proportion was greatest in the 45-65 age group. Interview responses suggest the main factors influencing stewardship behaviour are individual motivations, perceptions and attitudes; personal circumstances; and government policies and programs. These factors were incorporated into a model of stewardship behaviour for trees on public land in Canberra, adapted from that of Moskell and Allred.

Interviewees appreciated the *Street Forestry Program* for its inclusiveness and efforts to green the suburbs, but had greater expectations for the Program and the ACT Government in the broader context of urban greening issues in Canberra. These results suggest that, to encourage stewardship by residents, the ACT Government should engage in a suite of best practices: these include an adaptive approach to community engagement, guided by models of public participation; strengthening of coordination of operations; and collaboration with neighbourhood groups.

Further research should expand upon the foundations established by this study, addressing the knowledge gaps identified here, including wider themes of equity in urban development and socio-demographic factors. Like the *Street Forestry Program*, this study was limited in scope. A larger sample population across a wider range of Canberra suburbs would help inform future work to foster urban tree stewardship. Nevertheless, the findings of this study inform and support the ACT Government’s efforts

to foster urban tree stewardship behaviour in the community, which will in turn facilitate the success of Canberra's *Urban Forest Strategy*.

# Table of Contents

|                                                                                                           |            |
|-----------------------------------------------------------------------------------------------------------|------------|
| <b>Candidate's Declaration .....</b>                                                                      | <b>ii</b>  |
| <b>Acknowledgements .....</b>                                                                             | <b>iii</b> |
| <b>Abstract .....</b>                                                                                     | <b>iv</b>  |
| <b>Table of Contents.....</b>                                                                             | <b>vi</b>  |
| List of Figures .....                                                                                     | vii        |
| List of Tables .....                                                                                      | viii       |
| <b>Chapter 1: Introduction .....</b>                                                                      | <b>1</b>   |
| 1.1 Urban forests as a nature-based solution.....                                                         | 1          |
| 1.2 Urban forests in Canberra .....                                                                       | 1          |
| 1.3 Importance of stewardship in urban forests .....                                                      | 2          |
| 1.4 Research objectives and questions .....                                                               | 3          |
| 1.5 Thesis outline .....                                                                                  | 3          |
| <b>Chapter 2: Urban forests and stewardship .....</b>                                                     | <b>5</b>   |
| 2.1 Urban forests and their ecosystem services.....                                                       | 5          |
| 2.2 Defining community, environmental stewardship, and community activation.....                          | 8          |
| 2.3 Models of urban forest stewardship .....                                                              | 9          |
| 2.3.1 <i>Insights from international experiences of community stewardship in urban green spaces</i> ..... | 10         |
| 2.3.2 <i>Perceptions and attitudes of residents about urban trees</i> .....                               | 12         |
| 2.3.2.1 Studies internationally .....                                                                     | 12         |
| 2.3.2.2 Studies in Australia and Canberra.....                                                            | 14         |
| 2.3.3 <i>Governmental best practices to encourage stewardship by residents</i> .....                      | 15         |
| 2.4 Conclusions .....                                                                                     | 17         |
| <b>Chapter 3: Canberra as a case study .....</b>                                                          | <b>18</b>  |
| 3.1 Study site and context .....                                                                          | 18         |
| 3.2 The ACT Government's <i>Street Forestry Program</i> .....                                             | 19         |
| 3.3 Data collection and analysis methods .....                                                            | 21         |
| <b>Chapter 4: Findings of residents' perspectives and the <i>Street Forestry Program</i> .....</b>        | <b>23</b>  |
| 4.1 Survey results .....                                                                                  | 23         |
| 4.2 Participant observation.....                                                                          | 30         |
| 4.2.1 <i>Pop-up stalls</i> .....                                                                          | 30         |
| 4.2.2 <i>Webinar</i> .....                                                                                | 31         |
| 4.3 Interview results .....                                                                               | 31         |

|                              |                                                                                             |           |
|------------------------------|---------------------------------------------------------------------------------------------|-----------|
| 4.3.1                        | <i>What do residents value or not value about trees?</i>                                    | 31        |
| 4.3.2                        | <i>Sense of community and green behaviour amongst residents</i>                             | 34        |
| 4.3.3                        | <i>Role of government and community in caring for street trees</i>                          | 35        |
| 4.3.4                        | <i>Residents' experiences of the Street Forestry Program</i>                                | 37        |
| <b>Chapter 5: Discussion</b> |                                                                                             | <b>41</b> |
| 5.1                          | A plurality of values for trees                                                             | 41        |
| 5.2                          | Factors influencing stewardship behaviour                                                   | 43        |
| 5.3                          | Insights for upscaling the <i>Street Forestry Program</i> and other urban greening programs | 46        |
| 5.3.1                        | <i>Observations of the Street Forestry Program</i>                                          | 46        |
| 5.3.2                        | <i>Broader implications and recommendations</i>                                             | 47        |
| <b>Chapter 6: Conclusion</b> |                                                                                             | <b>52</b> |
| <b>References</b>            |                                                                                             | <b>54</b> |
| <b>Appendices</b>            |                                                                                             | <b>64</b> |
|                              | Appendix 1: Initial survey questions                                                        | 64        |
|                              | Appendix 2: Sample of vote card                                                             | 68        |
|                              | Appendix 3: Interview questions                                                             | 69        |

## List of Figures

|                                                                                                                                                                |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Figure 1. The ecological model of urban forest stewardship proposed by Moskell and Allred (2013a)                                                              | 10 |
| Figure 2. Actions that would be taken by the ACT Government to achieve outcomes within the <i>Urban Forest Strategy</i> (Reproduced from ACT Government, 2020) | 19 |
| Figure 3. Banner describing the activities included in the <i>Street Forestry Program</i> (Retrieved from ACT Government, 2021e)                               | 20 |
| Figure 4. Initial survey respondents by suburbs                                                                                                                | 23 |
| Figure 5. Survey respondents by age groups and engagement in stewardship behaviour for trees in nature strips                                                  | 24 |
| Figure 6. Residents' perception of the importance of various benefits of trees in Canberra across all 6 suburbs                                                | 25 |
| Figure 7. Residents' perception of the importance of various benefits of trees in Canberra across Florey and Mawson                                            | 26 |
| Figure 8. What is most valued about the nature strip: residents across all 6 suburbs (Note: 1-3 ranking, 1 highest)                                            | 27 |

|                                                                                                                                                                             |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|
| Figure 9. What is most valued about the nature strip: residents across Florey and Mawson (Note: 1-3 ranking, 1 highest).....                                                | 27 |
| Figure 10. Residents' preferences for street tree type across all 6 suburbs .....                                                                                           | 28 |
| Figure 11. Residents' preferences for street tree type across Florey and Mawson.....                                                                                        | 29 |
| Figure 12. Residents' perception on individual responsibility for street trees on their nature strips ....                                                                  | 29 |
| Figure 13. A conceptual model illustrating the factors influencing stewardship behaviour for trees on public land in Canberra, adapted from Moskell and Allred (2013a)..... | 45 |
| Figure 14. Sample vote card distributed for a given street .....                                                                                                            | 68 |

## ***List of Tables***

|                                                                                                            |    |
|------------------------------------------------------------------------------------------------------------|----|
| Table 1. Ecosystem services of urban forests .....                                                         | 6  |
| Table 2. Ecosystem disservices of urban forests.....                                                       | 7  |
| Table 3. Demographic information of interviewees (n = 10).....                                             | 31 |
| Table 4. Recommendations for community engagement methods based on the public participation spectrum ..... | 49 |

# Chapter 1: Introduction

## *1.1 Urban forests as a nature-based solution*

As the world has urbanised at a rapid rate in recent decades, the unprecedented growth of cities has served as a catalyst for a series of negative environmental impacts, many of which will be exacerbated by climate change (United Nations, 2019). The growing attention to ‘nature-based solutions to climate change and other pressing environmental problems’ in general (Cohen-Shacham *et al.*, 2016), has been mirrored in a corresponding focus on such solutions in cities (Frantzeskaki, 2019). In the urban context, these solutions can draw on the established concept of ‘green infrastructure’, defined as “an interconnected network of natural areas and other open spaces that conserves natural ecosystem values and functions, sustains clean air and water, and provides a wide array of benefits to people and wildlife” (Benedict and McMahon, 2012, pp. 1).

Urban forests, defined as “networks or systems comprising all woodlands, groups of trees, and individual trees located in urban and peri-urban areas, including forests, street trees, trees in parks and gardens, and trees in derelict corners” (Salbitano *et al.*, 2016, pp. 2), are commonly seen as the backbone of green infrastructure. The role of urban forests in the provision of ecosystem services is now well-established, with the widespread recognition of their extensive benefits ranging from environmental functions to socio-economic and health benefits (see Livesley *et al.*, 2016; section 2.1). These benefits emphasise the importance of urban forests, and of city-level policies and initiatives to strengthen the contributions of urban forests to the sustainability and liveability of cities, as well as to enhance their resilience in the face of climate change (Bulkeley and Betsill, 2013).

## *1.2 Urban forests in Canberra*

Canberra, the capital city of Australia situated within the Australian Capital Territory (ACT), is a planned ‘city in a forest’ (Banks and Brack, 2003). The urban forest that is integral to Canberra’s character is facing a range of challenges, associated with aging trees, changing forms of development, and increasing vulnerability to climate change (ACT Government, 2020). The *Urban Forest Strategy* reflects the enthusiasm of the government to realise the potential of urban trees in the contexts of a changing city and climate, and so support the sustainability and resilience of the city. The character of Canberra’s urban forests derives from a combination of planted street trees, planted and remnant trees in urban parks and community spaces, semi-natural woodlands in nature parks and conservation reserves, and mostly planted trees in private spaces like gardens or yards (Brack and Schirmer, 2020). The *Urban Forest Strategy* seeks to maximise the benefits urban forests bring in the context of an increasing scale and pace of urban densification, and of climate change, which has also been identified as a major challenge to the city (ACT Government, 2019a).

As a consequence of climate change, mitigating the Urban Heat Island (UHI) effect and its associated health risks have been identified as key priorities in the context of Canberra (ACT Government, 2019a). Trees in urban areas are recognised for their role in ameliorating urban heat and reducing surface temperatures through shade and evapotranspiration, providing an effective pathway to addressing these issues (Rosenzweig *et al.*, 2006). However, a recent study for the ACT Government (Meyers *et al.*, 2017) demonstrates an uneven distribution of vegetation cover in Canberra which translates to differing vulnerabilities to urban heat in different suburbs. Generally, newer suburbs have less established and a lower proportion of canopy cover than older suburbs, resulting in higher heat-related vulnerability. The design of many newer suburbs and of the urban infill taking place in some established suburbs also pose challenges to realising urban forest goals (Commissioner for Sustainability and the Environment, 2020). The *Urban Forest Strategy* sets a target to increase overall canopy cover to 30%, but also aims to realise a more equitable distribution of the urban forest canopy across to allow for more equal access to urban trees and the benefits they bring (ACT Government, 2020). Under Objective 2 of the *Urban Forest Strategy*, planting efforts will be concentrated in those areas of low canopy cover where residents are highly vulnerable to the impacts of heat, with a focus on street and park trees that can be established on public land.

### ***1.3 Importance of stewardship in urban forests***

While government policies provide the foundation for urban forestry in cities such as Canberra, the governance of public green spaces is embedded in complex socio-ecological systems, and the realisation of urban forests objectives will depend on the active participation of residents (Coffey *et al.*, 2020). Urban forests consist of trees on both public and private lands, and the high proportion of private trees in many cities reflect the role of residents in managing urban forests (Pearce *et al.*, 2013). Furthermore, large number of trees on public land are street trees abutting properties, and their survival will depend (at least to some extent) on the actions undertaken by residents (Loukaitou-Sideris *et al.*, 2009). However, trees are not always perceived positively, and conflicting values amongst stakeholders can hinder the successful implementation of urban forest goals (Carmichael and McDonough, 2018). A sustainable urban forest from which most benefits can be realised relies on community cooperation and engagement (Clark *et al.*, 1997). The stewardship of trees by individuals and groups of residents is crucial to realising the long-term benefits of urban forests (see section 2.3); in turn, citizens' willingness to act as stewards is related to a range of reasons such as perceptions and attitudes, which may influence their motivations and guide their behaviours (Klinger, 1977; Restall and Conrad, 2015). These are encompassed in a conceptual model proposed by Moskell and Allred (2013a), which informs my study. Knowledge of residents' perceptions of and attitudes to trees and related issues such as environmental stewardship may therefore help develop strategies to encourage urban forest stewardship within the community, and a range of benefits for urban forests, the community, and the responsible government.

## 1.4 Research objectives and questions

There is now a body of literature focusing on the diverse attitudes and perceptions urban residents have of trees and urban greening internationally, and on relevant themes of stewardship (see Chapter 2). However, the global state of knowledge on the role of urban residents as stewards to public trees focuses on community groups on parks and other public lands, with less attention at the individual level. There is also a paucity of Australian studies on environmental stewardship in urban forests and green spaces, with models of urban forest stewardship emerging primarily from the USA. As discussed in Chapter 2, Australian studies to date have not included Canberra (i.e. Kirkpatrick *et al.*, 2012; Saldarriaga *et al.*, 2020); whilst there is a variety of evidence about Canberra residents' attitudes to the urban forest, there are also gaps in relevant knowledge, particularly in relation to residents' willingness to play a stewardship role for urban trees. The ACT Government recently trialled a *Street Forestry Program* (see section 3.2) to address some of these issues, providing an opportunity to investigate residents' experiences and values in the context of the Program. This study therefore aims to develop a social account of the potential for residents to contribute to urban tree stewardship in Canberra, and inform government strategies to this end. My research questions are as follows:

- 1) What are the best practices to encouraging stewardship by residents of their neighbourhood trees?
- 2) What do Canberra residents think about trees on public land in proximity to where they live?
- 3) What are the factors influencing tree stewardship behaviour in Canberra residents?
- 4) What can we learn from the findings of this study for the *Street Forestry Program* and other urban greening programs?

Answering these questions will contribute to enriching our knowledge of residents' attitudes and behaviours in relation to stewardship of urban forest trees, and support the implementation of Canberra's *Urban Forest Strategy*, and thus of the longer-term sustainability and liveability of Canberra. At the broader level, this study will narrow the knowledge gaps present on individual stewardship of urban trees within residents beyond that of community groups. I will address Question 1 from literature, and Questions 2, 3 and 4 from my case study research.

## 1.5 Thesis outline

This thesis consists of five chapters in addition to this Introduction. Chapter 2 reviews the literature related to the nexus between urban forests, the community and government, and of urban tree stewardship in both global and local contexts. Chapter 3 outlines the research methods used in this study and describes Canberra as a case study. Chapter 4 presents the results of a survey, observations and interviews of residents' perspectives of trees and stewardship behaviour, expressed through and of the *Street Forestry Program*. Chapter 5 discusses the key findings from the results, and makes

recommendations for future initiatives encouraging tree stewardship. Chapter 6 concludes the thesis by summarising the findings from this study in relation to the research questions and objectives, and reflecting on the limitations of this study and future research.

## Chapter 2: Urban forests and stewardship

With the unprecedented growth of cities and the increasingly pressing issue of climate change, the concept of ‘sustainable cities’ has received significant attention globally (Bulkeley and Betsill, 2005). Despite cities being at the core of many environmental challenges, they also have the greatest potential to provide solutions given their concentration of knowledge, resources, and capacities (Bai *et al.*, 2017); this reflects the important role of cities in achieving broader sustainability goals. Concurrently, the implementation of nature-based solutions, such as those offered by green infrastructure and urban forestry, are increasingly recognised as pathways for cities to address sustainability issues while delivering a plethora of benefits (Kabisch *et al.*, 2016). Many city and municipal governments across the world have subsequently incorporated urban forests into their policies to take advantage of these benefits (Nowak *et al.*, 2005; see section 2.1).

In parallel, there has been an increasing emphasis on the role of community involvement in urban forest issues, ranging from initial tree plantings to their continual maintenance and management (Dwyer *et al.*, 2000; Young, 2011). The concept of stewardship by the community, which may be facilitated and encouraged by the government, is understood to be pivotal to realising the long-term benefits of urban forests (Roman *et al.*, 2015; Rosol, 2010). In this context, this chapter will review the factors influencing urban forest stewardship, framed by a model developed by Moskell and Allred (2013a); and review best practices for encouraging stewardship of neighbourhood trees by residents, both internationally and in Australia.

### 2.1 *Urban forests and their ecosystem services*

The broad concept of ‘nature-based solutions to climate change and other pressing environmental problems’ (Cohem-Shacham *et al.*, 2016) has emerged in the context of the Anthropocene and the challenges it presents to people and the planet (e.g. Malhi, 2017). As defined by the IUCN, nature-based solutions (NbS) refer to “actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits” (Cohen-Shacham *et al.*, 2016, pp. 5). The NbS concept has been adapted specifically for cities (Raymond *et al.*, 2017), encompassing several related concepts, including green infrastructure and urban forestry (Escobedo *et al.*, 2019). Such solutions are of increasing importance because of increasing urbanisation globally, and the implications for both urban residents and the environment (United Nations, 2019).

Urban forests serve as a means of implementing NbS in cities, to address some of the issues arising from urbanisation through the provision of ecosystem services and co-benefits (European Commission, 2015). The range of ecosystem services provided by urban forests include environmental, socio-economic, and health benefits, and are summarised in Table 1. Ecosystem disservices are also present

(see Table 2); recognising them does not undermine the role of urban forests and their ecosystem services. Rather, having a better understanding of ecosystem disservices can facilitate management strategies to address trade-offs and minimise negative impacts (Roman *et al.*, 2021). In general, the goals for urban forests have transitioned from an earlier focus on smaller scale anthropogenic benefits to a more holistic ecosystem-based perspective, as a means of delivering NbS to achieve broader agendas and provide a wider range of benefits (Raymond *et al.*, 2017). This has been reflected in the urban forest strategies and plans developed or revisited by city governments across the world, but particularly in the global North. Examples in North America and Europe include: Seattle's *Urban Forest Management Plan* (City of Seattle, 2020), Chicago's *Urban Forest Agenda* (City of Chicago, 2009), Toronto's *Strategic Forest Management Plan* (City of Toronto, 2013), and London's *Urban Forest Plan* (London Urban Forest Partnership, 2020). In Asia, examples include Singapore (Tan *et al.*, 2013) and many Chinese cities (Pei *et al.*, 2019). In Australia and New Zealand, the *Urban Forest Strategy* in each of Melbourne and in Auckland are prominent examples (Auckland Council, 2019; City of Melbourne, 2014).

**Table 1. Ecosystem services of urban forests**

| <b>Ecosystem services of urban forests</b> | <b>Examples (see Brack and Schirmer (2020) for a comprehensive overview)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Environmental benefits                     | <ul style="list-style-type: none"> <li>• Carbon sequestration               <ul style="list-style-type: none"> <li>- For example: annual carbon storage capacities of urban vegetation are estimated at 643 million tonnes across the USA (Nowak <i>et al.</i>, 2013a), 1.9 million tonnes in major Chinese cities (Chen, 2015)</li> </ul> </li> <li>• Improve air quality by removing air pollutants               <ul style="list-style-type: none"> <li>- For example: an estimated 711,000 metric tons of air pollution removal valued at \$3.8 billion is associated with urban trees in the USA (Nowak <i>et al.</i>, 2006)</li> </ul> </li> <li>• Reduce Urban Heat Island (UHI) effect (Norton <i>et al.</i>, 2015)               <ul style="list-style-type: none"> <li>- For example: a maximum of 4°C difference in air temperature was observed between a well-planted urban area and the urban centre in Singapore (Wong and Chen, 2005)</li> </ul> </li> <li>• Increase biodiversity (Alvey, 2006)               <ul style="list-style-type: none"> <li>- Green infrastructure in cities can support 20% and 5% of bird and plant species respectively, and provide novel habitats to support many threatened species (Aronson <i>et al.</i>, 2014; Ikin <i>et al.</i>, 2015)</li> <li>- In the Australian context, fauna such as arboreal marsupials are dependent on remnant trees and hollow-bearing trees in urban environments as refugia (Treby and Castley, 2015)</li> </ul> </li> </ul> |
| Socio-economic benefits                    | <ul style="list-style-type: none"> <li>• Climate regulation and resultant energy savings through reduced energy use (Ko <i>et al.</i>, 2015; Rosenzweig <i>et al.</i>, 2006)               <ul style="list-style-type: none"> <li>- For example: building energy savings from public forests in Canberra was valued at \$9 million in 2018 (Tapsuwan <i>et al.</i>, 2019)</li> </ul> </li> <li>• Enhance property and amenity value (Pandit <i>et al.</i>, 2013; Plant <i>et al.</i>, 2017)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               | <ul style="list-style-type: none"> <li>- For example: the removal of a single street or park tree in Canberra reduces the amenity value by \$10,600 on average (Brack, 2005)</li> <li>• Contribute to a sense of place and social belonging (URBES Project, 2015)</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Health and wellbeing benefits | <ul style="list-style-type: none"> <li>• Reduce the prevalence of respiratory illnesses and other diseases (Kampa and Castanas, 2008; Nowak <i>et al.</i>, 2006) <ul style="list-style-type: none"> <li>- For example: the removal of PM2.5 by urban trees has led to a reduction in human mortality in the US (Nowak <i>et al.</i>, 2013b)</li> </ul> </li> <li>• Improve mental health and personal wellbeing in times of crises (Maas <i>et al.</i>, 2009; Wood <i>et al.</i>, 2017) <ul style="list-style-type: none"> <li>- For example: a UK study has found lower mental distress and higher wellbeing for residents living in urban areas with more green spaces (White <i>et al.</i>, 2013)</li> </ul> </li> <li>• Urban green spaces can provide much needed places of solace and respite during crises like the COVID-19 pandemic (Berdejo-Espinola <i>et al.</i>, 2021; Ugolini <i>et al.</i>, 2020)</li> </ul> |

While less established in the Global South and economies in transition, urban forestry has also developed rapidly in many countries recently (Pei *et al.*, 2019). Generally, these strategies acknowledge the role of urban forests as a NbS in creating a more liveable and sustainable city, to better cope with the challenges of greater urbanisation and the increasing threat of climate change. Across the world, urban forest strategies serve as a pathway for governments to achieve their visions for greener cities with enhanced qualities of life and built environment; e.g. the government of Singapore strives to go beyond green towards embracing the concept of biophilic urbanism (Newman, 2014).

**Table 2. Ecosystem disservices of urban forests**

| <b>Ecosystem disservices of urban forests</b> | <b>Examples (see Roman <i>et al.</i> (2021) for a comprehensive overview)</b>                                                                                                                                                                                                                                                                                                                                                    |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Health issues                                 | <ul style="list-style-type: none"> <li>• Release of pollen can cause allergic responses and exacerbate existing health issues such as asthma (Cariñanos <i>et al.</i>, 2016; Eisenman <i>et al.</i>, 2019)</li> <li>• Some trees emit Biogenic Volatile Organic Compounds (BVOCs) which are precursors to ozone formation (Calfapietra <i>et al.</i>, 2013)</li> <li>• Facilitate the spread of vector-borne diseases</li> </ul> |
| Safety and wellbeing issues                   | <ul style="list-style-type: none"> <li>• May attract wild animals which can potentially endanger the safety of human beings (Lyytimäki and Sipilä, 2009)</li> <li>• Cause physical damage to people from tree failures during natural disasters (Schmidlin, 2009)</li> <li>• Green spaces and trees evoke fear, anxiety, or inconvenience for some individuals (Koskela and Pain, 2000; Lyytimäki and Sipilä, 2009)</li> </ul>   |

## ***2.2 Defining community, environmental stewardship, and community activation***

The terms ‘community’, ‘environmental stewardship’, and ‘community activation’ are important concepts in the context of urban forests. This section explores how they are defined.

The concept of ‘community’ was initially defined in terms such as those of Gusfield (1975), viz. that the usage of ‘community’ can be distinguished by either its territorial notions with reference to a particular geographical region (e.g. neighbourhood, city), or by relational aspects concerned with the character of human relationships irrespective of locality. Subsequently, use of the term has evolved, and it is now understood as more of a sociocultural construct than one merely focused on spatial boundaries and homogeneity (Liepins, 2000). While there is no single, standardised definition for ‘community’, the definition proposed by MacQueen *et al.* (2001) – a group of people of differing characteristics and backgrounds tied together by social ties and geographical settings – will be used in this study, as it is well suited to the local settings that are the focus of this work.

As Meppem (2000) notes, the term ‘community’ should not be treated as a panacea to social and environmental issues, due to the complexity of relationships that impact these; the pursuit of sustainability across various scales is a wider collective responsibility, not just of the community, but also that of government and other stakeholders (Pelenc *et al.*, 2013). Thus, while the community and its engagement with urban forests are an important part of responses addressing urban sustainability issues, these responses exist within the contexts of a wider suite of actions by and partnerships with government and other stakeholders.

Drawing from Indigenous belief systems (Appiah-Opoku, 2005), the concept of environmental stewardship has only been articulated and applied widely in Western societies after Leopold’s (1949) *A Sand County Almanac*; he referred to a land ethic with respect to interactions with the environment, stemming from caring for land by acting as a steward of it. Subsequently, ‘environmental stewardship’ has been defined by Bennett *et al.* (2018, pp. 599) as “the actions taken by individuals, groups or networks of actors, with various motivations and levels of capacity, to protect, care for or responsibly use the environment in pursuit of environment and/or social outcomes in diverse social-ecological contexts”. This concept has been widely referenced in many contexts, including forests (e.g. Messier *et al.*, 2015) and urban environments (e.g. Krasny and Tidball, 2012). In the context of this paper, environmental stewardship is understood to focus on actions taken by the community, collectively, and members of the community individually, to maintain and care for urban forests in pursuit of realising short- and long-term benefits for the sustainability of cities. Environmental stewardship is a form of ‘pro-environmental behaviour’ – the behaviour that is undertaken with the intention to change (benefit) the environment (Stern, 2000, pp. 408).

‘Community activation’ is a term that has its origins in the public health sector (VicHealth, 2018), and has not been well-defined and developed in the wider contexts. In contrast, ‘community engagement’ is a comparable term that is more commonly used; it is defined by the UN Food and Agriculture Organisation as the collaborative process of working with the community, and “as a prerequisite for empowering people in decision-making processes... [which] helps increase the capacity of communities to share responsibility and act personally on common and negotiated interests” (Salbitano *et al.*, 2016, pp. 107). The City of Hobart (2018, pp. 9) defines ‘activation’ as “an activity or an event that engages people with their environment and community through positive and creative cultural and social experiences”. Community activation can therefore be interpreted as the process of engaging the community to initiate and participate in efforts to achieve a specific goal. Correspondingly, here, community activation is understood as the process of fostering environmental stewardship by community members, such that an activated community takes ownership of its environment and voluntarily contributes to its care. Thus, in this study, I will use these terms to focus on governments’ efforts to activate communities to engage in the stewardship of urban trees, and so jointly to care for and manage urban forests more inclusively, effectively, and sustainably.

## 2.3 *Models of urban forest stewardship*

The emergence of stewardship as an important concept for safeguarding the environment has led to the development of models and frameworks to represent environmental behaviour. These include the value-belief-norm theory of Stern *et al.* (1999), the ecological citizenship model of Dobson (2003), and a multitude of others outlined within Kollmuss and Agyeman (2002). However, these models tend to be generic; in the context of this paper, the ‘ecological model of urban forest stewardship’ developed by Moskeell and Allred (2013a) is most relevant.

According to Moskeell and Allred (2013a), the behaviour of stewardship is influenced primarily by the natural environment, macro-policy, behaviour settings, and individual level attributes, and can be depicted by the model in Figure 1. These may be summarised in the terms below:

- The Natural Environment refers to the inherent connection between people and nature;
- Macro-Policy factors refer to the policies that govern the rules for action within behaviour settings, which can either discourage or facilitate stewardship behaviours (Moskeell and Allred, 2013a). Governments can facilitate a macro-policy environment that enables the development of stewardship behaviours for optimising urban forest outcomes, and this will require a suite of good practices (see section 2.3.3);
- Behaviour Settings are the social and physical situations under which human behaviour operate, and contain social and physical attributes that may influence behaviour (Sallis and Owen, 2002). Fostering behaviour settings that provide opportunities for stewardship action may then encourage

urban forest stewardship, for which community groups are a particularly important platform (see section 2.3.1);

- Individual-level attributes include perceptions, attitudes, and socio-demographic factors, which may influence motivation and behaviours for action. Section 2.3.2 summarises understandings of perceptions and attitudes, internationally and in Australia.

The following sections will focus on these factors in the wider context of the literature.

*(Figure omitted for copyright reasons)*

**Figure 1. The ecological model of urban forest stewardship proposed by Moskell and Allred (2013a)**

### **2.3.1 Insights from international experiences of community stewardship in urban green spaces**

Community stewardship of urban trees can play a significant role in the development and maintenance of urban forests, and may be understood in part in terms of the inherent relationship between human beings and nature. This is most substantially described by Kellert and Wilson (1993)'s biophilia hypothesis, which reflects humans' connection to nature shaped and grounded by evolutionary experiences. Human beings depend on the natural environment, physically and emotionally, and the fate of the environment is determined by our actions (Davis *et al.*, 2009). This mutual dependency is expressed in the urban context by people's interactions with that environment, including urban forests. Insights from experiences internationally will help better understand the role of community groups as a behaviour setting to facilitate urban forest stewardship.

The international literature is dominated by reports of activities in cities of the USA, where there has been a series of well-established community initiatives focused on tree planting and environmental stewardship related to urban forests. This follows recognition of the importance of community involvement in advancing the management of urban forests, in conjunction with political support and funding (Dwyer *et al.*, 2000; Elmendorf *et al.*, 2003). The role of community in long-term maintenance and care for urban forests is often even greater when governments lack sufficient human and financial resources to care for trees over extended periods of time (Young, 2011). Maximising the desired goals for management of urban trees will depend on the ability of trees to survive and reach maturity, to which community members have the capacity to contribute (Roman, 2014). Many studies have outlined the benefits of these community-based programs, including higher rates of tree survival and establishment success in cities when planting and maintenance have been stewarded by the community (Boyce, 2010; Koeser *et al.*, 2014; Roman *et al.*, 2015; Vogt *et al.*, 2015). The involvement of the community is necessary for the success of urban tree survival, which also serves to cultivate an attitude of ownership towards urban forests (Roman *et al.*, 2015).

As examples, the success of the community planting initiatives organised by non-profit organisations in Palo Alto and Philadelphia, USA, could be attributed to the use of volunteers to support stewardship activities of planting and maintenance, program management, and site characteristics (Roman *et al.*, 2015). Experienced volunteers and staff also took part in supervising other volunteers to enhance efficacy and efficiency. This process encouraged community activation and created opportunities for stewardship networks to be formed. Similarly, the results from a study of the stewardship program organised by Friends of Greenwich Street based in southern Manhattan, New York City, suggest that their stewardship efforts have substantially reduced urban tree mortality when supplemented with governmental support (Boyce, 2010); tree stewards were recruited from the local community through different routes such as neighbourhood networks, and undertook training to care for and maintain street trees. Carrying out these actions will require both the assistance of the community and a supportive institutional structure.

While not specifically focused on urban trees, there has also been significant attention on community involvement in stewarding urban green spaces such as parks and gardens. The increasing importance of community members as actors in urban green space governance has been recognised (Rosol, 2010), and governmental bodies have reflected their desire to accommodate this by facilitating the development of more bottom-up initiatives (van Dam *et al.*, 2015). Outside of the USA in European cities, there has been a rich history of green spaces being actively managed by community members. The review by Buijs *et al.* (2016) has outlined four cases in Amsterdam, Berlin, Milan, and Edinburgh, where the involvement of community groups in managing urban green spaces, alongside other actors such as the city governments, has brought enhanced biodiversity and socio-economic values. In the case of Berlin, Mattijssen *et al.* (2017) further reiterate the central role of the community in managing these spaces for community benefits.

In addition to their role in facilitating the success of urban green spaces, participation in stewardship programs can also increase neighbourhood ties and foster community spirit (Watkins *et al.*, 2018). Community projects have emerged after crises to provide individual and community resilience through means such as tree-planting and community gardens, while recreating a sense of community (Tidball *et al.*, 2010). These practices of stewarding nature in cities therefore allow for the integration of environmental, community, and individual outcomes (Krasny and Tidball, 2012). In fact, many urban forest strategies and policies around the world have sought to involve their communities to maximise these outcomes and have since placed considerable emphasis on community engagement and stewardship. Chicago's *Urban Forest Agenda* is one such example that has deeply established the importance of community, as outlined by its statement that "the work required to sustain a healthy urban forest cannot be done by the City and its sister agencies alone... inherent in the goal of growing our forest is the need for growing the number of stewards" (City of Chicago, 2009, pp. 16).

In Australia, there is a history of community stewardship in rural landscapes through the program that came to be known as Landcare; the nationwide Landcare program is an example of the government supporting the involvement of community volunteers to care for the environment (Landcare Australia, n.d.). The idea of Landcare has expanded from its rural base to include a focus on public greenspace in urban areas through programs such as Parkcare (ACT Government, 2021c). Most Australian cities support programs through which community groups can take stewardship roles for particular places, often in conjunction with city agencies and national organisations such as Landcare and Greening Australia. For example, Melbourne's *Urban Forest Strategy* prioritises the need to engage with the community and has proposed a list of actions to encourage environmental stewardship within the communities (City of Melbourne, 2014).

In summary, governance and management of urban green spaces is a multi-level and collaborative process with a range of actors including the community; experiences in many urban contexts around the world emphasised the significance of community involvement in stewardship programs (see also Ferreira *et al.*, 2020).

### **2.3.2 Perceptions and attitudes of residents about urban trees**

In addition to participation in community programs, actions taken independently by individuals to care for street trees proximate to their homes are also of high significance (de Guzman *et al.*, 2018). Indeed, the benefits of involving the community in managing urban forests can only be achieved if individuals are willing to contribute their time and effort in the first place. Jennings *et al.* (2016) demonstrated that attitudes towards trees can significantly influence the extent to which residents would support future tree-planting and tree care efforts. While trees have long been represented in the normative discourse as being loved by everyone (Braverman, 2008), many studies have revealed that appreciation of trees and nature varies in a community. Despite the suite of benefits and ecosystem services identified with trees and public green spaces, individuals' attitudes may be shaped by negative experiences or perceptions, for example in relation to ecosystem disservices (section 2.1). Understanding the range of perceptions and attitudes that exist with relation to trees can therefore aid in the development of targeted strategies to better support the management of urban forests (Kirkpatrick *et al.*, 2012; Monteiro *et al.*, 2013).

#### **2.3.2.1 Studies internationally**

Generally, studies of residents' perceptions and attitudes to urban trees have consistently found that most residents view and value trees positively (see review by Mullaney *et al.*, 2015; Fernandes *et al.*, 2019; Gwedla and Shackleton, 2019), and that their benefits largely outweigh their detriments (Schroeder *et al.*, 2006; Suchocka *et al.*, 2019). Nonetheless, critical views of urban trees still persist amongst these tree-loving residents as a result of the problems and inconveniences associated with trees.

These include fear of property damage from big trees, fallen debris and leaf litter, safety concerns, and trees as a source of allergenic pollen and insects (Fernandes *et al.*, 2019; Schroeder *et al.*, 2006; Suchocka *et al.*, 2019).

The positive perceptions and attitudes that residents have of urban trees reflect their value for a range of reasons. Residents tend to prioritise the aesthetic and practical attributes of trees, such as beautification and shade provision, evident in Western cities and in China (Lohr *et al.*, 2004; Jim and Chen, 2006). Social benefits, such as of improving the neighbourhood and quality of urban life through the planting of trees, are also valued upon by residents (Gwedla and Shackleton, 2019; Olive *et al.*, 2013). However, the extent in which urban trees are valued for and perceived positively may vary depending on residents' preferences of trees. Camacho-Cervantes *et al.* (2014) conducted a survey in the city of Morelia, Mexico, and concluded that respondents prefer a mixture of native and exotic tree species over the dominance of exotic species. Trees that dropped leaves and debris regularly were unpopular, as these represent inconveniences which contribute to negative views of trees, as noted earlier. In the USA, larger street trees are preferred over small trees for their aesthetic values (Heimlich *et al.*, 2008; Kalmbach and Kielbaso, 1979).

Additionally, socio-demographic factors can also influence residents' perceptions and attitudes to urban trees, as several studies report. Different age groups may perceive urban trees differently; for example, Fernandes *et al.* (2019) established that older residents in Porto, Portugal, tend to view trees as dangerous, due to their own increasing vulnerability. Conversely, Ode Sang *et al.* (2016) concluded that older residents in Sweden associate urban green spaces with more positive values of aesthetics and well-being than younger people. From a gender perspective, women generally value trees for their aesthetic and well-being values more than do men, but also associate them with a lower perception of safety (Sonti *et al.*, 2020). Ethnocultural background is another important factor shaping preferences and perspectives of urban forests (see Fraser and Kenney, 2000; Jay and Schraml, 2009). Socio-demographic factors, ethnic and cultural origins, personal experiences, and environmental value orientations will have to be considered when exploring perceptions and attitudes in green spaces (Swanwick, 2009). These examples show the importance of taking into account culturally- and locally-specific contexts, and the factors that influence them, in relation to perceptions and attitudes of urban trees.

A small number of studies have investigated residents' views of the assignment of responsibility of caring for urban trees between city governments and residents. Most respondents in a New York City study believed that the government should take on full responsibility for tree stewardship (Moskell and Allred, 2013b); similarly, residents surveyed in Alabama have strong beliefs about government responsibility for urban forest management (Zhang *et al.*, 2007). Other studies have investigated how residents responded to decisions made by governments about urban trees in proximity to their property. For example, in Detroit, USA, although residents wished to have trees planted in their neighbourhoods,

the lack of opportunity for their preferences about the choice of tree species to be incorporated in decision making resulted in requests to not have trees planted (Carmichael and McDonough, 2018).

### 2.3.2.2 Studies in Australia and Canberra

While there have been fewer studies conducted in Australia about the perceptions and attitudes of residents to urban trees and forests, Kirkpatrick *et al.*'s (2012) study in six eastern Australian cities provides a general sense of Australian urban residents' motivations for tree planting and removal. They found residents' attitudes to trees could be predicted by their income, gender, and education, but not by their age, ownership status or negative experiences with trees. However, ownership status can affect tree planting or removal behaviours; renters are less likely to plant trees compared to homeowners, and changes in ownership often lead to tree removal due to differing preferences (Kirkpatrick *et al.*, 2013). Generally, the results reported by Kirkpatrick *et al.* (2012) show that the primary reason for tree planting in Australia is the aesthetic quality of trees, while the main motivation for removing trees is their old age and potential to cause danger. Despite the presence of a small group of arboriphobes (tree-haters), Kirkpatrick *et al.* (2013) reported a general absence of tree-hating in Australia, and attributed negative attitudes of trees to residents' perceptions of the appropriate choice of species and location.

The available evidence suggests that Australian residents' preferences for trees differ from those in the USA. While larger trees have been preferred in the USA (section 2.3.2.1), medium-sized trees were favoured upon over smaller and larger trees in a study in Melbourne (Williams, 2002). In addition to aesthetic value, shade provision is another major reason for tree plantings in the USA (Lohr *et al.*, 2004), but has been less mentioned in Australia (Head and Muir, 2005; Kirkpatrick *et al.*, 2012). There is therefore a need to explore perceptions and attitudes of residents to trees individually in different country and city contexts, as the generalisability of results has been shown to be limited (Schroeder *et al.*, 2006).

In Canberra, there are few academic studies of residents' perceptions and attitudes to urban trees; exceptions are the study by Gilbert and Brack (2007), which observed a temporary rise in tree removal requests after the 2003 Canberra bushfires due to safety concerns; Yao's (2020) investigation of perceptions of green infrastructure after shock events; and the recent study by Pecenko and Brack (2021) which found that totem trees are generally favoured for conservation purposes but raise safety concerns. Canberra was not included in six-city study of attitudes to trees by Kirkpatrick *et al.* (2012). Nonetheless, reports from the ACT Government and local community groups provide a sense of Canberrans' perceptions and attitudes to urban trees. According to the Inquiry into Nature in Our City report (SCETCS, 2020), community submissions alluded to an appreciation of the benefits of urban trees for ameliorating urban heat and improving amenity of suburbs. This is supported by findings from the community consultation report of the ACT Planning Strategy (ACT Government, 2018), in which community consultations favoured the expansion of urban forests to cope with climate change. A

number of community groups have articulated their views: for example, the Friends of Black Mountain have stressed the importance of maintaining urban forests for biodiversity values, and expressed a preference for native trees and vegetation (SCETCS, 2020). A survey by Inner South Canberra Community Council (2020) revealed a generally positive view of urban trees by residents. When dissatisfaction about urban trees has been reported, it relates mostly to safety concerns or because of a perception of the lack of maintenance by government, as seen in the community consultation process for Haig Park (ACT Government, 2017).

Regardless, these findings are limited in their investigations, and there is a lack of research investigating broader perceptions and attitudes to tree-related issues such as stewardship and responsibility. A study exploring residents' perceptions and attitudes to trees and stewardship will be helpful in understanding the motivations and barriers relevant to community activation to care for Canberra's street trees.

### **2.3.3 Governmental best practices to encourage stewardship by residents**

As discussed on preceding sections, effective urban stewardship programs generally depend on a productive partnership between government and the community, with the government playing an important role in activating and supporting the community to engage in stewardship actions for achieving urban forest outcomes. The success of many community stewardship efforts mentioned in section 2.3.1 were attributed to the presence of a supportive government with robust institutional frameworks in place to facilitate stewardship. This section reviews our understanding of good practices for supporting stewardship, noting that these may be part of a wider discussion about more inclusive modes of governance.

Reasons for a lack of 'ownership' over public trees amongst residents often relate to a lack of knowledge about the entities responsible for the management of urban forests (Rae *et al.*, 2010). In Australia, a diverse set of actors including the government, private sectors, and the civil society, can all influence urban greening outcomes through a shared approach (Coffey *et al.*, 2020). Governmental efforts to raise awareness about this to the public and address potential misunderstandings may provide a pathway for greater acceptance of their ownership, where they will more likely be willing to steward the environment. Generally, knowledge-building has been identified as an important issue to address to increase community engagement; Butt *et al.* (2021) suggest that government should work towards building residents' knowledge on the characteristics of their urban forest and relevant regulations, aid in their recognition of the roles residents can hold in the community, as well as help create connections through local activities.

The creation of opportunities for individuals to voice their opinions on tree planting initiatives, including tree preferences, and other urban tree management can also promote an inclusive environment which may facilitate greater recognition of their role in tree stewardship (Van Herzele *et al.*, 2005). An

example of that is seen in Melbourne, Australia, where a visualisation map of public trees was made available and each tree on the map was also assigned an email (City of Melbourne, 2020). This provides a platform for community members to report on any potential issues and form a collaborative approach for managing the trees; the positive responses received reflected the willingness of the community to engage in such methods (Phillips and Atchison, 2020).

Community groups and initiatives can also be effective routes for activating others and encouraging wider engagement in the community, taking on some of the models mentioned in section 2.3.1. Governments play a fundamental role in supporting the operations and long-term success of community efforts (Lyons and Cavaye, 2016), and can create behaviour settings for stewardship by assisting with community initiatives and providing access to resources (i.e. social networks and knowledge) that would otherwise not be easily available to the community (Franklin and Marsden, 2015). Without these, the success of community efforts may be limited by their small scale and disconnectedness from related activities, resulting in participation falling off when members cannot witness any significant results coming out of their efforts (Abram and Cowell, 2004). As a result, governments should work towards facilitating what Lawrence *et al.* (2013) refer to as ‘governance with government’, to sustain community engagement through collaborative efforts between key stakeholders.

As individuals and community groups may be reluctant to engage with the bureaucracy associated with governments, there is a need for the government to take on a more integrative and mediating role (van Dam *et al.*, 2014), to make participation ‘easy’. This will require the government to improve inter-departmental coordination (Ordóñez *et al.*, 2020), and enhance the networking capacity of public managers to connect with the public (Franklin and Marsden, 2015). Communities should be granted a platform to discuss their options for reflecting their ambitions in policies and legal frameworks, and in doing so, promote greater trust essential for the government to maintain a good working relationship with these groups (van Dam *et al.*, 2014). Urban green spaces that are more responsive to the wishes of residents can then promote greater support for policies and more effective upscaling of community initiatives (Aalbers and Sehested, 2018).

The role of non-governmental actors, particularly that of non-governmental organisations (NGOs), is also important in supporting the government’s efforts to manage urban forests and engage with communities. With a growing shift towards a multi-level, collaborative mode of governance, NGOs can act as ‘scale-crossing brokers’ – defined as a social network position that connects disconnected social actor groups (Ernstson *et al.*, 2010) – to facilitate collaboration between the community and government; and as information brokers to mobilise greater citizen participation through knowledge-building (Buijs *et al.*, 2019). Given their degree of neutrality, they can be credible intermediaries for the governments to reach out to community groups reluctant about institutionalisation (Buijs *et al.*, 2019; Franklin and Marsden, 2015). NGOs can also serve as a platform to raise awareness and educate

residents on tree stewardship, and provide training resources that otherwise may not be possible given governmental constraints. Governments should therefore utilise partnerships with NGOs to activate the community and enhance environmental stewardship, while ensuring that regulatory frameworks are in place as a leverage (Foo, 2018). However, these partnerships cannot be seen as a substitute for public sector leadership; governments still have to acknowledge and address salient issues, including securing access to adequate financing and sustaining political support (Young, 2011).

While there is considerable complexity in this arena (see Buijs *et al.*, 2019), and other non-governmental stakeholders such as businesses may also have important roles in some contexts, the scope of this study and its focus on suburban Canberra limits its consideration to the community, individual and governmental levels. However, those discussed here is consistent with the most relevant factors in Canberra.

## **2.4 Conclusions**

The existing knowledge of urban forests and stewardship suggests that urban forests provide a range of ecosystem services; while ecosystem disservices are also present, the benefits generally far outweigh the negatives. However, the realisation of these benefits will depend on ongoing stewardship efforts by the community; understanding and nurturing these can be informed by the model developed by Moskell and Allred (2013a). Community groups provide opportunities for fostering stewardship, but stewardship behaviour still largely depends on individual residents' perceptions and attitudes. Despite the wealth of literature reporting the positive feelings of urban residents towards urban trees, both internationally and in Australia, more research needs to be conducted in the context of Canberra. Governments also play an important role in activating residents to engage in stewardship behaviour; there are best practices examples of knowledge-building, inclusivity, and strengthening of internal operations. This chapter has therefore set the basis for this study to investigate stewardship of urban trees in Canberra.

## Chapter 3: Canberra as a case study

### 3.1 Study site and context

Canberra is the capital city of Australia, situated within the Australian Capital Territory (ACT) and on Ngunnawal Country, whose people are the traditional custodians of the land (National Capital Authority, 2021). Following its designation as the capital city, the design of architects Walter Burley Griffin and Marion Mahoney Griffin and efforts of horticulturist Charles Weston laid the foundations for Canberra's identity as a 'bush capital' (ACT Government, 2016); subsequent works by botanist Lindsay Pryor and his successors reflect this legacy and further contribute to the greening of Canberra's landscapes (Banks and Brack, 2003). The rich identity of the urban forest in Canberra shaped by its historical context continues to manifest in the development of urban forest-related legislation, strategies, policies, and practices. As in many other cities, street trees planted on urban and suburban nature strips are an important element of the urban forest and character of Canberra (Brack and Schirmer, 2020).

Within the ACT Government, the Environment, Planning and Sustainable Development Directorate (EPSDD) is responsible for planning; Transport Canberra and City Services (TCCS) oversees the management and maintenance of the urban trees (ACT Government, 2021b, 2021d). The urban forest within Territory Land in Canberra is currently governed under a series of legislative frameworks, primarily the *Tree Protection Act 2005* (currently under review), *Trespass on Territory Land Act 1932*, *Public Unleased Land Act 2013*, *Heritage Act 2004*, and a series of other complementary acts including the *Planning and Development Act 2007* and *Nature Conservation Act 2014* (ACT Government, 2020, 2021a). In particular, the *Public Unleased Land Act 2013* is the main governing instrument for nature strips. Street trees are part of the nature strip, which means that they are on public land and are not part of residential property leases, where 'private' trees grow. Nonetheless, the ACT Government promotes a shared maintenance approach between the government and community members; this is seen as best practice for maximising the benefits of street trees (ACT Government, 2019c).

Following community consultation, an *Urban Forest Strategy* was released in 2020 as part of the *Living Infrastructure Plan* and the overarching *ACT Climate Change Strategy 2019 – 2025* (ACT Government, 2019a, 2019b, 2020). The *Living Infrastructure Plan* seeks to increase the average tree canopy cover in Canberra to 30%, with a priority on increasing canopy cover in areas of lower cover and higher vulnerability. The Strategy has 6 objectives:

- 1) Protect the urban forest,
- 2) Grow a resilient forest,
- 3) Balance and diversify the urban forest,
- 4) Take an ecological approach and support biodiversity
- 5) Develop infrastructure to support the urban forest and liveability, and

## 6) Partner with the community.

A list of actions in support of achieving these objectives has been outlined in the *Urban Forest Strategy* (ACT Government, 2020), and the ACT Government is now implementing these actions. Figure 2 shows the actions relevant to Objective 6 – Partner with the community, which is the focus of this study.

| No    | Actions                                                                                                                             | Timeframe |
|-------|-------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 6.1.1 | Expand and support community / volunteer programs to encompass a wider range of contributions to grow and maintain the urban forest | Ongoing   |
| 6.1.2 | Develop and make available to volunteers a citizen science data collection program                                                  | Immediate |
| 6.2.1 | Investigate incentives for retention of trees on private land including through collaboration with planning authorities             | Medium    |
| 6.3.1 | Develop community education material to convey the benefits of trees                                                                | Short     |
| 6.3.2 | Build indigenous engagement in caring for the urban forest                                                                          | Medium    |
| 6.3.3 | Consider ways to educate young people and how they can contribute to the urban forest                                               | Short     |

**Figure 2. Actions that would be taken by the ACT Government to achieve outcomes within the *Urban Forest Strategy* (Reproduced from ACT Government, 2020)**

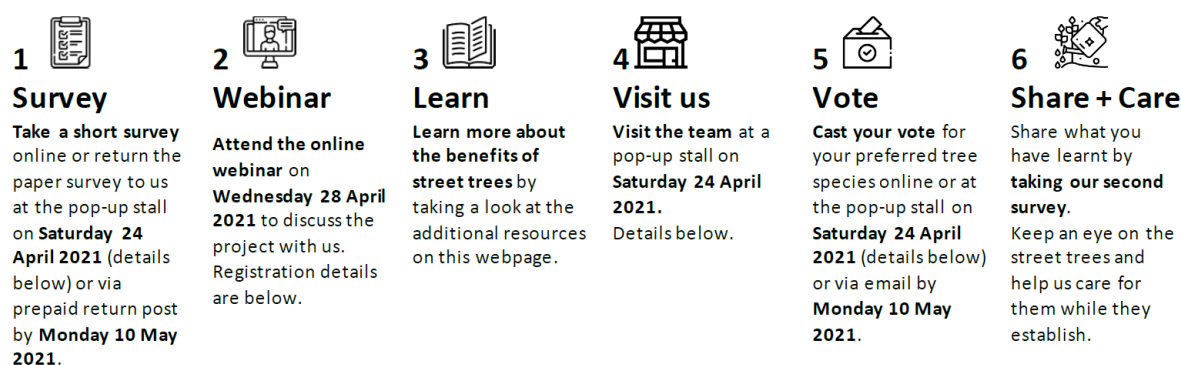
## 3.2 The ACT Government's Street Forestry Program

The ACT Government launched the *Street Forestry Program* in April 2021, as one initiative to address Objective 6 of the *Urban Forest Strategy* – Partner with the community. This pilot program seeks to help the government better understand the current level of awareness amongst the community in relation to street trees and explore ways to involve residents in decision-making (ACT Government, 2021e). Six pilot suburbs with low canopy cover were chosen, and the program aimed to engage those residents in efforts to encourage greater acceptance for trees and initiate care for street trees, in hopes of improving the canopy cover of their neighbourhoods.

The Program comprised a series of elements:

- Surveys seeking to better understand residents' perspectives;
- Pop-up events as a form of in-person engagement;
- A webinar as an online engagement platform;
- Vote cards to capture residents' preferences of trees

Figure 3 summarises the activities included as part of the Program.



**Figure 3. Banner describing the activities included in the *Street Forestry Program* (Retrieved from ACT Government, 2021e)**

The engagement process with the community was conducted by an external consultancy firm employed by the government, over three months from April 2021 to June 2021. Four primary modes of engagement were used to reach residents: surveys, a voting process, pop-up events, and a webinar. Over a thousand letters introducing the program were distributed throughout April to the residents within the six selected suburbs for the pilot – Bonython, Florey, Kambah, Mawson, Ngunnawal, and Scullin. The survey and tree species voting card were included with the letter and were available both physically in paper form and digitally online via the webpage <https://www.cityservices.act.gov.au/trees-and-nature/trees/street-forestry-program>.

The survey sought responses to questions related to the value of street trees, preferred tree species, existing care for residential trees, and optional household information (refer to Appendix 1). The vote card required residents to cast a vote for their most preferred tree of the choices proposed for their street; to match the given tree to their preferences, respondents were required to provide identifying information of their name and address (refer to Appendix 2). The deadline to return the survey and vote card physically at the pop-up events or via return post, or digitally online, was 10<sup>th</sup> May 2021.

Pop-up events were held on the 24<sup>th</sup> April 2021 across all six suburbs to promote the program and engage with the residents in person, and an online webinar introducing the program was hosted as another alternative to reach out to the residents and elicit feedback on the 28<sup>th</sup> April 2021. A follow-up evaluation survey was also released at the end of the program to investigate any changes in responses as a result of the engagement pathways used for the *Street Forestry Program*. These surveys were intended to assist in better understanding residents' perceptions and attitudes to street trees.

Trees, corresponding to those for which residents voted, were then planted in the respective neighbourhoods towards the end of June, as part of a wider tree planting program in these suburbs.

### 3.3 Data collection and analysis methods

The study was conducted in conjunction with, but independently of, the *Street Forestry Program*. It draws from a combination of quantitative and qualitative research methods, including surveys, participant observation, and semi-structured interviews. The rationale for engaging in a mixed-methods approach is summarised by Doyle *et al.* (2009); it allows for greater validity across the results and provides a more comprehensive picture of a topic. Here, the survey provides an overview of the range of respondents' perspectives, while the interviews allow for a deeper understanding of residents' opinions, and the participant observation complementing these methods. My research was approved by the ANU Human Ethics Research Committee (Protocol 2021/194).

Raw data from both the surveys and vote cards were collated by the consultants at the end of the Program and made available to me for analysis and interpretation, under a confidentiality agreement with the ACT Government. Microsoft Excel was then used to analyse these data and generate figures. The results of the follow-up evaluation survey were not investigated due to a very low response rate.

In the first part of my own data collection, I conducted participant observation at two *Street Forestry Program* pop-up stalls, in Mawson (ACT 2607) and Scullin (ACT 2614). Participant observation is a form of research method where the researcher plays an established participant role in the study site, and represents a humanistic and interpretive approach (Aktinson and Hammersley, 1998). As noted above, the pop-up events were held on the 24<sup>th</sup> April 2021, lasting 2.5 hours each. They provided an opportunity for residents in the selected suburbs to interact with the two facilitators onsite and address any queries that the residents may have about the program. An additional participant observation was made during the online webinar held on the 28<sup>th</sup> April 2021.

The second part of my own data collection was based on semi-structured interviews, which utilised both closed and open-ended questions. In mixed-method research, the use of semi-structured interviews is effective to supplement and provide greater depth to the other approaches (Adams, 2015). To recruit my interview participants, I handed out flyers to the small number of residents who visited the pop-up stalls in Mawson and Scullin, and dropped a further 140 flyers to household letterboxes in Florey. I received 5 responses from Mawson, whom all formed part of my pool of interviewees; I received 7 responses from Florey, but only 5 of them were willing to be interviewed, with the other two expressing their concerns through email. Thus, a total of 10 residents were interviewed face to face in their homes, between 28<sup>th</sup> June 2021 and 20<sup>th</sup> July 2021; each interview was typically 20 – 30 minutes long. This is a reasonable sample size given the constraints of an Honours project, while noting that the results inform deeper insights into respondents' views and are not intended for generalisation.

Interviewees were advised that their identity would be kept confidential. The interview questions addressed four broad themes: neighbourhood, urban trees in Canberra, the *Street Forestry Program*, and community and government responsibility (refer to Appendix 3). Additional basic demographic

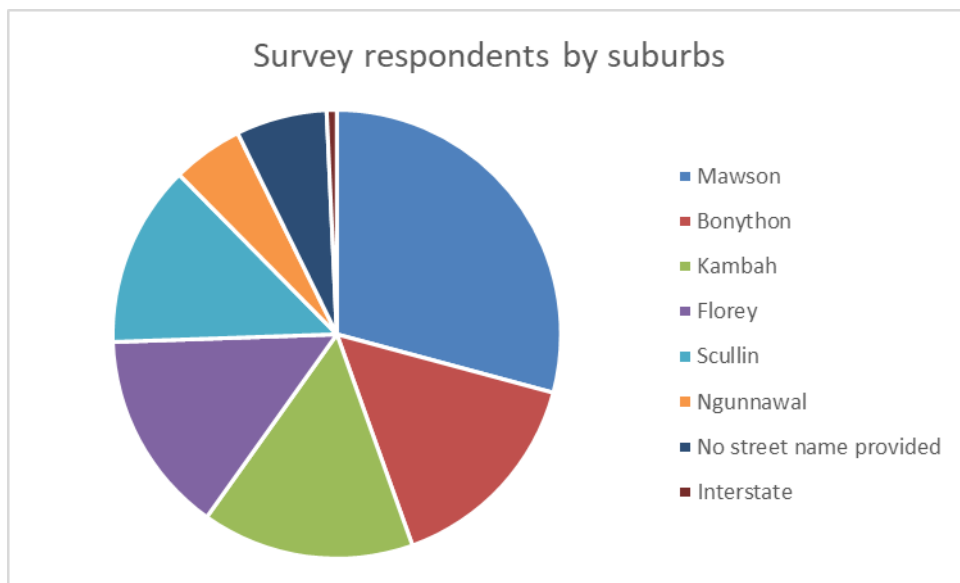
information was also recorded. The interviews were audio-recorded and transcribed, and common themes were identified. Interview excerpts were labelled either F for Florey or M for Mawson, and a unique number was associated with each interviewee in both suburbs (1 – 5).

## Chapter 4: Findings of residents' perspectives and the *Street Forestry Program*

This chapter outlines the results of each of the mixed-method elements: survey, participant observation, and interviews. The findings will provide insights into residents' perspectives of urban trees and the *Street Forestry Program*, and of their relationship to stewardship behaviour.

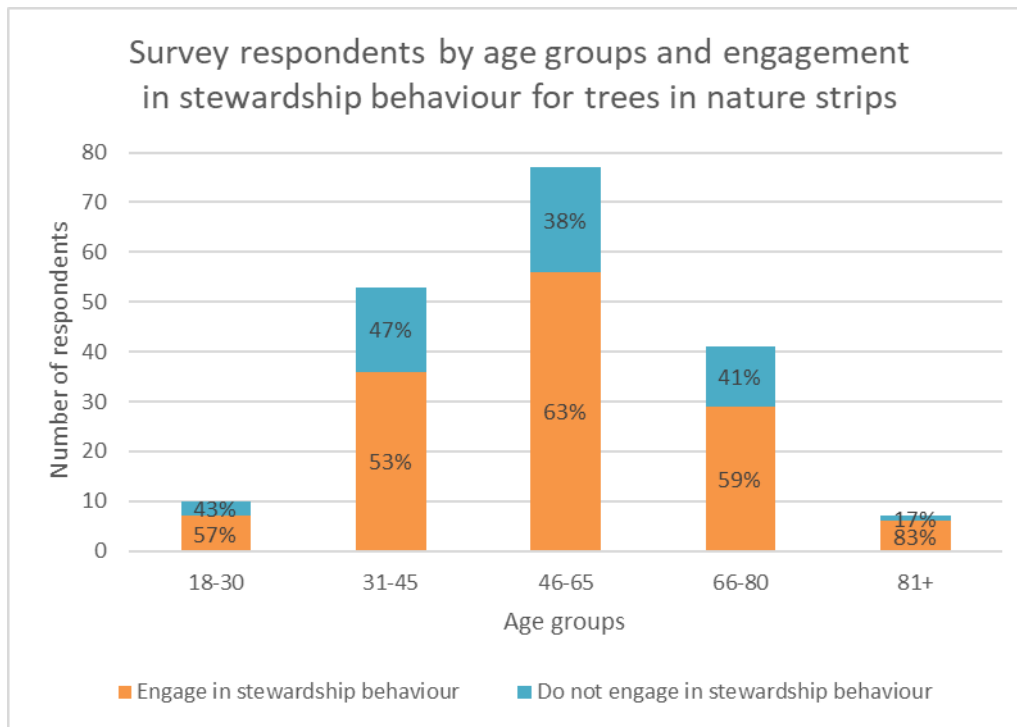
### 4.1 Survey results

The results below have been derived from the initial survey conducted by the *Street Forestry Program*, which received 137 responses out of 1163 targeted residents. Amongst all 6 suburbs, the majority of the survey respondents were from Mawson (40), Bonython (21), and Kambah (21) (Figure 4).



**Figure 4. Initial survey respondents by suburbs**

The household information of survey respondents is summarised below in Figure 5. Ninety-two percent of the survey respondents are between ages 31 – 80, and most respondents belong to the 46 – 65 age group. In terms of caring for street trees, 71% of the survey respondents engage in some form of stewardship behaviour, while those aged between 18 – 45 engage in less stewardship behaviour than the older age groups (Figure 5). The majority of the respondents are also homeowners (92%); tenants comprise only 8%.

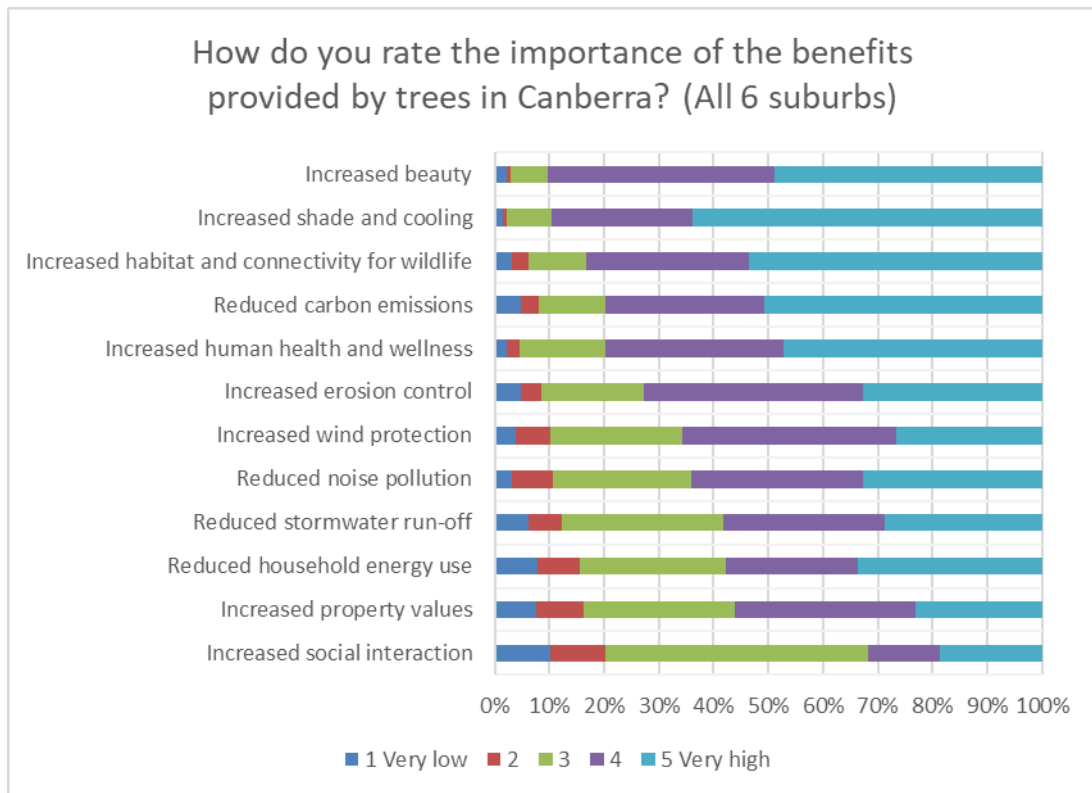


**Figure 5. Survey respondents by age groups and engagement in stewardship behaviour for trees in nature strips**

As the questions were optional, there were differing response rates to each individual question. The results reported here are therefore presented in terms of the relative percentage of the each data series. Figure 6 reports responses to the question of “how do you rate the importance of the benefits provided by trees in Canberra?”. The most highly-rated benefit was increased shade and cooling (64% as very high); the benefits of increased habitat and connectivity for wildlife, reduced carbon emissions, and increased beauty were next most highly rated, with around 50% rating these very highly. Reduced household energy use, reduced noise pollution, increased erosion control and reduced stormwater runoff were next most highly rated, with around 30% rating these very highly. Increased wind protection and increased property values were very highly rated by around 25%, and increased social interaction was seen as the least important benefit provided by trees, with only around 19% rating it very highly.

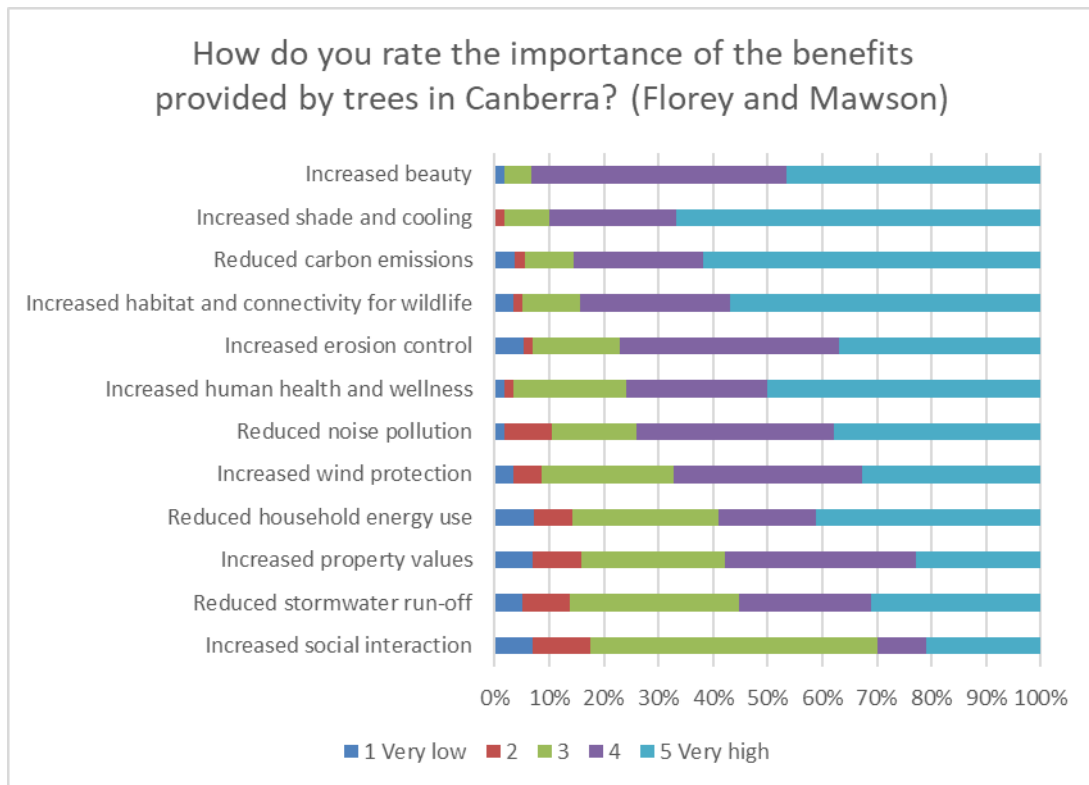
Overall, there is a strong positive recognition of the importance of trees in Canberra; all but one of the listed benefits are rated by more than half of the respondents as at least of high importance (Figure 6). Considering the very high and high ratings together, as an indication of ratings higher than the mid-range value, increased beauty (90%) and increased shade and cooling (89%) were essentially equivalent and first ranked. Increased habitat and connectivity for wildlife, reduced carbon emissions, and increased human health and wellness were next most highly rated, at around 80%. These were followed by increased erosion control, increased wind protection, and reduced noise pollution, averaging at around 65%; and reduced stormwater run-off, reduced household energy use and increased property values, at around 55%. Increased social interaction was least highly ranked of the benefits, with only

32% of respondents ranking it in the high-very high category. It also received the highest percentage of very low-low ratings at 20%, in contrast to increased shade and cooling which received the lowest percentage of very low-low ratings at 2%.



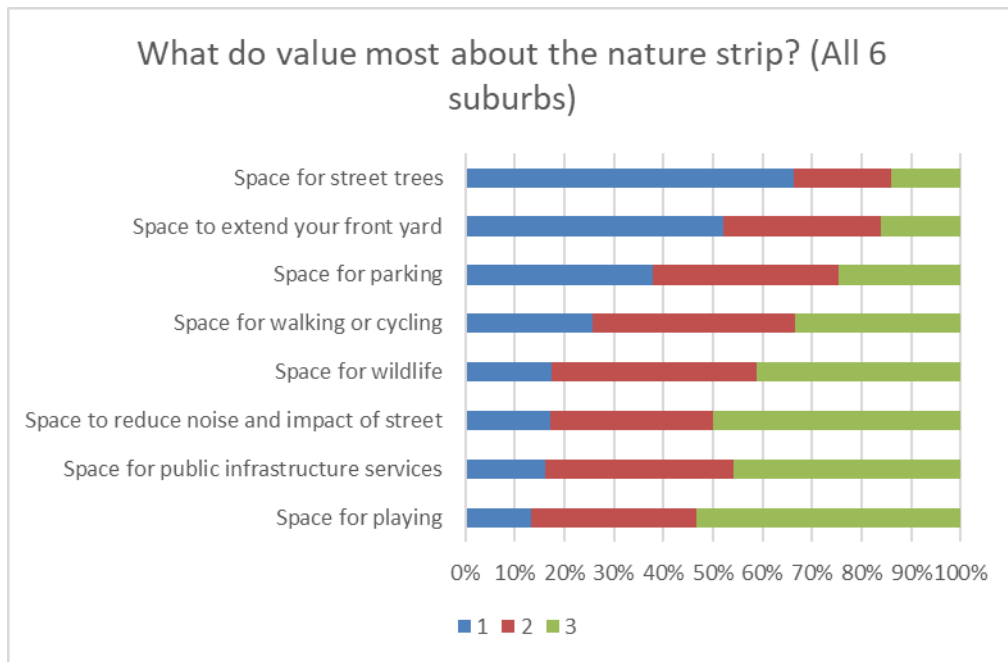
**Figure 6. Residents' perception of the importance of various benefits of trees in Canberra across all 6 suburbs**

Focusing on the suburbs of Florey and Mawson, results are largely consistent with the broader survey population, with minor differences (Figure 7). Increased erosion control and reduced noise pollution were valued more in these two suburbs compared to the totality of 6 suburbs, by 5% and 10% respectively in the combined high-very high categories.



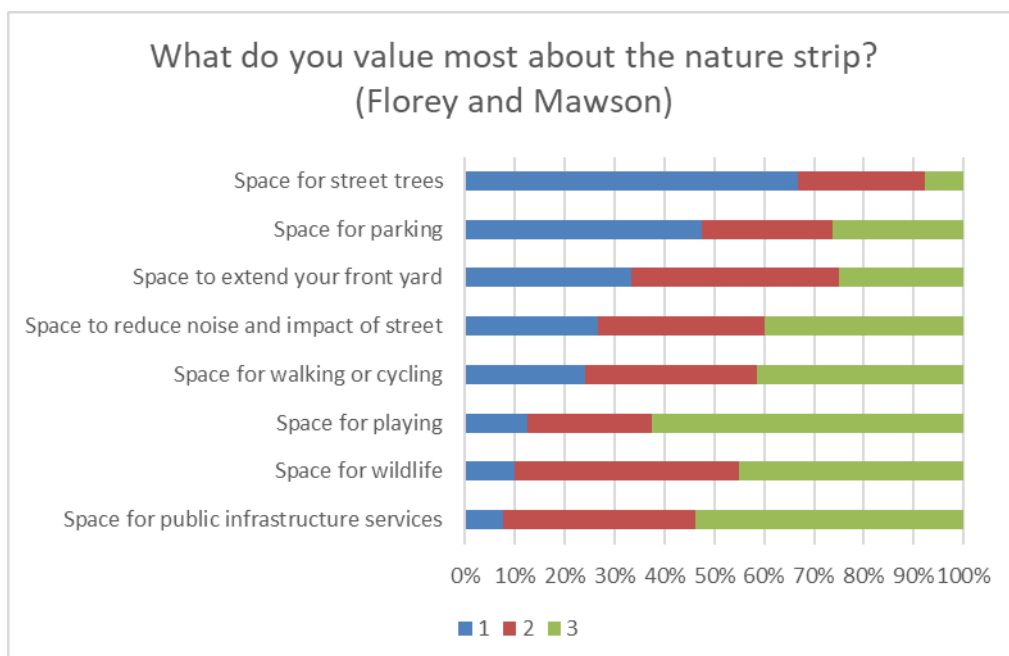
**Figure 7. Residents' perception of the importance of various benefits of trees in Canberra across Florey and Mawson**

In terms of what was most valued about the nature strip, space for street trees was ranked most highly by 66% of respondents; this was followed by space to extend their front yards (52%), followed by space for parking (38%); space for wildlife, for noise reduction and infrastructure was first ranked by 15-18%. Space for playing was least valued at 13% (Figure 8).



**Figure 8. What is most valued about the nature strip: residents across all 6 suburbs**  
(Note: 1-3 ranking, 1 highest)

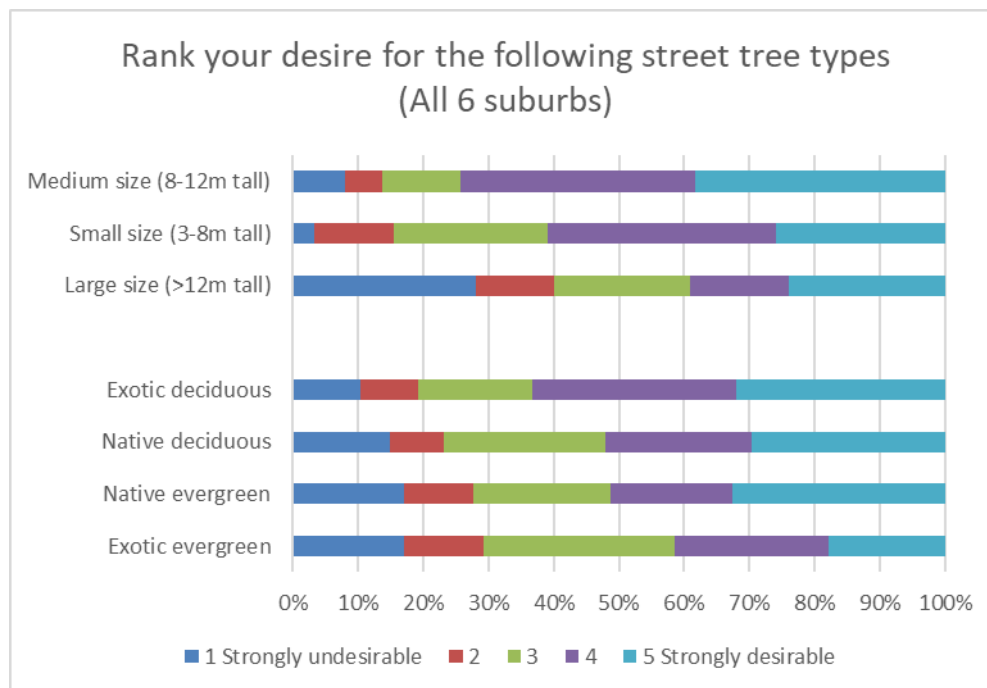
Results in Florey and Mawson differed in a few cases: the nature strip was valued more as a space for parking (47%) than to extend their front yards (33%), and space for public infrastructure was least valued, at around 8% (Figure 9).



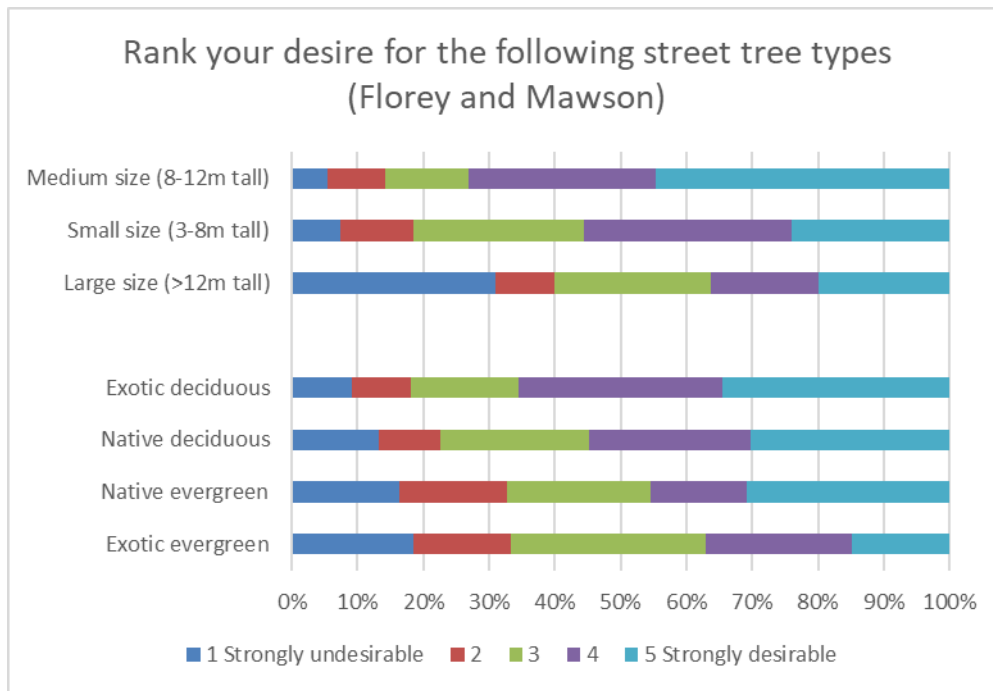
**Figure 9. What is most valued about the nature strip: residents across Florey and Mawson**  
(Note: 1-3 ranking, 1 highest)

In terms of street tree preferences, a range of opinions is evident amongst the residents. However, it is clear that large size trees (>12m tall) are the least preferred, with 40% of respondents rating large trees as strongly undesirable or undesirable (Figure 10). Medium-sized trees are also preferred over smaller trees, with 74% of respondents rating them as either desirable (38%) or strongly desirable (36%); in contrast, 61% rated small-sized trees as desirable or strongly desirable. This is broadly similar in the suburbs of Florey and Mawson, where 73% of respondents find medium-sized trees desirable (28%) or strongly desirable (45%), and only 56% responded similarly for small trees (Figure 11).

Residents prefer deciduous trees, particularly exotic species; 63% of respondents in all 6 suburbs see exotic deciduous as either desirable (31%) or strongly desirable (32%; Figure 10). Exotic evergreens are least desired, with only 41% rating them as either desirable or strongly desirable. An intermediate proportion of respondents (52%) rated native species as either desirable or strongly desirable; slightly more (33%) rated native evergreens as strongly desirable than they did for exotic evergreens (18%). This is consistent in Florey and Mawson (Figure 11), where exotic deciduous is most preferred with 65% rating it as either desirable (31%) or strongly desirable (34%), in contrast to exotic evergreens with only 37% in the same category (22% desirable, 15% strongly desirable).

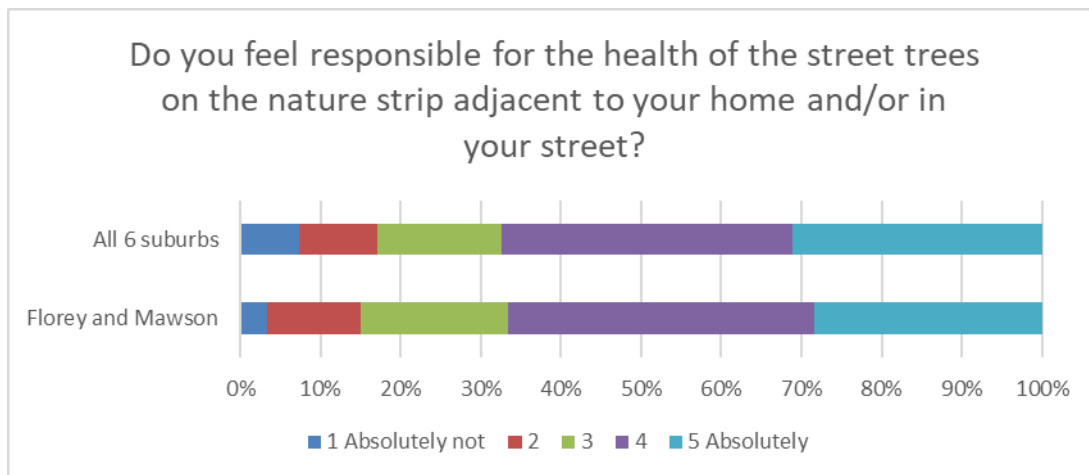


**Figure 10. Residents' preferences for street tree type across all 6 suburbs**



**Figure 11. Residents' preferences for street tree type across Florey and Mawson**

Lastly, most of the respondents agree that they are responsible to some extent for the health of the street trees on the nature strip adjacent to their homes (around 70% Absolutely or “Yes, I think so”; Figure 12). A small proportion of respondents from all 6 suburbs believe they are absolutely not responsible (7%), although these views are less prevalent in the respondents from Florey and Mawson (3%).



**Figure 12. Residents' perception on individual responsibility for street trees on their nature strips**

## 4.2 Participant observation

Participant observation was conducted at two of the *Street Forestry Program* pop-up stalls on 24<sup>th</sup> April and on the webinar of 28<sup>th</sup> April. This provided me with insights into aspects of implementation of the Program, which I summarise below.

### 4.2.1 Pop-up stalls

Each pop-up stall across the 6 suburbs was staffed by a member of the ACT Government agency staff and a representative of the consultants engaged to deliver elements of the *Street Forestry Program*. I visited the pop-up stalls in Mawson between 9.30am to 12pm and in Florey between 1 to 3.30pm, the two suburbs with the highest attendance at 15 and 11 residents respectively. Timing constraints meant that the pop-up stalls were held on Saturday 24<sup>th</sup> April, on a long weekend when more residents than usual may be away, which may have contributed to a low turnout. The stalls were also set up in the immediate vicinity of the target streets, which – although convenient for residents of these streets – were areas in which foot traffic was limited, primarily to residents who were aware of the stalls and were interested in participating. There was also limited signage.

The residents who visited the stalls were mainly the elderly, and there were a small number of mothers who dropped by with their children. They were generally interested to know more about the proposed locations of the trees to be planted under the Program, or to drop off their vote cards; many of those who attended the stalls asked for no tree to be planted in their nature strip, for a variety of reasons; some examples include the lack of space in their nature strip or the possibility of the trees blocking off the sunlight and solar panels. The pop-up stalls were also used by residents as an opportunity to raise general queries unrelated to the Program. Some knowledge gaps about governmental regulations emerged in discussions with the consultants, although these could be addressed by the government agency staff member at each stall; however, this may have reduced the efficiency of the pop-up stalls in responding to residents' questions. Nonetheless, there was a prompt response to those who visited, and residents were attended to almost immediately upon their arrival at the stall, as overall numbers were low.

Many residents across both pop-up stalls expressed their dislike for gum trees in urban areas, and shared their concerns with regards to maintenance issues. Some of the concerns were addressed by the government staff, who directed the residents to online resources available. A few residents also made known their appreciation for the pop-up stalls, as demonstrating the government's willingness to engage with residents. Overall, there was a friendly atmosphere at both pop-ups, and while many residents across both Mawson and Florey objected to having the planned trees and expressed negative views about certain matters, their participation in the pop-ups reflects a general willingness to be engaged.

### 4.2.2 Webinar

The webinar was conducted on the Wednesday following the pop-up event, at 12 noon, at a time that was chosen to best accommodate the working population, on the assumption that interested residents could participate during their lunch time. However, the total turnout was small, at 8 residents; participants fell in and out the Zoom meeting throughout, and little engagement was evident between the residents and the Program staff. The poor participation could be attributed to the webinar being held on a weekday during the day, and the poor engagement due to its format, which relied primarily on the presentation of slides with limited use of interactive elements. Where there was engagement, it was either through an online poll tool Mentimeter, in response to questions, or the chat function in Zoom where private messages were sent to the Program staff.

## 4.3 Interview results

Four common themes – those of the value of urban trees in Canberra, sense of community and associated green behaviour, private/public responsibility of trees, and the *Street Forestry Program* – emerged from the interviews with residents. Table 3 summarises the demographic information of the interviewees.

**Table 3. Demographic information of interviewees (n = 10)**

| <b>Gender</b>                | Number of respondents (n = 10) |
|------------------------------|--------------------------------|
| Male                         | 6                              |
| Female                       | 4                              |
| <b>Age group</b>             |                                |
| 20 - 29                      | 1                              |
| 40 - 49                      | 1                              |
| 60 - 69                      | 4                              |
| 70 - 79                      | 3                              |
| <b>Employment status</b>     |                                |
| Employed                     | 4                              |
| Retired                      | 6                              |
| <b>Home ownership status</b> |                                |
| Homeowner                    | 9                              |
| Tenant                       | 1                              |

### 4.3.1 What do residents value or not value about trees?

There is a consistent view from all the residents interviewed that trees are important and necessary, although there is a plurality of reasons for which they value trees. Consistent with expectations from

the literature (see section 2.3.2), they value trees mainly for aesthetic, environmental (e.g. biodiversity), and utilitarian reasons, which include climate regulation and provision of shade.

Different tree species provide varying benefits as a result of their characteristics (e.g. the period of shade provision differs between deciduous and evergreen trees), which likely means that tree species that provide the benefits that are valued for will most likely be preferred. In this case, many mentioned that they favour deciduous trees close to their blocks, mainly for their aesthetics and deciduous characteristics, which allow summer shade and winter sunlight. For example, a resident who prefers exotic species mentioned that:

... for Canberra's climate I think deciduous is better, because it does provide you with shade in the hotter months, and Canberra does get very hot, but then it does give you sunlight in the winter months (M2).

In contrast, shade provision was seen as a hindrance by one of the residents due to the location of his south-facing house; the amount of sunlight he receives throughout the year is limited, with sunshine only coming into the rooms at the peak of summer for one or two months. Regardless of this, the resident still acknowledged the importance of trees in other areas. Similarly, there was consensus on the importance of trees despite mentions of other tree-related inconveniences by other residents, summarised by a resident as follows:

I think the benefits of trees definitely outweigh these potential little not-so-good things (F2).

Half of the interviewees stated that they prefer to have a mix of species, including those who like natives but see benefits in a mix for reasons such as aesthetics and shade provision. Only one resident explicitly expressed their distaste for exotics, citing the need to “stop the colonisation of the country in any way”. A common theme that emerged amongst the remaining proponents for exotics was that they all perceived natives (i.e. gum trees) as disruptive and not suited for urban environments. This could be attributed to their personal experiences, where natives have damaged the infrastructure of their houses, or that they have witnessed incidents where those trees have posed as a danger to the safety of the public. One resident said:

I heard this almighty crack, and this huge branch fell down, and it was just lucky it wasn't a school morning where children were walking down the path or whatever... and if ever seen one of them falling, it's so quick, if you were walking under it you wouldn't have a chance of not being hit (F3).

These demonstrate that the residents interviewed largely based their tree preferences on the extent to which the tree characteristics align with their values. Despite dividing opinions that exist, there is nonetheless a consensus that their preferred tree species can bring about a range of benefits.

Social values of trees were less mentioned but present, and included the role of trees as an educational platform for children, as a form of privacy, and for noise reduction. The former was brought up by a mother in her 40s, whose responses reflected strong family values. She said:

Particularly if the kids could get involved, like I said before, and not everyone has kids and that's fine, but where we are at our stage of life, I would love if my children could learn about- so you know the tree that she helped plant across the road, it's gonna grow with her. And that's a really nice thing, so anything I can do to teach her, or even the older boys, the seeds will give them the skills, I'm totally up for (M3).

A similar point was also mentioned by a resident in his 60s, who said that the large amount of green space available in his block was a determining factor for purchasing the house before when his children were still young, so that they had the opportunity to learn and interact with greenery. This reflects a potential relationship between demographic factors and people's values of trees, such as the ability for age and stage of life to influence individual views of trees (e.g. Jim and Chen, 2006; Ode Sang *et al.*, 2016).

As trees serve to increase the aesthetic value of a place which is highly valued upon within residents, there is a greater willingness to pay for properties with the presence of more adjacent street trees which leads to increased property value (e.g. Pandit *et al.* 2013). This relationship was noted by a few of the residents, one of them described as follows:

Aesthetic values, and resale value of your home, I think there is a great deal of value if you resell your- if you got a strip that is leafy and green. People will want to live there (F1).

While only a minority of the residents mentioned property-based values, this above account further solidifies the range of values associated with trees, many which can be linked back to aesthetic reasons.

While the cultural values of trees were not often at the forefront of the responses, there were consistent mentions of Canberra's identity as a 'bush capital'. As discussed in section 3.1, Canberra as a city is characterised by its rich presence of trees, which has formed part of its identity. This was acknowledged by many of the residents interviewed, who expressed their appreciation of this unique identity which has shaped Canberra as a city, and the need to maintain it. One account is described below:

... when I moved to Canberra a long time ago, ACT was known as the garden state, and we don't have front fences, we have open gardens and we... in our suburb we have a feeling of sort of nature coming into the home space, and I really like that and I think that is a part of our identity here in Canberra (M3).

In one case, a resident said that he “felt good” after a friend from abroad visited Canberra and was impressed by the extensive treescape in Canberra; this reflects a form of place identity that may influence why people value trees and their resultant behaviours (Ramkissoo *et al.*, 2012).

Lastly, trees were also valued for their psychological and health benefits albeit rarely mentioned amongst the residents. The huge range of values cited above therefore emphasises the high value residents attribute to trees.

### **4.3.2 Sense of community and green behaviour amongst residents**

The residents interviewed generally did not have a strong sense of community and have limited interactions with neighbours, while a spectrum of green behaviour is noted. Most interviewees reported casual interactions with their neighbours, but their relationships seldom extend beyond brief encounters on the streets; some were close to a select few. A few interviewees are already participating in community events such as Parkcare activities in the neighbourhood, or expressed interest in doing so, as a means to socialise and be more connected to the community. Their motivations were largely social, but environmental reasons were cited as a significant benefit from engaging in such actions. For instance:

It's a chance for me to meet people in the neighbourhood, that's one thing I guess that we don't really know, we know who our immediate neighbours are but we don't socialise a lot and know the broader neighbourhood and that would be people in Mawson with a common interest, so I think we need to do, definitely need to do that to sort of know the community a little better. So yeah, that's the role, not only of bringing the community together but as well as actually creating a better space down there, which is good (M1).

Evidently, many residents see the neighbourhood as a social space despite an absence of a closely knitted community. Participating in community groups is therefore seen as a means to socialise while being able to value-add to the environment.

At a smaller scale, there were mixed responses about individual actions taken to care for street trees adjacent to interviewees' blocks, with some engaging in various actions while others take little to no action. Actions taken generally include watering, trimming, and cleaning up of fallen debris, and arise from an awareness of the needs of trees, or convenience and aesthetics of their blocks. The presence of mature trees or absence of street trees, lack of tree-related knowledge, perception that the government is responsible, and personal reasons, were cited as reasons for inaction. A few residents perceived mature trees as capable of withstanding harsh conditions without much intervention, or in some cases, worry that there may be more harm to the trees if 'too much' is done:

I wouldn't too, cause it's mature it can look after itself, it's designed to withstand drought. Yeah but umm... also getting a sense of what they actually need, cause the other thing is you don't want to go kill it by overloving it (M3).

These demonstrate the presence of knowledge gaps as a barrier to action in some residents, and while less prevalent, should be addressed to encourage greater green behaviour for street trees.

Apart from inaction, there were instances where the interviewees engaged in behaviours that may be detrimental to the trees, such as parking their cars on their nature strip. This is prohibited under the *Road Transport (Road Rules) Regulation 2017* (ACT Government, 2019c), but a few residents have mentioned that they tend to use the space as parking when there are additional cars.

I have friends around, and they park out at the front, and if they couldn't park there, then you know, that would be a little bit annoying (F3).

This further reflects the lack of related knowledge or awareness within some residents, and may also be related to broader values present within those residents; for example, parking under trees provide greater convenience which may be highly valued.

The responses to questions about this topic provide a sense that older, retired, and particularly, the more socially engaged people, are more willing to take actions to care for trees adjacent to their properties. Interviewees who have participated in events organised by community groups or are part of a community group within the neighbourhood (i.e. Parkcare, Neighbourhood Watch) have generally demonstrated proactive behaviour in caring for street trees. The majority of my interviewees were in their 60s or 70s, and the only two outside of this age bracket (in their 20s and 40s) both reported that they do not take any particular action to care for the trees on public land, nor were they willing to join any related community groups. Specifically, the parent in her 40s explained that she would be more willing to contribute monetarily than anything else, as she is in the stage of life where other things like family take greater priority; in contrast, a resident who mentioned her ability to volunteer said:

I have time in my hands, I am privileged also that I'm retired and I've got time, whereas when I was working I probably wouldn't have been able to give that time (M5).

These responses illustrate how personal circumstances, like life stage and time availability, can mediate the capacity for individuals to be engaged in community initiatives and environmental behaviour.

### **4.3.3 Role of government and community in caring for street trees**

While the care of trees in nature strips should ideally be a joint responsibility between the government and community, the extent to which the community contributes is highly dependent on

their perception of responsibility, especially their perception of the role of the government. It is less likely that a resident will act as a steward if they perceive the government as the sole responsible entity, as commonly reported in the USA (e.g. Moskell and Allred 2013b, Zhang *et al.* 2007). One of the residents who does not engage in any active action to care for street trees apart from reporting any issues to the authority, explained their perspective:

Street trees, as distinct from neighbourhood trees, are basically government's responsibility... and then there's the issue of trimming the trees, and that should definitely be the responsibility of the local government, because then you would have neighbourhood arguments... (M2).

More broadly, responses on this topic provide a sense of what residents think about responsibility for tree stewardship. In general, most of the interviewees think of it as a joint responsibility between the community and government, and acknowledge the necessity for the community to contribute especially in the case of trees on their nature strips. However, many emphasise the need for the government to facilitate or 'activate' the process, as community members may lack the awareness or knowledge to initiate action. The principle of 'community partnering', where a collaborative and inclusive approach is encouraged, is relevant here, supported by the literature on the role of government in activating the community as stewards (section 2.3.3). One resident commented that she sees caring for trees as a joint responsibility only if the government provides sufficient information and takes account of community opinions:

I think unless the government does something to alert the community to what is it they have got, it has to be the government, cause the community doesn't understand otherwise. But if the government keeps doing what it's doing now and engaging the community, I think it could be a shared responsibility (M3).

Likewise, the government should seek to incorporate individuals' preferences as residents may weigh their responsibilities based on the type of tree received. This can be inferred from the comments of another resident, who mentioned that she will see tree care as a joint responsibility if the tree is one that she likes. This is consistent with the approach of the *Street Forestry Program*, in giving residents an opportunity to select their tree species. However, routine inspections and regular maintenance such as tree removals and pruning are still seen as the government's responsibility.

While the residents interviewed generally seemed to be aware of their responsibility, a few expressed their concerns regarding the apathy that is present in many others. This speaks to the need for the government to focus on enhancing its public engagement methods and raise awareness about the issue. Different views are held by the residents about methods of government intervention to facilitate stewardship and one example noted through the Program is as follows:

I think the consultation was a good way to start that conversation, but I think it probably needs follow-up in some ways, I guess even the ACT Government newsletter that they put out, or maybe Facebook or whatever else they could kind of encourage it (M5).

The view of a resident of Asian descent who migrated to Australia decades ago further encapsulates the range of opinions that may exist across different communities (i.e. ethnic, migrants etc.):

I think it's the government's responsibility but they can engage community as well. They can provide some space for community to go and plant trees, like ethnic communities, migrants etc., they can go and say the trees in this space are planted by the Pakistanis communities and this space Indian communities, and in this space maybe the Chinese communities. Also they will have some sort of belonging... (F5)

In this case, cultural and ethnic diversity was identified as another factor that needed to be addressed by the government in facilitating the awareness and participation of migrants in tree stewardship.

Nonetheless, recognition of co-responsibility often does not necessarily translate to an actualisation of beliefs, as exemplified by a resident's response to the question of responsibility:

I think it's both, but as I said before, as a member of the community I'm way too lazy to do it. So I think, I should be more "I need to take care of them", but I do think, yeah but I'm not going to, I think. So it should be both, but for me personally, government only (F4).

This response then speaks to the need to understand people's motivations and barriers to them taking action. These insights reported above may help the government better understand residents' perception of responsibility, and where efforts to promote greater participation from residents in caring for their neighbourhood trees could focus. While there is general support for joint responsibility, there is limited guarantee that action will be reliably taken. Based on the observations, targeting the range of preferences, values, and backgrounds that exist, may therefore potentially help bridge this knowledge-action gap and facilitate stewardship behaviours.

#### **4.3.4 Residents' experiences of the *Street Forestry Program***

When I asked about the Program, there were mixed opinions; some of the residents think of it as a great initiative and are supportive of it, others were neutral or sceptical about it, and a few spoke critically of certain aspects. Only one of my respondents received a tree; the rest did not for a range of reasons – they were either not part of the targeted street, did not want or could not have a tree due to the location and space constraints, or requested the tree received to be removed for personal reasons.

Amongst those who viewed the Program positively, they cite its inclusiveness as a strength, in that the community was given the opportunity to be involved in decision-making. However, a resident who held this view also mentioned that she did not understand the Program completely, suggesting a potential area of improvement:

I'm not sure if I fully understand the whole program, but I do understand that they did a pilot of 6 suburbs, and what I did like about it was the way it brought the community in and the government together in a really nice way... (M3)

Another resident praised the efficiency of the program in actioning its ambitions within a short time period:

No, it's good. Like everyone gets involved, so if people get interested you know, they can have a chat and understand what is going on, and then the action taking place soon after, you know, not like a big period between, you forget about it and then all of a sudden oh okay I remember, it's about a few years ago (M4).

Some residents also see the program as a form of affirmation of the government's commitment in greening and 'rejuvenating' the suburbs, something that they value based on their perceptions of trees, as witnessed from accounts described in an earlier section. Many of the plantings of earlier eras are reaching their end-of-life in the coming years, and many trees will need to be replaced to achieve the city's target of reaching 30% canopy cover (ACT Government, 2020). A respondent observed that it is encouraging to see new trees being planted:

I can't believe the amount of plantings that's happening at the moment... usually, you know, you kind of see things happening during the election cycle, before an election, so you kinda think, you know they are sprucing things up then, but I'm really amazed how much plantings is happening around (M5).

On top of those positive views, this group of residents also expressed their desire to see the Program being scaled-up and rolled out in other suburbs in Canberra, especially in the newer suburbs with lower canopy cover. In contrast, this was the basis of scepticism from some residents who questioned the government's rationale for picking their suburbs for the Program, when they perceive them as sufficiently forested. They think that there are other 'more deserving' suburbs, as an example from each study suburb illustrates:

I honestly don't think Florey needed any more trees, it's a very green suburb. I think they would have been better putting in more trees in newer areas, and looking at the suburbs that needed more- or where you need replacement trees... (F3)

My overall reaction to that program in planting in Mawson was one of- Mawson is heavily treed, but the new suburbs are significantly not treed, and never will be, that is where they should be pushing those trees. I don't think Mawson required them (M2).

One of the two respondents who were highly critical of the Program expressed their discontent through the in-person interview, and the other made known their feelings through a written email. The latter seemed to either be misunderstanding the purpose of the Program or see it as unnecessary, while the resident who was interviewed see it as “a waste money and resources” as the government should focus on maintaining existing trees.

While the same resident has received two trees under the Program, he is planning to get them both removed, as he had never wanted them, and claimed that they had been planted despite his objection made to the on-site team responsible for the plantings. Similarly, another resident has had the tree planted as part of the Program removed after writing to the government, explaining that she did not consent to having the tree and that its location inconvenienced her. This contrasts with the experience of residents who wanted a tree but were not given one for reasons that were not conveyed to them. One of them has assumed that his nature strip was too bushy and difficult to access for a tree to be planted, although he would have appreciated a notice from the government:

I should write back to let them know that even though ours was a designated area, but they never come to plant it nor tell us why, or whatever, no drop in the letterbox for example (F2).

These responses suggest a possible lack of communication and delivery of information in the Program, as well as, in some cases, concerns or frustrations about the government generally rather than of the program itself. There is also perception that the government is not directing their resources to activities that some residents view as a greater priority, such as maintenance, which was consistently identified as an area of improvement throughout the interviews.

At the broader level, these observations about the Program reflect residents' perspectives of and expectations from the government more generally. There was a general sense of apprehension over the government's recent decisions, which respondents felt allowed developers greater freedom to clear land for developing dense housing blocks with minimal space for green growth. This has resulted in the newer suburbs suffering from below average canopy covers (see ACT Government, 2020), which has consequences for urban heat and equity. Similar feelings arose consistently in majority of the interviews, in which residents were appalled by the look of the newer suburbs and were disappointed with the government for facilitating this. This reflects how many residents associate Canberra's identity with a high level of trees, as noted earlier. An account is as follows:

I hate going out to the new areas like Molonglo and think like “wow, I can't believe Canberra has done it”, like it's taken the trees out like they have (M5).

Overall, the views held by the residents about the Program tend to be expressed as part of a larger outlook of the present cityscape and its associated development politics. The Program was generally recognised as a good initiative when viewed independently, but is seen less positively when associated with residents' personal beliefs and opinions on the wider context of urban greening in Canberra. Broader considerations have to be made at the government level to acknowledge and address residents' concerns reflected through this Program.

## Chapter 5: Discussion

This chapter synthesises the results reported in Chapter 4 and discuss them in relation to the literature and research questions 2, 3, and 4.

### 5.1 *A plurality of values for trees*

Research question 2 – *What do Canberra residents think about trees on public land in proximity to where they live?* – will be addressed in this section. The results suggest that trees are generally valued positively for a range of reasons, evident both in the survey respondents and the interviewees, and consistent with a recent survey conducted by Inner South Canberra Community Council (2020). Residents generally perceive the benefits of trees as more significant than their inconveniences (Schroeder *et al.*, 2006), and this was the case here. Aesthetic and utilitarian values, the latter of shade provision and temperature regulation, dominate the reasons for which trees were valued; the pre-eminence of aesthetic values is consistent with studies in Australia (Kirkpatrick *et al.*, 2012) and other western contexts (Lohr *et al.*, 2004). In contrast, Head and Muir (2005) and Kirkpatrick *et al.* (2012) reported that shade provision was less mentioned as a value in Australia. However, those studies did not include Canberra, where results from the few relevant studies available corroborate my findings (ACT Government, 2018; SCETCS, 2020).

The emphasis on the shading and cooling properties of trees might be attributed to the warming trend observed in the ACT, including the record heat of the 2019 -20 summer; Laforteza *et al.* (2009) reported recognition of trees in ameliorating the effects of climate change and urbanisation (i.e. UHI) as a result of personal perceptions and experiences of thermal discomfort. This is supported by Lo *et al.* (2017), whose Hong Kong study revealed that urban greenery is likely to be more regarded for its functional benefits when residents are concerned about future climate and weather changes.

Perceptions or understandings of a relationship between types or species of tree and particular benefits, noted in Avolio *et al.* (2015), were also evident here in terms of shade provision. Given Canberra's climate, many residents prefer deciduous trees as they provide shade in the summer but allow sunlight through in winter, in contrast to evergreen trees. The general lack of Australian native deciduous trees suitable for Canberra's climate means that almost all deciduous tree choices are exotic; but exotic species are also generally preferred over natives because of perceptions that see natives as dangerous, based on residents' personal experiences. Medium-sized trees are most favoured, consistent with Williams (2002), and this preference is presumably related to perceptions of safety.

The relationship between values and species preferences has also been noted by Kirkpatrick *et al.* (2012) in terms of the value of trees for biodiversity. This relationship relates to a pro-native narrative; a considerable literature indicates that native plants tend to be associated with a greater abundance of wildlife than exotics (e.g. Burghardt *et al.*, 2009; Pardee and Philpott, 2014). In this study, while

biodiversity was highly ranked, especially in the survey, there was a slight preference for exotic deciduous species both in the survey and interviews. This suggests that residents are clearly trading off other values with those of biodiversity, but may also be relevant that the pro-native narrative for biodiversity has been challenged recently, as some exotic species have been found also to support native wildlife (e.g. Gray and van Heezik, 2016; Schlaepfer *et al.*, 2020); thus, residents who value biodiversity may not feel compelled to prefer natives.

The survey included a few questions about social values, and while cultural values were not amongst these, they were identified in the interviews. Their mention demonstrates the wide range of values amongst residents in relation to trees, extending beyond environmental, aesthetic, and utilitarian values. Residents have suggested that trees in the neighbourhood can serve as an educational platform for children, providing them with opportunities to learn about nature. This corresponds to literature supporting the benefits of nature interaction for children, in facilitating a positive learning environment and fostering pro-environmental behaviour (Chawla, 2015; Křepelková *et al.*, 2020). Trees can also enhance quality of life in cities which subsequently has positive flow-on effects on the other values (Mullaney *et al.*, 2015), and may in certain circumstances help reduce prevalence of violent crimes in neighbourhoods (Kuo and Sullivan, 2001), although this was not noted in any of my results.

The survey did not ask about the cultural values of trees, notwithstanding the strong cultural value of urban trees in Canberra, embedded in its identity as a ‘bush capital’ or ‘city in a forest’ (ACT Government, 2016). However, these were strongly reflected in the interviews as a common theme within the residents. There was a general recognition and pride of Canberra’s highly forested landscape which can be attributed to its cultural identity, demonstrating the ability of urban green spaces in expressing cultural significance in cities as similarly stated in Thompson (2004). The cultural identity of Canberra as a ‘bush capital’ may also promote positive perceptions of trees, resulting in a strong sense of place identity where residents feel connected and attached to the place because of its strong presence of trees in the landscape. This was evident in a few of the interviewees and further relates to the relationship between place identity and one’s perception of environmental settings, which is illustrated by Mesch and Manor (1998).

Other values reported include the potential of trees to enhance property values, which was mentioned by a small proportion of the study across both the survey and interviews. Where negative values of trees emerged, they were due mainly to residents’ perception of the danger of trees to both their personal safety and infrastructure. This is consistent with much literature internationally (e.g. Fernandes *et al.*, 2019; Schroeder *et al.*, 2006), and in Australia and Canberra (e.g. Glibert and Brack, 2007; Kirkpatrick *et al.*, 2012; Pecenko and Brack, 2021). There are also related concerns about the perceived lack of maintenance from the government, noted similarly in previous local community consultations (ACT Government, 2017). While the framing of the survey to focus only on the benefits of trees may have biased respondents to these positives, the results from the interviews and the literature

reaffirm the positive feelings associated with trees generally, as well as the diverse reasons for which trees are valued. Trees were recognised as providing a range of benefits both in the general landscape and neighbourhoods in close proximity to residents, many of which have been recognised in this study.

## 5.2 *Factors influencing stewardship behaviour*

Recognising the many values of trees noted by the residents, this section discusses the stewardship behaviour demonstrated by residents, and addresses research question 3 – *What are the factors influencing tree stewardship behaviour in Canberra residents?*

Despite consensus on the importance of trees, there are varied forms and levels of participation in stewardship for trees in the neighbourhood. Often, residents' motivations for taking care of the street trees arise from knowledge of what care trees need, especially when they are newly planted or in periods of drought. This reflects the importance of educating the public on the necessity of caring for trees in one's nature strip and raising awareness about tree stewardship practices, as noted by Butt *et al.* (2021). In other cases, residents participate in certain stewardship behaviours for practical reasons of safety and to maintain the aesthetics of the street, consistent with the reasons for which they value trees. This suggests that there may be a greater incentive for individuals to take action when they perceive their actions will enhance or safeguard the benefits of trees which they value highly. This is consistent with the theory of planned behaviour (Ajzen, 1991), which holds that action will likely only take place if one hold favourable attitudes and has evaluated the outcomes or consequences resulting from that action (Ajzen and Fishbein, 1980).

Residents' stewardship behaviour to care for trees on public land is not limited only to individual actions for street trees, but also include participation in neighbourhood volunteering groups. Place attachment has been identified as a key determinant of pro-environmental behaviour, especially in a place-based setting such as a neighbourhood (Daryanto and Song, 2021), indicating a potential relationship between sense of community and stewardship behaviour. These results indicate that opportunities for social interaction is a primary motivator for some residents to engage in stewardship behaviour; the interviewees expressed their desire of wanting to be more connected to their community through their participation in Parkcare group activities. Many also recognise the potential of their contributions in maximising environmental and social outcomes for their living environment. These results are consistent with those of Measham and Barnett (2008), who listed the ability for one to contribute to the community, opportunities for social interaction, ethic of care for the environment, and place attachment, as some key motivations for environmental volunteering.

However, in the case of street trees as in other arenas of human behaviour, an individual's values do not necessarily translate to action; there may be a value-action gap (Blake, 1999). Residents may value trees for the many benefits they bring but may not be willing to engage in stewardship behaviours to care for these trees, as reported by Kocisky (2016). Pro-environmental behaviour is shaped by a range

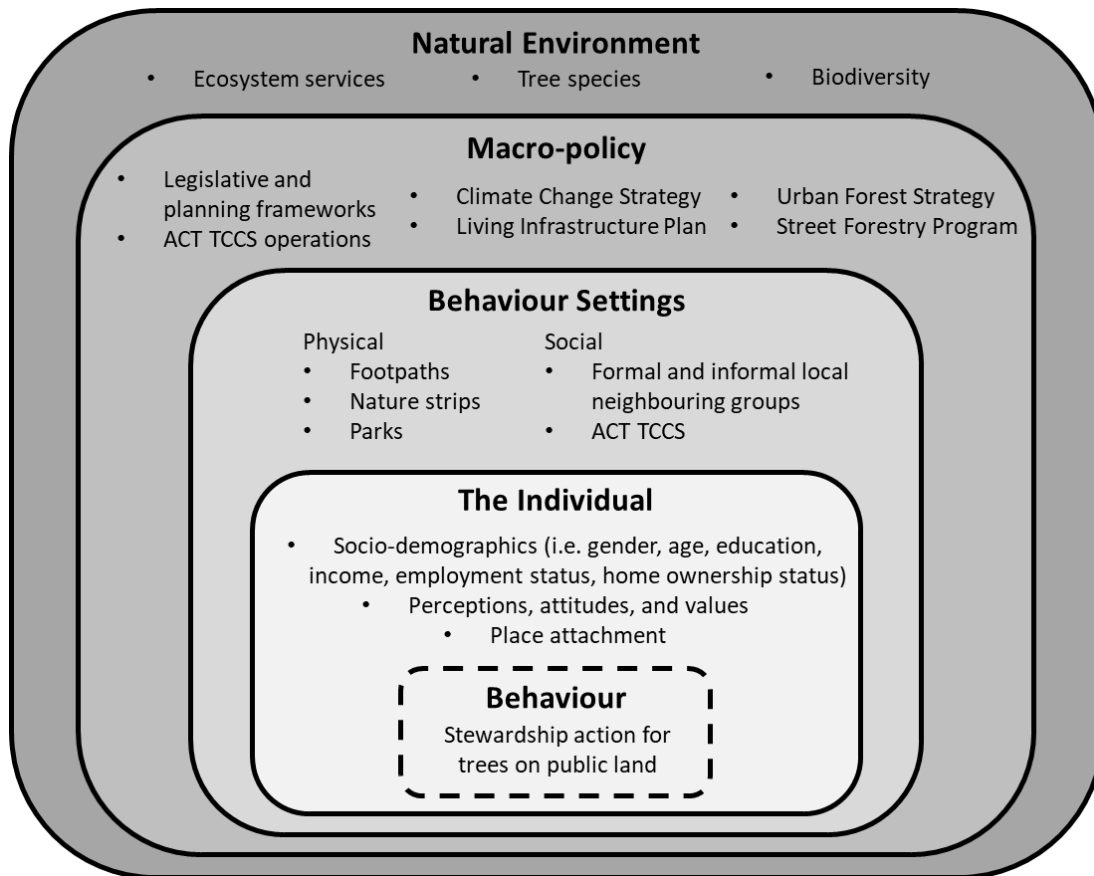
of factors, and values and perceptions are only a subset of them (Kollmuss and Agyeman, 2002). Other barriers to action include social or external factors, particularly the perceptions of institutions and responsibility (Blake, 1999). This is evident from my results, where perception of the responsibility being the government's was a main reason for minimal or no stewardship action; other reasons mentioned were the absence of street trees or presence of mature trees, and so a lack of feasible opportunity; lack of tree-related knowledge; and personal reasons, discussed further below. While only 7% of the survey respondents believe that they are 'absolutely not' responsible for the health of street trees, around a third (~30%) are either unsure or do not think that they are not responsible. These sentiments were evident amongst a similar proportion of the interviewees, and those who perceive the government as responsible for the care of trees tend to not engage in stewardship behaviours. This illustrates the importance of building an understanding on the part of residents as to why it would be beneficial for them to engage in stewardship behaviour in relation to street trees.

The personal reasons reported by interviewees relate to personal circumstances such as life stage and time availability, and can mediate the capacity for individuals to be engaged in stewardship behaviour. Similarly, Wilson (2000) states that certain life stages increase human capital, such as when individuals have sufficient time and income to be able to volunteer, which are then associated with higher rates of volunteerism. Generally, volunteers in Australia tend to be the older and retired (Beaton and Torgler, 2018), as this grants them with greater time availability to contribute compared to younger residents who are occupied with other family and career priorities. This was evident in my interviews where the majority of those who were retired claim to engage in some form of stewardship behaviour, more so than those who are currently working; while the sample size of the interviews is small, these results are consistent with those of the survey assuming that the retirees mainly belong to the older population (refer to section 4.1; Figure 5). Home ownership status can affect behaviours as noted in Kirkpatrick *et al.* (2013), although this relationship could not be investigated here as homeowners dominate the responses.

Education and gender are also important factors – educational level can determine the extent of one's pro-environmental behaviour, as more educated individuals tend to be more aware of the importance of engaging in stewardship behaviour or of the means to do so (Zsóka *et al.*, 2013); and women tend to express higher levels of environmental concern than men and act accordingly (Hunter *et al.*, 2004). Nonetheless, it is worth noting that while the majority of the interviewees had a broadly comparable level of education, as they were or are working as public servants, the extent of stewardship behaviour varied largely. This reflects the complexity of factors influencing stewardship behaviour, and the need to take on a holistic approach when examining those factors, as they are often not mutually exclusive and interacting (Steg and Vlek, 2009).

Additionally, the results from both the survey and the interviews suggest that some residents engage in behaviours detrimental to trees in their nature strip, knowingly or unknowingly. Despite

parking on nature strips being formally illegal, this rule is seldom enforced; for many residents in Canberra, nature strips are valued and used as parking areas. However, this is not mutually exclusive of stewardship behaviour: for example, an individual may still park their vehicle on the nature strip despite engaging in other behaviours to care for their street trees. Future research should be encouraged to better inform this issue of trade-offs between utility and other values.



**Figure 13. A conceptual model illustrating the factors influencing stewardship behaviour for trees on public land in Canberra, adapted from Moskell and Allred (2013a)**

Figure 13 summarises the factors influencing stewardship behaviour for trees on public land that emerged in my study, drawing from the ecological stewardship model (Moskell and Allred, 2013a; Figure 1) introduced in section 2.3. In Canberra, urban forests are governed by a set of legislative and planning frameworks and policy instruments (see section 3.1). The most relevant strategies, plans and guidance relevant to urban trees on public land in Canberra are the *Climate Change Strategy*, *Living Infrastructure Plan*, the *Urban Forest Strategy*, and guidance for residents provided by ACT TCCS (ACT Government, 2021d); the *Street Forestry Program* was developed and implemented in this context. In addition, TCCS operations such as those for public tree maintenance are also relevant to aspects of understanding people's behaviour. The focus of behaviour settings is on physical settings

and social actors relevant to trees on public land. At the individual level, socio-demographic factors of gender, age, education, income, and employment and home ownership status, appear to be important in influencing stewardship behaviour, based both on the literature and my results. Other relevant factors include perceptions, attitudes, values, and place attachment mentioned earlier in this section and in section 2.3.2. This model of individual behaviour may inform strategies and activities to encourage stewardship behaviour in residents to care for trees on public land.

### ***5.3 Insights for upscaling the Street Forestry Program and other urban greening programs***

Drawing from both my results and literature, this section then discusses research question 4 – *What can we learn from the findings of this study for the Street Forestry Program and other urban greening programs?*.

#### **5.3.1 Observations of the Street Forestry Program**

In general, the *Street Forestry Program* managed to achieve a number of its objectives, although its effectiveness was limited by a range of shortcomings as noted from the residents and personal observations made from the participant observation sessions. The initial survey, with an average response rate of 11.7% and coverage across the target suburbs, informed the government of the opinions of c. 137 residents with respect to urban trees and their values, and their stewardship behaviour. However, the evaluation survey at the end of the Program was not successful in eliciting further responses, as the response rate was less than 2%. This leaves questions about the effectiveness of the Program in enhancing knowledge and awareness of street tree-related issues unanswered; it also reflects that the Program was not able to sustain engagement within the residents over the three months of its duration, despite utilising various modes of engagement. The low turnout rates for the webinar and pop-up stalls were indicative of the limited reach of the Program. Citizen participation is enhanced by the implementation of a range of engagement techniques (see Kasymova, 2014); while this was recognised by the government in its approach to the Program, delays resulting from the COVID-19 pandemic and internal governmental processes, and limited staff and financial resources, constrained what could be done in practice.

The Program may also have been hampered by the different roles and responsibilities of government agencies and the consultancy firm hired to carry out the engagement process. The consultants reported back to the relevant governmental department (i.e. TCCS), who then communicated the information to the team responsible for carrying out the tree plantings. This division of responsibility appears to have constrained effective communication and coordination, as illustrated by the experience of one of the interviewees. It was also evident from observation at the pop-up stalls

that the consultants were not fully knowledgeable about governmental operations, although they were accompanied by a TCCS staff member who was able to respond to questions the consultants were not able to answer.

Where the survey findings were limited, the interviews that I conducted assisted in informing the effectiveness of the Program in encouraging a greater acceptance of trees. The extent to which trees are valued depends primarily on the tree species, as established in section 2.3.2, which suggests that residents may be more willing to accept a tree if their preferences are accommodated. This was acknowledged in the Program, as residents were allowed to nominate their preferred tree species for planting; this may have facilitated a greater acceptance of the planting of trees. Additionally, this process provides residents with the opportunity to be more involved in decision-making, facilitating an inclusive environment typical of good governance practices (Lockwood *et al.*, 2010). Many residents have noted this as a strength of the Program and were appreciative of the government reaching out to the community in this way. This suggests the government's commitment to facilitate a collaborative process with residents was worthwhile; it allows greater trust to be built between the government and the community, improving their working relationship, which is essential for enhancing urban greening outcomes (van Dam *et al.*, 2014).

In relation to its primary objective of increasing canopy cover consistent with targets set out in the *Urban Forest Strategy*, the Program has contributed to trees being (re)planted in the six selected suburbs, notwithstanding that its low engagement rates may have limited greater uptake of tree planting. However, there was minimal effort from the Program to foster stewardship behaviour and activate the community to care for the planted trees. This can be facilitated by the government through building capacities and knowledge, and by ensuring that residents can access a range of resources (section 2.3.3), which were not part of the Program. Stewardship education was not an issue raised at the pop-up stalls in which I participated; while this was the focus of the webinar, the small turnout meant that relevant information did not reach most of the residents. Information regarding actions that residents can take to care for trees was included in the letters mailed to all residents in the targeted streets, but the complexity of stewardship behaviour as established in section 5.2 suggests that more needs to be done if this behaviour is to be fostered. The interviews similarly indicate that the Program had little effect in encouraging greater stewardship behaviour amongst residents.

### **5.3.2 Broader implications and recommendations**

The *Street Forestry Program* was implemented as a pilot program, with a short timeframe and limited resources. Many interview respondents expressed their desire for the Program to be scaled up across more Canberra suburbs. In this section, I suggest how future programs with a similar intent might be improved, based on experience of this program.

Firstly, an adaptive approach to community engagement in future programs will foster greater levels of engagement and a wider reach. This will require sustained commitment from both the community and the government to establish a certain level of trust, and the provision of sufficient resources from the government to facilitate the engagement process (Bowen *et al.*, 2014). Future initiatives should also be conducted over longer periods of time in line; this will both foster trust-building, allow timely interventions to be made in the face of unplanned situations, and accommodate any potential changes. Table 3 draw from the Public Participation Spectrum (International Association for Public Participation, 2007) to suggest recommendations for community engagement, building from those used in the *Street Forestry Program*. These recommendations seek to enhance engagement with residents and maximise the potential for these initiatives to achieve their objectives.

Complementing this, the government should work towards strengthening its operational capacities for successful implementation. This will require better interdepartmental coordination where decisions can be coordinated more effectively across departments and levels of government (Ordóñez *et al.*, 2020). Improvements to existing communication tools will also help minimise misunderstandings and enhance the capacity for information to be relayed effectively to both the governmental departments and stakeholders (Konijnendijk, 2000). In the process, this will enhance the government's capacity to address broader concerns raised by the public with regards to the wider context of the cityscape and its associated development politics and policies. However, the common practice of contracting public sector services in Australia is often associated with a lack of coordination and communication (Quiggin, 1996), as noted in this study. Contracting provides a means for the government to cope a lack of internal resources while advancing its ambitions for the urban forest, but long-term success will ultimately rely on institutionalised arrangements (Young, 2011). These issues therefore need to be addressed if such arrangements are to persist into the future.

Table 4. Recommendations for community engagement methods based on the public participation spectrum

| Public Participation Spectrum element | Methods used in the <i>Street Forestry Program</i>                                                                                                                                                                                                                                                                                                                                                                                                 | Recommendations for future programs                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Inform</b>                         | <ul style="list-style-type: none"> <li>Information about the Program and actions residents can take to care for trees was included in the letters mailed to the residents;</li> <li>A website dedicated to the Program was created and provided visitors with access to relevant resources;</li> <li>A webinar was organised as a platform to educate residents about urban forests and stewardship behaviour</li> </ul>                           | <ul style="list-style-type: none"> <li>In addition to the letters, the government can utilise other forms of traditional media (i.e. television, radio) and social media to raise awareness and educate the public.</li> <li>Social media is an effective educational tool and allows a wide coverage of demographics, especially in the younger populations (Arceneaux and Dinu, 2018);</li> <li>An in-person seminar or focus group is encouraged instead of a webinar to facilitate a two-way communication (Kasymova and Schachter, 2014).</li> </ul> |
| <b>Consult</b>                        | <ul style="list-style-type: none"> <li>Surveys were distributed to the residents for the government to gain a better understanding of their opinions and levels of knowledge;</li> <li>One-off pop-up stalls were set up in the immediate vicinity of the target streets and served as a consultation process between the residents and the government. This allows residents to provide feedback and address their concerns in-person.</li> </ul> | <ul style="list-style-type: none"> <li>Surveys can be more comprehensive to encompass wider range of aspects;</li> <li>Pop-up stalls and/or community meetings could be organised more frequently throughout the span of a program, and in more centralised locations with greater foot traffic. The timing of these events should avoid holiday weekends or other major calendar clashes (eg, depending on timing, major sporting events).</li> </ul>                                                                                                    |
| <b>Involve</b>                        | <ul style="list-style-type: none"> <li>Vote cards were distributed to the residents (paper-based and online), allowing them to be directly involved in making decisions about tree species by nominating their preferences.</li> </ul>                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>The government should continue to integrate such processes into its decision-making and encourage a more inclusive environment.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                         |

|                    |                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                                                                                                                                                |
|--------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Collaborate</b> | <ul style="list-style-type: none"> <li>• The collaborative approach of the Program, using various engagement methods as noted (i.e. pop-up stalls, webinar, vote cards), allowed residents to make decisions alongside the government in relation to tree planting issues throughout the Program's duration.</li> </ul>                           | <ul style="list-style-type: none"> <li>• A platform for collaborative process to continue beyond the duration of a program should be established by the government, which will also aid in monitoring and evaluating the program.</li> <li>• Resident committees could be an option, where the government can conduct regular meetings with the representatives from the community.</li> </ul> |
| <b>Empower</b>     | <ul style="list-style-type: none"> <li>• Apart from having their preferences catered to through the vote cards, residents also had the final say in whether they wanted a tree to be planted in their nature strips. This was done through contacting the government officials at the pop-up stalls or webinar, or via correspondence.</li> </ul> | <ul style="list-style-type: none"> <li>• Existing methods can be built upon by organising more in-person meetings, which allows greater flexibility in decision-making.</li> <li>• There should be closer coordination between different groups within TCCS, to ensure residents' wishes are respected.</li> </ul>                                                                             |

Stewardship education should also be addressed specifically if the *Street Forestry Program* is to be scaled up, or when establishing new urban greening programs. Apart from informing and educating the public through engagement methods suggested in Table 3, the process of initiating and sustaining stewardship behaviour in the long-term will require targeted strategies that acknowledge the factors influencing stewardship behaviour, as identified in section 5.2. This allows the government to identify leverage points and be more responsive to residents' diverse motivations for action (see Mansourian, 2021). The plurality of values and needs of residents should be recognised when planning knowledge-building activities, and educational platforms should operate across formal, non-formal, and informal settings (see Kanowski *et al.*, 2020). Programs can include children, through both school-based and extra-curricular activities, and provide a platform for them to gain environmental knowledge, which may in turn encourage their parents to take positive action (Eilam and Trop, 2014). Acknowledging their potential, the government can also work with neighbourhood groups and draw from successful stewardship programs (see section 2.3.1) for local implementation. Other best practices identified in the literature presented in section 2.3.3 may further guide the government in encouraging stewardship behaviour (e.g. support key stakeholders, secure adequate financing, and sustain political support).

While issues of equity were not the subject of my research, they are important considerations for future urban greening projects and in the development of urban sustainability agendas (Cooke, 2020). The government should continue to work towards improving canopy cover across all suburbs and within suburbs, and ensure that communities characterised by lower socio-economic indicators continue to have good access to urban green spaces as cities change and densify (Lin *et al.*, 2015). Collaboration with other stakeholders such as NGOs and educational institutions may also enhance the government's capacities to develop and implement best practices for encouraging stewardship behaviour and improving urban greening outcomes.

## Chapter 6: Conclusion

The trajectory of climate change and urbanisation provides a timely opportunity for cities to engage in nature-based solutions (NbS), of which urban forests can provide a range of ecosystem services to combat these challenges. The emergence of urban forest strategies and plans across the world reflect city governments' enthusiasm to embrace such solutions, but the long-term success of establishing urban forests will depend on efforts from multiple stakeholders. Particularly, the community plays an important role in stewarding urban forests with the support of the government. Investigating residents' perceptions and attitudes to trees and related issues therefore becomes crucial for the government to encourage stewardship. In the broader literature, resident's perspectives of urban forests and the significance of stewardship in maximising the outcomes of urban forests are largely limited to the global context. Studies of community activation to facilitate stewardship behaviour are also focused on organised neighbourhood groups with less focus on the individual level. This thesis therefore aimed to address these knowledge gaps in the context of Canberra and the *Street Forestry Program*, and inform future government strategies to this end. Four research questions were addressed:

- 1) What are the best practices to encouraging stewardship by residents of their neighbourhood trees?
- 2) What do Canberra residents think about trees on public land in proximity to where they live?
- 3) What are the factors influencing tree stewardship behaviour in Canberra residents?
- 4) What can we learn from the findings of this study for the *Street Forestry Program* and other urban greening programs?

Literature broadly suggests knowledge-building, creation of an inclusive social environment, collaboration with other stakeholders, and strengthening of internal governmental operations as best practices to encourage stewardship of urban forests. Consistent with expectations from the literature, my results suggest a widespread view that street trees are important to Canberra residents for a range of reasons: the top five were aesthetic, shading, biodiversity, carbon sequestration and erosion control. However, a value-action gap exists and positive attitudes towards trees were insufficient to encourage stewardship behaviour.

My research makes a novel contribution to understanding urban street tree stewardship at the individual level, and how such stewardship might be fostered by community-level initiatives such as the *Street Forestry Program*. At the individual level, individual motivations, personal circumstances, and governmental policies emerged as the factors influencing tree stewardship behaviour, and represented in a model in the context of Canberra. These results led to recommendations, consistent with best practices, that suggest that future programs should take on an adaptive and collaborative approach, address internal governmental challenges, and acknowledge and respond to factors within the stewardship model identified in this study.

Acknowledging the limitations of this research, future studies should expand upon the foundations established by this study and investigate wider themes of equity in urban development. The relationship between socio-demographic factors and stewardship should be explored in greater detail and a larger sample population across a wider range of Canberra suburbs should be included. The role of other stakeholders in urban forest stewardship, in addition to that of residents, should be considered for a more holistic perspective. Urban forests as NbS will be increasingly important in the face of urbanisation and climate change, and this study helps to contribute to this growing area of activity. Its findings will also be able to support the ACT Government's efforts to foster stewardship behaviour in the community and facilitate the long-term success of Canberra's *Urban Forest Strategy*.

## References

- Aalbers, C. B. E. M. and Sehested, K., 2018. Critical upscaling. How citizens' initiatives can contribute to a transition in governance and quality of urban greenspace, *Urban Forestry & Urban Greening*, **29**: 261-275.
- Abram, S. and Cowell, R., 2004. Dilemmas of Implementation: 'Integration' and 'Participation' in Norwegian and Scottish Local Government, *Environment and Planning. C, Government & Policy*, **22**(5): 701-719.
- ACT Government, 2016. *Bush Capital - the natural history of the ACT* [webpage], Available at: <http://bushcapital.cmag.com.au/> (accessed 16 June 2021).
- ACT Government, 2017. *Haig Park Masterplan Development - Phase 1 Community Engagement Summary*. Available at: [https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/8314/9421/0037/Engagement\\_Summary\\_Report\\_Final.pdf](https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/8314/9421/0037/Engagement_Summary_Report_Final.pdf) (accessed 30 March 2021).
- ACT Government, 2018. ACT Planning Strategy 2018 - Community Engagement Report. Available at: [https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/8515/5797/6049/ACT\\_Planning\\_Strategy\\_-\\_community\\_engagement\\_report.pdf](https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/8515/5797/6049/ACT_Planning_Strategy_-_community_engagement_report.pdf) (accessed 30 March 2021).
- ACT Government, 2019a. *ACT Climate Change Strategy 2019-25*, Environment, Planning and Sustainable Development Directorate, Canberra, ACT. Available at: [https://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0003/1414641/ACT-Climate-Change-Strategy-2019-2025.pdf/\\_recache](https://www.environment.act.gov.au/__data/assets/pdf_file/0003/1414641/ACT-Climate-Change-Strategy-2019-2025.pdf/_recache) (accessed 10 March 2021).
- ACT Government, 2019b. *Canberra's Living Infrastructure Plan: Cooling the City*, Environment, Planning and Sustainable Development Directorate, Canberra, ACT. Available at: [https://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/1413770/Canberras-Living-Infrastructure-Plan.pdf](https://www.environment.act.gov.au/__data/assets/pdf_file/0005/1413770/Canberras-Living-Infrastructure-Plan.pdf) (accessed 10 March 2021).
- ACT Government, 2019c. *Your Nature Strip - Guidelines for Use of Residential Nature Strips*, Canberra, ACT. Available at: [https://www.cityservices.act.gov.au/\\_\\_data/assets/pdf\\_file/0004/1392088/Nature-Strip-Guidelines-2019.pdf](https://www.cityservices.act.gov.au/__data/assets/pdf_file/0004/1392088/Nature-Strip-Guidelines-2019.pdf) (accessed 27 July 2021).
- ACT Government, 2020. *Urban Forest Strategy*, Environment, Planning and Sustainable Development Directorate, Canberra, ACT. Available at: [https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/6715/9545/9570/Urban\\_Forest\\_Strategy-Final-accessible.pdf](https://s3.ap-southeast-2.amazonaws.com/hdp.au.prod.app.act-yoursay.files/6715/9545/9570/Urban_Forest_Strategy-Final-accessible.pdf) (accessed 10 March 2021).
- ACT Government, 2021a. *Information about Tree Protection on Leased Land* [webpage], Available at: [https://www.cityservices.act.gov.au/trees-and-nature/trees/information\\_about\\_tree\\_protection\\_on\\_leased\\_land#wiauf](https://www.cityservices.act.gov.au/trees-and-nature/trees/information_about_tree_protection_on_leased_land#wiauf) (accessed 20 April 2021).
- ACT Government, 2021b. *Territory Plan and the National Capital Plan* [webpage], Available at: [https://www.planning.act.gov.au/planning-our-city/territory\\_plan/territory-plan-and-the-national-capital-plan](https://www.planning.act.gov.au/planning-our-city/territory_plan/territory-plan-and-the-national-capital-plan) (accessed 16 April 2021).
- ACT Government, 2021c. *The ParkCare Initiative* [webpage], Available at: <https://www.environment.act.gov.au/parks-conservation/parks-and-reserves/get-involved/parkcare-and-urban-landcare-program> (accessed 22 October 2021).
- ACT Government, 2021d. *Trees on public land* [webpage], Available at: <https://www.cityservices.act.gov.au/trees-and-nature/trees/trees-on-public-land> (accessed 16 April 2021).
- ACT Government, 2021e. *Street Forestry Program* [webpage], Available at: <https://www.cityservices.act.gov.au/trees-and-nature/trees/street-forestry-program> (accessed 22 April 2021).
- Adams, W. C., 2015. Conducting semi-structured interviews, *Handbook of Practical Program Evaluation*, **4**: 492-505.

- Ajzen, I., 1991. The theory of planned behavior, *Organizational Behavior and Human Decision Processes*, **50**(2): 179-211.
- Ajzen, I. and Fishbein, M., 1980. Understanding attitudes and predicting social behavior, *Englewood Cliffs*.
- Atkinson, P. and Hammersley, M., 1998. Ethnography and participant observation, *Strategies of Qualitative Inquiry*. Thousand Oaks: Sage: 248-261.
- Alvey, A. A., 2006. Promoting and preserving biodiversity in the urban forest, *Urban Forestry & Urban Greening*, **5**(4): 195-201.
- Appiah-Opoku, S., 2005. *The Need for Indigenous Knowledge in Environmental Impact Assessment: The Case of Ghana*, Edwin Mellen Press, New York.
- Arceneaux, P. C. and Dinu, L. F., 2018. The social mediated age of information: Twitter and Instagram as tools for information dissemination in higher education, *New Media & Society*, **20**(11): 4155-4176.
- Aronson, M. F. J., La Sorte, F. A., Nilon, C. H., Katti, M., Goddard, M. A., Lepczyk, C. A., Warren, P. S., Williams, N. S. G., Cilliers, S., Clarkson, B., Dobbs, C., Dolan, R., Hedblom, M., Klotz, S., Kooijmans, J. L., Kühn, I., Macgregor-Fors, I., McDonnell, M., Mörtberg, U., Pyšek, P., Siebert, S., Sushinsky, J., Werner, P., Winter, M. and Sveriges, I., 2014. A global analysis of the impacts of urbanization on bird and plant diversity reveals key anthropogenic drivers, *Proceedings of the Royal Society. B, Biological Sciences*, **281**(1780): 20133330.
- Auckland Council, 2019. *Auckland's Urban Ngahere (Forest) Strategy*, Auckland, New Zealand. Available at: <https://www.aucklandcouncil.govt.nz/plans-projects-policies-reports-bylaws/our-plans-strategies/topic-based-plans-strategies/environmental-plans-strategies/Documents/urban-ngahere-forest-strategy.pdf> (accessed 14 April 2021).
- Avolio, M. L., Pataki, D. E., Pincetl, S., Gillespie, T. W., Jenerette, G. D. and McCarthy, H. R., 2015. Understanding preferences for tree attributes: the relative effects of socio-economic and local environmental factors, *Urban Ecosystems*, **18**(1): 73-86.
- Bai, X., McPhearson, T., Cleugh, H., Nagendra, H., Tong, X., Zhu, T. and Zhu, Y.-G., 2017. Linking Urbanization and the Environment: Conceptual and Empirical Advances, *Annual Review of Environment and Resources*, **42**(1): 215-240.
- Banks, J. C. G. and Brack, C. L., 2003. Canberra's Urban Forest: Evolution and planning for future landscapes, *Urban Forestry & Urban Greening*, **1**(3): 151-160.
- Beaton, T. and Torgler, B., 2018. Volunteering and life or financial shocks: does income and wealth matter?, *Applied Economics*, **50**(19): 2190-2209.
- Benedict, M. A. and McMahon, E. T., 2012. *Green infrastructure: linking landscapes and communities*, Island Press.
- Bennett, N. J., Whitty, T. S., Finkbeiner, E., Pittman, J., Bassett, H., Gelcich, S. and Allison, E. H., 2018. Environmental Stewardship: A Conceptual Review and Analytical Framework, *Environmental Management*, **61**(4): 597-614.
- Berdejo-Espinola, V., Suárez-Castro, A. F., Amano, T., Fielding, K. S., Oh, R. R. Y. and Fuller, R. A., 2021. Urban green space use during a time of stress: A case study during the COVID-19 pandemic in Brisbane, Australia, *People and Nature*, **3**(3): 597-609.
- Blake, J., 1999. Overcoming the 'value-action gap' in environmental policy: Tensions between national policy and local experience, *Local Environment*, **4**(3): 257-278.
- Bowen, P. M., Conallin, J., Watts, R. J., Conallin, A., Campbell, J., Wooden, I., McCasker, N., Baumgartner, L., Healy, S. and Knight, R., 2014. *Stakeholder engagement and adaptive governance in the monitoring, evaluation and adaptive management of environmental watering in the Edward-Wakool system*, 7th Australian Stream Management Conference, Townsville, Queensland.
- Boyce, S., 2010. It takes a stewardship village: Effect of volunteer tree stewardship on urban street tree mortality rates, *Cities and the Environment*, **3**(1): 1-8.
- Brack, C., 2005. *Environmental amenity and habitat values of an urban forest: how to determine and manage for them in Canberra*, Proceedings of the ISAAC Conference, Launceston, Tasmania.
- Brack, C. and Schirmer, J., 2020. *Social, economic and environmental values of street trees in the urban environment*, Transport Canberra and City Services Directorate, Canberra, ACT.

- Braverman, I., 2008. "Everybody loves trees" Policing American cities through street trees, *Duke Environmental Law & Policy Forum*, **19**(1): 81-118.
- Buijs, A., Elands, B., Havik, G., Ambrose-Oji, B., Geröházi, E., Van der Jagt, A., Mattijssen, T., Møller, M. S. and Vierikko, K., 2016. *Innovative governance of urban green spaces: Learning from 18 innovative examples across Europe*, Wageningen University, Wageningen, Netherlands.
- Buijs, A., Hansen, R., Van der Jagt, S., Ambrose-Oji, B., Elands, B., Lorange Rall, E., Mattijssen, T., Pauleit, S., Runhaar, H., Stahl Olafsson, A. and Steen Møller, M., 2019. Mosaic governance for urban green infrastructure: Upscaling active citizenship from a local government perspective, *Urban Forestry & Urban Greening*, **40**: 53-62.
- Bulkeley, H. and Betsill, M. M., 2005. Rethinking sustainable cities: Multilevel governance and the 'urban' politics of climate change, *Environmental Politics*, **14**(1): 42-63.
- Bulkeley, H. and Betsill, M. M., 2013. Revisiting the urban politics of climate change, *Environmental Politics*, **22**(1): 136-154.
- Burghardt, K. T., Tallamy, D. W. and Gregory Shriver, W., 2009. Impact of native plants on bird and butterfly biodiversity in suburban landscapes, *Conservation Biology*, **23**(1): 219-224.
- Butt, S., Smith, S. M., Moola, F. and Conway, T. M., 2021. The relationship between knowledge and community engagement in local urban forest governance: A case study examining the role of resident association members in Mississauga, Canada, *Urban Forestry & Urban Greening*, **60**: 127054.
- Calfapietra, C., Fares, S., Manes, F., Morani, A., Sgrigna, G. and Loreto, F., 2013. Role of Biogenic Volatile Organic Compounds (BVOC) emitted by urban trees on ozone concentration in cities: A review, *Environmental Pollution*, **183**: 71-80.
- Camacho-Cervantes, M., Schondube, J. E., Castillo, A. and MacGregor-Fors, I., 2014. How do people perceive urban trees? Assessing likes and dislikes in relation to the trees of a city, *Urban Ecosystems*, **17**(3): 761-773.
- Cariñanos, P., Adinolfi, C., Díaz de la Guardia, C., De Linares, C. and Casares-Porcel, M., 2016. Characterization of Allergen Emission Sources in Urban Areas, *Journal of Environmental Quality*, **45**(1): 244-252.
- Carmichael, C. E. and McDonough, M. H., 2018. The trouble with trees? Social and political dynamics of street tree-planting efforts in Detroit, Michigan, USA, *Urban Forestry & Urban Greening*, **31**: 221-229.
- Chawla, L., 2015. Benefits of Nature Contact for Children, *Journal of Planning Literature*, **30**(4): 433-452.
- Chen, W. Y., 2015. The role of urban green infrastructure in offsetting carbon emissions in 35 major Chinese cities: A nationwide estimate, *Cities*, **44**: 112-120.
- City of Chicago, 2009. *Chicago's Urban Forest Agenda*. Available at: [https://www.chicago.gov/content/dam/city/depts/doe/general/NaturalResourcesAndWaterConservation\\_PDFs/UrbanForestAgenda/ChicagosUrbanForestAgenda2009.pdf](https://www.chicago.gov/content/dam/city/depts/doe/general/NaturalResourcesAndWaterConservation_PDFs/UrbanForestAgenda/ChicagosUrbanForestAgenda2009.pdf) (accessed 3 March 2021).
- City of Hobart, 2018. *Community Engagement Framework*. Available at: <https://www.hobartcity.com.au/files/content/public/community/community-engagement/city-of-hobart-community-engagement-framework.pdf> (accessed 18 June 2021).
- City of Melbourne, 2014. *Urban Forest Strategy: Making A Great City Greener 2012-2032*. Available at: <https://www.melbourne.vic.gov.au/SiteCollectionDocuments/urban-forest-strategy.pdf> (accessed 3 March 2021).
- City of Melbourne, 2020. *Urban Forest Visual* [webpage], Available at: <http://melbourneurbanforestvisual.com.au/> (accessed 29 July 2021).
- City of Seattle, 2020. *2020 Urban Forest Management Plan*. Available at: [http://www.seattle.gov/Documents/Departments/UrbanForestryCommission/Resources/UFM\\_Pv11\\_100620.pdf](http://www.seattle.gov/Documents/Departments/UrbanForestryCommission/Resources/UFM_Pv11_100620.pdf) (accessed 3 March 2021).
- City of Toronto, 2013. *Sustaining & Expanding the Urban Forest: Toronto's Strategic Forest Management Plan*, Toronto, Ontario. Available at: [https://www.toronto.ca/wp-content/uploads/2017/12/8e0e-Strategic-Forest-Management-Plan-2012\\_22.pdf](https://www.toronto.ca/wp-content/uploads/2017/12/8e0e-Strategic-Forest-Management-Plan-2012_22.pdf) (accessed 19 April 2021).

- Clark, J. R., Matheny, N. P., Cross, G. and Wake, V., 1997. A model of urban forest sustainability, *Journal of Arboriculture*, **23**: 17-30.
- Coffey, B., Bush, J., Mumaw, L., de Kleyn, L., Furlong, C. and Cretney, R., 2020. Towards good governance of urban greening: insights from four initiatives in Melbourne, Australia, *Australian Geographer*, **51**(2): 189-204.
- Cohen-Shacham, E., Walters, G., Janzen, C. and Maginnis, S., 2016. *Nature-based Solutions to address global societal challenges*, IUCN, Gland, Switzerland.
- Commissioner for Sustainability and the Environment, 2020. *ACT State of the Environment - 2019 Report*, Canberra, ACT. Available at: <https://envcomm.act.gov.au/wp-content/uploads/2020/07/SOEfull.pdf> (accessed 15 June 2021).
- Cooke, B., 2020. The politics of urban greening: an introduction, *Australian Geographer*, **51**(2): 137-153.
- Daryanto, A. and Song, Z., 2021. A meta-analysis of the relationship between place attachment and pro-environmental behaviour, *Journal of Business Research*, **123**: 208-219.
- Davis, J. L., Green, J. D. and Reed, A., 2009. Interdependence with the environment: Commitment, interconnectedness, and environmental behavior, *Journal of Environmental Psychology*, **29**(2): 173-180.
- de Guzman, E., Malarich, R., Large, L. and Danoff-Burg, S., 2018. Inspiring Resident Engagement: Identifying Street Tree Stewardship Participation Strategies in Environmental Justice Communities Using a Community-Based Social Marketing Approach, *Arboriculture & Urban Forestry*.
- Dobson, A., 2003. *Citizenship and the Environment*, Oxford University Press.
- Doyle, L., Brady, A.-M. and Byrne, G., 2009. An overview of mixed methods research, *Journal of Research in Nursing*, **14**(2): 175-185.
- Dwyer, J. F., Childs, G. M. and Nowak, D. J., 2000. *Forestry in urban and urbanizing areas of the United States; connecting people with forest in the 21st century*, In: B. Krishnapillay, E. Soepadmo, N. Arshad, A. Wong, S. Appanah, S. Chik, N. Manakaran, H. Trong, and K. Choon (Eds.). *Forests and Society: The Role of Research*. Sub-Plenary Sessions Vol 1. XXI IUFRO World Congress, August 7–12, 2000, Kuala Lumpur, Malaysia.
- Eilam, E. and Trop, T., 2014. Factors Influencing Adults' Environmental Attitudes and Behaviors and the Role of Environmental Schools in Influencing Their Communities, *Education and Urban Society*, **46**(2): 234-263.
- Eisenman, T. S., Churkina, G., Jariwala, S. P., Kumar, P., Lovasi, G. S., Pataki, D. E., Weinberger, K. R. and Whitlow, T. H., 2019. Urban trees, air quality, and asthma: An interdisciplinary review, *Landscape and Urban Planning*, **187**: 47-59.
- Elmendorf, W. F., Cotrone, V. J. and Mullen, J. T., 2003. Trends in urban forestry practices, programs, and sustainability: Contrasting a Pennsylvania, U.S., study, *Journal of Arboriculture*, **29**(4): 237.
- Ernstson, H., Barthel, S., Andersson, E. and Borgström, S. T., 2010. Scale-Crossing Brokers and Network Governance of Urban Ecosystem Services: The Case of Stockholm, *Ecology and Society*, **15**(4): 28.
- Escobedo, F. J., Giannico, V., Jim, C. Y., Sanesi, G. and Laforteza, R., 2019. Urban forests, ecosystem services, green infrastructure and nature-based solutions: Nexus or evolving metaphors?, *Urban Forestry & Urban Greening*, **37**: 3-12.
- European Commission, 2015. Towards an EU Research and Innovation policy agenda for nature-based solutions & re-naturing cities, *Final Report of the Horizon2020 Expert Group on Nature-Based Solutions and Re-Naturing Cities*. Brussels: European Commission.
- Fernandes, C. O., da Silva, I. M., Teixeira, C. P. and Costa, L., 2019. Between tree lovers and tree haters. Drivers of public perception regarding street trees and its implications on the urban green infrastructure planning, *Urban Forestry & Urban Greening*, **37**: 97-108.
- Ferreira, V., Barreira, A. P., Loures, L., Antunes, D. and Panagopoulos, T., 2020. Stakeholders' Engagement on Nature-Based Solutions: A Systematic Literature Review, *Sustainability*, **12**(2): 640.
- Foo, K., 2018. Examining the Role of NGOs in urban environmental governance, *Cities*, **77**: 67-72.

- Franklin, A. and Marsden, T., 2015. (Dis)connected communities and sustainable place-making, *Local Environment*, **20**(8): 940-956.
- Frantzeskaki, N., 2019. Seven lessons for planning nature-based solutions in cities, *Environmental Science & Policy*, **93**: 101-111.
- Fraser, E. D. G. and Kenney, W. A., 2000. Cultural background and landscape history as factors affecting perceptions of the urban forest, *Journal of Arboriculture*, **26**(2): 106-113.
- Gilbert, M. and Brack, C. L., 2007. Changes in public requests to remove significant urban trees after severe bushfires in Canberra, Australia, *Urban Forestry & Urban Greening*, **6**(1): 41-48.
- Gray, E. R. and van Heezik, Y., 2016. Exotic trees can sustain native birds in urban woodlands, *Urban Ecosystems*, **19**(1): 315-329.
- Gusfield, J. R., 1975. *Community: A critical response*, Harper & Row New York.
- Gwedla, N. and Shackleton, C. M., 2019. Perceptions and preferences for urban trees across multiple socio-economic contexts in the Eastern Cape, South Africa, *Landscape and Urban Planning*, **189**: 225-234.
- Head, L. M. and Muir, P., 2005. *Living with trees—Perspectives from the suburbs*, Proceedings of the 6th National Conference of the Australian Forest History Society, Rotterdam, Millpress.
- Heimlich, J., Sydnor, T. D., Bumgardner, M. and O'Brien, P., 2008. Attitudes of residents toward street trees on four streets in Toledo, Ohio, US before removal of ash trees (*Fraxinus* spp.) from emerald ash borer (*Agrilus planipennis*), *Arboriculture & Urban Forestry*. **34** (1): 47-53., **34**(1).
- Hunter, L. M., Hatch, A. and Johnson, A., 2004. Cross-national gender variation in environmental behaviors, *Social Science Quarterly*, **85**(3): 677-694.
- Ikin, K., Le Roux, D. S., Rayner, L., Villaseñor, N. R., Eyles, K., Gibbons, P., Manning, A. D. and Lindenmayer, D. B., 2015. Key lessons for achieving biodiversity-sensitive cities and towns, *Ecological Management & Restoration*, **16**(3): 206-214.
- Inner South Canberra Community Council, 2020. *Final Report On ISCCC Online Community Survey 2019/20*. Available at: <https://www.isccc.org.au/final-report-on-isccc-online-community-survey-2019-20> (accessed 30 March 2021).
- International Association for Public Participation, 2007. IAP2 spectrum of public participation, International Association for Public Participation.
- Jay, M. and Schraml, U., 2009. Understanding the role of urban forests for migrants – uses, perception and integrative potential, *Urban Forestry & Urban Greening*, **8**(4): 283-294.
- Jennings, T. E., Jean-Philippe, S. R., Willcox, A., Zobel, J. M., Poudyal, N. C. and Simpson, T., 2016. The influence of attitudes and perception of tree benefits on park management priorities, *Landscape and Urban Planning*, **153**: 122-128.
- Jim, C. Y. and Chen, W. Y., 2006. Perception and Attitude of Residents Toward Urban Green Spaces in Guangzhou (China), *Environmental Management*, **38**(3): 338-349.
- Kabisch, N., Frantzeskaki, N., Pauleit, S., Naumann, S., Davis, M., Artmann, M., Haase, D., Knapp, S., Korn, H., Stadler, J., Zaunberger, K. and Bonn, A., 2016. Nature-based solutions to climate change mitigation and adaptation in urban areas: perspectives on indicators, knowledge gaps, barriers, and opportunities for action, *Ecology and Society*, **21**(2): 39.
- Kalmbach, K. L. and Kielbaso, J. J., 1979. Resident attitudes toward selected characteristics of street tree plantings, *Journal of Arboriculture*, **5**: 124-129.
- Kampa, M. and Castanas, E., 2008. Human health effects of air pollution, *Environmental Pollution* (1987), **151**(2): 362-367.
- Kanowski, P., Yao, D. and Wyatt, S., 2020. SDG 4: Quality Education and Forests - 'The Golden Thread'. (Eds, Katila, P., Pierce Colfer, C., de Jong, W., Galloway, G., Pacheco, P. and Winkel, G.), Cambridge University Press, pp. 108-145.
- Kasymova, J., 2014. Analyzing recent citizen participation trends in Western New York: Comparing citizen engagement promoted by local governments and nonprofit organizations, *Canadian Journal of Nonprofit and Social Economy Research*, **5**(2).
- Kasymova, J. T. and Schachter, H. L., 2014. Bringing Participatory Tools to a Different Level, *Public Performance & Management Review*, **37**(3): 441-464.
- Kellert, S. and Wilson, E., 1993. *The biophilia hypothesis*, Island Press, Washington, DC.

- Kirkpatrick, J. B., Davison, A. and Daniels, G. D., 2012. Resident attitudes towards trees influence the planting and removal of different types of trees in eastern Australian cities, *Landscape and Urban Planning*, **107**(2): 147-158.
- Kirkpatrick, J. B., Davison, A. and Daniels, G. D., 2013. Sinners, scapegoats or fashion victims? Understanding the deaths of trees in the green city, *Geoforum*, **48**: 165-176.
- Klinger, E., 1977. *Meaning and void: Inner experience and the incentives in peoples lives*, University of Minnesota Press, Minneapolis.
- Ko, Y., Lee, J.-H., McPherson, E. G. and Roman, L. A., 2015. Long-term monitoring of Sacramento Shade program trees: Tree survival, growth and energy-saving performance, *Landscape and Urban Planning*, **143**: 183-191.
- Kocisky, K. A., 2016. 'Evaluating residents' willingness to pay and volunteer for urban street trees on Logan Square's historic green boulevards in Chicago', M.A., Northeastern Illinois University, Ann Arbor.
- Koeser, A. K., Gilman, E. F., Paz, M. and Harchick, C., 2014. Factors influencing urban tree planting program growth and survival in Florida, United States, *Urban Forestry & Urban Greening*, **13**(4): 655-661.
- Kollmuss, A. and Agyeman, J., 2002. Mind the Gap: Why do people act environmentally and what are the barriers to pro-environmental behavior?, *Environmental Education Research*, **8**(3): 239-260.
- Konijnendijk, C. C., 2000. Adapting forestry to urban demands — role of communication in urban forestry in Europe, *Landscape and Urban Planning*, **52**(2): 89-100.
- Koskela, H. and Pain, R., 2000. Revisiting fear and place: women's fear of attack and the built environment, *Geoforum*, **31**(2): 269-280.
- Krasny, M. E. and Tidball, K. G., 2012. Civic ecology: a pathway for Earth Stewardship in cities, *Frontiers in Ecology and the Environment*, **10**(5): 267-273.
- Kuo, F. E. and Sullivan, W. C., 2001. Environment and Crime in the Inner City: Does Vegetation Reduce Crime?, *Environment and Behavior*, **33**(3): 343-367.
- Křepelková, Š. D., Krajhanzl, J. and Kroufek, R., 2020. The influence of interaction with nature in childhood on future pro-environmental behavior, *Journal of Baltic Science Education*, **19**(4): 536-550.
- Lafortezza, R., Carrus, G., Sanesi, G. and Davies, C., 2009. Benefits and well-being perceived by people visiting green spaces in periods of heat stress, *Urban Forestry & Urban Greening*, **8**(2): 97-108.
- Landcare Australia, n.d. *About the Landcare Movement* [webpage], Available at: <https://landcareaustralia.org.au/about/the-landcare-story/> (accessed 28 March 2021).
- Lawrence, A., De Vreese, R., Johnston, M., Konijnendijk van den Bosch, C. C. and Sanesi, G., 2013. Urban forest governance: Towards a framework for comparing approaches, *Urban Forestry & Urban Greening*, **12**(4): 464-473.
- Leopold, A., 1949. *A Sand County almanac, and sketches here and there*, Oxford University Press, USA.
- Liepins, R., 2000. Exploring rurality through 'community': discourses, practices and spaces shaping Australian and New Zealand rural 'communities', *Journal of Rural Studies*, **16**(3): 325-341.
- Lin, B., Meyers, J. and Barnett, G., 2015. Understanding the potential loss and inequities of green space distribution with urban densification, *Urban Forestry & Urban Greening*, **14**(4): 952-958.
- Livesley, S. J., McPherson, G. M. and Calfapietra, C., 2016. The urban forest and ecosystem services: Impacts on urban water, heat, and pollution cycles at the tree, street, and city scale, *Journal of Environmental Quality*, **45**(1): 119-124.
- Lo, A. Y., Byrne, J. A. and Jim, C. Y., 2017. How climate change perception is reshaping attitudes towards the functional benefits of urban trees and green space: Lessons from Hong Kong, *Urban Forestry & Urban Greening*, **23**: 74-83.
- Lockwood, M., Davidson, J., Curtis, A., Stratford, E. and Griffith, R., 2010. Governance Principles for Natural Resource Management, *Society & Natural Resources*, **23**(10): 986-1001.
- Lohr, V. I., Pearson-Mims, C. H., Tarnai, J. and Dillman, D. A., 2004. How urban residents rate and rank the benefits and problems associated with trees in cities, *Journal of Arboriculture*, **30**(1): 28-35.

- London Urban Forest Partnership, 2020. *London Urban Forest Plan*. Available at: [https://www.london.gov.uk/sites/default/files/londonurbanforestplan\\_final.pdf](https://www.london.gov.uk/sites/default/files/londonurbanforestplan_final.pdf) (accessed 3 March 2021).
- Loukaitou-Sideris, A., Ehrenfeucht, R. and Gottlieb, R., 2009. *Sidewalks : Conflict and Negotiation over Public Space*, MIT Press, Cambridge, United States.
- Lyons, I. and Cavaye, J., 2016. Community-Led Engagement With Government and the Role of Community Brokers in East New Britain, Papua New Guinea, *Society & Natural Resources*, **29**(4): 462-478.
- Lyytimäki, J. and Sipilä, M., 2009. Hopping on one leg—The challenge of ecosystem disservices for urban green management, *Urban Forestry & Urban Greening*, **8**(4): 309-315.
- Maas, J., Verheij, R. A., de Vries, S., Spreeuwenberg, P., Schellevis, F. G. and Groenewegen, P. P., 2009. Morbidity is related to a green living environment, *Journal of Epidemiology and Community Health*, **63**(12): 967-973.
- MacQueen, K. M., McLellan, E., Metzger, D. S., Kegeles, S., Strauss, R. P., Scotti, R., Blanchard, L. and Trotter, R. T., 2001. What is community? An evidence-based definition for participatory public health, *American Journal of Public Health*, **91**(12): 1929-1938.
- Malhi, Y., 2017. The Concept of the Anthropocene, *Annual Review of Environment and Resources*, **42**(1): 77-104.
- Mansourian, S., 2021. Disciplines, sectors, motivations and power relations in Forest Landscape Restoration, *Ecological Restoration*, **39**(1-2): 16-26.
- Mattijssen, T. J. M., van der Jagt, A. P. N., Buijs, A. E., Elands, B. H. M., Erlwein, S. and Laforteza, R., 2017. The long-term prospects of citizens managing urban green space: From place making to place-keeping?, *Urban Forestry & Urban Greening*, **26**: 78-84.
- Measham, T. G. and Barnett, G. B., 2008. Environmental Volunteering: motivations, modes and outcomes, *Australian Geographer*, **39**(4): 537-552.
- Meppem, T., 2000. The discursive community: evolving institutional structures for planning sustainability, *Ecological Economics*, **34**(1): 47-61.
- Mesch, G. S. and Manor, O., 1998. Social Ties, Environmental Perception, And Local Attachment, *Environment and Behavior*, **30**(4): 504-519.
- Messier, C., Puettmann, K., Chazdon, R., Andersson, K. P., Angers, V. A., Brotons, L., Filotas, E., Tittler, R., Parrott, L. and Levin, S. A., 2015. From Management to Stewardship: Viewing Forests As Complex Adaptive Systems in an Uncertain World: From management to stewardship, *Conservation Letters*, **8**(5): 368-377.
- Meyers, J. D., D, Van Niel, T. and Barnett, G., 2017. *Mapping surface urban heat in Canberra*, CSIRO, Australia.
- Monteiro, M., Tetto, A. F., Biondi, D. and De Souza, R. R., 2013. The users' perception of street afforestation on Cândido de abreu avenue, curitiba city, paran  state, Brazil, *REVSBAU*, **8**(2): 28-40.
- Moskell, C. and Allred, S. B., 2013a. Integrating Human and Natural Systems in Community Psychology: An Ecological Model of Stewardship Behavior, *American Journal of Community Psychology*, **51**(1): 1-14.
- Moskell, C. and Allred, S. B., 2013b. Residents' beliefs about responsibility for the stewardship of park trees and street trees in New York City, *Landscape and Urban Planning*, **120**: 85-95.
- Mullaney, J., Lucke, T. and Trueman, S. J., 2015. A review of benefits and challenges in growing street trees in paved urban environments, *Landscape and Urban Planning*, **134**: 157-166.
- National Capital Authority, 2021. *National Capital Plan*, Canberra, Australia. Available at: <https://www.nca.gov.au/planning-heritage/national-capital-plan> (accessed 15 April 2021).
- Newman, P., 2014. Biophilic urbanism: a case study on Singapore, *Australian Planner*, **51**(1): 47-65.
- Norton, B. A., Coutts, A. M., Livesley, S. J., Harris, R. J., Hunter, A. M. and Williams, N. S. G., 2015. Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes, *Landscape and Urban Planning*, **134**: 127-138.
- Nowak, D. J., Crane, D. E. and Stevens, J. C., 2006. Air pollution removal by urban trees and shrubs in the United States, *Urban Forestry & Urban Greening*, **4**(3): 115-123.

- Nowak, D. J., Greenfield, E. J., Hoehn, R. E. and Lapoint, E., 2013a. Carbon storage and sequestration by trees in urban and community areas of the United States, *Environmental Pollution*, **178**: 229-236.
- Nowak, D. J., Hirabayashi, S., Bodine, A. and Hoehn, R., 2013b. Modeled PM<sub>2.5</sub> removal by trees in ten U.S. cities and associated health effects, *Environmental Pollution*, **178**: 395-402.
- Nowak, D. J., Walton, J. T., Dwyer, J. F., Kaya, L. G. and Myeong, S., 2005. The increasing influence of urban environments on US forest management, *Journal of Forestry*, **103**(8): 377-382.
- Ode Sang, Å., Knez, I., Gunnarsson, B. and Hedblom, M., 2016. The effects of naturalness, gender, and age on how urban green space is perceived and used, *Urban Forestry & Urban Greening*, **18**: 268-276.
- Olive, A., Rusch, L. and Ayers, A., 2013. Public Perceptions of the Value of Urban Trees in the River Rouge Watershed, *Michigan Academician*, **41**(3): 310-331.
- Ordóñez, C., Threlfall, C. G., Livesley, S. J., Kendal, D., Fuller, R. A., Davern, M., van der Ree, R. and Hochuli, D. F., 2020. Decision-making of municipal urban forest managers through the lens of governance, *Environmental Science & Policy*, **104**: 136-147.
- Pandit, R., Polyakov, M., Tapsuwan, S. and Moran, T., 2013. The effect of street trees on property value in Perth, Western Australia, *Landscape and Urban Planning*, **110**(1): 134-142.
- Pardee, G. L. and Philpott, S. M., 2014. Native plants are the bee's knees: local and landscape predictors of bee richness and abundance in backyard gardens, *Urban Ecosystems*, **17**(3): 641-659.
- Pearce, L. M., Kirkpatrick, J. B. and Davison, A., 2013. Using size class distributions of species to deduce the dynamics of the private urban forest, *Arboriculture and Urban Forestry*, **39**(2): 74-84.
- Pecenko, A. and Brack, C., 2021. Habitat value of, and social attitudes towards, dead trees in Canberra's urban forest, *Australian Forestry*, **84**(2): 91-104.
- Pei, N., Wang, C., Sun, R., Xu, X., He, Q., Shi, X., Gu, L., Jin, J., Liao, J., Li, J., Zhang, L., Zhang, Z., Hao, Z., Jia, B., Qiu, E., Zhang, C., Sun, Z., Jiang, S., Duan, W., Zhang, Y., Zhu, Y., Lepczyk, C. A., Kress, W. J. and Konijnendijk, C., 2019. Towards an integrated research approach for urban forestry: The case of China, *Urban Forestry & Urban Greening*, **46**: 126472.
- Pelenc, J., Lompo, M. K., Ballet, J. and Dubois, J.-L., 2013. Sustainable Human Development and the Capability Approach: Integrating Environment, Responsibility and Collective Agency, *Journal of Human Development and Capabilities*, **14**(1): 77-94.
- Phillips, C. and Atchison, J., 2020. Seeing the trees for the (urban) forest: more-than-human geographies and urban greening, *Australian Geographer*, **51**(2): 155-168.
- Plant, L., Rambaldi, A. and Sipe, N., 2017. Evaluating Revealed Preferences for Street Tree Cover Targets: A Business Case for Collaborative Investment in Leafier Streetscapes in Brisbane, Australia, *Ecological Economics*, **134**: 238-249.
- Quiggin, J., 1996. Competitive Tendering and Contracting in the Australian Public Sector, *Australian Journal of Public Administration*, **55**(3): 49-57.
- Rae, R. A., Simon, G. and Braden, J., 2010. Public reactions to new street tree planting, *Cities and the Environment*, **3**(1): 10.
- Ramkissoon, H., Weiler, B. and Smith, L. D. G., 2012. Place attachment and pro-environmental behaviour in national parks: the development of a conceptual framework, *Journal of Sustainable Tourism*, **20**(2): 257-276.
- Raymond, C. M., Frantzeskaki, N., Kabisch, N., Berry, P., Breil, M., Nita, M. R., Geneletti, D. and Calfapietra, C., 2017. A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas, *Environmental Science & Policy*, **77**: 15-24.
- Restall, B. and Conrad, E., 2015. A literature review of connectedness to nature and its potential for environmental management, *Journal of Environmental Management*, **159**: 264-278.
- Roman, L. A., 2014. How many trees are enough? Tree death and the urban canopy, *Scenario Journal. Scenario 04*: 1-8.
- Roman, L. A., Conway, T. M., Eisenman, T. S., Koeser, A. K., Ordóñez Barona, C., Locke, D. H., Jenerette, G. D., Östberg, J. and Vogt, J., 2021. Beyond 'trees are good': Disservices, management costs, and tradeoffs in urban forestry, *Ambio*, **50**(3): 615-630.

- Roman, L. A., Walker, L. A., Martineau, C. M., Muffly, D. J., MacQueen, S. A. and Harris, W., 2015. Stewardship matters: Case studies in establishment success of urban trees, *Urban Forestry & Urban Greening*, **14**(4): 1174-1182.
- Rosenzweig, C., Solecki, W. and Slosberg, R., 2006. Mitigating New York City's heat island with urban forestry, living roofs, and light surfaces, *A report to the New York State Energy Research and Development Authority*.
- Rosol, M., 2010. Public Participation in Post-Fordist Urban Green Space Governance: The Case of Community Gardens in Berlin: Public participation in post-Fordist urban green space governance, *International Journal of Urban and Regional Research*, **34**(3): 548-563.
- Salbitano, F., Borelli, S., Conigliaro, M. and Chen, Y., 2016. Guidelines on urban and peri-urban forestry, *FAO Forestry Paper*, (178).
- Saldarriaga, N., Shrestha, K. K., McManus, P. and Bajracharya, A., 2020. Greening Sydney: attitudes, barriers and opportunities for tree planting, *Australian Geographer*, **51**(4): 469-488.
- Sallis, J. F., Owen, N. and Fisher, E., 2015. Ecological models of health behavior, *Health behavior: Theory, Research, and Practice*, **5**(43-64).
- SCETCS (Standing Committee on Environment and Transport and City Services), 2020. *Inquiry into Nature in Our City*, Canberra, ACT. Available at: [https://www.parliament.act.gov.au/\\_\\_data/assets/pdf\\_file/0005/1480091/9th-ETCS-10-Inquiry-into-Nature-in-Our-City.pdf](https://www.parliament.act.gov.au/__data/assets/pdf_file/0005/1480091/9th-ETCS-10-Inquiry-into-Nature-in-Our-City.pdf) (accessed 30 March 2021).
- Schlaepfer, M. A., Guinaudeau, B. P., Martin, P. and Wyler, N., 2020. Quantifying the contributions of native and non-native trees to a city's biodiversity and ecosystem services, *Urban Forestry & Urban Greening*, **56**: 126861.
- Schmidlin, T. W., 2009. Human fatalities from wind-related tree failures in the United States, 1995–2007, *Natural Hazards*, **50**(1): 13-25.
- Schroeder, H., Flannigan, J. and Coles, R., 2006. Resident's attitudes toward street trees in the UK and U.S. communities, *Arboriculture and Urban Forestry*, **32**(5): 236-246.
- Sonti, N. F., Campbell, L. K., Svendsen, E. S., Johnson, M. L. and Novem Auyeung, D. S., 2020. Fear and fascination: Use and perceptions of New York City's forests, wetlands, and landscaped park areas, *Urban Forestry & Urban Greening*, **49**: 126601.
- Steg, L. and Vlek, C., 2009. Encouraging pro-environmental behaviour: An integrative review and research agenda, *Journal of Environmental Psychology*, **29**(3): 309-317.
- Stern, P. C., 2000. Toward a Coherent Theory of Environmentally Significant Behavior, *Journal of Social Issues*, **56**(3): 407.
- Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A. and Kalof, L., 1999. A value-belief-norm theory of support for social movements: The case of environmentalism, *Human Ecology Review*: 81-97.
- Suchocka, M., Jankowski, P. and Błaszczuk, M., 2019. Perception of urban trees by polish tree professionals vs. nonprofessionals, *Sustainability*, **11**(1): 211.
- Swanwick, C., 2009. Society's attitudes to and preferences for land and landscape, *Land Use Policy*, **26**: S62-S75.
- Tan, P. Y., Wang, J. and Sia, A., 2013. Perspectives on five decades of the urban greening of Singapore, *Cities*, **32**: 24-32.
- Tapsuwan, S., Marcos-Martinez, R. and Schandl, H., 2019. *An environmental-economic accounting of services provided by the living infrastructure in the ACT: public urban forests and irrigated open spaces*, CSIRO, Canberra, ACT. Available at: [https://www.environment.act.gov.au/\\_\\_data/assets/pdf\\_file/0011/1537661/environmental-economic-accounting-living-infrastructure.pdf](https://www.environment.act.gov.au/__data/assets/pdf_file/0011/1537661/environmental-economic-accounting-living-infrastructure.pdf) (accessed 18 October 2021).
- Thompson, I., 2003. *Ecology, community and delight: An inquiry into values in landscape architecture*, Routledge, London.
- Tidball, K. G., Krasny, M. E., Svendsen, E., Campbell, L. and Helphand, K., 2010. Stewardship, learning, and memory in disaster resilience, *Environmental Education Research*, **16**(5-6): 591-609.
- Treby, D. L. and Castley, J. G., 2015. Distribution and abundance of hollow-bearing trees in urban forest fragments, *Urban Forestry & Urban Greening*, **14**(3): 655-663.
- Ugolini, F., Massetti, L., Calaza-Martínez, P., Cariñanos, P., Dobbs, C., Ostoić, S. K., Marin, A. M., Pearlmuter, D., Saaroni, H., Šaulienė, I., Simoneti, M., Verlič, A., Vuletić, D. and Sanesi, G.,

2020. Effects of the COVID-19 pandemic on the use and perceptions of urban green space: An international exploratory study, *Urban Forestry & Urban Greening*, **56**: 126888-126888.
- United Nations, 2019. *World Urbanization Prospects 2018: Highlights*, Department of Economic and Social Affairs, Population Division, New York. Available at: <https://population.un.org/wup/Publications/Files/WUP2018-Highlights.pdf> (accessed 3 March 2021).
- URBES Project, 2015. *Cultural Ecosystem Services - A gateway to raising awareness for the importance of nature for urban life*. Available at: [https://www.iucn.org/downloads/urbes\\_factsheet\\_08\\_web\\_1.pdf](https://www.iucn.org/downloads/urbes_factsheet_08_web_1.pdf) (accessed 7 September 2021).
- van Dam, R., Salverda, I. and During, R., 2014. Strategies of citizens' initiatives in the Netherlands: connecting people and institutions, *Critical Policy Studies*, **8**(3): 323-339.
- van Dam, R., Duineveld, M. and During, R., 2015. Delineating Active Citizenship: The Subjectification of Citizens' Initiatives, *Journal of Environmental Policy & Planning*, **17**(2): 163-179.
- Van Herzele, A., Collins, K. and Tyrväinen, L., 2005. Involving people in urban forestry - A discussion
- VicHealth, 2018. *VicHealth Community Activation Program* [webpage], Available at: <http://www.vichealth.vic.gov.au/programs-and-projects/vichealth-community-activation-program> (accessed 17 March 2021).
- Vogt, J. M., Watkins, S. L., Mincey, S. K., Patterson, M. S. and Fischer, B. C., 2015. Explaining planted-tree survival and growth in urban neighborhoods: A social-ecological approach to studying recently-planted trees in Indianapolis, *Landscape and Urban Planning*, **136**: 130-143.
- Watkins, S. L., Vogt, J., Mincey, S. K., Fischer, B. C., Bergmann, R. A., Widney, S. E., Westphal, L. M. and Sweeney, S., 2018. Does collaborative tree planting between nonprofits and neighborhood groups improve neighborhood community capacity?, *Cities*, **74**: 83-99.
- White, M. P., Alcock, I., Wheeler, B. W. and Depledge, M. H., 2013. Would you be happier living in a greener urban area? A fixed-effects analysis of panel data, *Psychological Science*, **24**(6): 920-928.
- Williams, K., 2002. Exploring resident preferences for street trees in Melbourne, Australia, *Journal of Arboriculture*, **28**(4): 161-170.
- Wilson, J., 2000. Volunteering, *Annual Review of Sociology*, **26**(1): 215-240.
- Wong, N. H. and Yu, C., 2005. Study of green areas and urban heat island in a tropical city, *Habitat International*, **29**(3): 547-558.
- Wood, L., Hooper, P., Foster, S. and Bull, F., 2017. Public green spaces and positive mental health – investigating the relationship between access, quantity and types of parks and mental wellbeing, *Health & Place*, **48**: 63-71.
- Yao, Z., 2020. 'Access to green infrastructure and wellbeing of Canberra residents: associations, use, perceptions and impacts of shock events', Honours thesis, Fenner School of Environment and Society, Australian National University, Canberra.
- Young, R. F., 2011. Planting the Living City: Best Practices in Planning Green Infrastructure-Results From Major U.S. Cities, *Journal of the American Planning Association*, **77**(4): 368-381.
- Zhang, Y., Hussain, A., Deng, J. and Letson, N., 2007. Public attitudes toward urban trees and supporting urban tree programs, *Environment and Behavior*, **39**(6): 797-814.
- Zsóka, Á., Szerényi, Z. M., Széchy, A. and Kocsis, T., 2013. Greening due to environmental education? Environmental knowledge, attitudes, consumer behavior and everyday pro-environmental activities of Hungarian high school and university students, *Journal of Cleaner Production*, **48**: 126-138.

## Appendices

### ***Appendix 1: Initial survey questions***

#### **STREET FORESTRY PROGRAM SURVEY**

#### **SECTION 1 – VALUE OF STREET TREES**

1. How do you rate the importance of the benefits provided by trees in Canberra? Please select one column for each benefit.

| <b>Function/Benefit</b>                         | <b>Very Low</b> | <b>Low</b> | <b>Neutral</b> | <b>High</b> | <b>Very High</b> |
|-------------------------------------------------|-----------------|------------|----------------|-------------|------------------|
| Increased shade and cooling                     |                 |            |                |             |                  |
| Increased beauty                                |                 |            |                |             |                  |
| Increased human health and wellness             |                 |            |                |             |                  |
| Increased social interaction                    |                 |            |                |             |                  |
| Increased property values                       |                 |            |                |             |                  |
| Increased habitat and connectivity for wildlife |                 |            |                |             |                  |
| Reduced noise pollution                         |                 |            |                |             |                  |
| Increased wind protection                       |                 |            |                |             |                  |
| Reduced stormwater run-off                      |                 |            |                |             |                  |
| Increased erosion control                       |                 |            |                |             |                  |
| Reduced household energy use                    |                 |            |                |             |                  |
| Reduced carbon emissions                        |                 |            |                |             |                  |
| Other (please specify)                          |                 |            |                |             |                  |

2. Write the first three words that come to mind when you think of street trees and/or how they make you feel.

3. What do you value most about the nature strip? Select your top three values and rank from 1 to 3.

|                          |                                                                          |
|--------------------------|--------------------------------------------------------------------------|
| <input type="checkbox"/> | Space for street trees                                                   |
| <input type="checkbox"/> | Space to extend your front yard                                          |
| <input type="checkbox"/> | Space for parking                                                        |
| <input type="checkbox"/> | Space for public infrastructure services i.e. streetlights and utilities |
| <input type="checkbox"/> | Space for walking or cycling                                             |
| <input type="checkbox"/> | Space for playing                                                        |
| <input type="checkbox"/> | Space for wildlife                                                       |
| <input type="checkbox"/> | Space to reduce noise and impact of street                               |
| <input type="checkbox"/> | Other (please specify)                                                   |

4. What are the current uses/treatments of your nature strip?

|                          |                                                    |
|--------------------------|----------------------------------------------------|
| <input type="checkbox"/> | Garden and/or mulch                                |
| <input type="checkbox"/> | Hard surfaces or decomposed granite                |
| <input type="checkbox"/> | Parking (e.g. car, trailers and/or other vehicles) |
| <input type="checkbox"/> | Storage (e.g. containers, building materials etc.) |
| <input type="checkbox"/> | Lawn                                               |
| <input type="checkbox"/> | Existing street tree                               |
| <input type="checkbox"/> | I do not use my nature strip                       |
| <input type="checkbox"/> | Other (please specify)                             |

5. How important do you think street trees are for improving your suburb's resilience to climate change?

|                          |                     |
|--------------------------|---------------------|
| <input type="checkbox"/> | Very important      |
| <input type="checkbox"/> | Somewhat important  |
| <input type="checkbox"/> | Important           |
| <input type="checkbox"/> | Not important       |
| <input type="checkbox"/> | Not sure/don't know |

## SECTION 2 – TREE SPECIES

6. What qualities do you want from the trees in your street? i.e. colour, flowers, pollinators, shade, year-round foliage

7. Rank your desire for the following street tree types. Please select **one** column for each tree type.

| Tree type                | Strongly Undesirable | Undesirable | Neutral | Desirable | Strongly Desirable |
|--------------------------|----------------------|-------------|---------|-----------|--------------------|
| Exotic evergreen         |                      |             |         |           |                    |
| Exotic deciduous         |                      |             |         |           |                    |
| Native evergreen         |                      |             |         |           |                    |
| Native deciduous         |                      |             |         |           |                    |
| Small size (3-8m tall)   |                      |             |         |           |                    |
| Medium size (8-12m tall) |                      |             |         |           |                    |
| Large size (>12m tall)   |                      |             |         |           |                    |

## SECTION 3 – CARING FOR RESIDENTIAL TREES

8. Do you feel responsible for the health of the street trees on the nature strip adjacent to your home and/or in your street? Please tick **one** box.

|                          |                       |
|--------------------------|-----------------------|
| <input type="checkbox"/> | Absolutely            |
| <input type="checkbox"/> | Yes, I think so       |
| <input type="checkbox"/> | I am not sure         |
| <input type="checkbox"/> | No, I do not think so |
| <input type="checkbox"/> | Absolutely not        |

9. What actions, if any, do you currently take to care for the health of the trees on the nature strip adjacent to your home and/or along your street?

**SECTION 4 - HOUSEHOLD INFORMATION - Please note that this section is optional.**

10. What is the name of your street?

11. Please circle your age group: Under 18 / 18-30 / 31-45 / 46-65 / 66-80 / 81+

12. Are you a:

- ☐ Owner/occupier
- ☐ Renting
- ☐ Other (please specify)

13. What best describes the type of dwelling you reside in?

- ☐ Apartment
- ☐ Detached house
- ☐ Duplex/townhouse
- ☐ Other (please specify)

14. How often do you use your local public green space (nature strip, parks, shared paths)? For example, when walking the dog, walking or riding to school, shops or work, maintaining your nature strip. Please select **one** option.

- ☐ Daily
- ☐ Weekly
- ☐ Fortnightly
- ☐ Monthly
- ☐ Rarely
- ☐ Never

## Appendix 2: Sample of vote card



### TREE SPECIES CHOICES FOR BARNARD CIRCUIT, FLOREY

|                                                                                    |                                                                                                                                                                                                        |
|------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|   | <p><b>OPTION 1</b><br/> <b>Red-flowering yellow gum</b><br/> <i>Eucalyptus leucoxylon</i><br/> <i>'Rosea'</i><br/>           Maximum size:<br/> <b>10m high x 9m wide</b></p> <input type="checkbox"/> |
|   | <p><b>OPTION 2</b><br/> <b>Sweet gum</b><br/> <i>Liquidambar styraciflua</i><br/>           Maximum size:<br/> <b>13-15m high x 8-9m</b></p> <input type="checkbox"/>                                  |
|  | <p><b>OPTION 3</b><br/> <b>Chinese pistachio</b><br/> <i>Pistacia chinensis</i><br/>           Maximum size:<br/> <b>8-10m high x 6m wide</b></p> <input type="checkbox"/>                             |

Your name \_\_\_\_\_

Your address \_\_\_\_\_

Once you have cast your vote for your preferred tree species please return this card via reply paid post or email to [communityengagement@act.gov.au](mailto:communityengagement@act.gov.au)

You may also vote online at  
[www.cityservices.act.gov.au/street-forestry](http://www.cityservices.act.gov.au/street-forestry)

Figure 14. Sample vote card distributed for a given street

## ***Appendix 3: Interview questions***

### Neighbourhood

1. How long have you been living here for?
2. How would you describe the living environment here, in terms of the physical environment and sense of community?
3. How often do you see or interact with your neighbours?

### Urban trees in Canberra

4. I am interested to know what you think is the value of trees in Canberra generally.
5. What do you think about trees in your streets?
6. Do you think the trees make a difference to the neighbourhood?

### *Street Forestry Program*

7. Did you receive a tree as part of the *Street Forestry Program*?
8. Do you have a preference for tree species?
9. What do you think about the program in general?

### Community and government responsibility

10. Whose responsibility do you think it is, is the government fully responsible or does the community play a role in taking care of street trees?
11. Are there any actions you do to take care of your street trees?
12. Are there any community groups around your neighbourhood related to greening the streets, and would you be interested to join any?
13. What do you think the government can do better in managing the urban forests in Canberra?

### Basic demographic information

14. What is your age bracket?
15. How many people are currently living in this house?
16. What is the ownership status of the house, are you a tenant or an owner?
17. Are you currently working or retired, what is/was your occupation?