# Are we on the verge of something new?

# An analysis of community perceptions and ecological value of local green space

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This thesis is presented for the degree of Bachelor of Science Honours,

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## Declaration

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

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21st May 2018

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## Abstract

Urban green spaces are under threat by current urban densification practices, so Australian local councils are looking at innovative ways to utilise current green spaces, such as road verges. However councils often lack resources to properly manage these areas, so many local councils are turning to their residents to help manage these spaces, which is what the City of Vincent's Adopt a Verge program aims to do. This study uses the City of Vincent's Adopt a Verge program as a case study to (1) evaluate the quality of the verge plantings in regards to ecological value, (2) establish participant's motives for adoption and non-adoption of verges, and (3) determine whether there is any relationship between the participant's motives for adoption and the ecological value of verge plantings.

Residents were classified as "Adopters" (participants in the Adopt a Verge program) and" Non-adopters" (those who did not participate).*In-situ* vegetation surveys were conducted to assess percent cover, and plant diversity and richness of adopted verges. In-person and online social surveys considered the motivations behind adoption or non-adoption (respectively), beliefs about the program aims, ecological world view using the New Ecological Paradigm, and general demographics.

Of 198 adopted verges surveyed, 85% had non-grass vegetation, and were covered on average by 29% non-grass vegetation. Adopters participated in the program to improve aesthetics of their verge (76%) while Non-adopters were unaware of the program (18%). Both groups were told of the aims of the program and it was found that Adopters had more positive attitudes towards the program aims than Non-adopters, and Adopters were more eco-centric in their ecological world view ($t=3499$, $p<0.05$). A third group of people who had planted native vegetation on their verge outside of the program was revealed—the Self-adopters (n=15). Verge vegetation percent cover, diversity and richness were correlated with increased positive attitudes for Adopters.

Adoption of verges by residents, as part of a wider urban greening program, was well received by those residents aware of the program. Most residents had a positive attitude towards the Adopt a Verge program, while the program was also successful in increasing native vegetation cover on verges over time. This study highlights potential motivations for verge adoption, including residents' aesthetic appreciation for native vegetation, understanding the likely benefits of verge planting and effective awareness of the program itself. Understanding the motivations of residents may aid in program uptake and enhance the contribution of resident verge adoption as part of an urban greening strategy.

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## Definitions and Abbreviations

| Phrase | Definition |
|---|---|
| Adopter | Residents of the City of Vincent who participated in the Adopt a Verge program. |
| Non-adopter | Residents of the City of Vincent who did not participate in the Adopt a Verge program. |
| Self-adopter | Residents of the City of Vincent who planted native vegetation on their verge, but did not participate in the Adopt a Verge program. |
| Green space | Areas within cities and their surrounding areas which contain plant life, making the areas look green. |
| The City | The City of Vincent |
| Verge | The area between the public road reserve and private property boundary. |
| NEP | The New Ecological Paradigm |

# 1. Introduction

## 1.1. Green Space in the Worldwide Urban Environment

Urban green space comprises a variety of vegetated areas in the urban environment; remnant vegetation, parks, gardens and vegetated streetscapes. Such areas in the urban environment have become more important over time in regards to aesthetically enhancing urban landscapes and in determining the liveability of cities. However, despite the acknowledged aesthetic and ecological value of these areas, urban green space is under threat by urban densification (Ewing, Catterall, & Tomerini, 2013; Nisbet, Zelenski, & Murphy, 2011; Pietilä et al., 2015; Sarkar et al., 2015; Simpson & Newsome, 2017). Urban densification is where existing spaces within urban areas are being used to house more people, rather than expanding city borders (Haaland & van den Bosch, 2015). In many cities this means that green spaces are being removed and built over to provide more housing and other urban infrastructure (Haaland & van den Bosch, 2015). Examples include converting parks to parking lots, or infilling a wetland to build apartment blocks.

Both wildlife and humans are benefitted when provided with access to green spaces. Humans need access to green spaces to promote mental and physical health and because these spaces provide "ecosystem services" (Haaland & van den Bosch, 2015; Maas, Verheij, Groenewegen, de Vries, & Spreeuwenberg, 2006; Milošević, Bajšanski, & Savić, 2017; Rupprecht, Byrne, Ueda, & Lo, 2015; Sarkar et al., 2015; Standish, Hobbs, & Miller, 2013; Van Den Berg, Hartig, & Staats, 2007). Ecosystem services can be defined as "human benefits derived from ecosystem functions", and can be split up into 4 categories: supporting, regulating, provisioning and cultural (Barau, 2015; Haaland & van den Bosch, 2015), which are all important considerations in urban green space planning. Urban green space is also utilised by wildlife as corridors to travel through urban areas, and as habitat

and food sources (Davis, Gole, & Roberts, 2013; Goddard, Dougill, & Benton, 2010; Haaland & van den Bosch, 2015; Stenhouse, 2004a; Valentine & Stock, 2008). Retaining and improving the quality of green spaces in urban environments can help both humans and wildlife.

### 1.2 Variety of Green Spaces

Green spaces can come in many different forms which can have a variety of uses and benefits. Some forms of green space can include parks, private gardens, verges, nature reserves and fringing vegetation of wetlands and rivers. Figure 1.1 is an example of how three forms of green space can be utilised in different ways, whilst all maintaining similar core functions of improving aesthetics, providing climate control and helping improve mental health. There is a wide variety of urban green spaces which function in different ways, but still provide certain core functions.

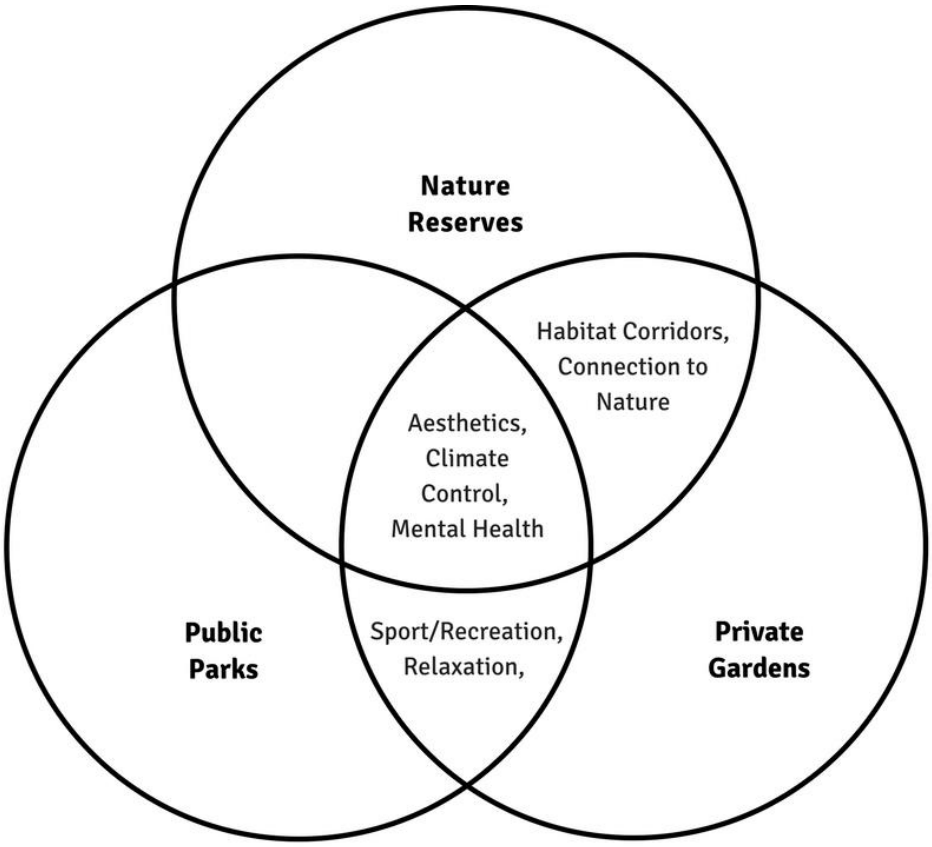


Figure 1.1: Three types of green space and how their uses are similar.

Native vegetation is an important part of urban green spaces as these plants are suited to the local climate and can provide habitat for native wildlife (Davis & Wilcox, 2013; Goddard et al., 2010; Stenhouse, 2004a). In being suited to the local climate, native plants use less water and are better able to tolerate the local climatic conditions (Knapp, 2014; Water Corporation of Western Australia). Native wildlife have adapted simultaneously with native vegetation (Calver, Lymbery, McComb, & Bamford, 2009; Goddard et al., 2010). Wildlife utilise native vegetation as habitat, food sources and corridors to move along, which are all important in terms of conservation (Calver et al., 2009; Davis & Wilcox, 2013; Goddard et al., 2010).

### 1.3 Urban Green Spaces in Australia

In 2004 approximately 75% of Australians lived in urban areas (ABS, 2007), hence, a large proportion of the population would rely on urban green space to provide some connection to nature. In the city of Perth, Western Australia, residents have access to a variety of green spaces (Jones & Newsome, 2015; Stenhouse, 2004a, 2004b). However Perth's Mediterranean climate with hot, dry summers, makes it very different to many European cities, so the green spaces which are suitable elsewhere, such as lawns and native European plants are not necessarily suitable in Perth. Accordingly, plants which are native to the local area are quite often best suited to form green spaces as they are adapted to the local climate and, once established, require less maintenance than non-native species. Local councils generally manage public green spaces, however management effort is reliant on suitable funding and resources, which local councils often lack (Stenhouse, 2004b).

### 1.4 Role of Road Verges in Urban Green Spaces in Australia

Road verges (verges) are a large component in the Australian landscape. Verges are considered as the area between the public road reserve and private property boundary, and can range from non-existent to 6 meters wide, and extend along the width of the

property. In Western Australia alone, there is over 18 500km of roads (Main Roads Western Australia, 2016). If we assume an average verge width of 3m, then in 2016 4.4% of Western Australia's area consisted of road verges. While this is a very generalised calculation, it shows that road verges are a significant component in the landscape of Australia that requires management.

Verges as a source of urban green space in an urban Australian context have received little attention in the literature. Verges in Europe, especially England, have received some attention (see Cilliers & Bredenkamp, 2000; Dunnett, Willis, Hunt, & Grime, 1998; O'Sullivan, Holt, Warren, & Evans, 2017; Staab, Yannelli, Lang, & Kollmann, 2015), however the difference in climate between European cities and Perth often make verge vegetation studies non-transferrable in the context of Perth. For example, Ignatieva, Eriksson, Eriksson, Berg, and Hedblom (2017) describe lawns as a suitable options for increasing urban green space in Sweden. However in Perth, the hot, dry summers cause lawns to die unless large amounts of water are used, which is not possible in the current climate. Hence, if the study by Ignatieva et al. (2017) was transferred to Perth, Western Australia, residents would end up with an area which does not contribute to urban green spaces.

### 1.5 Community Programs for Enhancing Green Spaces.

Not only is it important to consider what vegetation is used in urban green spaces, but it is also important to determine who is responsible for the management of any urban green spaces developed. In regards to public green space, it is generally the responsibility of the local council to maintain the space (Binning et al., 1999; Standish et al., 2013). However, local governments have limited resources allocated to maintain these areas which may cause green spaces to be overlooked (Binning et al., 1999; Standish et al., 2013). Involving the community is one way councils can reduce the strain on their resources while still

maintaining local green spaces (Ewing et al., 2013; Standish et al., 2013). Community involvement can also foster a sense of pride in local green spaces and community members (Ewing et al., 2013). Community involvement in programs organised by local councils has been researched, but is limited to restoring native vegetation, rather than the establishment of new vegetation on the resident's verge (Ewing et al., 2013; Standish et al., 2013).

This study explored the use of a local council's program to establish native verge gardens and aimed to fill knowledge gaps about road verges as urban green spaces and the perceptions of the community on these verges. The Adopt a Verge program run by the City of Vincent serves as a case study to show the community's perceptions about using verges as urban green space. The objectives of this study were:

1. To evaluate the quality of the Adopted verge plantings in regards to ecological value;
2. To establish participant's motives for adoption and non-adoption of verges;
3. To determine whether there is any relationship between the participant's motives for adoption and planting quality.

### 1.6 Structure of Thesis

This introductory chapter has outlined the importance of urban green space and explained the potential for road verges to increase green space in Perth, Western Australia. It has also outlined the study which is to be discussed further in this thesis.

Chapter 2, Literature Review, outlines the current knowledge on urban green space, the role of verges in enhancing the space, and the importance of community involvement.

Chapter 3, Methods, outlines the steps taken to assess programs for enhancing urban green space in Perth and the community's perceptions of these programs, using the City of Vincent's Adopt a Verge program as a case study.

Chapter 4, Results, outlines the results of this study.

Chapter 5, Discussion, discusses the findings of this study and places it within the context of the current literature.

# 2. Literature Review: Green space in urban environments and community involvement

Humans are increasingly living in urban environments, with over 50% of humans living in urban areas globally since 2008 (Grimm et al., 2008). As such, the retention of green spaces has received increasing attention in scientific literature (Antognelli & Vizzari, 2017; Haaland & van den Bosch, 2015; Rakhshandehroo, Mohd Johari Mohd, Arabi, & Jahandarfard, 2016; Rupprecht, Byrne, Ueda, et al., 2015; Thompson, 2002). Haaland and van den Bosch (2015) define urban green space as "any vegetation found in the urban environment, including parks, open spaces, residential gardens, or street trees". Although this is a very broad definition, it encapsulates the concept of green space that is considered further in this study. With such a broad definition it is pertinent to note that urban green space is a multidisciplinary concept, requiring the collective input from urban planners, managers, ecologists and policy makers alike (Goddard et al., 2010; Rakhshandehroo et al., 2016).

## 2.1 Urban Green Space

Urbanisation is increasing throughout the world. Haaland and van den Bosch (2015) point out that “Worldwide, the percentage of people living in urban areas will increase from 50% in 2010 to nearly 70% by 2050”. This will then lead to either greater urban sprawl or urban densification (Haaland & van den Bosch, 2015; Revell & Anda, 2014; Trubka, Newman, & Bilsborough, 2010). The main threat to urban green space is the growth of city infrastructure and urban infill. Green space in the urban environment exists at various spatial scales and consists of differing ecological composition. In an effort to study green spaces, researchers have classified different types of green spaces (Table 1.1). The research reported in this thesis is concerned with looking at existing areas in the urban environment which can be utilised as green space, such as road verges.

Table 1.1: The variety of categories of urban green space and their uses.

| Category | Definitions | Use in the Literature |
|---|---|---|
| Size | 3 main scales: metropolis, city and neighbourhood. | Biodiversity corridors<br><br>Landscape connectivity, holistic city planning (Jim & Chen, 2003). |
| Formal vs Informal | Formal—planned green space, both public and private, remnant vegetation.<br><br>Informal—areas where vegetation has spontaneously grown (e.g. Vacant blocks). | Determine how the public use green space.<br><br>The need for certain demographics to have 'wilderness' in cities (Rupprecht, Byrne, Garden, & Hero, 2015). |
| Public vs Private | Private—e.g. Home gardens.<br><br>Public—e.g. Parks, community gardens, remnant vegetation. | Planning and use of green space for all residents<br><br>Determines who is responsible for the upkeep of an area—e.g. residents or local governments (Rakhshandehroo et al., 2016; Rupprecht, Byrne, Garden, et al., 2015; Standish et al., 2013) |

Although the study of urban green spaces is currently becoming more prevalent in scientific literature, such spaces have always been important in cities (Ignatieva et al., 2017; Jim, 2004). Since the 1880s green spaces have been created and retained in cities to reduce the environmental impact of urbanised society and to increase the aesthetic appeal of an area (Jim & Chen, 2003). Urban green spaces are increasingly important in today's society for both social and ecological reasons (Haaland & van den Bosch, 2015; Newman, 2016; Sarkar et al., 2015; Simpson & Newsome, 2017). There are three main categories that these benefits fall into: human benefits, ecological benefits and climatic benefits.

Urban green spaces provide areas for people to relax and connect with nature, which can aid in fostering mental health (Ewing et al., 2013; Haaland & van den Bosch, 2015; Maas et al., 2006; Nisbet et al., 2011; Pietilä et al., 2015; Sarkar et al., 2015; Simpson & Newsome, 2017). These areas also provide a space for recreation and exercise (Haaland & van den Bosch, 2015; Pietilä et al., 2015; Sarkar et al., 2015; Simpson & Newsome, 2017). By creating opportunities for improving the health of citizens and increasing their access to green spaces, a city can become more 'liveable' (Antognelli & Vizzari, 2017; Jones & Newsome, 2015). In this regard the city becomes more appealing to visitors and residents alike (Jones & Newsome, 2015). By improving the health of residents, city productivity can also be increased (Pietilä et al., 2015; Trubka et al., 2010).

Urban green spaces also provide habitat to animals, offering both shelter and food required for animals to survive. Certain forms of urban green spaces, such as remnant vegetation, can also increase biodiversity in cities and allow animals to move between habitat patches, which enables genetic flow (Caryl, Thomson, & van der Ree, 2013; Haaland & van den Bosch, 2015; O'Sullivan et al., 2017; Simpson & Newsome, 2017). Biodiversity also contributes to city liveability (Ely & Pitman, 2014; Jones & Newsome, 2015; Taylor & Hochuli, 2015). A wide variety of vegetation is essential for animal species, enabling their survival in city environments (Caryl et al., 2013; Goddard et al., 2010; Taylor & Hochuli, 2015). By increasing the diversity and amount of vegetation in urban areas, biodiversity corridors can be created (Martin, Eldridge, & Murray, 2011; O'Sullivan et al., 2017; Perkl, 2016; West, Cairns, & Schultz, 2016). Such corridors are strips or patches of vegetation that allow animals to move through the landscape (Perkl, 2016; West et al., 2016).

Urban green spaces are able to improve the immediate climate of an area. The physical properties of vegetation help to keep streets and houses cooler, while also reducing noise and air pollution (Bowler, Buyung-Ali, Knight, & Pullin, 2010; Ely & Pitman, 2014; Emmanuel & Loconsole, 2015; Haaland & van den Bosch, 2015; Simpson &

Newsome, 2017). By retaining and including vegetation in urban areas, a natural cooling system can be fostered via the creation of shade and evapotranspiration which maintains cooler temperatures (Bowler et al., 2010; Ely & Pitman, 2014; Emmanuel & Loconsole, 2015; Milošević et al., 2017). Certain plants can reduce unwanted chemicals in the air and waterways (Ely & Pitman, 2014; Saunders, Dade, & Van Niel, 2011). Plant form and function contribute to liveability of a city by enhancing the quality of the environment (Ely & Pitman, 2014; Jones & Newsome, 2015; Taylor & Hochuli, 2015).

Despite all of these positive outcomes of urban greening and retainment of native vegetation, Bowd, McKay, and Shaw (2015) warn that there are many factors to consider other than basic green infrastructure to improve a city and produce urban green spaces. These factors include the current political climate and western society's consumerist culture, which can lead to green areas in cities being undervalued. They warn that assuming technology will be the solution to all environmental issues is problematic as the relevant research rarely combines social consequences with the environmental effects. Bowd et al. (2015) highlight the need for further investigation into "sociocultural and psychocultural" ideas that will influence urban greening in a consumerist society.

### 2.2 Native Vegetation in the Urban Environment

Native vegetation is an important component to urban green space for several reasons, including conservation, local climate and physical and psychological benefits for people (Binning et al., 1999; Ely & Pitman, 2014; Goddard et al., 2010; Taylor & Hochuli, 2015). Additionally, native vegetation is ecologically adapted to the local climate (Goddard et al., 2010; Knapp, 2014). This is in contrast to introduced vegetation such as lawn grasses, whose appeal originates from the United Kingdom. In the United Kingdom there is rainfall all year round, which makes lawn grass is easy to grow. However, even in regions that are not climatically suited to lush green lawns, such as deserts, people still expect to see this "idyllic" visage (Hunter & Hunter, 2008; Ignatieva et al., 2017). Lawn grasses require a large

amount of water to remain lush and green, not just during initial establishment but during their continued growth (Water Corporation of Western Australia, 2014). Hence, it is potentially more economically viable to use native plants already adapted to their local climate rather than introduced species from distant and very different climatic settings (Knapp, 2014).

Native vegetation also provides habitat for native animals which then aids in biodiversity conservation (Caryl et al., 2013; Ely & Pitman, 2014; Goddard et al., 2010; Taylor & Hochuli, 2015). By including native vegetation in urban green spaces, it is possible to create corridors through which animals can move (Caryl et al., 2013; Davis & Wilcox, 2013; Goddard et al., 2010), thereby increasing the connectivity of the landscape (Calver et al., 2009). While some animal species may not use these corridors, others will benefit. Davis and Wilcox (2013) found that generalist bird species were more likely to utilise garden spaces while specialists did not. An Australian study found that bird and butterfly species diversity increase with the presence of native plants (Goddard et al., 2010).

While many ecologists believe that restoring bushland to a pristine and 'natural' state is the most desirable option for conservation, it may not be the most practical one. In modern urban areas there may be altered hydrological regimes, increased heat and increased nutrient loading (Ely & Pitman, 2014; Grimm et al., 2008; Stenhouse, 2004b). These can all interact and make it difficult for the growth and persistence of native plants (Standish et al., 2013). While the restoration of urban spaces into intact and complete native ecosystems is not feasible, purposive management of urban vegetation can generate 'novel ecosystems': new assemblages of species that were not historically present and do not depend upon human intervention to persist (Kennedy et al., 2018; Standish et al., 2013). Novel ecosystems allow for multi-purpose urban green spaces which provide areas for both conservation and human well-being (Standish et al., 2013).

Not only can the changed physical conditions of urban environments affect the growth of native plants, but so can altered biological conditions. Most gardens will incorporate a variety of non-native plants species for a variety of reasons (Kirkpatrick, 2004; Kirkpatrick, Daniels, & Zagorski, 2007; Knapp, 2014; Standish et al., 2013; Zagorski, Kirkpatrick, & Stratford, 2004). While this does create interesting and new species assemblages, non-native plants can escape the confines of the cultivated garden and compete with native species in remnant bushland, causing a decline in historical vegetation (Kirkpatrick, 2004; Knapp, 2014). While novel ecosystems are important, Knapp (2014) warns against the dangers of having homogenised vegetation throughout the world.

Urban green spaces often occur as small patches or pockets that are not connected with one another (Grimm et al., 2008; Stenhouse, 2004b). Fragmentation is an issue in Australia as much of our natural bushland has been cleared since European arrival. Fragmentation is problematic for native flora and fauna because of the edge effect and lack of connectivity (Cross, Cross, Merritt, Dixon, & Andersen, 2016; Grimm et al., 2008; Martensen, Pimentel, & Metzger, 2008; Ramalho, Laliberté, Poot, & Hobbs, 2014). Edge effects are important because a patch of remnant vegetation can be impacted by external factors, such as invasive weeds and the noise of passing traffic (Calver et al., 2009; Ramalho et al., 2014). Where an area is large and round, the perimeter to area ratio will be small, meaning that more area is available for animals to live undisturbed. Conversely where an area is long and thin or small and round the perimeter to area ratio increases, meaning a decrease in undisturbed habitat. Fragmented areas are more prone to disturbance and can restrict movement of animals and plants to more suitable habitats (Cross et al., 2016; Grimm et al., 2008; Martensen et al., 2008; Ramalho et al., 2014). From an urban biota and conservation point of view, it is therefore important to connect fragmented landscapes to increase movement and resilience (Calver et al., 2009; Kath, Maron, & Dunn, 2009; Martensen et al., 2008; Perkl, 2016).

### 2.3 Wildlife Corridors in the Urban Landscape

Wildlife corridors are patches or strips of vegetation that allow native animals to move through the landscape and plants to propagate across space (Goddard et al., 2010; Ramalho et al., 2014; Shanahan, Miller, Possingham, & Fuller, 2011). Corridors comprising of native vegetation provide benefits to biodiversity conservation as they increase the available habitat size and allows movement between patches (Mumaw & Bekessy, 2017; Perkl, 2016; Ramalho et al., 2014). Biodiversity corridors also increase the genetic flow between populations (Douglas & Sadler, 2011; Goddard et al., 2010; Martensen et al., 2008; Perkl, 2016; Ramalho et al., 2014). Such gene flow keeps genes diverse (genetic heterozygosity) and stops inbreeding occurring (Calver et al., 2009; Richard & Alexander, 1998).

Wildlife corridors can be constructed or found in a variety of areas and sizes. Jim and Chen (2003) explored several strategies for biodiversity corridors in dense urban areas. Corridors can be created along rivers using the remnant riparian vegetation or along pedestrian footpaths (Crome, Isaacs, & Moore, 1994; Jim & Chen, 2003). Rupprecht, Byrne, Garden, et al. (2015) state that "large or linear sites such as powerline[s] and railway verge[s]" which contribute to urban green spaces can also function as biodiversity corridors. Another strategy is the garden block strategy, proposed by Jim and Chen (2003), where a strip of vegetation is inserted between houses or on either side of alleyways.

The garden block strategy is very similar to the idea of using road verges as wildlife corridors. Here, a road verge is defined as the area between a road and personal property. Verges can be several meters wide and many kilometres long—as long as the road itself. Although roads themselves can act as significant barriers to animal movement, road verges can offer the possibility of movement along roads (Davis & Wilcox, 2013; O'Sullivan et al., 2017; Richard & Alexander, 1998). Cilliers and Bredenkamp (2000) and Richard and Alexander (1998), however, point out the lack of evidence of verges acting as wildlife

corridors, such as for plant propagation. Richard and Alexander (1998) state that while there are few null model comparisons for the movement of animals along verges, some studies have found that animals do utilise verges for movement. It has been shown that invertebrate diversity is not correlated to garden size, which could indicate that road verges may act as suitable conduits for invertebrate dispersion (Goddard et al., 2010). The lack of conclusive evidence either for or against verges acting as wildlife corridors shows a need for more research into the appropriateness of verges for prompting connectivity.

### 2.4 Urban Road Verges

Road verges are a prominent part of the Western Australian landscape, and can be separated into two main groups: country road verges and urban road verges. While country road verges may be of ecological significance, this study pertains to urban road verges, specifically those verges in residential areas. Residential road verges are most likely to impact on people than country road verges, due to the increased density of people living in the city. Revegetation of the urban verge is an initiative that some local councils in Perth, Western Australia have undertaken to promote the benefits of urban greening. Despite the relative absence of literature to confirm the use of residential road verges as wildlife corridors, some Australian Government departments and local councils have "Roadside Conservation Committees" and various programs that encourage the use of road verges in conservation and sustainability. Urban road verges in Australia are often wide, sprawling areas of grass (although sometimes, and increasingly, with trees), which do not provide adequate cover for native animals to disperse along. Revegetating verges in suburban areas with native vegetation creates the possibility of connecting people to their environment and providing corridors for native animals (Ewing et al., 2013; Goddard et al., 2010; Haaland & van den Bosch, 2015; Hunter & Hunter, 2008; Standish et al., 2013).

The continual improvement of urban green spaces is unlikely to be achieved through governmental or private business intervention alone (Ewing et al., 2013;

Stenhouse, 2004b). Community support will be needed to achieve the vision of an interconnected and green Australia (Ewing et al., 2013; Hunter & Hunter, 2008; Stenhouse, 2004b). Verges are a public space that are ideal for encouraging community engagement in urban greening (Clayton, 2007). The public and visible nature of verges provides scope for residents to help share ideas, knowledge and simply connect with like-minded people (Clayton, 2007).

Road verges can cover huge areas of land; in the Netherlands, all road verges cover 800 $km^2$ (2% of the total land area), in Finland 135 400 $km^2$ (0.4% land area) and in the USA 4928 million $km^2$, with a typical verge being 2-5 m wide (O'Sullivan et al., 2017). If these areas were not big enough, there is a projected 60% increase "in global road networks between 2010 and 2050" (O'Sullivan et al., 2017). Across Western Australia, all road verges cover approximately 4.4% of the total land area (Main Roads Western Australia, 2016). In having such a large and linear area, road verges are important in providing space for the construction of biodiversity corridors (Douglas & Sadler, 2011; O'Sullivan et al., 2017; Richard & Alexander, 1998). Councils, both urban and remote, have access to this large area of land that would be useful in promoting urban greening and all of its benefits.

### 2.5 Community Involvement with Urban Green Spaces

Urban green spaces are very important to residents and local governments alike, and so communities are often encouraged and aided in increasing the quality of local green space (Stenhouse, 2004b). Interestingly, councils only began to commonly manage local bushland in the 1980s, which was primarily due to a push from local residents and council staff (Stenhouse, 2004b). During this time there was a global movement to protect the environment, which was caused by a shift in the attitudes of many people (Trigger, Mulcock, Gaynor, & Toussaint, 2008). Not only was there a shift in attitudes, but there was also a reduction in accessible natural areas near urban areas (Haaland & van den Bosch, 2015). Over the past few decades, more and more people have been moving into urban

areas (Haaland & van den Bosch, 2015). The resultant urban expansion can reduce access to local green space either by causing the green spaces to be of doubtful quality or to simply remove green space (Haaland & van den Bosch, 2015). In many urbanised areas, 50% of green space is provided by residential areas (Lin et al., 2017). Enhancement of half of a city's green space can be fostered by residents voluntarily utilising their property in accordance with "green city" concepts.

For non-residential urban green spaces, there are many local community groups who focus on restoring urban green space in the form of remnant bushland (Ewing et al., 2013; Stenhouse, 2004b). Governments generally lack the funding to restore these pockets of remnant bushland so the quality of these patches may depend upon the intervention of local community groups (Stenhouse, 2004b). Local councils may have conflicting priorities which stretches funds even more, and councils may rely on having community support to improve the quality and quantity of urban green spaces (Roy, 2017).

Despite their interest in conservation, Councils who plan urban green space may not implement it in a way that is in line with optimal environmental goals. Roy (2017) found that councils cited environmental reasons 92% of the time when asked why they ought to plant street trees, but exhibited a lack of awareness when asked how they decided which trees to plant. This disparity is possibly due to a lack of knowledge on how street trees benefit the environment (Roy, 2017). Stenhouse (2004b) found that most councils began managing urban green spaces because of pressure from their residents and staff. It has also been shown that community consultation is important in the planning of urban green spaces as the community are the people who understand how local areas function (e.g. as a park or thoroughfare), and are able to suggest ways to improve the area for the whole community rather than for a single purpose, such as providing wildlife corridors (Faehnle, Bäcklund, Tyrväinen, Niemelä, & Yli-Pelkonen, 2014). Therefore, councils must use a variety of resources and inspiration for their management of urban green spaces.

Understanding the underlying values and motivations of people in the creation and maintenance of urban green spaces can help to effectively plan urban areas. Gill, Waitt, and Head (2009) found that people in management positions tended to see humans as threats to remnant bushland. However the local people who were interviewed thought of nature as a social place, where the presence of people is a good occurrence. The local people also saw "people [in nature] as both guardians and threats" (Gill et al., 2009). It is important for communities to feel connected to their local natural areas as it can promote the conservation values of these areas (Gill et al., 2009). Community consultation will also help to inform managers of the importance and use of certain green spaces found in cities (Faehnle et al., 2014; Gill et al., 2009).

Most residents will use green space in one form or another, whether it is for recreation, enjoying the beauty of nature or joining local restoration activities. The large diversity of activities that occur in urban green spaces mean that the space is important to, and used by, a wide variety of people. For example, there are certain community groups that are concerned with the restoration of remnant bushland (Stenhouse, 2004b), which contributes to green space. Stenhouse (2004b) mentions that residents in the community who participate in bushland restoration often hold similar values to each other although there is no mention of what these values may be. Communities also participate in other urban greening activities, such as community gardens (Thompson, 2002).

In terms of private green space, there are several factors that alter the amount of vegetation cover on a property. Lin et al. (2017) found that residents who lived in "older residences, [had] larger yards, greater social advantage, [or] higher nature relatedness scores" generally had more vegetation cover in their front and back yards. "Nature relatedness scores" were "a measure of people's connection with nature" with a high score indicating a close relationship with nature. Additionally, it was found that older residents or families with young children utilised their yard space more than people of middling age

with no children (Lin et al., 2017). A similar study by Kirkpatrick et al. (2007) found similar results, where households with a high income tended to have more plants than low income households. Older residents also tended to have simpler, minimal input exotic gardens which was speculated to be due to their "frail old age" or a generational difference (Kirkpatrick et al., 2007).

There is evidence that immigrants take up urban greening in the form of community gardens as it helps to connect them to their previous home (Thompson, 2002). Similar to this is how European settlers would bring plants from their home and establish gardens with those plants. In Australia there has recently been a push towards using locally native plants in gardens, for both ecological and social reasons. It was stated by Trigger et al. (2008) that "a garden of local plants identifies our home as not just a house in a sea of suburbs but a place on the natural earth". That is, a native garden shows that the resident's home belongs to the land on which it stands (Trigger et al., 2008). Hence, people who decide to garden with native plants may be trying to embrace the place where they live.

Participating in urban greening is often a voluntary practice, so it is important to understand the motivations for volunteering in general before focusing on motivations for urban greening. There are several reasons that people volunteer; Bussell and Forbes (2002) state that the four main reasons that people volunteer are altruism, having family invested in the activity or product, "enjoying a 'selective incentive' (for example, prestige [or] social contact), and the improvement of human capital…([for example], to occupy spare time…, develop skills…, [or to] gain academic credit)". When it comes to participating in urban greening activities, many residents' reasons for participating will fall into one or more of these categories. However there are also the intangible motivations which are important in encouraging volunteers to participate (Bussell & Forbes, 2002). Generally, if a volunteer has similar values to the organisation or activity then they will be more inclined to participate (Bussell & Forbes, 2002). However there is much more research that needs to be done in

order to understand why some people volunteer and others do not (Bussell & Forbes, 2002).

Most residents will become involved in developing and maintaining green space because of the benefits that green spaces can offer, which include both ecological and human benefits, such as the provision of areas for recreation in conjunction with the opportunity to connect with nature and relax (Mumaw & Bekessy, 2017; Taylor & Hochuli, 2015). Community restoration groups can empower other people in their community by facilitating social interactions (Ewing et al., 2013). These social interactions are important for communities to connect with each other. Many volunteers describe the intangible benefits of participating in restoration activities (Ewing et al., 2013). Volunteering in general helps to promote a sense of well-being (Ewing et al., 2013).

The household garden is an important area of urban green space for many residents. It provides access to nature close to the home, but also allows residents to form their own "domesticated nature" experience (Barau, 2015; Cameron et al., 2012; Clayton, 2007; Daniels & Kirkpatrick, 2006; Lin et al., 2017). Many gardeners are motivated by their appreciation for nature, as well as social concerns and their various uses of their gardens (Barau, 2015; Cameron et al., 2012; Clayton, 2007; Daniels & Kirkpatrick, 2006; Lin et al., 2017). In terms of social concerns, American residents may feel pressured to have a lush, manicured lawn so as to avoid social stigma (Clayton, 2007). On the other hand, residents can also take great pride in showing that they participate in gardening and will engage in conversation with neighbours about their interests and habits (Clayton, 2007).

Residents also consider the environmental benefits of urban greening, which include providing habitat and corridors for animals or offsetting carbon emissions (Martinlopez, Montes, & Benayas, 2007; Torabi et al., 2016). These environmental issues can be considered in conjunction with the changing climate. Lo, Byrne, and Jim (2017) found that "where changes in weather and climate are seen as a threat, urban greenery

may be more likely to be regarded as a source of relief and an important asset". So where people believe themselves to be under threat by a change in climate they are more likely to engage with the concept of urban greening and potentially participate themselves.

Most local councils in Australia site pressure from residents and staff as their main drivers to manage urban vegetation (Stenhouse, 2004b). In 2004, local councils in Australia were not required by law to manage native vegetation (Stenhouse, 2004b), however many had started to manage native vegetation voluntarily (Stenhouse, 2004b). Currently, local governments are indirectly responsible for the management of native vegetation, through land use planning (COAG Standing Council on Environment and Water, 2012). In addition to local councils, local communities may decide to manage local native vegetation themselves (Stenhouse, 2004b). Many community groups receive funding from local governments so that they can carry out urban greening and restoration in areas that are important to them (Mumaw & Bekessy, 2017; Stenhouse, 2004b).

### 2.6 Community Involvement in Urban Green Space on Residential Verges

There is very little knowledge in the literature regarding why residents plant native vegetation on their verges, especially in Perth, Western Australia. Cameron et al. (2012) state that residents in the UK forgo vegetation on their front gardens for space to park cars, and that around the world people are opting for low-maintenance options such as decks or bricked areas. Despite this, research has shown that people want to be around aesthetically pleasing gardens, although what is considered beautiful is highly individual (Hunter & Hunter, 2008). In Australia, the default covering for verges is lawn, as it is in many European cities, which is most likely a remnant habit from European settlement of Australia.

There is research that shows that the visual appeal of an area can be improved by a well-kept lawn (Clayton, 2007; Hunter & Hunter, 2008). In fact, in America an untidy lawn can be considered as harmful to the appearance of neighbouring houses (Clayton, 2007).

The social pressure to have a well-kept front yard is great (Clayton, 2007). Unsurprisingly, the front yard reflects on both the owners of the yard and neighbouring houses (Clayton, 2007). People use their gardens to show their individuality and use this space as an extension of themselves (Clayton, 2007; Kirkpatrick et al., 2007; Knapp, 2014). A beautiful front garden and verge are almost a reflection on social status, indeed higher income houses have been shown to have more trees in their gardens (Kirkpatrick et al., 2007; Knapp, 2014). What is needed is a further shift of social perceptions on what is 'beautiful', and extend this idea to include a more heterogeneous garden that provides many benefits for both people and the environment.

Some people in Perth, Western Australia are attempting this transition from a European concept of beauty to an idea that is more suited to the Australian climate by using native plants. This is being achieved on both an individual and community scale, with some local councils in Perth encouraging the use of native plants on verges. This study aims to address gaps in the literature, including the potential for native vegetation to provide green spaces on verges in urban areas and role of residents in urban greening programs.

### 2.7 Study Objectives

1. To evaluate the quality of verge plantings in regards to ecological value;
2. To establish participant's motives for adoption and non-adoption of verges;
3. To determine whether there is any relationship between the participant's motives for adoption and the ecological value of verge plantings.

### 2.8 An Adopt a Verge Program in Perth, Western Australia

In 2013, the City of Vincent ("the City") began the Adopt a Verge program, which had 6 aims:

- To encourage planting of native plants on verges

- To contribute to urban greening
- To increase local diversity of native flora and fauna
- To improve wellbeing of local people
- To help native wildlife to move more easily through the urban area
- To enhance beauty of local streets

The City defined a verge as "the area between the road, your property and the property next door" (City of Vincent, 2017a), which is also the definition used in this study. Residents could choose to adopt their verge and were encouraged to invite neighbours to do the same. Adopting a verge involves 3 main steps:

1. Submitting a short application form and a rough plan of the verge design;
2. Awaiting the removal of grass and topsoil, and the application of mulch; and
3. Maintaining and planting plants picked up at the twice yearly plant sale, where the resident receives 20 plants for free and extra plants are available at a subsidised cost.

This process was completed twice a year to correspond with the plant sale, with each of these being considered an "Adoption round". Residents were able to request being "fast-tracked" which was where the council removes grass and topsoil but requires the resident to place the mulch themselves within one month of the grass removal. Fast-tracked verge adoption occurs outside the two rounds which typically occur during April and August each year. The application for adoption, purchasing of plants and maintenance of the verge occurs as described for standard verge adoptions. The City audited verges 5 months after the half-annual plant sale to determine whether verges had been planted and maintained. Auditing occurred until February 2016, but stopped after this date due to a lack of resources.

Upon being accepted, residents were expected to plant native plants on their verge and "maintain the developed verge, ensuring that plantings [were] kept in reasonable health and not overgrown with weeds" (City of Vincent, 2017b). The request of maintenance on adopted verges was not altogether different to non-adopted verges; "verges [were] the responsibility of the land owner or occupier and we strongly encourage[d] residents and tenants to care for their verge in order to increase the aesthetics of their property and the street" (City of Vincent). This may undermine some arguments that the program creates extra work for residents.

In order to evaluate the City of Vincent's Adopt a Verge Program, the following methods have been applied.

# 3. Methods

### 3.1 Area of Study: City of Vincent

The City of Vincent ("the City") is a local council in Perth, Western Australia comprising 10 suburbs: Perth, North Perth, East Perth, West Perth, Highgate, Leederville, Mount Hawthorn, Mount Lawley, Osborne Park and Coolbinia (City of Vincent, 2011). Perth is situated on the Swan Coastal Plain and has a Mediterranean climate. Situated approximately 3km from the central business district of Perth (Figure 3.1), the City has approximately 36 700 residents and covers 11.3 $km^2$, with 139 km of road (City of Vincent, 2011). In 2011, the median age of residents was 34 years, with an average just over 2

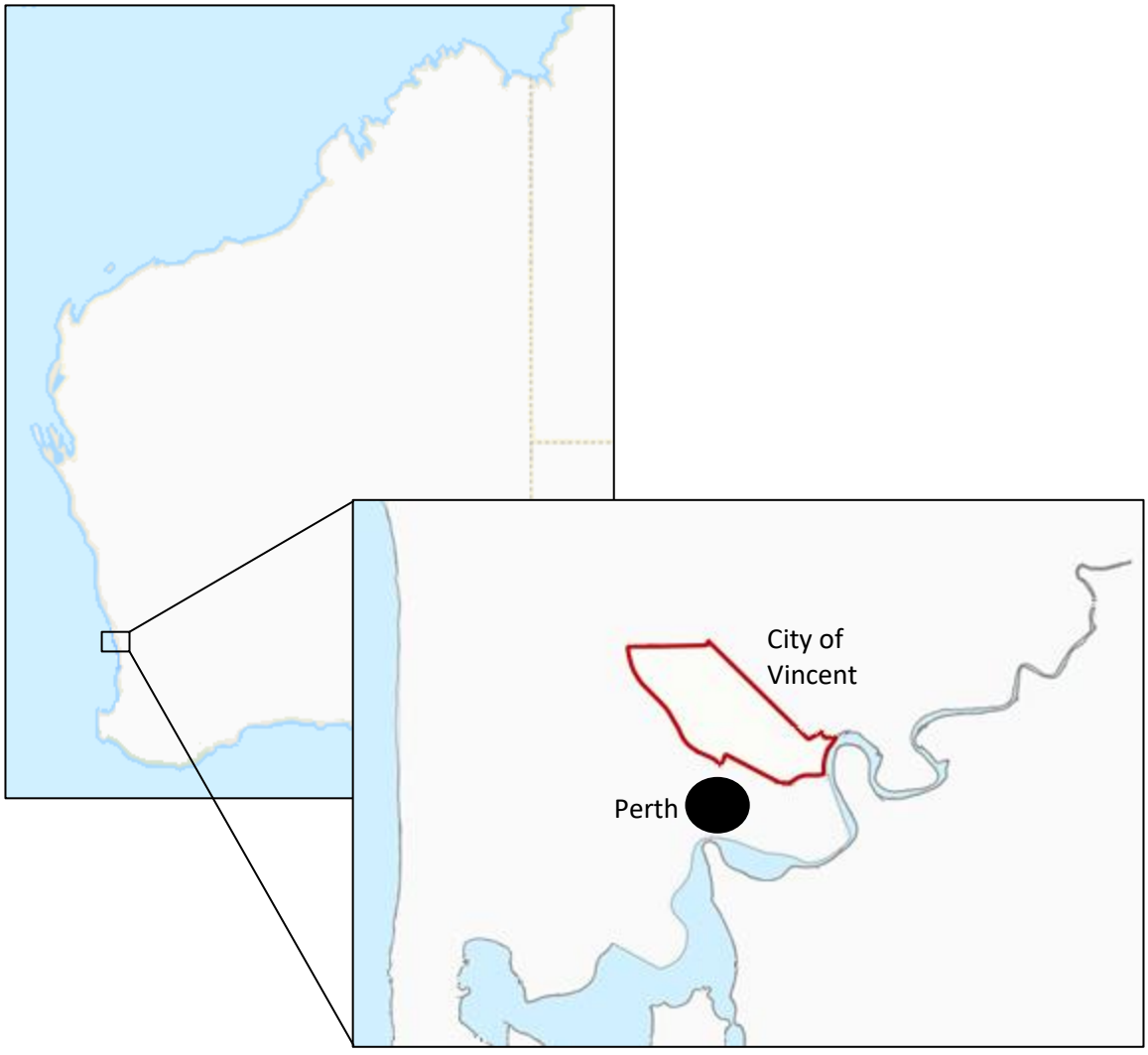


Figure 3.1: The location of the City of Vincent in relation to Perth, Western Australia.

people per household, and a median weekly income of approximately $1700 (Australian Bureau of Statistics, 2013).

### 3.2 The Adopt a Verge Program

The Adopt a Verge program was offered in all 10 of the suburbs in the City. The City provided a list of all adopted verges for this study and when they were adopted. At the time of the study there were 332 houses participating in the Adopt a Verge program. The participating verges were mapped out to determine any clusters of verges, of which there were few (Appendix 1). In order to maximise the number of verges sampled, streets with the greatest number of adopted verges were prioritised along with nearby adopted verges on different streets. Only residents who had their verges selected for vegetation surveying were asked to participate in the Adopters' social survey, discussed further in section 3.4.

This study was divided up into two sections: (a) A survey of the adopted verges' vegetation and (b) a social survey concerning the motivations of the Adopters and Non-adopter's for adoption/non-adoption. These will be discussed in detail in the following sections.

### 3.3 Adopted Verge Vegetation Survey

#### *3.3.1 Overview of the Vegetation Survey*

The vegetation on the adopted verges was surveyed from May to December 2017. Selected verges across the whole of the City were surveyed, with streets that had a higher number of adopted verges being prioritised. Some streets with only a few verges were also sampled due to their proximity to the streets with high number of verges (Appendix 1). The vegetation survey looked at the percentage cover of various surfaces, such as paths, plants and mulch, along with the form and diversity of the plants present (Appendix 2). Vegetation surveys were completed before the social surveys interview.

Several houses were situated on the corner of two streets, and these houses often had adopted verges spanning both sides of the corner. For ease, these verges were separated into two for sampling purposes and then results were combined to give one data set per verge. Modal heights were recorded for both sides of the corner verges, and as such the longer verge's modal height was used for the whole verge during analysis. Some residents applied twice to be a part of the program, so the most recent date of application was used as the date of adoption for analysis.

### *3.3.2 Verge Vegetation Survey Design*

The survey consisted of several sections (Appendix 2). Basic information included the date of survey, observer, address being surveyed and the number of the photograph(s) taken of the verge. Approximately halfway through data collection a 5$^{th}$ section was included—presence of irrigation—which was requested by the City. Due to time restraints, verges which had been sampled prior to the addition of the 5$^{th}$ section were not revisited and recorded as not applicable in the data analysis. Information regarding the presence and placement of paths maintained by the City were recorded, along with the number and type of City maintained trees. The maximum and modal heights of the plants were estimated to the nearest 10cm. A tape measure was used for an initial reference point. The percent cover of various surfaces present on the verge was estimated, which were separated into the following categories: soil/bare ground, mulch, hard surfaces ( sub-categories: rocks/gravel and self-made paths), raised beds, plants (sub-categories: grass and other plants), and other cover. The "other plants" sub-category was split into the different growth forms of the plants, which are described in section 3.3.4 of this paper, and the percentage cover of each plant form was estimated (minimum of 1% cover per form). Individual plant species were counted and classified according to their form.

### *3.3.3 Identification of Plants*

Plants were identified where possible. Plants such as *grevillea sp.* or *scaevola sp.* could have a variety of habits and species, which were included under these umbrella terms. For example, one verge could have a shrub *grevillea* and a ground cover *grevillea*, which were counted as two individual plants. However across two different verges, a recorded "shrub *grevillea*" may represent two different plant species. This division was not distinguished as determining the diversity on a single verge was the priority in this study, rather than identifying the same plant across different verges.

### *3.3.4 Vegetation Habit Classification*

The habit of vegetation on the verges was broken up into 4 main categories; trees, shrubs, tall strappy plants and ground cover, which are summarised in Table 3.1. Trees were plants that had a single main stem with branches that attached to a point along the stem which was elevated off the ground. Any plant that exceeded 200 cm tall was also considered a tree. Examples of trees include *Eucalyptus sp.*, Frangipani (*Plumeria sp.*) and Geraldton Wax (*Chamelaucium uncinatum*). Shrubs could be identified 3 ways: shrubs were woody plants that were taller than they were wide; the branches were generally elevated off the ground; or the plant had a modal height of 40cm or more. Examples of shrubs include *Pimelea sp.*, Bottlebrush (*Callistemon sp.*) and Rosemary (*Rosmarinus officinalis*). Tall strappy plants had leaves which originated at a point at or below ground level and did not have a single main stem. Tall strappy plants could be Kangaroo Paws (*Anigozanthos sp.*), Sedges (e.g. *Carex sp.*) or *Conostylis sp.*, among others. The final category of plant was ground cover. These plants were either woody or herbaceous and were wider than they were tall. The majority of the spread of the ground cover had to have foliage within 5 cm of the ground. Where plants which were shorter than 40 cm were densely packed as to obscure individual plants, these were considered groundcovers. Examples include Pigface (*Carpobrotus edulis*), Kalbarri Carpet (*Eremophila glabra*) and Pumpkin plants (*Cucurbita sp.*). Vegetation which

seemed to have been self-propagated was classified as weeds. Weeds included tufts of grass and self-propagated daisies.

Table 3.1: Descriptions of vegetation form considered in this study.

| Vegetation Form | Description | | | Example |
|---|---|---|---|---|
| | Height | Branches | Width | |
| Tree | >200cm* | Single main stem, branches elevated off the ground | | *Eucalyptus sp.*; Frangipani (*Plumeria sp.*); Geraldton Wax (*Chamelaucium uncinatum*) |
| Shrub | >40cm^ | Generally elevated off the ground^ | Taller than it is wide^ | *Pimelea sp.*; Bottlebrush (*Callistemon sp.*); Rosemary (*Rosmarinus officinalis*) |
| Tall Strappy Plant | | Leaves originated at or below ground level; no single main stem | | Kangaroo Paws (*Anigozanthos sp.*); Sedges (e.g. *Carex sp.*); *Conostylis sp.* |
| Groundcover | Majority of foliage within 5cm of the ground | Woody or herbaceous | Wider than it is tall | Pigface (*Carpobrotus edulis*); Kalbarri Carpet (*Eremophila glabra*); Pumpkin plants (*Cucurbita sp.*). |

*If the plant does not have a single main stem. ^Only one of these categories must be met.

### *3.3.5 Vegetation Cover and Height*

The percentage cover of each type of plant habit was estimated, along with various other surfaces such as mulch and self-made paths (Appendix 2). The percentage cover of plants was considered only within 100 cm of the ground, and as such the upper canopy of trees was excluded from this measurement. The upper canopy would have less value as cover for small animals, such as quendas, and it allows for additional cover to be established closer to the ground. The maximum and modal height of each verge was estimated to the nearest 10cm. For the purposes of this study, street trees are not considered in the percentage

cover or maximum and modal heights, as they are outside of the residents' control. Where the identity of the street tree was uncertain, for example, where there were various trees on the verge, one tree was designated as the street tree and the rest were included in the study.

## 3.4 Social Survey

### *3.4.1 Overview*

The social survey aimed to establish the motivations and values behind residents' actions in regards to the Adopt a Verge program. There were two distinct populations sampled for the social survey; households which had adopted their verge ("Adopters") and households which had not ("Non-adopters"). Each questionnaire had three sections; Perceptions of the Adopt a Verge program, an assessment of ecological world view using the New Ecological Paradigm, and general demographics (Appendix 3a and 3b). These were distributed in two separate ways, which are detailed below, and were worded slightly differently to suit each population group. Ethics approval was sought and obtained from the Murdoch University Human Research Ethics Committee (project number 2017/071).

### *3.4.2 Sample Selection*

This study looked at the residents of the City of Vincent, and separated them into 2 categories: Adopters and Non-adopters. Adopters were the households who formally applied to be a part of the Adopt a Verge program while Non-adopters were people who did not apply. Instead of selecting individual houses, whole streets were selected for surveying. Streets with higher numbers of Adopters were targeted first, to reduce travel time between the households, and Non-adopter houses on these streets were targeted along with surrounding streets. The reason for including surrounding streets was twofold; it reduced travel time and it reduced potential variables such as soil type and neighbourhood.

### *3.4.3 Questionnaire Design*

Both Adopters and Non-adopters received similar questionnaires (Appendix 3a and 3b), with slight alterations made to accommodate their status as Adopters or Non-adopters. There were three sections in the questionnaires;

- Perceptions of the Adopt a Verge Program to determine whether attitudes towards the program alters uptake ;
- An assessment of ecological world view using the New Ecological Paradigm to determine whether people with certain views tended to take up the program; and
- General demographics, to see "who" was adopting or not adopting their verge and to determine if these groups were different.

The questions asked in each section of the questionnaire, and which group received the questions, are summarised in Table 3.2.

*Perceptions*

The first question about resident's perceptions of the Adopt a Verge program asked why the resident did/did not participate in the Adopt a Verge program and gives the residents a list of options to choose from. This list varied greatly between the two questionnaires as the motivations for Adoption were assumed to be very different to the motivations against. The lists were devised through consultation with community members and other researchers. Both the Adopters' and Non-adopters' questionnaires asked how long the resident spends maintaining the verge, with several time brackets to choose from. The Adopters were asked whether any plants had gone missing from their verges while the Non-adopters were not asked this, as it is not relevant.

Adopters were asked about how satisfied they were and how they would rate the process to adopt their verges, with the process being split into the three stages mentioned

earlier in section 2.7 (application, landscaping, and planting and maintaining). Respondents indicated their opinion using a four point scale from highly satisfied to highly unsatisfied, with an additional 'no opinion' option. A similar system was used in the "rate the process" question. The even number of possible responses was aimed at reducing the number of neutral responses. Finally, the questionnaires both asked the resident whether the aims of the program were likely or unlikely to be achieved, and whether the aims were good or bad. Residents were given a scale of 1 to 7 and asked to rate each of the 6 aims, which was taken and modified from Brown, Ham, and Hughes (2010).

Table 3.2: Questions asked in social questionnaires, for verge Adopters and Non-adopters.

| Section | Question | Adopter's | Non-adopters |
|---|---|---|---|
| **Perceptions** | Why did you adopt/not adopt your verge? | Y* | Y* |
| | Hours of verge maintenance per week | Y | Y |
| | Is there anything about your verge you would change? | Y | |
| | Have any plants gone missing? | Y | |
| | Rate the three steps for adoption. | Y | |
| | Indicate your satisfaction with the three steps of adoption | Y | |
| | Are the following adopt a verge aims likely or unlikely to be achieved? | Y | Y |
| | Are the following Adopt a Verge aims good or bad aims to have? | Y | Y |
| **Ecological World View** | New Ecological Paradigm scale | Y | Y |
| **General Demographics** | Age, Gender, Occupation | Y | Y |
| | Do you rent or own your house? How many years have you lived here? | Y | Y |
| | How many people live with you and who are they? | Y | Y |

*Adopters and Non-adopters were offered different options to choose from in regards to why they did/did not adopt their verge.

*New Ecological Paradigm*

This section aimed to assess the values of Adopters and Non-adopters by using the New Ecological Paradigm as designed by Dunlap, Van Liere, Mertig, and Jones (2000). Both

Adopters and Non-adopters received the same questions. The New Ecological Paradigm asked residents to react to 15 statements which were designed to generally assess whether a person was more eco- or anthropo-centric in their ecological world view (Dunlap et al., 2000). A four point Likert scale was used; Strongly Disagree, Somewhat Disagree, Somewhat Agree and Strongly Agree. Removing the neutral response forced residents to choose to either agree or disagree, creating a greater difference in the scale produced and reducing the potential ambiguity of a neutral response (Nadler, Weston, & Voyles, 2015). For example, neutral could indicate a "no opinion", "unsure", or "equal" response (Nadler et al., 2015). To determine which response is meant by the respondent, more response options would be required, which could increase response time and reduce response rate (Dolnicar, Grün, & Leisch, 2011).

*General Demographics*

The final section of the social survey asked general demographic questions. Both the Adopters and Non-adopters received the same questions in this section. Residents were asked what their age range, gender and occupation were and whether they rent or own their house. The residents were asked how many years they had lived there, how many people they lived with and who they lived with in a general sense (e.g. spouse, housemate, children under 12 years old etc.). The aim of collecting these demographics was to determine whether Adopters and Non-adopters were different groups of people demographically. Finally, residents were asked for any further comments and were given the opportunity to provide their email to go into a draw to win 1 of 3 gift vouchers.

### *3.4.4 Questionnaire Distribution*

The distribution of the questionnaires varied between the two sample groups and detailed below.

*Adopters*

All Adopters were sent a letter in June 2017 informing them of the study (Appendix 4). The City contacted residents via the email provided on the resident's registration form for the program, or the residents received a letter via post where email was not possible. Both methods of contact received the same information about the study. The letter advised residents that the researchers would be knocking on doors and requesting residents to complete a questionnaire during a short interview. Some residents requested online access to the questionnaire instead of an in-person interview, and a link to the survey was provided to these residents.

Door-knocking commenced in September 2017 and continued until December 2017. As vegetation surveys commenced prior to door-knocking, those houses with a completed vegetation survey were prioritised initially. Vegetation surveys were then completed at the same time as door-knocking interviews to reduce travel time. Where residents were home, they were invited to participate in a semi-structured informal interview, where researchers filled out the online SurveyGizmo questionnaire for the residents. Where residents were not able to complete the survey at the given time, a paper version of the survey was left to be posted back via the reply-paid envelope provided to the residents. If residents were not home at the time of the door-knocking, a paper survey, reply-paid envelope and a short letter explaining the study and survey were left in the resident's letterbox. This process is summarised in Figure 3.2.

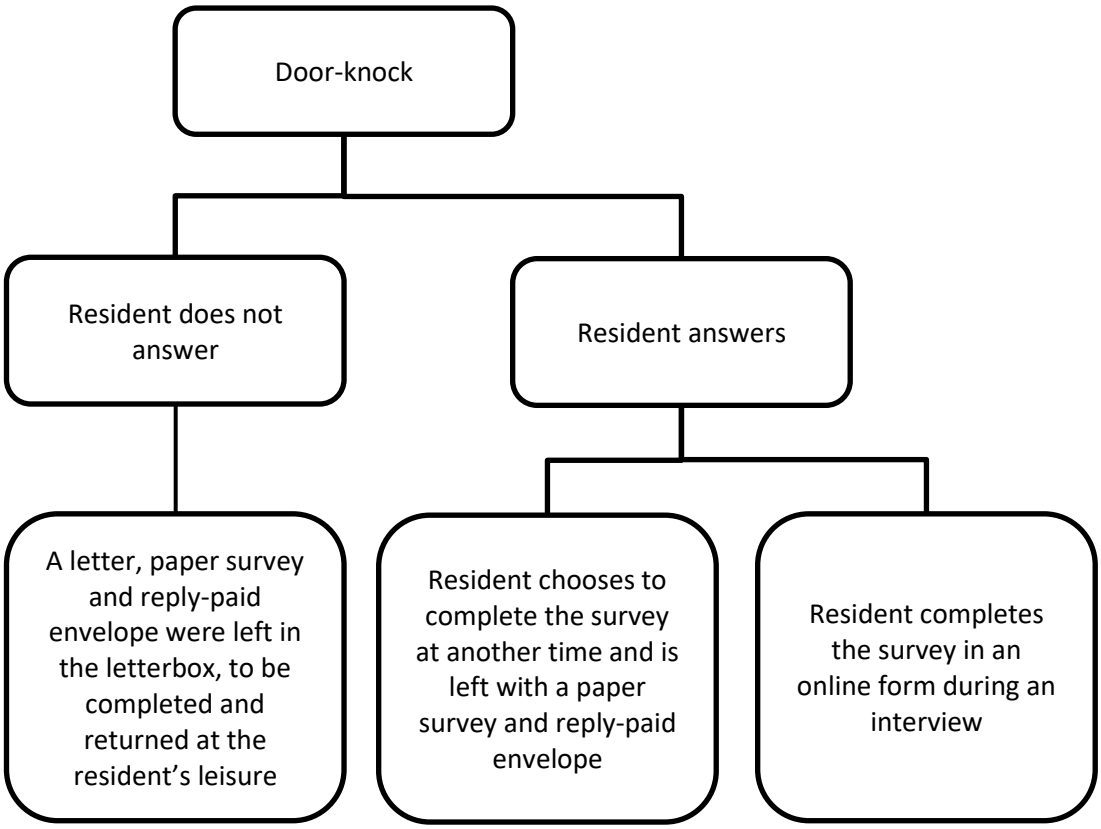


Figure 3.2: The process of completing the Adopters' social surveys.

*Non-adopters*

Letters for Non-adopters were dropped into 3200 letterboxes between September and October 2017 (Appendix 5), on the predetermined streets. This letter contained information on the study, a request to participate in the study and a link to the online questionnaire. Some properties were large unit blocks, where residents did not have direct control over their verge, so only 5 of these blocks received letters in every letterbox. Subsequent unit blocks received a letter in the "strata company" letterbox. Where residents were present at the time of the letter drop, the letters were handed directly to the resident. The response to the survey relied purely on the resident's interest, as the financial incentive offered at the end of the survey was not included in the letter, due to an oversight of the researchers.

### 3.5 Data Analysis

Vegetation data was analysed using a linear correlation between time since adoption and vegetation cover, richness and diversity. The average cover of verges was determined for both general cover and the different plant forms. Diversity and richness were determined on individual verges, with diversity being calculated using the Shannon-Wiener diversity index.

Resident's responses to the interview conducted were entered directly into an online form using the SurveyGizmo website. Data that was collected via paper questionnaires were entered into a separate online form once the questionnaire was returned to the researchers. Both of these online forms could then be downloaded into excel and imported into R Studio for analysis.

Respondents were able to explain their motivations behind their adoption or non-adoption status using the "other" category in the questionnaires. Some respondents used this section to indicate that they had received the wrong survey—some Adopters received the Non-adopter survey, potentially because they were new to the program and were not marked as Adopters on the list provided to the researchers. Where this occurred, the attitudes, ecological world view analysis and demographics of this group were combined with the Adopters for the purposes of analysis, but were excluded from the motivations due to the questionnaire design.

Some respondents to the Non-adopter survey indicated that they had planted native vegetation on their verge outside of the program. These respondents were excluded from both populations for the demographics and comparison tests and formed their own group—the Self-adopters. The Self-adopters were included when determining the motivations behind non-adoption.

Attitudes of participants were calculated using their belief strength and evaluation scores. Belief strength was converted from the 1 to 7 scale to a 0 to 6 scale by subtracting 1 from the resident's response. Belief evaluation was converted to a scale of -3 to +3, from the original 1 to 7 scale by reducing the resident's response by 4. The belief strength was multiplied by the belief evaluation to give the attitude score which had a possible range of -18 to +18. Where belief evaluation is above zero, this indicated that respondents thought the aim was a good thing to do. Similarly, any attitude score above zero indicated the aim was "good" and "likely".

Similarities between the Adopter, Non-adopter and Self-adopter demographics were determined using descriptive statistics. The Mann-Whitney U test was used to determine differences in the NEP score, belief strength and evaluation between the groups, while a t-test revealed any difference in the attitudes between the three groups.

Social and vegetation data were combined and analysed using linear regression to determine whether there was any correlation between the social aspects (attitudes and ecological world view), and the vegetation aspects (cover, diversity and richness) of the adopted verges.

# 4. Results

The results of this study are divided into 3 sections; vegetation survey results, social survey results and an analysis of the relationship between the two. The vegetation results centre around the percent cover, richness and diversity of the adopted verges. The social survey results compare Adopters and Non-adopters and reveal a third group, the Self-adopters, discussed further in section 4.2.3. The final section of the results considers the potential relationship between the adopted verge's vegetation measures and the Adopter's responses to the social questionnaire.

## 4.1 Vegetation Survey

### *4.1.1 General Composition*

Over the 4 years of the adopt-a-verge program, 332 residents entered the program by May 2017. Of these verges, 198 verges were sampled for vegetation. Consistent with the goals of the program, 85% of sampled verges had some form of non-grass vegetation present on the verge (Fig 4.1a). Mean percent cover of sampled verges was largely mulch (57% SE=2.1) followed by plants (29% SE=1.7) and then grass (5.2% SE=1.0; Figure 4.1a). Other features such as self-made paths (5% SE=0.9), bare soil (1.7% SE=0.4), rocks (0.9% SE=0.2), raised beds (0.2% SE=0.1), and other cover (1.4% SE=0.4) were minor components of the verges (Figure 4.1a).

When plant cover was broken down into plant form, shrubs and ground covers covered the largest area on average (11% SE=0.9 and 9.8% SE=1.0 respectively; Figure 4.1b). Tall strappy plants covered the third largest area on average (6.7% SE=0.7), with trees and weeds covering the least largest area (3.4% SE=0.9 and 1.1% SE=0.5; Figure 4.1b).The average number of plant forms on a verge showed a similar pattern to percent cover, with verges having the greatest variety of shrubs (4.3 SE=0.32), followed by ground covers (2.0 SE=0.14), tall strappy plants (1.7 SE=0.11), and trees (0.6 SE=0.09).

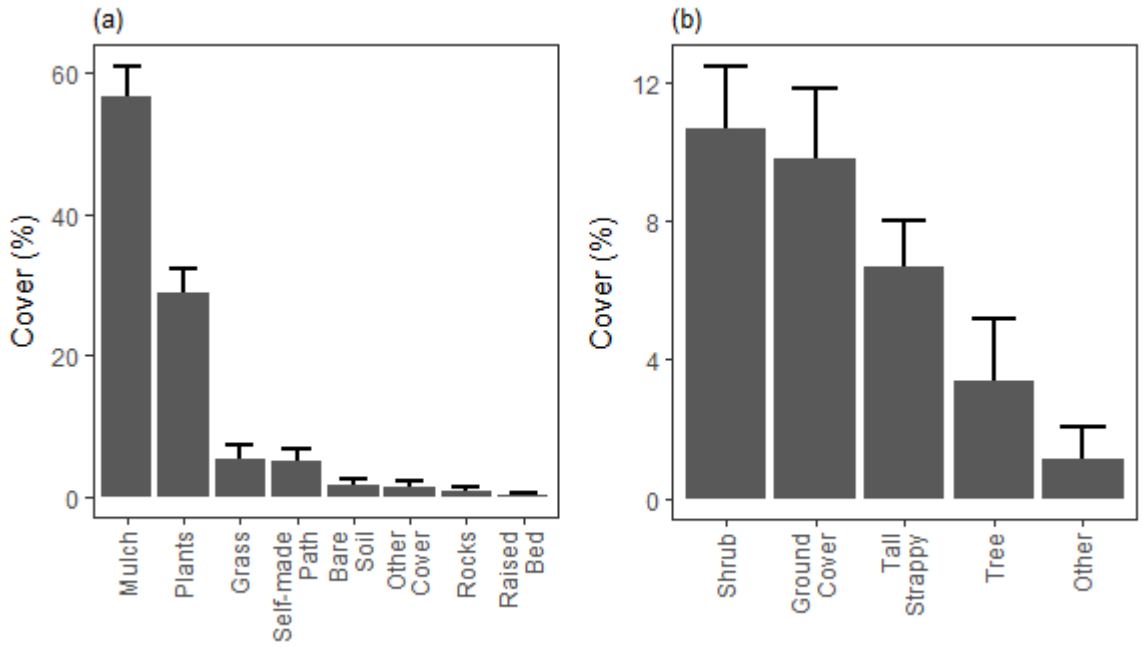


Figure 4.1: Mean percent cover for each type of cover on the sampled Adopted Verges of the City of Vincent (n=198), with the categories of cover type (a) and the different plant forms (b). Error bars represent a 95% confidence interval.

### *4.1.2 Change over Time*

Overall, percent cover of vegetation increased over time (Pearson r=0.28, $p<0.001$; Figure 4.2). Individually, ground cover and shrub cover both increased over time (Pearson r=0.22, $p<0.01$ and Pearson r= 0.21, $p<0.01$ respectively), while tall strappy plant cover and tree cover did not increase over time (Figure 4.2). Overall richness did not increase over time, nor did the richness of individual plant forms (Appendix 6). Diversity did not increase over time overall or for individual plant forms (Figure 4.2; Pearson r=0.08, $p=0.11$ and Pearson r= -0.04, $p=0.10$ respectively).

One corner verge had two definitive ages, as one side of the corner was adopted within the program while the other side had been "Adopted" prior to the start of the overall program, which was established during the interview with the Adopter. This corner verge was maintained as two separate entities for the purposes of looking at change over time in these results. The inclusion of the older side of the verge had no influence over the

correlations.


Figure 4.2: Percent cover, richness and diversity across four plant forms in response to time since adoption in months. Individual verges are represented as dots (n=198), and the line represents a rolling mean (span=5). The single dot (verge) at t=62 was removed from the rolling mean as it is an outlier.

### 4.2 Social Survey

In this section the results from the social surveys are explored. The Adopters, Non-adopters and Self-adopters are characterised by their demographics, motivations and attitudes towards the six aims of the Adopt a Verge program. Hence, it is pertinent to understand the aims of the Adopt a Verge program, and the corresponding abbreviations used further in this study (Table 4.1).

Table 4.1 The six aims of the City of Vincent's Adopt a Verge program and their abbreviations in this study.

| Aim | Abbreviation |
|---|---|
| To encourage planting of native plants on verges | Planting |
| To contribute to urban greening | Urban Greening |
| To increase local diversity of native flora and fauna | Diversity |
| To improve wellbeing of local people | Wellbeing |
| To help native wildlife to move more easily through the urban area | Corridors |
| To enhance beauty of local streets | Beauty |

The careers of participants were separated into 11 categories (Appendix 7) partially derived from the Australian and New Zealand Standard Classification of Occupations. The most prominent occupations were Managers, Professionals and Retirees. Managers are people who plan, organise and coordinate business operations and people. Professionals are people who "perform analytical, conceptual and creative tasks through the application of theoretical knowledge and experience" (Australian Bureau of Statistics, 2013), while Retirees are self-identified by the respondents.

### *4.2.1 Who are the Adopters*

Of the 198 Adopters approached about the study, 53 people completed in-person interviews and 36 people returned the paper surveys (47% response rate). The Adopters who participated in the study were generally middle-aged to older residents, with most Adopters being in the 35-44 age category (34%), or 45-54 (22%) or 65+ (22%; Figure 4.3a). Females made up 58% of the Adopter respondents and the majority of respondents had lived in their house for 8 or more years (60%; Figure 4.3b, 4.3c). Over half of the respondents were professionals in occupation (59%), while retirees were the next largest group (16%) and managers the third (11%). Most respondents spent less than one hour per week maintaining their verge (51%) with almost all of the rest spending between 1-2 hours per week (47%). The remaining 1.9% spent between 3-4 hours per week maintaining their verge.

The majority of Adopter respondents (41%) lived with one other person while households with 3 people were found almost half as much (23%), and households of 4 people were less common again (19%; Figure 4.3d). No Adopters reported having more than 5 people in their household (Figure 4.3d). Respondents reported living with a spouse/partner the most (75%; Figure 4.4). A third of respondents reported living with young children under 12 years of age (38%), and 6.5% of respondents lived alone (Figure

4.4).

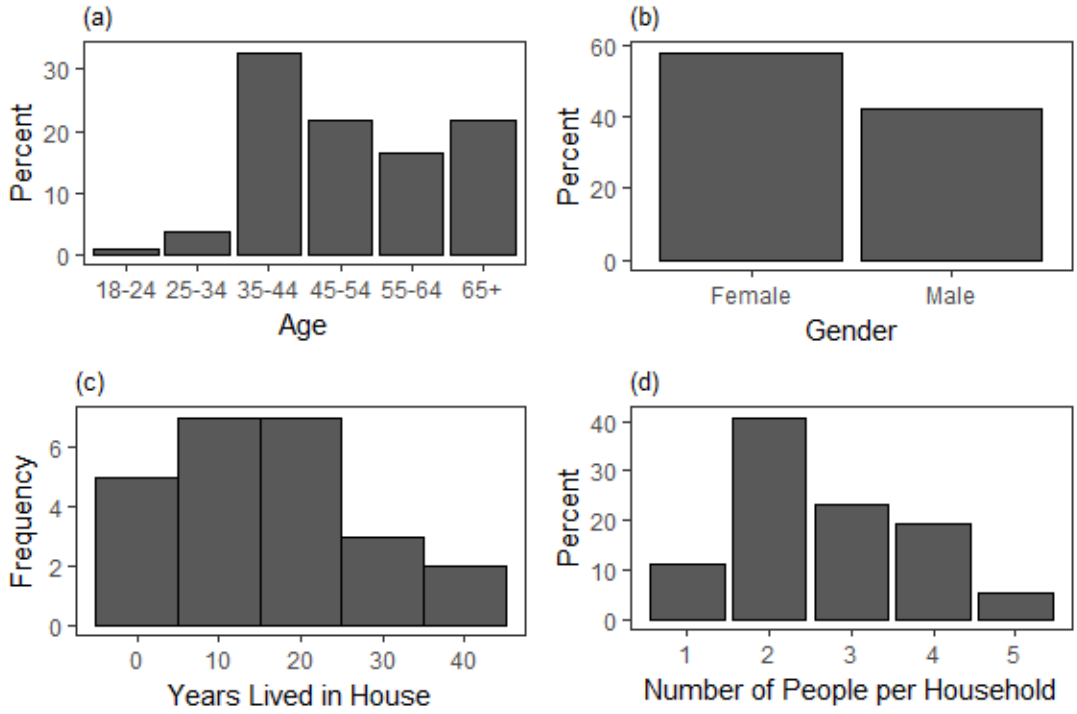


Figure 4.3: Age (a), gender (b), number of years lived in the house (c) and number of people living there (d) for Adopters (n=110).

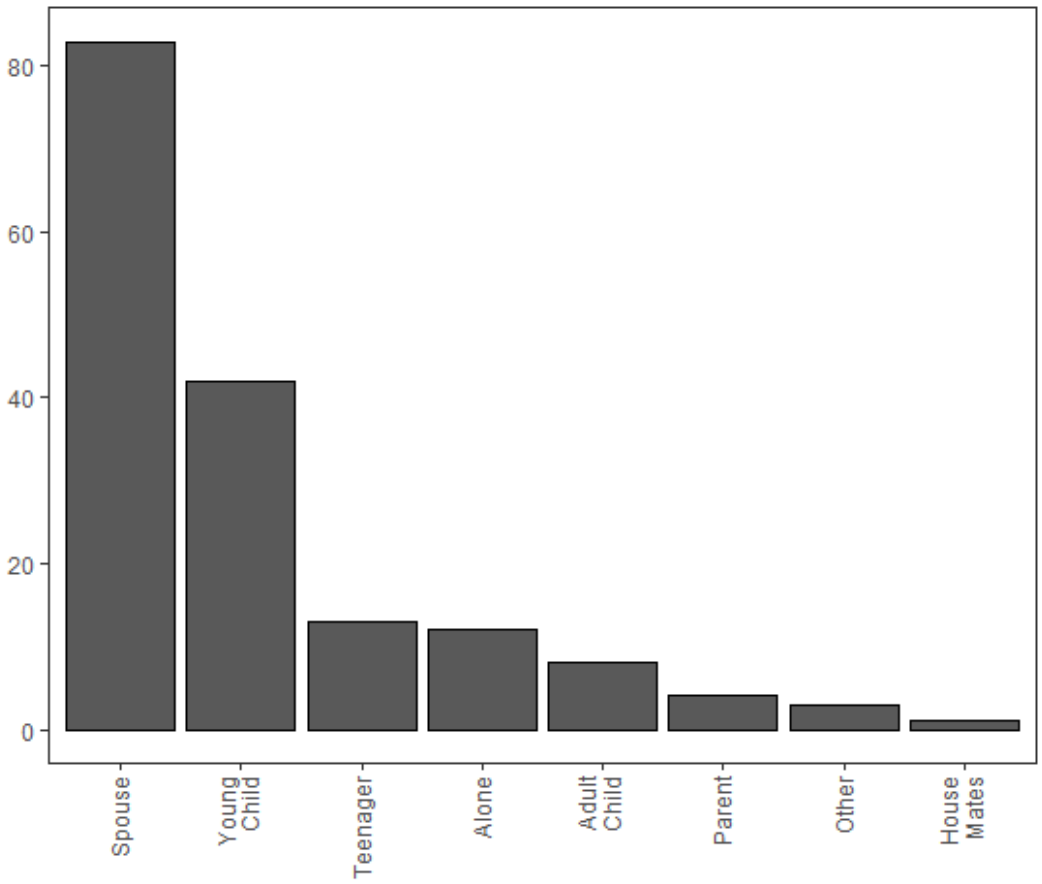


Figure 4.4: Percentage of Adopters who indicated that they lived with a certain type of person (n=110).

*Attitudes and Beliefs*

Overall, belief strength had a very positive mean and some spread of the data (mean=5.1, SD=1.2, minimum=0, maximum=6; Figure 4.5a). The belief evaluation for the respondent Adopters was strongly positive and had very little spread (mean=2.7, SD=0.68, minimum= -3, maximum=+3; see Figure 4.5b). The individual evaluation questions had very similar spreads and means, while the individual strength questions were slightly more varied in their spread and means (Figure 4.5a, 4.5b). The belief strength for both the "Improve wellbeing of local people" and "Help native wildlife to move more easily through the urban area" program aims had a slightly lower mean and a greater spread (mean=4.7, SD=1.5 and 4.6, SD= 1.5 respectively; Figure 4.5a, 4.5b).

Attitude scores had a maximum possible value of 18, indicating a strongly positive ("good" and "likely") attitude and a minimum possible value of -18, indicating a strongly negative ("bad" and "unlikely") attitude. The mean attitude score for Adopter respondents was 15.6 (SD=3; Figure 4.5c). Respondents had the most positive attitude towards beauty (mean=16, SD=3.4), but all mean Adopter attitudes were above 13 (Figure 4.5c). The mean of the total NEP score for Adopter respondents was 24.5 (SD=5.7), out of a possible maximum of 56 (anthropogenic views) and minimum of 0 (ecological views).

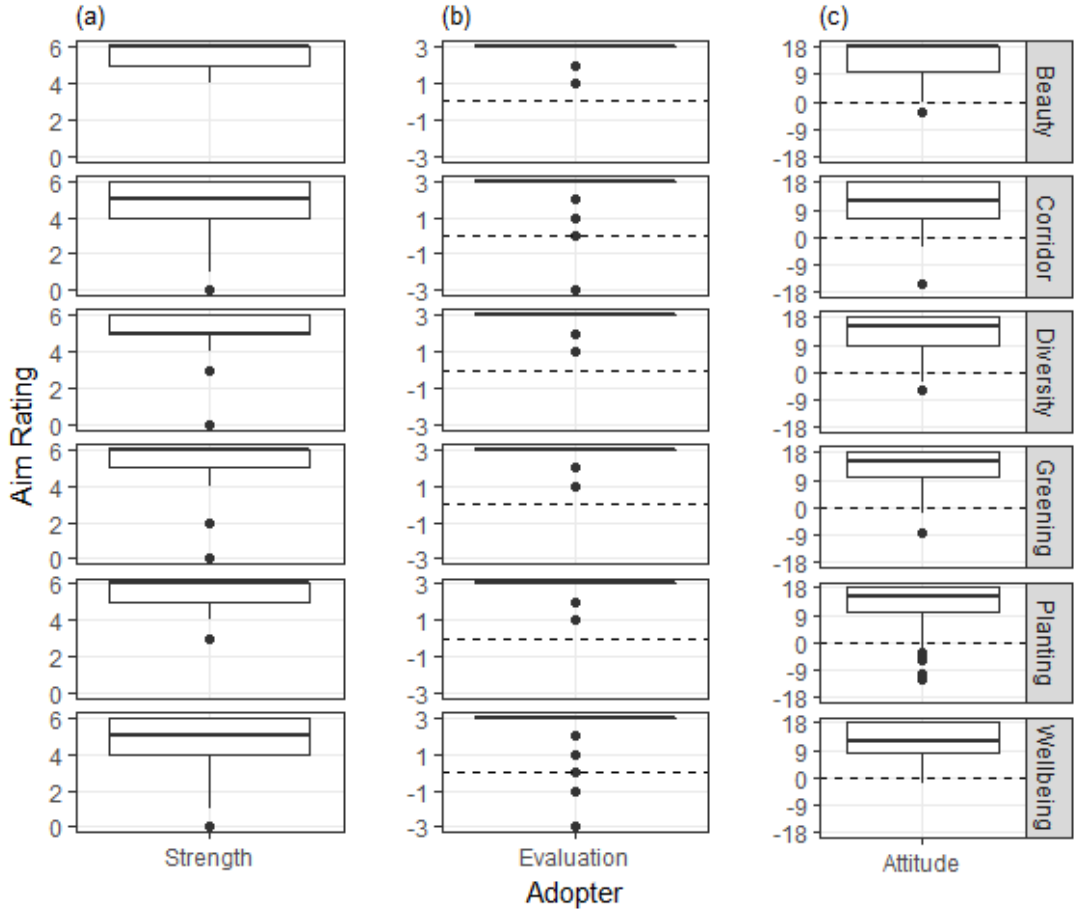


Figure 4.5: Boxplots show the distribution of the ratings given by Adopters (n=110) of how "Likely" (a) the program's aims were to be achieved and how "Good" (b) the program's aims were (Strength and Evaluation, respectively). Attitude is then calculated using these scores and gives an Attitude Score for Adopters. The single dots indicate people who were very different to the dataset (outliers). Dashed lines show where y=0.

*Motivations for Adoption*

The most cited motivation for adoption was to improve aesthetics (76%; Figure 4.6). Saving water and helping the environment were the second and third most commonly cited motivations for adoption (53% and 52% respectively; Figure 4.6). As respondents could pick more than one option, the total percent of cited motivations for adoption was above 100%. Peer-pressure was the least commonly cited motivation for adoption (18%), although anecdotally, casual discussion with residents during face to face completion of the questionnaire tended to have residents cite peer pressure more than mailed-back paper questionnaires. A large proportion of respondents chose the "other" category and while many of their responses fell into the pre-set categories, respondents also mentioned a wish to reduce labour and cost (n=8 and n=3, respectively), among other individual motivations for adoption.

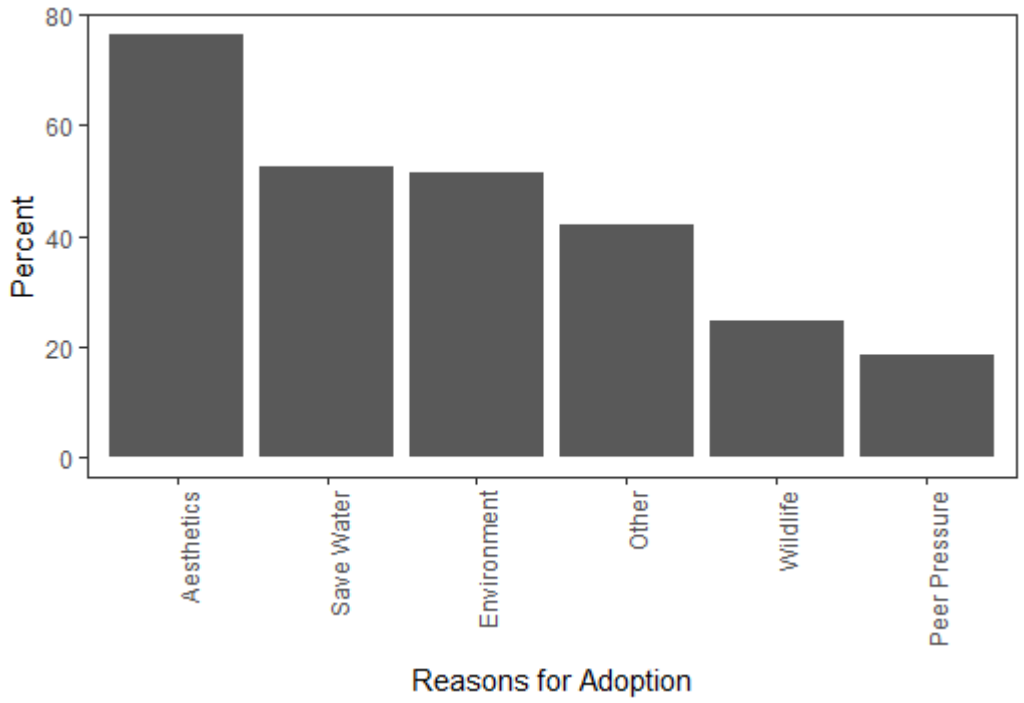


Figure 4.6: Why Adopters chose to participate in the program and the percentage of how many people selected that option (n=93).

### *4.2.2 Who are the Non-adopters*

Out of the 3200 letters dropped into letterboxes, 109 people responded via the online survey (3.4% response). There were even numbers of respondents between the ages of 35-44 and 45-54 (32% of respondents per category; Figure 4.7a). Of the people who responded to the questionnaire, 57% of them were women (Figure 4.7b). Most of the respondents had lived in their house for less than 20 years (87%), however one respondent had been residing in their house for 59 years (Figure 4.7c). The respondents were generally professionals (59%) or managers (13%). The majority of respondents spent less than one hour per week maintaining their verge (89%).

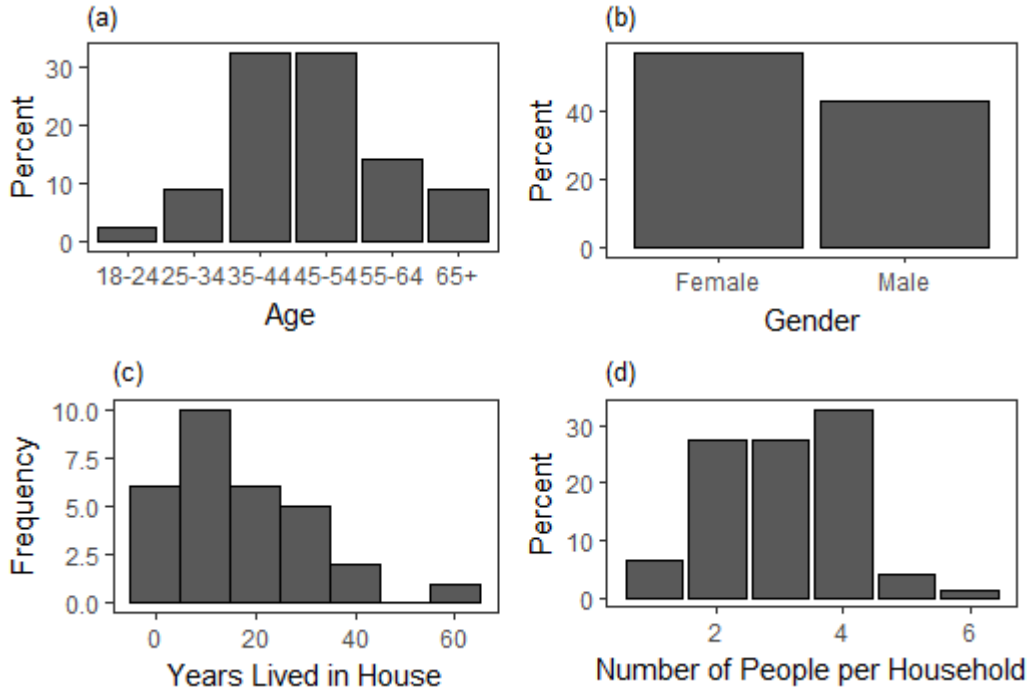


Figure 4.7: Age (a), gender (b), number of years lived in the house (c) and number of people living there (d) for Non-adopters (n=77).

One third of respondents had four people in their households (33%; Figure 4.7d). The second most common number of people per household was 2 or 3 people (28% each; Figure 4.7d). One respondent reported having 6 people in their household (Figure 4.7d). 74% of respondents lived with their spouse and 36% lived with young children under 12

years old (Figure 4.8). Teenagers were the third most common household residents (18%; Figure 4.8).

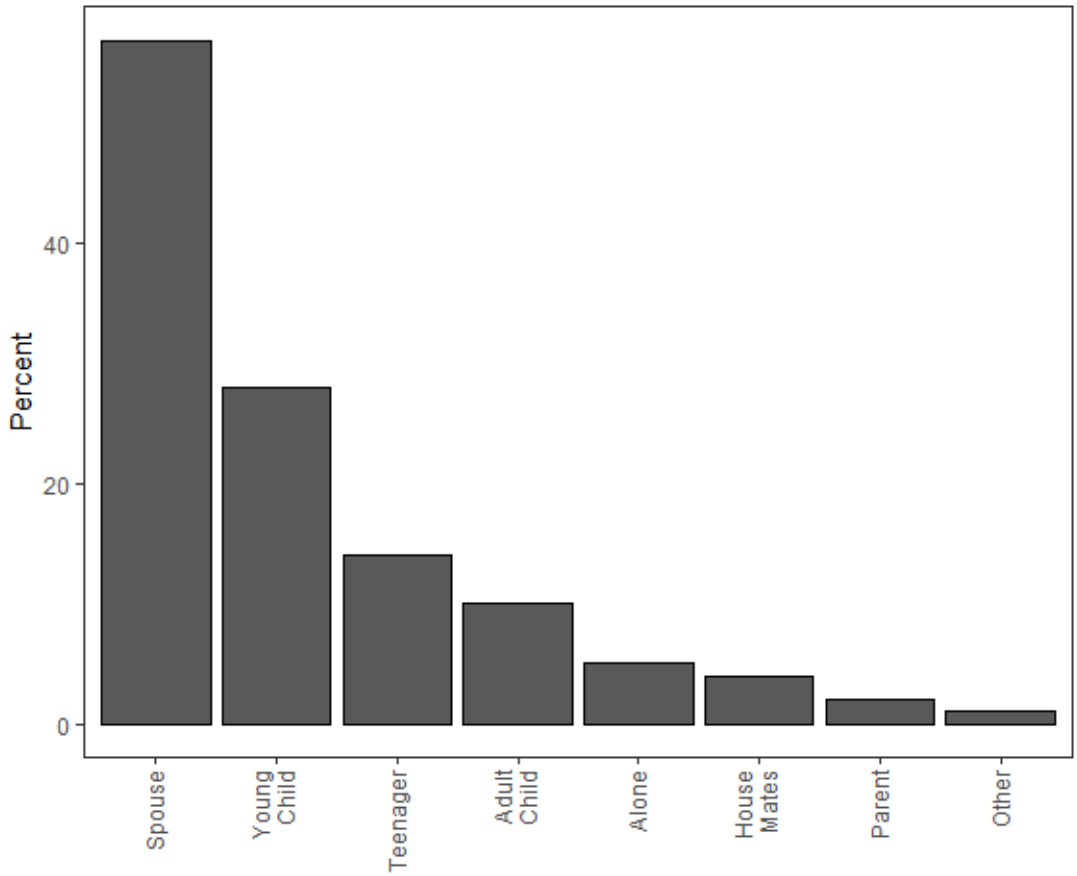


Figure 4.8: Percentage of Non-adopters who indicated that they lived with a type of person (n=77).

*Attitudes and Beliefs*

The average rating for belief evaluation among Non-adopter respondents was 5.0 (SD=1.5), while belief strength had a mean of 5.2 (SD=1.8; Figure 4.9). There was a wide spread of belief ratings across all six of the Adopt a Verge aims, with almost all aims receiving at least one "extremely unlikely" (0) or one "bad" (-3) rating. The only aim which didn't receive a rating of -3 was "Encourage planting of native plants on verges", which received a lowest rating of -2 (Figure 4.9). Non-adopter respondents had the most positive attitude towards "Enhancing the beauty of local streets" and "urban greening" (mean=11.5, SD=6.8; 11.4,

11.4, SD=7.0) and the least positive attitude towards "Helping native wildlife to move more easily through the urban area" (mean=8.1, SD=7.3; Figure 4.9). Non-adopter respondents had a total NEP score of 27.2 (SD=6.9).

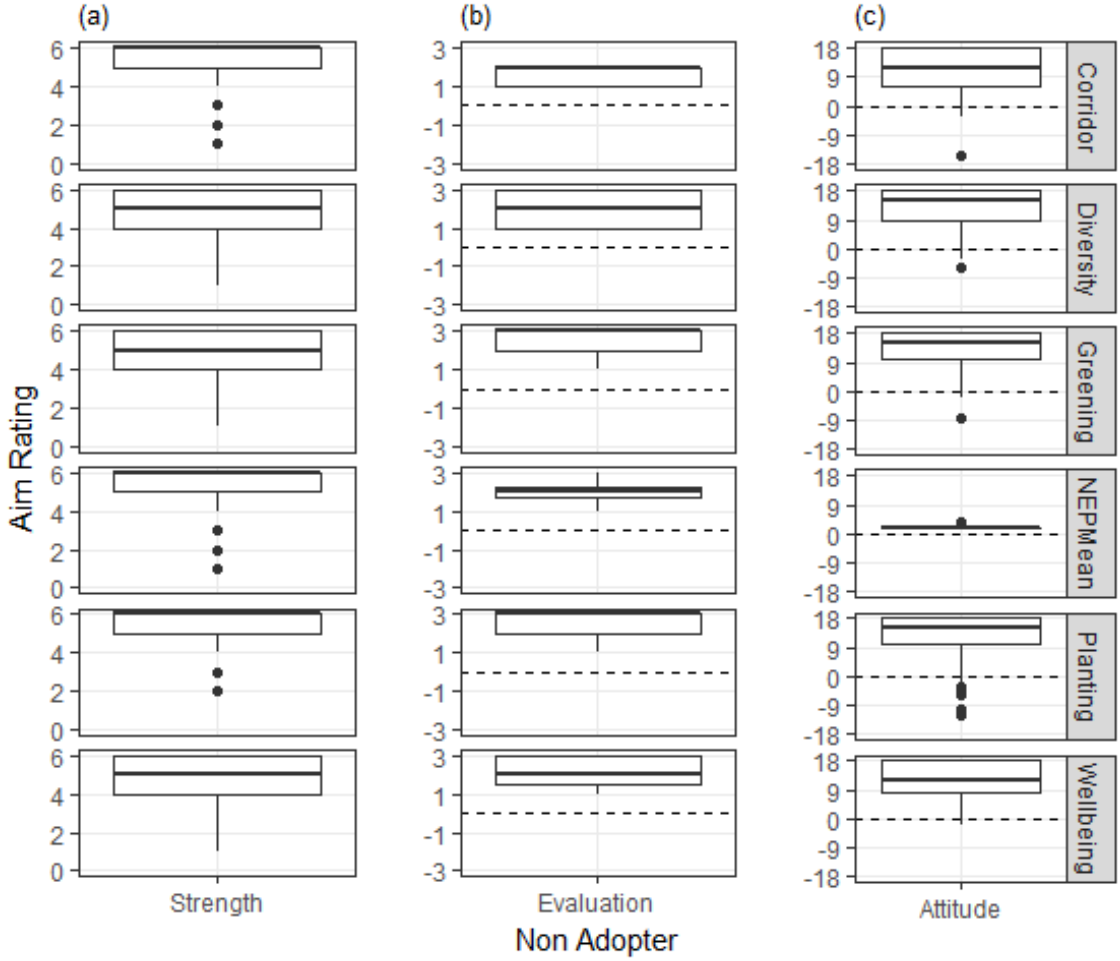


Figure 4.9: Boxplots show the distribution of the ratings given by Non-adopters (n=77) of how "Likely" (a) the program's aims were to be achieved and how "Good" (b) the program's aims were (Strength and Evaluation, respectively). Attitude is then calculated using these scores and gives an Attitude Score for Non-adopters. The single dots indicate people who were very different to the dataset (outliers). Dashed lines show where y=0.

*Motivations for Non-adopting*

The majority of Non-adopter respondents found that the pre-set categories did not encapsulate why they did not adopt, with 53% choosing the "Other" category. Most of

these “Other” responses were due to the respondents either already participating in the program or having created a native verge outside of the program (termed “Self-adopters”). When these responses are removed from the data, “Other” is still the second most selected option (17%; Figure 4.10). There was a large variety of responses for why respondents selected “Other”, summarised in Table 4.2. The most commonly cited motivation for Non Adoption was the respondents being unaware of the program (22%; Figure 4.10). Respondents also cited other uses for their verge (15%), their lack of time (14%) and self-adoption (14%) as their motivations for why they did not adopt (Figure 4.10). Only 5% of respondents did not like native plants or were just not interested in the program (Figure 4.10).

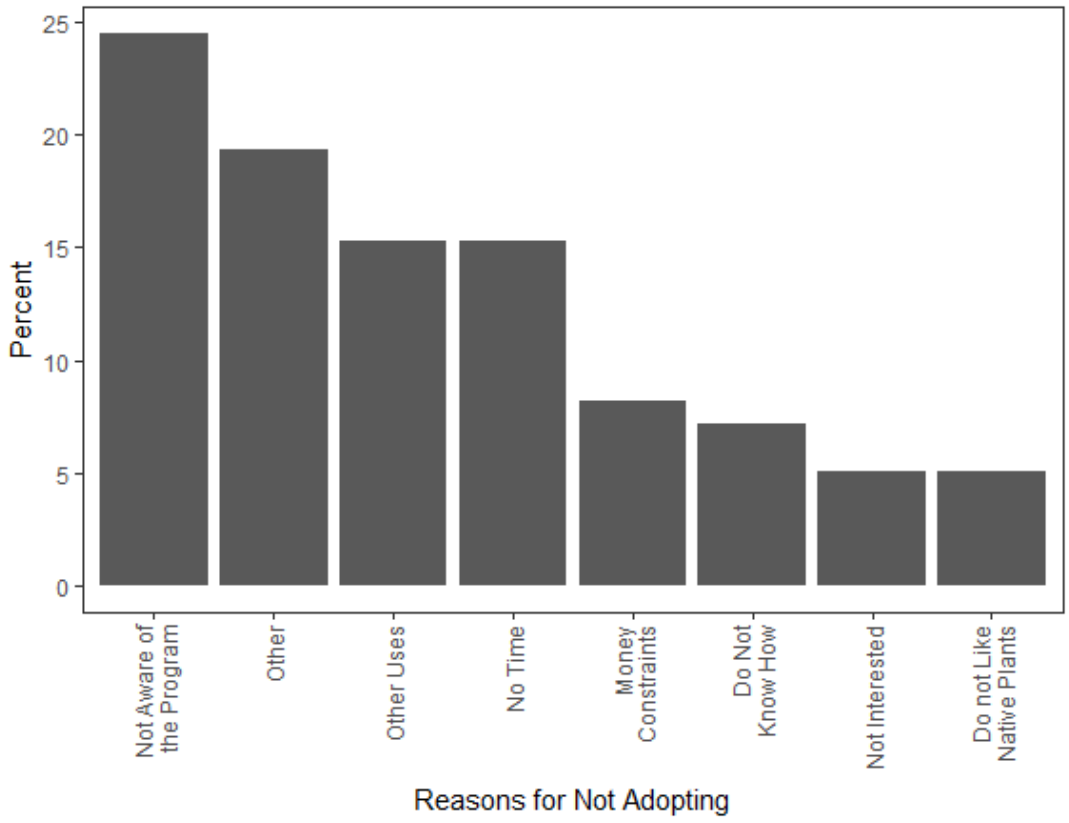


Figure 4.10: The percentage of Non Adopters who selected these motivations for not adopting, people who have “Already-adopted” and “Self-adopted” have been removed (n=77).

Table 4.2: The motivations identified by respondents for non-adoption and the number of respondents who identified these categories.

| Motivation for non-adoption | Number of responses |
|---|---|
| Already a part of the program | 17 |
| Self-adopter | 15 |
| Planning to join the program | 10 |
| The City should not use rate payers money on this program | 2 |
| No verge/rented property | 2 |
| Obstruction of view | 2 |
| Long wait time to participate in the program | 2 |
| Would like a verge vegetable patch for the community, not natives | 1 |
| Liability | 1 |
| Need more assistance from council. Time poor and cannot spend time drawing up a plan and sending it in | 1 |
| Council Legislation | 1 |
| Potential trampling from nearby shops | 1 |
| Prefer a cleaner look to the verge | 1 |
| Verge is maintained with lawn and reticulation | 1 |

### *4.2.3 Self-adopters*

Of the 109 Non-adopters who responded to the questionnaire, 15 had already created a native garden on their verge without going through the Adopt a Verge program, this group was subsequently labelled “Self-adopters”. All Self-adopters were above 35 years old, with an even split of 45-54, 55-64 and 65+ people (27% each; Figure 4.11a). 60% of respondents were female (Figure 4.11b). Self-adopters have lived in their houses for 2 to 35 years, with the most common being 30 years (n=3; Figure 4.11c). Most Self-adopters spent less than

one hour per week maintaining their verge (n=10) and were retired (n=6) or professional (n=5).

Of the 15 Self-adopters, 6 respondents had 4 people in their household, 4 respondents had 2 people and 3 respondents had 1 person (Figure 4.11d). Most Self-adopters lived with a spouse (80%) and a quarter lived with an adult child (27%; Figure 4.12). One fifth of Self-adopters lived alone or with young children (20% each; Figure 4.12).


Figure 4.11: Age (a), gender (b), number of years lived in the house (c) and number of people living there (d) for Self-adopters (n=15).

*Attitudes*

Self-adopters had a mean belief evaluation score of 2.2 (SD=1.5) and a mean belief strength score of 4.6 (SD=1.2; Figure 4.13a, 4.13b). Across the 6 aims of the program, the belief strength was consistently below the belief evaluation score (Figure 4.13a, 4.13b). The aim "encourage planting of native plants on verges" was tightly clustered for both the belief evaluation and strength, as was the aim "contribute to urban greening" (Figure 4.13a, 15b). On average, the Self-adopters had an attitude score of 12.6 (SD=6.2; Figure 4.13c). Self-

adopters had an average total NEP score of 22.9 (SD=6.8).

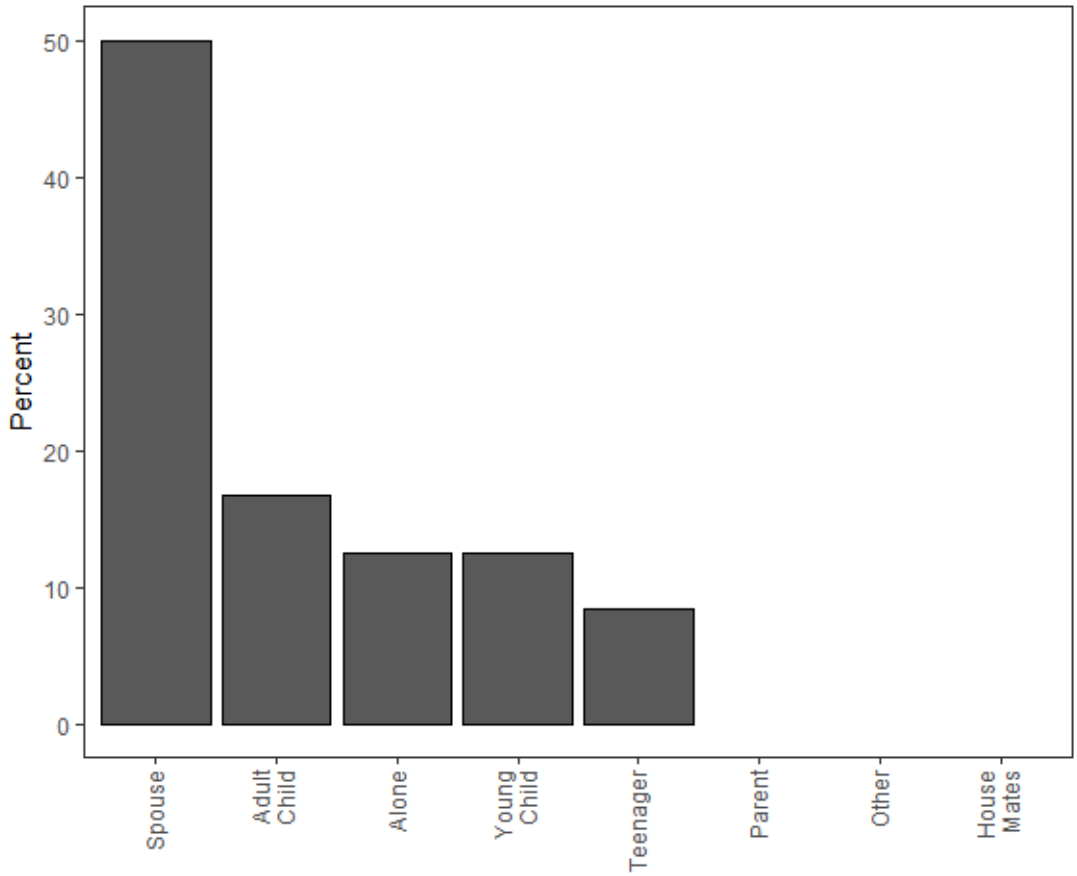


Figure 4.12: Percentage of Self-adopters who indicated that they lived with a type of person (n=15).

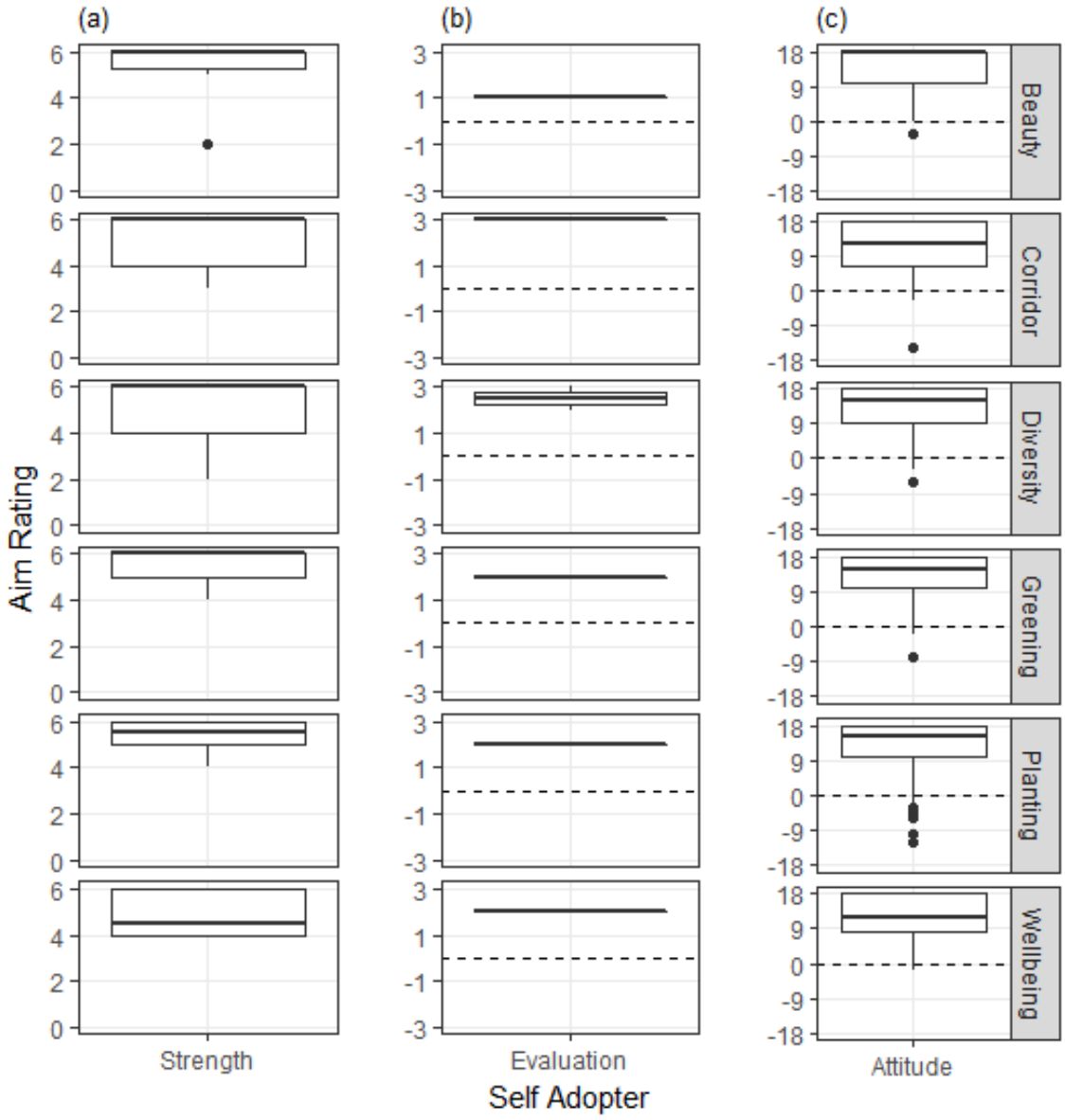


Figure 4.13: Boxplots show the distribution of the ratings given by Self-adopters (n=15) of how "Likely" (a) the program's aims were to be achieved and how "Good" (b) the program's aims were (Strength and Evaluation, respectively). Attitude is then calculated using these scores and gives an Attitude Score for Self-adopters. The single dots indicate people who were very different to the dataset (outliers). Dashed lines show where y=0.

### *4.2.4 Comparison of Adopters, Non-adopters and Self-adopters*

Adopters, Non-adopters and Self-adopters were similar in both age and gender distribution (Table 4.3). Their occupations were similar, however retirees made up 40% of Self-adopters, while they made up smaller proportions in Adopters and Non-adopters (Table 4.3). The people who lived in the household were similar as well, however the proportion of adult children was greater in Self-adopters (Table 4.3). The differences in the number of years that they have lived in their house across all three groups could be somewhat due to the questionnaire design—paper surveys limited Adopters to selecting 8+ years as their maximum number of years lived in their house. The main difference between the three groups was the number of household occupants (Table 4.3). Of the three groups, the most common number of people at the house ranged from 1 to 4 (Table 4.3).

Table 4.3: Summary of Adopter (n=110), Non-adopter (n=77) and Self-adopter (n=15) demographics.

| | Adopters | Non-adopters | Self-adopters |
|---|---|---|---|
| Age | 35-44 years | 35-44 and 45-54 years | Over 35 |
| Gender | Female (58%) | Female (57%) | Female (60%) |
| Number of Years Lived in their House | 8+ years | <20 years | 2 to 35 years |
| Occupation | Professionals (59%), Retirees (16%), Managers (11%) | Professionals (59%), Managers (13%), Retirees (6%) | Retirees (40%), Professionals (33%) |
| Number of Household Occupants | 2 people (41%), 3 people (23%), 4 people (19%) | 4 people (33%), 2 people (28%), 3 people (28%) | 4 people (40%), 2 people (27%), 1 person (20%) |
| Most Common Occupants | Spouse (75%), Young children (38%) | Spouse (74%), Young children (36%) | Spouse (80%), Adult children (27%), Young children (20%) |

All three groups had respondents with 4 people in their household, with Self-adopters having the highest proportion (40%), Non-adopters having the second highest proportion (33%) and Adopters having the lowest proportion (19%; Table 4.3). Only Adopters and Non-adopters had large proportions of the group's respondents living with 3 people (23% and 28% respectively; Table 4.3). All groups had large proportions of 2 people households, the largest being Adopters (41%) followed by Non-adopters (28%) and Self-adopters (27%; Table 4.3). Only Self-adopters had a large proportion of people living alone (20%; Table 4.3).

*Attitudes*

The belief evaluation of Adopters was more tightly spread and strongly positive, while Non-adopters were somewhat positive and more spread out (Appendix 8). Similarly, Adopters tended to have a high belief strength with little spread, while Non-adopters also had a strongly positive belief strength but had a greater spread (Appendix 8). Adopters had significantly more positive attitudes than Non-adopters across all 6 aims (Figure 4.14). All Adopters indicated positive attitude scores for each of the Adopt a Verge program aims and had a mean between 13 (SD=5.8) and 16 (SD=3.4; Wellbeing and Beauty, respectively; see Figure 4.14). Non-adopters had a minimum value of -15, which was for the aim "corridors". However, despite the broader responses, Non-adopters had an overall positive attitude towards the program aims, with a mean between 8.9 (SD=7.1) and 12 (SD=6.4; Figure 4.14). Adopters had a significantly lower average total NEP score than Non-adopters ($W = 2854$, $p<0.05$).

Self-adopters tended to be a mix between Adopters and Non-adopters in terms of their attitude, belief strength and belief evaluation. The Self-adopters only diverged from Adopter attitudes and beliefs, rather than Non-adopters (Appendix 9). The Self-adopter's

average total NEP score was lower than the score for Non-adopters but not Adopters (Appendix 9).

Adopters and Non-adopters had different motivations for their verge status, however Adopters generally picked at least two motivations for their adoption while Non-adopters would pick just one motivation for not adopting (mean=2.7, SD=1.2 and mean=1.3, SD=0.8, respectively).

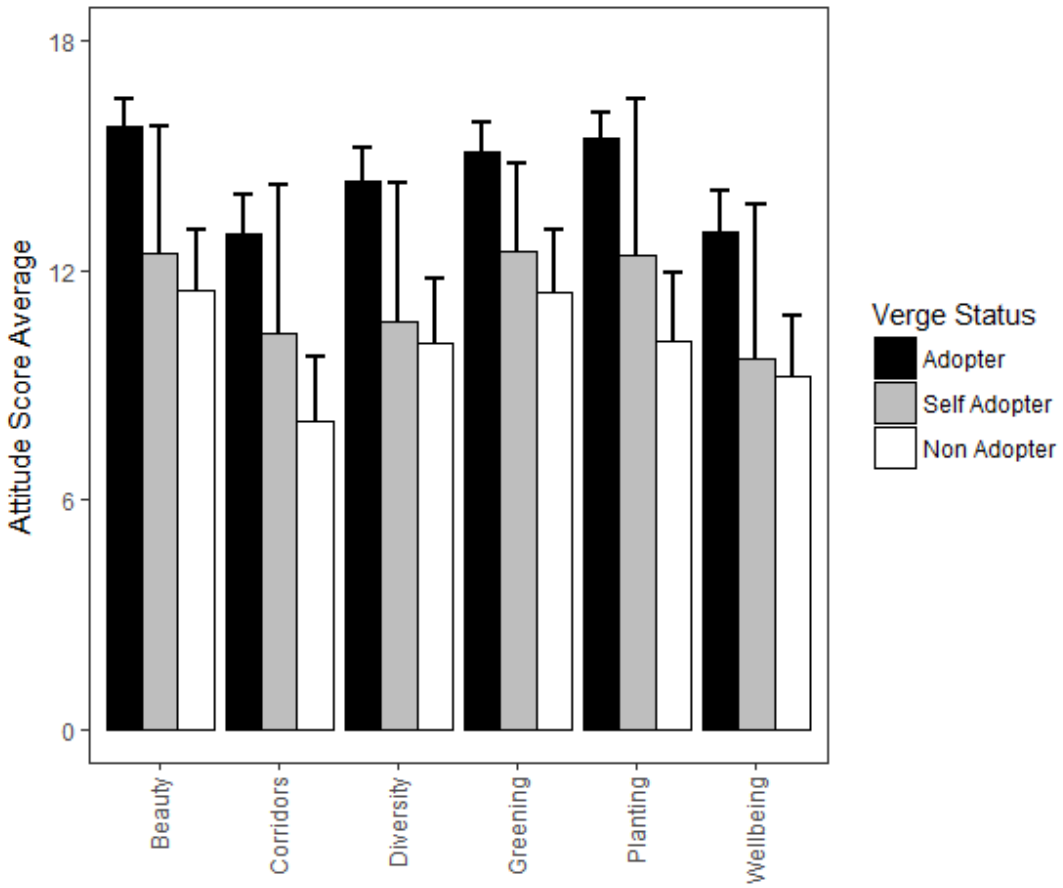


Figure 4.14: Mean attitude score for Adopters (n=110), Self-adopters (n=15) and Non-adopters (n=77), with error bars representing 95% confidence intervals.

## 4.3 Relationship between Vegetation and Social Surveys

### *4.3.1 Beliefs*

*Percent Cover*

As belief evaluation across the 6 aims increases (Table 4.1), so does the percent cover of plants, except for the aim "planting" which was not significantly correlated to percent cover (t=1.8, $p$=0.072; Figure 4.15). The aim "wellbeing" was the only aim where belief strength was correlated to percent cover (t=2.07, $p$=0.04; Figure 4.15). All other aims had no correlation between belief strength and percent cover (Figure 4.15).

*Diversity*

Of the 6 aims of the program, the belief evaluation and strength of "urban greening", "diversity" and "wellbeing" all increased with diversity (Figure 4.15). The belief evaluation and strength of the aim "corridors" was not correlated with diversity (Figure 4.15). The belief evaluation of the aim "beauty" was not correlated with diversity (t=1.75, $p$=0.08) but the belief strength of this aim was (t=2.51, $p$<0.05; Figure 4.15). The aim "planting" was the opposite; belief evaluation was correlated to diversity (t=2.47, $p$<0.05) while belief strength was not (t=0.26, $p$=0.796; Figure 4.15).

*Richness*

Richness was not correlated with the belief evaluation of any of the 6 aims, but was correlated to the belief strength in two of the aims (Figure 4.15). "Corridors" and "wellbeing" both increased with increasing richness (t=2.77, $p$<0.01 and t=2.36, $p$<0.05, respectively; Figure 4.15).

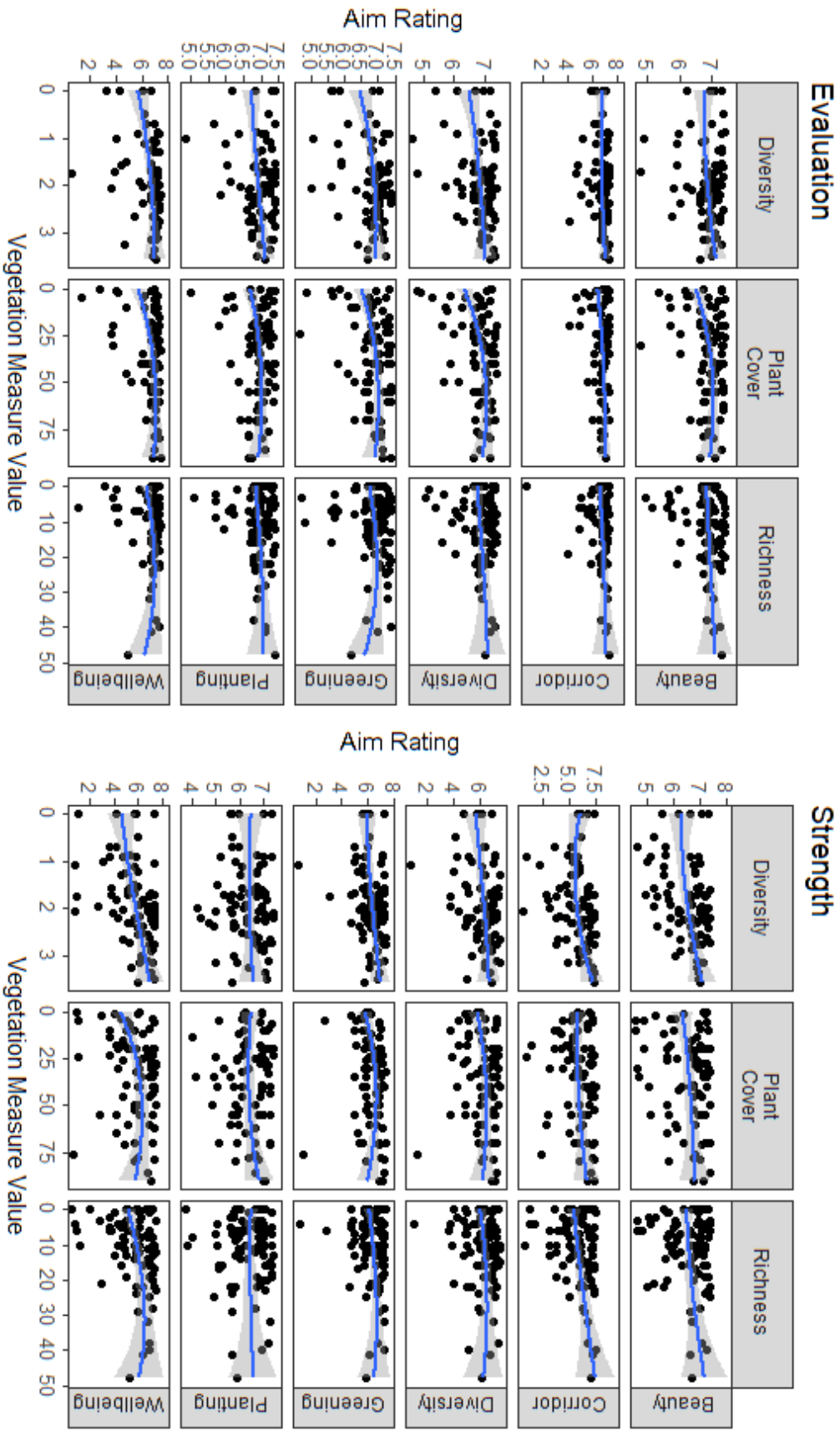


Figure 4.15: Belief Evaluation and Strength across the 6 aims of the Adopt a Verge program, in relation to the three vegetation measures, percent cover, diversity and richness. Individual verges are represented as dots (n=93), and the line represents a rolling mean (span=3).

### *4.3.2 Attitudes*

Of the six aims of the program, "planting" was the only aim to not be correlated with any of the three vegetation measures—precent cover, diversity and richness (t=1.62, *p*=0.11, t=1.83, *p*=0.0.07 and t=1.81, *p*=0.07, respectively; Figure 4.16). "Urban greening" was not found to be correlated with percent cover (t=1.78, *p*=0.08), but it did increase with increasing diversity and richness (t=3.31, *p*<0.01 and t=2.43, *p*<0.05, respectively; Figure 4.16). All other aims increased with increasing percent cover, diversity and richness (Figure 4.16).

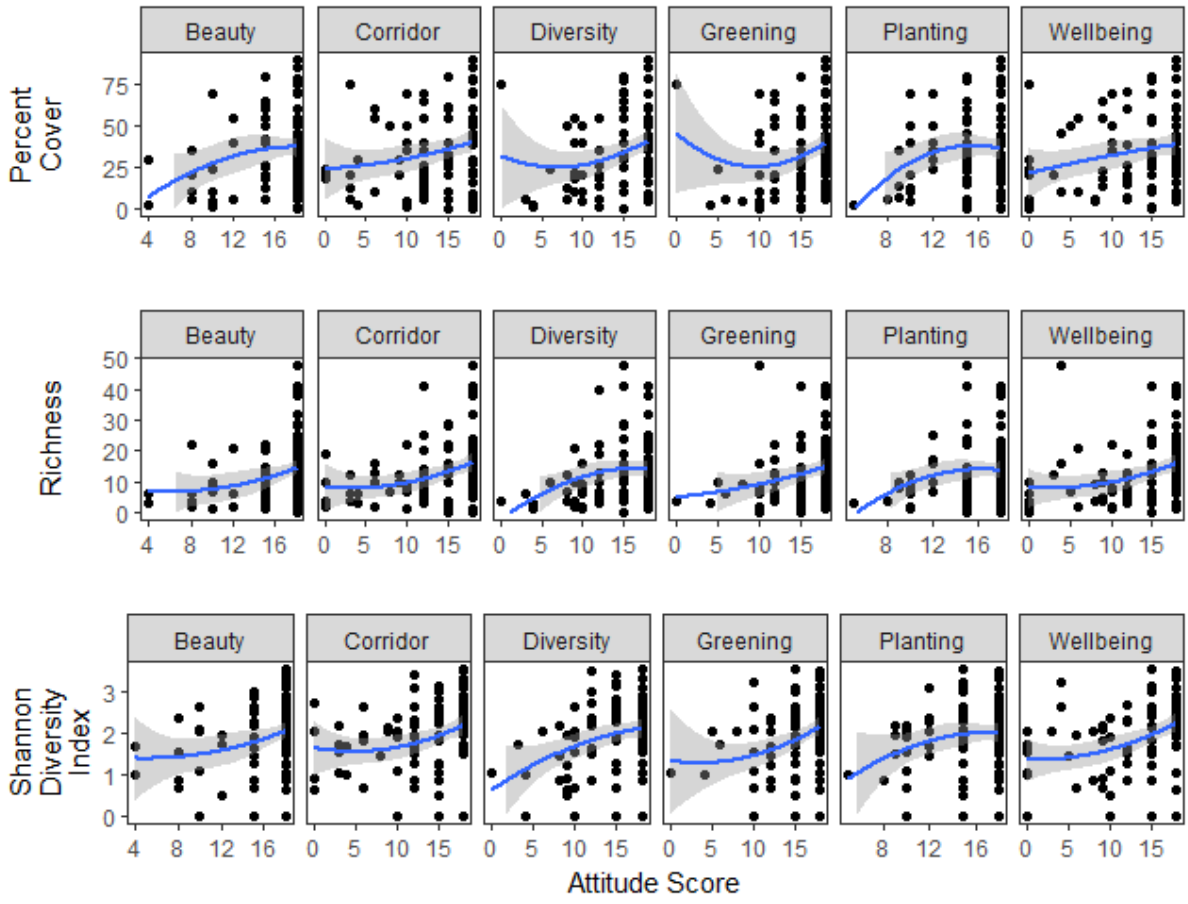


Figure 4.16: The Attitude score across all 6 aims of the program in relation to 3 vegetation measures—diversity, richness and percent cover. Individual verges are represented as dots (n=93), and the line represents a rolling mean (span=5).

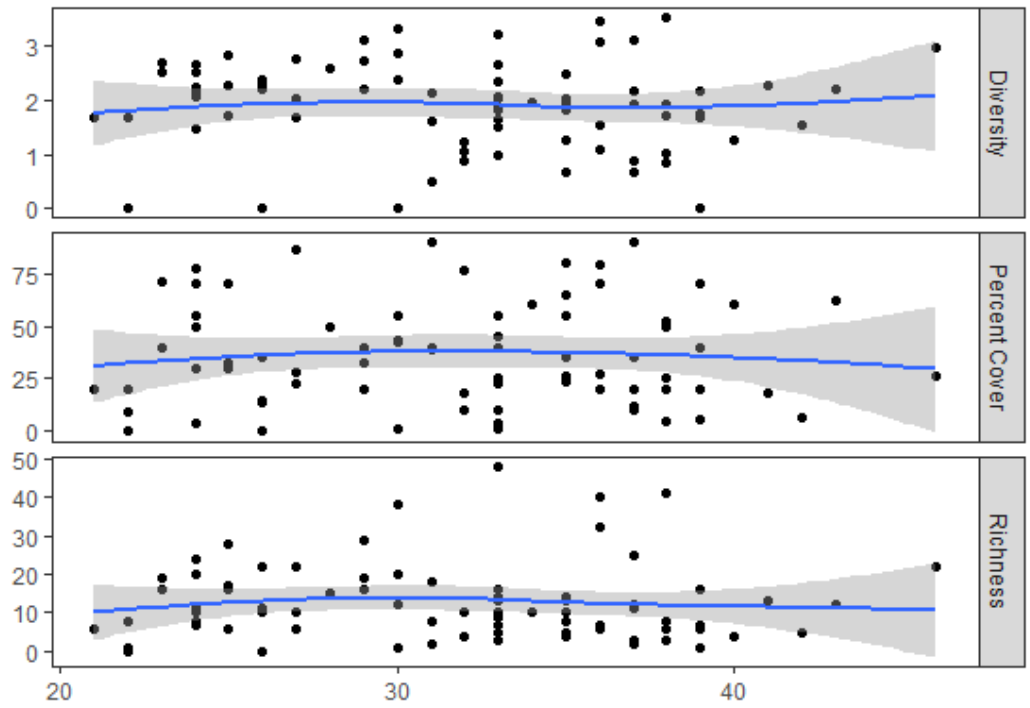


Figure 4.17: The relationship between the New Ecological Paradigm score sum and percent cover, richness and diversity. Individual verges are represented as dots (n=93), and the line represents a rolling mean (span=2).

### *4.3.3 New Ecological Paradigm*

The average total New Ecological Paradigm score was not correlated with diversity or percent cover, but did increase with richness (t=2.56, $p$=0.012; Figure 4.17).

### *4.3.4 Motivations*

Of the six motivations for adoption identified, selection of "the environment" was significantly correlated with higher means for percent cover, diversity and richness (t=2.88, $p$<0.01, t=2.30, $p$<0.05, t=2.67, $p$<0.01, respectively; Figure 4.18). Selection of "Wildlife" was also correlated with a higher mean percent cover and diversity (t=2.33, $p$<0.05, t=2.04, $p$<0.05, respectively; Figure 4.18).

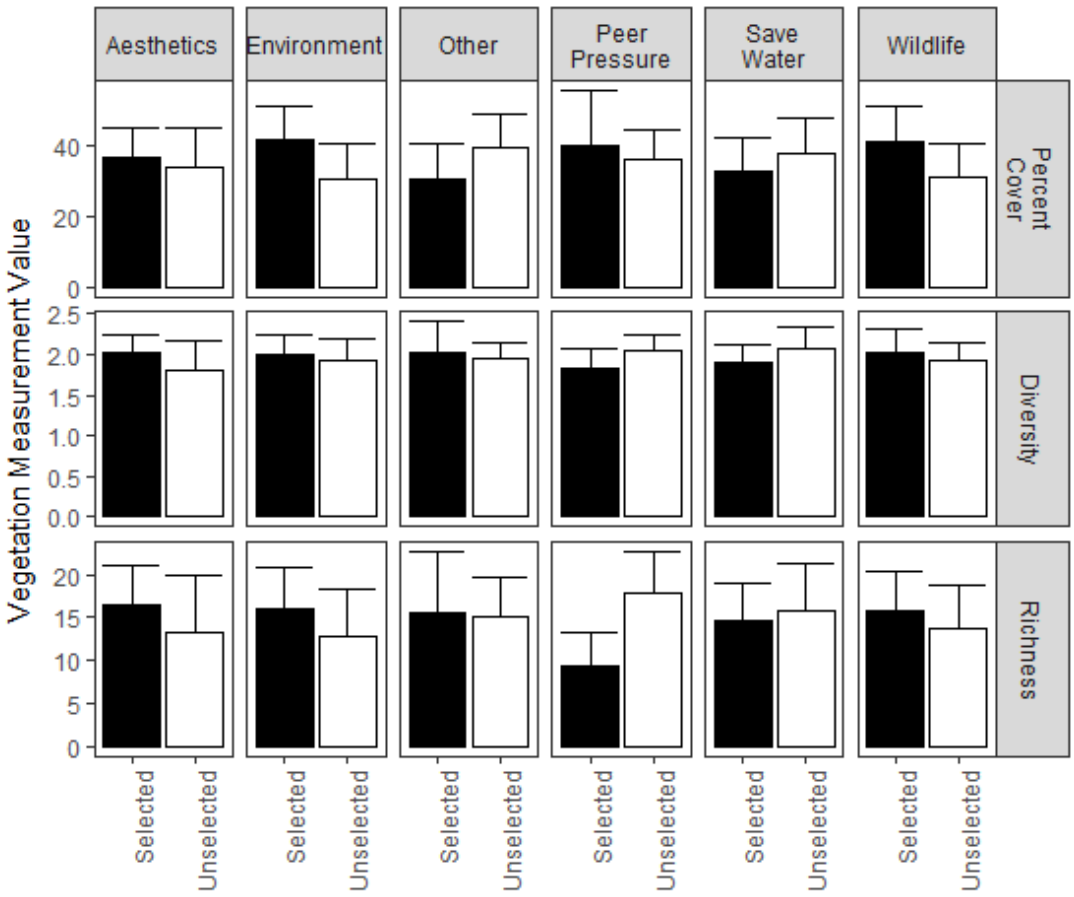


Figure 4.18: The relationship between the motivations for Adoption and the 3 vegetation measures—percent cover, richness and diversity. Respondents could choose several options and where respondents chose a particular motivation they were “Selected”. Where residents did not choose a motivation, they were “Unselected”. The bars represent the average vegetation measure for either “Selected” or “Unselected motivations, and error bars show the 95% confidence interval.

# 5. Discussion

Residents who adopted their verge had significantly more positive attitudes towards the aims of the Adopt a Verge program than Non-adopters. These more positive attitudes were also correlated with greater percent cover, diversity and richness present on the adopted verges. Torabi et al. (2016) explains that "the awareness and values of … environmental and productivity benefits" of a program influence the uptake of the program, which is somewhat reflected in this study's results, where people with more positive attitudes participated in the program. While several studies look at community perceptions of urban greening or effectiveness of urban greening, few look at the correlation between the two (Barau, 2015; Bussell & Forbes, 2002; Cameron et al., 2012; Clayton, 2007; Douglas & Sadler, 2011; Ewing et al., 2013; Faehnle et al., 2014; Goddard et al., 2010; Sarkar et al., 2015). The results from this study support the viability of urban greening programs such as the Adopt a Verge program in terms of their success in increasing vegetation in urban streets and the interest in the community for such programs.

### 5.1 Vegetation

Across the 198 verges sampled in this study, there was a high proportion of mulch (57% cover) and non-grass vegetation (29% cover). An unpublished study by Boyle (2018) has revealed that across Perth, 2000 front gardens had a high proportion of grass (41% cover) and non-grass vegetation (17% cover). According to this data, the percent cover of non-grass vegetation is nearly doubled by the Adopt a Verge program. This is in line with the programs aims of encouraging planting of native plants, contributing to urban greening and increasing the diversity of native flora and fauna.

There are four aims of the Adopt a Verge program which pertain to native vegetation, and three of which this study addresses; to encourage planting of native plants on verges, to contribute to urban greening, and to increase local diversity of native flora

and fauna. The planting of native plants on verges can be assessed using the data collected by this study. Of the adopted verges, 85% of verges have non-grass vegetation present and of the non-adopted verges, 14% of residents stated that they had native vegetation on their verge (the Self-adopters group). This equates to an increase of 71% for the presence of native vegetation on verges. The Adopt a Verge program has contributed to urban greening.

Adopted verges increased the diversity of native flora and fauna in the City of Vincent. Several studies have shown that birds and invertebrates utilise garden spaces in urban environments, and increased complexity (i.e. diversity and structure) of these garden spaces can predict the abundance and diversity of birds and invertebrates (Barth, FitzGibbon, & Wilson, 2015; Davis et al., 2013; Goddard et al., 2010; Kath et al., 2009; Mumaw & Bekessy, 2017). While all vegetation contributes to biodiversity, native vegetation alone is an important predictor of animal diversity (Ely & Pitman, 2014; Goddard et al., 2010; Mumaw & Bekessy, 2017). Encouraging residents to use native plants in their gardens will help increase urban biodiversity. Hence, by increasing the diversity and abundance of native vegetation in the City of Vincent using the Adopt a Verge program, residents are also helping to increase the diversity of animals. Some residents mentioned increased sightings of birds and butterflies in their gardens.

Of the four plant forms described in this study, shrubs and ground covers covered the most area across all verges (11% and 9.8% respectively). This is in line with the spreading habit of these plant forms. In native woodlands, studies have found between 12% and 55% of understory cover which includes ground covers and shrubs (Brown, Paczkowska, & Gibson, 2016; Saunders et al., 2011). While vegetation cover on adopted verges does not mimic native local woodlands, the Adopt a Verge program still promotes an increase in native plants, urban greening and diversity on verges.

### 5.2 Social Survey

Adopters had a significantly more positive attitude towards the six aims of the Adopt a Verge program than did Non-adopters. This indicates that people who participate in the program considered the aims of the program to be more “likely” and “good” than people who did not participate. However, it is unknown whether these differences are pre-program or post-program. That is, whether more positive attitudes caused one set of people to participate, or whether the act of participation is what has caused these differences in attitudes. It has been shown that by participating in a successful program, people can have their attitudes reinforced (Mumaw & Bekessy, 2017; Sousa, Quintino, Palhas, Rodrigues, & Teixeira, 2016; Wilson & Dyke, 2016). Therefore it is possible that the significant difference between Adopter’s attitudes and Non-adopter’s attitudes could be replicated in new Adopters, as the actual difference between the mean attitude score was slight (Adopter’s attitude score mean ranged between 13-16, Non-adopters ranged between 8.9-12).

The demographics of the Adopters and Non-adopters were found to be very similar. This is in contrast to a study by Lin et al. (2017), who found that older houses, older participants and people with children all tended to have more vegetation in their gardens. While the study by Lin et al. (2017) considered backyard gardens, it is interesting to consider that as a house ages, the amount of vegetation increases in their garden. This particular finding was supported by this study, with older Adopted verges having a greater percent cover of non-grass vegetation. This can be expected, as most forms of vegetation will spread out as they grow and age.

It was found that participants in the Adopt a Verge program often had several motivations for participating in the program, with the majority of people citing aesthetics as a motivator. It is important for managers to understand the importance of aesthetics

when marketing and implementing programs such as the Adopt a Verge program, as aesthetics is highly important to residents in front gardens (Cameron et al., 2012; Clayton, 2007; Daniels & Kirkpatrick, 2006; Kirkpatrick et al., 2007; Shackleton, Chinyimba, Hebinck, Shackleton, & Kaoma, 2015; Stenhouse, 2004b), and the verge is essentially an extension of the front garden. By improving the aesthetics of the verge, the residents may be trying to exert control over the garden (Cameron et al., 2012), show their affluence (Clayton, 2007; Kirkpatrick et al., 2007), express their personality and values (Clayton, 2007; Daniels & Kirkpatrick, 2006), or improve the monetary value of the house (Pandit, Polyakov, Tapsuwan, & Moran, 2013). Aesthetics is something that managers can potentially market towards, but must also be at the forefront of implementation of these programs.

Adopters were also motivated by helping the environment and wanting to save water. Despite this, Martinlopez et al. (2007) found that people generally were interested in conserving animals that they were more emotionally attached to, rather than species with ecological value. Managers of green spaces also have this disparity, with council officers quoting environmental reasons for planting street trees, but not considering it when choosing what tree species to plant (Roy, 2017). In contrast to the current study, Mumaw and Bekessy (2017) found that program participants in their study were not motivated by the desire to "support the 'environment' in the broadest sense of the term", rather, participants cited motives such as planting native plants and removing weeds. This is in contrast to the current study, which found that 52% of respondents wanted to support the environment in some way. This could be due to the smaller ranger of options for Adopters to indicate their motivations in the current study.

Mumaw and Bekessy (2017) also found that participants were motivated to join the program to obtain gardening advice. The City of Vincent's Adopt a Verge program did not explicitly offer gardening advice, which is most likely why Adopters were not motivated

by this. The program studied by Mumaw and Bekessy (2017) had experts visit each participant's property and work individually with the participant to create a plan enhance the garden for wildlife, which was found to be a highly positive aspect of the program. Torabi et al. (2016) stated that participants of a program consider the environmental benefits of a program when choosing whether to participate. Participants are also influenced by peers, and are more likely to participate in a program if peers have also participated (Torabi et al., 2016). The current study found that while peer-pressure was a motivator for some residents, it was less cited than all other motivators.

It is important for managers to understand the motivations of program participants, such as the environment and saving water. Other studies also found that the environment is a major motivator in program uptake (Bussell & Forbes, 2002; Stenhouse, 2004b; Torabi et al., 2016; Zagorski et al., 2004). Interestingly, Zagorski et al. (2004) found that environmentally minded people with gardens containing local native species had more invasive plant species in their gardens. Zagorski et al. (2004) postulate that this could be due to a lack of maintenance on the resident's part, and this could be mitigated using education (Sousa et al., 2016). On average, the Adopt a Verge program only had a small proportion of weeds present in gardens (1.4%), which somewhat aligns with the motivation of improving aesthetics, as a weed-ridden verge is considered "messy" (Clayton, 2007).

Non-adopters tended to have one or two motivations for non-adoption. The most commonly cited motivation was a lack of knowledge about the program. Bussell and Forbes (2002) point out that organisations which require volunteers (the Adopt a Verge program is completely voluntary) ought to find "recruitment niches" to help them market effectively. The Adopt a Verge program may not have done this successfully, as several Non-adopters were in fact interested in the program, once they were aware of it (n=10). Despite this, there was little difference in the demographics of Adopters and Non-adopters, so instead

the “recruitment niche” may not be the issue, but rather where and how the program is marketed. In addition, the results from Clayton (2007) agree with this study, where people who were concerned with money and time spent on maintenance tended to not use their yards.

In the Non-adopters survey, there were 15 people who said they had informally adopted their verge outside of the program. The attitudes of this new group of people, the Self-adopters, consistently sit between those of the Adopters and Non-adopters, and are more closely aligned with the attitudes displayed by the Non-adopters. Despite this, the Self-adopter’s ecological world view was found to be more closely aligned with the Adopter’s. This split could be from the questions themselves, with attitude questions linking directly into the program and world view questions being broader. The attitudes could be influenced by the City of Vincent, with a lack of faith in the City driving down the Self-adopter’s attitude score, rather than disagreeing with the aims in general. Torabi et al. (2016) noted that where residents find program providers more credible, residents are more likely to participate in the program. Future research should focus on this group of people, seeing whether their verges are different to Adopter’s verges and whether their attitudes are truly similar or dissimilar to Adopters and Non-adopters.

## 5.3 Relationship between Social Factors and Vegetation Measures

### *5.3.1 Attitudes and Vegetation Measures*

The positive correlation between vegetation measures and attitudes shows that people who think that the Adopt a Verge program is good and likely to work will have more ecologically significant gardens. However, the sample did not provide a great spread of attitudes, so we must be cautious in extrapolating that as attitudes continue to decrease, so would the residents’ verge vegetation quality. Zagorski et al. (2004) also found a strong correlation between attitudes and species composition of gardens in Hobart, Tasmania. In

contrast to the research by Zagorski et al. (2004), this study found that there were two distinct populations, in terms of both attitudes and verge vegetation (i.e. Adopters and Non-adopters). It is unknown whether Adopter attitudes towards the Adopt a Verge program aims drive the increase in vegetation measures or whether vegetation measures cause an increase in attitude, as it has been shown that success in programs can bolster participant's attitudes (Mumaw & Bekessy, 2017; Sousa et al., 2016).

### *5.3.2 Motivations and Vegetation Measures*

Higher vegetation measures were not correlated with the presence of a particular motivator for adoption, with four exceptions; the motivator "environment" was related to higher percent cover, richness and diversity, and "wildlife" was related to higher percent cover. This indicates that motivations for participation do not alter the success of the program, except for "environment" and "wildlife". Other studies have found that there is an association between certain motivations and the ecological value of a garden (Clayton, 2007; Ewing et al., 2013; Lin et al., 2017; Martinlopez et al., 2007; Mumaw & Bekessy, 2017). For example, Mumaw and Bekessy (2017) state that wanting to attract wildlife can increase the presence of native vegetation in gardens, which is reflected in the current study.

It is important to note that while this research investigated the ecological significance of verge plantings, there are other reasons for encouraging the planting of vegetation on verges. In participating in the program, residents can form connections to nature and each-other. Standish et al. (2013) state that "the benefits of promoting positive interactions between people and nature are potentially far reaching for both biological diversity and human well-being". This highlights the need for researchers to be conscious that programs such as the Adopt a Verge program fulfil a variety of functions. It is also

important to know how these different functions will interact, as this may affect the effectiveness of the program.

The Adopt a Verge program utilises urban greening to achieve several beneficial outcomes, such as appreciating the aesthetic value of the plants, whilst residing in cooler streets and gaining the mental and physical health benefits of urban green spaces (Barau, 2015; Clayton, 2007; Gill et al., 2009; Shackleton et al., 2015). These benefits were echoed by residents who were interviewed as a part of this study. Residents commented on the compliments they received from passing neighbours about the beauty of their verges. Clayton (2007) also found that how neighbours perceive a front garden will have a direct impact on the enjoyment of the garden's owner. Many residents found that the verge was a great way to stimulate conversation between neighbours and build community spirit, which is supported by the finding of Clayton (2007). Community spirit can be important for mental well-being. Some residents reported altering their normal walking route to pass more adopted verges, simply to admire them. This speaks to the benefits that all residents, not just Adopters, can gain from urban greening and the beauty that is created by the Adopt a Verge program.

Programs which contribute to urban green spaces are important for several reasons, including the provision of native vegetation on verges and contributing to streetscape aesthetics and city liveability. Native vegetation in the urban environment aids in the provision of habitat to native animals and provides greater connectivity through the urban environment (Davis et al., 2013; Goddard et al., 2010; Mumaw & Bekessy, 2017). The Adopt a Verge program has increased the amount of non-grass vegetation in urban areas almost twofold (Boyle, 2018), and native vegetation is central to the program. As native vegetation is central to the Adopt a Verge program, this increase in non-grass vegetation could indicate an increase in native plants. It is important to remember that while native

vegetation is ideal for wildlife, novel ecosystems also aid in the provision of habitat and urban green space (Kennedy et al., 2018; Trigger et al., 2008; Valentine & Stock, 2008).

City liveability is enhanced by urban green space (Ely & Pitman, 2014; Jones & Newsome, 2015). Programs which incorporate green spaces into the urban environment are aiding in the productivity of the city, increasing the aesthetic appeal of the streetscape and encouraging residents to become more mentally and physically healthy (Ely & Pitman, 2014; Jones & Newsome, 2015; Taylor & Hochuli, 2015). This study has shown that improving aesthetics is important to residents, which shows that city liveability is important to residents, and this can be enhanced by programs which incorporate urban green spaces.

It is pertinent to note that there are several factions which need to be involved in the creation and management of urban green spaces. Communities need to be consulted, as they are the people who ultimately know the area and how green spaces will be used (Faehnle et al., 2014). Policy makers and researchers need to work together to incorporate a wide variety of disciplines into planning urban green spaces (Taylor & Hochuli, 2015). Local governments are often responsible for the management of urban green spaces, and need to work with all the aforementioned groups to manage these spaces efficiently and effectively (Faehnle et al., 2014; Stenhouse, 2004b).

## 6. Conclusion

This study has shown that urban greening programs, such as the Adopt a Verge program, are successful in achieving an increase in urban greening through uptake of the program. The vegetation on the adopted verges increased the proportion on non-grass vegetation on streets by almost 100% which helps to increase local diversity and wildlife movement through urban areas. Residents were open to the idea of adopting their verge, and many

Adopters were motivated by improved aesthetics, saving water and environmental reasons.

The implication of this research for local councils and managers of public urban green space is the need for further advertisement and a continuation of programs similar to the Adopt a Verge program run by the City of Vincent. One potential way to improve program uptake could be to produce a compendium of verges, so that potential participants can visually see the outcome of the program while also providing inspiration. Other similar programs found that including individualised consultation at the beginning of the program helped to motivate participants (Mumaw & Bekessy, 2017), as did interacting with local governments and others who had participated in the program (Ewing et al., 2013; Torabi et al., 2016). It is important for local councils and managers to interact with their target audience and establish a connection, which will help motivate residents and promote communication.

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**Appendix 1:** *Map of City of Vincent Adopted Properties*


**Legend**

April 2014
August 2014
October 2014
April 2015
August 2015
April 2016
August 2016
October 2016
April 2017

**Appendix 2:** *Vegetation Data Collection Sheet*

| | | | | | |
|---|---|---|---|---|---|
| Date | | Observer | | | |
| Address | | | | | |
| Irrigation | | Picture | | | |
| **% Cover** | | Council Path<br>Edge Center Off-Center<br>None | | Max Height<br>Modal Height | |
| Soil/Bare | | | | | |
| Mulch | | Tree Type | | | |
| Hard Surface | | Type | Talley | Description/Name | |
| Rocks/Gravel | | | | | |
| Path | | | | | |
| Self | | | | | |
| Council | | | | | |
| Raised Bed | | | | | |
| Plants | | | | | |
| Grass | | | | | |
| Other (native) | | | | | |
| Other | | | | | |
| TOTAL | 100 | | | | |
| **Composition** | | | | | |
| Ground Cover | | | | | |
| Tall/strappy | | | | | |
| Shrub/Bush | | | | | |
| Tree | | | | | |
| Other | | | | | |

**Appendix 3a:** *Social Questionnaire: Adopters*

**Section 1**

*Please answer the following questions about your perceptions of the Adopt-a-Verge Program.*

1. Using the list below, please indicate by ticking the box why you adopted your verge. Select any that apply.

   ☐ To increase birds or other wildlife in the garden

   ☐ To reduce water use

   ☐ For aesthetic reasons

   ☐ Because it is good for the environment

   ☐ Because family/friends/neighbours were doing it

   ☐ Other (please specify) _____

2. How many hours of maintenance do you spend on your verge per week? This includes mowing, watering by hand, trimming of plants etc. Please circle your response.

   0-2 3-4 5-6 7-8 9+

3. If you have completed planting your verge, would you change (please tick the box of any that apply):

   ☐ Your verge design (whether you would have less/more grass, put in more plants etc.)

   ☐ The plants you used

   ☐ The process to apply to adopt your verge

   ☐ The way the program was marketed

   ☐ Other (please specify) _____

4. Have any of your plants gone missing (Please circle)?

Yes No

5. Please indicate how you would rate the following steps in the adoption of your verge by ticking the appropriate box.

| | Awful | Unpleasant | Good | Amazing | No opinion |
|---|---|---|---|---|---|
| Application Process *(including finding out about the program, applying and receiving the outcome of your application)* | | | | | |
| Waiting for the landscaping of your verge *(removal of grass and spreading of mulch)* | | | | | |
| Selecting plants, planting and maintaining your verge | | | | | |

6. Please indicate how satisfied you are with the following steps in the adoption of your verge by ticking the appropriate box.

| | Highly Unsatisfied | Unsatisfied | Satisfied | Highly Satisfied | No opinion |
|---|---|---|---|---|---|
| Application Process *(including finding out about the program, applying and receiving the outcome of your application)* | | | | | |
| Waiting for the landscaping of your verge *(removal of grass and spreading of mulch)* | | | | | |
| Selecting plants, planting and maintaining your verge | | | | | |

7. Below is a list of statements about what the Adopt a Verge program aims to achieve. For each of the statements, please indicate how likely you think it is that the program will work to achieve the aim by ticking the appropriate box. There are no right or wrong answers, we just want to know what you think.

| | Extremely Unlikely | | | | | | Extremely Likely |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Encourage planting of native plants on verges | | | | | | | |
| Contribute to urban greening | | | | | | | |
| Increase local diversity of native flora and fauna | | | | | | | |
| Improve wellbeing of local people | | | | | | | |
| Help native wildlife to move more easily through the urban area | | | | | | | |
| Enhance beauty of local streets | | | | | | | |

8. Below is a list of statements about what the Adopt a Verge program aims to achieve. For each of the statements, please indicate the extent to which you think the aim is a good or bad thing to do. There are no right or wrong answers, we just want to know what you think.

| | Bad | | | | | | Good |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Encourage planting of native plants on verges | | | | | | | |
| Contribute to urban greening | | | | | | | |
| Increase local diversity of native flora and fauna | | | | | | | |
| Improve wellbeing of local people | | | | | | | |
| Help native wildlife to move more easily through the urban area | | | | | | | |
| Enhance beauty of local streets | | | | | | | |

**Section 2**

*Please indicate how much you agree with each of the following statements by ticking the appropriate box. Do not think too hard on each statement, your initial response is probably the best indication of what you truly think. Please note that* ***there are no right or wrong answers*** *as this is simply to find out what you think.*

| | Strongly Disagree | Somewhat Disagree | Somewhat Agree | Strongly Agree |
|---|---|---|---|---|
| We are approaching the limit of the number of people the earth can support. | | | | |
| Humans have the right to modify the natural environment to suit their needs. | | | | |
| When humans interfere with nature it often produces disastrous consequences. | | | | |
| Human ingenuity will insure that we do NOT make the earth unliveable. | | | | |
| Humans are severely abusing the environment. | | | | |
| The earth has plenty of natural resources if we just learn how to develop them. | | | | |
| Plants and animals have as much right as humans to exist. | | | | |
| The balance of nature is strong enough to cope with the impacts of modern industrial nations. | | | | |
| Despite our special abilities humans are still subject to the laws of nature. | | | | |
| The so-called “ecological crisis” facing humankind has been greatly exaggerated. | | | | |
| The earth is like a spaceship with very limited room and resources. | | | | |
| Humans were meant to rule over the rest of nature. | | | | |

| | Strongly Disagree | Somewhat Disagree | Somewhat Agree | Strongly Agree |
|---|---|---|---|---|
| The balance of nature is very delicate and easily upset. | | | | |
| Humans will eventually learn enough about how nature works to be able to control it. | | | | |
| If things continue on their present course, we will soon experience a major ecological catastrophe. | | | | |

**Section 3**

*Please tell us about yourself so that we can better understand your responses to the previous questions.*

1. What is your age range (please circle)?

   18-24 25-34 35-44 45-54 55-64 65+

2. What is your gender(please circle)?

   Male Female

3. What is your occupation?
4. Do you rent or own the house (please circle)?

   Own/mortgage Rent Other (please specify)_____

5. How many years have you lived in your current house (please circle)?

   0-1 1-4 5-8 8+

6. How many people live in your house (please circle)?

   1-2 3-5 6-8 9+

7. Using the categories below, please indicate who you live with, select any that apply by ticking the box.

   - ☐ Alone
   - ☐ House mates
   - ☐ Partner/Spouse
   - ☐ Young child (less than 12 years)
   - ☐ Teenager (13-17 years)
   - ☐ Adult child (more than 18 years)
   - ☐ Parent
   - ☐ Other

8. Do you have any additional comments?

**Appendix 3b:** *Social Questionnaire: Non-adopters*

**Section 1**

**Please answer the following questions about your perceptions of the Adopt-a-Verge Program.**

Using the list below, please indicate why you have not adopted your verge. Select any that apply.

Not aware of the program

Just not interested

Don't know how

Verge needed for other activities (e.g. Car parking)

Don't like native plants

Not enough time

Financial constraints

Other (please specify) _____

Below is a list of statements about what the Adopt a Verge program aims to achieve. **For each of the statements, please indicate how likely you think it is that the program will work to achieve the aim**. There are no right or wrong answers, we just want to know what you think**.**

| | Extremely Unlikely | | | | | | Extremely Likely |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Encourage planting of native plants on verges | | | | | | | |
| Contribute to urban greening | | | | | | | |
| Increase local diversity of native flora and fauna | | | | | | | |
| Improve wellbeing of local people | | | | | | | |
| Help native wildlife to move more easily through the urban area | | | | | | | |
| Enhance beauty of local streets | | | | | | | |

Below is a list of statements about what the Adopt a Verge program aims to achieve. **For each of the statements, please indicate the extent to which you think the aim is a good or bad thing to do.** There are no right or wrong answers, we just want to know what you think.

| | Bad | | | | | | Good |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Encourage planting of native plants on verges | | | | | | | |
| Contribute to urban greening | | | | | | | |
| Increase local diversity of native flora and fauna | | | | | | | |
| Improve wellbeing of local people | | | | | | | |
| Help native wildlife to move more easily through the urban area | | | | | | | |
| Enhance beauty of local streets | | | | | | | |

How many hours of maintenance do you spend on your verge per week? This includes mowing, watering by hand, trimming of plants etc.

0-2 3-4 5-6 7-8 9+

**Section 2**

**Please state how much you agree with each of the following statements. Do not think too hard on each statement, your initial response is probably the best indication of what you truly think. Please note that there are no right or wrong answers as this is simply to find out what you think.**

| | Strongly Disagree | Somewhat Disagree | Somewhat Agree | Strongly Agree |
|---|---|---|---|---|
| We are approaching the limit of the number of people the earth can support. | | | | |
| Humans have the right to modify the natural environment to suit their needs. | | | | |
| When humans interfere with nature it often produces disastrous consequences. | | | | |
| Human ingenuity will insure that we do NOT make the earth unliveable. | | | | |

| | | | | |
|---|---|---|---|---|
| Humans are severely abusing the environment. | | | | |
| The earth has plenty of natural resources if we just learn how to develop them. | | | | |
| Plants and animals have as much right as humans to exist. | | | | |
| The balance of nature is strong enough to cope with the impacts of modern industrial nations. | | | | |
| Despite our special abilities humans are still subject to the laws of nature. | | | | |
| The so-called “ecological crisis” facing humankind has been greatly exaggerated. | | | | |
| The earth is like a spaceship with very limited room and resources. | | | | |
| Humans were meant to rule over the rest of nature. | | | | |
| The balance of nature is very delicate and easily upset. | | | | |
| Humans will eventually learn enough about how nature works to be able to control it. | | | | |
| If things continue on their present course, we will soon experience a major ecological catastrophe. | | | | |

**Section 3**

**Please tell us about yourself so that we can better understand your responses to the previous questions.**

1. What is your age range?

   18-24 25-34 35-44 45-54 55-64 65+

2. What is your gender?

   Male Female Other

3. What is your occupation?

   _____

4. Do you rent or own the house?

   Own/mortgage  Rent  Other (please specify) _____

5. How many years have you lived in your current house? [respondent enters a number]

6. How many people live in your house? [respondent enters a number]

7. Using the categories below, please indicate who you live with, select any that apply.
   a. Alone
   b. House mates
   c. Partner/spouse
   d. Young children (less than 12 years)
   e. Teenagers (12-18 years)
   f. Adult children (more than 18 years)
   g. Live with parent(s)
   h. Other

Do you have any further comments?

**Appendix 4:** *Information Letter sent to Adopters.*

Dear Resident,

You are invited to participate in this study.

We would like to invite you to assist with our evaluation of the City of Vincent's Adopt-a-Verge Program, regardless of whether you participated in the program. We are doing research to understand the reasons why City of Vincent residents may or may not decide to participate in the city's Adopt-a-Verge program, and what residents think about the program generally. It is anticipated that information from this study will help the City of Vincent and other councils to improve their Adopt-a-Verge programs.

The survey will take between 10-15 minutes and will be completely anonymous. You can decide to withdraw your participation at any time. We would appreciate your feedback regardless of whether or not you participated in, or know of, the Adopt-a-Verge program. The survey will ask about your age, occupation and your thoughts on the Adopt-a-Verge program.

At the end of the survey you will have the option of going into the draw to win 1 of 3 Coles/Myer Gift Vouchers by supplying your email. This is not compulsory.

You can decide at any time to withdraw your consent to participate in this research. If you decide to withdraw, any material you have given us will be destroyed. Withdrawing from the research will have no consequences for your ongoing participation in the program. To withdraw from this study please send an email to the researchers listed below, stating your address. This will be used to identify your survey answers so that they can be removed from the study.

It is anticipated that the information you provide will be used to improve the Adopt-a-Verge program and other similar programs. No risks are foreseen by participation in this study. We are happy to discuss any concerns you may have about this study.

This project is expected to be completed by December 2017. A summary of our findings will be given to the City of Vincent to be distributed in their community newsletter. You may also request a copy of the summary to be sent directly to you.

Thank you for your time,

Sincerely,

Etc.

**Appendix 5:** *Information letter sent to Non-adopters.*

Dear Resident,

The City of Vincent has been running an Adopt a Verge Program for residents for almost four years. This program encourages residents to plant native vegetation on their street verge and aims to increase the amount of 'green' on our local streets, increase and foster local biodiversity and to facilitate animal movement through the City by creating biodiversity corridors.

As part of the evaluation of this program, the City has engaged a team of Murdoch University researchers to conducting a household survey to determine what resident's views are in regards to planting native vegetation on their verge. We are interested in your thoughts whether or not you have or plan to participate in the program itself.

The City of Vincent and Murdoch University are now inviting you to take part in an online survey which will focus on finding out your views on planting native vegetation on your street verge. We would greatly appreciate your participation, as your thoughts as a City of Vincent resident are valued.

Participation in the survey is voluntary and all information provided to the researches will be anonymous. If you would like to participate in this study then please enter the following web address into your browser. Alternatively, contact Elizabeth Culverhouse for other methods of participation. **Insert web address here**

Thank you in advance for your time,

City of Vincent

**Appendix 6:** *The relationship between time since adoption and plant form, measured using linear regression.*

| | | Pearson Test Statistic | Confidence Interval | | Correlation Coefficient | *p*-Value |
|---|---|---|---|---|---|---|
| Richness | No Plants | 0.706 | -0.086 | 0.181 | 0.048 | 0.481 |
| | Ground Cover | 0.763 | -0.082 | 0.185 | 0.052 | 0.446 |
| | Tall Strappy | 1.110 | -0.059 | 0.208 | 0.076 | 0.268 |
| | Shrub | -0.527 | -0.169 | 0.098 | -0.036 | 0.599 |
| | Tree | -0.558 | -0.171 | 0.096 | -0.038 | 0.577 |
| | Total | 0.032 | -0.132 | 0.136 | 0.002 | 0.974 |
| Diversity | Ground Cover | -0.813 | -0.228 | 0.096 | -0.068 | 0.417 |
| | Tall Strappy | 1.586 | -0.032 | 0.286 | 0.130 | 0.115 |
| | Shrub | -0.153 | -0.166 | 0.142 | -0.012 | 0.878 |
| | Tree | -1.659 | -0.443 | 0.043 | 0.213 | 0.102 |
| | Total | -0.235 | -0.150 | 0.118 | -0.016 | 0.814 |
| Cover | Ground Cover* | 3.299 | 0.089 | 0.344 | 0.220 | $1.14 \times 10^{-03}$ |
| | Tall Strappy | 0.924 | -0.071 | 0.195 | 0.063 | 0.356 |
| | Shrub* | 3.214 | 0.084 | 0.339 | 0.215 | $1.51 \times 10^{-03}$ |
| | Tree | -0.151 | -0.144 | 0.124 | -0.010 | 0.880 |
| | Total* | 4.275 | 0.153 | 0.400 | 0.281 | $2.89 \times 10^{-05}$ |

Plant forms with an asterisk (*) indicate a significant relationship between the plant form and time since adoption

**Appendix 7**: *The range of occupational classes that respondents were sorted into. Definitions denoted by an asterisk (*) were defined by the Australian and New Zealand Standard Classification of Occupations (ANZSCO)(Australian Bureau of Statistics, 2013). Note that the major occupational class "Machinery Operators and Drivers" is not included in this table, as no respondent's occupations fell within this category. Four occupations which did not fit into the ANZSCO were given their own class, namely Home Duties, Retiree, Student and Unemployed.*

| Occupational Class | Definition |
|---|---|
| Clerical and Administrative Worker | Provides support to Managers, Professionals and organisations by organising, storing, manipulating and retrieving information. * |
| Community and Personal Service Worker | Assists Health Professionals in the provision of patient care, provide information and support on a range of social welfare matters, and provide other services in the areas of aged care and childcare, education support, hospitality, defence, policing and emergency services, security, travel and tourism, fitness, sports and personal services. * |
| Labourer | Performs a variety of routine and repetitive physical tasks using hand and power tools, and machines either as an individual or as part of a team assisting more skilled workers such as Trades Workers, and Machinery Operators and Drivers. * |
| Manager | Plans, organises, directs, controls, coordinates and reviews the operations of government, commercial, agricultural, industrial, non-profit and other organisations, and departments. * |

| Occupational Class | Definition |
|---|---|
| Professional | Performs analytical, conceptual and creative tasks through the application of theoretical knowledge and experience in the fields of the arts, media, business, design, engineering, the physical and life sciences, transport, education, health, information and communication technology, the law, social sciences and social welfare. * |
| Sales Worker | Sells goods, services and property, and provides sales support in areas such as operating cash registers and displaying and demonstrating goods. * |
| Technicians and Traders Worker | Performs a variety of skilled tasks, applies broad or in-depth technical, trade or industry specific knowledge, often in support of scientific, engineering, building and manufacturing activities. * |
| Home Duties | A person who performs house upkeep and family organisation. Eg. Stay-at-home Mum, Domestic Goddess. Identified by the respondent. |
| Retiree | A person who has left employment. Identified by the respondent. |
| Student | A person who is primarily occupied by studies. Identified by the respondent. |
| Unemployed | A person who currently has no employment, but may be seeking employment. Identified by the respondent. |

**Appendix 8:** *The belief strength, evaluation and attitude score of the three groups (Adopters, Non-adopters and Self-adopters).*


The belief strength (a), evaluation (b) and attitude score (c) of the three groups (Adopters, Non-adopters and Self-adopters). These are broken down further into the six aims of the Adopt a Verge program. The boxplots indicate the spread of the data and the individual points represent outliers. The dashed lines run along y=0, showing the split between positive and negative attitudes.

**Appendix 9:** *A comparison of Self-adopters to Adopters and Non-adopters using pairwise Wilcoxon rank sum tests.*

| | | Adopter | Non-adopter |
|---|---|---|---|
| Evaluation | Beauty | 0.014* | 0.946 |
| | Corridor | 0.13 | 0.32 |
| | Diversity | 0.1 | 0.41 |
| | Greening | 0.059 | 0.569 |
| | Planting | 0.13 | 0.23 |
| | Wellbeing | 0.0487* | 0.7981 |
| Strength | Beauty | 0.0244* | 0.6805 |
| | Corridor | 0.11885 | 0.46152 |
| | Diversity | 0.0244* | 0.6805 |
| | Greening | 0.0018* | 0.4597 |
| | Planting | 0.3027 | 0.27825 |
| | Wellbeing | 0.07229 | 0.49304 |
| Attitude | Beauty | 0.012* | 0.789 |
| | Corridor | 0.1 | 0.34 |
| | Diversity | 0.00953* | 0.9552 |
| | Greening | 0.00455* | 0.77316 |
| | Planting | 0.065 | 0.326 |
| | Wellbeing | 0.06196 | 0.9092 |
| NEP | | 0.368 | 0.043* |

Significant results, where either Adopter or Non-adopters are significantly different to Self-adopters, have been highlighted by an asterisk (*)