School of Built Environment

Department of Urban and Regional Planning

Planning Public Parks under Resilience Theory: A Framework for Negotiating Ecosystem Services and Organised Community Sport

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Declaration

To the best of my knowledge and belief this thesis contains no material previously published by any person except where due acknowledgement has been made. This thesis contains no material that has been accepted for the award of any other degree or diploma in any university.

Signature:

Date: 24/09/2016

Abstract

While public park planning in the middle of the 20th century focus mainly on the provision of opportunities for organized community sport, contemporary parks now serve a fundamentally ecological role combining environmental conservation with the provision of opportunities for contact with nature. Despite government policy initiatives acting to increase participation in community sport, this planning shift has seen a decrease in the amount of sporting playing fields provided within new residential areas. This thesis is a response to this emerging situation – identified in several Australian cities but most notably through recent research in Perth – and has the aim of investigating how demand for space for organised community sport can be met in a way that acknowledges and complements the fundamental ecological role of contemporary public parks.

To meet its aim, this thesis begins by outlining a theoretical framework for planning public parks to achieve its ecological role, which is understood as the provision of both regulating and cultural ecosystem services. Using insights from urban ecological resilience theory, it outlines three practices that can allow parks to support the conservation and management of biodiversity and urban water resources: complementary spatial planning, ongoing adaptive management by diverse social networks and multi-functional design. Under human health resilience theory, it outlines three key insights for how public parks can best provide the four key cultural ecosystem services of mental restoration, physical activity, social interactions and environmental education: the need to focus on socioeconomically disadvantaged areas and those individuals most vulnerable to poor health, providing the specific environmental qualities most likely to facilitate each service for vulnerable individuals, and the need to include these individuals in design and ongoing governance of local parks. Through a case study of planning practice in Perth's northern suburbs, this thesis then outlines planning practice that can allow the sporting function of parks to be provided within this framework. The case study contains two separate investigations: one investigating alternate locations for sporting parks; and the second investigating their design.

Primarily using a quantitative spatial mapping approach, the location investigation looks at the potential of both co-located local school sporting parks and larger district sporting complexes to effectively meet demand for community sporting fields alongside ecological planning approaches. Whilst barriers exist to their widespread

implementation, it is determined that each location has considerable potential benefits: school sporting parks can help meet demand for playing fields at the local level, whilst making greater use of the playing field during the school day and potentially increasing the benefits of school time active recreation; district sporting complexes can meet demand for playing fields at the district level, whilst providing more comprehensive organised sporting facilities that may enhance the community-building function of sport.

Using primarily an intercept questionnaire survey combined with the systematic and descriptive observations, the design investigation looked at four different ecological landscapes that could potentially facilitate cultural ecosystem services within sporting parks. It primarily compared a permanent water area and a seasonal drainage area transformed into an off-the-leash dog park. While the dog park was more highly used, the permanent water area was found to be more likely to facilitate each cultural ecosystem service besides social interactions. This lead to the conclusion that permanent water areas may be most effective at facilitating mental restoration, and to a lesser extent physical activity and environmental education, however are problematic in Perth’s climatic conditions. Transforming seasonal drainage basins into dog parks can be an effective way of utilising their recreational potential, particularly for facilitating social interactions, however flooding and rubbish from runoff can create issues for users. Some preliminary, primarily theoretical findings are also outlined for the other two landscapes: remnant vegetation appears most effective at facilitating neighbourhood walking and active environmental education, however may represent negative value for some users; community gardens have theoretical potential to facilitate each of the four cultural ecosystem services within a relatively small space, but may have low use that could make their community-driven governance style unsustainable.

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1. Introduction

1.1 Context of Research

The planning of public parks has evolved significantly since the original Victorian public parks were opened in English cities during the height of the Industrial Revolution. Here, the primary function of parks was to provide access to fresh air and opportunities for informal recreation in rural-themed natural landscapes (Taylor 1995). This model was adopted around the western world, with many prominent inner city parks in America and Europe taking a similar form. At the start of the 20th century, however, new public parks in early suburban areas were planned primarily to facilitate structured active recreation, most notably organised sport (Walker and Duffield 1983). The second half of the 20th century saw the embrace in park planning of two broader emerging planning trends: the first conserving and restoring key environmental areas; the second providing urban residents with opportunities to experience nature and learn about the natural environment (Cranz and Boland 2004; Eisenman 2013).

When considering the role of suburban public parks planned in the 21st century within this historical context, three broad functions can be identified. As urbanisation increases, the environmental role of parks as one of the few remaining green spaces in urban areas remains crucial, in particular as sites for conserving and managing biodiversity (Niemelä et al. 2010) and urban water resources (Yang et al. 2015). On top of this is the need to provide for two distinct forms of recreation: on the one-hand activities in a social environment – the obvious but not the only example being organised sport – and on the other hand activities in a natural environment that may be more likely to be solitary (Cattell et al. 2008; Ward Thompson 2002). One simple but useful summary of these three functions is 'nature-to-nature', 'people-to-people' and 'people-to-nature' activities (Harnik 2010).

Negotiating each of these park functions is a complex planning challenge. To an extent, they can be considered compatible and even complementary with each other. This is encapsulated by the term *ecosystem services*, which emphasises that ecological approaches to planning urban landscapes can also provide health benefits to urban residents. However, forms of recreation within social environments, and the landscapes needed to facilitate this recreation, may not be so compatible with an ecological planning approach and the provision of unstructured forms of recreation.

The consequences of this incompatibility can be seen in current trends in the provision of space for organised community sport in Australian cities. In line with aforementioned trends, sporting playing fields and accompanying infrastructure enabling formal competition were well supplied to Australian suburban communities in the middle of the 20th century (Hedgcock 2015). Recent decades, however, have seen shifts in park planning towards the embrace of environmental concerns and a wider range of recreational opportunities (Hedgcock 2015). Parallel to this recent shift has been the emergence of concerns within inner (Burgin, Parissi and Webb 2014) and outer urban areas (Australian Social & Recreation Research 2008; Middle, Tye and Middle 2012; Northern Sydney Regional Organisation of Councils 2011) that the supply of local sporting facilities is no longer meeting the demand of communities.

This is concerning given the unique value of community sport to Australian society. Perhaps most *visible* is the role of grassroots participation in the nation's history of success at the elite level, along with its strong broader sporting culture (Independent Sport Panel 2009). However, perhaps most important are its contributions at the individual and community level: sports participation is a major source of physical activity for young people (Olds, Dollman and Maher 2009); it can lead to improved indicators of mental health, including stress relief (Asztalos et al. 2009); facilitate social interactions (Eime et al. 2010); and provide an educational role through the teaching of core human values (Parry 2012). Sports participation can also complement broader educational goals – diverting at-risk youth from anti-social activities whilst providing motivation for academic performance – making it most valuable for socioeconomically disadvantaged individuals (Holt et al. 2011).

This complex situation is best encapsulated by recent research from Perth (Middle, Tye and Middle 2012), which preceded this current study. Since 1955, 10% of new residential developments in Perth has been required to be provided for public parkland, with 85% of this land given up for organized active (sporting) recreation (Stephenson and Hepburn 1955). However, the introduction of new planning policies has seen a significant reduction in turfed open space at the expense of unstructured recreation, walkability and environmental concerns (Grose 2009). The aforementioned study was able to quantify the reduction in sporting playing fields between established and newly developed suburbs, occurring in contrast to increases in ecological landscapes for biodiversity conservation and stormwater management as well as a general shift towards smaller pocket and linear parks.

The potential social impacts of these shifts were further explored in a follow up report that reviewed available demographic, health and sports participation data (Tye et al. 2012). It found that the newly developed suburbs where these shortages are occurring contain communities with greater than average socioeconomic disadvantage, and where the majority of children enrolled in government programs aiming to increase sporting participation rates are located. This reflects the findings of earlier Australian studies: that socioeconomically disadvantaged individuals, despite being more likely to benefit from organized sport, are actually less likely to participate in organized sports than those from more advantaged backgrounds – in part due to their lack of access to sporting facilities (Dollman and Lewis 2010; Olds, Dollman and Maher 2009).

This research from Perth provides a compelling case to review the level of provision of sporting open space in new residential developments. Indeed, the most recent draft update of the State's 'Liveable Neighbourhoods' policy, which controls all new residential subdivisions, now includes a minimum standard per capita for community sporting playing fields (Western Australian Planning Commission 2015). The advent of such a standard is in line with recent calls for sporting open space to be given the same weight as other forms of social infrastructure in strategic urban planning, in order to counteract the pressures placed on playing fields by other planning policies (Burgin, Parissi and Webb 2014). Yet, while a promising development in acknowledging the role of public parks in providing space for organised community sport, actually meeting this standard alongside the current ecological role of parks requires a more holistic approach towards integrating the social – that is, the 'people-to-people' function of parks – with its original and now fundamental functions of conserving environmental values and providing human contact with nature. It is in this context that the current study can be understood: the need to better integrate the sporting and ecological functions of contemporary public parks.

1.2 Research Aim and Questions

This emerging situation in Australian cities, encapsulated in the research from Perth, highlights the need to better integrate social forms of recreation, and specifically organised sport, into the now dominant ecological role of public parks. Progressing this integration in both theory and practice of public park planning is the primary aim of this thesis:

To identify theory and practice that can allow demand for space for organised community sport in a way that acknowledges and complements the fundamental ecological role of contemporary public parks.

Investigation of this aim is guided by concepts and findings from resilience theory in urban ecological and human health research. This thesis combines insights from both of these independent but conceptually similar theories to investigate eight research questions. For these questions, the established concept of 'ecosystem services' is applied to represent the ecological functions of public parks: 'regulating' ecosystem services encapsulate key environmental functions such as biodiversity conservation and stormwater management, while 'cultural' services encapsulate the benefits of human recreation in natural environments. The term 'sporting services' is coined to represent the sporting function of public parks.

The first two research questions are purely theoretical, and investigate the ecological functions of public parks:

How can public park planning facilitate regulating ecosystem services in suburban areas under urban ecological resilience theory?

How can public park planning facilitate cultural ecosystem services in suburban areas under human health resilience theory?

The first question is addressed through the application of urban ecological resilience theory, exploring concepts including spatial connectivity, adaptive management and multi-functionality. The second question is addressed through the application of human health resilience theory, identifying insights including the need to target socioeconomic disadvantaged populations, quality over quantity of green space, and public participation in the creation and governance of these spaces. The findings under these two questions are summarised through a flow chart and table that clearly identifies a set of criteria for planning public parks to facilitate ecosystem services under resilience theory. These findings together represent the theoretical framework of the thesis, which is then applied to investigate the sporting functions of public parks.

The more practice-based component of this thesis is a case study of sporting park planning in the northern outer suburbs of Perth. This case study investigates six further research questions, which together address two fundamental aspects of public park planning that allows sporting services to be provided alongside ecosystem services. The first set of two questions relates to the spatial (i.e. within or outside of residential areas) and cadastral (i.e. zoning within local planning schemes) *location* of community playing fields, which have typically been provided as single and dual sporting parks primarily within a suburbs allotted 10% local parkland. The second set of four questions relates to the *design* of sporting parks, specifically how they incorporate ecological landscapes and non-sporting recreation alongside sporting playing fields and supporting infrastructure. Each set of research questions are investigated through separate comparative analyses with the case study area, each using distinct methodological approaches. These approaches adopt common planning data collection and analysis techniques, however with their implementation designed and/or their findings discussed within the theoretical framework.

The first 'location' investigation of the case study serves more as a preliminary analysis: addressing two research questions regarding how sporting parks might be best located in new residential areas, whilst informing the subsequent primary design investigation. Central to the investigation is the premise that the recent increase in ecological landscapes and pocket/linear parks within the limited amounts of local residential parkland necessitates new locations for sporting parks if their supply is to meet the demand of local communities. Two common practices for locating community playing fields outside of these restrictions are investigated under the following research questions:

What are the benefits and limitations of sporting parks co-located with local schools for facilitating ecosystem and sporting services under resilience theory?

What are the benefits and limitations of district sporting complexes for facilitating ecosystem and sporting services under resilience theory?

The methodology used to investigate these questions is not directly informed by the resilience framework, but rather adopts a combined spatial mapping and quantitative analysis approach used in the study that preceded this research (Middle, Tye and Middle 2012). This approach is applied across two developing residential districts in the case study area, with the findings between the two districts compared and then discussed in relation to key concepts from the resilience framework. Given it has only limited links back to the findings of the theoretical, the emphasis is less on the methodology and more on how the findings relate back to ecosystem services literature and resilience theory.

Investigation of the design research questions is the primary analysis of the case study: addressing four research questions using a methodological approach and a primary dataset designed and discussed under resilience theory concepts. Central to this investigation is the premise that sporting parks are best designed when containing landscapes that serve an environmental function whilst also facilitating non-sporting recreation. Four separate ecological landscapes – two common and two emerging in Perth planning practice – are investigated for their potential to facilitate ecosystem services adjacent to sporting areas:

What are the benefits and limitations of remnant bushland for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of permanent water for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of seasonal drainage basins for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of community gardens for facilitating ecosystem services alongside sporting services under resilience theory?

To address these questions, two common techniques for researching the use and value of public parks are applied – observations and questionnaire surveys of park users – but in a manner that is consistent with the insights provided specifically by human health resilience theory. Data is collected from three parks in total, however the focus is a comparison between areas within two parks, and specifically the landscapes of permanent water and seasonal drainage. The findings of these techniques are complemented by an extended review of the literature relating to each of the four landscapes, as well as insights from interviews with Local Government planners.

The research aim and related questions of this thesis are summarised in Figure 2 below.

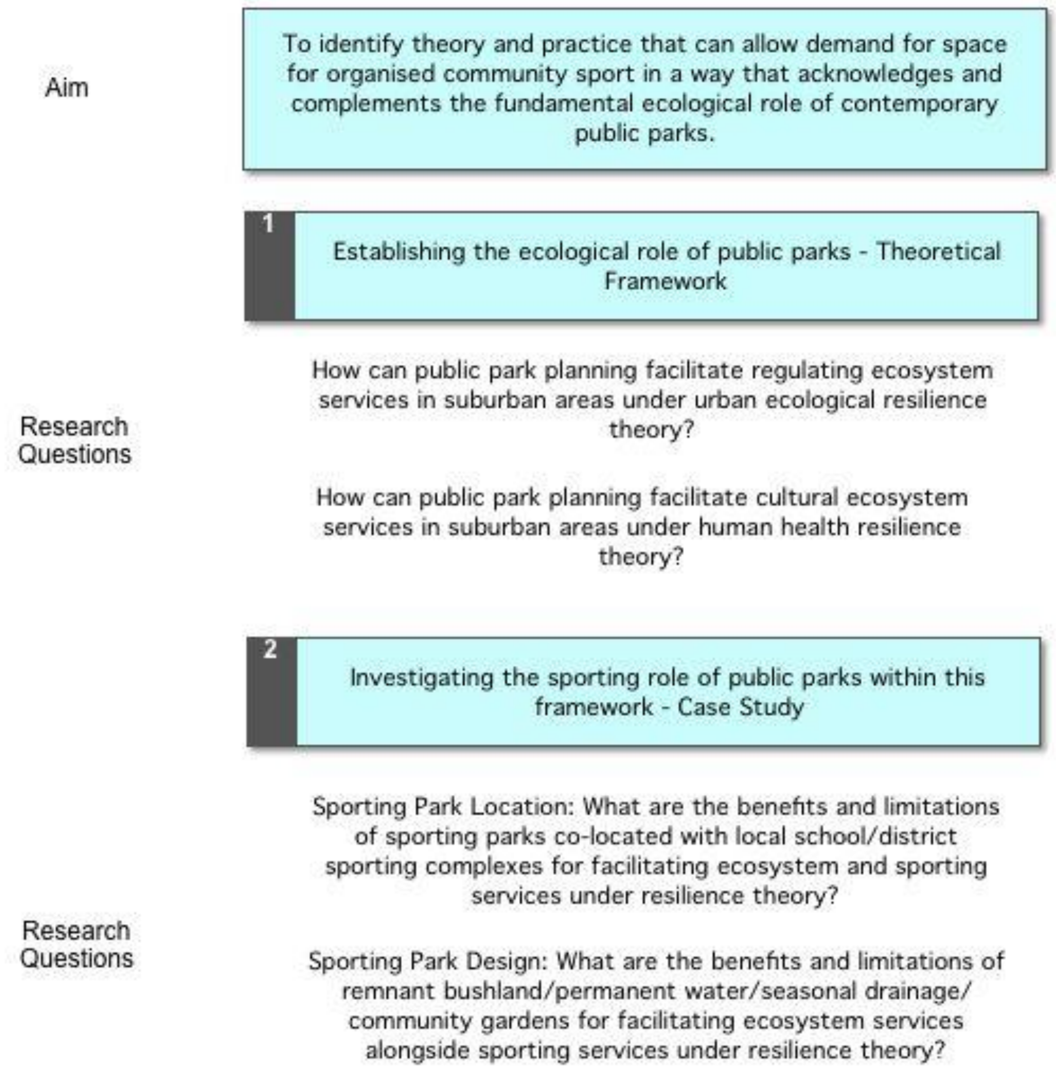


Figure 1: Summary of research design

1.3 Research Significance

This thesis makes significant contributions to both theory and practice relating to the field of public park planning. The primary significance of this thesis emerges from its central aim, which is to better incorporate the provision of community sporting facilities into public park planning without compromising its ecological role. The need to ensure the adequate provision of community sporting facilities was originally raised in the 'Crawford Report', however with no specific mention of the role of public parks or open space planning (Independent Sport Panel 2009). A similar need has also been identified within outer suburban areas in Melbourne (Australian Social & Recreation Research 2008) and Northern Sydney (Northern Sydney Regional Organisation of Councils 2011), as well as more recently in inner Sydney areas (Burgin, Parissi and

Webb 2014). Most important in forwarding this agenda been the recent research in Perth (Middle, Tye and Middle 2012, 2013), which has more conclusively linked this emerging shortage within newly developed outer suburbs directly to trends in public park planning. This current thesis is a continuation of this research, seeking to complement the recent inclusion of per capita standards for community playing fields in the latest Liveable Neighbourhoods draft (Western Australian Planning Commission 2015). Further, its investigation of sporting park design continues the precedent set by research out of the University of Western Australia, which includes several key academic papers researching Perth parks (Giles-Corti et al. 2005; Sugiyama et al. 2010), along with a recent online fact sheet (Sunarja, Wood and Giles-Corti 2013).

The theoretical framework of this thesis also contributes to acknowledged gaps in interdisciplinary urban research. At the broadest level, this framework addresses calls for greater integration of the social sciences into urban ecological research (Breuste, Niemela and Snep 2008; Wu 2008). More specifically, it reflects the need to further integrate human health and development resilience into broader ecological resilience and systems theory (Masten and Obradovic 2008). Previous contexts for this integration include environmental learning by Lundholm and Plummer (2010), and also the value of urban nature during times of disaster and acute stress by Tidball (2012). This thesis builds on this research, using public park planning and specifically the concept of ecosystem services as a context relevant to both resilience theories.

Further, integrating resilience research can contribute to a more holistic understanding of green space in urban areas (James et al. 2009; Tzoulas et al. 2007). In reference to the dimensions of urban green space research identified by James et al. (2009), and also summarized by Niemelä (2014), this thesis does not address in detail the various pressures (social, economic, environmental, technological etc.) that drive changes in the role of urban green space, and the social processes that govern how urban green space planning adapts to these pressures (Niemelä 2014). It primarily contributes to the development of a framework for integrating the social and environmental/ecological goals or outcomes of urban green space planning; specifically, the provision of ecosystem services.

1.4 Definition of Key Terminology

1.4.1 Public Parks

In this thesis, the term 'public parks' refers to combinations of natural, semi-natural and built urban landscapes utilised as publicly accessible recreation spaces by local residents. In the case of Perth, where this research is situated, parks are typically reserved as Local Government land, and managed for recreational, and more recently environmental conservational, purposes by these authorities. Depending on the context, they might be described as or be synonymous with either public *open* or *green* spaces. For the purposes of this thesis, these different terms and their connotations require some clarification.

According to the discussion by Swanwick, Dunnett and Wooley (2003), *open* spaces within urban areas can be defined as all aspects of the external urban area, excluding those functionally restricted such as main roads and car parks. They include both sealed, hard 'grey' spaces such as concrete or tarmac, as well as unsealed, soft 'green' spaces such as soil, grass and trees. Green spaces are thus a subset of open spaces in this framework. Public open spaces would include all publicly accessible combinations of built *and* green landscapes, but exclude restricted green spaces such as private gardens, or functional areas such as protected habitats or buffer areas (Swanwick, Dunnett and Woolley 2003). Under this framework, public open spaces would therefore appear to be the best representation of the public park.

This thesis is primarily concerned with public parks in outer suburban areas, a subset of public parks that requires further clarification. The specific proportions of natural, semi-natural and built landscapes typically found within public parks, ranging from the inner city to outer suburbs, can differ significantly. Traditional civic open spaces such as plazas and town squares, pedestrian street-sides and inner city playgrounds may be entirely built over. Alternatively, paths and signage may be the only built infrastructure within conservation parks and bushland areas on the urban fringe. Local suburban public parks planned as part of residential subdivisions fall somewhere in between: natural and semi-natural landscapes combined with built features that increase their recreational value. Under the framework adopted from Swanwick, Dunnett and Woolley (2003) in Figure 1 below they can be positioned broadly in the centre, as indicated by the arrows.

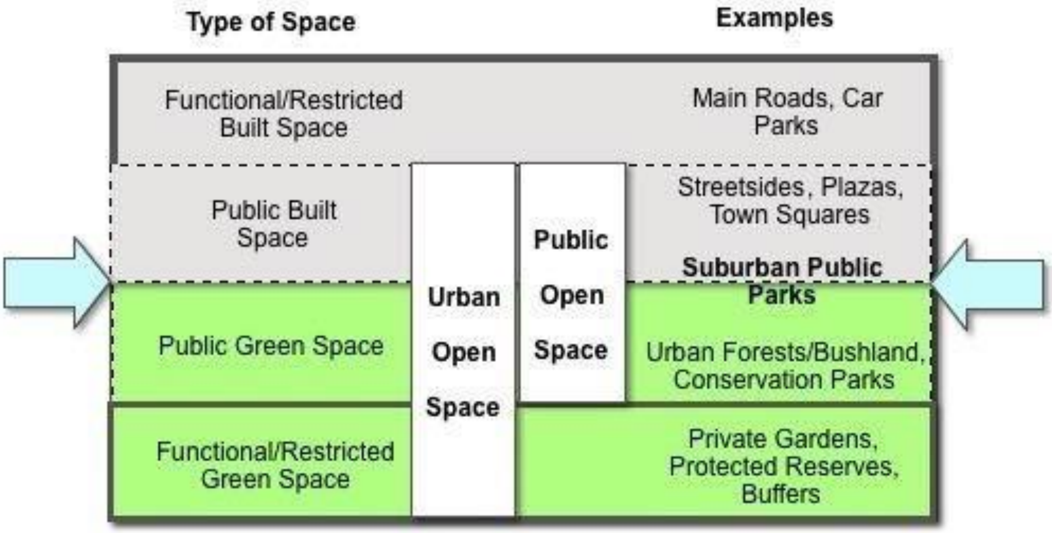


Figure 2: Public parks within the urban landscape, adapted from Swanwick, Dunnett and Woolley (2003)

While referring to these parks as open spaces may be more technically correct, recent trends in the way suburban public parks have been provided requires re-considering the terminology used to most appropriately describe them. As outlined in Chapter 2, public parks in the first half of the 20th century were often dominated by the semi-natural landscapes of playing fields, along with the built infrastructure of asphalt surfaces, clubrooms and other features that facilitate sporting competition. In the second half of the 20th century, however, suburban parks have taken an increasing ecological focus: serving key environmental functions relating to biodiversity conservation and urban water management whilst providing local residents with accessible contact with nature. Swanwick, Dunnett and Wooley (2003) note that the terminology of *green space* has emerged only recently out of urban conservation movements, as well as attempts to expand thinking about what constitutes public open space in urban areas. In this context, the term 'public green space' more accurately reflects the recent ecological shift in public park planning. Accordingly, the terms public parks and urban green spaces are used interchangeably in this thesis, and allows the role of public parks to be discussed within broader urban green space research.

1.4.2 Ecological Park Functions and Ecosystem Services

This thesis adopts the concept of *ecosystem services* – defined as the benefits that humans derive, either directly or indirectly, from the functioning of natural ecosystems (Costanza et al. 1997) – to broadly represent the key ecological functions of contemporary public parks. More specifically, it adopts the framework outlined by Niemelä et al. (2010), which classified ecosystem services provided by urban green spaces as either *regulating*, *cultural* or *provisioning*. Regulating ecosystem services refers to ecological processes upon which other services are reliant. It is used in this thesis to broadly represent the environmental function of public parks that, when applied to the context of public park planning in Perth, include primarily the conservation and management of biodiversity and urban water resources (see justification in Section 3.2). Cultural ecosystem services are the immaterial benefits for humans that emerge from these processes, which reflect the importance of parks in providing urban residents opportunities to experience natural environments. Four cultural ecosystem services are investigated: mental restoration, physical activity, social interactions and environmental education. The rationale for selecting these services as being representative of the primary outcomes of public park recreation is outlined in Section 3.3. Provisioning ecosystem services, or the material benefits gained from green space, are discussed briefly in Chapter 7 in relation to community gardens.

It should be noted that this selected framework is not a universally applied classification system in ecosystem services research. Originally, the United Nations Millennium Ecosystem Assessment (2005) classified ecosystem services as provisioning, regulating, cultural or *supporting* services. In this framework, urban water services would remain as regulating services, while biodiversity conservation would be classified as supporting. Alternatively, Ahern (2010) uses the classification system 'abiotic', 'biotic' and 'cultural/landscape' services. Services relating to urban water resources fall under abiotic in this framework, while biodiversity conservation would be a biotic service.

1.4.3 Sporting Park Functions and Sporting Services

To complement the adoption of the term ecosystem services, but also to acknowledge its limitations in describing forms of park recreation undertaken in and benefiting from social environments, this thesis coins the term 'sporting services'. This term encapsulates the range of health, community and educational benefits that participation in organized sport or involvement in community sporting clubs in public parks provides. It reflects literature indicating the benefits of sport emerge from both the structured and informal social environment that sport is held within, as compared to a 'natural' environment that is the connotation of ecosystem services. These two sets of park services are therefore fundamentally differentiated by the environments through which they are facilitated: ecosystem services arise from recreational activities in natural environments, whereas sporting services arise from both formal sporting competition as well as the informal social environment of community sporting clubs.

1.4.4 Resilience Theory

The term *resilience*, whilst having differing connotations in specific contexts, has been defined in the broad sense as the ability of a system to experience disturbance and still retain its basic structure and function (Walker and Salt 2006). Resilience theory has been increasingly embraced as a metaphorical and practical concept for aiding interdisciplinary understanding of the dynamics of complex social-ecological systems such as cities (Krasny and Tidball 2009a; Pickett, Cadenasso and Grove 2004). As well as this broader ecological theory, resilience also exists in human health and development research, where it shares many fundamental concepts (Masten and Obradovic 2008; Zautra et al. 2008). As discussed in more detail in Chapter 3 of this thesis, resilience theory in its various forms has great potential as an overarching framework for public park planning. Further explanation of each of these independent yet conceptually similar theories is required here.

1.4.4.1 Urban Ecological Resilience

The theoretical framework of this thesis, which allows for the negotiation of ecosystem and sporting services within public park planning in Perth suburbs, is grounded in social-ecological resilience theory. This theory is derived original from the work of Holling (1973, 1996), who first defined two aspects of an ecological system: its *resilience* (the ability of the system to persist despite fluctuating away from equilibrium) as distinct from its *stability* (the ability of the system to remain near equilibrium). The emergence of resilience theory in the study of urban areas represents a shift towards a non-equilibrium research paradigm, which understands cities as complex ecosystems that are inherently unpredictable and changing (Ahern 2010). This thesis uses the term 'urban ecological theory', as it acknowledges both the roots of this theory in the study of isolated ecosystems, and its more recent application to urban areas and urban green spaces in particular.

This thesis adopts resilience as a generally positive property of urban areas, as it describes the capacity to maintain the provision of ecosystem services despite external and internal stresses. Yet it should be noted that resilience could have contested meanings and negative connotations, particularly when applied to social systems (see discussion in Section 3.1.6). The understanding of ecological resilience applied in this thesis might be best described as *evolutionary* resilience (Davoudi et al. 2012), which emphasises flexibility, adaptation and transformation in the face of stress. These concepts are continually emphasised throughout this thesis when urban ecological resilience theory is applied to the context of public park planning.

1.4.4.2 Human Health Resilience

Given research on resilience in humans is broad in disciplinary and methodological scope (Zautra et al. 2008), this concept also requires some clarification as it is applied in this thesis. A simple definition of human resilience is the capacity to achieve positive outcomes despite challenging or threatening circumstances (Zolkoski and Bullock 2012). There are three parts of this definition that are relevant in the context of this thesis: the type of initial risk factors, the type of positive outcomes, and the type of protective factors that contribute to these outcomes. This research looks specifically at lifestyle factors inherent in many urban areas that typically lead to poor physical and mental health outcomes: for example stress, social isolation, physical inactivity and estrangement from nature. Resilience is the capacity to maintain good health while living in these areas, while parks are discussed as one protective factor capable of building this capacity – specifically in their capacity to facilitate both ecosystem and sporting services.

This thesis adopts the term 'human health resilience' to define resilience specifically as the capacity of an individual to maintain positive physical and mental *health* in the face of risk-factors that would typically be expected to lead to negative health outcomes. As a contrast, it has also been found that access to green space is related to *emotional* and *behavioural* resilience in children from disadvantaged backgrounds (Flouri, Midouhas and Joshi 2014), but not specifically health. The discussion throughout this thesis is grounded in but not limited to theory from human development or individual resilience research, which lies primarily in the fields of psychology and sociology with a focus on young people and the disadvantaged. It is largely distinct from broader resilience theories that deal with the ability of communities or societies to cope with and adapt to change and adversity, however it does acknowledge the broader role that the overall health and resilience of a community plays in protecting its most vulnerable.

1.4.5 Socioeconomically Disadvantaged Areas

This thesis also uses the term socioeconomically disadvantaged areas, frequently in relation to human health resilience, and often interchangeably with outer suburban areas. As discussed further in Section 3.1.4, living in areas with socioeconomic deprivation is one of the most significant health risk factors for urban residents (Poortinga 2012; Sanders, Lim and Sohn 2008). Given it has been argued that the study of resilience should be reserved for populations facing adversity (Ungar 2012), these areas are thus most relevant for applying human health resilience theory. As discussed in Section 3.3.1, the role of public parks in protecting from various health risk factors is also particularly important in these areas.

The locations of socioeconomically disadvantaged areas are likely to differ across different contexts. In Australian cities there is research suggesting many outer suburban areas are overrepresented by socioeconomic deprivation. In Perth for example, communities in outer suburban areas generally perform poorer on indicators of unemployment, income, disengaged youth and overall health (Tye et al. 2012). While this thesis makes the assumption, supported by demographic data, that communities in outer suburbs typically face greater adversity than average urban residents it does so specifically in the context of Australian cities.

1.5 Structure of Thesis

Chapter 2 of this thesis provides the background to the research. It firstly summarises the evolution of public park planning from its origins in Victorian Britain during the Industrial Revolution. This leads into a discussion of the role of contemporary public parks, including their key functions and the relationship between public park planning and organized community sport in Australian cities. A detailed background to public park planning in Perth is then provided, which leads into a brief overview of the need for an overarching theoretical framework to guide the planning of contemporary parks.

Chapter 3 outlines the theoretical framework of the thesis and addresses the first two research questions. It provides an overview of resilience theory in an urban ecological context, before outlining the parallels between this theory and resilience in human health research, including its relevance to public park planning. It is then applied in a theoretical discussion of the ecological role of contemporary parks using the linking concept of ecosystem services.

Chapter 4 provides a broad overview of case study approach employed by this thesis to address its six sporting park research questions. It introduces each specific investigation, and then establishes the specific case study area and individual parks and the reasons for their selection.

Chapter 5 outlines each of the data collection and analysis techniques and their relevance to researching public parks under resilience theory, before discussing how each of these methods were applied within the case study are in order to investigate the research questions.

Chapter 6 documents the investigation of practice for locating sporting parks, both co-located with local schools and outside of residential areas within district sporting complexes. It presents the results of the combined spatial and quantitative comparative analysis between the two recently developed residential districts, which identifies the degree to which each of these two alternate locations for sporting parks have been utilized to prove adequate supply of community sporting playing fields alongside of increases in ecological landscapes from suburbs planned in the middle of the 20th century. These findings are then applied in a broader discussion of the value of each of these two types of sporting parks under the resilience framework.

Chapter 7 documents the investigation of practice for the design of sporting parks to include remnant vegetation, permanent water, seasonal drainage and community gardens. It presents the results of both observations and questionnaires together for each of the three parks, however with a focus on a direct comparison between the questionnaire results from users within the permanent water and seasonal drainage areas. These results are then applied in a broader discussion of the value of each of the four landscapes under the resilience framework.

Chapter 8 concludes the thesis by reiterating its key theoretical and practical findings and the significance of these findings to urban planning research.

2. Background

This chapter establishes the background to this research: providing an overview of the evolution of public park planning at an international, Australian and Perth level, before concluding with an analysis of the current state of public park planning.

2.1 Historical Trends in Public Park Planning

2.1.1 Rus in Urbe: The Country in the City

The emergence of the urban public park can be traced back almost two centuries to Victorian-era Britain, where decision-makers were searching for a means to combat the social consequences of the rapid urbanisation within London and other industrial towns during the Industrial Revolution (Eisenman 2013; Taylor 1995; Walker and Duffield 1983).

As outlined by Eisenman (2013), the introduction of parks was largely a response to the poor living conditions of early urban development. Despite significant advances in human prosperity, the physical and institutional infrastructure of industrial towns was unable to keep up with the everyday needs of communities. Working class residents were exposed to a range of poor living conditions: both physical (e.g. polluted air and drinking water, lack of waste management) as well as economic (e.g. working conditions and income disparities). This initiated a series of social reforms relating to the physical fabric of cities, with the introduction of public parks being one of the most significant. Following a major outbreak of cholera in 1833, it was recommended to Parliament that every industrial town in England should have its own park (Eisenman 2013).

As further outlined by both Taylor (1995) and Walker and Duffield (1983), the public park also emerged from the realisation of the inherent value of open/green space to public health and vitality. Before the Industrial Revolution, working class communities had been living in rural towns that provided plentiful access to open space, both agricultural land and other surrounding countryside. Communal meeting places such as town squares and plazas were also typically provided as part of the fabric of pre-industrial developments. The loss of access to these landscapes prompted calls for the creation of new types of public open space – the Victorian Public Parks (Taylor 1995; Walker and Duffield 1983).

Rather than being designed specifically for working class communities, many of the early Victorian parks were Royal hunting and pleasure grounds opened up to the general public (Taylor 1995). The coherent green space of Hyde Park and Kensington Gardens is the most famous example, which along with Green and St James Parks, combine to create an almost continuous stretch of parkland across one of the most densely populated areas of London. Further from the city center, Richmond Park is another notable example.

The first parks designed and created specifically for working class communities provided a similar environment to these Royal parks. Prince's Park in Liverpool was a limited first step, being designed exclusively for use by and to add amenity value for residents living around its periphery (Taylor 1995). The first park designed and managed for the general public is widely accepted to be Liverpool's Birkenhead Park, which was opened in 1843 (Taylor 1995; Ward Thompson 2011). Birkenhead Park and the landscapes that followed, both in England and other European countries, took a similar form to the Royal parks: expansive and aesthetically pleasing landscapes that endeavoured to provide a sense of *rus in urbe*, or 'the countryside in the city' (Taylor 1995).

The design of these landscapes would provide the inspiration for the famous American landscape architect Frederick Law Olmstead. After being inspired by a visit to Birkenhead Park, Olmstead won a competition for the design for New York's new Central Park; his naturalistic plan was preferred over entrants that favoured more formal features such as statues and fountains (Eisenman 2013). As such, Olmstead's creations, which also include Prospect Park in Brooklyn and the Emerald Necklace in Boston, reflected their European prototypes whilst expanding upon them in several ways: often larger (526 acre Prospect Park compared to the 125 acre Birkenhead Park); making use of woodland and water; and employing techniques such as tunnels and overpasses to contrive a more varied and uninterrupted scenic experience (Ward Thompson 1998).

In short, the first public parks both in European and American cities placed similar emphasis on re-creating rural settings, achieved not exclusively but fundamentally with natural, or *green,* landscapes.

2.1.2 Organised Active Recreation and Planning Standards

While Olmstead's earliest designs conformed largely to the Victorian model, one of his stated aims was for park design to respond to local conditions; to continue to represent a tool for improving social welfare and a setting for urban democracy (Ward Thompson 1998). True to this wish, a series of significant shifts in park landscape design, and the planning processes that underpinned them, can be witnessed in the first half of the 20th century, each corresponding to the changes in social circumstances at the time.

As outlined by Cranz (1982), the emergence of playgrounds represented the first shift away from the Victorian model. The emergence of these new parks was driven by a powerful social reform movement, which advocated for more accessible recreational areas for working class families and children in particular. The parks produced by this movement could not have been more different to their predecessors: generally contained within a single or several adjacent city blocks and barely distinguishable from their built surroundings (Cranz 1982). This left city centres with two contrasting sets of public park landscapes, providing quite different recreational experiences.

A further shift in public park planning was prompted by the exceptional social circumstances at the beginning of the 20th century (Walker and Duffield 1983). In the years following World War I, and with the threat of a second imminent, there were growing concerns over the fitness of Western populations to deal with the physical and mental rigours of warfare. This lead to the creation of new recreation programs specifically targeting those likely to be defending the country in the near future. In Britain, the passing of the 1937 Physical Training and Recreation Act provided the legislative support for the widespread establishment of open space for active sports and other forms of trained physical activity, both for youth and young adults. This was followed by the 1944 Education Act, which also ensured every school had adequate active recreational facilities. The motivation for these initiatives was not just physical, but related to the perceived moral decline of the population – particularly its youth, who were seen as most at risk from the morally oppressive conditions of industrial conditions (Walker and Duffield 1983).

The first half of the 20th century also saw fundamental changes to the planning processes responsible for delivering public parks. Much of the early provision of urban parks had been largely opportunistic rather than systematic, often relying on private donations, and resulted in large disparities between neighbourhoods (Walker and Duffield 1983). Throughout the early 20th century, park planners increasingly adopted formalised park *standards*: quantitative approaches for providing parkland that relied on numerical formulas such as acres/hectares per population (Byrne, Sipe and Searle 2010; Veal 2008a, 2008b). With the combined impact of the Great Depression and two world wars, the post-war period left little political will to continue the park movement, as well as waning support of populations. Standards were thus increasingly adopted in order to provide recreational opportunities systematically within growing suburban areas in these conditions (Harnik 2010).

This shift to active recreation and planning standards represented a significant shift away from the original Victorian park era. Rather than being planned as rural-themed landscapes in urban areas, parks were now being designed first and foremost with the needs of organised sports in mind (Walker and Duffield 1983). Rather than being determined on a site-by-site basis, standardisation often resulted in the duplication of design features, producing a system of single purpose and highly utilitarian park landscapes (Cranz 1982). Park design thus increasingly favoured functionality over aesthetic form, with green landscapes such as playing fields and surrounding trees serving a utilitarian purpose rather than as a source of 'nature'. One way to interpret this shift is that, whilst being originally provided as large green spaces, public parks in the middle of the 20th century functioned primarily as open spaces.

2.1.3 Environmental Planning and Green Infrastructure

Two factors underlie the evolution of public parks in the post-war years into the 21st century: an increasing understanding of the ecological impacts of urban development, and a renewed focus on the health and well-being benefits of contact with natural environments.

Following on from the introduction of standards approaches, public park planning continued to take on a more systematic approach in the second half of the 20th century. Cranz and Boland (2004) suggest that the need to plan parks not as independent spaces but as connected 'open space systems' was recognised from the 1960's onwards. However, Eisenman (2013) suggests that the need to plan urban parks as connected systems was also identified by Olmstead at the end of the 19th century, demonstrated most notably by the series of parks that form Boston's 'Emerald Necklace'. As discussed further in the next section, this example was not the only instance his ideas on the public park would predate those of contemporary research by almost a century.

The need for parks to be planned coherently rather than as single spaces related not just to their social functions, but also to an increasing awareness of the environmental role required of parks. McDonnell (2011) suggests that a focus on the ecological aspects of cities began in earnest at the beginning of the 1960's. With changing perspectives of humans as components rather than separate from natural systems, it was becoming increasingly apparent that human development was significantly altering ecological processes (McDonnell 2011). Further, Benedict and McMahon (2002) suggest that wildlife biologists and ecologists soon recognised that the preservation of plants, animals and key ecological processes required the creation of interconnected systems of conservation areas. This saw public parks become more connected both to each other and to significant ecological urban landscapes (Benedict and McMahon 2002). As well as the conservation of natural areas, parks also provide sites where the public could engage in the active restoration of significant ecological areas (Eisenman 2013).

The environmental/ecological role of public parks now appears firmly established. In discussing the key functions of public open spaces in the 21st century, Ward Thompson (2002) highlights the need to better incorporate ecological understandings. As such, open spaces in the 21st century must be understood as *green networks*: a connected series of spaces spreading out from the city core into suburban fringe areas and surrounding countryside. Similarly, Cranz and Boland (2004) identify a more pronounced ecological role for the modern public park, which includes allowing urban residents to find new ways to engage with natural landscapes.

One concept that encapsulates this more coherent, ecological planning approach is *green infrastructure*. Green infrastructure refers to spatially and functionally integrated systems of both natural and hybrid (i.e. human modified) green space (Ahern, Cilliers and Niemelä 2014; Tzoulas et al. 2007). It seeks to place similar, if not greater, importance on green spaces and the services they provide as other forms of grey infrastructure (Eisenman 2013). It is argued that such an approach reflects the mechanism through which public parks can best provide their services in urban areas: not only in the 21st century, but according to early visions of the public park's most famous early proponent in Olmstead (Eisenman 2013).

2.1.4 Biophilia and Contact with Nature

Along with this environmental movement, public park planning towards the end of the 20th century began to embrace research on the human benefits of conserving and restoring natural landscapes in urban areas. One notable attempt to explain the relationship between the natural environment and human health and well-being has been the Biophilia Hypothesis, as outlined by Kellert and Wilson (1993) and reviewed recently by Kellert (2008). Well before the first modern cities arose from the Industrial Revolution, countless generations of humans evolved exclusively within challenging and diverse natural environments. As a result of this evolution, humans have an inherent tendency, encoded into our DNA, to affiliate with and gain unique benefits from exposure to natural environments: a trait called Biophilia (Kellert 2008; Kellert and Wilson 1993).

This hypothesis has fundamental implications for urban planning. The United Nations has predicted that by 2050 the population of humans living within urban areas will have doubled, while conversion of land from rural/wild to that suitable for urban occupancy likely to occur at a higher rate than population growth (Pickett et al. 2011). As such, humans are increasingly residing within areas where nature is either removed or hidden (Miller 2005). There is now growing evidence that this detachment from the environments that have dictated human evolution for so long has resulted in a range of adverse outcomes: not just in terms of human health but also to mental well-being and levels of happiness (Gullone 2000).

Alternatively, urban environments can be inherently beneficial to humans. For example, it is argued that urban areas provide the necessary conditions for interactions between socially 'distant' individuals, thus representing the hubs of innovation that can drive urban sustainability and resilience (Ernstson et al. 2010). Ensuring that these benefits are balanced through everyday opportunities to maintain a connection with the natural world therefore represents a pressing planning challenge (Beatley 2011). Public parks, as one of the few publicly accessible forms of nature in urban areas, are uniquely placed to provide this connection.

Again, there are significant parallels between recent conceptions of the role of public parks with those of Olmstead's. As outlined by Eisenman (2013), Olmstead was optimistic of the opportunities provided by cities to further society, but thought these advantages were accompanied by a 'psychosocial' environment that endangered the mental health of its inhabitants. The natural scenery frequently incorporated into his landscapes was intended to allow relief from these environments; essentially outlining the health benefits of contact with nature for urban residents, and the role of parks in providing this function, over a century before its embrace in academic research (Eisenman 2013).

2.2 Public Park Planning and Organised Sport in Australian Cities

The previous overview highlighted the evolving nature of public park planning: the form of park landscapes, the types of park recreation and underlying park planning processes have changed significantly from their origins in Victoria Britain. That public park planning could have evolved so significantly from its origins to the present day is explained by the fundamental purpose of these unique urban landscapes. A review of the evolution of public park planning in America by Cranz (1982) explains that public parks have passed through numerous distinct planning models, with each reflecting a response to the specific needs of society at that point in history. If public parks are essentially a form of planning intervention used by governments to solve pressing social problems, as Cranz suggests, then the planning and design of park landscapes must continue to change as the nature of society and these problems also change.

Thus, park evolution can be understood through the social context within which a park planning model is located. Initially, the most pressing social challenges of the first industrial cities were the deteriorating health and morale of working class families, caused in part by a loss of access to natural open space. At the start of the 20th century, when parks were being provided in expanding suburban areas, the most pressing social issue was to mentally and physical train younger populations throughout the world wars; a function that sport was able to best provide. In the second half of the 20th century, park planning became primarily informed by growing research-based knowledge on the need to ameliorate the emerging negative impacts of urban development, including the need for conservation and restoration of ecological processes and the associated health and well-being benefits of contact with nature.

A brief review of the evolution of public parks and open spaces in Australia identifies a similar pattern, with prevalent park models having strong parallels with these international trends whilst also reflecting specific local social conditions.

2.2.1 Public Park Planning in Australia

As discussed by Garnaut (2000), early Australian cities faced similar challenges to those in British industrial areas. Rapid increases in population, a result of the wealth of economic opportunities for potential migrants, resulted in high density and largely unplanned residential development with minimal natural or open recreation space (Garnaut 2000). Much like in Britain, the first Australian parks – notably Royal Botanic Park in Melbourne and Centennial Park in Sydney – were a response to these conditions, however also possessed their own motivations and reflections of local character. Using the examples of the Sydney's inner city parks (The Domain, Hyde Park and the Botanic Gardens), Hoskins (2003) identifies the creation and regulation of public parks as central to the formation of Australia's character as a civilised nation comprised of respectable peoples. This civilising motivation, it is suggested, and the importance of nature in such endeavours, is encapsulated in the words of town planner J. D. Fitzgerald: if 'the destiny of a progressive race is fixed as that of town-dwellers in the future, then country conditions must, so far as possible, be combined with city conveniences' (Hoskins 2003, 7). Importantly, the potential for active sporting recreation in early Australian parks was limited: in the case of Sydney, while Centennial Park permitted 'rational' sporting pursuits such as tennis and cricket, strict regulation was enforced to encourage mainly 'respectable' forms of passive recreation (Hoskins 2003). To these ends, the design of Australia's first parks were arguably more impressive than their antecedents: able to transform nature from harsh bushland – something to be tamed and overcome through urban development – into a healthy antidote for the social problems that emerged from this development (Hedgcock 2015).

Again in parallel to international trends, rapid suburbanisation in Australian cities during the first half of the 20th century would correspond with fundamental shift in the function of public parks and the way in which they were provided. Shifts from high-density urban development to low-density suburban development was particularly accelerated in Australia compared to other industrialising nations, where the desire for detached houses in large lots motivated much migration, and was facilitated by favourable economic conditions and centralised government (Davison 1993). Garnaut (2000) suggests that the systematic inclusion of parks and natural open space within suburban development was first considered in the second decade of the 20th century, when 'Garden City' ideals and its fundamental premise of integrating nature into cities began to be embraced by local town planners. While only a few suburban areas were created in full alignment with Garden City principles, this embrace ensured that the inclusion of extensive open space in planning processes became mandatory (Garnaut 2000). While the Great Depression put a temporary halt to the implementation of systematic metropolitan planning, the 1940s saw a renewed commitment towards centralised planning departments and the development of master estates, as well as the adoption of several influential planning ideas from Britain and America (Howe 2000). For example, it was in the 1940s that standards for public park provision were first introduced in parts of Australia (Veal 2008b).

This period also corresponded with the growing value of physical and mental fitness during the inter- and post-war periods. In line with the aims of the British Act of 1937, Australia introduced its own National Fitness Act in 1941, which sought to encourage widespread participation in school physical education through greater provision of sporting facilities (Hedgcock 2015). While influenced by the broader trends in Western nations for public parks to be complementary to military training, Australia also had its own specific temporal circumstances that likely contributed to such a focus on active recreation and organized sport. A nation well known for its sporting identity (Clarke 2012), Australia's sporting success was arguably at its peak in the immediate post-war decades. Australia had just won its first track gold medal through Marjorie Jackson, and was preparing for the Melbourne Olympics in 1956. These games would prove even more successful and herald an era of world domination in non-Olympic sports: including golf, squash, tennis and even Formula 1 (Clarke 2012). The result of these multiple influences was a range of standards for the provision of local parkland in residential areas, with at least half of this parkland typically dedicated to sporting playing fields (Veal 2008b).

In more recent decades, however, this focus on formalised park planning and active recreation has evolved considerably to incorporate a more diverse set of functions. Central to these changes have been the embrace of environmentalism, and specifically the role of planning in preserving the natural landscape in the midst of spreading suburbanisation. As discussed by Alexander (2000), Australia underwent a significant period of economic and population growth across the 1950s and 60s, which lead to accelerated residential and infrastructure development but little thought towards its environmental footprint. Even initial attempts to acknowledge the need for environmental conservation, such as the Cumberland Country Plan's green belt policy, were eventually overwhelmed by economic imperatives (Alexander 2000). This focus began to shift in the 1970s, beginning with the introduction of corridor plans that acknowledged the environmental problems of unconstrained urban sprawl, and built upon in the 1980s with a growing focus on environmental sustainability through the 1987 Brundtland report (Lennon 2000). Indeed, Hedgcock (2015) suggests that, backed by a range of state and community-based environmental groups, environmental protection became a core function of open space provision from the 1980s onwards.

Hedgcock (2015) also summarises the recent evolution of the recreational role of public parks in Australian cities. The embrace of environmental conservation as a function of open space provision also created new opportunities for passive recreation; in fact, it is argued that much of the motivation for the conservation of early 'regional open spaces' was for recreation rather than environmental purposes. This corresponds with changing recreational preferences around the 1970s: away from simply active sporting recreation to include passive and informal uses, along with more accessible active pursuits such as dog walking. It is further argued that perhaps the most defining characteristic of contemporary park planning in Australia has been a shift away from the provision of recreation opportunities for specific user groups, but instead to provide for the needs of a range of demographic and cultural groups. The end result has been a shift towards multi-purpose spaces that provide for varied active, passive and environmental functions in direct response to the specific demands of local communities (Hedgcock 2015).

2.2.2 Organised Community Sport in Australian Cities

The previous discussion indicates a reduced role for organised sport within public park planning in the 21st century in Australian cities. While this is an accurate reflection of the evolving role of public parks in Australian society, it nonetheless has potentially significant broader consequences for communities in newly developed residential areas.

While this evolution away from the provision of sporting playing fields has been occurring, a parallel shift can be identified in other policy areas: one acting to increase the demand for organised community sport in recently planned suburban areas in Australia. Growing awareness of the health and well-being services of sport, as well as its broader role in Australian culture and identity, has seen a range of initiatives with the aim of increasing participation in organised community sport. This is highlighted by the national release of the 'Crawford Report' in 2009 (Independent Sport Panel 2009). Compiled by the Australian Government-commissioned Independent Sport

Panel, the Crawford Report investigated possible reforms that would ensure the sustainability of both the elite and community sporting systems. Interestingly, it overlooked the broader rationale of encouraging sports participation during the middle of the 20th century: making no mention of links between sport and the military, whilst recommending a shift away from the funding of niche sports that serve mainly to boost medal counts at international events. Rather, it emphasised the benefits at the community and individual level: encouraging greater participation in sports that are deeply embedded into Australian culture, including those more likely to contribute to health promotion, community building and educational agendas across the lifetime of participants (Independent Sport Panel 2009). The Crawford Report was followed by a report by the Australian Government, which outlined a range of initiatives for boosting sports participation (Australian Government 2010).

Despite these aims, there does not appear to be parallel policy initiative for ensuring sufficient community sporting facilities to cater for this planned increase in sports participation. Residents in outer growth areas typically perform poorly on a range of key socioeconomic indicators, and are hence more likely to benefit from participation in organised sport (Australian Social & Recreation Research 2008) and also utilise government assistance initiatives (Tye et al. 2012). Yet many of these areas – including outer growth areas in Melbourne (Australian Social & Recreation Research 2008) and Northern Sydney (Northern Sydney Regional Organisation of Councils 2011) – are currently facing shortages in the availability of playing fields to cater for sporting demand. Further, this situation appears not just limited to outer suburbs, but has also been identified in inner Sydney areas (Burgin, Parissi and Webb 2014).

These conclusions reflect broader academic literature on community sports participation. While young people from socioeconomically disadvantaged backgrounds are more likely to *benefit* from organised sport, research shows that these individuals are less likely to *participate* in organized sports than those from more advantaged backgrounds (Dollman and Lewis 2010; Holt et al. 2011; Olds, Dollman and Maher 2009). One of these studies (Dollman and Lewis 2010) identified a number of significant barriers that restrict the ability of children from low socioeconomic families to participate in organized sport and access its benefits. Not surprisingly, financial restrictions were a common factor, including for registration fees and uniforms. Transport availability was another issue, which is linked to the issue of time management and scheduling demands for parents. However, it was also found that *access to sporting facilities* differed significantly across socioeconomic gradients (Dollman and Lewis 2010).

It could be hypothesized that the recent shifts away from the provision of opportunities for organised sport in public park planning, identified in the previous section, are contributing to this unsustainable situation; that demand for sporting parks is being actively increased even though parallel planning forces are actively decreasing their supply. Indeed, the role of public park planning is noted was a report for the coalition of National Sporting Organisations in 2007. While there are requirements (i.e. standards) in place in most states and territories for 'public open space' provision, there are no standards for sporting provision. The current trend towards 'ornamental' pocket parks primarily for passive recreation is therefore limiting the amount of parkland provided for sporting purposes (Sport Business Partners 2007).

Aside from this now publicly unavailable report, the role of public park/open space planning in upholding organised community sporting participation appears largely overlooked. For example, the Crawford Report explicitly states: 'there is little point in taking action to increase participation without a concurrent program to ensure there are enough facilities available to take advantage of interest generated' (Independent Sport Panel 2009, 111). When addressing the lack of adequate supply of community sporting facilities, it makes a series of recommendations: including the need for greater investment in community sporting infrastructure, the need to to better address the threat posed on sporting facilities by drought, and the need to better utilise sports facilities in education and defence institutes to offset current supply shortages. However, there appears no mention of the role of public parks or open/green space in providing the playing space that much community sport would be held within – seemingly one of the most fundamental components of any agenda to ensure the sustainability of sporting clubs, organizations and the sporting system as a whole. As a point of comparison, Sport England's 'Planning for Sport' initiative provides comprehensive guidance to providing adequate playing fields that specifically addresses different open and green space planning mechanisms (Sport England 2005).

Since the release of the Crawford Report, the need to actively address the planning processes that provide space for organised community sport has been addressed by Burgin, Parissi and Webb (2014). They note that while government planning policies such as healthy lifestyle campaigns have greatly increased demand for sporting open spaces, opposing planning pressures such as urban consolidation have been acting to reduce the provision of these spaces. As well as forcing local authorities to turn away new community clubs and hence potential sports participants, these policies also have the effect of increasing use of playing fields above their carrying capacity, which reduces the experience and safety for sporting users. The authors suggest that sporting open space be given the same weight as other forms of social infrastructure in strategic urban planning (Burgin, Parissi and Webb 2014).

Given the planning trends identified previously, a greater consideration than currently exists of the fundamental role of public park planning in facilitating many forms of organised community sport is required. Indeed, one of the key recommendations of the Crawford Report was for an improved evidence based to inform discussions on community sporting infrastructure (Independent Sport Panel 2009, 112). It is in this context that the situation in Perth's outer suburbs, and the emerging research investigating the relationship between public park planning and the provision of sporting playing fields, holds great significance.

2.3 Public Park Planning and Organised Sport in Perth

The impact that trends in public park planning have had on the provision of space for organised community sport becomes clear when taking a holistic analysis of the situation in Perth.

Perth's oldest and most famous parks are directly influenced by Victorian designs, most notably Kings Park (Figure 3). Kings Park has many of the hallmarks of the famous public parks of London: winding paths and roads, cultivated botanic gardens and numerous open grassed recreational areas. This was later expanded to include unique Australian elements; over two thirds of its current area is dedicated to the conservation and study of Perth's richly biodiverse remnant bushland. The Zoological Gardens – now Perth Zoo – is another example of a Victorian-themed open space, with the original aim of introducing European plants and animals to Australian conditions that extended into a valuable educational function. The inspiration behind other notable inner city parks, such as Hyde Park (Figure 4) in North Perth and Queens Gardens in East Perth, are present in their names as well as their use of water features and exotic vegetation.

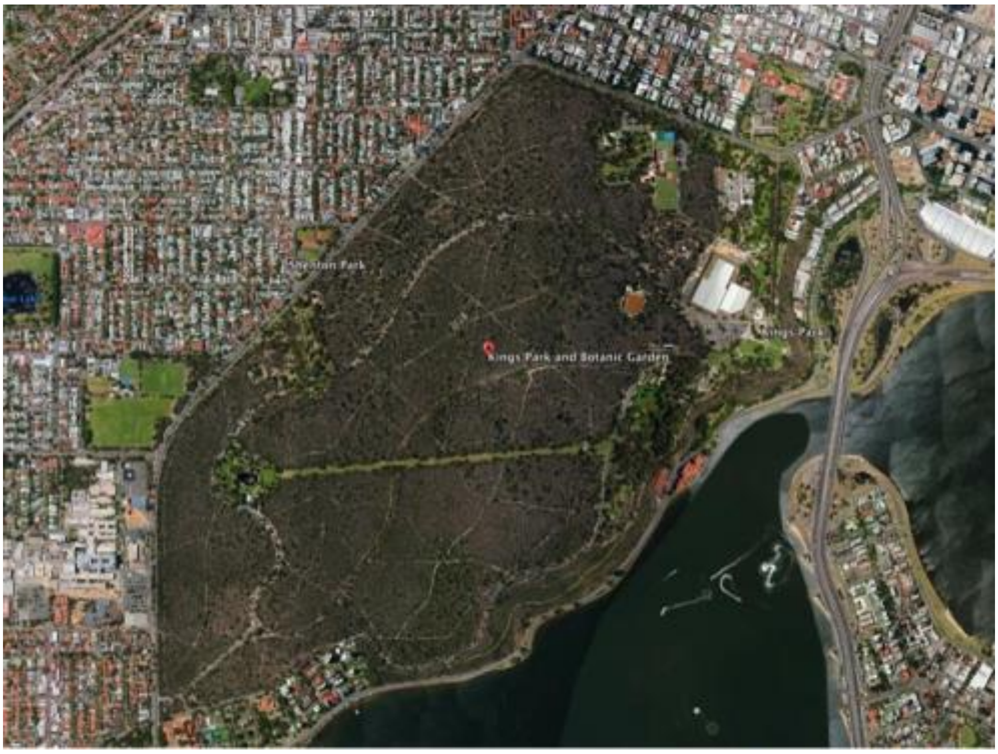


Figure 3: Aerial photo of Kings Park (Source: Google Earth)

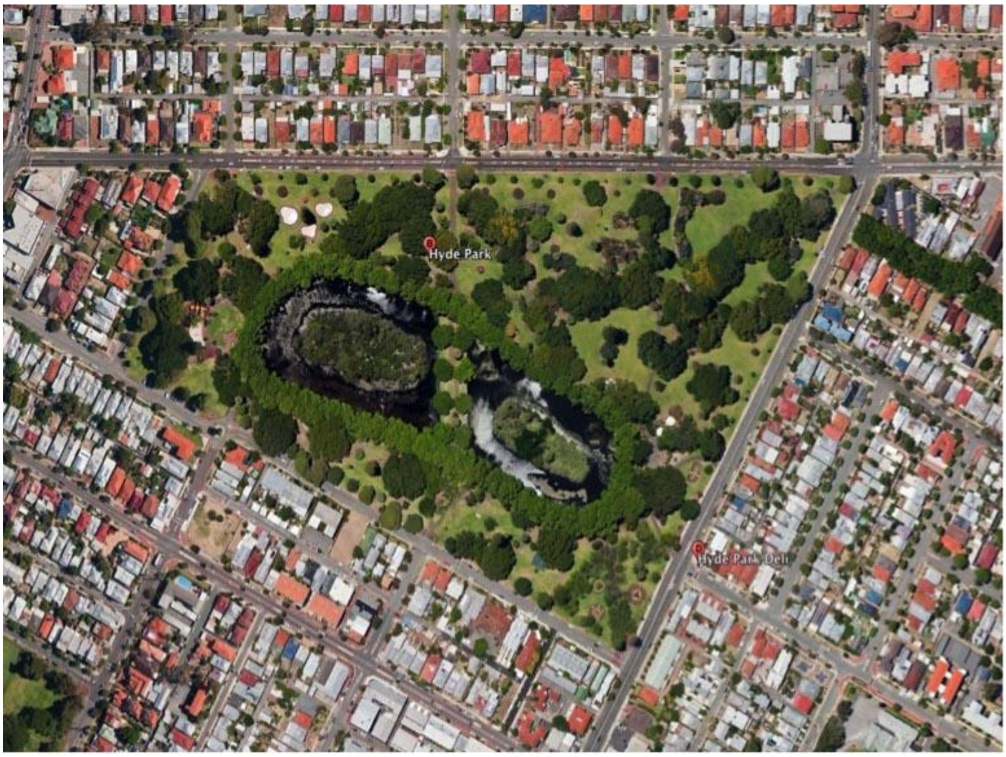


Figure 4: Aerial photo of Hyde Park (Source: Google Earth)

As Perth suburban areas began to spread at the start of the 20th century, there was a need for a more systematic approach to providing local parkland than the previous ad-hoc approach behind these original parks. This was the start of the evolution of public park planning in Perth: firstly towards the widespread provision of open space for organised sport, and then through conservation and recreation movements similar to those outlined internationally and in other Australian cities.

2.3.1 Planning Standards and Playing Fields

The responsibility for providing open space in inner Perth suburbs initially rested on the state government through the Department of Land, who released surplus land where possible in the vicinity of new subdivisions. This approach was often ineffective in practice, with that land secured often being of low quality and unsuitable for recreational purposes (Metropolitan Town Planning Commission 1930). On some occasions, good outcomes were achieved through the initiative of developers to provide their own open space. Otherwise, the only alternative was for local authorities to purchase land themselves on a freehold basis, which also produced less than desirable outcomes. In some situations, the expense required to acquire good quality parkland would leave no money to actually develop the land for recreational purposes. In other areas, only small provisions of parkland were provided (Western Australian Town Planning Department 1981).

This mostly ad-hoc planning mechanism for delivering public parks and open space was fundamentally overhauled in 1955 with the release of the Stephenson-Hepburn (S-H) Plan (Stephenson and Hepburn 1955). The S-H Plan provided a comprehensive and overarching metropolitan planning framework for Perth, with specific implications for public parks in line with international trends. The S-H Plan was an example of standards approaches to planning public parks (see Section 2.1.2). It required that developers of new residential subdivisions give up 3.36 hectares per 1000 population of subdividable land free of charge to the local authority as local parkland (Stephenson and Hepburn 1955). This equated to a standard of approximately 10% of the gross residential area being devoted to public parkland (Western Australian Town Planning Department 1981). These prescriptions have proved to be quite robust, with a 10% provision still in place for local open space provision into the 21st century (Western Australian Planning Commission 2002).

As well as providing a formal mechanism for ensuring adequate quantities of local parkland, the S-H Plan also put in place guidelines for the specific qualities that this parkland would have, which were also very much in line with the broader planning trends at the time. The S-H Plan put an overwhelming focus on opportunities for community sport: of the 10% of a suburb's area set aside open space, 85% was to be provided as space for active (sporting) playing fields (Stephenson and Hepburn 1955). As established earlier, this reflected the aims of the National Fitness Act introduced by the Commonwealth Government in 1941, which was itself based on Britain's similar Act (Hedgcock 2015). On top of the role of sport in Australian society at the time, Perth had its own specific sporting focus, as it would soon be hosting the British Empire Games in 1962. These additional factors likely combined with broader trends to give organised sport such a pronounced role in public park planning in Perth.

2.3.2 Shifts in Environmental Conservation

As well its prescriptions for the quantity and quality of residential parkland, the S-H Plan also marked the beginning of an urban conservation movement that would eventually become intertwined with local park planning. As outlined by Singleton (1992), the S-H Plan identified the need for regional open spaces (ROS) to secure areas of environmental or cultural value such as beaches, river foreshores, wetlands and escarpments. However, rather than for conservation purposes, the main motivation for securing these areas was to exploit them for their passive recreational potential. The S-H Plan also largely overlooked that value of many key urban wetlands, which were originally reserved for sporting use. The environmental role of ROS was consolidated firstly through the implementation of the Metropolitan Region Scheme (MRA) in 1963, then the Corridor Plan in 1970, as well as the System 6 report in 1981 (Singleton 1992).

The 21st century has seen significant conservation policy developments in Perth. The first was Bush Forever in 2000, which formalised many of the System 6 recommendations that were left unimplemented. Bush Forever sought to better acknowledge the unique biodiversity of the South-West region that Perth lies within by establishing a comprehensive metropolitan-wide bushland conservation framework (Western Australian Planning Commission 2000). This ecological movement was incorporated into local parkland through Liveable Neighbourhoods (LN) policy. One of the key aims of the policy was to better acknowledge key environmental areas through their incorporation into a neighbourhood's park system (Western Australian Planning Commission 2009). This conservation movement has been further consolidated recently through a policy guidance document released by the Environmental Protection Authority (EPA) in 2013, which sought to integrate all aspects of biodiversity planning across regional and local open spaces (Environmental Protection Authority 2013). This embrace of conservation within Perth planning is reflected by a new categorization framework for public parks, recently released State Government's Department of Sport and Recreation. This removes both the active and passive connotations and replaces them with *sporting* and *recreational* space respectively, as well as adding a third categorization of *nature* space to better acknowledge the growing ecological role of public parks (Department of Sport and Recreation 2012).

An additional environmental function of parks emerged with the introduction of a range of stormwater management practices, together described as Water Sensitive Urban Design (WSUD). Bringing multi-functional landscapes such as seasonal basins and permanent water features more prominently into local parks, WSUD practices treated stormwater as a natural resource that not only required conserving for ecological reasons, but could also provide unique individual health and community benefits (Grose and Hedgcock 2006; Vernon and Tiwari 2009).

The importance of both biodiversity and water conservation areas is reflected in the most recent draft release of LN, which allows for up to 2% of a residential area, or one fifth of local parkland, can be allocated to 'restricted use' features: that is, open space with no recreational value such as conservation category wetland buffers. This ensures that a minimum of 8% as unrestricted parkland, to be divided between 'sporting', 'recreational' and 'nature' open space (Western Australian Planning Commission 2015). Under this framework, natural areas with significant recreational value such as native vegetation with trails and wetlands below conservation category are considered unrestricted. Thus, the amount of actual turfed and landscaped open space would typically be well below 8%, particularly when developing in ecologically sensitive areas. This situation is a marked shift from the 85% of local open space allocation for active recreation suggested by the S-H Plan.

On top of these environmental factors acting against the provision of sporting playing fields is the issue of decreasing groundwater supplies. The seriousness of this issue was central in bringing together the coalition of the National Sporting Organisations to address the nation-wide decline of adequate community sporting facilities in Australia

(Sport Business Partners 2007). However, it is arguably even more of a pertinent issue for Perth, which Deeley, Milani and Deeley (2006) suggest is experiencing an unprecedented crisis in groundwater availability. Declining rainfall is resulting in subsequent declining inflows both to dams and underground aquifers. This is occurring whilst the city is undergoing population growth that continues to exceed previous projections, which is placing great pressure on aquifers that are already at, nearing or exceeding full allocation (Deeley, Milani and Deeley 2006). Along with other more visible uses such as potable water and private open space, irrigated public park landscapes will be one of the main consumers of groundwater in the urban fringes that will incorporate most of this population growth (Government of Western Australia 2014). Indeed, the groundwater usage of public parkland is a serious issue for LG, particularly for turf areas, which take up a significant proportion of water and maintenance budgets (Grose 2009). These concerns have seen a series of innovations in park landscape design and management: including the retrofitting of passive turf areas with less water intensive native plant species, more efficient irrigation practices that target the specific water usages of different green landscapes, and a gradual shift towards acceptance of the need for use of synthetic sporting turf areas (Government of Western Australia 2014). However, even with these innovations, the availability of groundwater remains a significant barrier to providing and maintaining sporting recreation space up to a suitable and safe standard for organized sporting competition.

2.3.3 Shifts in Park Recreation

Parallel to and incorporated into this environmental movement was a shift away from the limited recreational considerations of the S-H Plan. While a reflection of various social factors present at the time of the S-H Plan's release, these generous provisions for playing fields did not reflect the popularity of sport as a form of park recreation – a fact highlighted in a report by the WA Town Planning Department in 1981. Noting data suggesting informal sports and recreation were significantly more popular then organised sports, it recommended reconsideration of the traditional emphasis of open space planners on providing playing fields for organised sport rather than facilities for informal activities (Western Australian Town Planning Department 1981).

This over provision was gradually corrected in subsequent decades, as discussed in a review of the changing requirements of public open space in Perth by Grose (2009). While the focus of the S-H Plan on structured active recreation was largely unchallenged up until the 1970s, forms of unstructured recreation began to be embraced thereafter. This was followed by greater focus in the 1990s on planning parks to improve physical fitness (Grose 2009). As well as its conservation function, LN also consolidated many of these emerging trends into an overarching planning framework for new residential subdivisions. One of the primary aims of this policy was to create healthier and more walkable neighbourhoods, which included the integration of parkland into suburb design to create connected green networks (Western Australian Planning Commission 2009). Consequently, it now recommends a balance between passive, active and conservation areas (i.e. sport, recreation and nature space) within public parkland (Western Australian Planning Commission 2015).

This broader recreational role has also extended to environmental educational opportunities. Based on the perspectives of a range of local open space planners, Grose (2009) predicted a greater focus on children's contact with nature in the second decade of the 21st century. Such practice can be witnessed currently through the work of programs such as Nature Play WA, which seek to make nature-based playgrounds a more prominent feature of local parkland. Other examples of innovative opportunities for informal educational activities include signed walk trails that allow users to enjoy the recreational benefits of Perth's unique remnant natural bushland whilst learning about their ecological and cultural value.

2.3.4 Supply and Demand of Sporting Services

It is now emerging that these combined environmental and recreational planning shifts are resulting in a reduced role for organised sport and playing fields in the parkland of new Perth subdivisions. This issue was first raised in a position paper by Parks and leisure WA, which warned that the focus of LN on walkability and accessibility through smaller pocket and linear parks has come at the expense of parks large enough to hold organised sport and other forms of active recreation (Carter 2011). These warnings gained empirical support through results of the aforementioned research project by Middle, Tye and Middle (see mainly report in 2012, as well as 2013 summary document by same authors). Prompted by the concerns of Local Governments and sporting clubs, the study analysed public park landscape trends across 60% of the Perth metropolitan area, including all Local Government areas experiencing significant suburban growth. It found that the number and total area of playing fields available per capita for organized sport in newly developed suburbs had decreased significantly compared with that provided in suburbs planned in the middle of the 20th century. This reduction came in opposition to increases in conservation and drainage areas resulting from planning policies promoting biodiversity conservation and improved stormwater management, as well as tendencies towards the provision of pocket/linear parks that reflected new urbanism concepts such as walkable neighbourhoods (Middle, Tye and Middle 2012, 2013).

Aerial photos provide further support for these findings. As illustrated in Figure 5, the shift from flat, fragmented grassed open spaces into more spatially connected green spaces leaves limited opportunities for parks large enough to cater for organised sport.

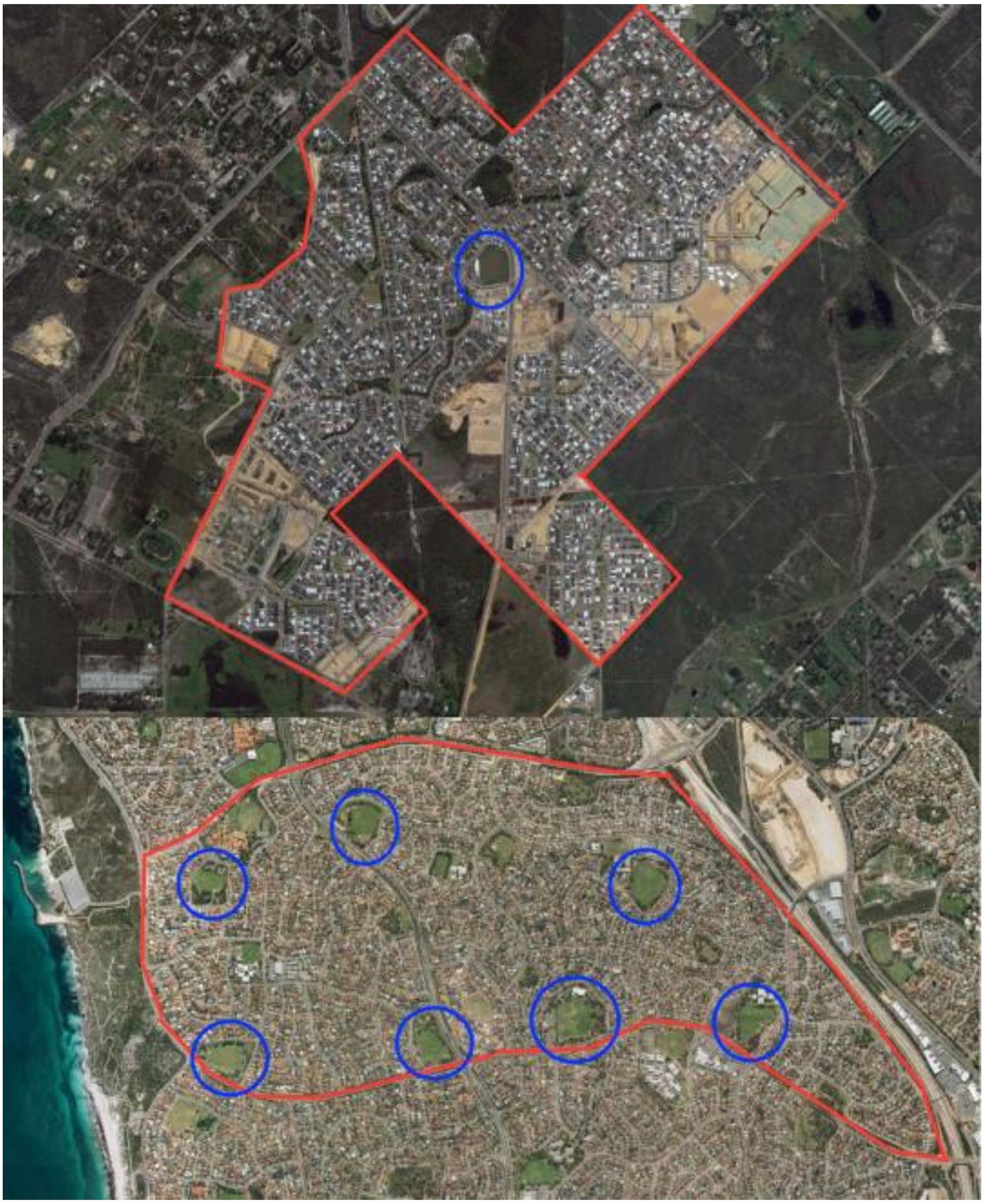


Figure 5: Comparison between number of playing fields within the parks in Perth suburbs planned during the middle of the 20th century (bottom) and 21st century (top) shown at the same scale. As indicated by the circles, the newer area will have only a single public playing field once built out compared to 7 in the older area, despite being slightly larger in size (approximately 710 ha compared to 570 ha). (Source: Google Earth with added annotations)

Compounding this situation, these shifts are coming in the context of policy with the primary aim of increasing participation in sports likely to be held in suburban areas subject to these planning shifts. In Perth, there are numerous government-funded initiatives that aim to increase sports participation in young and at-risk demographics. For example, the State Government has recently introduced the 'KidSport' program, which aims to directly enable sporting participation for children from socioeconomically disadvantaged families by providing financial assistance for club registration fees. A follow-up report (Tye et al. 2012) found that newly developed outer suburbs are typically comprised of young families with children who perform poorly on a range of key socioeconomic indicators: median income, unemployment, disengaged youth, education level, and overweight individuals. This suggest they are more likely to benefit from participation in organised sport, and more likely to utilise any financial assistance to overcome the greater barriers that they face towards this participation. Not surprisingly then, analysis of KidSport data found that 66% of enrolled children lie within the outer metro suburbs, of which a further 80% are enrolled in 'turf' based sports that typically are held within local parks. It is these same suburbs that are experiencing the significant reduction in playing fields identified above (Tye et al. 2012).

In short, these recent trends in public park planning in Perth are causing a decreased supply of sporting playing fields in new residential public parkland, which are thus unable to meet the growing demand for sporting services in these communities. In this context, it is notable that the most recent draft update of the State's 'Liveable Neighbourhoods' policy (Western Australian Planning Commission 2015), which controls all new residential subdivisions, now includes a minimum standard for sporting playing fields in public open space. Rather than as a spatial measure as a percentage of the total residential area, the suggested standard is per capita: 6.5m^2 of playing fields per resident in every new residential area, a figure derived from the original study by Middle, Tye and Middle (2012).

Yet clearly, simply advocating for greater provision of sporting parkland cannot in itself resolve this complex situation. It was in fact the over-provision of opportunities for organized sport that inhibited their fundamental role as one of the few remaining green spaces in urban areas, capable of carrying out environmental functions whilst permitting opportunities for human contact with nature. Now, with an increasing focus these latter functions, the reverse is occurring – resulting in less space remaining for resource-intensive playing fields cleared of vegetation and with limited functionality beyond organized sport. Building on the above studies, this current research essentially aims to find the middle ground in this situation: where sufficient space for organized sport may be provided in a manner that minimizes impact on, or even complements, broader role of public park planning in providing environmental functions and a wide range of recreational opportunities. Finding this middle ground first requires the identification of a suitable framework that encapsulates the full range of core functions of contemporary public parks.

2.4 Contemporary Frameworks for Public Park Planning

While noting that park history can be divided into periods where one model has become dominant, Cranz (1982) also makes the observation that no model is ever replaced or dies out. Thus, when considering the role of public parks in the 21st century, planners must consider all of the underlying social needs that the public park has upheld throughout its history. Sections 2.1.3 and 2.1.4 identified more recent roles role of environmental conservation and contact with nature, and further that these functions have significant parallels with visions of the role of the public park of its early advocates, most notably Olmstead, summarized in Section 2.1.1. Lying between and in contrast with these two periods is the planning era summarised in Section 2.1.2, where the primary function of public parks was to provide organised forms of recreation, firstly structured play and then also sport. The following sections outline potential existing frameworks for encapsulating these contrasting functions.

2.4.1 Balancing 'Nature' and 'Social' Park Functions

To understand how the core functions of public parks during these periods can be distinguished, this thesis refers to the discussion of public park functions by Harnik (2010). In this discussion, several different dichotomies are identified that have typically been used to represent different forms of recreation: 'competitive and non-competitive', 'regulated and un-regulated', and most commonly 'active' and 'passive' recreation (Harnik 2010). This latter dichotomy is one way to understand these different park planning models in terms of the types of recreation catered for. For example, the transition of public park planning from its original Victorian model to the provision of playgrounds and playing fields has been described as a shift from passive recreation to active recreation (Walker and Duffield 1983). However, this dichotomy does not hold up so well when considering recent trends in public park planning to encourage active healthy lifestyles: not so much through formal activities such as sport, but through informal forms of recreation such as walking within green environments (Carpenter 2013).

More importantly, this dichotomy does not fully reflect the way that participation in organised sport provides its benefits to participants. While sport is often understood and promoted primarily as a form of physical activity, looking closely at sport research suggests that the benefits it provides arise largely from the social environments within which these activities are held. The social interactions that arise from participation in community sporting clubs emerge from both structured (sporting competition) and unstructured, non-participant social involvement – the latter being one of the key functions of these clubs (Eime et al. 2010). The enjoyment derived from social interactions inherent in many sports is proposed as one of the reasons why, unlike other forms of exercise, sports participation is consistently associated with stress reduction (Asztalos et al. 2009). This is supported by a study that found children spending time in team sports compared to individual sports showed greater self-concept and self-esteem (Slutzky and Simpkins 2009). Indeed, it is now suggested that the social aspects of organized sports participation are the primary reason why club and team-based sports are associated with improved health outcomes when compared to individual activities (Eime et al. 2013). In this context, the recent shift in public park planning is not so much away from active to passive, but from recreation within a primarily social environment to a primarily natural environment.

Considering this perspective, there is a further method for classifying park activities identified by Harnik (2010) that is more relevant to this thesis: 'nature-to-nature', 'people-to-nature' and 'people-to-people'. Under this admittedly simplistic framework, nature-to-nature can be considered as planning purely for conservation. People-to-nature refers to instances when human recreation involves a relationship with the surrounding natural environment. Lastly, people-to-people activities represent those activities requiring other humans, typically in areas such as skate parks, dog parks, playgrounds and sports fields. While this does not mean these users cannot also undertake 'people-to-nature' activities, it emphasises that the presence of natural features is not central to the services that are provided: 'no matter how beautiful the setting… the real reason people come is to play against each other' (Harnik 2010, 24).

This is reflective of other research into the mechanism by which parks provide opportunities for recreation and health benefits. For example, Cattell et al. (2008) suggest that, while some people derive 'restorative' benefits in public spaces from opportunities to be alone, for others it was the social environment of the space that was instrumental in health and well-being outcomes. This is similar to the complexity noted by Ward Thompson (2002): that parks must simultaneously act as social spaces for both interactions and anonymity, but also as places of refuge and contact with 'nature'. Further, this framework is also broadly (but not completely) equivalent to the recent classification framework for public open space (parks) released in Perth, which breaks down parks into three similar categories: *nature* spaces, *recreation* spaces for informal recreation and *sporting* spaces for formal recreation (Department of Sport and Recreation 2012).

This thesis therefore adopts Harnik's classification framework to encapsulate the three core functions of public parks in the 21st century. As one of the few remaining forms of green space in urban areas, parks must serve a key environmental conservation role, whilst allowing recreational activities – both passive and active – within or around these ecological areas. In addition, they must also provide opportunities for social forms of recreation: both through formal examples such as organised sport, but also informal social activities that may not necessarily involve physical exertion.

2.4.2 Ecosystem and Sporting Services

While a useful framework for understanding the different functions of public parks, this quite simplistic framework has limited applicability when linking public park research with broader urban research. This section therefore seeks to frame these core functions of parks within a broader theoretical context.

This thesis posits that the contemporary ecological role of public parks can be largely encapsulated by the concept of *ecosystem services*. As established in Section 1.1.2, the term was originally defined as the benefits that humans derive, either directly or indirectly, from the functioning of natural ecosystems (Costanza et al. 1997). Its embrace as a planning concept reflects a now fundamental assumption of sustainable development: that physical and mental health and well-being is reliant on functional natural environments (Millennium Ecosystem Assessment 2005). That is, the health of humans is inextricable linked to the health of ecosystems. The concept represents an *anthropocentric* attitude to nature: differing from a *biocentric* approach to conservation planning, where nature is understood to have its own unique value worth protecting (Gagnon Thompson and Barton 1994). This reflects research revealing the significant utilitarian value for humans of functional ecosystems (Baldwin, Powell and Kellert 2011). Adopting the terminology of ecosystem services represents an attempt to quantify this value to give it more weight in policy decisions (Costanza et al. 1997).

The concept is relevant in urban areas: not just at the broad scale, but also to the study of discrete ecological landscapes such as public parks. Ecological perspectives of cities now understand them as urban ecosystems whose biophysical processes have become intertwined with human actions: social, economic and institutional (Alberti and Marzluff 2004). Further, Bolund and Hunhammar (1999) have suggested that the interface between individual ecosystems in urban areas is diffuse. Thus, while it is possible to define an entire urban area as a single human-dominated ecosystem, individual green spaces such as parks can also be considered ecosystems (Bolund and Hunhammar 1999). Indeed, the ecosystem services concept is increasingly acknowledged in urban green space research (Niemelä et al. 2010; Elmqvist et al. 2004; Ernstson, Sorlin and Elmqvist 2008). It is strongly linked with other concepts associated with public park planning, including green infrastructure and spatial connectivity, and has been proposed as a concept that can help identify and assess the multiple functions of such green infrastructure in urban areas (Ahern, Cilliers and Niemelä 2014).

The different types of ecosystem services proposed in literature are useful for encapsulating the different functions of public parks identified by Harnik (2010) in the previous section. The United Nations Millennium Ecosystem Assessment classified ecosystem services as provisioning, regulating, cultural or supporting services (Millennium Ecosystem Assessment 2005). More recently, Niemelä et al. (2010) have classified the services specifically provided by urban green spaces into provisioning (material benefits, such as food, fresh water and timber), regulating (regulation of ecological processes upon which other services are reliant) and cultural (immaterial human benefits that emerge from these regulating processes). Regulating and cultural ecosystem services are most relevant for this thesis: the former reflecting the conservation function of public parks, and the latter representing the human benefits that can arise from these ecological functions. Specifically, as expanded on in the next chapter, this thesis proposes that both the conservation of biodiversity and the effective drainage of stormwater runoff represent key regulating services provided by public parks. Further, the key outcomes of park recreation can be encapsulated by four cultural ecosystem services: physical activity, mental restoration, social interactions and environmental education.

To an extent, the concept of ecosystem services also has relevance to the social functions of public parks, and specifically organised sport. That the potential to facilitate social interactions has been proposed as a cultural ecosystem service suggests that the concept can, in theory, be extended to include the social function of parks. Indeed, as will be discussed in more detail in the Theoretical Framework chapter (see Section 3.3.1.2), there is a range of research linking greener and more aesthetic natural environments to the creation of social ties. Further, the benefits provided by participation in organised sport in public parks, or indeed involvement with community sporting clubs more generally, align closely with the four cultural ecosystem services just introduced. In Australia, sport represents the primary source of physical activity for adolescents (Olds, Dollman and Maher 2009). As an enjoyable and social form of exercise, it confers on its participants unique mental health benefits (Asztalos et al. 2009). This social role of sport is especially important, both for individual and broader community health and well-being (Eime et al. 2013; Okayasu, Kawahara and Nogawa 2010). On top of this, participation in organised sport also has significant educational benefits (Holt et al. 2011; Parry 2012).

Conversely, applying the concept to include organised sport as a key role of public park planning also has significant limitations. As discussed in more detail in Chapter 3, there also exist some fundamental incompatibilities between the ecological and social functions of parks. On one hand, 'natural' and ecologically complex landscapes will not necessarily represent valued recreational destinations for all urban residents, with many preferring less complex and manicured green spaces (Qiu, Lindberg and Nielsen 2013; Tzoulas and James 2010). Further, satisfying the fundamentally different motivations for visiting a park for either solitary or social experiences often requires providing distinct park environments. Organised sport can represent an extreme example of this incompatibility: both sporting activity and the landscapes required to facilitate these activities may be inhibitory to both recreation and conservation functions of parks.

Further, applying the concept of ecosystem services and its premise of the fundamental role of nature to encapsulate organised sport as a type of park recreation would misrepresent the social mechanism of community sport outlined in the previous section. Thus, rather than ecosystem services, this thesis suggests that benefits of involvement in organised community sport can be described as 'sporting services'. Each of these labels reflects the alternate mechanism through which public parks can provide health and well-being benefits to local communities.

Indeed, the case of organised community sport in public parks in outer Perth suburbs can be interpreted an example of the need for public parks to do more than simply provide for regulating and cultural ecosystem services, but also requires finding a place for sporting services. From this situation emerges the central aim of this thesis: to identify theory and practice that can allow demand for space for organised community sport in a way that acknowledges and complements the fundamental ecological role of contemporary public parks. There are two components to addressing this aim: firstly, to identify a theoretical framework for effective planning of the *ecological* functions of public parks; and secondly to identify current planning practice that allows the sporting functions of parks to be provided within this framework. The rest of this thesis is structured to address each of these steps in turn.

3. Theoretical Framework

The previous chapter provided an overview of the evolution public park planning internationally, in Australian cities and finally in Perth, with a specific focus on the implications of this evolution on the provision of space for organised community sport (i.e. sporting parks). It concluded by identifying the primary aim of this research, which is essentially to achieve a balance between the ecological and sporting functions of public parks. Achieving this aim, which is done primarily through a case study of planning practice in Perth, first requires the determination of a framework for the ecological role of contemporary parks: that is, how to plan public parks to facilitate regulating and cultural ecosystem services.

This chapter outlines the theoretical framework for this thesis, which combines insights from resilience theory in both urban ecological and human health research. As well as its primary role in guiding a case study of planning practice in Perth in order to address the sporting research questions, the framework has significance as a standalone theoretical contribution for how public parks and urban green spaces as a whole might be planned to facilitate ecosystem services in suburban areas.

The chapter contains 3 sections. The first introduces resilience theory and summarises its relevance as a framework for public park planning. It begins with an overview of resilience as a broad planning concept, including its location within a broader paradigm shift within the study of ecological and social systems. This is followed by an introduction to the specific application of resilience theory in both urban ecological and human health research, as well as existing support for the integration of these two largely independent fields of research. The second section provides a brief overview of the established insights urban ecological resilience theory provides for planning public parks for *regulating* ecosystem services, as well as its limitations in incorporating the more complex social factors inherent in planning for *cultural* ecosystem services. The third and main contribution of this chapter is the application of human health resilience theory to the planning of public parks to facilitate cultural ecosystem services. This third section begins with a detailed discussion of the literature surrounding each of four cultural ecosystem services, and how each service represents the potential for a park to increase the resilience of local residents to health risk factors inherent in suburban lifestyles. Key concepts from resilience theory are then applied to identify practice that can best allow these services to be facilitated.

Throughout this chapter, a flow chart is developed step-wise that summarises the key insights gained from resilience theory as they are discussed sequentially. After the first section, the relationship between resilience theory and planning for the key functions of public parks is summarised, the latter then substituted for regulating and cultural ecosystem services. In the second section, the specific regulating services that public parks are able to help facilitate are identified, followed by the addition of specific insights provided by urban ecological resilience theory for facilitating these services. The third section takes a similar approach: first the specific cultural ecosystem services that public parks provide are identified, followed by the insights from human health resilience for how these services might be best facilitated. This final flow chart is also expanded upon through a table that summarises the specific environmental qualities that have been identified in literature for facilitating each cultural service. Together, this flow chart and table represent the theoretical framework of this thesis.

3.1 Public Park Planning and Resilience Theory

3.1.1 Ecological Resilience and the Non-Equilibrium Paradigm

Resilience theory as it applies to urban areas at the broad scale has its origins in the study of isolated ecological systems, first discussed by Holling (1973). Holling explicitly differentiated the *resilience* of an ecological system – the ability of the system to absorb changes of variables and parameters and still persist – from its *stability*, which is simply the ability of the system to remain near equilibrium. Based on these definitions, a system that fluctuates significantly under extreme conditions, but is still able to cope with this change, is a resilient but not necessarily stable system. In contrast, homogenous systems with low variability, such as an economic or manufacturing systems, may well be stable under controlled conditions, but are almost certainly not resilient to sudden changes to structural components or desired outputs. Resilience thus implies that the ability to persist with a single system state is not reliant on a prompt or full return to a previous state of equilibrium, even if this means an initial reduced stage of productivity. Key concepts include the need to keep options open, view events from a wide perspective and to maintain heterogeneity (Holling 1973).

Holling (1996) later noted the difference between the ecological interpretation of resilience with that found in disciplines such as mathematics and economics: *engineering* resilience. Both of these definitions of resilience dealt with the stability of systems, but did so within a fundamentally different context. Engineering resilience concentrated on stability near an equilibrium state, while ecological resilience dealt with stability at conditions far from equilibrium. They effectively occupied distinct paradigms that reflected the traditions and disciplines of each devotee: one that focused on maintaining efficiency of function (engineering resilience), and one that focused on maintaining the existence of function (ecological resilience). A useful summary of these two perspectives is that engineering resilience aims for a *fail-safe* design, while ecological resilience was about searching for *safe-fail* designs (Holling 1996).

Another way to understand the difference between these two definitions of resilience is through the broader paradigms within which they are situated. Ahern (2010, 2011) has proposed that ecological resilience theory lies within a paradigm shift in the study of living systems. Traditional models of sustainability were based around a deterministic or *equilibrium* conception of living and technological systems. Such thinking lead to a fail-safe mentality within fields researching social and economic development, human health and the environment. More recently, however, a new understanding has been increasingly embraced in these fields. This paradigm is based on chaos or *non-equilibrium* theory that argues that natural and human systems are inherently variable and prone to unexpected change. Rather than attempting to control or restrict this change, sustainability in a non-equilibrium world is better achieved through measures that allow disruption to be absorbed and overcome (Ahern 2010, 2011).

In this context, resilience theory represents a framework for understanding sustainability within this non-equilibrium paradigm. Resilience has more recently been defined broadly as 'the capacity of a system to absorb disturbance and still retain its basic function and structure' (Walker and Salt 2006, xiii). Resilience theory therefore deals fundamentally with the properties of a system that give it the ability to continue – to *sustain* itself – through circumstances that would otherwise threaten this ability. Achieving resilience is thus equivalent to achieving sustainability in an unpredictable, non-equilibrium world.

3.1.2 Urban Ecological Resilience Theory and Urban Planning

While originally derived from the study of isolated ecosystems, this new ecological paradigm proved relevant to the study of natural systems directly influenced by human actions, including those in and and on the periphery of urban areas. Holling and Gunderson (2002) suggest that one of the assumptions of ecological resilience theory is that natural systems are inherently resilient until intervention. However, given the growing influence of human actions across the planet, there are now few if any natural ecosystems that are not directly or indirectly affected by human. While many outcomes of human development such as climate change and habitat loss can threaten the resilience of natural systems, processes such as conservation and restoration can also act to increase it development (Holling and Gunderson 2002). Ecological resilience theory is now commonly applied to the pursuit of sustainability through these practices within these linked social-ecological systems, where changes in one domain will inevitably impact the other (Walker and Salt 2006).

Now established in the study of social-ecological systems, current understandings of resilience bring into question some of its previous fundamental tenets. Extending the non-equilibrium perspective is the term 'evolutionary resilience' discussed by Davoudi et al. (2012). The theory underpinning this concept posits that change in complex systems does not necessarily come from external forces, but also from internal stresses; essentially, unpredictable change is inherent in social-ecological systems. Rejecting the idea that such systems return or 'bounce back' to a previous equilibrium state, the capacity to change, adapt and transform become crucial responses to stress (Davoudi et al. 2012).

The fundamental evolving nature of complex system is encapsulated in the 'adaptive cycle' model and the concept of 'panarchy' outlined by Holling, Gunderson and Peterson (2002). Panarchy theory posits that emergent change in complex systems occurs through interactions of social and ecological variables across multiple scales – for example, individual residents or species at the small scale, social institutions of management or climate at the broad scale. Each scale of a system is undergoing similar cycles of adaptation: exploitation or rapid growth (r), conservation (K), release (omega) and reorganisation (alpha). Unlike traditional hierarchies, however, change is not simply determined through actions at broad scales through top-down control, but though a dynamic two-way process. Thus, while significant control of the system still occurs at higher broad scales, rapid changes at lower levels can potentially cascade upwards if it is particularly potent (such as collapse during the release phase) or if higher levels are particularly vulnerable (such as during the end of a conservation phase). As illustrated in Figure 6, complex ecological systems can therefore be understood as linked, nested adaptive cycles, whose change is initiated through synchronisation of actions at lower levels (revolt) and constrained through accumulated knowledge at broader level (remember) (Holling, Gunderson and Peterson 2002).

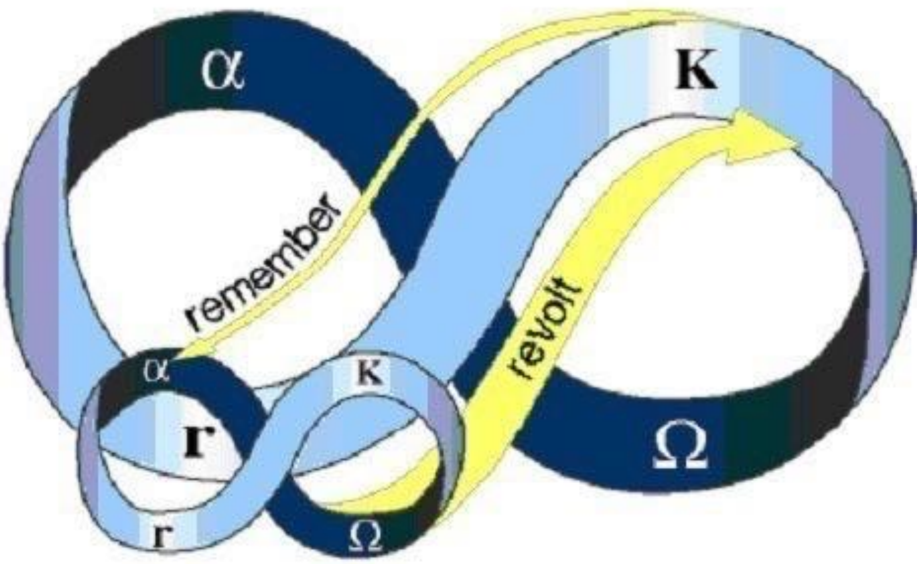


Figure 6: Illustration of Panarchy. Social-ecological systems consist of linked adaptive systems that each pass through cycles of growth/exploitation (r), conservation (k), release (omega), and re-organization (alpha). Change at lower levels affects broader functioning through the process of revolt, whilst being constrained by through the process of remember. *(http://www.resalliance.org/index.php/adaptive_cycle)*

Resilience theory and its conception of the evolving nature of change in complex systems has many qualities that make it a useful framework for urban planning. Firstly, as explained by Ahern (2010, 2011), the non-equilibrium paradigm from which resilience theory has emerged is particularly relevant in urban areas. Cities – complex urban ecosystems where humans live at high densities within highly modified landscapes – are especially prone to significant change and fluctuation by both known and unknown causes. It is therefore being increasingly recognised that the disciplines responsible for determining the structure of a city such as urban planning and design must also operate within this new paradigm, which accepts that uncertainty and variation as inherent properties of cities (Ahern 2010, 2011).

Further, resilience is also a highly versatile concept, which has metaphorical significance whilst also providing practical planning insights. The word resilience represents a powerful metaphor for sustainability in living systems; it is applicable at the system level, such as for a whole city or ecosystem, as well as at the level of the individual (Masten and Obradovic 2008). As a metaphorical concept, the core principles of withstanding, adapting and transforming in the face of adversity can be applied across multiple levels of organisation (Krasny and Tidball 2009a). As such, it represents a theoretical framework that permits better understanding of the complex and uncertain conditions that natural or human systems operate under: hence the term *resilience thinking* used by Walker and Salt (2006). This ability to act as a metaphorical concept relevant across disciplines makes it a valuable integrative tool (Pickett, Cadenasso and Grove 2004).

At the same time, resilience theory can also provide practical guidance for achieving urban sustainability in non-equilibrium conditions. Resilience theory emphasizes several core concepts that can be applied across different scales and contexts: diversity, multi-functionality, enhanced connectivity between these functional components, and the capacity for learning and adaptation, among others (Ahern 2010; Walker and Salt 2006). These properties apply not just to a physical and spatial perspective of how cities should be planned and designed, but also provide guidance on the desirable properties of social networks and institutions to withstand broad-scale disturbances such as climate change (Tyler and Moench 2012). The fundamental concepts of resilience theory also align with emergent *interpretive* approaches to planning, which emphasises fluidity, reflectivity and connectivity over fixity, rigidity and isolation (Davoudi et al. 2012). Consequently, resilience theory has now been embraced widely within an urban context (Ernstson et al. 2010; Newman, Beatley and Boyer 2009; Resilience Alliance 2007), including specifically to urban green space (Colding 2007; Colding and Barthel 2013; Erixon, Borgström and Andersson 2013) and green infrastructure planning (Ahern 2010). It therefore represents a potential framework for planning the ecological aspects of public parks.

3.1.3 Parallels Between Human Health and Ecological Resilience Theories

Resilience theory also exists within the study of human health and development, which this thesis proposes can also be related to the planning of public parks to provide their core functions in urban areas. While resilience theory in each of these contexts emerged at similar times during the 1970s, they did so independently and have continued on largely separated for several decades (Masten and Obradovic 2008). Despite this, there are clear conceptual similarities between the two: primarily that resilience theory in human health research can also be situated within a broader non-equilibrium paradigm shift within its native field of research.

As explained by Lindstrom and Eriksson (2006), human resilience theory represents a branching from the *pathogenic* paradigm that the study and treatment of human health has traditionally operated under. Within this paradigm, negative life influences during early stages of development – such as individual trauma experiences or toxic social conditions – would almost inevitably result in negative health consequences later in life. Under this paradigm, public health concerned itself primarily with the reasons for disease in humans, and how human health could be brought back to previous states of health before illness. During the 1970s, however, new epidemiological research on human health and disease began to challenge these assumptions. A medical sociologist called Aaron Antonovsky undertook one notable example of such research. While studying women who had survived WWII concentration camps, Antonovsky found surprising evidence of many of these women displaying a remarkable capacity to maintain good health and lead a positive life despite the considerable adversity they had faced (Antonovsky 1979). Breaking from existing pathogenic assumptions, Antonovsky hypothesised that chaos and stress were actually a natural and unavoidable part of life. Operating under this new understanding, Antonovsky suggested that new research should be focused not simply on risks to human health, but also on the reasons that humans were able to continue to survive and even thrive in these circumstances. He called this a *salutogenic* approach toward health research: derived from the Latin 'salus = health' and the Greek 'genesis = origins'. This approach shifted more focus onto the specific factors that promote and support human health, including both the personal abilities of individuals as well as their external environments (Lindstrom and Eriksson 2006).

It is from this salutogenic paradigm that human health resilience theory emerged. Masten (2001) traces the origins of resilience theory to pioneering longitudinal studies of the development paths of at-risk children in the 1970s. The children in these studies had been exposed to a variety of acute and chronic adversity, due to both genetic and experiential circumstances. These risk factors and their effect on the subsequent trajectories of the children were the initial focus of the studies. However, as the research progressed, the investigators found significant variation in the development outcomes of these children, with many demonstrating remarkable successes in different domains of life. Much like Antonovsky above, this caused a shift in focus to the protective factors that were able to make the differences in coping capacity in these individual's lives (Masten 2001).

The difference between these two approaches to human health is encapsulated in the subsequent emergence of two separate definitions of resilience that represent fundamentally different understandings of what constitutes healthy and positive development. As outlined by Zautra et al. (2008), resilience can be understood as a concept relating to both *recovery* and *sustainability* of human health. Recovery is essentially an equilibrium approach to human health, where the desired outcome is to return the health of an individual back to a previous state that existed prior to adversity or disease. The sustainability approach to resilience, however, does not share the notion that good health is a state that must be returned to. Rather, it suggests that the natural course of human life has an inherent forward lean towards positive endeavours such as engagement, purpose and perseverance, and that a good life is not defined simply by the absence of disease. From this perspective, resilience implies more than simply the ability to return to a previous state free of bad health, but rather the continuing capacity to move ones life forward and to sustain pursuit of the positive (Zautra et al. 2008).

These two definitions of resilience are notably similar to the *engineering* and *ecological* definitions of ecological resilience identified in the previous section. Specifically, the sustainability definition outlined by Zautra et al. (2008) reflects many of the central concepts of ecological resilience theory, particularly the evolutionary model identified by Dovoudi et al. (2012). Sustainability resilience is defined as the amount of stress that a person can endure without a fundamental change in capacity to pursue aims that give life meaning. Changes to the capacity to sustain oneself do not occur at any single level, but are dynamic, non-linear, and the result of the relationships across multiple scales. If these changes occur to the extent that they cross over *tipping points*, it will affect healthy functioning – not only at specific functional levels such as cognition and behavior, but also the nature of the relationships between these core human responses that determine an individual's function at a broader scale (Zautra et al. 2008).

In essence then, resilience in human health and development research represents the capacity for individuals to sustain their own positive progress in life despite significant adversity and disruption. Together with ecological theory, it may therefore provide a common framework for an understanding of how complex living systems at various scales can remain sustainable in the face of change and adversity.

3.1.4 Human Health Resilience and Urban Planning

Despite these similarities, early human health resilience theory has little relevance to urban planning, and more specifically public parks. Resilience research on humans fundamentally deals with the specific factors that allow an individual to demonstrate positive outcomes in the face of greater than normal stress and adversity in their lives. Early research focused primarily on individual factors, effectively framing resilience as something an individual either did or didn't have, and leaving little place for external factors to influence this capacity. However, recent approaches that include resources in the physical environment make the concept relevant to this thesis.

Limited primarily to the domain of developmental psychology, resilience was initially considered an internal process dependent on person-centered variables (Bonanno et al. 2007; Zautra et al. 2008). In this understanding, individuals possessing, or able to acquire, internal characteristics such as optimism, hardiness or self-enhancement were more likely to demonstrate the capacity for resilience than those who did not have these characteristics. As resilience research broadened, it became clear that the capacity for resilience extended beyond an individual's intrinsic ability to overcome the odds. It is now accepted that resilience is determined by a complex matrix of factors interwoven into the life of an individual: emotional and cognitive characteristics; primary social networks; and also the physical and sociocultural profiles of their neighbourhoods (Bonanno et al. 2007).

This broader understanding has been described by Ungar (2011b) as a *social ecological* perspective of human resilience. This term and its connotation are derived from Bronfenbrenner's ecological model, which essentially sought to widen psychological research beyond study of an individual's behaviour to encompass the individual's interactions with their immediate environment (Bronfenbrenner 1994; Ungar 2011b).

Under a social ecological understanding, resilient behavior is similarly understood as a process resulting from continuous interactions between an individual and their physical and social environments, interactions that are as (or, it is suggested, more) influential than individual characteristics (Ungar 2011b).

In this context, resilience is best understood as a multi-layered social construct. Factors for resilience include not just the capacities of an individual, but also the ability of social institutions to provide the necessary resources that facilitate resilience in its most vulnerable individuals (Obrist, Pfeiffer and Henley 2010). This is a fundamentally different conception of resilience than was first proposed, and makes it far more relevant to fields such as urban planning that are responsible for creating these environments. It also frames human health resilience as a fundamentally political process, where consideration needs to be given by those responsible for the allocation of resources as to where and how they can be most effective (Ungar 2011a). Accepting this, urban planning can play a significant – both negative and positive – role in an individual's resilience depending on the focus and efficacy of planning institutions to areas where risks to normal human health and development are most prevalent.

Such a claim is supported through the concept of *ordinary magic* coined by Masten (2001). Conclusions drawn from the earliest studies on the coping capacity of at-risk children were that individuals displaying a positive adaptive capacity to adversity were outliers, and possessed some uniquely special abilities that were not afforded to the majority. As research has grown, however, the opposite now appears true: the capacity of an individual to use their own resources and those around them to overcome and even thrive from adversity should be viewed as the norm rather than an exception. The capacity for resilience, while seemingly miraculous, is in fact within every individual: ordinary magic. However, the inherent capacity for ordinary magic in an individual is based on the assumption that they function under conditions conducive to good health. If these normal operating conditions are disrupted or destroyed, such as through exposure to negative social and physical environments, the individual's capacity for resilience can be severely compromised (Masten 2001).

This understanding of human resilience has significant implications when considering the health consequences of urban lifestyles, particularly in socioeconomically disadvantaged areas. In the 21st century, disparities between social and economic resources are creating increasingly vulnerable social groups (Marmot 2007). Poverty and socioeconomic deprivation represent one of the primary risk factors for human health in urban areas: limiting access to education and employment opportunities among other things, which have the flow-on effect of leading to poorer self-regulation and hence inevitably poorer health outcomes (Marmot 2007; Poortinga 2012; Sanders, Lim and Sohn 2008). Arguably, individuals in these deprived areas are having their inherent capacity for ordinary magic undermined by the environments within which their development is taking place.

Conversely, new and effective government and community interventions within socioeconomically disadvantaged areas could have great potential to facilitate resilience in at-risk individuals. Central to this alternate perspective is the complex relationship between factors that will typically cause poor development outcomes (risks), and factors that will typically foster positive outcomes (resources) (Zautra et al. 2008). Rather than existing at opposite ends of a single continuum, risk and resourcefulness are better understood as separate dimensions of health that are largely (but not exclusively) independent of each other. In other words, the extent of negative life factors must not predict the extent of positive factors. This supports the hypothesis that being predisposed to socioeconomic deprivation does not inevitably lead to negative health outcomes (Zautra et al. 2008).

To summarise, this combined research suggests that the presence of positive and meaningful resources within their broader physical and social environments may allow individuals in socioeconomically disadvantaged areas to assist in overcoming health risk factors inherent in their lives. Social processes and institutions that determine the provision of these resources, including urban planning, may therefore positively influence the capacity for resilience for individuals in socioeconomically disadvantaged areas.

3.1.5 Human Health Resilience and Public Park Planning

At present, there appear to be no examples of an explicit link being made between human health resilience theory and either urban green space or public park planning. The majority of the human health and development resilience research cited in this thesis comes from the fields of psychology, public health and sociology – where environmental protective factors and social interventions would typically include those primarily determined by health professionals, educators and sociologists. Yet, while not discussed in detail, the role of the urban environment typically determined by planners has been acknowledged in passing, including specifically green spaces and parks (Sanders, Lim and Sohn 2008; Zautra et al. 2008).

Conversely, the potential for public parks to represent resources for increasing human health resilience is implicit in recent research on urban green space, if not always clearly stated. One of the most notable early studies linking green space to positive health outcomes was a study by Ulrich (1984), who found that hospital patients with natural views showed greater rates of recovery compared to patients with a view of a brick wall. Urban green spaces are now increasingly recognised for their potential to promote public health (Ward Thompson 2011; Wells and Donofrio 2011). As discussed further in Section 3.3.1, urban green spaces also appear to have a greater effect on health in socioeconomically disadvantaged areas (Groenewegen et al. 2012; Mitchell and Popham 2008).

The particular value of public parks for promoting good health, rather than simply helping with recovery, is summarized by Tzoulas and Greening (2011). Section 3.1.3 outlined two separate paradigms within public health: the pathogenic paradigm, or concern with treatment of disease; and the salutogenic paradigm, concerned more with the factors that promote good health. It was from this latter paradigm that resilience theory emerged. Tzoulas and Greening (2011) present a similar argument when discussing approaches to dealing with the most significant health threats to urban populations in the 21st century, most notably cardiovascular disease and mental illness. Approaches that deal with these issues can be of two kinds: 'downstream' approaches that focus on treating the symptoms of ill-health; or 'upstream' approaches that create the conditions – social, economic and environmental – that help prevent these illnesses and diseases from occurring. As aspects of the physical environment, green spaces can contribute to universal conditions for good human health through services such as the reduction of air pollution and noise, as well as localised air-cooling. However, more important to creating the conditions for human health and well-being are the activities that individuals might undertake because of a nearby green space (Tzoulas and Greening 2011). Thus, it is the outcomes of activities within public parks that are likely to be most important to health resilience.

In this context, well-planned public parks can be understood as health-promoting resources in the physical environment. It would therefore seem logical to apply the same theory across all environmental resources with the potential to facilitate health resilience. Further, given that ecological resilience theory is already widely applied to urban green space planning, reinforcing this already implicit link with human health resilience theory has significant integrative and interdisciplinary value.

3.1.6 Critiques of Resilience Theory

Based on the previous overview, there appears significant potential for integrating these two largely independent fields of resilience research onto the context of urban green space and specifically public park planning. However, it should also be noted that there have been numerous critiques of resilience theory and its relevance across both ecological and social contexts.

While resilience is now widely embraced in the study of social-ecological systems such as cities, its evolution as a concept and its now wide-ranging application opens the possibility of ambiguity and confusion as to its true meaning. As discussed by Brand and Jax (2007), resilience began as a descriptive concept used to understand the state of a system, without necessarily attributing a judgment of value to this state. As ecological theory became increasingly linked to human systems, resilience became more understood as a normative concept, in that it represented the state of a natural system that was desirable for humans. When linked to the concept of ecosystem services, for example (as this thesis does), resilience specifically describes the capacity to maintain desirable ecosystem services despite disturbance (Brand and Jax 2007). However, it can in fact have negative connotations, such as when a resilient system shows resistance from external forces to remain within a negative state (Wallace et al. 2007). Consequently, the now common understanding of resilience as a wholly normative concept is tied to the concepts of flexibility, learning and adaptation (Brand and Jax 2007) – that is, the understanding of resilience as an evolutionary process as discussed by Davoudi et al. (2012).

Another point of confusion may also arise from the different nuances of resilience theory across different contexts. Despite having a similar basing in a non-equilibrium understanding of the world, it has been noted by numerous scholars that ecological resilience theory is not fully transferable to social systems. The relevance of ecological understandings of resilience for the study of social systems was first discussed by Adger (2000). While noting the relevance of resilience as an antonym for vulnerability across both contexts, the author warns against the complete equivalence of the two – this assumes there to be no essential difference between an ecological system and a society whose functioning is dictated to a large extent by often diverse institutional structures (Adger 2000). This argument is expanded upon by Davidson (2010). While noting the relevance of the adaptive cycle for understanding the general nature of breakdown and renewal in societies, the author also notes many of the fundamental assumptions of what makes a resilient ecological system may not necessarily hold true when considering the influence of human agency in social systems. Thus, while causes of change in an ecological system and its transition through the different phases of the adaptive cycle can be considered relatively deterministic, purposeful human action (particularly when agency and power is distributed disproportionally) may be able to intervene in the cycle and either postpone or accelerate change and transformation (Davidson 2010). This is also noted by Davoudi et al. (2012), who suggest that progress of a society through the adaptive cycles should be considered a *tendency* rather than an inevitability.

A further critique of resilience theory, and specifically the application of resilience theory in the study of social systems, is that it creates political connotations surrounding the respective roles of the individual and their environment. As identified earlier, human health resilience has been argued to place extra responsibility on decision-making institutions to protect the most vulnerable individuals in a community (Ungar 2011a). The importance of a positive environment to the resilience of an individual is fundamental to Masten's (2001) idea of 'ordinary magic': humans have inherent capacity for resilience, but this is reliant on conditions being conducive to realising this capacity. Yet resilience in a more ecological context can also imply a shifting of responsibility to the individual, or civic society as a whole, as elaborated on by Davoudi et al. (2012). They suggest that, when applied to a society, the idea of self-organisation in ecological systems becomes synonymous with the neoliberal ideology of self-reliance. However, it is argued that the use of resilience as justification for the rollback of the state is misguided, as the inherent adaptive and transformative capacity of engaged civil social networks cannot fully ameliorate the need for effective governance. Framing resilience as a desirable quality in social systems will therefore always represent challenges in regards to justice and fairness, underlined by the reality that increased resilience for one party may lead to a loss of resilience for others (Davoudi et al. 2012). Indeed, as will be elaborated on in Section 3.3.1, embracing human health resilience implies a greater focus on achieving outcomes for low socio-economic communities and individuals that, when applied to public park planning, can potentially undermine the parks fundamental role as a democratic public space.

3.1.7 Resilience Theory as an Integrative Public Park Planning Framework

While the applicability of a concept as complex as resilience across both ecological and social contexts is still contested, there is considerable theoretical significance for continuing to integrate resilience theory in its various contexts. Specifically, and most relevant for this thesis, is support for further integration between the parallel yet largely independent theories from urban ecology and human health.

As well as its relevance to public park planning and the context of this research, such an integration would also be in line with recent calls for and attempts of integration between resilience theory in ecological and human health and development research (Lundholm and Plummer 2010; Masten and Obradovic 2008; Tidball 2012). It would also reflect broader calls for the need to further integrate theory from the social sciences into urban ecological research (Breuste, Niemela and Snep 2008; Wu 2008). Further, the need to combine concepts from both ecological and social science research within the specific context of urban green space planning is becoming increasingly acknowledged. The work by James et al. (2009) – encompassing professionals from the disciplines of psychology, sociology, planning, ecology and health – represents one notable attempt to develop such an integrated urban green space research agenda.

This thesis continues these calls for integration, proposing resilience theory as a *transdisciplinary* framework for public park planning. Summarising the findings of Lattuca (2001), Musacchio et al. (2005) suggest several qualities of transdisciplinary approaches. Firstly, they should identify similarities in structure and relationships within different natural and social systems. Further, rather than borrowing different theories and concepts from a discipline, they should present a unique conceptual framework, often based on a scientific paradigm, which allows it to transcend and remain relevant to different fields of research (Musacchio et al. 2005).

Resilience theory meets each of these criteria. As summarised by Masten and Obradovic (2008), resilience theory exists in both ecological and human health and developmental research, with each sharing conceptual underpinnings. Both theories embrace probabilistic rather than deterministic approaches within their broader fields of research, where the dynamic nature of living systems makes the future largely uncertain. Both also emphasise the need for flexibility and adaptive capacity in order for the system to remain viable in the face of uncertainty and change. These similarities arise from the grounding of both theories within general systems theory, and a common shift out of a traditional paradigm of stability and equilibrium (Masten and Obradovic 2008).

This thesis proposes that urban green space planning, and specifically public parks, may be one context for the integration of these theories. Pickett, Cadenasso and Grove (2004) have already demonstrated the integrative value of resilience in an ecological context. Many of the key concepts of ecological resilience theory complement those of urban planning and the related discipline of landscape ecology. In this way, it has been crucial to the integration of ecological concepts into urban planning (Pickett, Cadenasso and Grove 2004). This integrative potential is especially relevant to the context of public park planning. Human resilience theory extends across the disciplines of public health, psychology and sociology (Herrman et al. 2011). Given its established relevance to ecology and urban planning, it has the potential to provide guidance for each of the disciplines outlined by James et al. (2009): psychology, sociology, planning, ecology and health. As summarised in Figure 7, it is proposed that ecological resilience theory can guide public park planning in its role in conserving key environmental functions in the face of threats to ecological functioning in urban areas. Further, resilience theory in human health research can guide the simultaneous provision of recreational opportunities in these natural environments, as well as opportunities for recreation in social environments. Engaging in either form of recreation can potentially protect residents from health risk factors inherent in socioeconomically disadvantaged areas.

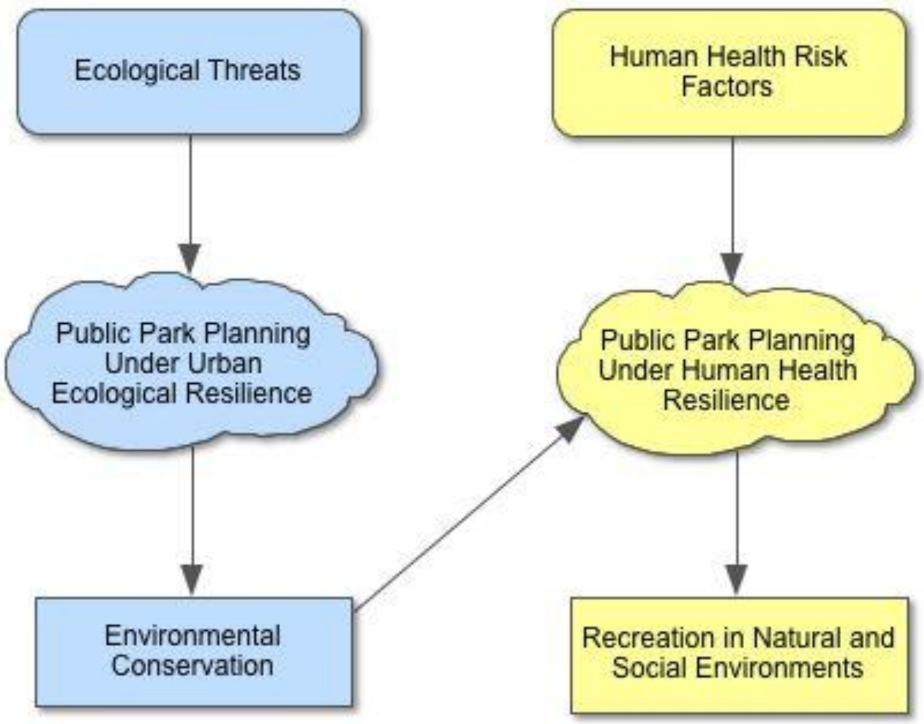


Figure 7: Flow chart introducing the basic theoretical framework for this thesis.

By substituting in the concept of ecosystem services to represent the core functions of contemporary public parks, as discussed in Section 2.4, the flow chart can be updated as shown in Figure 8:

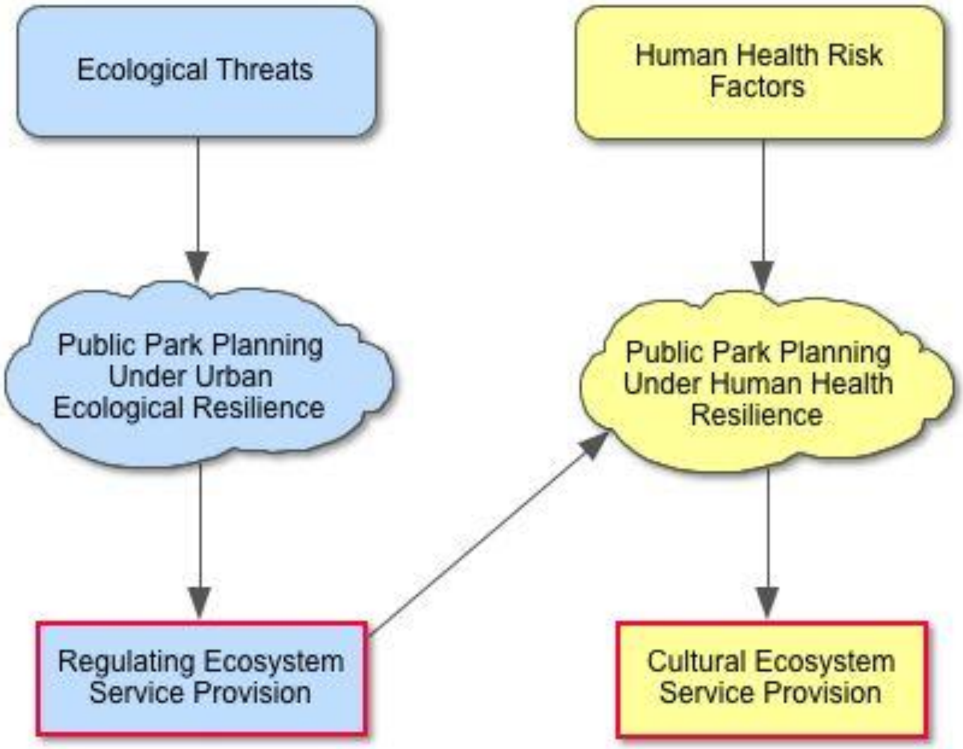


Figure 8: Updated theoretical framework flow chart of this thesis with regulating and cultural ecosystem services substituted for the core functions of public parks; updates in red.

With this basic framework established, the following sections go into more detail into the insights provided by both urban ecological and human health resilience theories for facilitating ecosystem services through public parks.

3.2 Public Park Planning, Urban Ecological Resilience and Ecosystem Services

This section identifies the two key regulating ecosystem services that public parks in Perth can provide, before discussing the insights and limitations of urban ecological resilience theory for planning public parks to provide both these regulating and cultural ecosystem services in suburban areas.

3.2.1 Urban Ecological Resilience and Regulating Ecosystem Services

One of the key concepts of resilience theory in linked social-ecological systems, as discussed by Walker and Salt (2006), is the concept of ecological *regimes*. Regimes describe a particular stable state that a system might occupy, defined by distinct structure and function. Social-ecological systems remain within a regime as a ball might remain within a basin: while changes may cause the ball to move up the basin, it will inevitably roll back to the lowest point – its equilibrium state – once normal conditions return. However, if the system is disturbed to the extent that it crosses over its *threshold*, represented by the highest point of this basin of attraction, then it will shift into a new regime with a different structure and function. The resilience of a system is then essentially its ability to absorb disturbance and change and still remain within its current regime (Walker and Salt 2006). In Figure 9, resilience of a system is represented by the distance from its threshold (top of the basin) to its equilibrium state (bottom of the basin).

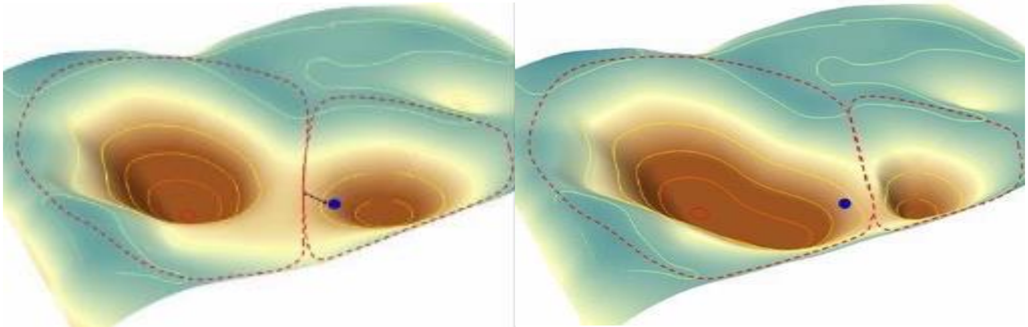


Figure 9: Visual illustration of the 'ball-in-a-basin' metaphor of resilience. The ball shifting from one basin of attraction to another represents the transition of a system from one regime to another (http://www.resalliance.org/index.php/key_concepts)

The importance of ecological systems remaining within favourable regimes becomes more relevant in urban areas, where the resilience of a system is directly related to its provision of ecosystem services. As discussed by Ernstson et al. (2010), healthy ecosystems provide a range of services that can both directly and indirectly improve the health and well-being of urban communities. These services emerge from interlinked ecological processes occurring at a range of different scales across the system, and are therefore unique to a specific regime. If the ecological system were disrupted to an extent that it changes regimes, the set of ecosystem services provided by that regime would also be affected or lost. Within urban areas, these ecological processes become highly entangled within and modified by social-political processes. Thus, while the complexity of these ecological processes means humans can't directly control the production of ecosystem services, urban societies can still govern in a way that either sustains or improves a desirable regime, or helps transition the system into a more desirable regime (Ernstson et al. 2010).

As explained by Walker and Salt (2006), one concept central to the resilience of an ecosystem is its *biodiversity*, or range and number of flora and fauna species. Biodiversity ensures both functional and response diversity within a system. Functional diversity, or redundancy, ensures key ecological processes can be performed by several different species if any of these species were to be lost through a sudden disruptive event. Response diversity refers to the range of different types of responses for a single function that are possible from species within a system during times of disturbance. Thus, while functional redundancy ensures that a function can still be carried out under stress, response diversity is the number of different ways that this function can be carried out. Both factors are crucial to the ability of the system to continue to provide its core set of services during times of high disturbance (Walker and Salt 2006).

Niemela et al. (2010) also discuss the relationship between biodiversity and ecosystem services in urban areas. Many key cultural ecosystem services are dependent on different aspects of urban biodiversity, including species density, interactions and mobility. Biodiversity can therefore be understood as a *regulating* ecosystem service, as it ensures the regulation of processes from which cultural ecosystem services may arise (Niemelä et al. 2010). Biodiversity conservation is a particular concern in Perth, which lies within one of the world largest and most significant biodiversity hotspots (Western Australian Planning Commission 2000). As discussed in the background chapter, the retention of biodiversity in public parks has been increased, firstly through the inclusion of standards for natural areas in Liveable Neighbourhoods, the inclusion of the park classification of 'nature space' (Department of Sport and Recreation 2012), and also through the recent release of a local biodiversity policy statement from the Environmental Protection Authority (2013).

A further regulating ecosystem service with particular relevance to public park planning in Perth relates to the conservation and management of urban water resources. Ahern (2010) provides an overview of the importance of water resources in urban sustainability and resilience. Water is essential for all life and a primary integrating resource, however its quality and management is threatened by urban development. The conservation of these resources is thus one of the greatest challenges for urban planning and design, and can be understood as 'the tail that wags the dog' in terms of urban resilience (Ahern 2010). Bolund and Hunhammar (1999) nominate rainwater drainage as one of the key ecosystem services in urban areas; vegetated areas such as parks break up the predominantly impervious built surfaces, allowing water to seep through to groundwater reserves. This is supported by Yang, Zhang and Li (2015), who suggest that water-related ecosystem services provided by urban green spaces include efficient reduction of stormwater runoff but also removal of the pollutants within this runoff. These regulating and purification functions can also be considered 'regulating' ecosystem services (Yang et al. 2015). The relationship between these services and recreational outcomes can be understood when considering stormwater runoff directly into wetland with significant recreational value. Unfiltered runoff with high levels of nutrients may cause this ecosystem to shift to a new regime, particularly with already low levels of biodiversity.

As explained by Grose and Hedgcock (2006), public parks and open spaces in Perth have an increasingly important role in the regulation of stormwater runoff. The Perth metropolitan area sits on the highly pervious Swan Coastal Plain, with a groundwater system that typically sits close to the surface. Much of Perth, including initial settlement over the Great Lakes system extending out to low-lying newer developments, have been developed over significant wetlands. Effective stormwater drainage systems that facilitate speedy removal of runoff are required both to prevent localised flooding, but also to prevent contamination of these remaining ecologically sensitive wetlands. Drainage 'sumps' are able to fulfil each of these functions: providing a temporary basin for directing runoff that allows for filtration before it re-enters the groundwater system. Yet the typical form of these sumps, often fenced and hidden out of view, fail to utilise the social and aesthetic potential of water in such a dry climate. This has seen a range of new stormwater management practices (Water Sensitive Urban Design) that increasingly integrate effective drainage practice into public park landscapes (Grose and Hedgcock 2006). Two of these practices in particular are considered in this thesis: permanently wet drainage basins that serve both an aesthetic and habitat function, as well as seasonally wet drainage basins that can potentially be utilised for recreation when dry.

To summarize, the effective conservation and management of both biodiversity and urban water resources are therefore vital to the ability of urban ecosystems, including single urban green spaces, to remain in desirable regimes and thus continue to produce their full range of services to communities. While these are not the only regulating services that urban green spaces can provide – for example climate regulation, improved air quality (Pataki et al. 2011) – they have direct relevance to the current environmental planning trends in Perth identified in the background chapter. The updated flow chart in Figure 10 below highlights these findings.

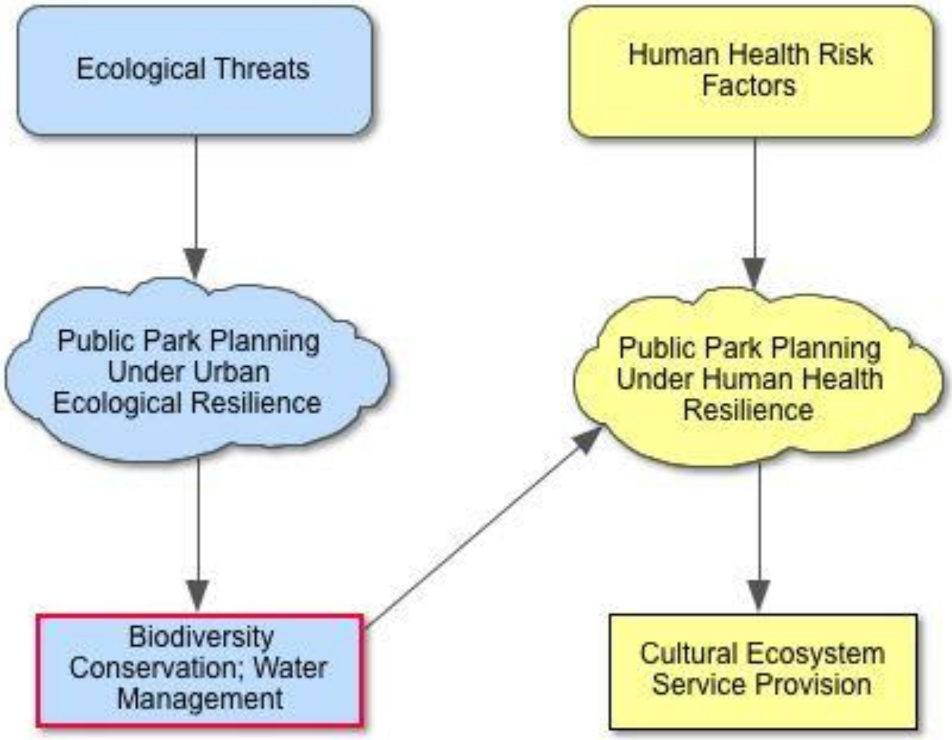


Figure 10: Updated theoretical framework flow chart with specific regulating ecosystem services facilitated by public parks; updates in red

3.2.2 Planning Public Parks to Facilitate Regulating Ecosystem Services

This section outlines three broad strategies through which public park planning can facilitate these two regulating ecosystem services: by contributing to broader spatial habitat connectivity and complementation, as sites for adaptive management, and as multi-functional landscapes that facilitate a range of ecological and social services.

Understanding the spatial patterns of urban green spaces that are conducive to maintaining biodiversity and water quality is one pathway to increase their resilience. 'Fluxes' within and between urban landscapes – such as species movement between distinct habitat patches for obtaining resources or plant seed dispersal and pollination – are crucial to maintaining biodiversity (Pickett and Cadenasso 1995). This makes the fragmentation inherent in highly-developed urban areas a significant threat to biodiversity: large yet isolated urban green spaces have been found to lose significant proportion of their biological diversity over time (Elmqvist et al. 2004). Connectivity is also essential for the health of urban hydrological systems and their ability to provide multiple ecosystem services (Ahern 2010). Spatially planning green spaces for ecological resilience is therefore more than simply identifying and conserving significant ecological areas, but also depends on the degree of connectivity between them.

While complete connectivity within highly developed urban areas is virtually impossible, the orientation and location of urban green spaces can still be achieved in ways that better support ecological function. The concept of Ecological Landscape Complementation (ELC), coined by Colding (2007), is one example. ELC provides a framework for building resilience through spatial planning and design, and is based on the simple principle that green spaces in highly developed urban areas are best utilized for their role in promoting biodiversity when orientated to complement each other, rather than in isolation. It especially deals with the configuration of those spaces that are provided primarily for purposes other than biodiversity conservation, including publicly accessible parks. It thus provides a framework for planning varied and heterogeneous green spaces towards the overarching aim of biodiversity conservation (Colding 2007). Spatial landscape planning theories such as ELC provide the practical foundations for planning different types of urban green spaces not as single spaces, but as complementary if not wholly connected networks. Such networks should consist of both regional and local components: large and contiguous green spaces, supported by smaller green areas that simultaneously connect these larger areas whilst providing emergent cultural ecosystem services to residents at the local level (Niemelä et al. 2010). Resilience theory therefore reinforces the need for public parks to be planned together as spatially coherent green infrastructure systems.

As well as the need for effective spatial configurations of urban landscapes, resilience theory also emphasizes the importance of understanding the way that these landscapes change over time, and the role of humans in influencing and adapting to this change. It is now understood that planning for sustainability and resilience is not a static process that once achieved can be expected to persist for generations. Instead, it is a dynamic process that requires the capacity for continuous adaptation to both social and ecological changes (Holling and Gunderson 2002; Walker et al. 2004). As summarised by Walker et al. (2004), human systems are an integral part of this adaptive capacity in urban areas. Natural systems in isolation have the innate capacity to self-organize and adapt to external changes, possible through high functional and response diversity. In linked social-ecological systems such as cities, however, this capacity is strongly influenced by the actions and intents of humans, and is therefore fundamentally a social responsibility. Adaptive capacity can therefore be defined as the combined ability of individuals and groups to manage the system for resilience, or to keep it within a desirable regime, despite significant changes (Walker et al. 2004).

Thus, there is also the need to understand the various social factors that interact with urban green spaces to determine the dynamics behind the production of ecosystem services. This includes the different management practices that allow certain green spaces to hold higher levels of biodiversity, and hence maintain their own adaptive capacity and resilience, than others (Ernstson, Sorlin and Elmqvist 2008). Colding (2007) uses the term 'adaptive co-management' to describe the experimentation of different user groups with different management techniques to determine their effectiveness in different ecological situations. In this context, public parks are well-suited as sites where biodiverse habitats, including water landscapes, can not only be conserved but made accessible to the public so that the effectiveness of different management groups and practices can be experimented over time.

From this brief overview, it is clear that ecological areas in public parks must serve a range of functions simultaneously: conserving ecological areas and the functions they carry-out, whilst also permitting human access for their ongoing management. Further, fundamental to acting as public landscapes is to be accessed for recreation by a range of social groups. Thus, a final key property of park landscapes that can effectively provide both regulating and cultural ecosystem services is *multi-functionality*. Multi-functionality has been identified by Ahern (2010, 2011) as one of the central strategies for building resilience in urban areas. It is an inherently spatially efficient planning and design strategy, which seeks to find new ways to provide ecosystem services in increasingly constrained urban spaces. Typical strategies for multi-functionality include intertwining, combining, stacking or time shifting different functions in the same spatial area (Ahern 2010, 2011).

These insights are summarised in the updated flow chart in Figure 11 below. Extensive urban development is identified as a significant risk to ecological function, which causes habitat loss and fragmentation as well as increasing impervious surfaces. However, through complementary spatial planning, along with ongoing adaptive management, conservation of biodiversity and management of urban water resources can still be supported. These ecological processes are central to providing urban residents with cultural ecosystem services, as long as they are also made available for human recreation.

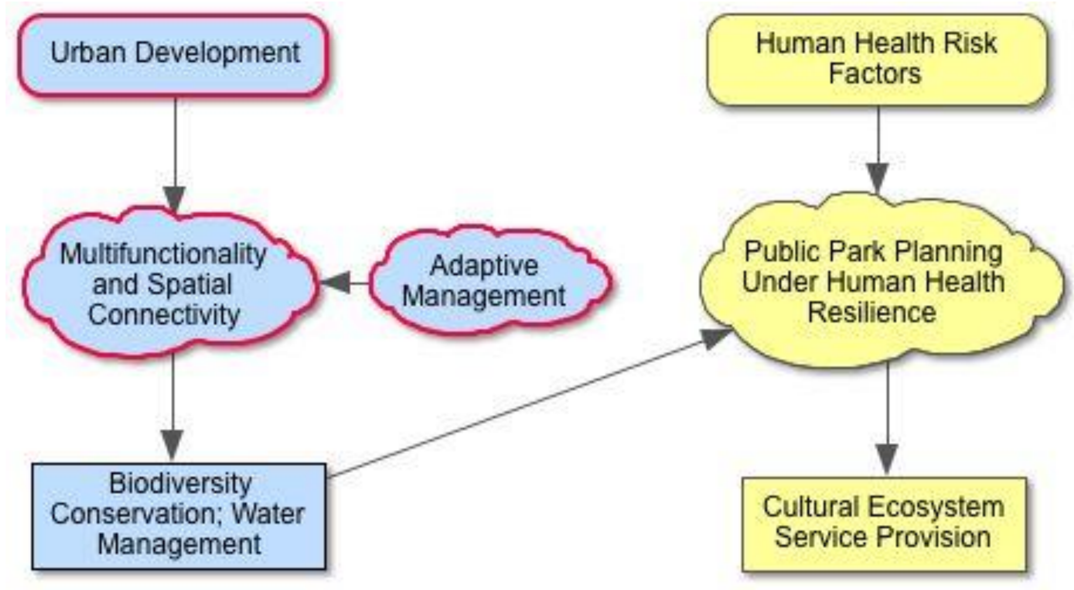


Figure 11: Updated theoretical framework flow chart with insights from urban ecological resilience theory; updates in red

3.2.3 Public Parks, Urban Ecological Resilience and Cultural Ecosystem Services

This brief review highlights key public park planning practices under urban ecological resilience theory. Parks should represent multi-functional, connected and complementary spatial configurations of ecological landscapes, which are accessible as sites for the ongoing adaptive management by diverse social networks. Such practices are essential for ensuring that regulating services such as the conservation of biodiversity and regulation of urban water resources can continue to be provided despite significant urban development. At the same time, individual local parks should also act as sites for the cultural services that might emerge from ecological areas to be accessed by local residents. It is from this final function that the main limitation of ecological theory for the purposes of this thesis emerges.

Providing accessible ecological areas is complicated when considering the inherent variation in the way nature provides its benefits to humans. As introduced in Section 2.1.4, biophilia is described as a *bio-cultural* phenomenon, as it is the product of both genetics and cultural factors (Kellert 2008). While the genetic tendency to affiliate positively to natural environments is innate in humans, this tendency lies dormant until actively developed. Thus, the degree to which different individuals will express these tendencies depends on the degree to which they are both affirmed or denied:

both by the individual themselves, as well as how they are developed externally through learning, experience and socio-cultural support (Kellert 2008).

This is supported by research suggesting that a visit to a green space can be a highly subjective experience, with outcomes tied into the unique social and cultural background of the individual. For example, Douglas and Ravetz (2011) discuss the challenges in planning urban ecosystems to address social and cultural issues. People react very differently to natural landscapes: wild vegetation may be perceived as exciting and challenging for many, while for others these areas can evoke fear. They also note how use of these landscapes can change with the age of the user. While natural environments serve a more practical role for younger groups, including a first experience of nature for children and more advanced play and adventure for teenagers, for adults and the elderly it is more likely to serve as a backdrop to more leisurely dog and social walking (Douglas and Ravetz 2011).

Further research suggests that the relationship between biodiversity and cultural ecosystem services is not straightforward. For many people, a highly biodiverse space may represent a desirable recreational venue. It has been suggested that there is a close relationship emerging between biodiversity and human health and well-being (Bird 2007; Carrus et al. 2015), and specifically between biodiversity and psychological benefits (Fuller et al. 2007). Yet conversely, the biodiversity of a space can be negatively related to its recreational potential for some users. Several studies have found that many green space users prefer more maintained and ordered landscapes rather than more wild and remnant landscapes that are likely to have higher biodiversity values (Kaplan 2007; Qiu, Lindberg and Nielsen 2013; Tzoulas and James 2010).

This variation in preferences for biodiverse landscapes reflects the broader findings of green space literature. James et al. (2009) explain that different individuals and cultures have different relationships with nature. As a result, green spaces will play a vastly different social role across different individuals and cultural groups. This makes negotiating the ecological dimensions of urban green spaces with their use by communities a complex planning challenge; planning green spaces so that they provide contact with nature within urban populations, whilst still meeting ecological criteria such as biodiversity targets, is one of the most important areas of green space research (James et al. 2009). Further, Niemelä (2014) also identifies the planning and management of urban green spaces for the benefit of both communities and biodiversity to be one of the central challenges in urban ecological research.

3.3 Public Park Planning, Human Health Resilience and Ecosystem Services

Section 3.2 concluded that planning public parks based on insights from urban ecological resilience theory is not in itself enough to ensure the provision of cultural ecosystem services to communities. This suggests an additional step is required to link ecological park planning practice to tangible human benefits – in other words: how planning for *regulating* ecosystem service provision can best facilitate *cultural* ecosystem services. From a theoretical perspective, the previous section also highlighted a need to look beyond ecological perspective on urban green space planning, to theories that deal specifically with the complex relationships between humans and green space in urban areas. This section discusses in more detail the relevance of human health resilience theory to this end, and the insights it can provide for planning public parks to facilitate cultural ecosystem services.

3.3.1 Public Park Planning in Socioeconomically Disadvantaged Areas

Understanding public parks as resilience resources can provide insight into how they can best be planned to facilitate cultural ecosystem services and positive health outcomes. The first of these is to focus on the benefits of parks specifically within socioeconomically disadvantaged areas, and to target the most vulnerable individuals in those communities.

That resilience is a concept most relevant for populations facing adversity (Ungar 2012) suggests that resources planned to promote resilience should target these populations. Indeed, the findings of several key public health studies support the value that urban green spaces such as parks provide specifically to urban communities under most adversity. A series of British studies have noted the salutogenic, health-promoting potential of green spaces to mitigate symptoms of low socioeconomic positions that might typically lead to poorer health: hence reducing the inherent health disparities within these neighbourhoods (Mitchell, Astell-Burt and Richardson 2011; Mitchell and

Popham 2008). This is similar to the findings of a comprehensive mixed-methods Dutch research program titled 'Vitamin G' (G is for green). Across numerous studies, it was found that the positive relationship between green space and health was consistently stronger for at-risk individuals: including those of low socioeconomic status, younger age groups, and the elderly (Groenewegen et al. 2006; Groenewegen et al. 2012).

The value of public parks in socioeconomically disadvantaged areas is further supported by research specifically into each of the four cultural ecosystem services investigated in this thesis. The following sections discuss how each cultural ecosystem service can be understood as a different example of how a visit to a park can result in positive health outcomes for individuals in the face of different health risks. Further, it also identifies how such visits can also contribute to the support of regulating ecosystem services in the long term.

3.3.1.1 Public Parks and Mental Restoration

The positive benefits of contact with nature and green space on human health has been widely researched and reviewed (Bowler et al. 2010; Lachowycz and Jones 2013; Lee and Maheswaran 2010; Wells and Donofrio 2011). A constant theme throughout this research is the significant benefits that can be gained from these resources for *mental* health. This is pertinent given the current focus on mental health in population health agendas. For example, the World Health Organisation emphasises the fundamental role of mental health in overall human health outcomes and health-promoting agendas, and has declared that 'there is no health without mental health' (World Health Organisation Europe 2005).

The relationship between green space and mental health is particularly relevant in cities. As discussed by Eisenman (2013), the negative mental implications of cities were one of the central beliefs underlying the creation of Olmstead's famous parks. He suggested, for example, that the artificial sights of built urban environments induced negative internal emotions such as tension and anxiety, and that the restrained and confined nature of city streets encouraged negative emotions towards others. More recent evidence supports these hypotheses, with urban dwellers found to be at greater risk of anxiety, mood disorders and schizophrenia then rural residents (Eisenman 2013).

Olmstead's belief in mental-health promoting potential of green space is supported by recent research. It is suggested that green spaces have unique 'restorative quality' that allows them to both improve psychological functioning and behavioral choices, whilst improving physiological indicators of stress that buffer the negative physical health outcomes of its prolonged presence (Bird 2007; Eisenman 2013; Van den Berg, Maas, et al. 2010; Ward Thompson 2011). This ability of nature to restore crucial indicators of mental health has been described as a 'psychological ecosystem service', as it encapsulates the ways in which natural environments might positively influence the human mind (Bratman, Hamilton and Daily 2012). While not strictly 'mental' in the many aspects of the human experience that it encapsulates, adopting the term 'mental restoration' does reflect the strong role that these services play in the mental health of urban residents. It also differentiates it from the process of *ecological* restoration, which refers to the actions of humans to restore and enhance ecological functions.

Two separate mechanisms have been proposed to explain mental restoration in natural landscapes: Stress Recovery Theory (SRT) and Attention Restoration Theory (ART). As discussed by Hartig (2007), these two mechanisms for restoration are largely complimentary with each other, but should also be understood as discrete in the aspect of the human experience they relate to. SRT, also described as a psychoevolutionary theory, refers to a 'hard-wired' biological response in physiological and emotional activity to certain environments that reduce levels of stress. ART deals with the ability of an environment to allow psychological recovery from the attentional fatigue that can result from difficult and tedious mental tasks. The two theories are to an extent related: attention fatigue may be an after-effect of stress, or alternatively attention fatigue may make someone more susceptible to stress. However, they should not be considered fully equivalent; elevated arousal and negative emotions that signify stress can occur independently from attention fatigue, and vice versa (Hartig 2007).

Stress Restoration and Resilience

SRT is an emotional and physiological hypothesis that deals with the restorative effects of natural environments on high levels of stress (Ulrich et al. 1991). Stress is defined here as the psychological, physiological and behavioural processes an individual exhibits in response to situations that threaten or challenge their well-being. For example, psychological responses might include emotions of fear and anger; physiological responses might include increased activity in cardiovascular, skeletomuscular and neuroendocrine systems; behavioural responses might include avoidance and substance abuse (Ulrich et al. 1991). Thus, as well as relating to mental health, the relevance of SRT can also be extended to physical health outcomes.

Important to this theory is that stress only becomes a negative factor to human health over a prolonged period of time. As discussed by Grahn and Stigsdotter (2010), stress responses are not inherently negative, but rather represent natural survival reactions to a dangerous situation (i.e. *fight or flight*). From an evolutionary perspective, stress is therefore a positive adaptive response. In urban settings, however, we rarely need these responses, and are thus left with the continuation of these reactions that we experience as stress. Prolonged exposure to stress is related to physical symptoms including damage to the cardiovascular and neuro-hormonal systems, as well as mental health symptoms including schizophrenia, anxiety and depression (Grahn and Stigsdotter 2010). In fact, such is the risk to human health of prolonged exposure to stress, the World Health Organisation has identified stress as one of the major causes of death in the developed world (World Health Organization 2009).

Given the health risk that stress represents, any intervention that actively reduces stress levels would represent a valuable health-promoting resource. Stress responses can be counteracted through positive changes to psychological states, physiological activity and behaviour. Ulrich et al. (1991) use both ‘recovery’ and ‘restoration’ interchangeably to collectively describe these processes. Natural environments may have unique potential to perform this restorative function. In line with the Biophilia Hypothesis, they suggest such responses reflect the positive role that non-threatening and safe natural environments such as open vegetated and water landscapes have played in our species evolution. In the modern world, contact with these landscapes still evokes a favourable reaction, and essentially give us unconscious signals of security that allow for relaxation (Ulrich et al. 1991). It should be noted that, whilst providing a convenient explanation, the assumption that SRT is the result of an adaptive trait developed through evolution in natural environment has recently been questioned (Joye and van den Berg 2011).

SRT theory is supported by the apparent tendency of many people to seek out natural environments in times of acute stress. The ability to experience nature can represent a valuable coping resource during times of significant personal crisis (Ottosson and Grahn 2008). In America for example, National Parks received a significant increase in use following the September 11 terrorist attacks in 2001 (Van den Berg, Maas, et al.

2010). Further, parks also became significantly more popular during the height of the decline in the national and global economy (Beatley 2011). Intimate green spaces such as gardens in particular are now recognised as valuable resources for individual to recover from high levels of stress (Adevi and Mårtensson 2013; Tenngart Ivarsson and Hagerhall 2008).

The potential health-promoting role of green space in relation to stress is summarised by Van den Berg et al. (2010). The authors suggest that the natural environment acts as a 'buffer' that moderates the relationship between stressful events and subsequent health outcomes. In other words, access to green space represents an intervention that prevents the occurrence of stress manifesting in poor mental and physical health (Van den Berg, Maas, et al. 2010). In this scenario, the availability of green space is independent to the presence of the potential health risk. The presence of a nearby park does not prevent the event that might cause stress in the first place, but it can act as a resource that alleviates the stress before it results in negative health outcomes. This suggests that the stress-restoring properties of green spaces may be of most value to human health when they are experienced before the onset of poor health, or as an 'upstream' health resource.

Attention Restoration and Resilience

That many humans have an innate tendency to seek out nature during times of crisis, as suggested in the previous section, is supported by recent developments of the Biophilia Hypothesis. Tidball (2012) argues that the biological attraction between humans and nature is heightened during times of both acute and chronic stress and adversity. He describes this tendency to actively seek out contact with nature as a coping mechanism during such times as 'urgent biophilia' (Tidball 2012). While recovery from stress could be seen as one manifestation of this theory, the author also notes the direct link established between the Biophilia Hypothesis and Attention Restorative Theory (ART).

ART is based on the proposition that humans have two separate forms of attention: *directed attention*; and *involuntary attention*, or fascination (Kaplan 1995). Directed attention is called upon during much of our daily lives, helping us process and negotiate mentally challenging tasks, or several tasks at once. These tasks are not generally pleasant, often taking great effort and concentration. Involuntary attention, in contrast, is effortless and pleasurable. When engaged, it also allows for directed attention to recharge. Sustained engagement of directed attention can result in *directed attention fatigue* (DAF), which has a range of negative implications for the individual and society as a whole. Fatigued individuals are less able to solve simple problems and carry out unpleasant but necessary tasks, and more likely to exhibit irrational and short-term behaviors. This can lead to a lack of personal effectiveness and competency, and hence devastating social consequences if the individual is in a position of significant responsibility (e.g. airline pilots, ship captains) (Kaplan 1995).

Aside from these social consequences, sustained use of direct attention and the onset of DAF can have serious detrimental effects on an individual's capacity to maintain their own health and well-being (i.e. resilience) in the face of stressful life events. The importance of normal cognitive function in Antonovsky's salutogenic model of human health, introduced in Section 3.1.3, is encapsulated through the concept of Sense of Coherence (SOC) (Lindstrom and Eriksson 2006). SOC refers to the capacity to continue to perceive and negotiate the different stressors in one's life regardless of the complexity of their current situation. It has three key components: the cognitive component of comprehensibility; the behavioural component of manageability; and the motivational component of meaningfulness (Lindstrom and Eriksson 2006).

As summarised by Bird (2007), the concept of SOC is reflected in current understandings of mental health. While mental health has many different definitions, the growing consensus is that it should involve more than simply the absence of disease or disorders. Mental health is thus increasingly related to concepts such as well-being, quality of life and autonomy; it entails the ability to make sense of ones surroundings, feel in control, to cope with everyday demands and to maintain an overall sense of purpose in life, among other things (Bird 2007).

The premise of ART is that DAF can be avoided by exposure to restorative environments that specifically engage involuntary attention. Drawing on the similar suggestions made by Olmstead decades earlier, the Kaplan's suggest natural environments have unique potential to meet and maintain each of these criteria for psychological restoration (Kaplan and Kaplan 1989). This frames public green spaces such as parks as significant mental health-promoting resources, allowing an individual to rebuild their capacity to meet the demands of everyday life.

3.3.1.2 Public Parks and Social Interactions

As well as their restorative abilities, the social role of public parks is another pathway through which they can act as resilience resources in socioeconomically disadvantaged areas. One of the primary functions of parks since they were first created has been as a social space, providing benefits not just at the individual level but also for communities as a whole. Ward Thompson (2002) discusses the fundamental social role of parks and open spaces. Public parks, particularly in America, were originally conceived as democratic spaces. They were one of the few places in the urban environment where strangers could interact regardless of often-discriminatory qualities such as background, financial status and ethnicity – allowing democracy to be literally worked out on the ground. This role remains strong in the 21st century, where parks must negotiate a range of different uses across diverse social and cultural groups (Ward Thompson 2002). For example, urban green spaces have been found to be valuable resources for facilitating social inclusion in youth from different cultures (Seeland, Dubendorfer and Hansmann 2009), for facilitating social cohesion in ethnically diverse areas (Peters, Elands and Buijs 2010), and for creating social ties in inner city areas (Kazmierczak 2013; Kuo et al. 1998).

Berkman et al. (2000) summarise the relationship between social relationships and health. They propose four pathways through which an individual's social network can influence their health status: social support; social influence; social engagement and attachment; and access to resources and materials. These pathways can act relatively directly on human health in ways comparable to restoration – including physiological stress recovery as well as improving psychological states such as self-esteem and self-efficacy – but also provide benefits further 'downstream' after the initial interaction has take place (Berkman et al. 2000). In line with this discussion, social interactions in parks may increase health resilience both directly as sources of positive social support, and also indirectly through the creation of social ties that can be called upon in times of adversity. This evidence indicates that contact with nature is not essential to the health-promoting potential of public parks, and that providing positive social environments might also facilitate similar benefits.

Bridging Social Interactions and Resilience

The ability of parks to facilitate social interactions appears crucial to their relationship with health outcomes. Maas et al. (2009) discuss the potential health benefits of social interactions in public parks, which they refer to as social 'contacts' to encapsulate the different health-enhancing aspects of social relationships. They found that a lack of green space was related to loneliness and lack of social support, suggesting that providing sources of social support may be a particularly important function of public parks (Maas et al. 2009). Further, in reviewing the evidence surrounding 'nearby nature' and human health, de Vries (2010) suggests that social contacts along with stress and attention restoration are likely to be particularly significant.

While not unique in their ability to facilitate social interactions, it is the nature of the interactions made within urban green spaces that appear important to their health-promoting potential. As Cattell et al. (2008) explained, social interactions can be of two kinds: *bonding* between individuals within the same social or cultural group, or through weaker *bridging* connections between individuals from dissimilar groups. While generally beneficial, a prevalence of bonding ties can actually result in the reinforcement of negative behaviours and emergent negative health outcomes. Instead, social networks comprised of a broad range of ties are more likely to lead to positive health outcomes (Cattell et al. 2008).

This is encapsulated by the concept of *homophily* proposed by McPherson, Smith-Lovin and Cook (2001). Homophily describes the natural inclination of humans to associate with others from similar backgrounds. It is argued that this tendency has the potential to significantly limit an individual's worldview and the subsequent attitudes they develop, and can contribute to creating entrenched social divides (McPherson, Smith-Lovin and Cook 2001).

In this light, the true value of public parks as a social space can be seen as their potential to create new social relations rather than simply strengthen existing ones. De Vries (2010) suggests that while other urban spaces typically reinforce existing bonding relationships between individuals within similar social groups, parks and green spaces are more likely to facilitate 'superficial' ties that can lead to the creation of new relationships between individuals from different social groups. Processes occurring within parks as simple as listening and observing with others can be enough for the establishment of social recognition and initial interaction, which can then lead the development of stronger ties at a later stage (Cattell et al. 2008). Thus, simply by providing for more low-intensity contacts – as 'a medium for the unpredictable, the spontaneous, the unplanned…' – these spaces provide the context by which more intense and complex social relationships can grow (Gehl 2011, 19).

Social Capital and Resilience

As identified previously by Berkman et al. (2000), the health benefits of social networks are not always direct, and may in fact lead to benefits at a later stage such as through the provision of resources and materials. Thus, while these social interactions can have immediate health benefits, the social networks that result from repeated interactions in parks could also increase an individual's capacity for resilience during future occasions of adversity.

Hartig (2007) provides a useful term to describe these delayed benefits when discussing the unique role of the natural environment in an individual's sense of coherence and mental health. The resources an individual uses to meet the everyday demands of life can be easily depleted, requiring adequate possibilities for restoration of these resources in order for the inevitability of new future demands to be met and health problems to be averted. However, Hartig also identifies the natural environment as capable of providing benefits that deepen and strengthen an individual's overall capacity for resilience. This process is referred to as *instoration* (Hartig 2007). Thus, rather than simply restoring attention and the indicators of mental health to normal levels, which more accurately describe the processes of SRT and ART, regular visits to green spaces can *proactively* build-up an individual's capacity for resilience to mental health risks. Hartig further nominates social resources such as the help of family, friends and co-workers as part of the restoration process (Hartig 2007). Indeed, based on the discussion of Berkman et al. (2000), the social ecosystem services of urban green spaces may be one of the most significant contributors to an individual's resilience, and an example of the instorative resources that proactively build the capacity for resilience.

Ungar (2011a) discusses the relationship between social resources and resilience in vulnerable individuals. Indicators of resilience such as recovery, sustainability and growth are highly dependent on the extent to which resources are nurtured within a community *before* a negative event occurs. Central of these resources are the informal social supports of an individual, or their *social capital*: the positive norms of behavior developed within communities such as co-operative social networks, reciprocity, trustworthiness, and perceptions of safety (Ungar 2011a).

Other research supports that social capital is most valuable in socioeconomically disadvantaged areas. Given that the financially poor generally have fewer resources than those more advantaged, social capital represents a particularly important health resource for these individuals (Cattell et al. 2008). Indeed, social capital is noted as one of the leading antidotes for social vulnerability: providing structures and supportive resources enabling the capacity of the individual to adapt to life's challenges (Poortinga 2012; Zautra et al. 2008). The concept of social capital is therefore central to understanding the restorative and instorative potential of urban green spaces and public parks. The process of interacting with other individuals in a green space can have its own direct health benefits. However, their greater value may be the capital they build up over time that can be utilised during times of need.

Kazmierczac (2013) provides an overview of the link between social interactions in public parks, social capital and the resilience of an individual. Numerous factors inherent within 21st century urban areas – for example the disappearance of local industries that increase distance between work and home, the added mobility of increased car ownership, and new forms of electronic communications – have all decreased the occurrence of face-to-face relations with neighbours. This has particular implications for human health in socioeconomically disadvantaged areas, where local social ties provide a source of mutual aid, self-help and dissemination of information that can increase awareness of resources and employment opportunities. With the increasing privatisation of urban space, parks represent one of the few free and openly accessible spaces to facilitate inclusionary interactions that help to protect individuals in socioeconomically disadvantaged areas during times of vulnerability (Kazmierczak 2013).

3.3.1.3 Public Parks Physical Activity

One of the characteristics of urban lifestyles is sedentary behaviour. It is suggested that reductions in physical activity are an inherent consequence of modern urban lifestyles (estimated to require less than a third of the energy expenditure compared with pre-industrial lifestyles) (Barton and Pretty 2010). It was estimated recently that 31% of the world's population are not meeting minimum recommendations for physical activity i.e. are physically inactive (Hallal et al. 2012). The World Health Organisation suggests physical inactivity can be attributed to over 3 million deaths worldwide annually, and have consequently identified it (alongside stress) as one of the major causes of death in the developed world (World Health Organization 2009).

Thus, effective strategies for increasing physical activity represent an important pathway for increasing human health. The literature suggests that regular physical activity is linked to the prevention of a range of syndromes including cardiovascular disease, diabetes, cancer, hypertension, obesity and osteoporosis. Further, physical activity also reduces the risk of depression and other indicators of mental health and well-being such as mood, as well as overall health related quality of life and functional capacity (Bauman 2004; Penedo and Dahn 2005; Warburton, Nicol and Bredin 2006).

Green spaces such as parks have been identified as venues for physical activity (Maas et al. 2008). Such hypotheses sit within *social-ecological* approaches for increasing population-wide levels of physical activity in urban areas (Giles-Corti and Donovan 2002; Lachowycz and Jones 2011). Social ecological models for active living categorise the factors influencing physical activity levels into the domains of individual, social, physical and political (Sallis et al. 2006). While individual factors have generally been thought to be most influential, the relatively unchanging character of many of these factors such as socioeconomic status and education has seen an increasing focus on environmental factors, such as parks and green spaces, and the planning practice that might influence them (Schipperijn et al. 2013). Bird (2004) suggests that well-planned green spaces can help facilitate physical activity through two pathways: as a *venue* for exercise in natural environment (green exercise), as well as a *destination* for modes of active transport, particularly neighbourhood walking. Each are discussed here in turn.

Green Exercise and Resilience

There are several reasons why green spaces should, in theory, represent popular venues for physical activity. It is suggested that people are more likely to undertake exercise in an aesthetically appealing environment, and that natural environments are generally perceived as being more attractive than built environments (Maas et al. 2008). Importantly, opportunities offered for exercise in public parks are generally free or low cost (Schipperijn et al. 2013), which may make them particularly important resources for physical activity in socioeconomically disadvantaged areas.

Yet, despite this potential, and despite physical activity appearing to be one of the most widely researched health-promoting functions of public parks and green spaces, evidence linking the availability of these resources to increased physical activity is inconclusive. In a review of the possible mechanisms behind the availability of green space and health, de Vries (2010) suggests that physical activity is likely to be less of a factor than other commonly researched mechanisms such as restoration and social cohesion. Further to this, reviews of the literature investigating the relationship between green space and/or natural environments and physical inactivity/obesity have found the evidence to be inconclusive (Kaczynski and Henderson 2007; Lachowycz and Jones 2011); while some studies found a significant positive relationship between green space and neighbourhood physical activity (e.g. between the size and attractiveness of local parks and walking by Giles-Corti et al. in 2005), others that have found only a weak or even no relationship (for example the comprehensive study undertaken by Maas et al. in 2008).

One possible factor in the weak relationship between green space and physical activity is that, when denied access to green space, individuals seeking to exercise will find alternative locations within the built environment to meet their needs. For example, it is noted that parks represent only one of many locations where individuals might undertake physical activity (Dahmann et al. 2010; Giles-Corti et al. 2005). In comparison, green spaces may be more unique in their potential to provide opportunities for restoration and bridging social interactions. However, while green space interventions may not determine *how often* residents engage in physical activity, they can determine *where* they engage in it (Maas et al. 2008). Thus, even if it doesn't increase overall levels of physical activity, encouraging more physical activity in these spaces will still provide improved health outcomes through the other health benefits that come with exposure to these environments.

Physical activity in a natural environment – or *green exercise* – has been found to provide significant mental health benefits beyond that provided by exercise in an urban setting; including stress reduction and improvement in mood and self-esteem (Bodin and Hartig 2003; Pretty et al. 2005). Regular green exercise would therefore help to combat two of the primary health risk factors in the 21st century identified by the World Health Organisation (2009). Benefits also extend beyond these two factors: green exercise can lead to enhanced ecological knowledge, increased social bonds and influence behavioral choices in individuals (Barton and Pretty 2010). Further, exercise undertaken in a natural setting, where environmental and social concerns take precedent over being active, is also likely to be more sustainable over the long term (Bird 2004). Thus, encouraging more people to undertake physical activity within public parks can provide a range of protective benefits to communities simultaneously above those provide by other forms of exercise.

Neighbourhood Walking and Resilience

Planning public parks to increase neighbourhood walking in particular may be one of the most effective approaches to combating physical inactivity. Walking has great potential as a form of physical activity to promote health, due to its well-documented health benefits and its accessibility across social groups (Lee and Buchner 2008). Further, Bird (2004) suggested that initiatives for increasing population-wide levels of physical activity should focus in particular on moderate forms of exercise, most notably walking, which are accessible for the most at-risk social groups such as the elderly. It is further suggested that green spaces can play a major role in increasing levels of walking (Bird 2004).

One example of the role of green spaces in facilitating walking in vulnerable social groups comes from the United Kingdom's Walking for Health program (Tzoulas and Greening 2011). The program specifically targets inactive people living in areas of general poor health. Upon evaluation, it was found that the program had been successful in attracting individuals from disadvantaged groups, with participants both reaching and retaining recommend levels of physical activity. Importantly, local green spaces were used as central locations for undertaking healthy walks (Tzoulas and Greening 2011).

The role of parks in increasing neighbourhood walking has also been researched in Australia. Giles-Corti (2006) discusses the importance of planning urban areas to facilitate walking, which remains one of the most popular forms of physical activity in Australia. It is suggested that sprawling low-density suburb designs typical to Australian cities negatively influence levels of physical activity; poorly connected street networks and lack of access to neighbourhood shops and services encourages car-use over active transport, even for short trips. These areas are described as *obesogenic* environments. Well-planned local parks are crucial to designing suburbs that facilitate rather than inhibit active transport (Giles-Corti 2006). Indeed, the relationship between local parks and levels of neighbourhood walking has been widely investigated in Australia. For example, several studies have investigated how local parks can best facilitate neighbourhood walking (Giles-Corti et al. 2005; Sugiyama et al. 2010). A consistent finding of these studies is that large and attractive local parks can indeed play a significant role in increasing neighbourhood walking.

3.3.1.4 Public Parks and Environmental Education

While perhaps not as widely researched as these other cultural services, public parks also are being increasingly recognised as sites for environmental education. Taylor (1995) suggests the first Victorian parks had a strong educational function, seen as capable of instilling civilized values – such as nature, science, art and society – into the working classes. After earning a living off the land for generations, largely uneducated working class communities had moved into the vicinity of industrial towns and their oppressive living conditions, yet with no offer of the civilizing influence of the city. The more wealthy soon saw it as their role to educate these classes, both for the benefit of the working class as well as to ensure their own safety and security from the perceived threat of uprising (Taylor 1995). Park design and management was soon reflecting this function. The inclusion of paths and walkways helped to encourage civilised behaviour, as did the employment of park keepers and police to control any spontaneous behaviour deemed unacceptable (Walker and Duffield 1983). Later, the widespread introduction of botanic gardens was indicative of early attempts to educate park users about science and the natural world (Taylor 1995).

Current literature indicates green spaces such as parks have significant potential as educational resources. Learning represents an ongoing process of change in the way humans view the world; dependent on each the learner, the object of learning, and, importantly, the context in which the learning takes place (Krasny, Lundholm and Plummer 2010; Lundholm and Plummer 2010). Green space would appear to be a positive context for learning to take place, with natural environments linked to a range of positive attention and academic outcomes (Eisenman 2013). Thus, regardless of the type of learning taking place, the presence of nature has the potential to facilitate positive educational outcomes.

In terms of environmental education specifically, it is likely that effective education of ecological issues should allow individuals to be in contact with the objects about which they are being taught. For example, Bendt, Barthel and Colding (2013) argue that the most effective way to reengage urban citizens with natural processes is not through extracted collections of ecological knowledge, but through forms of environmental learning that allow citizens to engage with nature first hand *in practice*. Colding (Colding 2011) also suggests that semi-natural areas in cities are able to play unique 'pedagogic' roles by representing learning arenas that permit interaction with ecosystem services.

However, there appears to be less research on the ability of public parks to facilitate environmental education compared to the three previous services. James at el. (2009) note the need to better utilise green spaces for their role in environmental education and education agendas in general. In line with these findings, there is a growing research base for the active educational potential of 'civic' green spaces such as allotment and community gardens (Barthel, Folke and Colding 2010; Bendt, Barthel and Colding 2013; Krasny and Tidball 2009b). There is less evidence of such research on traditional green spaces such as parks, even noting the suggestions of Cranz and Boland (2004) that educating citizens about ecological processes should be one of the primary functions of public parks in the 21st century.

Environmental Learning and Human Health Resilience

The role of environmental education in health-promotion can be explained through the concept known as *extinction of experience* (Miller 2005). Humans are increasingly residing in urban areas where the ecological processes that sustain human health and well-being are hidden. This has led to nature commonly being seen as expendable and a luxury, and thus relegated behind other socioeconomic concerns. This has created a compounding, generational amnesia towards the environment, where cycles of society increasingly diminish ecological values themselves and our perceptions of its value (Miller 2005).

This loss of direct experience of nature has particular consequences for young people, where the environment they encounter forms the baseline for experiences of nature later in life (Miller 2005). A study by Ward Thompson, Aspinall and Montarzino (2008) found a strong relationship between frequencies of childhood visits to green spaces with the subsequent likelihood of visiting green spaces alone as an adult. They describe this as the 'childhood factor'. Thus, a lack of exposure to green space in childhood could inhibit an individual's desire to visit these spaces later in life (Ward Thompson, Aspinall and Montarzino 2008). In terms of resilience, these findings suggest that an individual denied exposure to nature at an early age will be less likely to use green spaces as health resources later in life. Thus, combating this extinction of experience is vital to utlise the potential of public parks to increase resilience to health risks in socioeconomically disadvantaged areas.

Some further explanation for the value of early environmental education in facilitating green space resilience later in life comes through the Biophilia Hypothesis (Kellert

2008). The hypothesis suggests that the expression of the genetic tendency to affiliate with nature will vary depending on the extent that it has been developed through processes such as learning, experience and socio-cultural support. Once sufficient stimulation and support is provided, this genetic programming is activated and engaged relatively easily. However, until this process occurs, an individual may display a reduced affinity to nature than others (Kellert 2008). Thus, environmental education early in life may be the prerequisite for other health-promoting ecosystem services of parks to be fully utilised by many individuals.

Environmental Learning and Ecological Resilience

There are also broader implications for this loss of contact with nature beyond the individual. As well as generating benefits for health and well-being, early and regular experience of nature is essential to developing strong emotional ties that form motivation for conservation efforts later in life (Kaplan and Kaplan 1989). Regular exposure to nature, at a young age and throughout life, would thus appear essential to the formation of a civic society capable of managing these resources for ecosystem services. In Miller's words: 'If people no longer value nature or see it as relevant to their lives, will they be willing to invest in its protection?' (Miller 2005, 431).

This becomes more important given that effective management practices are becoming less reliant on traditional institutions and more on civic networks. The majority of research surrounding the protection and management of urban green spaces has traditionally dealt with formal, top-down planning processes. Yet a study by Sandström, Angelstam and Khakee (2006) found that a majority of planners involved in the protection of urban biodiversity agreed that local governments lack the necessary resources, qualifications and organization to successfully implement plans for the protection and ongoing maintenance of green spaces with significant biodiversity values. Instead, a *civic turn* can now be witnessed, where the protection of urban green spaces for ecosystem services rests not on legislative powers but through active and organized civil social networks (Ernstson, Sorlin and Elmqvist 2008).

While local knowledge of ecological practices is essential to the successful management of ecosystem services in urban areas, building this knowledge requires space for this collective memory of civil society to be retained and transmitted (Barthel, Folke and Colding 2010). Consequently, facilitating environmental learning within civic social networks is now recognized as central to the resilience of linked social-ecological systems (Holling and Gunderson 2002). In this context, environmental education is also central to the capacity to adaptively manage the ecological aspects of green spaces for regulating services such as biodiversity conservation.

Thus a loss of direct experience of nature not only directly affects the health of an individual, but also reduces their ability to effectively manage ecological areas for ecosystem services. Conversely, this indicates a dual role for environmental education under this theoretical framework: both directly to create positive individual behaviours for utilising green spaces for cultural ecosystem services; but also indirectly, as these individuals are more likely to invest in local nature and ensure that regulating ecosystem services are supported in the long term.

3.3.1.5 Summary of Public Park Planning in Low SES Areas

The previous sections discussed how green spaces represent unique resources for at-risk individuals to overcome acute adversity or long-term risk factors associated with living in socioeconomically disadvantaged areas. In other words, green spaces function as resilience resources that can protect at-risk individuals from negative health outcomes. This discussion allows the flow chart for this chapter to be further updated, as shown in Figure 12. Notably, it shows that each cultural ecosystem service is an adaptation to a different health risk factor inherent in socioeconomically disadvantaged suburban lifestyles. It also highlights the unique risk of extinction of natural experience to both ecological and human health, and the unique role of environmental education in facilitating both ecological and human resilience.

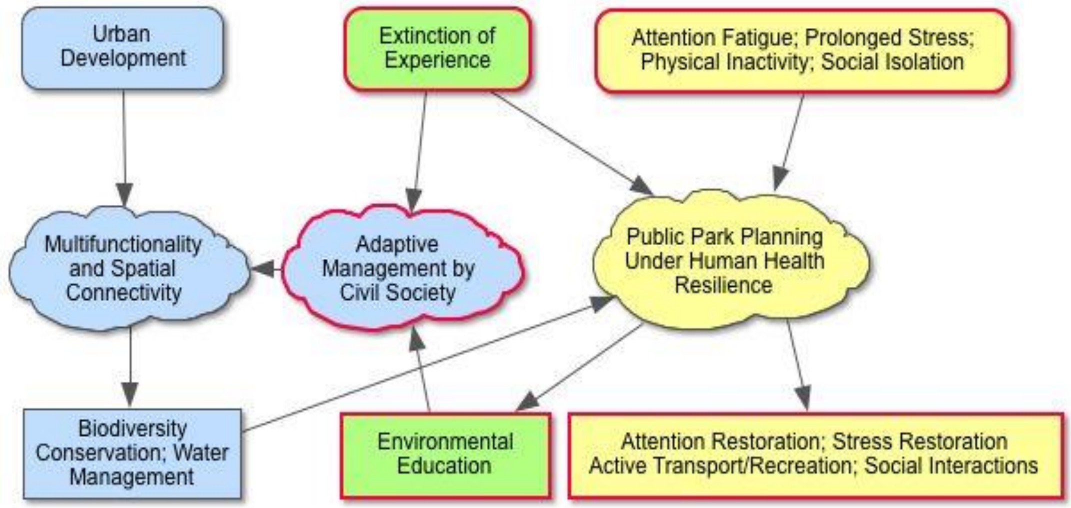


Figure 12: Updated theoretical framework flow chart, with insights from human health resilience theory; updates in red.

This discussion also has implications for how public parks can best be planned to facilitate resilient outcomes. While the social role of parks as democratic spaces means they should be made available to all residents, individuals more exposed to different health risks will be more likely to benefit from the use of a local green space. Further, Niemela (2014) notes research that suggests green space may be particularly valuable in socioeconomically disadvantaged areas as residents are less able to travel to other forms of nature. Investment in parks in these areas should also extend to ongoing maintenance and surveillance measures: Gidlow and Ellis (2011) note that local green spaces in socioeconomically disadvantaged areas are often underused due to their poor quality and concerns of safety with the park. Thus, it could be argued that investment in public parks, both initial and ongoing, is most needed in socioeconomically disadvantaged areas, and that the design of these spaces should specifically accommodate those individuals most at-risk to poor health within these communities.

3.3.2 Public Park Planning and Environmental Qualities

Resilience theory can also provide insight for how cultural ecosystem services can be best provided to those most at-risk within socioeconomically disadvantaged communities. Zautra et al. (2008) suggest that resilience is best understood as an *outcome* that arises from a positive adaptation to adversity. Characteristics of the person or their environment that would typically be identified as positive only represent resources for building resilience capacity once it has demonstrated to have contributed to improved health under stress (Zautra et al. 2008). This interpretation of resilience is important, as it acknowledges that what represents a resilience resource to one individual may hold different value to another.

One of the fundamental tenets of human health resilience as a social-ecological concept, as outlined by Ungar (2012), is that it is best studied across different social contexts and cultures. The context of the individual, including the nature of the risk and adversity that they are facing, will determine how they use resources in the social and physical environment. Thus, a resource will only contribute to a resilient outcome if it matches up to the individual's specific set of *socially-determined criteria*. Resources that meet these criteria represent *facilitative* environments. Resources that fail to meet these criteria are *non-facilitative* environments, which not only fail to represent a meaningful resource, but also may even act as a barrier to health and well-being (Ungar 2012).

This is consistent with findings from green space research. For example, Dinnie, Brown and Morris (2013) found that experiences of green space, and the benefits received from these experiences, are mediated through an individual's relation to a particular social group. As a result, different meanings will inevitably be associated with green spaces, often resulting in contention between these meanings across social groups (Dinnie, Brown and Morris 2013). Further, the variation in how parks are utilised by individuals of different race and ethnicity is being increasingly recognised, and discussed in detail by Byrne and Wolch (2009). One notable study of a foreshore area in Chicago found that individuals of European descent were more likely to undertake active recreation, while other ethnic groups were typically seen engaged in passive and social activities (Gobster 2002). This variation between social groups can even lead to negative outcomes. For example, it has been noted that parks in socioeconomically disadvantaged areas that are poorly maintained or become used primarily by a particular social group can represent sources of distress and conflict (Gidlow and Ellis 2011; Solecki and Welch 1995). This variation also makes sense when considering the relationship between health risks and cultural ecosystem services: social groups most exposed to a particular risk-factor, or who stand to benefit more from a particular service that nature can provide, will be more likely to use a space that is designed specifically for that corresponding ecosystem service.

Ungar (2012) suggests such social and cultural variation necessitates a more targeted approach to providing meaningful resilience resources. Resilience is conferred through specific *processes* that the individual undertakes in times of acute or chronic adversity. A process is a complex interaction with the individual's environment, and may therefore function in different ways depending on the favourability of the environment to the individual's specific needs. In Ungar's words: 'processes associated with resilience tend to be heavily reliant upon the *quality* (emphasis added) of the environment to protect the individual and provide optimal conditions for healing and behavioural change' (Ungar 2012, 388).

The need to focus on specific characteristics, or qualities, of health-promoting resources is particularly relevant to urban green space planning. It is now suggested that the relationship between green space and health is moderated by a range of demographic factors – gender, ethnicity, socioeconomic status for example – as well as specific characteristics of the spaces themselves (Lachowycz and Jones 2013). This reflects an increasing research focus on the health-promoting *qualities* of a green space environment, rather than indicators of quantity or simply the presence of nearby green space (Francis et al. 2012; Van Dillen et al. 2012). The need to better consider specific qualities of public parks when planning them within socioeconomically disadvantaged areas is reflected in the updated flow chart in Figure 13.

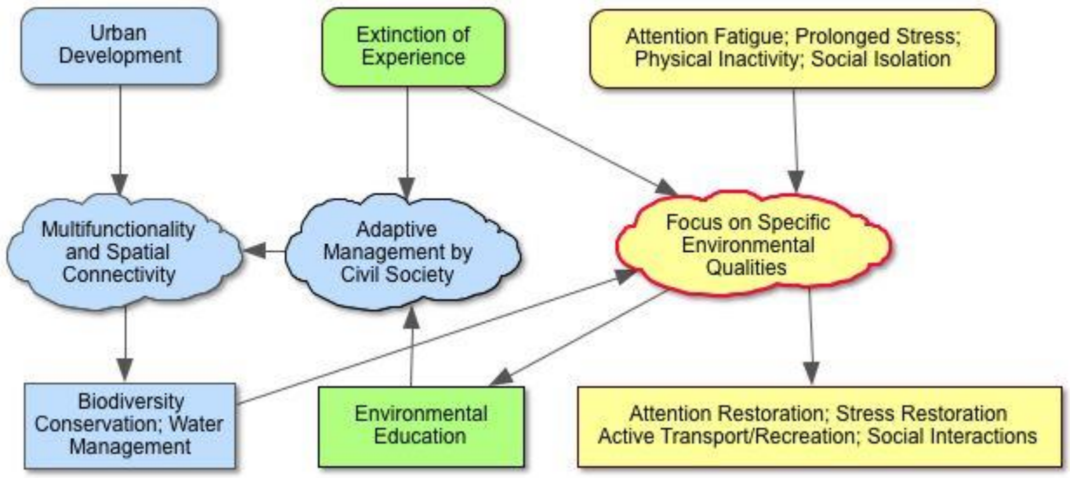


Figure 13: Updated theoretical framework flow chart, noting the need to consider specific environmental qualities of public parks; updates in red.

In line with this research, the following sections identify some of the environmental qualities – physical and social – that are most likely to facilitate each cultural ecosystem service.

3.3.2.1. Public Park Qualities and Mental Restoration

Hartig (2007) provides a starting point for understanding the specific park environmental qualities most likely to facilitate mental restoration. Broadly, a restorative environment should meet two basic requirements: it permits restoration, and it promotes restoration. In other words, a restorative environment should both remove negative qualities whilst providing positive ones. Hartig also suggests that attention and stress restoration are related but not fully equivalent. It is therefore necessary to determine the specific qualities that will likely inhibit and facilitate each form of restoration.

Public Park Qualities and Attention Restoration

The suggestions of Hartig (2007) on the need to both remove negative qualities and provide positive qualities reflect the central tenets of ART theory (Kaplan 1995). ART theory outlines several distinct qualities that restorative environments must meet. *Being away* describes the ability of an environment to remove the individual, either physically or conceptually, from the mental activity that was depleting directed attention to begin with; it is just as likely to be a conceptual as a physical shift. Further, another of the most fundamental properties of a restorative environment is that it is *fascinating*; the term fascination is in fact largely interchangeable with the concept of involuntary attention (Kaplan 1995). The properties of being away and fascination reinforce the fact that restorative environments should both remove an individual from their normal environment, whilst providing the qualities that actively facilitate restorative processes. To this can be added the quality of *extent*, which is described as providing the richness and coherency able to constitute an entirely new world (Kaplan 1995). This quality has also been described as the dimension of *space*, in that it provides spaciousness and freedom whilst also having the necessary connectedness to represent a single environment (Grahn and Stigsdotter 2010). Finally, ART theory also identifies the quality of *compatibility* as a requisite for restoration to occur. Compatibility emphasises that any environment must still fit with the aims and purpose of the individual in visiting that environment (Kaplan 1995). In other words, it must correlate with an individual specific conception of an attractive and restorative natural environment.

Further qualities can be taken from a series of Scandinavian studies that investigated the likely potential of different components of inner city pocket parks to facilitate attention restoration. In line with the theory of ART that green or more natural environments are more restorative, they found grass, bushes and trees to be most predictive of the likelihood of restoration. They also found water features to strongly influence fascination, with larger parks also more likely to permit opportunities for restoration. That said, they also conclude that intelligent spatial design can enhance the perception of being away from the surrounding built environment (Nordh, Alalouch and Hartig 2011; Nordh et al. 2009). Thus, even smaller urban green spaces can represent valuable restorative resources when the right environmental qualities are provided.

Sources of fascination and attention restoration are not limited to physical park features, and may also come from the presence of other people. Expanding on the original ART theory, Herzog et al. (1997) suggest that attention restoration can be broken down into two components: attention recovery, which includes clearing the mind and recovering from DAF; and *reflection*, which includes that ability to deal with personal problems and reflect on one's life goals. Different types of settings and the nature of fascination they bring contribute differently to these components. Watching sport, along with other common forms of relaxation such as computer games and watching TV involves *hard fascination*, which is a higher level of fascination that 'fills the mind'. As such, while it allows opportunities for DAF to recover, it gives little chance for reflection. In contrast, viewing a natural environment evokes *soft fascination* that allows for a more full restorative experience including opportunities for reflection. To support these findings, Herzog et al. (1997) tested the effectiveness of three types of environments in restoring attention: ordinary natural, sports/entertainment and everyday urban. Ordinary natural settings showed the highest restorative effectiveness, urban the lowest, whilst sports/entertainment was in between (Herzog et al. 1997). Thus, while reinforcing the value of fascinating natural features, this also suggests that the presence of humans may also provide an alternate source of attention restoration, and is in line with the findings of Cattell et al. (2008) that many people will visit a park simply to watch the behaviour of others.

That social qualities of a park environment can positively influence attention restoration is also suggested by the findings of Staats and Hartig (2004). This study specifically investigated the role of a companion on attention restoration in a green space setting. It found that restoration was often enabled by the presence of a companion for many users of highly natural environments. However, they further note that this outcome was due primarily to its perceived effect on *safety*. When safety was controlled, solitude was the preferred context for enhancing restorative experiences, specifically under ART (Staats and Hartig 2004). This suggests that the restorative and social services of urban green spaces can in some instances be complementary.

Public Park Qualities and Stress Restoration

While many of these qualities may also be effective at facilitating stress restoration, there can also be seen significant differences in the types of environmental qualities likely to facilitate each type of restoration.

One notable study that has investigated the specific environmental qualities likely to facilitate stress restoration is by Grahn and Stigsdotter (2010). This study sought to determine the sensory dimensions of urban green spaces specifically related to restoration from stress. It investigated a wide range of dimensions: Serene, Space, Nature, Rich in Species, Refuge, Culture, Prospect and Social. In relation to ART theory, they note that it is likely that Nature, Space (for extent) and Rich in Species (for fascination) will be most preferred for those who are mentally fatigued. For stress, their results suggest that Nature would be the most optimal solution for creating a restorative environment using a single dimension. It is therefore suggested that the dimension of Nature is likely to facilitate restoration from both stress and attention fatigue. They interpret this dimension as ‘an experience of the inherent force and power of nature, designed and manifested on nature’s own terms’ (Grahn and Stigsdotter 2010, 270). It is therefore not as simple as providing certain natural features, but requires the creation of an environment that facilitates a distinct natural experience.

As discussed by Bratman, Hamilton and Daily (2012), it is through this quality of nature that significant variation can occur in what is perceived as a restorative environment. Concepts of nature are overwhelmingly subjective, with the degree, amount or attractiveness of nature in a landscape defined by cultural and individual factors. They therefore define nature, in the context of restoration, broadly as all areas containing elements of natural systems across a range of scales and degrees of management. Such restorative natural environments can range from a small urban park through to wilderness areas such as forests or bushland (Bratman, Hamilton and Daily 2012). Thus, while the quality or dimension of *nature* should generally represent a property of a green space likely to facilitate restoration, actually providing this environment appears quite complex.

The basic theory of SRT outlined by Ulrich et al. (1991) is that restorative natural environments are those with a positive role in our evolution. Under SRT, *unthreatening* natural elements such vegetation, water and some wildlife that were critical for the survival and well-being of early humanity (for example signaling an end to a search for food or water) are biologically linked to a positive physiological response. Threatening and highly stimulating environments are fascinating in the sense that they engage involuntary attention. Yet they are not necessarily stress relieving, and can also elicit negative emotions and activate the autonomic nervous system (Ulrich et al. 1991).

Grahn and Stigsdotter (2010) provide further insight into the qualities of a natural environment that might best facilitate stress restoration. Looking beyond single factor results, they suggest a restorative environment would ideally include a combination of Nature and Refuge. They define Refuge as an enclosed and safe environment, and related to qualities such as 'cosy', 'green oasis' and also 'children's play'. They also discuss other potentially positive qualities, including 'space', which can be related to the ART quality of 'extent' (Grahn and Stigsdotter 2010). Thus, it might be hypothesised that users seeking either attention or stress restoration are likely to seek out nature for slightly different reasons: as a source of fascination for the former, and a source of refuge for the latter.

The discussion and findings of Grahn and Stigsdotter (2010) also provide insight into the role of social factors in stress restoration. Being able to master the different relationships with the environment is crucial to recovery from crises. However, at such times, more complicated relationships may be too much to handle for some individuals. Social relations are the most complex of these relations, and could in fact add to the stress burden of users seeking out restoration. In contrast, relationships with inanimate objects are the simplest, while the plants and animals will generally fall in between. Such qualities may thus be able to provide a range of sensations (for example fascination) whilst still being simple enough to process. This is supported by their subsequent findings that, while the dimension of *Nature* was most strongly related to those with stress, the dimension of *Social* was the least related i.e. the presence of other people was not favoured by stressed individuals (Grahn and Stigsdotter 2010).

Conversely, it is likely that elements of a social environment may be conducive to stress restoration. For example, de Vries (2010) suggests that a high level of social cohesion that comes from the social contacts in parks may enhance restoration by reducing perceptions of fear and crime. It could therefore be further hypothesised that the presence of other people may be both complementary and inhibitory to each form of restoration depending on the circumstance and the individual.

3.3.2.2 Public Park Qualities and Social Interactions

The previous section identified a complex relationship between restorative outcomes and the social environment of a park. Some outcomes of each service may support the other, such as when the safety of a companion or overall sense of social cohesion may facilitate restoration. Conversely, it could be hypothesised that if an environment was able to restore an individual with high levels of stress and attention fatigue, they would then be more likely to interact positively with others. To support this, a series of American studies have found that the amount of vegetation within neighbourhood spaces was positively related to the amount of social activity within them, and hence the likelihood of creating new social interactions (Kuo et al. 1998; Sullivan, Kuo and Depooter 2004). Alternatively, because the need for restoration and the need for social interactions represent fundamentally different motivations for visiting a park, they are to an extent incompatible. Thus, different environmental qualities must therefore be provided to properly facilitate each service.

The ability for a public park to facilitate social interactions appears closely linked to its overall ability to attract and retain park users. In other words, the more people visit a park, and the longer they stay in the park, generally the more likely it is that social interactions will occur. In analysing the use of outdoor public spaces, Gehl (2011) suggests that outdoor activities can be broadly classified as necessary, optional or social activities. Social activities are also classified as *resultant* activities, as they arise spontaneously from activities in the other two classifications, and are thus indirectly supported when conditions facilitate these primary activities. Poor quality spaces are generally used only for necessary activities. In higher quality spaces, while the number of necessary activities is approximately the same, they tend to go for longer and are hence more likely to lead to social activities. Most importantly, however, high quality spaces facilitate a wide range of optional activities – inviting people to stop, eat and play for example – which in turn greatly increases the number of resultant social activities (Gehl 2011). This would indicate that the quality and attractiveness of a park is strongly linked to its ability to facilitate longer optional visits and hence positive social interactions.

Gobster (1998) has discussed the factors that might increase the value of a park for facilitating interactions between diverse social groups, using a case study of a large park in Chicago. Trail areas in the park appeared to have limited interactional value, with few 'trail parties' comprised of individuals from different racial and ethnic groups, and with limited interactions observed between different groups. Sporting areas and playgrounds were both observed as sites for interracial interaction. The location of these recreational features on the perimeter of the park may have contributed to their high use, increased their accessibility and more seamlessly integrated the park with the broader neighbourhood. Further, the management of the park and its facilities was also crucial to its social value. This would include physical management of park features that reduces the appearance of neglect or danger, but also social practices such as the provision of programs that target a diverse range of social groups (Gobster 1998).

The findings of Kazmierczak (2013) also support that the quality of the features within a park, as well as the standard of maintenance that reduces the appearance of neglect or danger, increase the social value of a space. Pedestrian routes such as walking trails are unlikely to have significant interactional value without features such as seating areas, activity spots and scenic places that encourage users to stop and stay within the park. Playgrounds in particular may have potential to bring people together, owing largely to the 'ice-breaker' role of children (Kazmierczak 2013).

3.3.2.3 Public Park Qualities and Physical Activity

Section 3.3.1.3 noted that the literature on the link between green space and physical activity found mixed conclusions. However, one review (Lachowycz and Jones 2011) does go on to suggest that a focus on the specific qualities of green spaces linked to exercise may represent more effective approaches to increasing population-wide levels of physical activity. While insignificant at a population wide level, the relationship between green space and physical activity has varied according to factors such as age, socioeconomic status and the measure of green space used. This indicates that future research should identify these specific factors – or 'when, how and for whom' – that may best mediate relationships between green space and physical activity (Lachowycz and Jones 2011, 187).

Not surprisingly, parks with more attributes/features were likely to be attractive destinations for neighbourhood walking (Giles-Corti et al. 2005), as well as likely to promote physical activity in general (Kaczynski, Potwarka and Saelens 2008; Schipperijn et al. 2013). In this sense, the number and quality of features is related both to a park's ability to attract users likely to engage in neighbourhood walking and green exercise, and also then to engage in social activities during their visit.

There also appears to be a close relationship with environmental qualities for both restoration and physical activity. Schipperijn et al. (2013) found many trees (e.g. wooded areas) and water features, along with the presence of a well-lit walking route, to be significantly related to physical activity. Interestingly, features such as sports fields and facilities that might be expected to increase physical activity were found to have no relationship (although they note this may be due to only adults being included in the sample). Further, various natural features including trees, water bodies and plant and animal life to be among those most preferred by residents in their local green space; built features such as exercise trails and play equipment were less preferred (Schipperijn et al. 2013). This suggests that features likely to facilitate restoration are also likely to be most related to physical activity. Indeed, Kaczynski, Potwarka, and Saelens (2008) also suggest that natural park features such as water areas, woodlands and meadows appear to be strongly associated with the use of a park for physical activity, and require further research.

Hartig (2007) also notes the link between physical activity and restoration theory: that the characteristics that make a park attractive for neighbourhood walking could also be those that make it restorative. In this sense, parks with natural features providing a source of fascination and refuge may be related both to restoration and neighbourhood walking. Further, given that outcomes of restoration, such as stress reduction, are also outcomes of physical activity, it could be hypothesised that people in need of restoration are likely to undertake physical activities in a more restorative green space (Hartig 2007).

For such users seeking a park for physical activity but with restoration in mind, the park must still be compatible with the desired activities that users seek to undertake. Trails available both for walking and other forms of active recreation are likely to be most important here. Kaczynski, Potwarka, and Saelens (2008) found that the presence of paved and un-paved trails along with wooded areas were significantly associated with park-based physical activity. Paved trails are more versatile in terms of catering for a range of activities and age groups, while un-paved may be more popular for walkers and runners seeking soft surfaces (Kaczynski, Potwarka, and Saelens 2008). Thus, the inclusion of paths throughout and in the vicinity of natural areas may make them more attractive for walkers, joggers or cyclists.

As well as number and type of features, the size of a park is also a quality that influences its use for physical activity. Both Giles-Corti et al. (2005) and Schipperijn et al. (2013) found that the size of a park was significantly related to increased physical activity. Given large parks are able to provide more attributes due to their increased size, this may be one reason for these findings. Indeed, in each of these studies the inclusion of size as a factor appears to reduce the significance of the number of features. Alternatively, the study by Kaczynski, Potwarka, and Saelens (2008) found the number of features but *not* size to be significant. Another explanation is that a larger park may also represent a more restorative park. Giles-Corti et al. (2005, 173) refer to ART theory when suggesting that larger parks may give the opportunity for park users to 'lose oneself'. Certainly, it could be hypothesised that larger parks are more likely to provide both the qualities of *being away* and *extent* outlined under ART. Large parks may therefore be inherently more restorative and attractive than smaller parks of a similar type, and can be even made more attractive for walkers if they provide more attributes likely to make the park more restorative: including trees, water features and bird life.

What this discussion indicates is that the ability of a park to provide the ecosystem service of mental restoration is closely linked to the ecosystem service of physical activity. As well as providing greater restorative benefits, large public parks with restorative natural environments are also likely to represent more attractive destinations for neighbourhood walking. If these parks can be made compatible with different forms of physical activity, most notably through the inclusion of trails, they could also represent venues for green exercise.

3.3.2.4 Public Park Qualities and Environmental Education

Environmental education can occur through a variety of different mechanisms. As such, a variety of different qualities will be required to facilitate this ecosystem service.

To an extent, the qualities of a park that facilitate restoration also have the potential to facilitate environmental education. This is supported by research by Hartig, Kaiser and Strumse (2007). This study found that individuals who access park settings for mental restoration are also likely to gain a greater appreciation of nature, which is then expressed through ecological behaviours. Ecological behaviours are described as any action that reduces human impact on the natural environment. This relationship between restoration and ecological behaviour may be mediated by a range of 'value orientations': an increased concern about the natural environment that stems from concern for the environment itself (ecocentrism); concern of the negative impacts on these environments on the health and well-being of others (anthropocentric altruism); or more self-interested personal harm from the loss of natural environments (Hartig, Kaiser and Strumse 2007). These findings suggest that restorative experiences may be a valuable first step in the creation of greater awareness of the value of the natural environment, even if it is initially only for self-interested reasons. While the study does not explicitly link ecological behaviour to the management of green spaces for ecosystem services, it could be hypothesised that experiencing restorative services of urban green spaces, and the increased awareness of the benefits of the natural environment this brings, could encourage behaviours that enhance their ecological functioning.

This hypothesis is supported by Cranz and Boland (2004), who also suggest that opportunities for environmental education can be as simple as allowing passive experience of nature. Such passive learning, while limited in its educational potential, can be facilitated through simple and careful design that orientates park features such as benches or walkways to allow direct experiences of nature. Park design can also facilitate opportunities for environmental learning from passive experience of nature more directly. This could include techniques such as signage explaining local ecological processes, as well as demonstrating these processes in action through their incorporation into a park's design. For example, parks can provide examples of sustainable, low watering plant choices that can still create a desired naturalistic effect. This might include the replacement of conventional turf areas with less-resource intensive species (Cranz and Boland 2004).

Perhaps the most effective pathway for public parks to facilitate environmental learning is through socially mediated educational programs that require active engagement with ecological areas. Parks have already been used for community and school-based stewardship programs, which simultaneously allow for the teaching of ecological processes whilst actively contributing to their preservation and restoration (Cranz and Boland 2004). One example of such organized group educational activities is the 'BioBlitz': group cataloguing of a parks biodiversity in a short period of time that, as well as compiling important scientific information, has the additional benefits of building stronger communities with a greater appreciation of local ecological values (Beatley 2011). Such activities are an example of mutually beneficial people-nature interactions, where human benefits are gained from processes that enhance ecological functioning (Baldwin, Powell and Kellert 2011). Facilitating these activities requires more complex natural areas with higher biodiversity values, rather than simply aesthetic and unthreatening nature. They also require the presence of organised social networks. Thus, unlike many instances of restoration, opportunities for environmental education are likely to be more effective in a social environment.

3.3.2.5 Summary of Public Park Qualities

The insights from this discussion are summarised in Table 1, which outlines the specific park qualities that are likely to facilitate each cultural ecosystem service.

Table 1: Overview of the park qualities likely to facilitate each cultural ecosystem service.

Cultural Service	Facilitative Park Qualities
Attention Restoration	*Being away*; *extent*; *compatibility* (Kaplan 1995); *Fascinating* nature: vegetation and water (Nordh et al. 2009), *rich in species* (Grahn and Stigsdotter 2010); People for *hard fascination* (Herzog et al. 1997); People for safety (Staats and Hartig 2004).
Stress Restoration	Unthreatening nature: vegetation, water, some wildlife (Ulrich et al. 1991); *Refuge* e.g. safe, child-friendly (Grahn and Stigsdotter 2010); *Space* (Grahn and Stigsdotter 2010); Solitude i.e. no social (Grahn and Stigsdotter 2010)
Social Interactions	Vegetation (Kuo et al. 1998; Sullivan et al. 2004); Features for optional activities (Gehl 2011), on park perimeter (Gobster 1998); Play areas (Gobster 1998; Kazmierczac 2013); Maintenance and management (Gobster 1998; Kazmierczac 2013).
Physical Activity	Features (Giles-Corti et al. 2005; Kaczynski et al. 2008; Schipperijn et al. 2013); Restorative natural features: wooded areas, water (Kaczynski et al. 2008; Schipperijn et al. 2013); Trails in restorative environments (Kaczynski et al. 2008; Schipperijn et al. 2013); Size (Giles-Corti et al. 2005 and Schipperijn et al. 2013).
Environmental Education	Restorative nature for enhanced appreciation (Hartig et al. 2007); Ecological nature for explanation and demonstration (Cranz and Boland 2004); Ecological nature for learning in practice (Cranz and Boland 2004; Beatley 2011).

3.3.3 Public Park Planning and Public Participation

The previous section identified some qualities of a park that are likely to facilitate each cultural ecosystem service, with a summary table provided. Within this discussion, some qualities of a park environment appear generally positive (e.g. water features, aesthetic vegetation) while others will be more specific to certain services for certain individuals (e.g. complex vegetation, the presence of other people). However, identifying these qualities provides only a starting point for planning public parks in socioeconomically disadvantaged areas. Many of these qualities are quite broad, and outline the general properties of an environment rather than actual features (e.g. 'being away', 'extent', 'refuge'). The specific park features that will combine to create these qualities may differ for different individuals. Further, some qualities for the same service are contradictory, particularly the alternatively positive and negative role that the presence of other people can play in restorative outcomes. Finally, the extent to which local park systems create environments that facilitate each cultural ecosystem service must be based on the demand for these services within the community. In short, a focus on specific park qualities within green space research does not overcome the inherent variation within different social and cultural groups in socioeconomically disadvantaged areas.

One concept from human health resilience theory that can help address this variation is that of *negotiation*. As outlined by Ungar (2011a), while resilience resources are of most value to those most at-risk in a community, it is often these individuals who have the poorest access to meaningful resources in their immediate environment. To an extent, individual resilience is therefore linked to the capacity of the community to more effectively provide these resources to its most vulnerable. However, also important are the processes that allow individuals and community groups to engage with and influence government and institutions that are responsible for these resources. Thus, ensuring the provision of meaningful resilience resources is a constant facilitated negotiation between the providers and the users (Ungar 2011a).

The importance of an individual negotiating for meaningful environmental resources is reflected in the progression of public park planning since the middle of the 20th century. As discussed in Section 2.1.2, planning standards became the most common approach to providing public parks in the middle of the 20th century. Byrne, Sipe and Searle (2010) and Veal (2008a, 2008b) suggest that planning standards, which peaked in use at different stages in the 20th century, continue to form the basis of approaches to public park planning, notable in Australian cities. While successful in securing sufficient quantities of parkland in rapidly developing areas, standards approaches have also been criticised, among other things, for failing to provide quality parks that actually meet the needs of local residents (Byrne, Sipe and Searle 2010; Veal 2008a, 2008b). By focusing on quantity rather than quality, it could be argued that standards approaches are fundamentally at odds with planning public parks under human health resilience theory.

The limitations of such 'top-down' approaches to public park planning have also been noted in especially bureaucratic planning conditions in China and Taiwan (Huang 2010; Shan 2012). Similar to the findings above, this research has found that government-controlled planning approaches have generally failed to produce good quality park landscapes that engage with and reflect the needs of local residents. Excluding local residents from the planning process has also positioned users as passive agents in this process, and resulted in low or non-use of the park from certain groups or even inappropriate use and damage requiring additional government expenditure (Huang 2010; Shan 2012).

One of the fundamental reasons for the failure of top-down planning approaches such as planning standards is that they fail to properly include the views of local residents into the planning process (Byrne, Sipe and Searle 2010; Veal 2008a, 2008b). As these limitations have become more evident, attempts (not always successful) have been made to move away from planning standards. This has seen the emergence of new and innovative park planning approaches that actively engage residents early in the planning process to produce better quality green space that better reflect the needs of diverse communities (Byrne, Sipe and Searle 2010; Veal 2008a, 2008b). Such approaches are essential to ensure that park environments provided in socioeconomically disadvantaged areas meet the specific needs of the most at-risk groups.

As well as producing spaces that better reflect the needs of residents, involvement in the creation of a green space can have other benefits. Being directly involved in the creation of a landscape allows an individual to develop a much greater understanding of its potential benefits (Francis 1989). Thus, the benefits of engaging the public in the design and creation of parks extend beyond the ability to produce a space more fitting to resident needs, and can also help to establish a deeper connection between the user and the landscape. For example, Kaplan (1980) found that even for those who don't use it, knowing that the public has been involved in the planning of a public space increases its value to the community.

Thus, genuinely including the local residents in public park planning negotiations, particularly those most at-risk individuals who will stand to benefit most from appropriate design, is crucial to providing public parks as meaningful resilience resources. With this in mind, the flow chart of this chapter is updated in Figure 14. It illustrates that to properly provide the specific park qualities likely to facilitate specific cultural ecosystem services there is a need to include those within a community most likely to benefit from these resources in park creation and ongoing management.

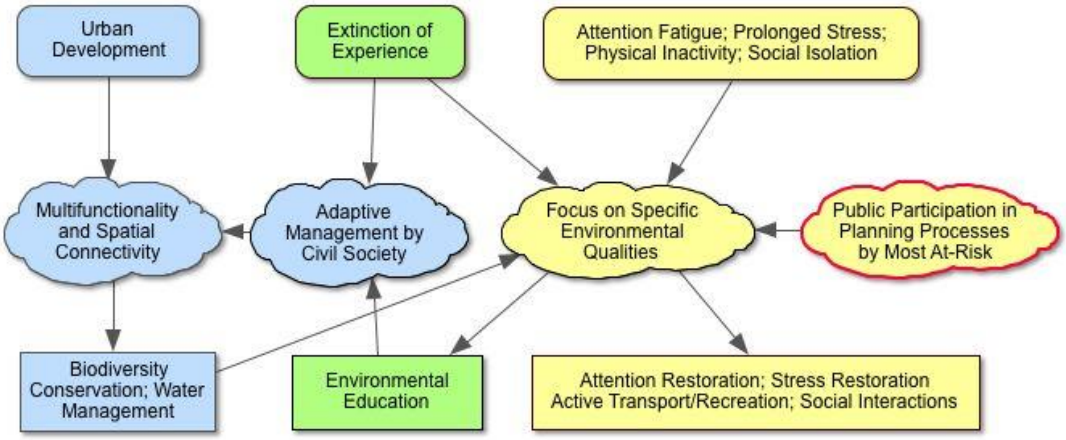


Figure 14: Updated theoretical framework flow chart, noting the need for participation in the planning process by those most vulnerable to health risks in socioeconomically disadvantaged areas; updates in red.

4. Case Study Overview

Having established a set of key criteria for planning public parks to provide ecosystem services, as summarised in Figure 14 and Table 1, this thesis now turns to the identification of practice that allows sporting services to be provided in a way that complements this ecological role. This is achieved through a case study of public park planning practice within the northern outer suburbs in the metropolitan area of Perth, Western Australia. It contains two separate investigations, each undertaken within the scope of two distinct aspects of public park planning in the area. This chapter provides an overview of this case study approach, the two investigations, and the selected case study area and parks used for the investigations.

4.1 Case Study Design

The defining characteristic of a case study is that it investigates a particular phenomenon within its real-life context (Yin 1981). The evidence supporting the direct link between shifts in public park planning and reductions on space for organised community sport, as identified in Chapter 2, is most conclusive through the research by Middle, Tye and Middle (2012) within Perth's outer suburbs (the 'original study' from hereon in). Thus, while it is likely that emerging shortages of community playing fields in other Australian cities are to some extent related to shifts in the provision of public parks and open spaces, it cannot be assumed to be a universal phenomenon at present. Further, there are some factors considered in the following investigations that are relatively unique to Perth and the south-west of Australia. For example, it is suggested that Perth has particularly complex and biodiverse remnant bushland (Environmental Protection Authority 2013), much of which is retained in public parks. The increasingly dry climate of Perth also places acute pressure on landscapes that consume significant groundwater resources and complicates the creation and maintenance of aesthetic water bodies and wetlands (Grose and Hedgcock 2006). For these reasons, conducting a case study within the same context as the original study is appropriate for the aims of this thesis. That said, many of the insights provided by this case study are likely to be applicable to new suburban developments in Australian and indeed other Western cities where ecological park planning agendas are becoming increasingly embraced.

The case study in this thesis builds upon and expands the scope and methodology of the original study, thus undertaking a more holistic investigation of public park planning within outer Perth suburbs. Two distinct aspects of sporting park planning practice in these new suburbs are investigated: their location and their design. Both aspects are identified as central to public park planning processes in Perth (Carter 2011), and have strong precedent research to build on: the original study by Middle, Tye and Middle (2012) in terms of the location of sporting parks; and, in terms of the design of sporting parks, the paper by Giles-Corti et al. (2005) along with follow-up research (Sugiyama et al. 2010; Sunarja, Wood and Giles-Corti 2013). While the entire case study is informed by the outcomes of the theoretical chapter, the link back to the resilience framework is weaker for the design investigation than the location investigation. As such, the latter represents more of a preliminary investigation: addressing two research questions that build on gaps identified by the original study, while also providing context to the subsequent design investigation with its four research questions and more substantial methodological approach.

To facilitate such a holistic investigation of both the location and design of public parks, this research employs a broad, mixed method approach: taking established methods for researching public parks and applying them to the specific context of sporting park planning in Perth's outer suburbs. As outlined by Creswell (2009), mixed methods approaches that utilise the respective strengths of both quantitative and qualitative data are becoming increasingly popular. Quantitative methods, while reductive and deterministic, allow for the determination of measures that can then be used to test a theory or hypothesis. Conversely, qualitative approaches are more interpretive, in that they rely to a degree on the perspective of the researcher themselves. They are also more holistic in trying to describe a much broader picture of complex situations, and provide a greater depth of understanding into the factors behind the emergence of phenomena (Creswell 2009). While both approaches are used in this research, each investigation is based primarily around quantitative data: the location investigation primarily utilises numerical indicators of cumulative spatial areas of ecological and sporting park landscapes for its analysis, while the design investigation is structured around systematic observations and survey questions on the use and value of sporting parks answered by park users on a numerical scale. As such, each investigation is structured as a separate comparative analysis: the location investigation at the district level through comparison of these spatial indicators within Ellenbrook and Coastal Wanneroo, and the design investigation at the park level though a comparison of these numerical indicators from two sporting parks within these two districts. Additional qualitative data is then incorporated to provide a broader understanding of these situations: interpretations of demographic data and accessibility in the location investigation, and from additional open-ended survey questions and descriptive observations of park users for the design investigation. For both investigations, qualitative findings are also gained from interviews with local park planners. These methods are outlined in more detail in Chapter 5.

To provide the necessary context and to support the rationale for the selection of the case study area and parks, the following two sections provide a brief introduction to each investigation.

4.2 Overview of Location Investigation

The aspect of location in sporting park planning emerges directly from the original study, and refers to the spatial (i.e. within or outside of residential area structure plans) and cadastral (i.e. zoning within local planning schemes) location of sporting parks. It builds on a key finding of the original study – that it is no longer possible to meet demand for organised community sport solely within a suburb's 10% park provision. This is distinct from previous planning models, where community playing fields were provided almost solely through single and dual use local sporting parks (see Figure 5 previously).

Central to this investigation is the incompatibility between environmental and recreational functions of public parks, and specifically, social forms of recreation such as organised sport. The notion that the environmental and recreational roles of green/open spaces such as parks can be complementary differs from the traditional land use dichotomy identified by Maruani and Amit-Cohen (2007): on the one hand, the provision of opportunities for recreation and other social services (demand); and on the other the conservation of natural values (supply). Embracing the concept of ecosystem services in urban green space planning highlights that recreation and conservation can in fact represent complementary rather than alternative and incompatible functions. When looking more specifically at organised sport, however, the dichotomy between social 'demand' and environmental 'supply' becomes more salient. Sporting areas in parks are typically flat turf or paved landscapes, with built infrastructure integrated either on (cricket pitches, goal posts) or adjacent (clubrooms, floodlights) to them. While grassed playing fields can be considered semi-natural, they function for utilitarian purposes rather than as a source of nature, and have no significant ecological value. In fact, their lack of features such as remnant vegetation and water are fundamental to their potential for organized sporting recreation. As explained in Section 2.3.2, they are also heavy users of diminishing local groundwater supplies in Perth specifically (Grose 2009). This competition between sporting and ecological park functions becomes more acute in urban areas with contested land use negotiations, and in planning situations (likely most situations) where the total area of parkland is constrained. In such cases, an increase in sporting playing fields in public parks will have to come in the form of a reduction in ecological landscapes, and vice versa.

The case of public park planning in Perth clearly demonstrates these constraints. Suburbs planned under the S-H Plan were subject to a restriction of 10% local parkland (which, it should be noted, compares well to many other cities). This rule still appears to apply to new residential developments (Western Australian Planning Commission 2002, 2015). While there appears to be a strong argument for relaxation of the 10% rule, particularly for development in ecologically sensitive areas (Grose 2009), provisions of landscapes likely to facilitate sporting services and ecosystem services are effectively in direct competition with each other at present. Given the trend towards a higher provision of ecological landscapes and opportunities for non-sporting recreation are desirable over sporting playing fields, then meeting demand for organised community sport must be achieved through alternate means.

This investigation considers the viability of alternate locations for sporting parks within the context of the resilience framework. There are two alternate locations for sporting parks that are becoming more common in new residential developments in Perth: those within residential subdivisions that are partly or fully within the cadastral boundaries of local schools; and those within larger regional sporting complexes located within land parcels outside of local structure plans. Each is investigated through the following research questions:

What are the benefits and limitations of sporting parks co-located with local schools for facilitating ecosystem and sporting services under resilience theory?

What are the benefits and limitations of district sporting complexes for facilitating ecosystem and sporting services under resilience theory?

The location investigation methodology employed a spatial mapping method to produce numerical indicators representative of the proportion of various ecological and sporting landscapes across different residential areas. This method is an expansion of the approach taken in the original study: with a more advanced and detailed spatial mapping approach and additional analysis of accessibility and demographic data. Ecological indicators determined in this approach included measures for remnant bushland, permanent water and seasonal drainage areas; sporting indicators included measures for local, school and district playing fields. This quantitative analysis tested the hypothesis that the use of these alternate sporting park locations can allow increases in ecological landscapes within a suburb's 10% provision whilst still meeting estimated demand for sporting playing fields. Further insight into the value of each of these alternate locations under the theoretical framework was gained through additional qualitative data.

4.3 Overview of Design Investigation

While the location of community sporting playing fields is important to ensure demand for organised community sport in outer suburban communities is effectively met, so too is the design of the parks that contain these facilities. In the context of this investigation, design refers to the incorporation of ecological landscapes and opportunities for non-sporting recreation adjacent to sporting playing fields. This investigation builds on consistent findings from previous papers regarding the need for large local parks such as sporting parks to cater for a range of different uses (Carter 2011; Giles-Corti et al. 2005; Sugiyama et al. 2010; Sunarja, Wood and Giles-Corti 2013). Again, this is distinct from previous park models, where sporting parks would typically be limited to playing fields, supporting built infrastructure and basic playground equipment.

Figure 15: Aerial photo illustrating a typical sporting park planned in the middle decades of the 20th century. Facilities for senior organised sport are provided along with a small play area. A small area of remnant vegetation is retained, however is inaccessible and has little recreational value (Source: Google Earth).

While the location investigation focusses on incompatibilities between environmental and recreational functions of parks, the design investigation deals with the relationship between different forms of recreation, notably sporting and non-sporting. This thesis has identified two distinct forms of park recreation that can provide health-benefits to local residents: activities in social environments and activities in natural environments. The discussion in Chapter 3 demonstrated that these alternate forms of recreation must not necessarily be in opposition to each other. For example, the fact that social interactions have been widely investigated as a service that natural environments can provide indicates that 'people-to-people' activities and the social interactions and capital that result can be enhanced when held in a natural setting. Conversely, as they often represent fundamentally different motivations for visiting a park, there is also likely to be some conflict between these alternate forms of recreation. Indeed, it was discussed in Section 3.3.2 how the presence of other people can often be inhibitory to users seeking restoration.

This incompatibility may be of greatest issue in the case of organised sport, which represents in many ways an extreme social park environment. Based on the insights established in Chapter 3, the qualities of sporting parks, particularly during peak periods of use such as evenings and weekends, are likely to be in direct opposition to the facilitation of restorative services. The increased human activity associated with competitive sport – yelling, cheering, and whistles for example – may limit the ability of the park to allow users to 'be away' from their everyday urban surroundings under ART theory, or removed from the sensory dimension of 'social' under SRT theory. Further, research on park recreation in Australia suggests that users engaging in both passive and informal active recreation may perceive heavily manicured and maintained spaces such as playing fields as bland and unattractive (Corti, Donovan and Holman 1996; Giles-Corti et al. 2005). This suggests that both the social and physical environments provided by sporting parks may have limited value for non-sporting users, particularly those seeking restoration.

Conflict between sporting and non-sporting recreation is more likely in parks planned under standards approaches, with evidence suggesting early sporting park design generally failed to provide any consideration to alternate forms of recreation. Public parks provided under standards approaches have been criticised for failing to produce parks capable of catering for the diverse recreational needs of communities (Byrne, Sipe and Searle 2010; Harnik 2010). This is also encapsulated by Cranz (2000) who, in summarising the legacy of the standardized park planning era, concluded: 'the resulting banality of urban parks from this era has dulled our ability to think of them as potentially interesting, amusing, stimulating or exciting'.

The limitations of parks produced under standards approaches can also be seen in Perth. Parks planned in the decades after the release of the S-H Plan have been criticised as monotonous, with limited recreational potential beyond sport and active recreation, as well as little sensitivity to local ecological conditions (Grose 2009). This may explain the emergence of a park recreational dichotomy in Perth, with parks being classified as either active or passive (Carter 2010). Active parks under this dichotomy are generally considered to be those with the space and facilities suitable for organised sport, with passive parks those providing for all unstructured and non-competitive activities.

Yet this dichotomy does not reflect emerging practice in the design of sporting parks, which commonly make use of their size and location adjacent to other community facilities by providing a range of landscapes and recreational opportunities. This investigation considers the potential of four different ecological landscapes to facilitate cultural ecosystem services adjacent to sporting areas using insights from the theoretical framework:

What are the benefits and limitations of remnant bushland for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of permanent water for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of seasonal drainage basins for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of community gardens for facilitating ecosystem services alongside sporting services under resilience theory?

The primary method for this investigation was an intercept questionnaire survey of park users, with questions that gained both numerical and descriptive answers. This was complemented by both systematic and descriptive observations of park users, which helped to gain an understanding of the size and makeup of the population of each park area, along with finer details of user behaviours that provided additional insights when discussing the questionnaire results. This approach has a more defined link with the theoretical framework than the previous investigation: both observation and questionnaires are discussed for their potential and limitations to investigate the complex concepts of cultural ecosystem services and human health resilience, whilst the questionnaire instrument is designed with direct reference back to the theoretical framework.

4.4 Case Study Area

The investigation of each of these aspects of sporting park planning took place within a defined case study area in the northern our suburbs of the Perth metropolitan area. The original study covered the entire outer metropolitan area of Perth, including all Local Government areas (LGAs) currently experiencing significant suburban growth. The case study for the current research was undertaken in the adjacent LGAs of Swan and Wanneroo, which together form the vast majority of the north-east outer metropolitan suburbs of the city (Figure 16). A range of factors were also important when considering the choice of these LGAs, with the most significant being demographic makeups likely to have high demand for organised community sport. Both LGAs have higher proportions of households with children (49.5% for Swan; 52.2% for Wanneroo) compared to the average for Greater Perth (41.5%). Further, both have a lower (i.e. poorer) index of relative socio-economic disadvantage (a number calculated by factors including income, educational attainment, unemployment and skilled occupations): 1010.6 or 52nd percentile for Swan and 1025.5 or 60th percentile for Wanneroo compared to 1033.4 or 65th percentile Greater Perth (City of Swan 2016; City of Wanneroo 2016).

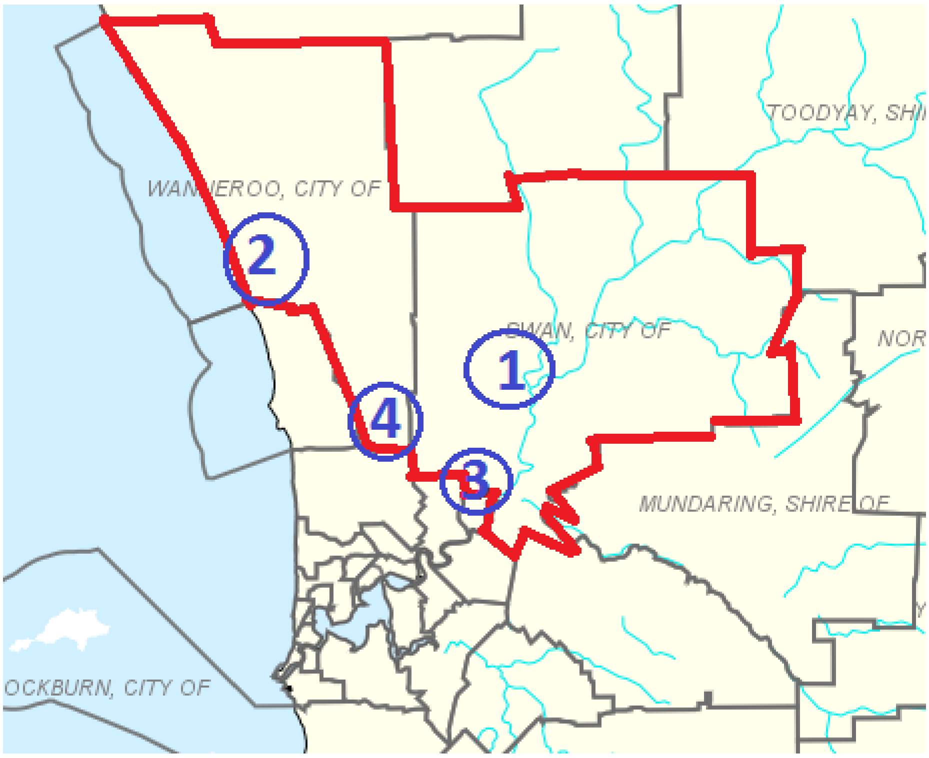


Figure 16: Map showing location and size of case study area in red, including four specific residential districts: Ellenbrook (1), Coastal Wanneroo (2), Altone (3) and South Wanneroo (4) (Source: City of Wanneroo Intramaps with added annotations)

Within this case study area, four separate coherent residential areas, or 'districts' from hereon in, were selected for further analysis: Ellenbrook, Coastal Wanneroo, Altone and South Wanneroo. Two of these districts are newly developed and still developing regions: one in each LG.

The first is Ellenbrook in the north east of the City of Swan, which encompasses the rapidly expanding residential estate of Ellenbrook and Aveley, a section of Henley Brook and the established golf course estate of The Vines (Figure 17). It can be analysed as a relatively discrete residential district, as it is separated from other residential regions within Swan by rural properties within Henley Brook and areas of the conservation reserve Whiteman Park. Several residential developments are proposed or already in the first stages of development in the region that stretches north from Bennett Springs in Altone place up to the edge of Henley Brook. These estates will eventually link up to form their own discrete residential district within the broader 'Urban Growth Corridor' master plan for the corridor.

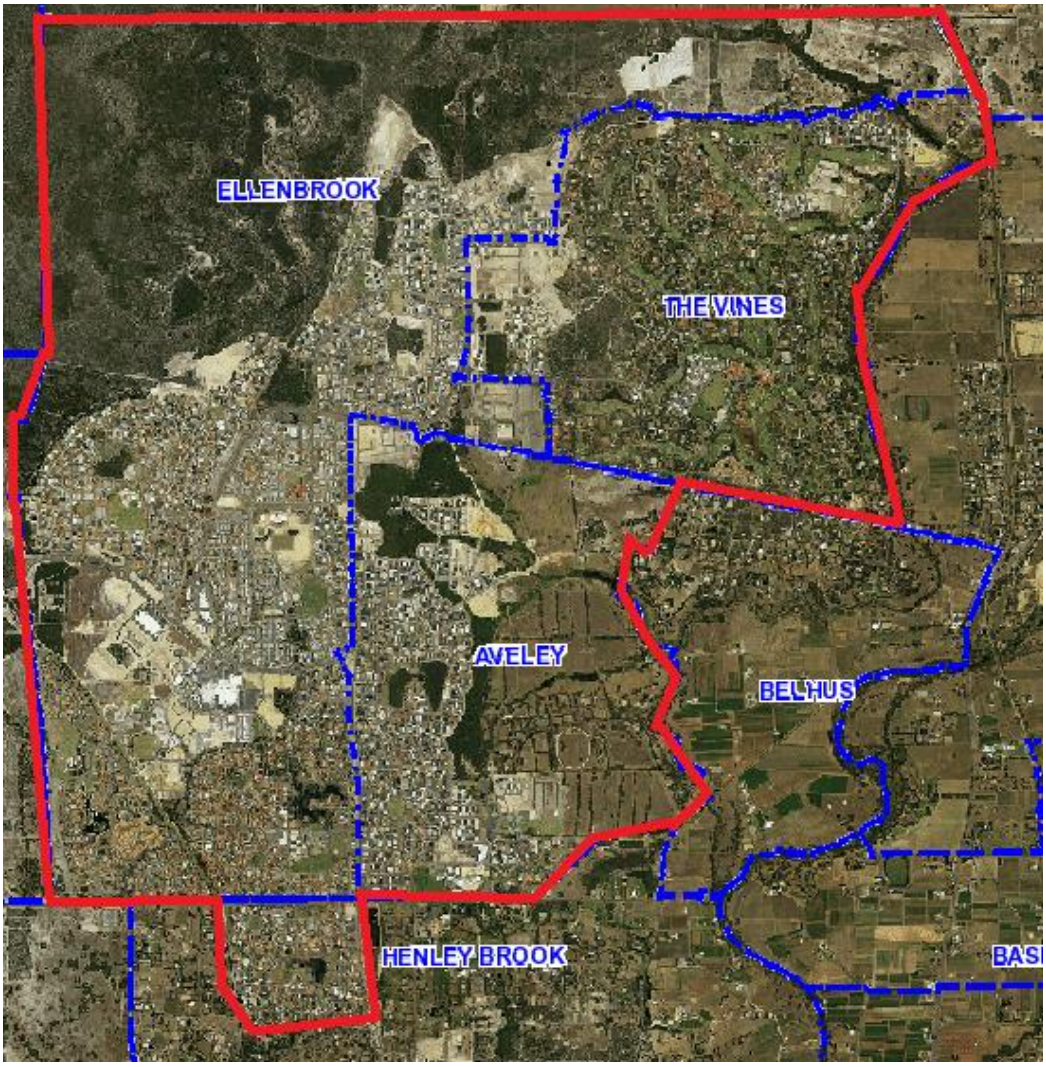


Figure 17: Boundary of (red) and localities comprising (blue) Ellenbrook (Source Landgate SLIP Map Service Aerial Imagery and Localities)

Wanneroo contains a large block of recent and still developing suburbs further north along the coastline ('Coastal Wanneroo'). Coastal Wanneroo stretches north from Clarkson and Mindarie up to but not including the developing residential estates in Alkimos, and includes the localities of Butler, Clarkson, Mindarie, Merriwa, Ridgewood Quinns Rocks and Jindalee (Figure 18). Like Ellenbrook, it can be analysed as a relatively discrete residential district. To the south, it is separated from the suburbs of Northern Joondalup and Central Wanneroo by the conservation reserve Tamala Park. To the north, the district lies adjacent to the developing residential estates within Alkimos, which sits within the district of North Wanneroo according to the City's own plans. Eventually, the residential areas within Alkimos will link up with the North Wanneroo suburb of Yanchep, forming a coherent suburban strip, however this level of development is still some years off.

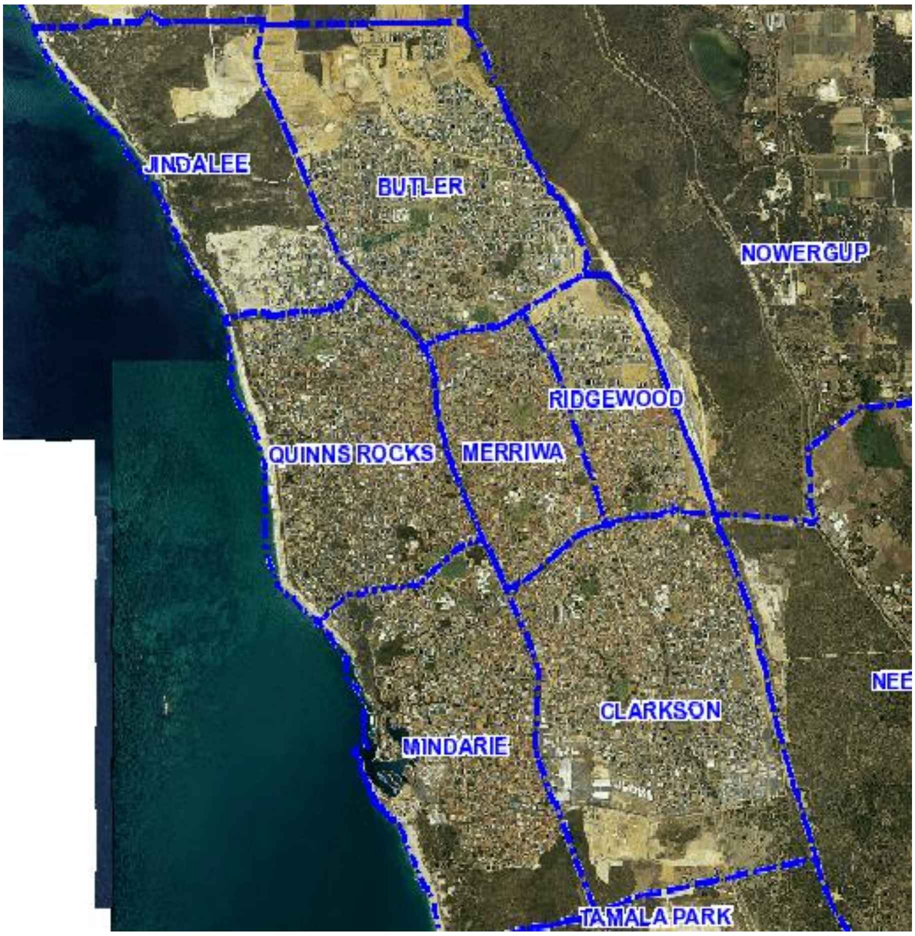


Figure 18: Localities comprising Coastal Wanneroo (Source Landgate SLIP Map Service Aerial Imagery and Localities)

These two areas were selected because the challenges of negotiating ecological and sporting park functions are particularly acute. Both areas were developed in complex ecological conditions – encroaching upon or enveloping high quality coastal remnant vegetation in the case of Coastal Wanneroo, or low lying wetlands in the case of Ellenbrook – and thus have much of their parkland dedicated to biodiversity conservation and stormwater drainage purposes. At the same time, populations in these developments are likely to have high demand for community sports facilities. At the 2011 census, the percentage of households with children in Ellenbrook was 56.1% compared to the Greater Perth average of 41.5%, while the suburbs within Coastal Wanneroo combined had 53.1% households with children (City of Swan 2016; City of Wanneroo 2016). It should be noted that while being lower than the greater Perth average overall, index of relative socio-economic disadvantage figures varied within these two districts. For example, Figure 19 shows the golf course estate of the suburb of The Vines in Ellenbrook had higher index values and hence lower disadvantage than the recently or still developing estates in Ellenbrook and Aveley suburbs. Similarly, Figure 20 shows disadvantage was lower in the beachside Coastal Wanneroo suburbs of Jindalie, Mindarie and Quinns Rocks compared to the inner suburbs.

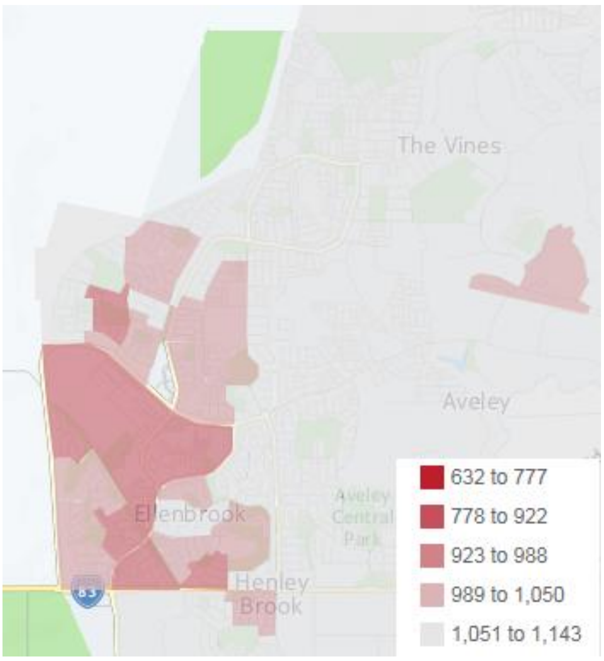


Figure 19: Index of Relative Socio-economic Disadvantage across SA1 Areas in Ellenbrook, dark shade indicates higher SES disadvantage (Source: City of Swan Social Atlas)

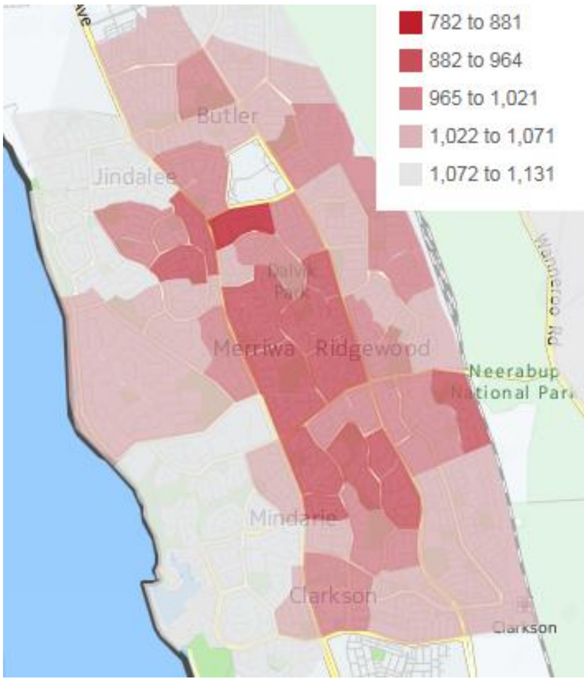


Figure 20: Index of Relative Socio-economic Disadvantage across SA1 Areas in Coastal Wanneroo, dark shade indicates higher SES disadvantage (Source: City of Wanneroo Social Atlas)

Due to the combination of ecological constraints placed and a likelihood of having high demand for local organised sport facilities, these suburbs are examples of the need for public park planning practice that effectively balances ecosystem and sporting service provision. As such, these two districts were the main focus of the case study. However, there was also a need for a comparison between these areas and suburbs planned more towards the middle of the 20th century in line with the prescriptions of the S-H Plan. In Swan, the adjacent established residential areas of Beechboro, Lockridge and Kiara that form 'Altone' district was selected (Figure 21), while in Wanneroo the southern block of older suburbs (Alexander Heights, Girrawheen, Koondoola and Marangaroo) that form 'South Wanneroo' were selected (Figure 22).

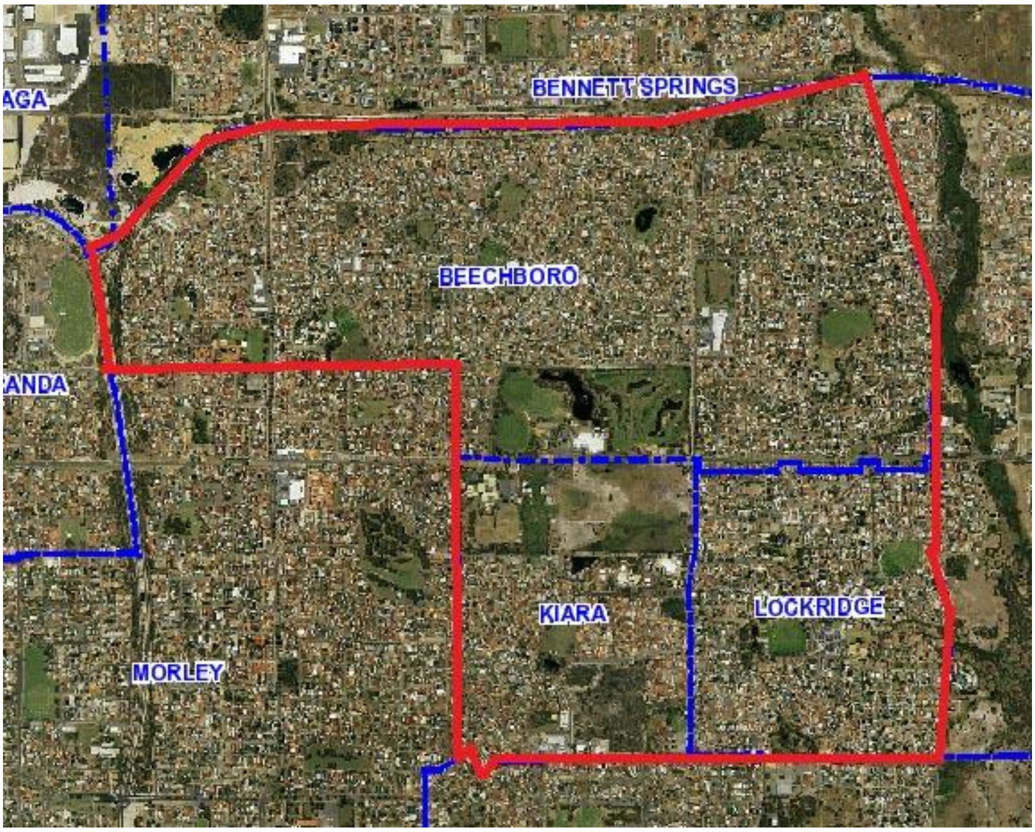


Figure 21: Boundary of (red) and localities (blue) comprising Altone (Source Landgate SLIP Map Service Aerial Imagery and Localities)

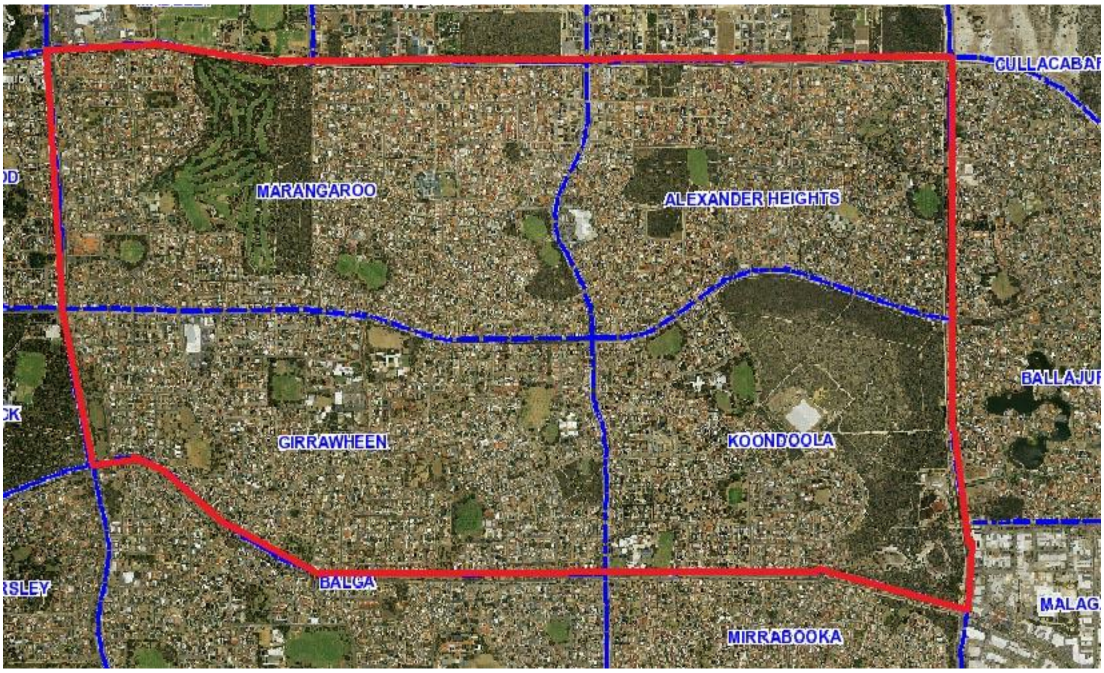


Figure 22: Boundary of (red) and localities (blue) comprising South Wanneroo (Source Landgate SLIP Map Service Aerial Imagery and Localities)

4.5 Case Study Parks

This diversity in suburb type allowed for a comparison between the landscape trends within both old and new suburbs, and specifically the changes in provision of ecological and sporting landscapes across these two broad periods, which was central to the original study and necessary for the location investigation in this research. Investigating the design research questions, however, also required looking specifically at a series of sporting parks within the case study area and their potential to facilitate cultural ecosystem services. As a result of their planning constraints, each of the two primary new residential districts outlined had a range of sporting parks that demonstrated relative innovation in integrating opportunities for non-sporting recreation based around ecological landscape. Three multi-functional sporting parks were selected for further investigation, based on the rationale of encapsulating each of the four ecological landscapes contained in the research questions.

Ridgewood Park is located within the suburb of Ridgewood within the district of Coastal Wanneroo. The park contains two distinct recreational areas in addition to the sporting area: a permanent retention basin to the west of the playing field with BBQ facilities and a nearby playground, and an area of conservation bushland with walking trails that has been ‘adopted’ by a local primary school. It therefore allowed for investigation of both a permanent water area and a publicly accessible area of remnant vegetation within the same park.

Figure 23: Ridgewood Park. Permanent water feature is located to the west of the sporting clubrooms, the bushland further north of the carpark (Source: Google Earth)

Coolamon Park is located in the residential estate of Coolamon in Ellenbrook. The park contains a single senior-sized playing field; while the park is adjacent to a school site, the playing field itself is not actually co-located. It contains a range of design features offering different non-sporting recreational opportunities, including a playground and informal play area to the west of the playing field and a skate/BMX park to the north. The most unique feature in the park is a fenced off drainage basin to the north of the park, which has been converted into an off-the-leash dog exercise area.

Figure 24: Coolamon Park. Dog exercise area located directly to the north of the playing field (Source: Google Earth)

Finally, Charlie Gregorini Memorial Park in Ellenbrook was also selected as it contained a community garden: a relatively rare feature in public parkland but nonetheless one with significant potential to provide multiple ecosystem services. Charlie Gregorini is perhaps one of the most unique parks, sporting or otherwise, in Perth. It has a small hockey field with no supporting infrastructure, which is used competitively only during winter. The park is heavily used during summer, primarily from the public and free water playground adjacent to the playing field. The park also contains several other features to the north/west: a permanent irrigation lake, a BMX track, the community garden, and a men's shed.

Figure 25: Charlie Gregorini Memorial Park. Community garden located at the west of the park (Source: Google Earth)

5. Research Methods

Before presenting these investigations, this chapter provides an overview of the methodological approaches employed, including the various specific data collection and analysis techniques and their relevance to the planning of sporting parks. Each section starts broadly with the relevance of each technique to research on public parks and then narrowing down on their specific design and application for this current study.

5.1 Literature Review

It is worth firstly noting the significant role that reviews of academic literature have played in this research. Creswell (2009) identifies several characteristics of an effective literature review. Most fundamental is to communicate to the reader the outcomes of previous research in the area: including key findings, ongoing dialogues, parallels and gaps. It is also crucial in establishing the scope of the research at an early stage, and allowing a concise and well structured thesis to be produced whose significance and key findings are clearly identified (Creswell 2009).

The review for this research initially undertook a broad sweep of international and local literature within the fields of public park planning and organised community sport, from which Chapter 2 (Background) is the result. The key finding of this review is the relatively unacknowledged relationship between the ecological shift in public park planning and the growing deficit of community sporting playing fields, from which emerged the primary aim of the thesis.

The review was then extended to a broader theoretical context, to include the concepts of urban green space, ecosystem service and resilience research. Chapter 3 (Theoretical Framework) was the primary outcome of this broader review: identifying key themes overlaps across these fields, such as the key ecological concepts that span resilience, urban green space and ecosystem service research; but also relatively unfulfilled parallels, such as the relevance of key concepts from human health resilience theory to the planning of public parks for cultural ecosystem services.

Analysis of literature, specifically when narrowed to a local Perth context, was also central to this case study. This review was crucial in determining the scope of the study, as it isolated the location and design of sporting parks as the primary issues to be addressed in the case study area. Each investigation also begins with a further theoretical discussion that applies concepts established in the Theoretical Framework chapter upon planning research and policy specifically from Perth. Arrival upon the final mixed methods approach of this case study also required an analysis of the data collection techniques used across the key precedent studies for this current research.

5.2 GIS Mapping and Biotope

As the primary method of the location investigation, this case study adopted and further developed a spatial mapping technique applied in the original study. This method firstly identified the location and areas of various ecological and sporting park landscapes, before then calculating numerical figures indicative of the relative proportions of the respective landscape types within different residential areas. Before outlining this method, the similarities and differences with the mapping process employed in the original study and the current case study are discussed.

5.2.1 Comparison with Original Study Method

The fundamental approach to mapping individual parks and the different ecological and sporting landscapes within them remained consistent across both studies. This approach has parallels with key principles of 'landscape ecology' theory, which itself has conceptual similarities to urban ecological resilience theory. As outlined by Pickett and Cadenasso (1995), landscape ecology understands urban landscapes as discreet *patches*, which are distinguished through different biotic or abiotic composition. Different vegetation types and densities are examples of biological patches, while the nature and density of buildings, infrastructure and transportation pathways are examples of physical patches. The predominant landscape patch exists as a continuous matrix within which other patches are imbedded. Thus, an urban area can be viewed as a series of different green patch landscapes, many being parks, interspersed within a grey matrix of connected built patches. Importantly, patch heterogeneity in landscape ecology exists over multiple scales of a landscape. This means green patches can be further broken down to a variety of habitat patches – e.g. grass, bushland, agriculture – which themselves also contain different patterns of biotic species or abiotic surfaces such as rocks and soils (Pickett and Cadenasso 1995). Thus, as well as spatially discrete green space within the urban matrix (i.e. each park), patches in the context of this investigation also include different discrete landscapes within each park.

Despite these similarities, there are key differences between the current approach that makes it more than simply a replication of the original study's data collection process. The primary difference between the original and current studies was the more advanced mapping method used. In the original study, measurements were made using basic online mapping software – typically the relevant LG 'Intramaps' application. Records of the areas measured were compiled in PDF documents by overlaying polygons on the aerial photo of each park. For the purposes of this current case study, a more sophisticated (albeit still fairly basic) mapping approach was undertaken using the Geographic Information Systems application ArcGIS, which provided greater efficiency and accuracy. The significance of using GIS mapping technology to map and quantify park landscape patches is considerable, as it represents an established technique for investigating the social and ecological dimensions of urban landscapes (Ryan 2011; Stahle 2006). Further, there are considerable areas of residential development within the case study area that have occurred since the original dataset had been compiled. Considering all these factors, it was therefore appropriate to repeat the mapping process, rather than simply re-analyse and extend the original dataset.

5.2.2 Application

One notable example of the application of GIS mapping to urban green spaces, and one which underlines the mapping approach taken for this research, is the 'Green Map' created by the City of Stockholm, which spatially mapped the ecological, social and cultural values of Stockholm's green spaces. The Stockholm Green Map was comprised of two primary layers: a *biotope* that mapped the ecological aspects of these spaces, and the unique concept of a *sociotope*. The sociotope emerged out of the communicative turn in urban planning; integrating data gained from citizen participation into spatial form (Stahle 2006). Of particular relevance for this investigation, however, is the biotope concept. The biotope is a product of the ecological shift in green and open space planning in the 1980s, which put extra focus on planning for biodiversity in urban areas (Stahle 2006). Now an established planning technique, biotopes typically spatially map the different land-cover types of green space systems with the aim of identifying different indicators that can then be used for decision-making (Löfvenhaft, Björn and Ihse 2002). In the case of the Stockholm biotope, recycling areas such as stormwater drainage were included along with areas of significant biodiversity (Stahle 2006).

The current approach can be understood as a modified example of this biotope, created using landscape ecology principles where park landscape patches at different scales and of a range of different compositions and functions were identified and quantified. Firstly, each discrete local park was mapped as a single green space. Each ecological landscape patch was then mapped within each local park: every piece of remnant vegetation such as bushland and wetlands, permanent water features, and every seasonal drainage area (as opposed to drainage areas such as fenced sumps closed to recreational use). This mapping process was then replicated for each local playing field, and extended to take in any playing field area used for community sport lying partially or fully outside of local parkland. Areas for organized sport located purely within local park provisions were classified as *local* sporting fields. Those co-shared with local primary schools were classified as *school* sporting fields, with the areas within both parkland and Education zoning distinguished, as shown in Figure 26. Finally, those outside of residential areas were classified as *district* sporting fields, given they serve the district as a whole rather than any local residential area.

Figure 26: Example of a playing field co-located with a local school. For this investigation, the portion of the playing field zoned within the school parcel (the eastern portion) was measured separately (Source: City of Wanneroo Intramaps)

Park and landscape patches were identified through a combination of desktop work and field trips in summer of late 2013 and early 2014. The current aerial photography, cadastre data and the 'reserves' layer (i.e. those current during this period) were accessed either through Landgate's SLIP Portal or provided directly from the two LG's. These datasets were accessed, and the mapping itself undertaken, using the GIS mapping software ArcMap 10. In the case of remnant bushland and permanent water areas, the boundaries of each park and different physical landscapes within the park could be easily distinguished from these aerial photos and datasets overlays. However, in some circumstances, such as when attempting to map the exact extent of seasonal grassed drainage basins or playing fields, a two-dimensional perspective was insufficient. Thus, site visits and photography were undertaken at each park, with the information gained from these visits correlated with the aerial photo to map the boundaries of each park and the individual landscape patches within them.

Each different landscape type was uniquely colour-coded: a green base layer for every park, light green for local parks and dark green for regional parks; a purple layer for remnant vegetation; light blue for seasonal drainage; aqua for permanent water; and yellow for playing fields. Remaining 'green' parkland – including informal grassed areas, exotic or interspersed vegetation, play areas and other infrastructure – was not considered in calculations. As such, calculations of these landscapes undertaken in Chapter 6 do not add up to the total parkland area. In addition, a further brown layer with a polygon outlining the area of every distinct residential area throughout the case study area was also created to assist with later calculations. This method was systematically applied across the case study area to produce the full biotope.

Figures 27 to 33 show in more detail the approach taken for mapping each specific polygon. Polygons were drawn manually in most cases, except where the 'trace' function was used to match the edge of cadastral parcels.

Figure 27 demonstrates an example of mapping the total area of each park along the useable edge of the open space area, which sometimes but not always aligned with the edge of the 'reserves' land parcel.

Figure 27: Example of mapping of total area of individual parks – polygon creation aimed to represent actual useable area of open space (in this case bollards that separated grass from road reserve) rather than boundary of land parcel.

Remnant vegetation was mapped along the edge of coherent bushland, excluding paths and other sparsely vegetated areas (Figure 28).

Figure 28: Example of mapping of remnant vegetation.

Seasonal drainage areas were mapped along the edges of the basin contours, where the slope evened out to the level of the surrounding landscape (Figure 29). Edge of basin was often difficult to determine from aerial photos, and was therefore verified through site visits.

Figure 29: Example of mapping of seasonal drainage.

Permanent water areas were mapped based on the edge of the basins when full, which sometimes but not always aligned with the edge of the water body on the aerial photography (Figure 30).

Figure 30: Example of mapping of permanent water.

Sporting areas were mapped at the edge of the manicured playing surface, which again required verification from site visits to accurately determine (Figure 31).

Figure 31: Example of mapping of playing fields.

Residential areas, typically the boundaries of established localities but in new areas also distinct residential estates, were mapped along the edge of main road boundaries, and excluded regional open spaces, high schools and shopping centers (Figure 32).

Figure 32: Example of mapping residential areas by locality (top, South Wanneroo) and by estate (bottom, Ellenbrook)

As well as visually identifying the areas of each park and landscape patch, the biotope mapping process also quantified these areas into numerical tables. ArcGIS data exists in both spatial form as polygons, and numerical form as tables. Thus, every polygon drawn under the same theme is entered as a row within a corresponding table. For this investigation, each individual polygon drawn during the mapping process, representing either a park patch or landscape patch, had its total area automatically calculated and stored within a different row in a corresponding table within the software. Thus, lying 'underneath' the biotope were a range of different tables: a parks table containing a different row and the calculated area for every green park polygon; and different landscape tables containing a separate row and the calculated areas of each purple vegetation polygon, blue drainage polygon, aqua water polygon, and yellow playing field polygon.

Collation and analysis of the data in these tables enabled creation of a range of indicators of the area in hectares of each landscape type. The creation of these indicators allowed for comparison between the proportions of ecological and sporting parkland in old and new residential areas, which provided the main component of the investigation of the two sporting park location research questions. The method used for this analysis could best be described as a public park *needs assessment*. Needs assessments are common local planning tools, which have the principle aim of determining *gaps* between existing and ideal park resources (Wells and Donofrio 2011). For example, a typical needs assessment by a local government might seek to establish gaps in provision of playgrounds within each of its suburbs against an established standard. For this research, the needs assessment was undertaken to identify gaps in the proportions of local ecological landscapes patches and sporting landscape patches – not just local but also school and district playing fields – between old S-H and new LN areas. As identified in the original study, it would be expected that proportions of ecological landscapes would increase at the expense of sporting landscapes within local park provisions. The purpose of this assessment was therefore to investigate whether use of school and district playing fields was able to offset the reduction of dedicated sporting space.

The first step in the needs assessment process was to identify gaps in ecological and sporting landscapes specifically within 10% local park provisions – that is, to determine the extent to which local park planning has shifted from sporting to ecological park functions. Only completed residential areas were included in these calculations, so that the final proportions of different park landscapes could be accurately determined. This included every residential area in Altone and South Waneroo, but required excluding some residential areas in Ellenbrook and Coastal Wanneroo. For Ellenbrook (Figure 33), this includes Charlotte's Vineyard, Coolamon, Morgan Fields, The Bridges and Woodlake; it excludes the still developing estates of Malvern Springs, Lexia and Woburn Estate in Ellenbrook and The Vale in Aveley. It also excludes the master planned golf course estate in the Vines, which was not planned under LN principles. In Coastal Wanneroo (Figure 34), all residential areas in Ridgewood, Merriwa, Clarkson and Mindarie were included; Jindalee and still developing areas in northern Butler were excluded. The old townsite of Quinns Rocks (south portion of the suburb) was also excluded, as it was also not planned under LN principles.

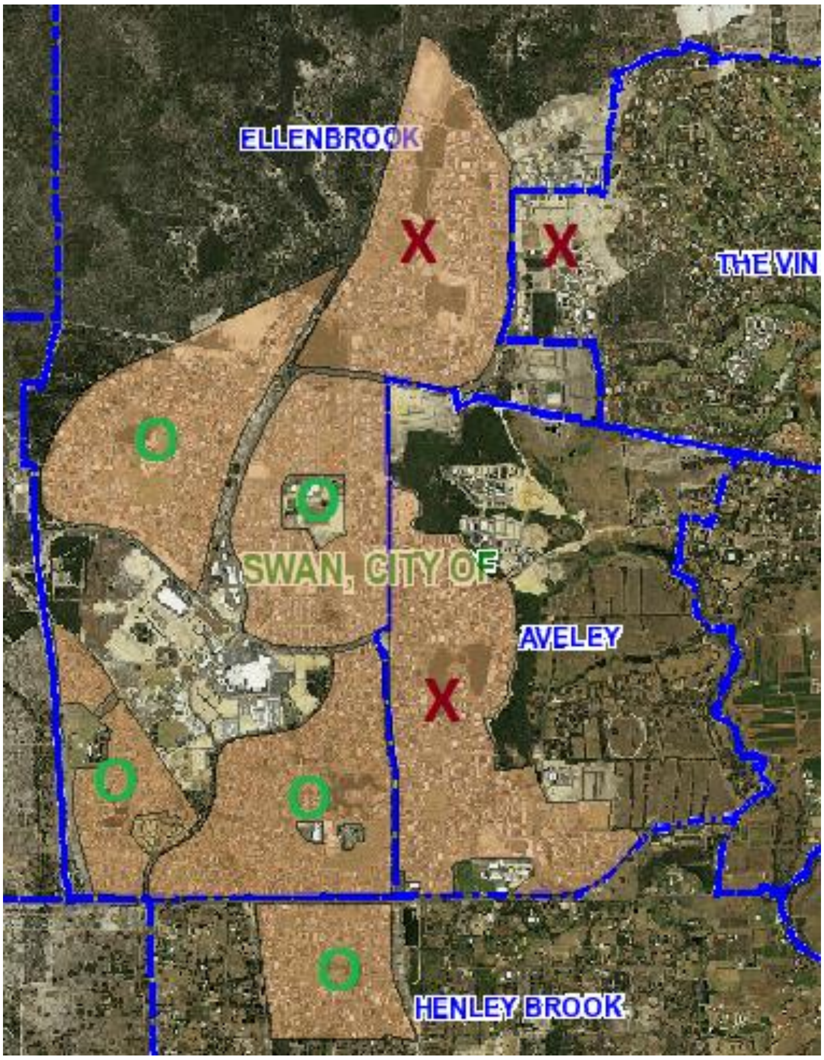


Figure 33: Completed and LN planned residential areas included in Ellenbrook (green circles as opposed to red crosses)

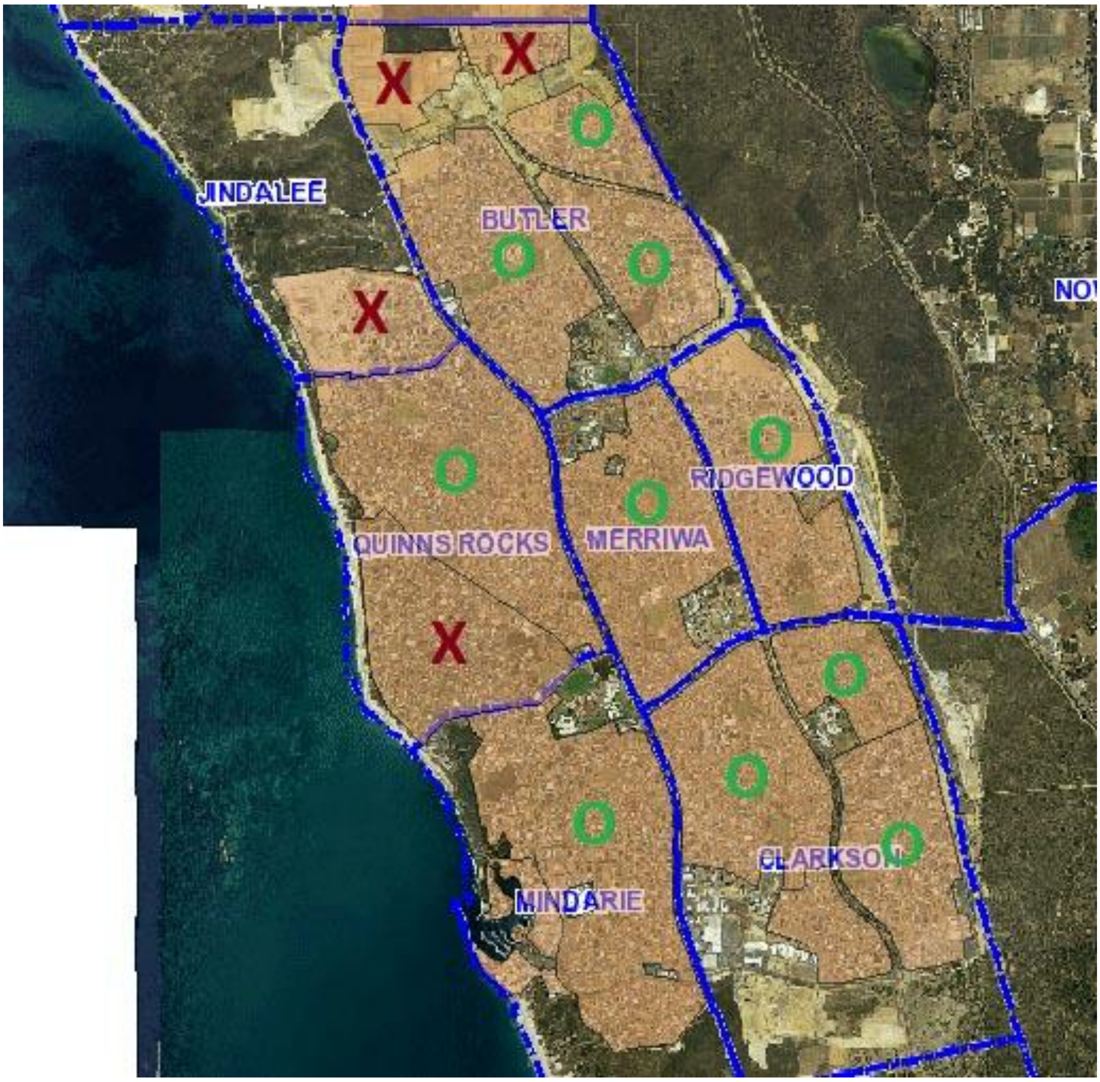


Figure 34: Completed and LN planned residential areas included in Coastal Wanneroo (green circles as opposed to red crosses)

For each residential area in each of the four residential districts, the total proportions of local parkland were calculated (% local parkland/residential area). This figure indicated how close to the 10% standard, in place since the introduction of the S-H plan, the proportion of local parkland fell. The proportions of each ecological landscape patch relative to the total residential area were also calculated (e.g. % vegetation/residential area), along with local playing field patches (% local playing fields/residential area). A baseline standard for each landscape type was calculated from the average proportions of the landscapes across all residential areas in Altone and South Wanneroo. Similar averages were calculated from the identified residential areas within Ellenbrook and Coastal Wanneroo, with gaps indicating either an increase or decrease in ecological/sporting landscapes from the S-H standards. As well as this baseline standard, the percent of playing fields within local parkland was also compared against a standard of 1.4%, which was used in the original study as an indicator of adequate provision for local playing fields.

Table 2: Indicators for local provision used in investigation.

Local Park Indicators
% local parkland/residential area
% remnant vegetation/residential area
% seasonal drainage/residential area
% permanent water/residential area
% ecological landscapes/residential area
% local playing fields/residential area

The second step required determining comparable indicators of sporting landscapes that were in part or fully located outside of residential areas. To begin with, the proportion of each different type of playing field (local, school, district) of the total area of playing fields was calculated (e.g. % local playing fields/total sporting area). Following this, a comparable indicator for the total area of playing fields then had to be determined. Given that regional sporting fields lie outside of the calculated residential areas, the % residential area value is effectively redundant; creating an indicator scaled by an area when some of those playing fields lie outside of that area produces a meaningless value. Relevant indicators for the total area of sporting fields were instead calculated based on current and forecast population figures from 'forecast.id' accessed from each LG website (m^2 playing field/resident). While this allowed for comparison between districts, it didn't allow for a judgement on whether the figure was in itself likely to be 'adequate' in meeting local demand for organized community sport. To make this assessment, the same standard was used from the original study: 6.5m^2/resident. Two different indicators were created: one using the forecast 2016 population to roughly indicate current demand, and one using the forecast 2021 population to roughly indicate future demand.

Table 3: Indicators for district park provision used in investigation

District Park Indicators
% local playing fields/total sporting area
% school playing fields/total sporting area
% district playing fields/total sporting area
m^2 playing field/resident 2016
m^2 playing field/resident 2021

The process to produce these indicators utilised various functions within Microsoft Excel spreadsheets, and has little theoretical relevance in terms of broader public park and resilience research. As such, it is not outlined in full here, but is contained within Appendix 1.

5.2.3 Limitations

There are some significant limitations of this approach that should be noted and considered in context with the results.

As noted, the standards for total area of playing field were taken from the original study. It provided a standard both for the % of playing fields relative to the total residential area (1.4% of the residential area) and relative to the projected population ($6.5m^2$/resident). These standards were determined in 2012 through a combination of quantitative analysis and a consultative process with Local Government and recreation planning stakeholders (Middle, Tye and Middle 2012). It was noted in the original study that these figures should be taken as indicative benchmarks only, and not to be rigorously followed. As such, they serve in this current investigation only as guides for what might be considered 'adequate' provision of community playing fields at both the local and district level.

Using a spatial value such as total residential area to create landscape indicators assumes a constant residential density exists across all suburbs. When considering ecological values of these landscapes, such as for biodiversity, this is not so much of a concern. However, it may produce misleading indicators when considering their value to communities: for example, two suburbs of similar spatial size and with similar total areas of local sporting fields but with significantly different population densities or demographics. This is therefore an inherent limitation of the % playing field/residential area indicators, and a further reason why indicators calculated using population projections were used for sporting playing fields.

It should also be noted that indicators for the different ecological park landscapes are not a comprehensive reflection of the extent to which the park systems in the case study area actually provide ecosystem services. Creating quantitative indicators for a concept with the complexity of biodiversity ideally involves consideration of context-specific factors that exist over multiple scales (Kohsaka 2010). For example, under urban ecological resilience theory, assessing biodiversity should include an analysis of the level of connectivity between these landscapes, rather than simply their cumulative areas. This approach also assumes that all areas of remnant vegetation have equivalent biodiversity value, which is unlikely. A more detailed approach might have distinguished different bushland areas based on vegetation density, for example. The Stockholm Biotope was compiled through rigorous research and mapping at expert level (Stahle 2006), which presumably allowed it to address some of these additional factors. Given the scope of this thesis, such expertise was not available in the creation of the biotope.

Similar complexity in ecological and social value exists for water landscapes, both permanent and seasonal. While it could be assumed that permanent water areas will generally serve an ecological function whilst providing some recreational value, this value may vary. In fact, it has been suggested that water features planned with an aesthetic purpose in mind may actually represent unsustainable use of Perth's sensitive urban water resources (Grose and Hedgcock 2006). Additionally, it is doubtful whether many seasonal drainage areas have significant recreational value when not flooded.

Despite these limitations, it should be remembered what the aim of creating the indicators was. These indicators were not proposed as a robust method for assessing the multi-functionality of different ecological landscapes: whether bushland was used for recreation or education; whether permanent water areas served a useful ecological function; or whether seasonal drainage areas actually functioned as recreational areas when dry. Rather, the aim was to simply create indicators for landscapes that had the *potential* to facilitate ecosystem services by being functional at multiple scales. Consequently, going into more detail into the classification of these non-sporting landscapes would be of little value to the aims of the research question. This limitation is addressed to some degree in the subsequent investigation of the design of sporting parks in Chapter 7 including discussion as to how these ecological landscapes can most effectively provide opportunities for cultural ecosystem services.

5.3 Observations

As well as building on the original study with its focus on the location of sporting parks using its spatial mapping methodology, this research also goes into more detail into the design of sporting parks and how the design influences its use by local residents. This required techniques that gather data directly from human users of these parks, which can then be related to the capacity of these parks to facilitate cultural ecosystem services. Two common techniques for investigating park use are discussed here: observations and questionnaire surveys.

5.3.1 Overview

As outlined by Kawulich (2005), observation represents one of the fundamental methods for data collection in social research. It refers to the process of learning about the activities of people within their natural setting, including through description of events, behaviours and artefacts. As such, while it can involve the active participation of the researcher, in other situations it may require a degree of 'deception and impression management', so as to ensure that those being observed are acting in a natural manner. Importantly, observation is also useful for developing more detailed guidelines for sampling and other data collection techniques (Kawulich 2005). Denscombe (2014) identifies two broad forms of observations for social research: systematic observation that that generates quantitative data and enables statistical analysis; and participant observation that produces qualitative data more capable of shedding light on cultural processes in the observed population.

Observation of park user behaviour is an established technique for investigating how the design of parks and green spaces influences their use. For example, Tzoulas and James (2010) preferred observations spaces over other data collection techniques such as questionnaire and interview methods for their research on public green spaces in England. This was based on the rationale that it allowed data to be collected about users without them being influenced by the impression that they were being studied at that time, thus reducing any potential response bias from users changing their behaviour (Tzoulas and James 2010). User observations have also been previously employed in research on public park design and use in Perth (Giles-Corti et al. 2005).

Observational studies of public spaces have been undertaken at varying levels of detail, ranging from descriptive to more quantitative and methodical approaches. For example, several papers have investigated quantitative methodologies for linking patterns of use within public spaces with their design. These approaches involve linking observations of user behaviours with GIS mapping techniques (Golicnik and Ward Thompson 2010; Marusic´ 2011; Ostermann 2010). It is suggested that this integrated methodology – 'GIS Behavior Mapping' – has potential to provide design guidance based on diverse uses of public spaces, and also for making better use of the irreplaceable role of GIS for analyzing and displaying spatial planning data beyond its current limited application (Marusic´ 2011).

For this investigation, GIS behaviour mapping offered a *potential* tool for investigating the ability of each park to facilitate different cultural ecosystem services. Such a hypothetical approach would begin by compiling a list of common park activities, with each activity categorised under the cultural ecosystem service(s) it was likely to provide access to. For example, typical passive activities – sitting under a tree, relaxing, enjoying nature – would be classified as restorative; physical activities – from walking up to running – would be classified as moderate or vigorous; while social activities – from saying hello to meeting with friends – classified as bridging or bonding interactions. Sporting and ecological areas within the parks could then be observed to determine the activities that were most prevalent in each, indicating the extent that each area is able to facilitate different cultural ecosystem services. Observing the park at different periods of the day would allow for changes in use of the park throughout the day, including how the park was used for non-sporting activities both during and outside of organized sporting use, which would allow for investigation of the influence, if any, of organised sport on different park activities in different park areas.

5.3.2 Limitations

There are however significant limitations of park observations and other 'external' planning techniques under a resilience framework. As established in the theoretical discussion, a key insight of human health resilience theory is that environmental resources do not act to facilitate resilient outcomes universally across diverse populations. Understanding the basis for this variation is essential to designing a methodological approach that best allows for investigation of the potential of a park to facilitate cultural ecosystem services. As introduced in Section 3.3, resilience arises from specific processes that an individual undertakes to cope with and adapt to adversity. The level of protection afforded to the individual from these processes depends on both their culture (e.g. the values and practices that an individual identifies with) and context (e.g. socio-economic circumstances and exposure to risk) (Ungar 2012). In short, a process generally likely to lead to a resilient outcome will function in different ways depending on both the situation in which it occurs and the individual themselves.

The need to distinguish between processes and outcomes in the context of resilience resources can be applied to visits to public parks. Processes in this context could represent different recreational activities that someone might undertake in a park. While some activities are generally indicative of certain outcomes, the same activity can potentially lead to different services being provided in different environments. For example, the outcome that results from sitting in a park will vary according to the surrounding environment: doing so in a pleasant natural area may lead to restoration, or in a casual social area may lead to strengthened or new social ties. Ungar (2012) also suggests that processes that provide the greatest protection will usually be those that are taken in response to a specific type of adversity, or that utilise a specific type of protective factor. Thus, particularly stressed individuals may benefit most from solitary park activities within parks that provide a safe and unthreatening natural environment. Conversely, individuals most exposed to the risk of social isolation will likely benefit more from interactional processes within a park that provide positive social environments.

These insights expose the limitations of observational techniques for investigating human health resilience, and specifically the relationship between restorative and social ecosystem services. It cannot be assumed that all park users who undertake passive activities in a natural green space experience the same outcomes, as it does not take into account how that environment corresponds to the needs of the individual. Similarly, the degree that activities in the presence of other users have lead to new superficial social interactions, and how these interactions may or may not be reinforced over repeated visits to this space, cannot be investigated from observational techniques.

Observations also have limited use for investigating physical activity as an ecosystem service. One of the main ways that a park can increase levels of physical activity is by encouraging users to visit the park through active transport. While in some cases the mode of arrival of visitors can be observed, in many cases it is not possible. Another limitation is that the exact motivations behind the mode of arrival, such as proximity to the park or the specific qualities that make it an attractive destination for neighbourhood walking, would remain unknown. If 5 minutes of active transport to and from a park each day is an individual's only form of physical activity, then by itself it is unlikely to be contributing to improved health. Additionally, the benefits of engaging in active recreation *within* a green space extend far beyond physical activity, as it is quite possible that the same exercise would still be undertaken within an urban environment if it was not for the presence of the green space. Thus, the most valuable outcomes of these processes would be those that come with exposure to the green environment, which again cannot be determined through external observation.

5.3.3 Application

With these limitations in mind, observations were not pursued as the primary data collection method for the design investigation, with a questionnaire method instead developed (see next section). Instead, both systematic and participant observations were employed as a secondary and complementary method to questionnaires – similar in this sense to the mixed methods approach taken in the paper by Giles-Corti et al. (2005). Systematic observations allowed for a limited analysis of the makeup of the population of users for each park location, and further for broad trends in the use of each location by its population to be uncovered. Participant, or qualitative, observations also allowed for some descriptive analysis on park usage within each area, which complemented the more detailed questionnaire results in the discussion and synthesis sections of the design investigation.

As discussed by Harnik and Kimball (2005), accurately counting the number of users of well-used parks is virtually impossible. Manual counting of park users, or 'census' methods, are costly and time consuming in themselves, providing only a small snapshot at a specific time of day and thus allowing for only a limited analysis unless replicated across multiple time periods and days. As such, simpler and less expensive methods are often employed. 'Sampling' is where numbers are counted within different locations and then a set of ratios developed that allows for the number of users in multiple locations to be estimated from counts within a single location. Finally, 'estimates' are where potential parks users are surveyed about they frequency of use of a park, with its total use then extrapolated from these responses (Harnik and Kimball 2005). While it is noted that these latter methods have potentially fatal flaws, including overlooking out-of-town visitors and one-off special event users, these are more relevant to large inner city tourist parks rather than local parks investigated in this research.

With this background in mind, an estimation of the population of users of each park area was made via observations over the course of a single day. As counts of users were required only of specific small areas within each park, which could be observed fully from a single location, sampling ratio methods as outlined above was not necessary. At each park location, observations were undertaken over 12 daylight hours from 7am to 7pm, with short comfort breaks taken roughly every 3 hours. It is possible that some users were missed, however given breaks were typically less than 15 minutes in length, and the average observed duration of visits to each park was at least 15 minutes for each park (see Section 7.2.2), any omissions are unlikely to be significant. Observations on both parks were undertaken in February 2016: the last and often hottest month of summer in Perth. In line with the rationale of Giles-Corti et al. (2005) to reduce variation in weather dependent behaviour, observations were only undertaken on sunny days where the daytime temperature ranged from 20C to 32C. Each unique user during that period was recorded. Additional information including gender, approximate age and duration of visits were also recorded, allowing for some reflection on the representativeness of the subsequent questionnaire sample for these variables, as well as comparison between the demographics of each area.

The obvious limitation of this approach is that it captures the population of the park and its use across only a single 12-hour period. While it was decided to observe on a weekday, as this was more representative of the daily use of the park than a weekend, it is likely that usage patterns would alter on a weekend. It is also likely that usage would change during cooler months with less daylight hours. The results of these observations should therefore be considered a 'snapshot' of the general use of each area by a sub-section of its total user population on a summer weekday.

In addition to the observations undertaken for investigation of the design research questions, further observations were undertaken to allow for a more comprehensive investigation of one aspect of the location investigation. One of the premises of this investigation is that the co-location of sporting parks with local schools may allow the playing field to be better utilised for active recreation throughout weekdays, when it may others be largely unused. For an initial test of this hypothesis, observations of school time use was undertaken of the playing field of a co-located park in Ellenbrook: Charlotte's Vineyard Oval. The general area of use during recess and lunchtime by students across a single day was sketched onto a site plan of the park. While clearly a limited investigation only, it did allow some insight into the potential for the multi-functionality of playing fields to be increased through co-location.

5.4 Questionnaire Survey

With the discussion of the limitations of observations in mind, a more suitable method for investigating public park design under resilience theory would be capable of overcoming assumptions that the same activities will lead to the same outcomes in individuals. It has previously been suggested that this barrier between the top-down systems world occupied by planners and the real world of local citizens can be overcome through *dialogue activities* such as interviews, focus groups and questionnaires (Stahle 2006).

Questionnaire surveys have particularly promise for the design investigation. De Leeuw, Hox and Dillman (2008) define surveys broadly as any method used to gather information from a specific sample of people. When properly designed and implemented, they allow for precise estimates to be made despite surveying only small proportions of a total population that is of focus (de Leeuw, Hox and Dillman 2008). Surveys employed in small-scale social research projects, such as this current research, may employ a range of techniques to gain representative data from a population: typically questionnaires administered either face-to-face or through distance means such as telephone or post, but also through systematic observations or document analysis (Denscombe 2014). Questionnaire surveys (questionnaires from hereon in) have been a widely-used method for investigating the relationship between green spaces and different subjective human variables such as values, attitudes and preferences. They are therefore better suited for investigation of a concept such as human health resilience, and hence this specific research context. Drawing on this literature, the following section outlines the rationale and design of the instrument used for this investigation.

5.4.1 Instrument Design

The specific design of the questionnaire instrument and method for this research, provided in Appendix 2, considered a range of factors that have varied in previous use of questionnaires on public parks and green spaces: scale of focus; location either off site or onsite; and the type of data collected. Specific questions were directly informed by insights from the theoretical framework so that they could more effectively investigate the complexity of how cultural ecosystem services are facilities by public parks.

The scale and focus of previous applications of questionnaires to public parks and green spaces varies significantly. Some studies used the technique to gain data about various issues relating to park and green space planning in general (Ward Thompson et al. 2005; Ward Thompson, Aspinall and Montarzino 2008); others used the technique to determine the variations in values between different parks in a case study area (Mäkinen and Tyrväinen 2008; Tyrvainen, Makinen and Schipperijn 2007), or the different use and values associated with a specific park (Chiesura 2004). The scale of focus for this thesis is on specific recreational areas created around ecological landscapes within different sporting parks, rather than the park as a whole or the neighbourhood's broader park system. Thus, questionnaires were undertaken to gather data relating to the experiences of users specifically within these areas, with questions that also referred to the influence of the sporting area of the park.

Another way in which applications of questionnaires can vary is whether the perspectives of participants are captured on-site or off-site. On-site questionnaires require intercepting users within the park and gaining their responses during their visit (Chiesura 2004), while off-site questionnaires utilize techniques such as postal mail outs (Mäkinen and Tyrväinen 2008; Tyrvainen, Makinen and Schipperijn 2007) or, more recently, through on-line responses (Brown and Weber 2011; Rantanen and Kahila 2009). The delivery and completion of questionnaires on-site have been used effectively to determine user relationships within a specific park, and have the advantage of ensuring a greater rate of response and more accurately capturing the users' immediate experience within the space (Chiesura 2004). Such accuracy is particularly important for the purposes of this investigation, so that perceptions could be related directly to the specific recreational zone of the park being investigated and its environmental qualities. Users would be able to reflect directly on the park environment and how they used and valued it as they answered the questionnaire questions. For this reason, on-site questionnaires, where the perspectives of residents were captured within the specific recreational zone within the sporting park, were determined to be most appropriate.

Much like observational studies, subjective questionnaire techniques have also been undertaken at different levels of detail, including at the quantitative spatial level. The integration of human perceptual data into GIS format has received increasing attention as a systematic way to include the human landscape dimensions into planning agendas (Ryan 2011). The sociotope created for the City of Stockholm's Green Map appears to be one of the first notable attempts at this integration (Stahle 2006). Another recent example – itself inspired by the original Stockholm sociotope – is the concept of *social value mapping* by Tyrväinen, Mäkinen and Schipperijn (2007), which combined a questionnaire based method with GIS mapping. The value maps created through this technique allowed for both a range of different values for each individual park to be identified, and for highly valued sites and problem sites to be distinguished.

Based on previous research, it was determined that a range of both quantitative and qualitative questions would be the most effective method for this investigation. In line with the study by Tyrväinen, Mäkinen and Schipperijn (2007), quantitative data for the value of different sporting park recreational zones for different cultural ecosystem services was determined by asking park users to rank the park area for a range of activities and outcomes on a Likert scale from 1-10: one being lowly valued and 10 being highly valued. Mapping these values on top of the biotope layers could have been a useful but not essential further step, and was not pursued.

However, focusing only on numerical values would have limited the potential of the technique for the aims of this investigation. Perceptual data can be highly variable and often contradictory in nature (Faehnle, Bäcklund and Tyrväinen 2011). Reducing these perceptions down to numerical values can therefore be limiting in terms of capturing such complex data. Gathering more descriptive responses from park users for different activities and outcomes would add further depth to the quantitative method. Additionally, collecting quantitative responses for some of the factors investigated was not practical. For example, gathering information relating to the influence of environmental qualities within different recreational areas and in the park as a whole, including the effect of organized sport, would require more qualitative responses from the users. Extra space was therefore provided under the value-ranking questions, allowing any additional comments on different activities and outcomes to be recorded along with the ranking. Using this method, questionnaires were open-ended enough so that they could be extended into informal interviews that extracted extra qualitative data from more engaged participants.

The more detailed structure of this questionnaire was guided by insights gained directly from ecosystem services research and resilience theory. Firstly, values were collected both for different common park activities (for example walking, sitting, observing) and outcomes that might arise from these activities. For physical activity, both walking and vigorous exercise were investigated as forms of active recreation. Investigation also went beyond activities within the park, and included the means of transport by which a user arrived at the park and the contribution to the individuals' overall levels of physical activity.

For the ecosystem service of mental restoration, two separate outcomes – stress restoration and attention restoration – were distinguished. The outcome of 'relaxing' was used for the former, while 're-focusing and re-charging' was used for the latter. The individual contributing factor of both 'being away' from challenging environments and the presence of natural components likely to actively facilitate restoration were also investigated. For these purposes, the outcome of 'escaping everyday life' was used for the former, and 'greater appreciation of nature' used for the latter.

For the service of increasing social interactions, the activity of interacting with other park users and the subsequent outcomes of increased social ties were distinguished. Also distinguished were the outcomes of bonding and bridging ties and capital, the latter able to be created through largely spontaneous and superficial interactions as basic as simply observing others within the space. Hence, activities of 'observing other users' and 'interacting with other users' were included, as well as the outcomes of 'creating new relationships' and 'strengthening existing relationships'. Noting the increased likelihood of social interactions that come with longer visits, a question was included at the start of the questionnaire on the typical duration of visits.

For the service of environmental education, the activity of passively 'observing nature' was distinguished from actively 'engaging with nature'. Similarly, the outcome of a 'greater appreciation of nature' that might arise from passive exposure to restorative features was differentiated from the accumulation of new ecological knowledge from more active engagement.

To allow greater exploration of the environmental qualities that were central to facilitating specific outcomes, more open-ended questions were included at the end of the questionnaire that allowed users to describe the physical features and presence or lack thereof of other users that contributed most to the main outcomes of their visits. This included any negative outcomes of visiting the area. This was followed by several open-ended questions looking specifically at the influence of organized sporting landscapes and activities on their use of the park and its outcomes.

To investigate the potential of each of the four ecological landscapes to facilitate cultural ecosystem services, this questionnaire method was administered across the three case study sporting parks. An initial round of questionnaires was administered in April 2014 at each park: 16 at Ridgewood, 15 at Coolamon and 6 at Charlie Gregorini. A second round of questionnaires were then administered at Ridgewood and Coolamon parks in February 2016 to bring the total sample size for each park up to 30: as recommended by Denscombe (2014). Further discussion of this administration process and its implications are given in Section 7.2.1.

5.4.2 Limitations

There are several limitations of this method for investigating the design research questions. A discussed further in Section 7.2.1, the most significant is the small sample size gathered from the questionnaire, which was at the low end of the scale deemed acceptable for small-scale social research. There was also the issue, also discussed in Section 7.2.1, of some variance in the results from the samples across the two periods of questionnaire administration.

Beyond these sampling issues, several limitations of the questionnaire method itself should be acknowledged for investigating the use of public parks under the theoretical framework. Ideally, investigating a concept such as human health resilience would require actual measurement of different indicators of health and relating them either to access or number of visits to local parks. They would also take into account the background of the individual, including their relative exposure to different health risk factors. Such approaches native to health disciplines are outside the scope of this planning-based research.

Looking beyond this issue, the questionnaire method selected is limited by only investigating residents actually using the sporting parks. It is suggested by Ryan (2011) that, to pick up the perceptions and attitudes of individuals who may not find meaning within their local green space, the individual themselves should be made the unit of analysis in subjective data collection methods, rather than the park. This is one flaw of on-site questionnaires (and observations): they only capture residents who are actually using the park under investigation, producing data that is not representative of the entire community. Thus, the results of on-site questionnaires should not be seen as representative of community-wide attitudes, but of those who actually use the park.

Another theoretical limitation of this questionnaire method is that it does not consider the culture and contexts of the individuals, and how outcomes from park visits might vary based on these variables within the sample of users intercepted. Even with a large sample size of park users, this would be a difficult variable to investigate in the questionnaires; asking questions about an individual's race and cultural background is likely to be sensitive. Thus, apart from relatively basic demographic questions such as age and gender, these socio/cultural variables were not further investigated. In retrospect, however, questions that enquired about the specific extent of different risks in each individual's lives would have been useful: for example, if users of a more social park environment were more exposed to social isolation in their lives.

5.5 Expert Interviews

One perspective so far missing from these methods are those most intimate with the planning processes underlying the provision of public parks in outer suburbs, along with those responsible for the ongoing governance and management: namely the relevant LG's. Gaining such perspectives is crucial to uncovering barriers and limitations to different locations and designs of sporting parks that are not immediately apparent from an academic investigation. To gain these perspectives, a series of interviews were undertaken with individuals involved in public park planning in Perth.

Denscombe (2014) suggests that interviews are an appropriate method whereby more specific and detailed information is required from a relatively small number of participants as opposed to more superficial information from a wider sample. They are also useful when the investigator is seeking to access privileged information from key plays in the relevant field (Denscombe 2014). Interviews have been central in recent research seeking to gain holistic perspectives of public park planning in Perth, by allowing access to those individuals intimately involved in their planning and governance. Parks and Leisure Australia's position paper on public open space planning in Perth was compiled with interviews, along with workshops and discussions, with individuals and organisations involved in the planning process, notably LG officers and consultants (Carter 2011). Similarly, Grose (2009) used a series of open-ended interviews with a range of randomly selected stakeholders in order to provide a balanced analysis of the issues surrounding the planning and governance of public open space in Perth.

For this research, perspectives were gathered through two interviews with experts in public park planning within the case study area between October 2014 and January 2015. The first interview was a one-on-one interview with a local planner in a current position with Parks and Leisure WA – the peak industry body for professionals in the parks and recreation planning industry. The subject also formerly held a position in open space and community facilities planning at the City of Swan. This included working on many key open space projects in Ellenbrook, including Coolamon Park, one of the case study parks. As such, perspectives could be gained relating to issues both general in Perth's new residential developments and those specifically in Ellenbrook. The second interview was undertaken simultaneously with five employees of the City of Wanneroo, each involved in different aspects of public park planning, governance and management. This included a facilities planner who dealt with local park policy, a planner who dealt with approval of local structure plans, a landscape architect and two individuals involved in the day-to-day use and management of local parks.

Turner (2010) outlines three broad types of interviews available to investigators: 'informal conversation interviews' where questions arise largely spontaneously and conversation evolves naturally; 'general interview guide approaches' where more structure is provided whilst still allowing for a degree of flexibility; and 'standardized open-ended interviews' where questions are carefully worded and the structure of the conversation is tightly controlled. The interview process employed could best be described as a general interview guide approach. Each interview consisted of a series of prepared questions encompassing the general issues relating to public park planning, along with specific questions relating to the location and design of sporting parks (see Appendix 3). Conversation was allowed to flow beyond issues directly addressed in the questions, and was useful in gaining alternate perspectives on the same issue in the group interview. Conversations were recorded but not transcribed, with notes also taken during proceedings to identify the times that key themes were raised. Interviewees signed consent forms acknowledging their participation in the research under the condition of anonymity, and left contact details in the case of further questions arising.

6. Location of Sporting Parks

This chapter investigates two research questions relating to the location of sporting parks outside of their traditional place within a suburb's 10% provision:

What are the benefits and limitations of sporting parks co-located with local schools for facilitating ecosystem and sporting services under resilience theory?

What are the benefits and limitations of district sporting complexes for facilitating ecosystem and sporting services under resilience theory?

6.1 Locating Sporting Parks Under Resilience Theory

Before directly addressing the benefits of each alternate sporting park location, this investigation begins by applying the theoretical framework to test the assumption that the shift from sporting to ecological landscapes as the dominant features of local park systems is indeed positive. This is achieved through a discussion of the respective values of sporting and ecological local park landscapes in terms of providing multiple park functions: i.e. their multi-functionality. It then discusses the relative merits of each alternate location, in terms of their potential to meet demand for local playing fields outside of local park provisions, and then to more effectively provide sporting services to local residents.

6.1.1 Organised Sport as a Source of Human Health Resilience

Given sport is most commonly understood as a form of physical activity, it is in the context of this ecosystem service that this discussion of the role and value of sport is commenced. Community sport represents a valuable mechanism to encourage sections of the population to be physically active, particularly younger demographics. In Australia for example, sports participation rates are highest in adolescents, where it makes up over half of all moderate-to-vigorous physical activity for 9-16 years olds (Olds, Dollman and Maher 2009). Thus, as a source of exercise for young people, organized sport could be hypothesized as one of the 'when, how and for whom' factors that could mediate the relationship between green space and population-wide levels of physical activity identified by Lachowycz and Jones (2011, 187).

Sports participation also brings other health benefits as a form of physical activity. As discussed by Asztalos et al. (2009), sports participation has the added benefits of recreation, enjoyment and social interactions compared to other forms of exercise. As such, sport generally represents a chosen or elected form of exercise, rather than more utilitarian physical activity done out of necessity or obligation. It can also provide participants a sense of joy that comes with mastery and autonomy. All of these factors may explain their finding that, out of five different forms of exercise, sport alone was shown to decrease stress and distress (Asztalos et al. 2009). In this context, sport may be more effective at restoring indicators of mental health than forms of active transport, as well as other forms of green exercise less engaging and enjoyable. Given the suggestion of Bird (2004) about activities where physical exertion is not the primary motivation, the added enjoyment of sport may make it a more sustainable form of physical activity for young people. That said, sport is not always leisurely in nature, and has its own requirements for utilitarian exercise: to build up fitness during preseason, for example.

Even during these more utilitarian times of participation, the social nature of many team sports undertaken in public parks can confer unique benefits to participants. Participation in sporting clubs provides opportunities both for structured (sporting competition) and unstructured, non-participant social involvement – the latter being one of the key functions of community sporting clubs (Eime et al. 2010). In fact, it is suggested that these social aspects of organised sports participation may be the main reason why club and team-based sports are associated with improved health outcomes compared to individual activities (Eime et al. 2013). As well as having individual health benefits, the social aspects of organised sport also play a broader role. This extends to non-participant involvement such as through volunteering, which plays a significant role in promoting active citizenship and fostering positive social networks (Commission of the European Communities 2007).

Sport as a form of park recreation could also have a unique role in creating social capital. Ungar (2011a, 1745-1746) outlines two different forms of social capital. The first is the 'collective commons' of a community, typically based on common sense of purpose that can be facilitated simply through the provision of public spaces in which to gather. However, at other times the 'serendipity of social support' may not be enough, particularly when factors such as migration and violence may have broken down informal social networks. In these cases, coordinated services and formal programs may be required to create meaningful social capital (Ungar 2011a). In the context of park recreation, forming the social capital required to support at-risk individuals during times of crisis may require formal park recreation rather than simply the provision of an attractive public green space. Organised sport, along with other formal park activities such as group fitness sessions, would be examples.

Sport can also provide educational benefits, albeit not with the environmental focus possible from activities in a natural environment. Sports competition presents opportunities for 'moral education', where habits of virtue such as teamwork, responsibility and courage are instilled into participants through repeated practice (Parry 2012, 3). Sports participation can also be complementary to broader educational goals: diverting at-risk youth from anti-social activities whilst providing motivation for academic performance (Holt et al. 2011). Further, participation in sport has been linked to a range of positive health behaviours relating to fruit and vegetable consumption, tobacco and illegal drug use and sexual intercourse compared to non-participants (Pate et al. 2000).

Most relevant within the theoretical framework of this thesis is that sport is of most value to vulnerable individuals. Notwithstanding the potential risks of sport (e.g. injury, delinquent behaviours, misuse of alcohol and exposure to illicit drugs), sport is at its most valuable when provided to at-risk individuals who are unable to access the range of benefits it provides through other pathways (Holt et al. 2011). Providing health services though organised sport is therefore in line with how public parks should best be planned under resilience theory as discussed in Section 3.3.1, which is to target socioeconomically disadvantaged communities and their most vulnerable individuals. It is in this context that the health-services provided by participation in organised sport – sporting services – can be considered to have potential to increase resilience to health risks in the same way as ecosystem services.

6.1.2 Limitations of Organised Sport as a Source of Health Resilience

Conversely, sport also has significant limitations as a form of park recreation. For example, its value as a source of physical activity specifically for young people also makes organised sport limited as a source of physical activity across populations. While older demographics may still remain involved in sport in some way, reasons such as time constraints and physical demands mean they can no longer rely on it to meet their exercise needs. Indeed, the benefits of sport may be limited even within younger age groups: the aforementioned study also found participant levels in Australia peaking at age 12-13 and dropping by almost 50% by the age of 16 (Olds, Dollman and Maher 2009). This is supported by another recent study into organised sports participation (Walters et al. 2009). This study found that, while younger age groups most commonly participate in sport, participation drops off significantly following school years. This research raises questions of the dependence on sport as a form of exercise in younger demographics. It is possible that an over reliance on sport for a source of physical activity in youths can lead to insufficient exercise levels in years following high school, when sports participation inevitably decreases, and particularly for socioeconomically disadvantaged groups (Olds, Dollman and Maher 2009). The alternative argument from the previous section could thus be made: that an oversupply of sporting playing fields in public parks provides an explanation for the inconclusive relationship between green space provision and population-wide levels of physical activity.

This argument is supported by the popularity of sport as a form of park recreation. Tzoulas and James (2010) suggest recent observational studies have consistently shown that only a small proportion of green space activities are sporting, and that in general a majority of users undertake informal rather than formal activities. These findings suggest that only a small proportion of park users probably access the significant health benefits possible through participation in organised sport. The active recreation planning era, and specifically the systematic provision of organised sport, therefore represents both the potential and limitations for public parks to facilitate physical activity.

Further, there is also the potential for exposure to additional risks that can come with sports participation. While beneficial for many vulnerable individuals, it may not be effective for every individual. For example, several studies have found that, despite the *potential* of sport to facilitate bridging social interactions and capital between at risk individuals, it can also expose them to negative social encounters such as discrimination and aggression (Spaaij 2012; Walseth 2008). Another study found that participation in specific forms of organised sport was related to increased substance use both in males and females (Moore and Werch 2005). Thus, the relationship between sports participation and improved community outcomes is not straight-forward, and further supports the suggestion that participation in organised sport is not for everyone.

Lastly, perhaps the most significant limitation of organised sport as form of park recreation is its limited potential to provide contact with nature for participants, unless it is linked to other forms of recreation.

6.1.3 Multi-functionality of Sporting and Ecological Park Landscapes

The value of sporting areas compared to other local parks landscapes under human health resilience theory is thus clearly complex. On the one hand, they provide a similar range of health-promoting services compared to natural landscapes, and specifically to at-risk individuals. On the other, organised sport provides these to only a small proportion of the population, while also not without its own risks for participants. In this context, organised sport represents a primary example of the social and cultural variation that exists within public park and urban green space planning. Throughout the evolution of public park planning, it could be argued that the same four broad categories of human benefits – physical, mental, community and educational – were still provided, albeit through a different mechanism. In the Victorian era, health benefits were gained primarily from the open space and rural character provided by the first parks. During the active recreation era, health benefits were primarily provided through the form of social engineering that is sport, including both sports participation and the process of belonging to a sporting club. Recently, the dominant mechanism for providing health benefits has again shifted towards the provision of natural landscapes and the services they provide to urban residents.

One way to assess the effectiveness of this shift is through the concept of *multi-functionality*, as introduced in Section 3.2. While sporting park landscapes are not used purely for organized sport, their functionality under urban ecological and human health resilience theory is limited compared to other park landscapes. As already discussed, sporting areas have limited ecological value, while their use of groundwater resources arguably makes them of negative value to strategies to increase ecological resilience. Further, the health benefits that they provide are likely to be accessed by only a small proportion of park users. Outside of sporting times, the wide open spaces of playing fields have the potential to function as venues for a range of recreational activities: including informal sporting play, but also other formal activities such as group or personal fitness and dog walking groups to name a few (the value of sporting areas for non-sporting use is discussed further in Chapter 7). Yet it could also be argued that smaller grassed spaces in greener surrounds may still be able to represent alternative, and possibly more attractive and beneficial, venues for these other types of active recreation.

In contrast to sporting areas, many of the multi-functional practices outlined above are common in ecological landscapes in public parks in Perth. As well as providing a biodiversity conservation function, pathways and rest areas are often integrated into or above remnant bushland and wetland areas: potentially turning them into accessible natural park environments removed from the surrounding environment for users seeking mental restoration. The addition of educational signage into these paths may facilitate opportunities for environmental learning, which in turn could lead to restoration efforts that increase its ecological value. Alternatively, as discussed in Section 3.2.3, biodiverse landscapes will not be valued equally by all residents, with many preferring more manicured landscapes, and possibly even sporting areas.

Permanent water landscapes may also perform both ecological and recreational functions at once. Permanent water bodies can also serve as wildlife habitats: both temporary for bird species and permanent for water-based species (Scheffers and Paszkowski 2013). These areas therefore have the potential to contribute to local biodiversity in the same way as vegetated areas but for different species. Wetlands in particular have been suggested to be the most valuable landscape types in urban areas, given their ability to provide many of the key ecosystem services found in urban areas, including cultural services (Bolund and Hunhammar 1999). The use of features such as boardwalks and lookouts to increase their aesthetic value are examples of the multi-functional practice of vertical integration.

A variation on these typically permanent water areas are drainage basins that may be dry outside of periods of high rainfall. Stormwater drainage areas in Perth provide numerous functions simultaneously: protecting communities against localized flooding, whilst also helping to maintain the quality of groundwater resources by retaining stormwater runoff and removing pollutants (Grose and Hedgcock 2006). Seasonally dry drainage areas that also function as recreational surfaces represent examples of real-time scheduling: where different ecosystem services can be provided in the same location but at different time periods (Ahern 2010).

This overview is purely theoretical, with the multi-functional potential of these landscapes to facilitate cultural ecosystem services likely to be dependent on a variety of context-specific factors. However, it does suggest that sporting park areas are significantly limited in their multi-functional potential when directly compared.

6.1.4 Balancing Sporting and Ecological Landscapes in Local Parkland

That ecological landscapes likely have greater value under the theoretical framework of this thesis is significant when considering what proportion of local park provisions they should comprise.

Alberti and Marzluff (2004) suggest that the replacement of ecosystem services with human services in urban areas is likely to be unsustainable over the long term. This is essentially what has occurred across the evolution of public park planning. Sporting services were not introduced in new parks at the start of the 20th century to complement the existing function of conserving nature and providing access to its inherent health benefits. Rather, it saw the replacement of ecological services with social, and specifically sporting, services; natural features largely made way for maintained landscapes and built infrastructure. In this context, the shift to active recreation and organised sport meant that public parks were no longer providing one of their most fundamental functions. It can therefore be argued that a shift back towards nature as the primary source of health-promoting park services was both necessary and inevitable.

These conclusions are reflected in the extra focus given to ecological landscapes in Perth park planning. Suburbs planned directly after the release of the S-H Plan were constrained by having 85% of their local parkland dedicated to the primary function of organised sport. Based on the previous discussion, an increase supply of these three types of ecological landscapes – remnant vegetation, permanent water areas and seasonal drainage basins – within the 10% provision would increase the capacity of park systems to provide regulating and health promoting services, assuming they generally represented widely utilised recreational features. This is reflected in requirement 5 of the latest LN draft (Western Australian Planning Commission 2015), which states that 2% (i.e. one fifth of local parkland) be allocated to 'restricted use' features: natural and cultural features, water management areas, artificial lakes and permanent drainage ponds, and natural wetlands. The remaining 8% is typically to be provided for the purpose of both active and passive recreation, however requirement 6 also allows for this 2% to be increased in certain circumstances (Western Australian Planning Commission 2015).

While confirming that ecological landscapes should take precedence over sporting landscapes within local park restrictions, the theoretical framework also emphasises that the value of organised sport for younger and many at-risk individuals must still be adequately acknowledged. While organised sport may be used by only a minority, for these users it remains an important mechanism for accessing the range of health and well-being benefits that public parks can provide. However, based on the findings of Middle, Tye and Middle (2012) and Tye et al. (2012), this increase in ecological landscapes has reduced the supply of sporting areas below the current demand for the sporting services they provide. This takes away from the potential of public park systems as a whole to adequately protect at-risk local residents. For this to be amended without a subsequent decrease in ecological landscapes, alternative mechanisms for meeting the demand for sporting services must be determined outside of the 10% constraints of local parkland.

Two alternate mechanisms for providing community sporting areas are co-location with local schools, and within larger community sporting complexes outside of residential subdivisions. As well as allowing for a greater proportion of ecological landscapes within local park provisions, the following sections discuss how these alternate locations may both increase the multi-functionality of playing fields and enhance the health-promoting potential of the sporting services provided by these parks.

6.1.5 School Sporting Parks

Meeting the demand for sporting services in socioeconomically disadvantaged areas requires making sporting parks as accessible as possible. Communities in socioeconomically disadvantaged areas, such as many of those in outer suburbs in Perth, already face significant barriers to accessing organised sport facilities, including time constraints and travel costs (Dollman and Lewis 2010). Travel is an inherent part of participation in organised sport, particularly at more senior and competitive levels. However, having local access to sporting facilities for training and home games would help lessen the effect of these barriers. For example, Sport England has the objective that sporting parks accessed by disadvantaged groups be easily accessible either by walking, cycling or public transport (Sport England 2005). In addition to these considerations, large and attractive sporting parks that are within walking distance of local residents have unique value as environmental resources under human health resilience theory, as discussed further in Chapter 7. One opportunity for providing accessible sporting parks partly or fully outside of local park provisions is through co-location with schools. This allows for the provision of local playing fields, accessible for community clubs and often non-sporting users, in such a way that a portion of the open space is zoned not as local parkland but as educational land.

As well as allowing the supply of community playing fields to be increased outside of local park provisions, there are other benefits that come with co-locating playing fields with local schools. Perhaps a greater benefit of these arrangements is the potential for making better use of the playing field throughout the day by students, thus overcoming the 'empty oval syndrome' of many community-only parks identified by Grose (2009, 60). Enhancing the multi-functionality of the sporting space in this way would be another example of real-time scheduling, which was noted previously as a key strategy in planning for resilience (Ahern 2010). Thus, this is another way in which sporting parks can be located under the secondary research question.

From the perspective of student recreation, co-location also has the potential to increase the health-benefits of school-time activities undertaken within the playing field. It has been found that school children are more likely to be active on green surfaces than hard surfaces (Andersen et al. 2015), with a study in Perth finding the amount of physical activity of school children increasing with the area of school grassed surface (Martin et al. 2012). Greenery may also contribute to the attractiveness of favourite socialising and play areas (Mårtensson et al. 2014). Green areas adjacent to schools may also represent unique sites for environmental education, allowing these progressive forms of learning to be integrated into everyday school activities (Iojă et al. 2014; Malone and Tranter 2003). Allowing students to engage in the process of making school grounds greener can also be an effective way to develop positive relationships with vegetation and nature from an early age (Jansson et al. 2014). Thus, green school areas may be effective at facilitating the health benefits of school time outdoor activity, while also potentially addressing the 'extinction of experience' outlined by Miller (2005) and the 'childhood factor' identified by Ward Thompson, Aspinall, and Montarzino (2008) that are typically a limitation of recreation within sporting areas. Co-locating may be an effective way to provide adjacent green space to schools, especially when considering the decrease in open space area in Perth schools identified by Martin et al. (2012). The park landscapes that might be most effective at exposing school students to ecosystem services are discussed in more detail in Section 7.3.

To summarise, this overview suggests that co-location of sporting parks can increase the multi-functionality of the playing field area, while also enhancing the health benefits of activities within these areas.

6.1.6 District Sporting Parks

As well as these benefits, co-located sporting parks also have their limitations. Simply providing single playing fields either through local or co-located sporting parks appears unable to adequately meet demand for sporting services by themselves (Middle, Tye and Middle 2012). Under LN, the co-location of local sporting parks, referred to as district open spaces, is generally encouraged (Western Australian Planning Corporation 2009). Given many residential areas only contain a single school site, in practice this would provide only one sporting park. Indeed, LN suggests that district parks would typically serve three neighbourhoods, and hence be located on the periphery of the neighbourhood in which it is located (Western Australian Planning Corporation 2009). In short, these provisions for local co-located sporting parks within LN appear unlikely to be sufficient to meet demand for sporting services. This is supported by the findings of Middle, Tye and Middle (2012), who suggests the creation of community playing fields outside of residential subdivisions, such as within ROS parks, is required to address current playing field shortages.

Further, the size of many local and school-shared sporting parks limits their recreational potential. LN guidelines for sporting parks are between 2.5-7 hectares, supposedly to allow adequate size for grassed and hard surfaces to facilitate organised sport (Western Australian Planning Corporation 2009). A minimum of 2.5 hectares leaves open the possibility that a sporting park in a new subdivision may not actually be provided to a standard to cater for organised sport. As shown in Figure 35, while local school-shared sporting parks in Perth generally allow local access to space for junior competition and senior training, many are too small to contain playing fields of the size necessary for senior competition, and often lack facilities such as change rooms and floodlights. Larger sporting parks would allow for the provision of full-sized playing surfaces and also better supporting infrastructure and facilities, and thus enhance the potential for safe and enjoyable organized sporting recreation.

Figure 35: Sporting park in Perth's outer suburbs without the size and facilities to cater for senior sport; segment of playing field is cut-off due to school buildings (Source: Google Earth).

Under resilience theory, larger sporting complexes may also be able to enhance the social benefits of both formal and informal participation in community sporting clubs. Relevant to this hypothesis are the two forms of social capital outlined by Ungar (2011a). Section 6.1.1 suggested that formal park activities such as organised sport might have unique potential for creating *formal* social capital. However, Ungar (2011a) also notes that in many cases, formal programs for creating social capital are weak substitutes for informal social capital. This is demonstrated by the research also outlined in Section 6.1.2 that suggests sport can actually play an exclusionary and negative social role.

One approach for better utilising the potential of organised sport to create formal social capital is through the creation of 'comprehensive' sporting clubs. Okayasu et al. (2010) define comprehensive sporting clubs as those clubs accessible for a range of age groups and skill levels, including providing opportunities for non-sporting activities; those clubs attractive for a wider range of community members. As such, they have greater potential for creating social capital than limited sporting clubs, and can help overcome criticisms of sport as acting only to further reinforce homogenous social bonds (Okayasu, Kawahara and Nogawa 2010).

Larger sporting complexes are more likely to allow for comprehensive sporting clubs to be formed. Rather than simply facilitating traditional playing field sports such as cricket and various football codes, larger sporting complexes may allow for a range of different sporting and non-sporting recreational opportunities within the same park. It may also allow for the co-location of various sporting clubs at the same venue, allowing for sharing of the same facilities and hence broadening the types of social interactions beyond the often-narrow range of a single sporting club.

Locating these larger sporting parks within local park provisions, including community sporting complexes that contain numerous senior-sized playing fields and facilities, would significantly reduce the ability of local park networks to support regulating services whilst providing sufficient opportunities to access cultural ecosystem services. This requires locating district sporting parks outside of residential areas.

6.1.7 Summary

The previous discussion establishes there are significant benefits to each alternate location for community playing fields. Noting first that ecological landscapes most likely represent more effective use of local parkland, the primary benefit of both alternate locations – but particularly district sporting parks – is their potential to allow demand for access to organized sporting facilities to bet alongside greater provisions of ecological landscape within local park provisions. Further, these locations could also increase the functionality of playing fields as venues for active recreation, whilst enhancing the health benefits of the activities within them. School sporting parks can make better use of the playing field during weekdays, while also providing greener and more attractive outdoor environments for school active recreation. District sporting parks can provide more comprehensive facilities for a range of recreational activities, and may therefore create an environment more likely to facilitate diverse social interactions and the creation of bridging social capital. These insights are summarized below in Table 4.

Table 4: Summary of potential benefits of each alternate location for community playing fields

Alternate Location	Theoretical Benefits
School Sporting Parks	Adequate provision of playing fields at the local level; Enhanced multi-functionality through use by students during weekdays; Enhanced benefits of school-time active recreation through exposure to ecological landscapes.
District sporting complexes	Adequate provision of playing fields at the district level; Better quality facilities for a range of organised sports; Greater potential for social capital creation between both sporting and non-sporting clubs.

6.2 Results and Discussion

To test this primary hypothesis in practice, the spatial mapping approach outlined in Section 5.2 was applied across the case study area and its four specific residential districts. This allowed for a comparison of the ecological and sporting landscapes within local park provisions, and the extent to which these alternate locations have been used effectively to meet demand for community sporting fields.

6.2.1 Establishing Standards

The first analysis established standards for local park landscape patches within suburbs across the districts of Altone and South Wanneroo. It is important to note that these standards were not determined by calculating the average of the averages of these suburbs. Instead, they were determined by calculating the cumulative areas of every park and landscape category, which was then divided by the cumulative area of every residential area. Firstly, a standard was created for the proportion of local parks in each residential area across all old suburbs, which indicated how close the proportions of local parks in these suburbs fell to the suggested 10% figure. Figure 36 shows this overall standard, as well as the indicators from each individual locality. While there was some variation across each locality, the average provision of parkland across these suburbs was 9.95%, and thus in accordance with the prescriptions of the S-H Plan and the 10% rule that subsequently emerged.

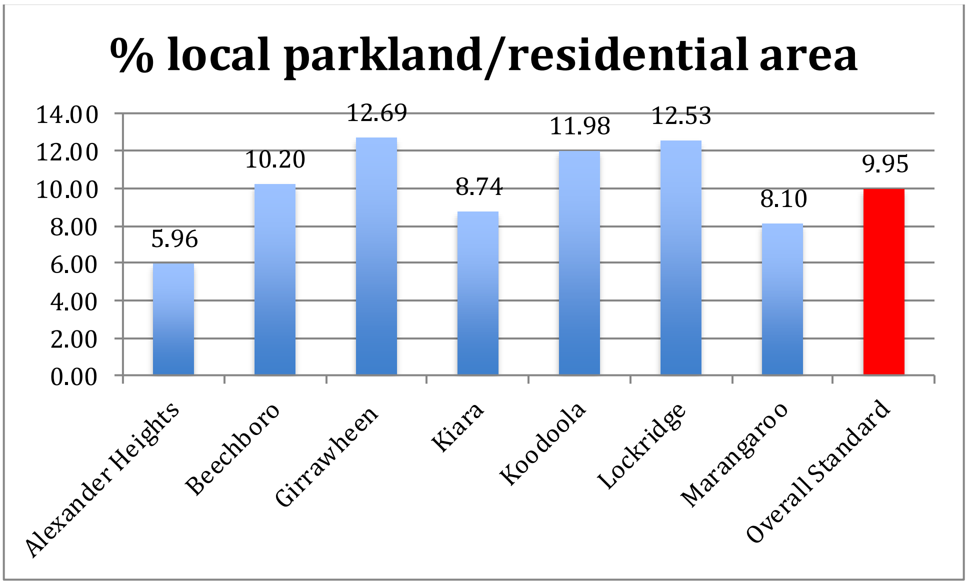


Figure 36: Standard for local parkland/residential area in S-H areas.

Standards were then created for each different type of landscape patch across these same suburbs: seasonal drainage, permanent water, remnant vegetation, and playing fields. It should be remembered that these landscapes together do not add up to the total area of local parkland, as various other areas (i.e. informal grass, carparks, other infrastructure) were not included in the calculations. Figure 37 firstly shows the cumulative areas of each landscape patch. Remnant vegetation is the most prevalent ecological landscape: 2.24 ha of permanent water, 3.73 ha of seasonal drainage, and 25.33 ha of remnant vegetation. When summed together, ecological landscapes are only slightly greater in area than local sporting landscapes: a total of 30.24 hectares (ha) of playing fields were located within parkland in these areas, compared to a total of 31.30 ha of ecological landscapes. Figure 38 then shows the equivalent indictors for the percent of each landscape in the total residential area. Interestingly, the standard for playing fields by residential area of 1.79% is significantly above the standard of 1.4% determined by Middle, Tye and Middle (2012). This indicates that some loss of playing fields within new residential districts was arguably necessary.

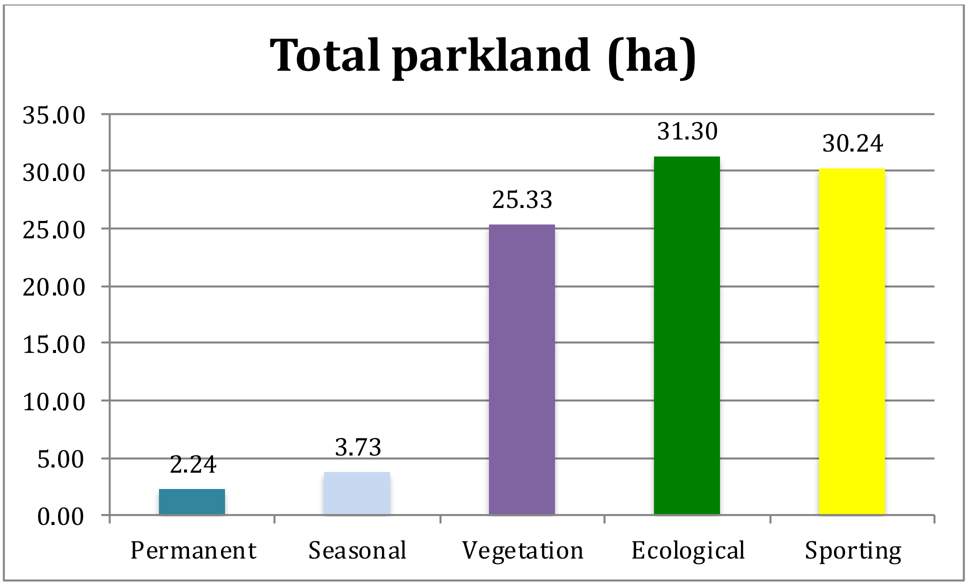


Figure 37: Cumulative areas of ecological and sporting landscape patches in S-H areas.

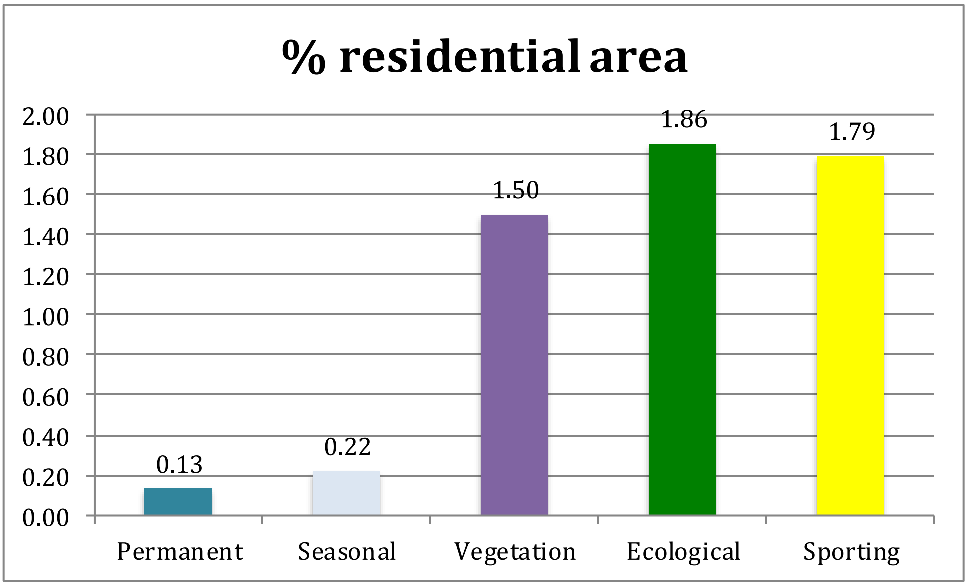


Figure 38: Standards for ecological and sporting landscape patches in S-H areas.

6.2.2 Ellenbrook

The first district analysed against these standards is Ellenbrook. Figure 39 gives the percent total parkland across every completed, LN planned residential area in the district. As outlined earlier, this excludes the still developing estates of Malvern Springs, Lexia and Woburn Estate in Ellenbrook, The Vale in Aveley, and The Vines. Notable is the large increase in this indicator across all the estates, and overall. This value is somewhat skewed by the parkland dedicated to the Bunbury to Dampier Natural Gas Pipeline, which runs through the estates of The Bridges and Woodlake. Even after taking this into consideration, there is still a significant increase in the proportion of parkland in these residential areas from the standard.

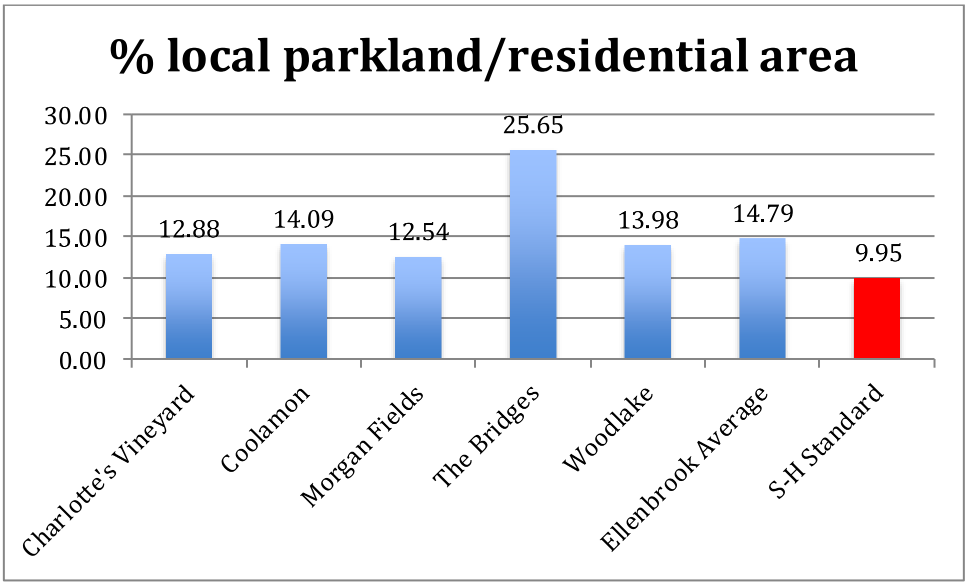


Figure 39: % local parkland/residential area for Ellenbrook compared to S-H standard.

Figure 40 shows the cumulative areas of each landscape patch across each residential area. Immediately an increase in the proportions of ecological landscapes can be seen: while this proportion was roughly equivalent in the S-H areas, here ecological landscapes are almost three time greater supplied than sporting playing fields (14.37 ha compared to 4.88 ha).

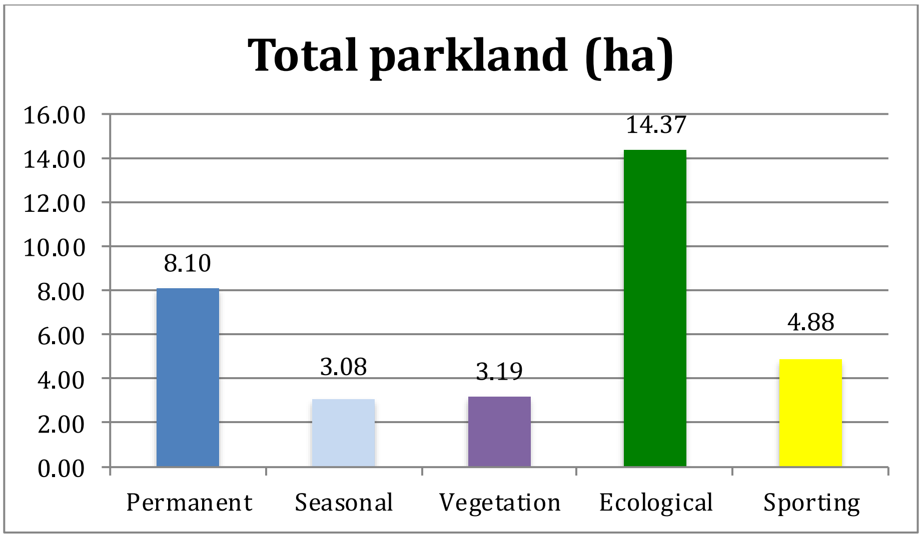


Figure 40: Cumulative areas of ecological and sporting local park landscape patches in Ellenbrook.

This is reinforced in Figure 41, which shows the percent residential area indicators of ecological and sporting local park landscapes across these estates, compared to the standards. They show an increase in total proportions of ecological landscapes (2.66%) from the standard (1.86%). This increase is attributable to a large increase in permanent water landscapes (1.50% from 0.13%), which compensates for a decrease in remnant vegetation (0.59% from 1.50%). There is a significant decrease in playing fields within local parks (0.90%) from the standards (1.79%): almost exactly half.

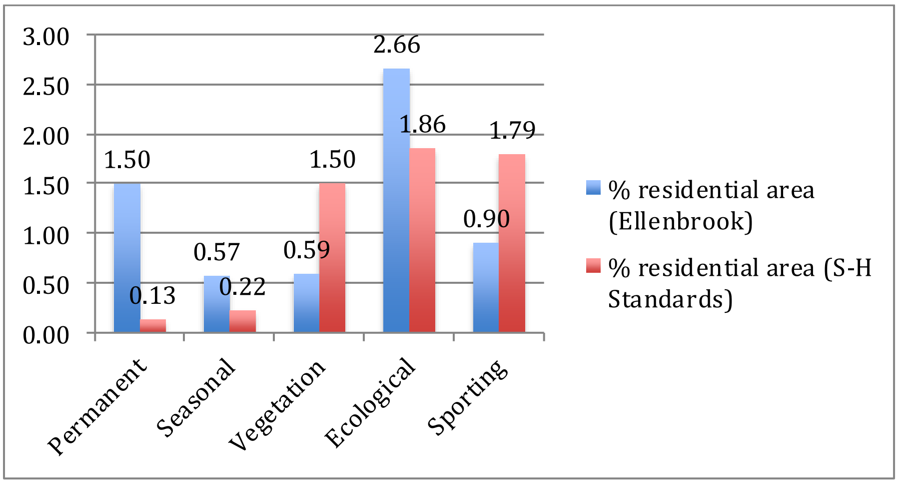


Figure 41: % Residential area indicators for ecological and sporting landscape patches in Ellenbrook compared to standards.

As Figure 42 shows, including areas of playing fields zoned within school land adds an extra dimension to calculations of provision of local playing fields. The Charlotte's Vineyard and Woodlake sporting parks each have significant areas of playing field located within school land: 1.17 ha and 1.55 ha respectively (Figure 43). This provides an extra 2.72 ha of playing field, still within the total residential area, up to a total of 7.60 ha. This additional area brings the percent residential area value up to 1.41%: equal to the standard set for adequate sporting space. This is not even including the additional playing fields within Ellenbrook Secondary College and Charlie Gregorini, which sit right in the middle of these four estates, but not within defined residential areas and thus were not included as 'local' playing fields. Thus, when considering the extra space outside of local parkland and within school land, it could be argued that the provision of playing fields in these established residential areas is adequate at the local level.

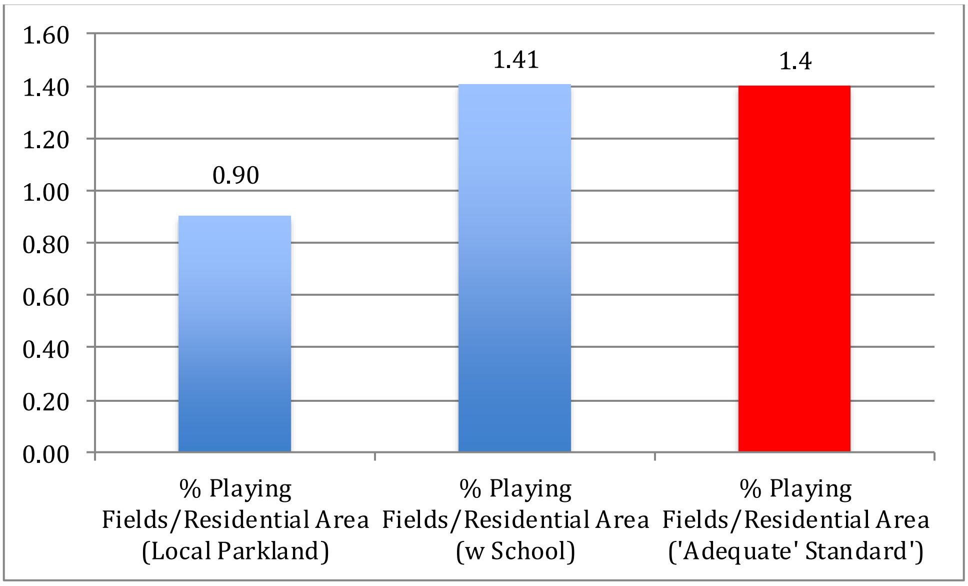


Figure 42: Indicators for local playing fields in established Ellenbrook estates with and without school-zoned playing fields compared to 'adequate' standard

Figure 43: Co-located playing fields in Woodlake (top) and Charlotte's Vineyard

Adding to this is the fact that local playing fields that are provided are well distributed within the established residential areas in Ellenbrook (Figure 44). The estates of Woodlake, Charlotte's Vineyard and Coolamon each have one local sporting park: Woodlake Oval (1), Charlotte's Vineyard Oval (2) and Coolamon Oval (3). The Bridges estate is adjacent both to the Hockey field within Charlie Gregorini Memorial Park (4) and Ellenbrook Secondary College playing field (5), which is used by community clubs.

Only the estate of Morgan Fields has no local playing field, however it is walking distance (via an overpass across Gnangara Road) to the Woodlake playing fields. The Vale estate (located in the suburb of Aveley but still within the Ellenbrook district) also has a local playing field co-located with a primary school: Turkich Parade Reserve (6). The estate of Malvern Springs does not have any local sporting fields, however is located adjacent to the future Ellenbrook District Open Space (7), which is discussed further below. Thus, in terms of local and accessible playing fields, it could be argued that the Ellenbrook district is adequately provided for.

Figure 44: Location of each community playing field in the Ellenbrook district

The usefulness of these indicators is limited, as it does not consider the demand for sporting playing fields within the Ellenbook district as a whole. According to 'Forecast id.', the projected population for the Ellenbrook district in 2016 is approximately 36,500 (City of Swan 2016). This includes significant population growth still to occur in incomplete estates within Aveley (The Vale) and northern Ellenbrook (Annie's Landing). It also incorporates the population of The Vines estate, who rely on playing fields within Ellenbrook and Aveley. Sporting parks in Ellenbrook are required to adequately cater for this broader population, rather than just local neighbourhoods.

It is for this reason that indicators calculated from projected population figures are more useful at the district level. Figure 45 shows four separate indicators for provision of playing fields at the district level, compared to the 'adequate' standard of 6.5 m^2/resident. The first shows the provision only within established residential areas: that is the 7.60 ha from playing fields within local and school parkland. While arguably adequate at a local level, this provision alone falls well short of the adequate standard of 6.5 m^2/resident.

The second indicator predicts the future provision of local playing fields when each residential state has been built out. It includes the three playing field mentioned above – Turkich Parade Reserve, Charlie Gregorini and Ellenbrook Secondary College – and also estimates for future playing fields. If planning practice in these undeveloped areas was to be consistent with that demonstrated in the completed Ellenbrook estates, then an additional two sporting parks providing approximately 4 ha are likely: one within the The Vale estate, and one within Annie's Landing estate. Even when including these extra playing fields, the m^2/resident for the district (4.32) is well below the established standard for adequate provision (6.5).

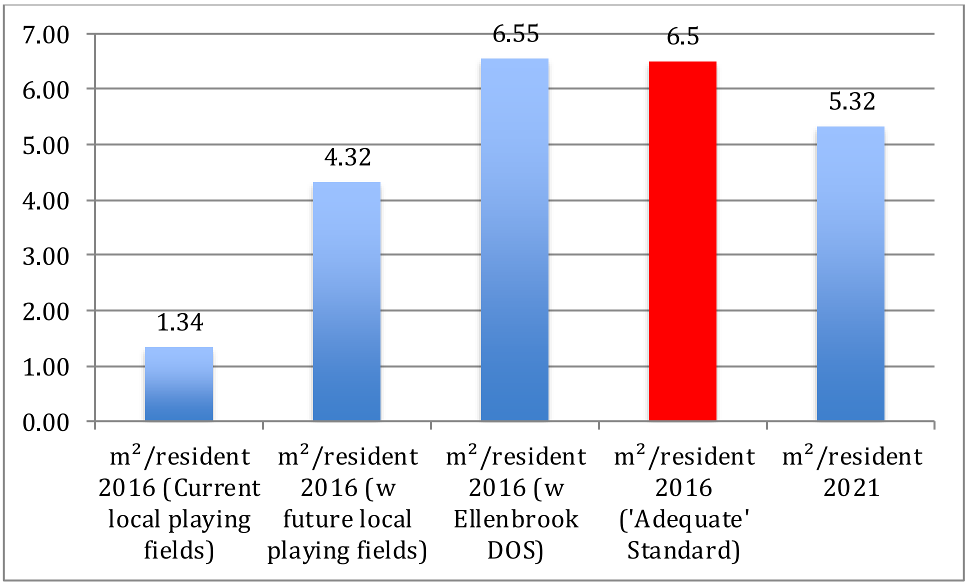


Figure 45: District-level indicators for sporting landscapes in Ellenbrook, created using projected 2016 and 2021 population. Includes additional playing fields outside of established residential areas, and the estimated areas of undeveloped playing fields likely to be built by 2016

The third indicator includes the current and future playing fields provided within Ellenbrook District Open Space (DOS), and illustrates how significantly the situation changes when a large sporting complex is included into calculations. Given the high rate of population growth (three times the rate of the broader metropolitan area) and levels of physical activity in Ellenbrook, there was a clear need for additional sporting open space to meet this current and future demand within the district. The City actively planned and designed the DOS to meet this need, whilst at the same time to represent an integrated community hub for a range of passive and active recreational opportunities (City of Swan 2010). The DOS is made up of 19 ha located at the junction of the suburbs of Ellenbrook, Aveley and The Vines, allowing it to service the populations of each suburb equally. While not yet completed, the final area of playing fields within Ellenbrook DOS can be accurately predicted. It will contain two distinct sporting areas: three overlapping AFL and cricket ovals to the North, and 4 synthetic soccer fields to the South. The ovals were almost completed at the time of writing (Figure 46), and their combined area (5.6 ha) could be measured through GIS. The soccer fields had not been developed, however, structure plans were available (Figure 50). These plans indicated that the southern area would contain four 100m x 64m fields, or approximately 2.56 hectares of sporting space. The Ellenbrook DOS is therefore likely to contain approximately 8.16 ha of playing fields. When included in calculations, this brings the m^2/resident for the district up to 6.55: just above the established standard for adequate playing fields.

Figure 46: Structure plan and aerial photo of Ellenbrook DOS (Sources: City of Swan 2014; Google Earth with added annotations)

To summarise, this analysis suggests that the effective use of both co-located school sporting park and district sporting parks will allow the district of Ellenbrook to adequately cater for the demand for community playing fields. That said, the final column in Figure 45 shows the same provision of playing fields when subsisting in the projected 2021 population of the Ellenbrook district. It suggests that further provision within the next 5 years will be needed to continue to cater for the continued population growth in the area.

6.2.3 Coastal Wanneroo

Coastal Wanneroo provides an interesting comparison with the district of Ellenbrook, both in the use of co-located local sporting parks and larger district sporting complexes. Figure 47 gives the percent local parkland across every completed, LN planned residential area in the district. As outlined earlier, this excludes the still developing residential areas within the suburb of Jindalee, the northern most estates in Butler. It also excludes the section of Quinns Rocks (Quinns Rocks South) that lays SE of Tapping Way and north of Quinns Road, which was planned in the 1960s as a rural townsite. This is important, as it excludes the sporting park Gumblossom Park from these *initial* calculations. While not to the same extent as Ellenbrook, this data shows that the percent parkland in these suburbs (10.40%) has increased from the standard of 9.95%.

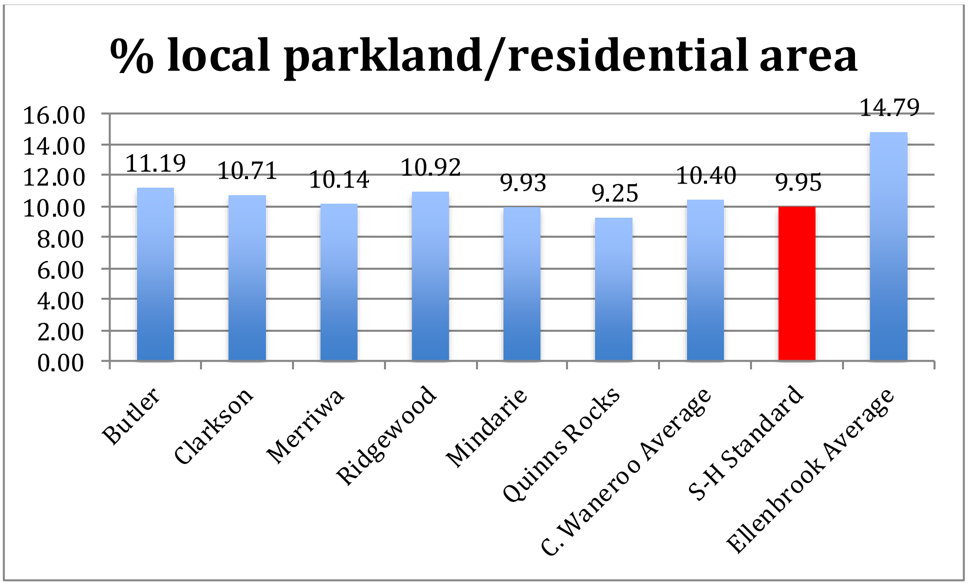


Figure 47: % local parkland/residential area for Coastal Wanneroo compared to S-H standard.

Figure 48 shows the cumulative areas of each landscape patch across each residential area. Again, an increase in the proportions of ecological landscapes can be seen, although no to the extent as in Ellenbrook: while this proportion was roughly equivalent in the S-H areas and almost three times in Ellenbrook, here it is roughly twice the area of sporting landscapes (27.56 ha compared to 14.60 ha).

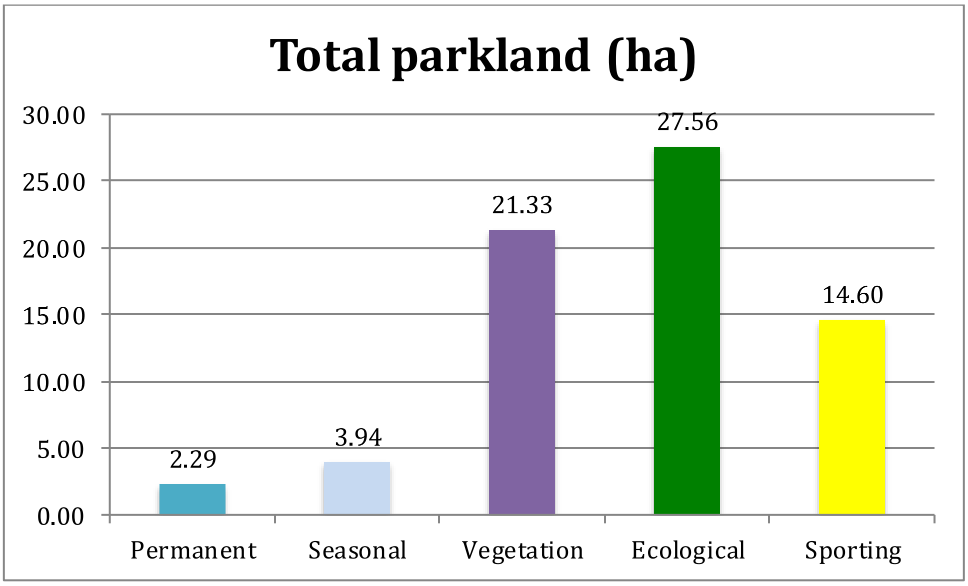


Figure 48: Cumulative areas of ecological and sporting local park landscape patches in Coastal Wanneroo.

Figure 49 shows the percent residential area indicators of ecological and sporting local park landscapes compared to S-H standards, as well as against those calculated for Ellenbrook. It shows that the provision of each specific ecological landscape in Coastal Wanneroo is relatively equivalent to that in the S-H districts, with only a small increase in the total proportion of ecological landscapes (1.91% compared to 1.86%). Ellenbrook is notable for its large provision of permanent water but decrease in remnant vegetation retained. In contrast, there is a considerable decrease in the proportion of playing fields within local parks (1.01%) from the S-H standard (1.79%), however not to the extent as in Ellenbrook (0.9%). This 'other' parkland is largely accounted for by the inclusion of several parks containing large informal grassed active recreation space in Coastal Wanneroo, which were not included in these calculations. Two such examples of such 'informal' sporting parks, which provide large grassed open spaces but without the necessary size and facilities for organised sport, are shown in Figure 50.

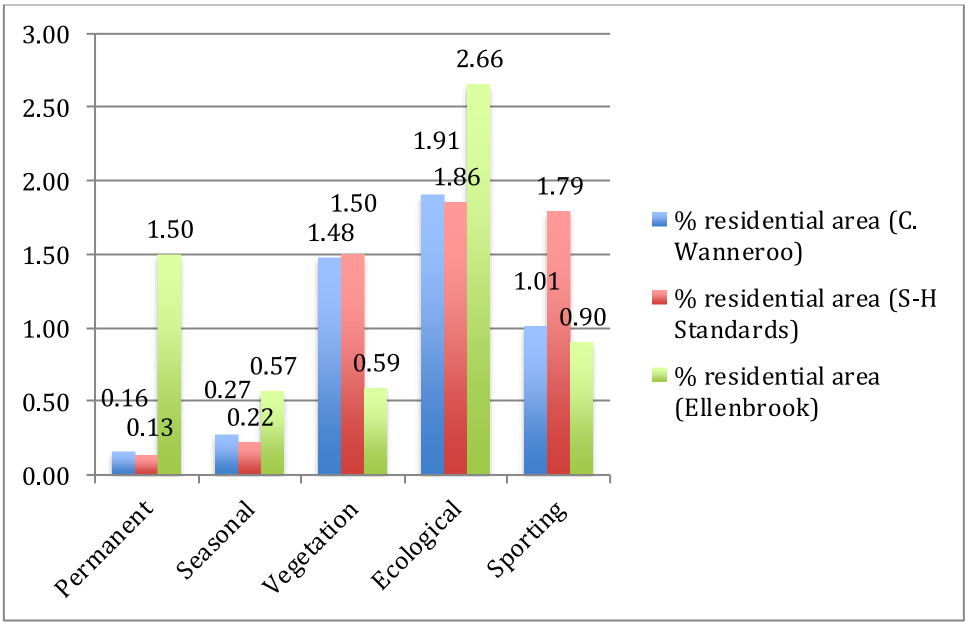


Figure 49: Indicators for ecological and sporting landscapes in Coastal Wanneroo compared to S-H standards and Ellenbrook

Figure 50: 'Informal' sporting parks within Coastal Wanneroo (Source: Google Earth)

That this provision of playing fields within local parkland only is lower in Ellenbrook than Coastal Wanneroo is noteworthy, especially when considering the use of co-shared sporting parks and the extra local sporting space that these arrangements can provide. Similar to Ellenbrook, Coastal Wanneroo also has a relatively good distribution of local playing fields (Figure 51). Each of the established suburbs has at least one local playing field: Mindarie contains Abbeville Park (1), Merriwa contains Addison Park (2), Ridgewood contains Ridgewood Park (3) and Butler contains Kingsbridge Park (4). Quinns Rocks has two, of which only Belhaven Park (5) is located in the LN portion of the locality, with the other being the aforementioned Gumblossom Park (6). The locality of Clarkson has three separate sporting parks: Riverlinks Park (7), Richard Aldersea Park (8) and Anthony Waring Park (9).

Figure 51: Location of each community playing field in the Coastal Wanneroo district (Source: Google Earth with added annotations)

Importantly, however, the extent of co-location of playing fields is not equivalent between the two districts. Three sporting parks within Coastal Wanneroo have small areas of their playing fields zoned as school land: Belhaven Park in Quinns Rocks, Riverlinks Park in Clarkson and Kingsbridge Park in Butler. As shown in Figure 52, these extra areas contribute little to the total amount of local playing fields, bringing it from 14.60 ha to 15.92 ha. Unlike Ellenbrook, it appeared that no school grounds had been opened up to use by community clubs. As result, less than a tenth (8%) of total local playing fields are located within school land, compared to over a third (36%) in Ellenbrook. This allows Ellenbrook to have a smaller proportion of playing fields located within local parks (0.90%) than Coastal Wanneroo (1.01%), yet a larger overall proportion of playing fields (1.41%, or at adequate standard) compared to Coastal Wanneroo (1.10%) when considering these school spaces. In short, the provision of local playing fields in Coastal Wanneroo improved slightly when considering school areas, but not to the same extent as Ellenbrook, where this figure was actually brought up to adequate standard. This indicates that effective co-sharing of sporting parks, including the use of school grounds by community clubs, is crucial to adequately providing sufficient local playing fields in new residential areas.

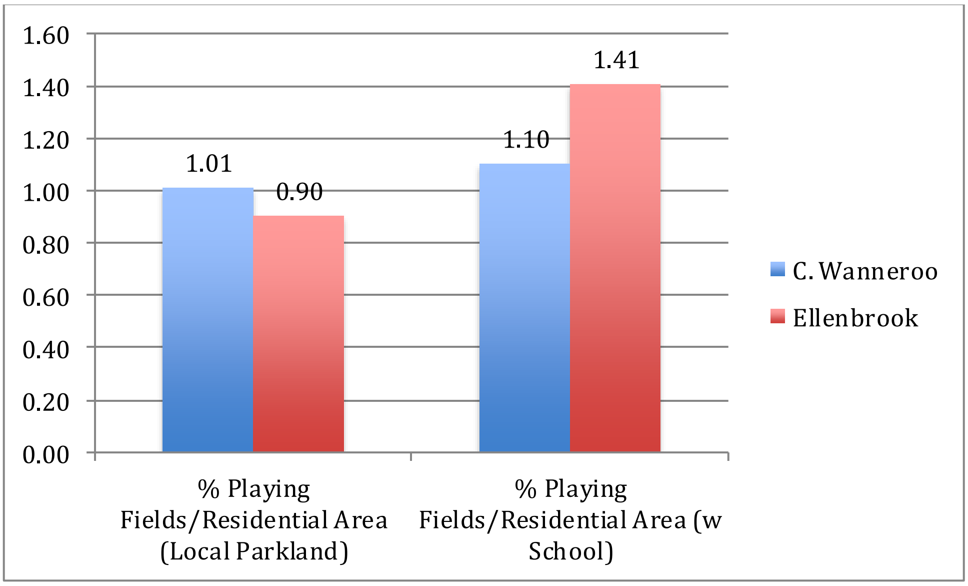


Figure 52: Indicators for local playing fields in Coastal Wanneroo with and without school-zoned playing fields compared to Ellenbrook

Another interesting comparison with Ellenbrook can be made when analysing Coastal Wanneroo at the district level using population projections. Figure 53 shows four separate indicators of sporting landscapes at district level based on the 'Forecast id.' projected population for 2016 of approximately 60,000, compared to the 'adequate' standard of 6.5 m^2/resident. As before, the first indicator includes only local playing fields within the established, LN planned residential areas (15.92 ha as outlined above). At 2.66 m^2/resident, is it well short of the 'adequate' standard'.

The second indicator, also similar to Ellenbrook, includes estimates for future playing fields within the currently unfinished developments in Jindalee and Butler, as well as future developments in the south of Mindarie and Clarkson ('Catalina' estate). Based on current structure plans for these areas, it is likely that a total of two further co-located sporting parks will be provided, which using the same estimates would provide an extra 4 ha of sporting space. Also included are the playing fields within Gumblossum Park (3.06 ha). In total, this provides an extra 7.06 ha of playing fields for the area. However, even with these additional playing fields the m^2/resident for the district (3.85) is well below the established standard for adequate provision (6.5).

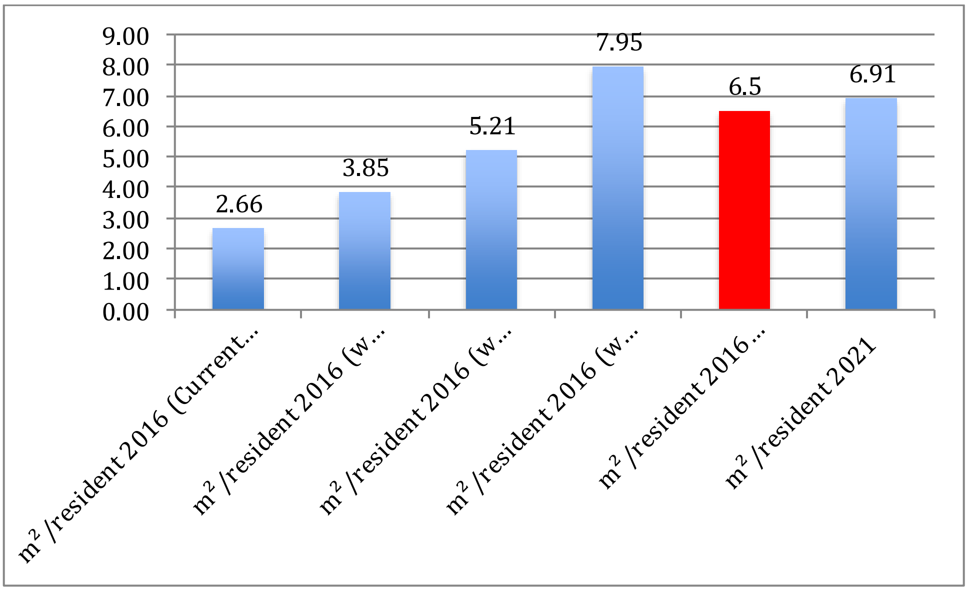


Figure 53: District-level indicators of playing fields in Coastal Wanneroo

The third indicator includes the hypothetical situation that a sporting complex the size of Ellenbrook DOS was located within Coastal Wanneroo. However, given the projected population of Coastal Wanneroo (60,000) is well above the projected population of

Ellenbrook place (36,500), even with this hypothetical addition the m²/resident value raises only to 5.21. Instead, a larger regional sporting complex would be necessary. If the hypothetical example of Kingsway Sporting Complex was instead used (Figure 54), which is located in the Wanneroo locality of Madeley and contains 24.5 ha of playing fields, then this figure rises to 7.95. Even when extending this to 2021 population projections, it remains above the standard at 6.91. This suggests a regional sporting complex somewhere between the sizes of the Ellenbrook DOS and the Kingsway Sporting Complex would be necessary to provide adequate opportunities for organised sport to the Coastal Wanneroo district.

Figure 54: Aerial photo of Kingsway Sporting Complex (Source: Google Earth)

6.2.4 Summary

This analysis has investigated the relationship between locations of sporting parks and the proportion of local ecological and sporting park landscapes in two new residential districts. Interestingly, the total amount of local parkland had increased above the S-H standard of 9.95% in both Ellenbrook and Coastal Wanneroo. Also in both of these districts, a significant reduction in playing fields provided within local parkland provisions was identified. In Ellenbrook, this reduction was offset by the utilisation of school playing fields – both co-located with public parkland, but also through the hiring out of previously school-only ovals for community clubs – as well as a larger district sporting complex. In Coastal Wanneroo, where utilisation of school playing fields was less effective and there was no supplementary district complex, the supply of playing fields was below the adequate standard both at a local and district level. Ellenbrook had the largest increase in ecological landscapes from S-H standards, primarily from permanent water landscapes. Coastal Wanneroo had only a small increase in ecological landscapes, far less than the reduction in sporting landscapes. In summary, the practice demonstrated in Ellenbrook supports the hypothesis that locating local parks partially or fully outside of local park provisions, whilst being supplemented by a larger regional-sized sporting complex, can allow for increases in ecological landscapes whilst still providing adequate space for organised community sport.

6.3 Synthesis and Findings

This final section brings together the previous findings, and combines them with some additional further investigation to discuss the overall benefits and limitations of each alternate sporting park location.

6.3.1 School Sporting Parks

The results of the previous analysis suggest that effectively co-locating community sporting fields with local schools can allow for adequate provision of playing fields at the local level alongside an increase in ecological landscapes. In Coastal Wanneroo, little space was freed up through co-located playing fields, as only small portions of the playing field were within education zoning. In Ellenbrook, however, considerable additional sporting space was provided by playing fields zoned within school parcels.

Woodlake Oval for example, had 1.55 ha of its total 2.55 ha located outside of park zoning. Further, Ellenbrook Secondary College – the only school-only playing field used for community purposes – added 1.75 ha to the total sporting landscape in the district. Across Ellenbrook, there was in fact more area of playing field available to community sporting clubs located within school land (5.76 ha) compared to local parkland (4.88 ha). While this wasn't enough at the district level to bring the amount of playing fields to adequate levels without the DOS, it does demonstrate that school sharing arrangements are an effective planning mechanism for increasing the provision of local playing fields to communities. Thus, it can be concluded that making playing fields located on school grounds available to community clubs, including those previously used only by school students, can greatly assist in overcoming, albeit not completely, the emerging shortage of playing fields in these areas.

As well as allowing the supply of community playing fields to be increased outside of local park provisions, it was also hypothesised in Table 4 that co-location of playing fields with schools may increase its use for active recreation during the day, thus making it a more multi-functional local park landscape. In order to provide extra insight into the multi-functionality of co-located playing fields, informal observations were undertaken at Charlotte's Vineyard Oval in Ellenbrook. As shown in Figure 55, school students used a small proportion of the playing field twice daily for active recreation. While arguably not significant, it is nonetheless a more effective use of a playing field than a comparable park not co-located. Alternatively, there may be the possibility that the use of the oval by school students may discourage other non-sporting users, for example dog-walkers, during the day. Indeed, there was little additional use of the oval by such users during the observations. However, this may have more to do with the design of the park, as it has few additional features likely to make it an attractive recreational destination. It also has a relatively small periphery area between the playing field and the surrounding built environment, and what trees are there are yet to mature and thus currently provide little shade.

Figure 55: Approximate area of active use of Charlotte's Vineyard Oval by school students in red

It was also hypothesised that co-location could enhance the health benefits of this school active recreation by exposing students to greener park environments. However, there were few examples of this potential benefit being utilised by planners within the case study area. Within the districts of Ellenbrook and Coastal Wanneroo, there were a total of seven co-located sporting parks. Of the two in Ellenbrook, neither contained permanent water or remnant bushland areas. Of the five co-located sporting parks in Coastal Wanneroo, only Kingsbridge Oval had permanent water landscapes. Only one of the co-located sporting parks in the new areas of Coastal Wanneroo had bushland areas (Belhaven Park), however this was actually located within school zoned land. This is despite Wanneroo having an educational program in place that allows local schools to utilise local bushland for educational purposes (the 'Adopt a Bushland' policy discussed in more detail in Section 7.3), which would be best supported by locating bushland directly adjacent to the school. Thus, the potential of co-locating for increasing the benefits of school-time active recreation, including creating new opportunities for young people to experience nature, does not appear to be widely utilized in the case study area.

One further benefit of co-location revealed through interviews with local planners in the case study area is the potential to reduce the consumption of groundwater resources. For example, Wanneroo encourages co-location where appropriate based on grounds including optimisation of use and management, to create 'community hubs', but also for rationalisation of water resources (City of Wanneroo 2010). Savings in water resources may in fact be the most important outcomes of co-sharing arrangements, particularly in the northern corridor where Coastal Wanneroo is situated where water resources are extremely limited. It is predicted that over half of the planned future schools in the Perth metropolitan area in the next 25 years will be constructed in Wanneroo, mainly the northern district stretching from Coastal Wanneroo to Two Rocks. Co-locating many of these schools with community playing fields will be essential to cut back on the total amounts of irrigated green space and the water resources required to maintain them. Thus, especially in cities such as Perth with water restrictions, these savings may be one of the most significant contributions that co-location of sporting parks with schools can provide under a resilience framework.

The interviews also revealed some potential limitations of co-locating sporting parks with local schools. In co-located parks, the boundary between the open space and school parcels often crosses directly across the playing field area. This can create issues as communities evolve over time, and land-use may have to be altered. In some cases, the Department of Education has sold off schools for housing developments. If this were to occur for a co-located school oval, the LG would be left with half a playing field, and would have to purchase the other half of the playing field at considerable expense to continue to use the space for organized sport. These challenges are supported by the recommendations made by Carter (2010) in Parks and Leisure WA's position paper. While the co-location of sporting parks with schools is appealing in theory, in practice they may be more problematic: requiring arrangements between LG's and the school in order for the uses to be successfully negotiated. Additionally, far from increasing the total amount of local parkland, PLA believe that co-location results in *less* overall land for public use in new subdivisions. Further to this, there is also the potential for the land to lie undeveloped for periods of time after the establishment of an estate, if the community need for the school is not immediate (Carter 2010).

6.3.2 District Sporting Complexes

While the previous section suggested that co-location with local schools can increase the total supply of local playing fields when done effectively, even with this practice it is unlikely to meet the total demand for community playing fields at a district level. Provision in Ellenbrook at a district level was only brought up to standard through a sizeable district park not included within local park provision of any residential estate. There was a clear need for a similar community sporting complex for the suburbs in Coastal Wanneroo, equivalent at least to that being created currently within Ellenbrook, but ideally a larger regional sporting complex similar to Kingsway Sporting Complex in the City of Wanneroo.

It was also hypothesised that the general larger size of district sporting parks would allow for more 'comprehensive' sporting clubs to be created. Local park planners confirmed that larger DOS and ROS sporting complexes allow for more flexibility in use. As well as sporting events, these parks can also accommodate major community events such as concerts. Larger parks also give opportunities for multiple sporting clubs to come together, possibly leading to the creation of local sporting associations that allow for the sharing of resources. This can be witnessed in the aforementioned Kingsway Sporting Complex, which is the home to multiple senior and junior soccer and cricket clubs, along with clubs for hockey, baseball/softball, athletics and AFL – with many clubs sharing the same clubrooms and facilities.

A further example of this can be seen in the plans for the future 'Whiteman Park ROS' in Swan. On advice from the developers initial structure plan for the site, the park has been planned to include numerous distinct sporting areas designed with the specific facilities to accommodate a wide range of different outdoor team sports. This not only maximises the benefits for sporting participants, including making the sports safer, but also enhances the experience for spectators. Further, the park is being designed to accommodate alternative adventure and extreme sport and recreation activities not generally incorporated into public parks, including commercial go karting and water sports. It also provides various non-sporting recreational areas such as playgrounds and nature paths, as well as opportunities for music and cultural activities (Lanfear and Thorpe 2014). While the discussion of Kingsway and Whiteman Park ROS do not prove the hypothesis in Table 4, relating to social capital creation, they do provide potential examples of how larger sporting complexes *may* help to maximise these unique benefits that come from the non-participant social aspects of involvement in a sporting club.

Another benefit of locating playing fields in these larger sporting complexes is allowing for the use of synthetic playing surfaces, which are utilised both in the Ellenbrook DOS and the future Whiteman Park ROS plans. Synthetic surfaces can allow for greater and higher intensity use, without the need for large amounts of groundwater resources. They are also the preferred surface for many 'rolling ball' sports, most notably hockey. However, they have little functionality outside of sport, as they cannot be used for common non-sporting forms of recreation such as dog walking. Synthetic surfaces therefore have even less functionality then grassed sporting areas, which is why they are typically only provided in larger sporting complexes rather than local parks.

Despite these potential benefits, securing space for playing fields outside of residential areas, and in particular in ROS parks, has proved to be problematic in practice. Most land reserved in regional parks has already been identified for conservation purposes early in the planning process, with little consideration for active and sporting use. Despite the expression of the need for the securement of land for recreational purposes within regional planning documents, there are no actual mechanisms or processes that currently exist to allow for this land to be retained and developed for sporting purposes (Carter 2010). This again emphasises the competition between sporting and ecological park functions, even outside of local park restrictions.

7. Design of Sporting Parks

This chapter investigates four research questions, each relating to a different ecological landscape that might be included in a sporting park to increase its potential to facilitate cultural ecosystem services:

What are the benefits and limitations of remnant bushland for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of permanent water for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of seasonal drainage basins for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of community gardens for facilitating ecosystem services alongside sporting services under resilience theory?

7.1 Designing Sporting Parks Under Resilience Theory

Similar to the previous chapter, this investigation begins by applying insights from the theoretical framework onto the context of sporting park planning. Whereas the previous location investigation discussed the value of organised sport as a form of park recreation, and hence sporting areas, this investigation looks more broadly at the value of sporting parks as a whole. A discussion of the theoretical potential of four different ecological landscapes to provide cultural ecosystem services then follows.

7.1.1 Sporting Parks as Sources of Human Health Resilience

As mental restoration is the cultural ecosystem service that best represents the 'people-to-nature' function of parks, it provides the starting point for discussing the potential of sporting parks to facilitate resilience in non-sporting users. As just established, both the social and physical qualities of sporting parks may be non-conducive to restorative outcomes. Alternatively, based on the findings of Herzog et al. (1997), sport can still provide a fascinating experience for park users when compared to an everyday urban environment, although one that is unlikely to be as restorative by allowing for reflection compared to a natural setting. In order to provide the structured environments capable of facilitating sport, built features and often overused barren grassed areas largely replace psychologically engaging natural features such as water, vegetation and wildlife – those features likely to provide the quality of *nature*. Thus, even when considering these additional benefits for spectators, sporting areas in parks will have reduced potential to facilitate mental restoration than a comparatively natural environment.

Alternatively, it could be hypothesised that the presence of sport may increase the value of a park for social interactions. It was established in Section 3.3.2 that a well-maintained public space that provides an array of features could encourage more users to visit, to stay for longer, and to interact. Given its potential as a source of fascination, the presence of sport may present one such reason for a user to visit a park, stay longer than usual, and offer a source of commonality to initiate interaction with other users. A better maintained space, and a more attractive periphery with features such as shade, seating and play areas will encourage people will stay longer and hence interact with others.

Looking more broadly beyond the sporting area, the generally larger size of sporting parks may give them inherent restorative value. In Section 3.3.2 it was suggested that the size of a park might be more likely to facilitate restoration, whilst also being more likely to be used as destinations for neighbourhood walking and green exercise. This would support the findings of a study investigating different indicators of green space, which found that large spaces are likely to be particularly effective in improving the health of local residents (Mitchell, Astell-Burt and Richardson 2011). Thus, due to their extra size, sporting parks may represent valuable resources for improving health in socioeconomically disadvantaged areas.

Further, well-planned and multi-functional sporting parks may also have the capacity to provide restorative experiences distinct from the sporting area. The findings of Nordh et al. (2009) suggest that intelligent design of small green spaces can provide sources of fascination whilst enabling the perception of 'being away' from the surrounding urban environment. By extension, it should also be possible to create distinct green space settings *within* a single large park, able to provide a more restorative experience than an area such as a highly used playing field. In turn, this would also make the park as a whole a more attractive destination for active transport and green exercise.

Increasing the multi-functionality of large public parks is now a common theme in park planning in Perth. The University of Western Australia has published a fact sheet on design principles for planning multi-functional 'Healthy Open Spaces', including specific advice for larger sporting parks (Sunarja, Wood and Giles-Corti 2013). Parks and Leisure Australia WA have also raised the need for enhanced multi-functionality in park design: releasing background and position papers citing concern over the lack of well-designed and multi-functional large parks. These papers recommend a greater focus on enhancing functionality, usability and diversity of local park design (Carter 2010, 2011).

Under the theoretical framework, multi-functionality should include features able to serve ecological as well as recreational functions. If distinct recreational areas within sporting parks were created around ecological landscapes that support regulating ecosystem services, they could therefore function under both urban ecological and human health resilience simultaneously, in addition to the sporting services they facilitate. The location investigation in Chapter 6 outlined three ecological landscapes also able to provide recreational opportunities: permanent water, seasonal drainage and remnant vegetation. While not yet common in public parks, community gardens are another green space landscape with the potential to provide a range of ecosystem services to complement adjacent sporting services. The next sections discuss the theoretical potential of each landscape to facilitate cultural ecosystem services in sporting parks in Perth.

7.1.2 Permanent Water in Sporting Parks

As previously outlined in Section 3.3.2, permanent water areas have the potential to serve biodiversity and water regulating functions. A broader literature review suggests that, in theory, they also have great potential to directly promote human health by providing a variety of cultural ecosystem services at the same time.

Völker and Kistemann (2011) have reviewed the value of water, or 'blue space', under a salutogenetic understanding of human health. Water represents one of the most universally preferred landscapes features, is a strong indicator of a perception of nature, and is thus essential to landscape design considerations. It evokes strong feelings of cleanliness and freshness, has significant spiritual and symbolic value, and is thus valuable to the creation of a sense of place. Finally, blue space has been recognised a valuable therapeutic landscape, with the appreciation of water bodies strongly linked to human health and well-being (Völker and Kistemann 2011).

Most relevant from this review is the significant restorative and recreational potential of water. As summarised in Table 1 the presence of water is an environmental quality likely to facilitate numerous cultural ecosystem services. Water has been proposed as a fascinating landscape element that is therefore capable of facilitating attention restoration (Nordh et al. 2009). Calm water has also been proposed as one of the natural elements likely to evoke stress restoration responses (Ulrich et al. 1991). Given that water landscapes are generally perceived as attractive, it might be also hypothesized that the inclusion of permanent water can greatly increase the value of a park as a destination for neigbourhood walking. Further, that water areas are one of the most universally preferred landscape types suggest they may provide a context for interactions across different social groups.

Water landscapes may have even greater value to facilitate these services in the specific context of this investigation. Water as a landscape element is arguably of highest importance in arid ecosystems, where rainfall is low and unevenly distributed and where it might represent a 'true oasis' for humans (Burmil, Daniel and Hetherington 1999). While not strictly arid, it is argued that Perth is already experiencing the impacts of a drying climate, including significant reductions in rainfall (Deeley, Milani and Deeley 2006), suggesting water features may be particularly valuable as aesthetic landscape elements. Further, it might be hypothesised that water areas may also be particularly valuable in a sporting park, with the contrast it can provide to the comparatively dry and barren playing field.

The value of permanent water in Perth parks is supported by several studies. Syme, Fenton, and Coakes (2001) studied the effect of lot size and access to private green space with the use of public green space. Public green space was investigated separately both as local parks and larger wetlands. It was found that, while individuals from households with less private green space were not more likely to visit local parks, they were more likely to visit local wetlands (Syme, Fenton and Coakes 2001). While this could be explained by the general larger size of these wetland parks, it may also support the attractiveness of permanent water within parks in Perth.

The value of permanent water features in Perth residential areas have also been discussed by Vernon and Tiwarri (2009) for their potential to contribute to 'sense of place'. As well as their functional value, water features are able to satisfy different psychological needs, including local identity, aesthetics and symbology that allow an individual to create attachment to their immediate environment (Vernon and Tiwari 2009). Indeed, there are several examples in the case study area of water features being central to the creation of new communities (see Figure 56). The 'Woodlake' estate in Ellenbrook was created around a large natural lake of the same name, while both 'The Bridges' and 'Vale' estates also feature large water bodies. In the Coastal Wanneroo suburb of Butler, a large water body stretches from the main shopping centre across the two central parks in the area, one of which is a co-located sporting park. These examples suggest that permanent water landscapes already have significant value as components of park systems in outer Perth suburban areas, and should make them a valuable feature within sporting parks.

Figure 56: Permanent water features within the case study area: Woodlake in Ellenbrook (top) and Butler in Coastal Wanneroo (Source: Google Earth)

7.1.3 Seasonal Drainage in Sporting Parks

In theory, seasonal or dry drainage areas can also provide recreational opportunities whilst providing their regulating ecological services. However, it may take more innovative planning approaches to utilise this potential.

Given the absence of permanent water and other natural features, seasonal drainage areas are unlikely to be able to provide a natural restorative experience in a similar way as water and vegetated areas. However, it has been established in this thesis that restorative benefits similar to those provided by a natural environment could also be facilitated through positive social environments. In the words of Cattell et al. (2008, 556): 'some people gained restorative benefits from the opportunities provided to be alone, but for many others, it was their social value'. In this context, seasonal drainage landscapes might be best utilised as recreation features by providing the features capable of attracting and keeping park users whilst encouraging them to interact with others.

The creation of fenced, off-the-leash dog exercise areas may be an innovative way of activating the social potential of these landscapes. Firstly, dog parks have been found to have significant potential to increase the community value of underutilised spaces. Urbanik and Morgan (2013, 294) suggest that dog parks are likely to be an increasingly prominent feature of public parks: 'Just as parks have evolved to accommodate children, picnickers, walkers, solitude-seekers, tennis players, and Frisbee throwers, accommodating dogs may be a new addition to the urban human-nature-park process'. They have already been demonstrated to activate the community value of poor quality space, including areas of a park typically used for illegal activity to a highly valued space for community engagement. Creating dog parks in under-utilized areas of parkland would also reduce (but not eliminate) community opposition that provides a barrier to their more widespread creation (Urbanik and Morgan 2013). Thus, locating dog parks within seasonal drainage basins could in fact address two park planning issues at once: activating these potentially multi-functional ecological landscapes, whilst identifying under-utilised parkland for locating dog parks readily available in many residential areas.

Further, dog parks have also been found to have significant potential to facilitate positive social interactions. The social value of off-the-leash dog parks has been summarised by Graham and Glover (2014). Pets and particularly dogs are a source of meaning that are central to the narratives of many people's lives, with dog owners thus more likely to perceive other owners as more likeable and approachable. In this way, dogs can help facilitate interactions (provide the 'social lubricant') between previously unacquainted people both similar and dissimilar to themselves (Graham and Glover 2014). Thus, it is possible that dogs could play a similar 'ice-breaking' role to initiate the creation of social ties as children do, as identified by Kazmierczak (2014).

Dog parks in sporting parks may also increase their potential to facilitate physical activity. Given that 40% of Australian households own at least 1 dog, plus the enjoyment dogs and hence their owners gain from being walked, a focus on dog walking could represent an effective strategy for increasing population wide levels of physical activity (Christian et al. 2013). Further, a recent review of the literature surrounding dog ownership and physical activity identified access to appropriate walking areas, such as off-leash areas, as one strategy for encouraging more owners to walk their dogs (Westgarth, Christley and Christian 2014).

In summary, dog parks may be an innovative way to activate the potential of seasonal drainage landscapes in sporting parks to also provide health-promoting services along with their regulating function.

7.1.4 Remnant Vegetation in Sporting Parks

As well as their biodiversity function, large areas of remnant bushland in sporting parks may be of significant value in facilitating physical activity, and specifically walking. Both Kaczynski, Potwarka and Saelens (2008) and Schipperijn et al. (2013) found that 'wooded areas' in a green space were related to higher levels of physical activity, with paved and un-paved trails also significant. Further, the location of a large area of remnant bushland would also greatly increase the overall size of the park, which should therefore make it a more attractive destination for neighbourhood walking.

Whether bushland areas are perceived as restorative or not will likely influence this value for facilitating physical activity. Remnant vegetation such as bushland areas represents natural environments removed from the surrounding urban environment. In theory then, they have the potential to facilitate restorative outcomes. However, Section 3.2.3 established that the meaningfulness of a complex natural environment could differ significantly for different individuals: while areas with levels of biodiversity may be the preferred green space environment for some, for others it will be a more manicured and maintained landscape. One explanation for this variation is the degree to which the 'biophilic' affiliation with nature has been developed in different individuals. Another explanation may be found in a study by Van den Berg and van Winsum-Westra (2010), which investigated preference for green landscape in the specific context of gardens. The authors use the concept of 'personal need for structure' as a psychological predictor for preference for manicured, romantic or wild garden styles. It found that respondents with a high personal need for structure were more likely to prefer manicured or romantic gardens compared to wild gardens (Van den Berg and van Winsum-Westra 2010). It could be hypothesised that an individual's personal need for structure could be a significant factor in their preference for either manicured or wild and biodiverse park landscapes as well.

Those who prefer a more complex and fascinating natural environment, which could be interpreted as individuals with a more developed 'biophilic' instinct or less of a personal need for structure, will be more likely to utilise these areas for restoration. Certainly, there are few other green space settings that could allow residents to 'be away' to such an extent from everyday urban surroundings. Perth bushland also allows for appreciation of indigenous flora species, and for the opportunity to view rare native fauna such as insects, reptiles and birds. As well as providing sources of fascination, and hence attention restoration, such features could also be utilised as both passive and active environmental education resources.

Conversely, these potentially positive qualities of bushland could also be a negative for some users. Ward Thompson (2002) has discussed the fundamental roles that 'wooded' landscapes play for different urban residents. For many individuals, including children, these areas provide a sense of freedom as well as opportunities to play and manipulate the environment. Alternatively, women and individuals from ethic minorities may feel excluded due to concerns about being attacked or becoming lost. Thus, the very qualities that make a landscape attractive to one person may be perceived as anything from unsettling through to dangerous by another (Ward Thompson 2002). This is in line with human health resilience theory, which posits that an environment that does not meet an individual's needs (in this case a wild, complex green space for those who prefer tame landscapes) may even represent non-facilitative environments and hence negative resources (Ungar 2012).

The potential negative role of complex vegetated landscapes is reflected in the discussion by Ulrich (1993) of the evolutionary underpinnings of SRT. As well as a biophilic response, there also exists an argument for a corresponding *biophobic* response to some natural stimuli that may have presented threats to our species survival throughout history. Such features may act to increase levels of stress, rather than decrease them, as an evolutionary response to enable survival related responses (Ulrich 1993). This is certainly relevant in Perth. Local bushland often comes with signed warnings that the user is passing through venomous snake habitat, and where spider species roughly the size of a human hand can be regularly observed adjacent to (or, in some instances, stretching across) recreational paths. Consequently, whilst mentally engaging, passing through these areas during summer in particular can also be anything but relaxing. Thus, it could therefore be hypothesised that remnant vegetation areas may be quite effective at facilitating attention restoration, but less effective for restoration from stress.

Figure 57: Signage warning of the dangers of snakes in Perth bushland (Source: Author)

In summary, remnant vegetation areas in sporting parks may be of most value in facilitating physical activity. In terms of restoration, the remnant bushland areas may differ significantly for different individuals, to the extent that they represent a negative environment for some users. Because they represent the most extreme example of landscapes that facilitate 'people-to-nature' activities, they may therefore be expected to be less likely to facilitate social interactions. That said, in line with the findings of Staats and Hartig (2004), the presence of a companion may be essential for bushland areas to be perceived as restorative by many individuals more exposed to the perceived risks of these areas. Due to the presence of a complex natural environment, and the general preference of such landscapes for children, these vegetated areas also have potential to facilitate environmental learning.

7.1.5 Community Gardens in Sporting Parks

Community gardens may not represent a typical urban ecological landscape, however they can carry out a range of key ecological processes (Krasny and Tidball 2009b). As components of urban garden infrastructure, community gardens can contribute to numerous regulatory ecosystem services: localised air-cooling, flood mitigation and rainwater filtration, and biodiversity havens for bird and insect species (Cameron et al. 2012; Okvat and Zautra 2011). These services may be particularly valuable in high-density areas, where domestic gardens are less prevalent. As public green spaces, community gardens also have relatively unique potential to provide *provisioning* ecosystem services, which Niemela et al. (2010) define as those material benefits that can be gained from urban green spaces. Food production in community gardens can play a role addressing food security issues, as well as healthier and more sustainable food choices (Evers and Hodgson 2011). Together with the economic savings that food production allows, this service has particular value in socioeconomically disadvantaged areas (Dunn 2010). Yet, as is being increasingly acknowledged in community gardens research, the greatest value of these unique green space landscapes may be their potential to facilitate each of the four cultural ecosystem services investigated by this thesis. A full discussion can be found in Middle et al. (2014), with a summary given here.

As a form of green space recreation, gardening can facilitate both attention and stress restoration. Kaplan (1973) suggests that gardening and the ability to grow things is a highly fascinating activity that easily engages indirect attention. In terms of stress, a

Dutch study on allotment gardening found that 86% of participants felt less stressed after gardening (Van Den Berg, Van Winsum-Westra, et al. 2010). Indeed, a follow up study found that gardening decreased the stress hormone cortisol to a greater degree than reading (Van Den Berg and Custers 2011). Community gardens may also provide passive green space destinations to experience restoration without engaging in gardening. Well-designed community gardens could be effective at meeting the design guidelines of Nordh et al. (2009), and the sensory dimensions of Grahn and Stigsdotter (2010). In the latter case, this may be particularly true for the dimension of 'refuge' that is linked to stress restoration. The fencing and vegetation of gardens may create an ideal location for children to play (and learn) within a safe natural environment. This hypothesis is supported somewhat by studies that have investigated the restorative potential of gardens (Adevi and Mårtensson 2013; Ottosson and Grahn 2008; Tenngart Ivarsson and Hagerhall 2008).

In line with the theoretical framework of this thesis, the potential restorative value of community gardens may also make them effective resources for increasing physical activity through local parks. Indeed, community gardens have been acknowledged to be valuable resources for encouraging walking in urban areas (Bird 2004; Kingsley, Townsend and Henderson-Wilson 2009). Their creation in large sporting parks as a contrast to sporting areas may be one way to better utilise this potential. Further, gardening itself may also be an effective and sustainable form of green exercise. Bird (2004) suggests that gardening has many benefits as a source of physical activity: it can increase upper body strength unlike walking and cycling; the broader aims of food production may make it a more sustainable form of exercise in the long term; and it is accessible to individuals with lower fitness levels. Gardening has also been found to be a particularly accessible form of physical activity for the elderly (Bird 2004; Van Den Berg, Van Winsum-Westra, et al. 2010). That gardening is more accessible to elderly and less active social groups may make it give community gardens even greater potential to encourage higher levels of neighbourhood walking in these groups.

Community gardens can also provide an array of social services to local communities, with these benefits one of the most commonly demonstrated benefits in a recent review of community garden research (Guitart, Pickering and Byrne 2012). As one of the most common forms of recreation in Australia, gardening offers a context for bringing people together (Stocker and Barnett 1998). In this sense, it could potentially provide a similar social function as children or dogs. Many gardens also actively enhance the potential for the creation of bonding and bridging capital by holding organized social events (Firth, Maye and Pearson 2011; Glover 2003). It could thus be argued that well-organised community gardens could provide a similar range of social services to sporting clubs, but for different demographics.

The social environment provided by community gardens may also make them effective in facilitating environmental learning. Barthel, Folke and Colding (2010) investigated the processes that lead to environmental education in urban gardens, finding that, as well as physical aspects of the garden, learning was facilitated through social processes such as imitation, oral communication, rituals and rules. This is supported by Bendt, Barthel and Colding (2013) who found that community gardens with broad management regimes and lack of obstacles for participation allowed for a higher degree of cultural diversity and associated environmental learning outcomes as distinct from more closed forms of urban gardening. The potential for community garden to facilitate active environmental learning has already been demonstrated in Perth by Stocker and Barnett (1998), who documented the success of a community garden as an educational tool, including as a venue for the formal teaching of various local environmental principles.

A further benefit, and one of the most unique and valuable services that community gardens can provide, are opportunities for local residents to actively engage in local park planning processes, thus allowing a degree of negotiation for meaningful green space environments. Rather than the product of formal planning institutions such as LG’s, many community gardens are designed, created and managed by local residents themselves (Hou, Johnson and Lawson 2009; Lawson 2005). The direct involvement of local residents in the creation of a community garden can produce a green space that better reflects the needs of the community (Francis 1989; Okvat and Zautra 2011), and would be an example of *needs-based* approaches to park planning discussed as a way to overcome the shortcomings of standards approaches (Byrne, Sipe and Searle 2010; Veal 2008b). Community gardens are also an example of ‘bottom-up’ green space planning, where responsibility for green space creation and management is progressively shifted away from under-resourced formal institutions towards civic society (Rosol 2010).

A final benefit of community gardens is that, unlike the other ecological landscapes discussed in this thesis, they do not have to be considered in the initial design of a park. Thus, much like dog parks, they have great potential to activate under-utilised space both in new and older suburban parkland. Community gardens are also often quite small, and can be created in peripheral areas of a park, such as those adjacent to a sporting area, which might otherwise have little use. Indeed, they have already been proposed as a way to activate poor quality parkland in Australian suburbs (Freestone and Nichols 2004), and might serve a similar function in sporting parks produced under standards approaches.

7.1.6 Summary

The previous discussion has identified a series of theoretical hypotheses relating to potential of each ecological landscapes to facilitate cultural ecosystem services in sporting parks. These are summarized in Table 5 below, and are investigated further through the observational and questionnaire data.

Table 5: Summary of theoretical potential services provided by each ecological landscape

Ecological Landscape	**Theoretical Hypotheses for Facilitating Ecosystem Service**
Permanent Water	Stress restoration as a calming, safe natural environment; Attention restoration as a fascinating natural environment; Destination for neighbourhood walking due to general attractiveness; Venue for social interactions due to universal social preference for water; Particularly valued in dry climates and as an alternative to barren sporting landscapes.
Seasonal Drainage	Potential for utilisation for off-the-leash dog exercise; Venue for social interactions as a by-product of dog exercise; Destination for neighbourhood walking as a by-product of dog exercise.
Remnant Vegetation	Destination and venue for neighbourhood walking when trails incorporated; Variable value for mental restoration, with generally more potential for attention restoration; Potentially negative venues for some users (e.g. women, minority groups); Low potential for social interactions outside of presence of a companion; Sites for environmental learning for young people.
Community Gardens	Stress and attention restoration through both gardening and passive experience of nature; Physical activity through both gardening and neighbourhood walking; Social interactions through informal meetings and organised events; Environmental education through informal and formal teaching practice; Community participation in public park planning and governance; Spatially efficient landscape for activating under-utilised parkland.

7.2 Results and Discussion

To test and expand upon these theoretical hypotheses, this section presents and discusses the results of the observational and questionnaire approach outlined in Chapter 5.

7.2.1 Questionnaire Implementation and Sample Size

To recap briefly, the primary source of data was on-site questionnaires of users within each distinct recreational area undertaken (or attempted) using the instrument contained in Appendix 2. The combined qualitative and quantitative data gained from these questionnaires was complemented with both systematic and descriptive observations of user behaviour in each area. Unfortunately, the questionnaire method could not be applied across each of the four ecological landscapes. This section details the implementation of the questionnaire across each of the case study parks, and discusses the final sample sizes and their implications on the subsequent analysis.

The questionnaire survey was originally implemented with the aim of gaining data from a representative sample of the population of people that used each specific area of the park. Various measures exist for what constitutes a sufficient questionnaire survey sample, including small-scale studies such as this. Denscombe (2014) suggest a minimum of 30 responses is needed for the results to be valid, although such a low number would limit the potential for rigorous statistical analysis. Ultimately, however, a sample size should be reflective of the population from which it represents, both in terms of the proportion of the total population and individual demographic groups that it captures (Denscombe 2014). For this research, the total population was the number of people that actually use each specific park area.

As the implementation of this questionnaire method progressed, it became clear that some of the selected recreational areas were problematic for intercepting a sample size of users considered acceptable for a social research project. The community garden within Charlie Gregorini Park was visited in April 2014 across several weekends during the garden's planned busy bees, when it was expected to have its highest visitation numbers. However, even during these times, the same few visitors were encountered each time, and only 6 questionnaires could be completed. While a small number, and well below the mark outlined above for a sufficient sample size, it was largely representative of the population who were using the community garden at the time. As such, it allowed for some preliminary discussion under the community garden research question. The low visitation rate is also itself an insight that is also considered in the final synthesis, however prevented the garden from being quantitatively compared with areas in the other two sporting parks.

Applying the questionnaire within the bushland area in Ridgewood also proved problematic. Use of the bushland area was lower than the lake area, with users typically in transit as part of a walking circuit. This made it difficult to survey, as the questionnaire aimed to intercept users who actually stayed within the area rather than simply in transit, and to do so in a way that reduced interference with the activity they were engaging in. The setting of the bushland area – with a narrow path, often limited visibility in front and behind, and isolated environment – was also an uncomfortable setting to administer intercept questionnaires. Additionally, the total length of the bushland path, along with its multiple entrances, made it impossible to accurately record every user in the necessary detail and hence to replicate the systematic observational method. The method was therefore applied for this specific area, however some limited perspectives for the use of the bushland area were gable to be gained from lake users.

Even for the lake area in Ridgewood Park, overall visitation levels, and specifically users suitable to be intercepted, were also lower than expected. Many users commented that the area was rarely used in the late afternoon or evening, when it was typically occupied by groups of young people in the BBQ area. Others noted that the condition of the lake was a deterrent for many. Further, many users only passed through the area briefly in transit; only those who used the area as a destination were intercepted. Initially, 16 questionnaires were collected from the area, with a similar number of questionnaires (15) were collected from the dog exercise area in Coolamon in April of 2014. While enough for trends to emerge in the responses between these two recreational areas, this small sample size fell below the minimum level identified above by Denscombe (2014). Consequently, a second round of questionnaires were taken from each park in February 2016, to take the mark for each park up to 30. While collecting questionnaires across these different periods was not ideal, as it is likely that the population of each park area changed across this period of time, there were no significant changes to the physical environment of either park, and there were no instances of the same user being intercepted twice. Response rates were high for both areas (upwards of 75%), and there was no clear response bias in those who declined the questionnaire.

It is possible that a different method of questionnaire circulation, such as door knocking or mail drops in the neighbourhood surrounding each park, may have produced a greater sample size. That said, it is likely that the actual user population of each park is quite small, and thus this approach may have been inefficient by targeting large numbers of non-users, while also reducing the ability for more precise answers from those who actually do use the park. The collected sample of 30 represents approximately 50% of the population of users of each park on a single weekday during summer (50 individual users were recorded for Ridgewood, and 61 for Coolamon; see Section 7.2.2). Given the high proportion of daily users as determined through the questionnaire (33% for Ridgewood, 57% for Coolamon; see Section 7.2.3), the actual population of residents who use the park on a regular basis is unlikely to be significantly greater than this, particularly for Coolamon.

As such the following discussion compares the results from the Ridgewood Park lake area and the Coolamon Park dog exercise area. As shown in the photos in Figure 58, these two areas provide contrasting green space environments: Ridgewood the more aesthetic environment with water, vegetation, ducks and plenty of shade; Coolamon with only a single small area of vegetation, otherwise primarily grass with dirt patches around the drainage areas and a single shaded seating area.

Figure 58: Contrasting 'natural' environments provided by Ridgewood (top) and Coolamon parks (Source: Author)

According to the findings in Table 5 above, it would be expected that these green space environments would be likely to facilitate different sets of ecosystem services. The lake area might be expected to be most effective at facilitating both forms of restoration, and to a lesser extent neighbourhood walking and social interactions. The main service facilitated by the dog park is social interactions, while it might also represent a valuable destination for neighbourhood walking. Indeed, these hypotheses are largely born out in the results in the following sections, with some points of difference also revealed. Firstly, an overall summary of the results of the observations and then the questionnaires are presented. Next, the results from each method in relation to the influence of organized sport and sporting areas on non-sporting recreation in each area are discussed. Following this, the results relating specifically to each cultural ecosystem service are grouped together and discussed.

Before the results are presented, it should also be briefly noted that there was some variation between the samples collected at each time period. Figures 59 to 62 show the average values of respondents for each activity and outcome for each park. This is similar to the presentation of results in Section 7.2.3 onwards, however rather than comparing the results from each park, they compare the results from each *sample* (sample 1 being obtained in April 2014, sample 2 being obtained in February 2016). It shows the average activity rating to be fair similar for both parks, with the most notable difference being the value of 'interacting with nature' in Coolamon. However, there are more notable discrepancies for the outcome value averages: with values constantly higher in the second sample for Ridgewood but consistently lower in the second sample for Coolamon. Some tentative hypotheses can be put forward for these discrepancies based on the time of year they were undertaken. A more vegetated green space such as Ridgewood with a water feature may become more attractive and valued during hotter summer months. Alternatively, a more sparse landscape such as the Coolamon dog exercise area may be less attractive doing these months. The quality of the dog exercise area also appeared slightly poorer in terms of grass coverage compared to dirt coverage during the second round of observations. When considering the sample as a whole with the inclusion of this second round of data, some of the findings that had been proposed signally had to be reconsidered and re-written. This should be taken into account when considering the reliability of the questionnaire data.

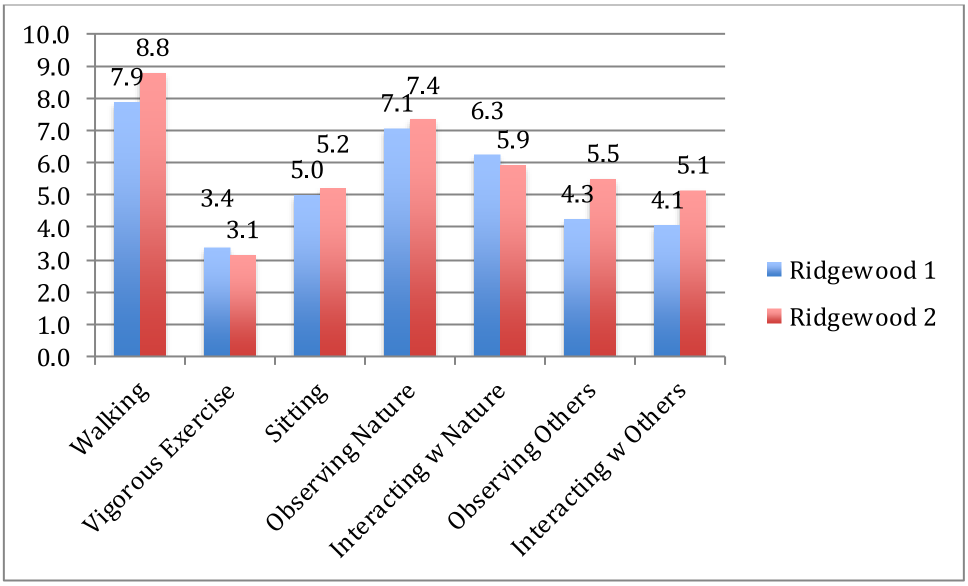


Figure 59: Value averages for each activity between the two Ridgewood samples: N= 16 for the first round and N = 14 for the second round.

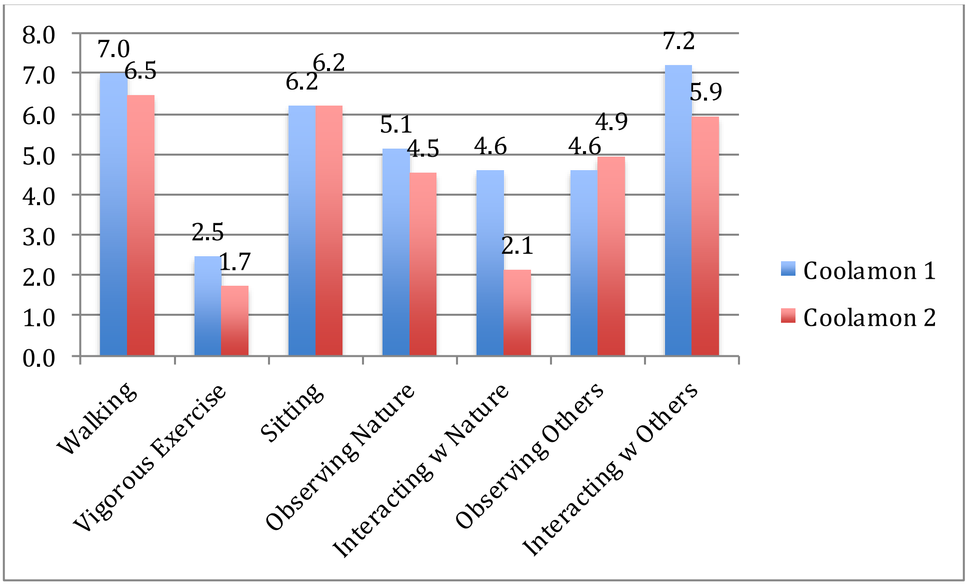


Figure 60: Value averages for each activity between the two Coolamon samples: N = 15 for each round.

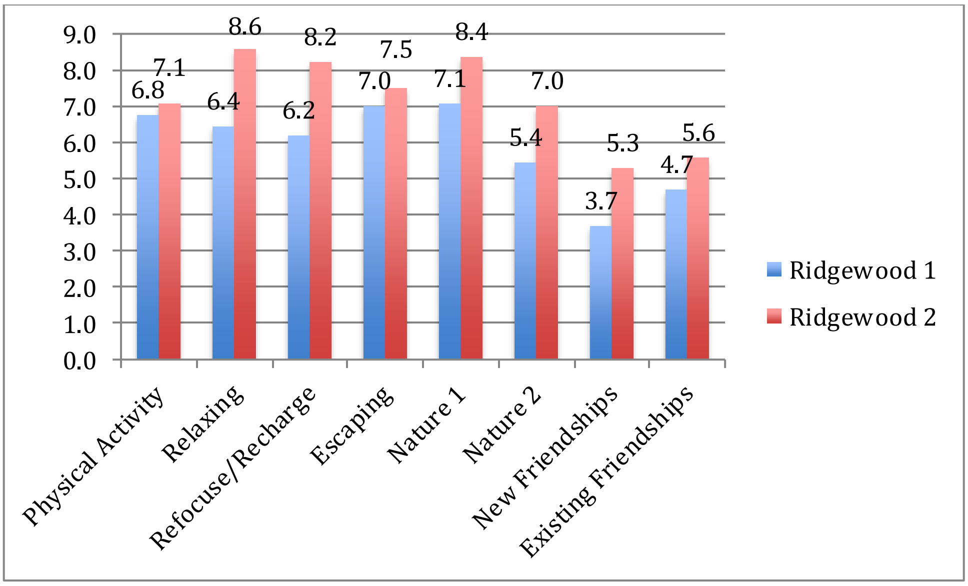


Figure 61: Value averages for each outcome between the two Ridgewood samples.

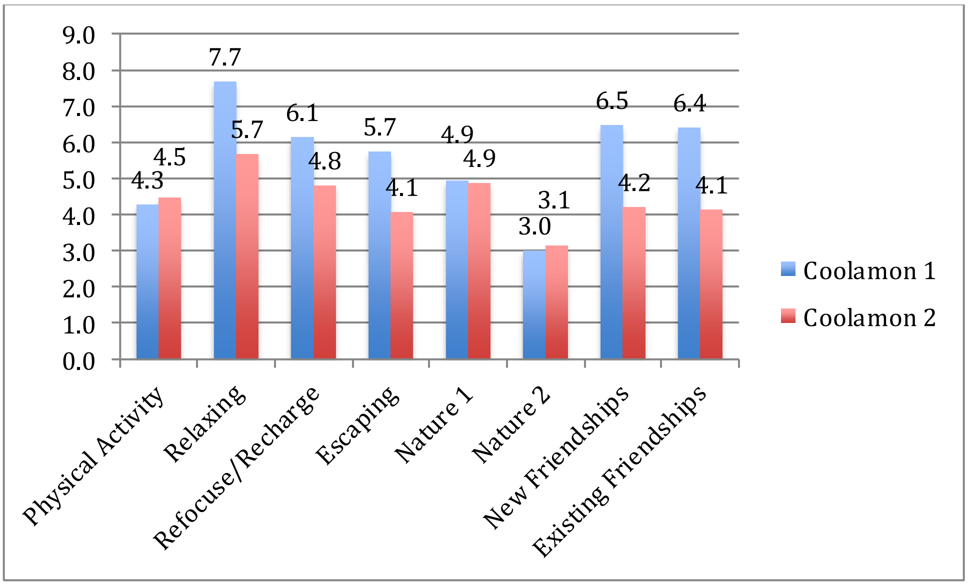


Figure 62: Value averages for each outcome between the two Coolamon samples.

7.2.2 Observation Results Summary

As outlined in Section 5.4, systematic observations were undertaken at each park between the hours of 7am and 7pm. Each unique park user judged to be over the age of 18 was recorded, with their estimated age group, gender, time of visit and activity type(s) noted. In total, 50 individual users were observed in the Ridgewood Lake area, and 61 in the Coolamon dog exercise area. Figure 63 shows how this use varied across the day for each area, grouping the time of arrival of each user into one-hour blocks. Both parks were used primarily in the morning and evenings, with little use between 10:00am and 2:00pm. There was some difference in use across the parks during these peak periods: Ridgewood had slightly more use in the morning, with more users arriving in each hour block from 7:00am to 10:00am compared to Coolamon. The heaviest period of use was between 8:00am and 9:00am, when 10 users arrived. The heaviest use of Coolamon was clearly in the evening after 5:00pm, with 26 users arriving in this last two-hour period and 17 alone from 5:00pm to 6:00pm.

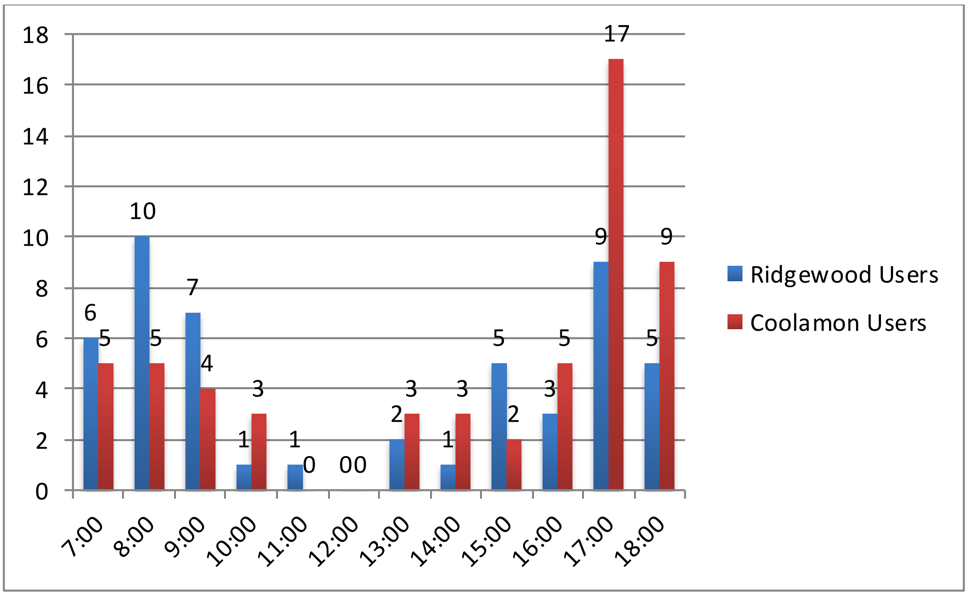


Figure 63: Total number of visitors who entered each park area during each hour block

One of the most notable differences in the observational data between the two parks was in the duration of visits, with Coolamon users clearly spending longer periods of time in the park when visiting. The average duration for all observed visits where both the time of entry and exit were recorded was 36 minutes in Coolamon, compared to 15 minutes in Ridgewood. This is further illustrated when breaking down the data by time periods, as shown in Figure 64. Over half of all visits to Ridgewood lasted less than 10 minutes, reflecting its use as a path or circuit within a broader walking route. This compares to only 6% for Coolamon, with the majority of visits lasting between 10 and 60 minutes – reflecting its primarily passive/social use. Over half of visits to Coolamon lasted more than half an hour, compared to 16% for Ridgewood.

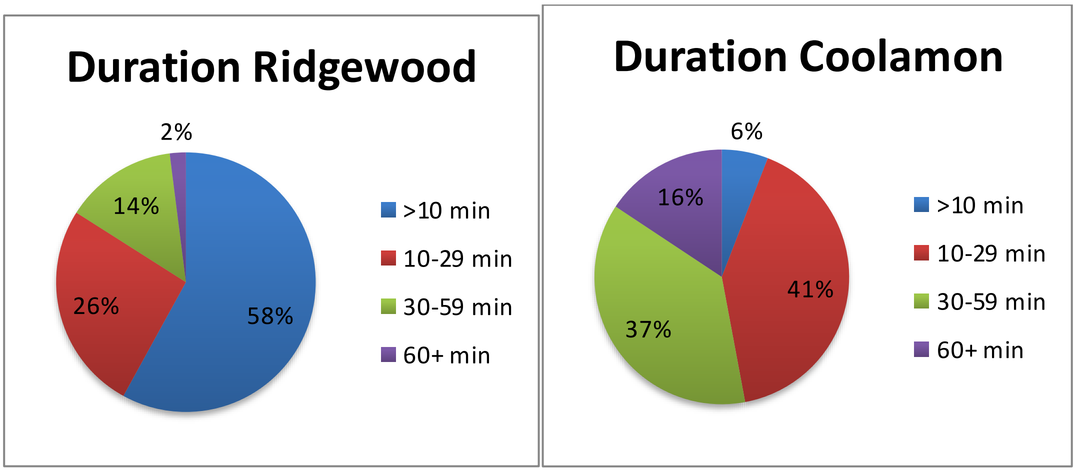


Figure 64: Duration of visits for each park area, expressed as a percent of total population for each time bracket

The observations also revealed differences in the demographic makeup of the user populations of each park area. As shown in Figure 65, the dog park in Coolamon had a generally younger population: while there were similar proportions of 30-50 year olds, 31% compared to 18% of Coolamon users were estimated to be between 18 and 30, while only 23% over the age of 50 compared to 40% in Ridgewood. Figure 66 shows that females were better represented than males across both parks, with the proportion slightly higher for Ridgewood (62% compared to 56%).

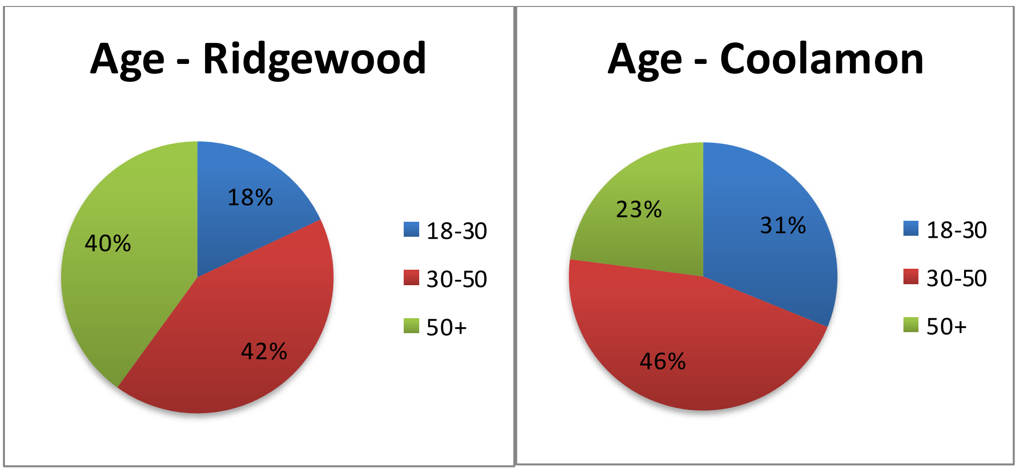


Figure 65: Age makeup of populations of each park area

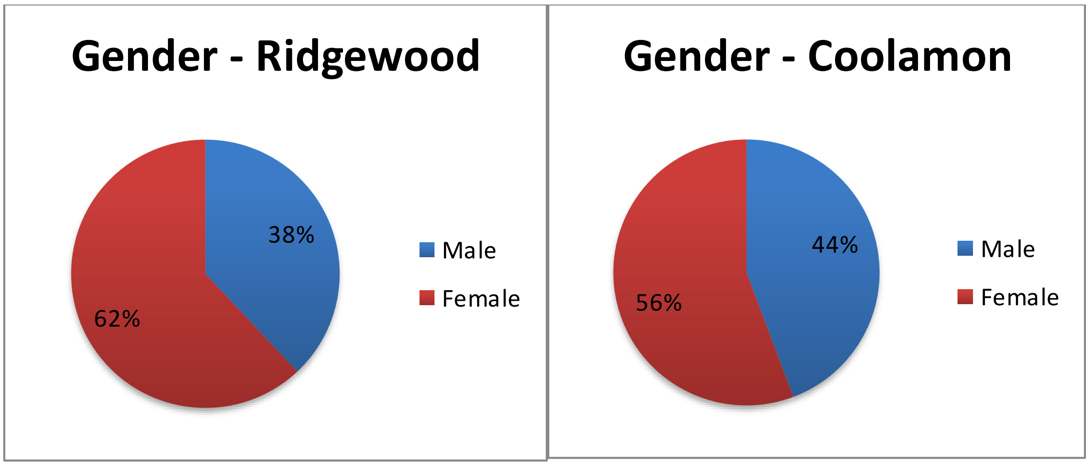


Figure 66: Gender makeup of populations of each park area

There were also differences observed in the broad types of recreational activities prevalent across each park area (Figure 67). Each user was broadly categorised as 'active', 'passive' or 'both'. Active users were those engaging in non-incidental walking or fitness activities as the sole reason for their visit. 60% of Ridgewood users were categorised as such, compared to 10% of Coolamon users. Passive users engaged in no physical activity besides their transit to and from the main area of stay within the park (for example, walking to and from the playground or the edge of the lake for Ridgewood users; walking to and from the shade area or cleaning up after their dog in Coolamon). This category included 20% of Ridgewood users: primarily users enjoying the lake, feeding the ducks and/or supervising children in the playground. This compared to 49% of Coolamon users: typically users sitting or standing in the vicinity of the central shaded area either watching their dogs play or interacting with other users. Examples of the remaining users categorised as both active and passive included walkers who stopped to appreciate the lake in Ridgewood, or users who engaged in social activities in the shade area but also spent periods walking and playing with their dogs in the open space areas in Coolamon.

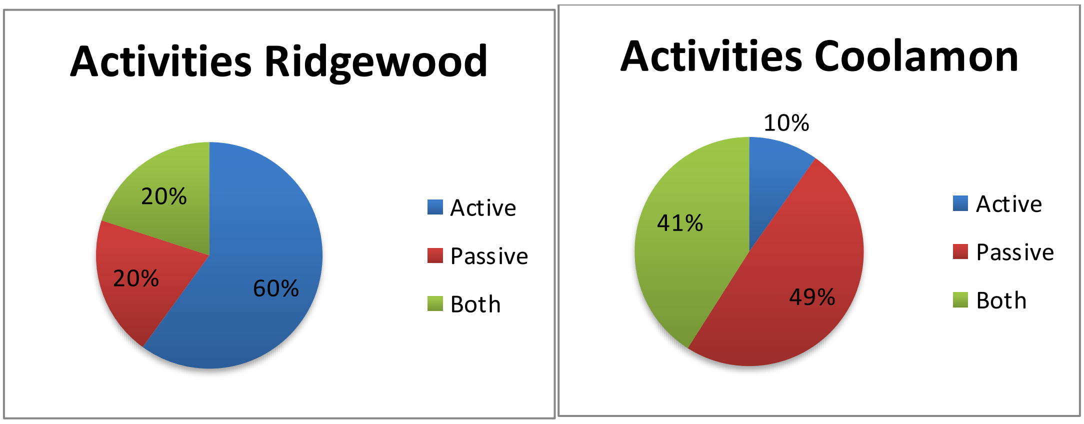
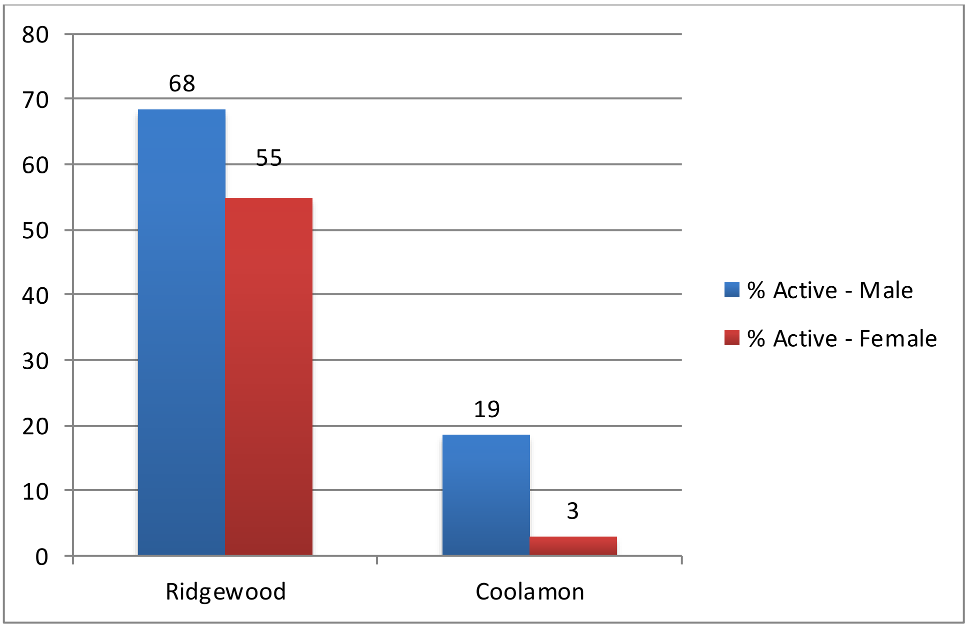


Figure 67: Breakdown of the recreational use of each park area

Analysing park use based on the different demographic variables also revealed some interesting findings. Figure 68 shows that use of each park for active recreation was more common for males, with a 13% differential in Ridgewood and 16% in Coolamon. Conversely, there is favourability towards passive activities by females, with a 7% differential for Ridgewood and 15% for Coolamon.



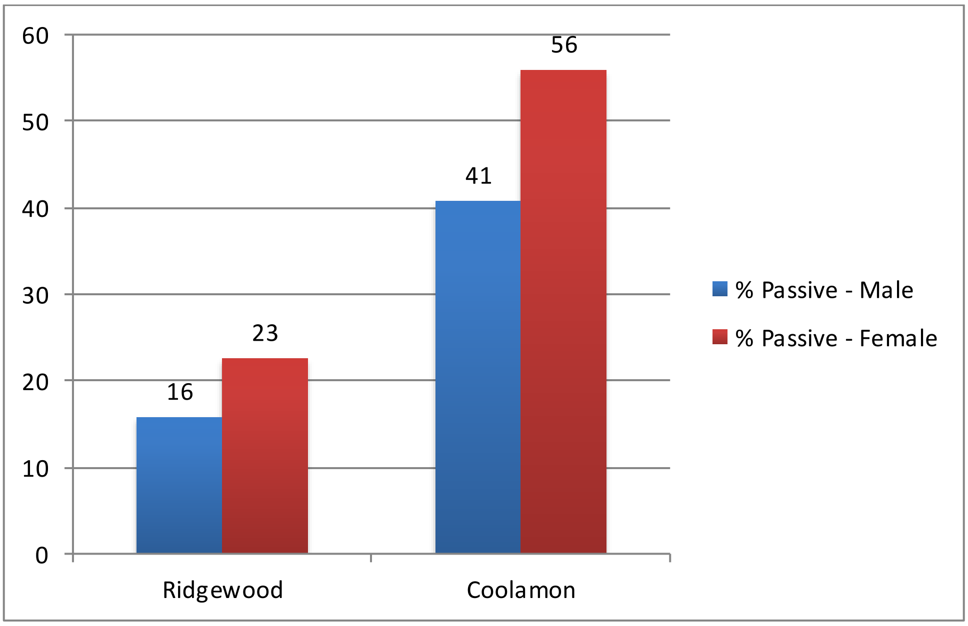
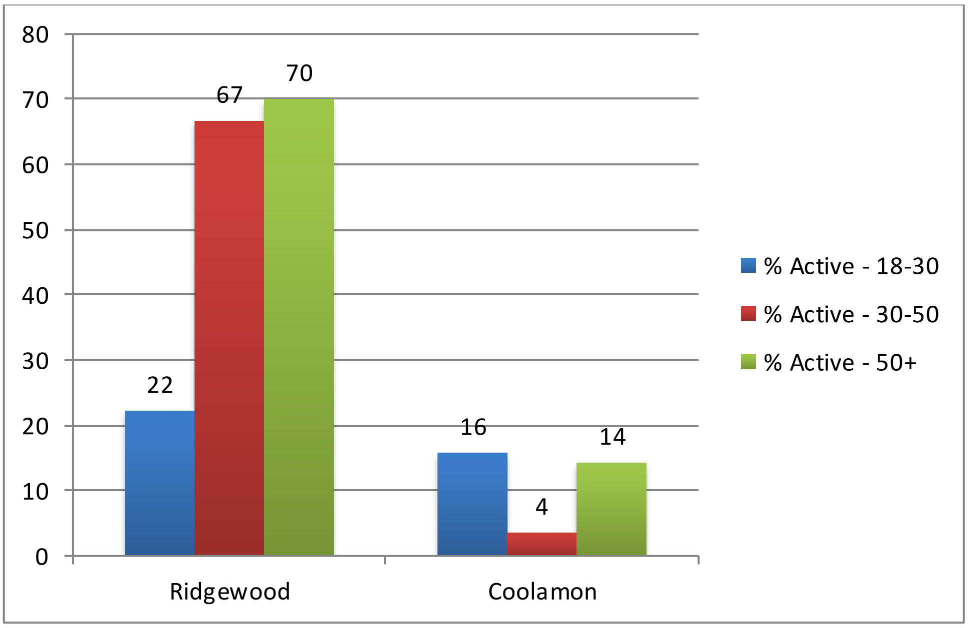


Figure 68: Recreational use of each park area by gender

When activity type was analysed by age bracket (Figure 69), there appeared to be a trend for likelihood to engage in active recreation for older Ridgewood users: only 22% of users aged 18-30 engaged solely in active recreation, compared to 67% of those 30 to 50 and 70% of those beyond 50. There was no similar trend for Coolamon users however.



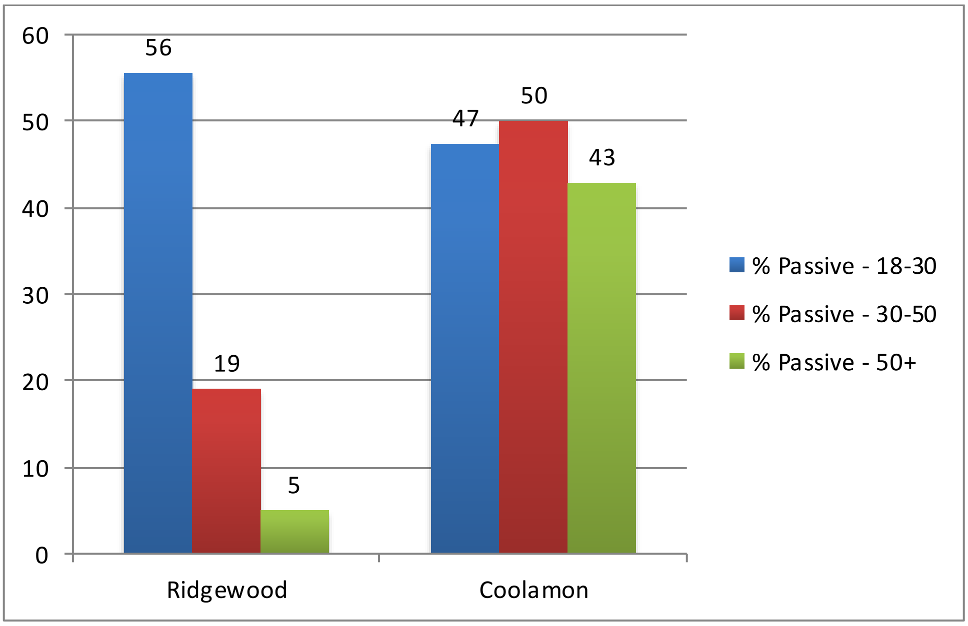


Figure 69: Recreational use of each park area by age bracket

Another interesting finding revealed through cross-tabulation was the tendency for females to stay longer for their visits than males. As shown in Figure 70, the average duration for both parks was longer for females: 18 minutes compared to 10 minutes for Ridgewood, and 41 minutes compared to 30 minutes for Coolamon.

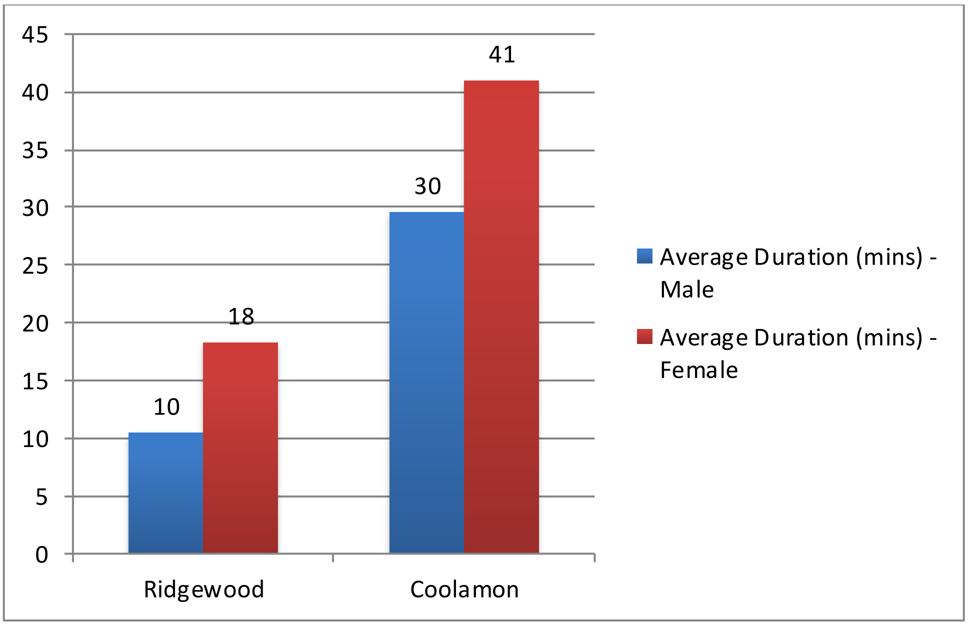


Figure 70: Average duration of visits to each park area by gender

A trend was also identified between duration and age bracket for both parks. As shown in Figure 71, average duration decreased progressively as the age bracket increased: from 22 minutes for 18-30 year olds to 16 minutes and finally 11 minutes for those older than 50 in Ridgewood; from 44 minutes for 18-30 years olds to 35 minutes and finally to 26 minutes for those older than 50 in Coolamon.

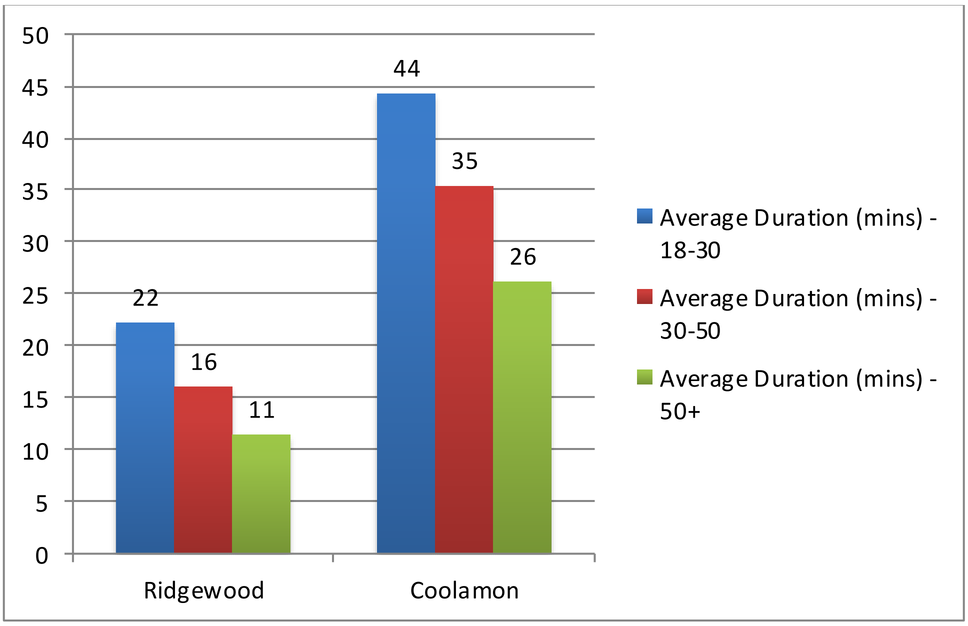


Figure 71: Average duration of visits to each park area by age bracket

To summarise, there are two key findings from the observational data. Firstly, Coolamon was the better occupied park area of the two, with slightly more individual users and longer average duration of visits for these users. There was also a fairly clear trend in the recreational use of each park area: Ridgewood was used more frequently for short active visits, while Coolamon was used more frequently for passive recreation that appeared primarily for social interactions rather than solitary reflection.

7.2.3 Questionnaire Results Summary

As outlined at the start of this chapter, intercept questionnaires were undertaken of 30 users in both park areas. As shown in Figure 72, gender breakdowns of the questionnaire sample of each park differed slightly: 70% of respondents in Ridgewood were female, compared only 47% in Coolamon. When compared to the breakdowns of the observation sample in Figure 66, this shows a slightly higher proportion of females for Ridgewood (70% in the questionnaire compared to 62% in the observed population) and slightly lower for Coolamon (47% compared to 56% in the observed population). In hindsight, more considerations could have been put into selecting respondents so that these numbers were more representative of the overall population of users for each park area. Figure 73 shows similar age profiles for the sample across each park: the most common ages for both parks are 25-34 followed by 35-44, with no one intercepted over the age of 75. Given the different age brackets used, it is difficult to compare this sample to that from the overall population from the observations.

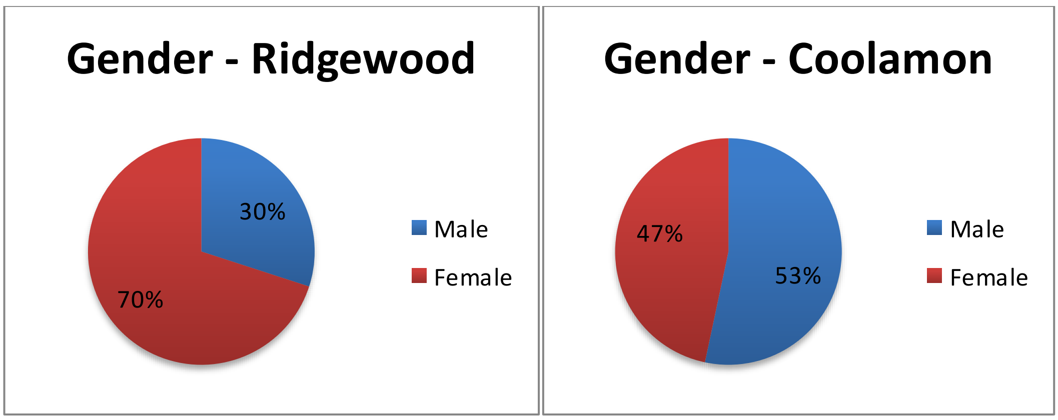


Figure 72: Gender of questionnaire sample for each park area

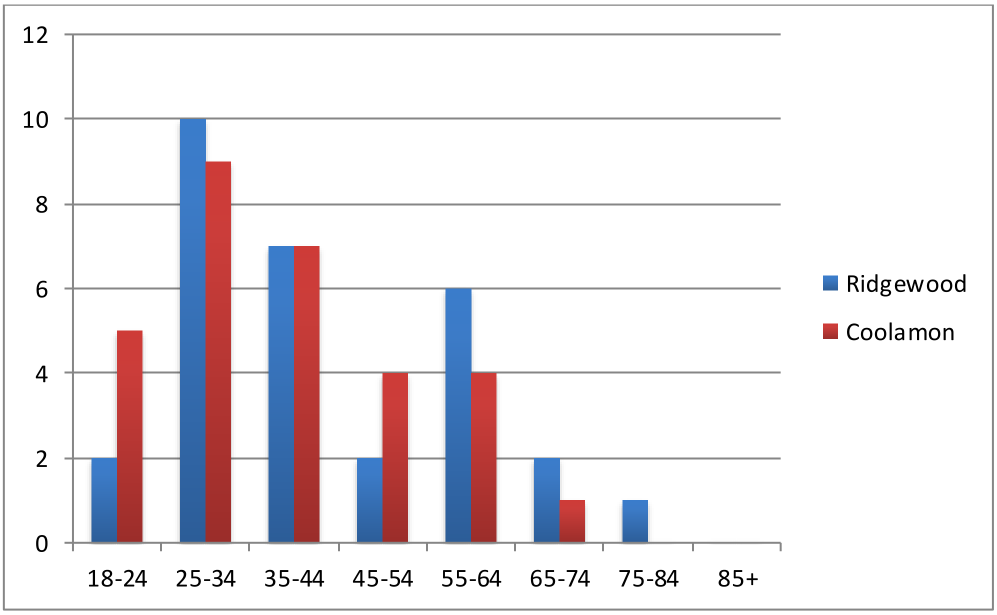


Figure 73: Age breakdown of questionnaire sample for each park area

The next questions asked respondents to estimate their frequency of use of the park area, along with their typical duration. As Figure 74 shows, the main difference in terms of frequency of use was in daily visitation: while daily was the most common response from users of each park, it accounted for over half (17, or 57%) of Coolamon responses compared to a third (10, or 33%) from Ridgewood. The average self-reported duration of users visits were 42 minutes for Ridgewood compared to 65 minutes. While this is a similar differential between users of the two park areas then the *observed* average duration of users (15 minutes compared to 36 minutes), these durations are notably longer. Figure 75 shows the groupings of self-reported durations for each park area: more users of Ridgewood estimated their visits to range between 10 and 29 minutes, while more users of Coolamon estimated their visits to last for over an hour. A notable difference with the observation data is that no one reported typical durations of less than 10 minutes, whereas these visits comprised over half of observed visits to the Ridgewood lake area. This could reflect users rounding short visits up to ten minutes, or users reporting their stay with in the park as a whole, of which only a small amount of time was spent (typically walking through) the lake area.

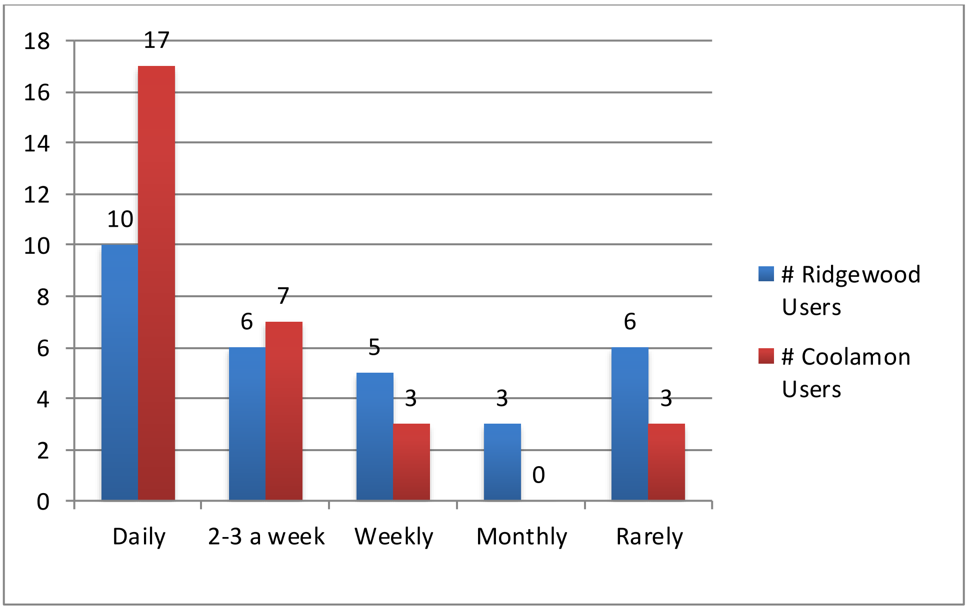


Figure 74: Frequency of visits of users of each park area

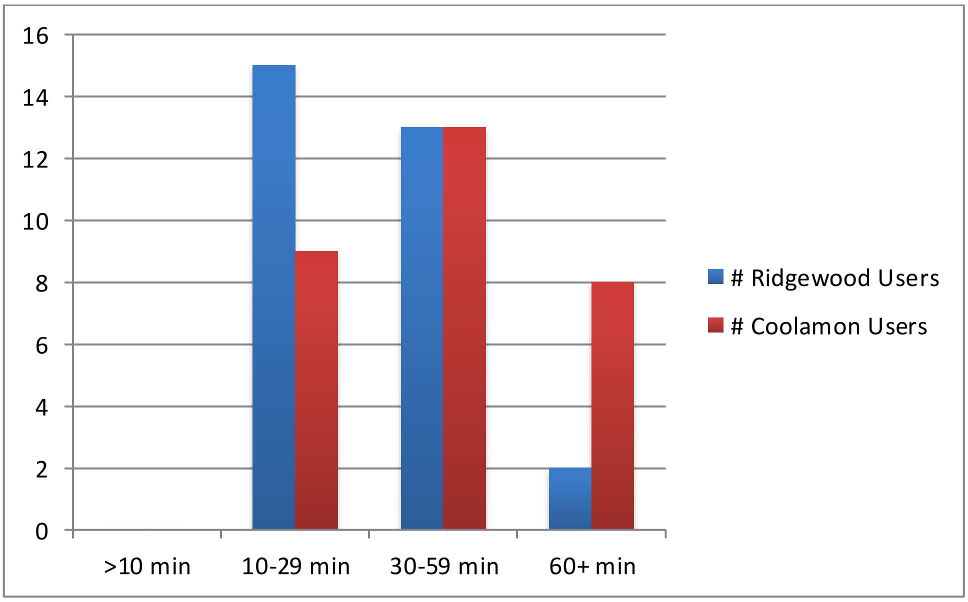


Figure 75: Duration groupings of visits of parks users from each park area

The primary aim of the questionnaire was to investigate the likelihood of each park area to facilitate different cultural ecosystem services. This was achieved by asking respondents to rate from 1 to 10 a list of different activities and outcomes. Figure 76 shows the average values for each *activity* across respondents from *both* park areas. Walking was clearly the most valued activity, with vigorous exercise clearly the least valued. Figure 77 compares the value averages specifically for *each* park area, and shows several key differences. The largest differences are in the two 'nature' activities ('observing' and 'interacting with'), both favouring Ridgewood, which is not surprising given the differences in the physical park environments. Ridgewood was rated higher for walking by a margin of 1.6, while Coolamon was rated higher for only two activities: 'interacting with others' by a margin of 2 and 'sitting' by a margin of 1.1.

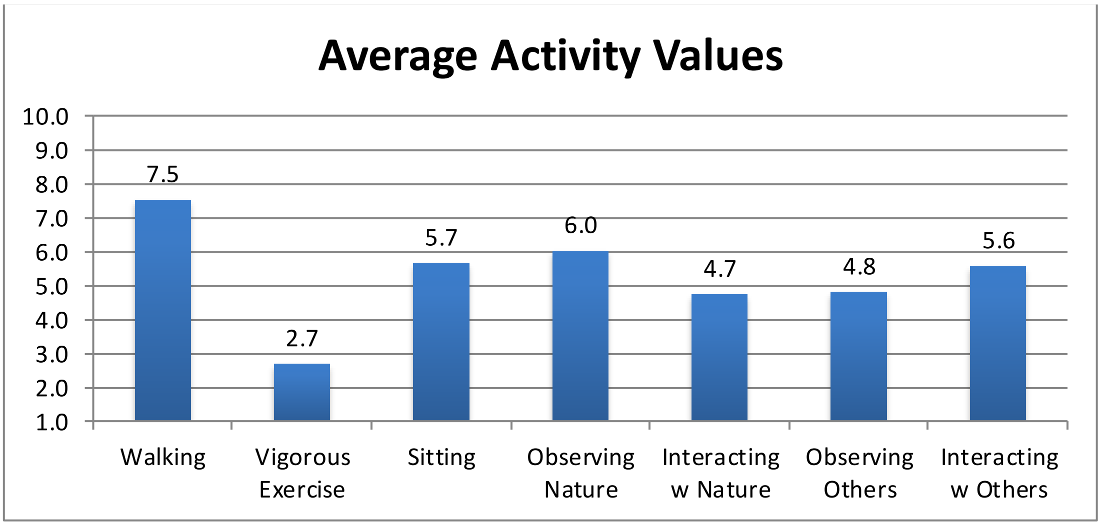


Figure 76: Average values for each park activity across all respondents

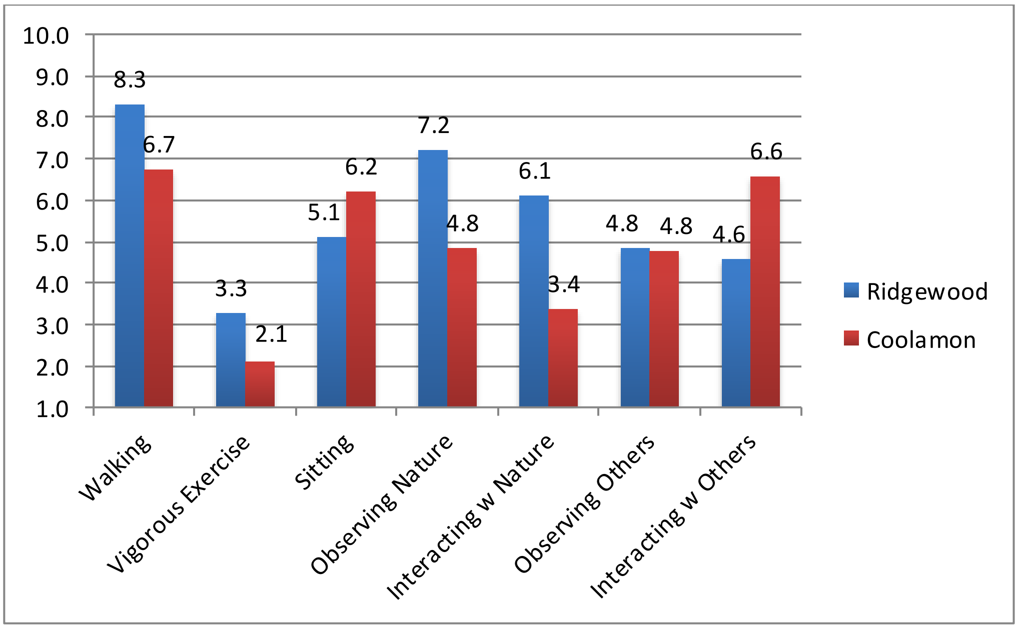


Figure 77: Average values for each park activity for respondents from each park area

Figure 78 shows the average values for each *outcome* across all respondents. 'Relaxing' was the most valued outcome at 7.5, with the other three 'restorative' outcomes effectively second: 're-focusing and re-charging' and 'greater appreciation of nature' at 6.8 followed by 'escaping everyday life' at 6.7. 'Physical activity' rated at 6, followed by both social outcomes – 'strengthening existing friendships' at 5.5 and then 'creating new friendships' at 5.1 – with the latter equally lowest rated alongside 'greater knowledge and understanding of nature'. When comparing the values for each specific park area in Figure 79, it can be seen that Ridgewood again rates generally higher than Coolamon. In fact, Coolamon rated at least 2 points lower than Ridgewood on four outcomes: 'physical activity', 'escaping everyday life' and both 'nature' outcomes. Coolamon rated higher only for both social outcomes, however by less than 1 point in both instances. As discussed previously, this reflects a limitation of the questionnaire method and its two separate rounds of interception, as these value outcomes were much closer for the first round of questionnaires than the second round.

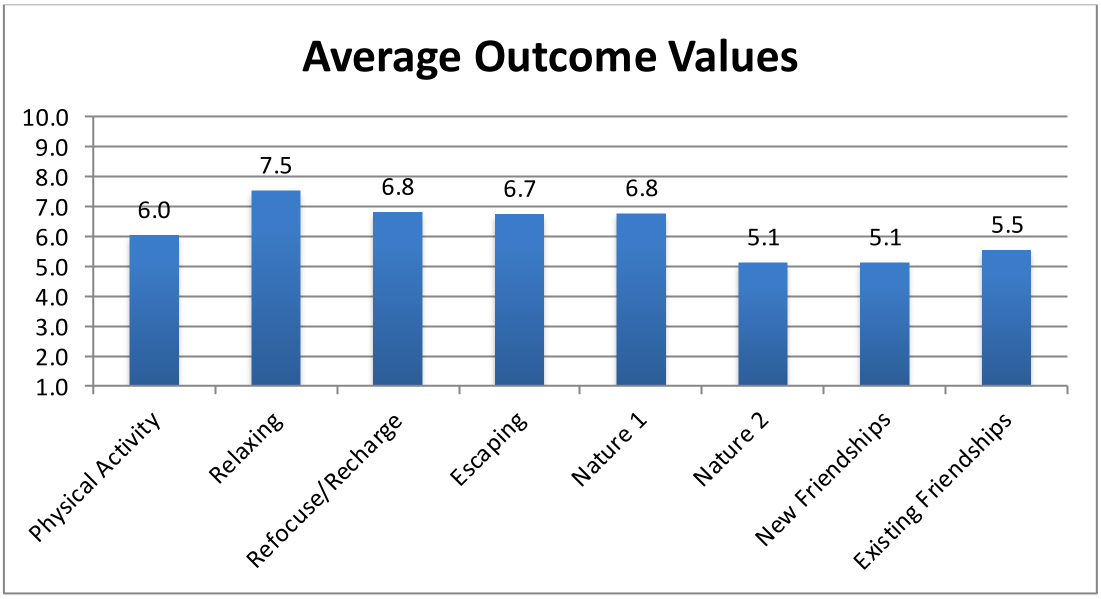


Figure 78: Average values for each park outcome across all respondents

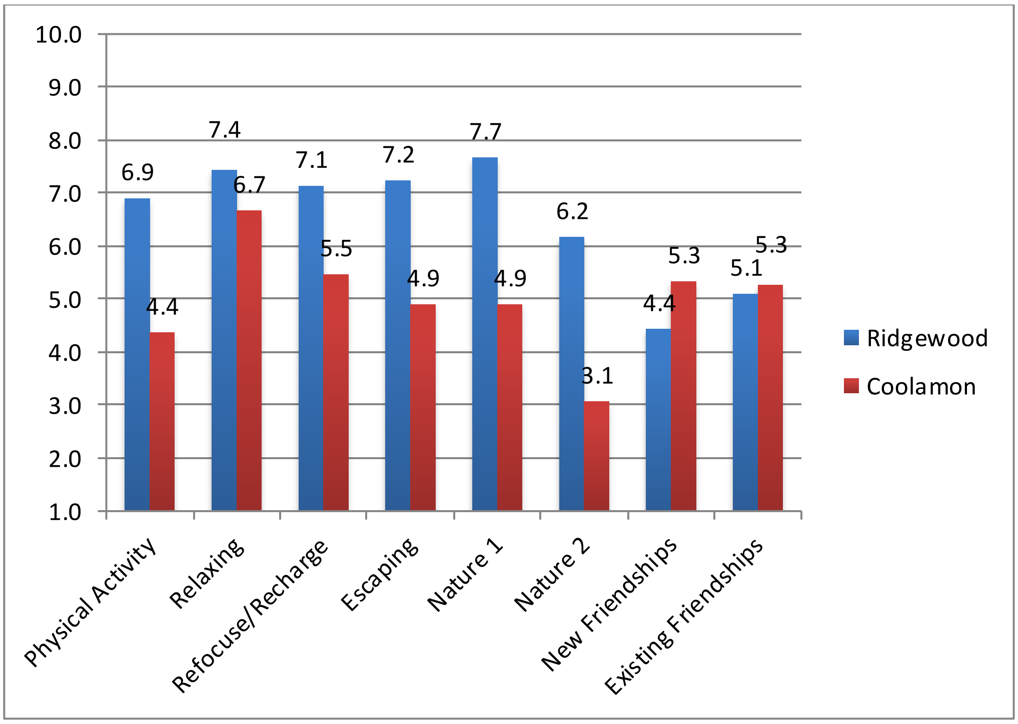


Figure 79: Average values for each park outcome for respondents from each park area

Broadly speaking, the values averages for activities and outcomes both support and contradict key findings from the observations. The general higher rating of Ridgewood by its users seems at odds with slightly higher number of users, the length for which these users stayed, and greater proportion of 'daily' users of Coolamon. Looking more specifically, these results support the key finding that Ridgewood was used more for active recreation, and Coolamon for passive recreation largely as a means to interact with other users.

The reason for differentiating between activities and outcomes was in acknowledgement of the complexity of park use under human health resilience theory: where users undertaken similar activities may experience different outcomes depending upon the compatibility of the environment with their own context and reasons for visiting. Indeed, some interesting findings can be seen when looking between these two sets of values. For example, looking at the activity values across both parks, 'walking' was clearly the most valued activity for all surveyed park users. Yet, the outcome of 'physical activity' was rated below the four outcomes most closely related to mental restoration: 'relaxing', 'refocusing and recharging', 'escaping everyday life' and 'greater appreciation of nature'. Further, and looking at the comparison data now between parks, Coolamon was rated higher for 'sitting' than

Ridgewood, yet was rated lower for these same four restorative outcomes. It did however rate higher for both social outcomes ('creating new friendships' and 'strengthening existing friendships'). Possible implications of these findings are discussed further in the following sections, however one interpretation is that walking might be the most effective activity for facilitating restoration, while passive sitting may be favoured for facilitating social interactions.

Another interesting finding emerges when taking the average of all activities and all outcomes for each park: that is, the average of every rating given to a possible activity within each park, along with the average of every rating given to a potential outcome. Figure 80 shows that the average values for all activities for Ridgewood was slightly higher (0.7) than intercepted Coolamon users: 5.6 to 4.9. When looking at the average outcomes, this is differential more than doubles: 6.5 to 5 or a difference of 1.5.

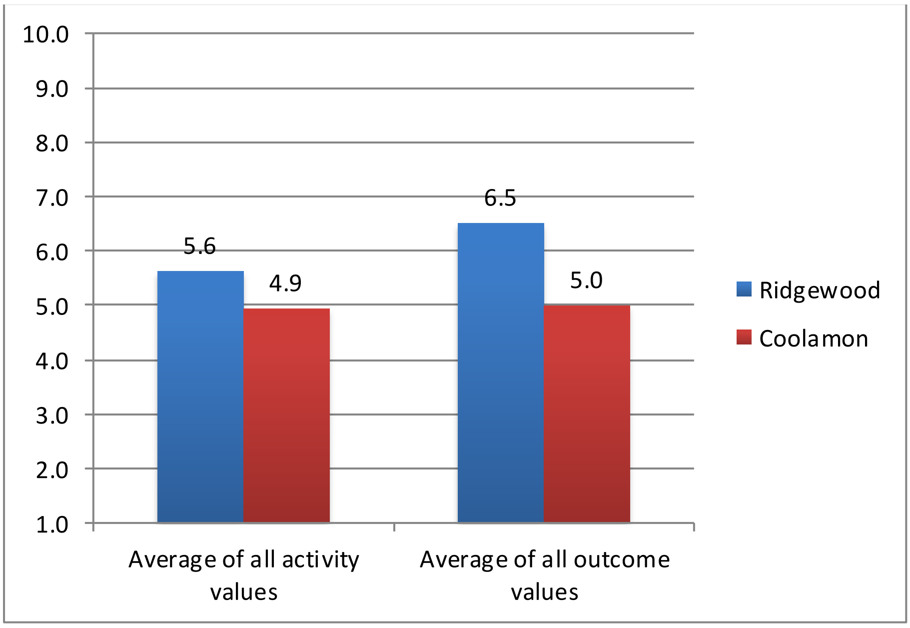


Figure 80: Average values of all activities and outcomes for each park area

One interpretation of these findings is that the provided list of outcomes was not fully representative of the main outcomes of visits to Coolamon, specifically that of exercising or socialising their dogs. In other words, many Coolamon users visited the park primarily for 'selfless' reasons rather than personal outcomes, which were not adequately captured in the questionnaire design. This would also partially explain a key discrepancy between the observational and questionnaire data: that Coolamon was observed having more users who stayed longer in the park compared to Ridgewood, yet generally was rated lower for positive outcomes. Had such outcomes been provided, this may have raised the overall averages for the dog exercise area.

Alternatively, another interpretation of this data is that the environment provided by the Coolamon dog exercise area was not as facilitative as Ridgewood in terms of translating recreational activities into positive outcomes. For example, rather than the barren and often crowded setting provided, many users of the dog exercise area may have also desired an attractive and aesthetic natural environment. Not having such an environment may not generally prevent users from visiting and staying for an extended period in the park, as their main purpose remains the need to keep their dogs happy. Yet, if provided, it may have better facilitated some of these 'restorative' and 'nature' outcomes that were notable rated lower by Coolamon users. These are speculative hypotheses only, however do demonstrate the added level of analysis possible from differentiating between park activities and outcomes.

Some more insight on this hypothesis is provided through the answers to a follow-up open-ended question on the most valuable activities and/or outcomes of each respondent. These responses highlight the value of allowing for such open ended, descriptive responses along side the gathering of quantitative questionnaire data: allowing for outcomes relating to users' dogs to be picked up to some extent. Generally, responses were able to be grouped into each of the four ecosystem service categories: responses referring to 'relaxation', 'escape', 'peacefulness' and 'nature' were grouped as restorative; 'walking' or 'exercise' were grouped as physical activity; 'friendships', 'interactions' and 'socializing' were grouped as social interactions; and any response indicating the fundamental role of the natural environment was also grouped as environment education. Single users were placed under more than one group if they gave multiple responses. A further grouping relating to walking, exercising or socializing dogs was also created. Other responses given by multiple users but which did not fit under any group included 'fresh air' and variations on 'getting out of the house'. Figure 81 shows how responses for each of these groupings differed across users of each park. It largely supports the value average findings: Ridgewood is more valued more for mental restoration and physical activity, and Coolamon for social interactions. It also clearly highlights the use and value of Coolamon primarily for dog activities.

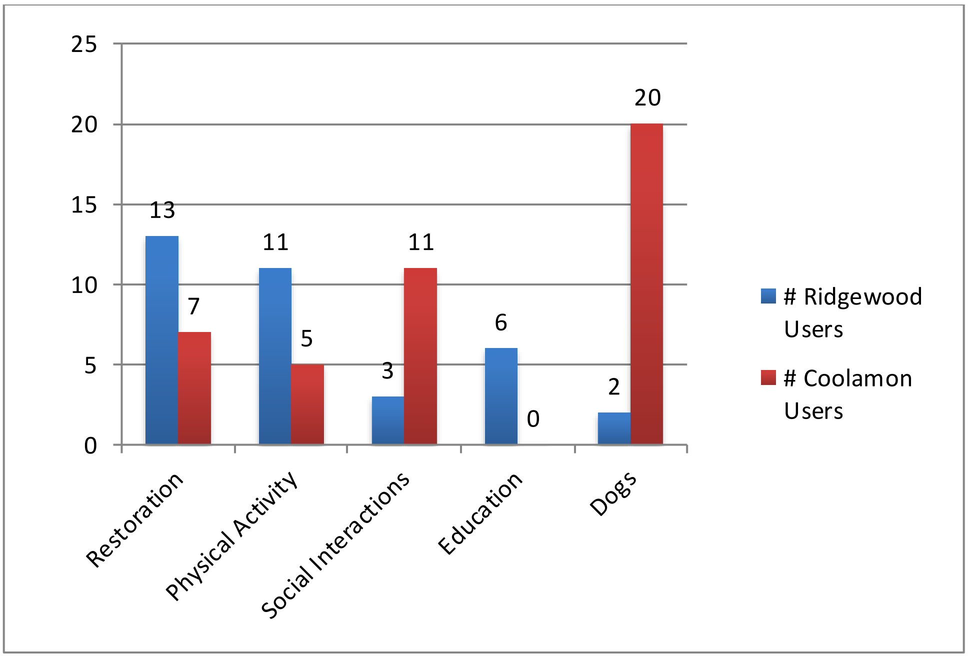


Figure 81: Groupings for most valuable activities/outcomes for visits to each park area

Besides these value averages, there were also a series of further questions that allowed for quantitative values to be determined in regard to the use of each park area. The implications of these results are presented here but discussed in more detail in relation to each ecosystem service later. Question 5 asked users the main reason why they chose to use the park in question, with the options being 'close to residence/work', 'organised sport' or 'visiting this specific area'. As shown in Figure 82, this question provided quite stark responses between each park area: while no respondents gave organised sport as the reason for their visits, the proportions for the other two responses effectively reversed for each park area.

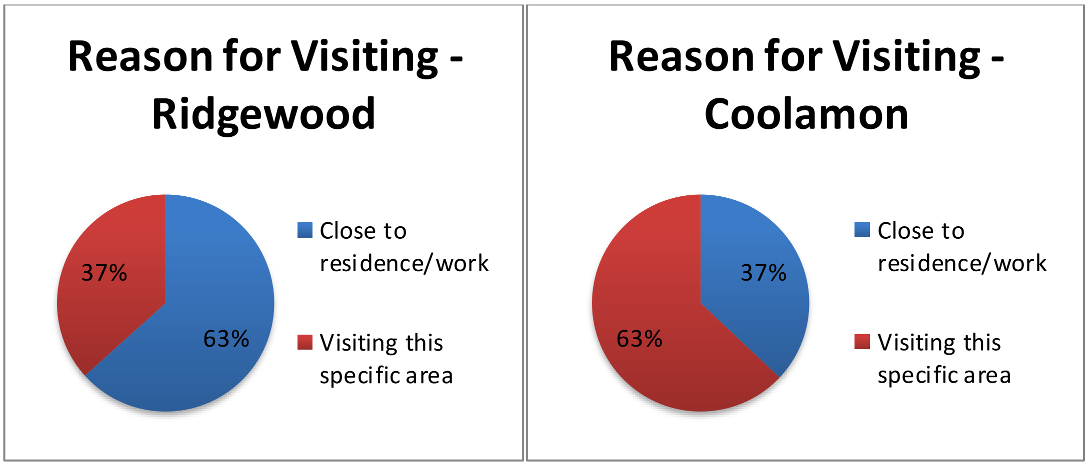


Figure 82: Primary reason for visits to each park area

The above results suggest Ridgewood is more likely to be used as a local park for its accessibility rather than specific unique features, and this was supported by responses to question 6: usual mode of transport. Only the responses 'car' and 'walk' were nominated by users ('bus' and 'cycle' being the others), with the proportions of each response shown in Figure 83 again differing between the park areas: Ridgewood clearly being used most as a destination for neighbourhood walking.

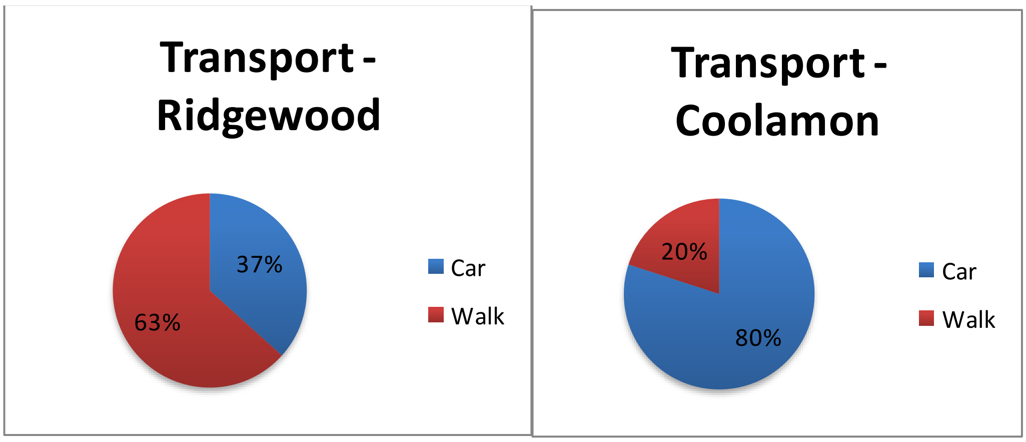


Figure 83: Usual mode of transport to visit each park area

Respondents were also asked to nominate their preferred social environment for their visits: 'no people', 'some people', 'busy' or 'don't care'. These results are shown in Figure 84, and suggest a general preference for solitary environments by Ridgewood users and social environment for Coolamon users.

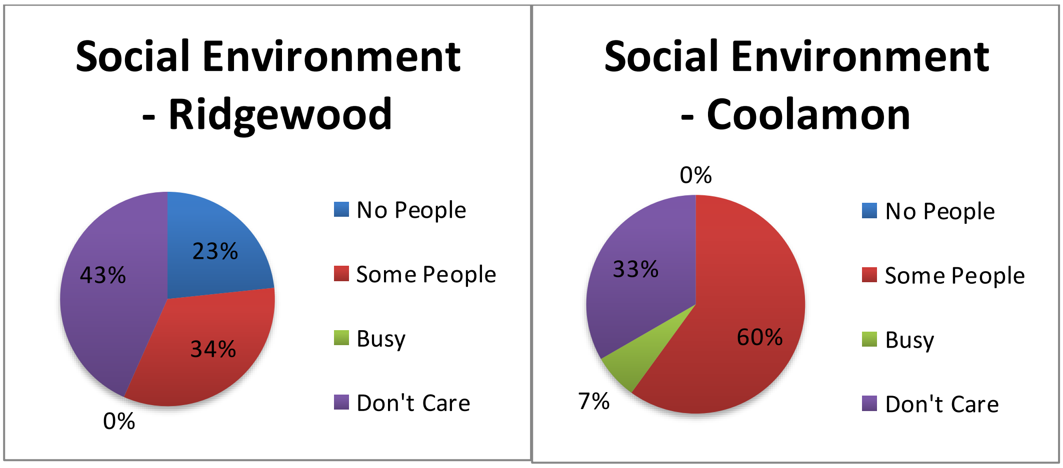


Figure 84: Preferred social environment for visits to each park area

Two further questions were also asked that allowed for descriptive responses to be gained. These included the most valuable physical features for these visits and any negative things about the park and their visits. More detail on these descriptive responses, and how they relate to different cultural ecosystem services, is provided in the following sections.

7.2.4 Influence of Sporting Area and Organised Sport

Before discussing the results across both areas for each cultural ecosystem service, this section presents the results of observations and questionnaire questions relating to the influence of sporting areas and organised sporting activity on non-sporting recreation.

Broad observations of each park suggested that sporting areas in parks can represent attractive destinations for a range of different forms of non-sporting park recreation. Aside from informal sporting activity, non-sporting recreational activities observed included group and individual fitness sessions, informal dog walking and also organised dog walking groups. Further, use of non-sporting areas of the park was heaviest during weekday late afternoon and evenings, when parks were also being used for organised sport training. While this is not surprising given after work is a logical time to use a park during the week, it does suggest that the presence of sport is not necessarily an inhibitor of non-sporting recreation in these examples.

More insight into the value of sporting areas to these non-sporting users comes from questionnaire results to question 15, which asked users if they used the adjacent sporting area during their visits to the park. Figure 85 shows that, across both parks, there were slightly more respondents who didn't use the sporting area during their visits (62%) than those who did (38%). Proportions differed for each park however, as shown in Figure 86. In Ridgewood, 50% of respondents typically used the sporting area, while for Coolamon 27% said they use the playing field whereas 73% did not. Based on the qualitative questionnaire answers, these above results may reflect the greater use of Ridgewood as a destination and venue for walking, with the most common response (eight respondents in Ridgewood and five in Coolamon) saying they used the periphery of the playing field as part of their walking route. In these cases, value comes more from the extra size that the sporting field provides to the park as a whole, rather than the presence of the sporting area itself. The larger proportion of users from Ridgewood may be put down to dog exercise: if one of the main uses of playing fields outside of formal use is for dog walking, then there is less need for this use in Coolamon Park with its dedicated area for such purposes.

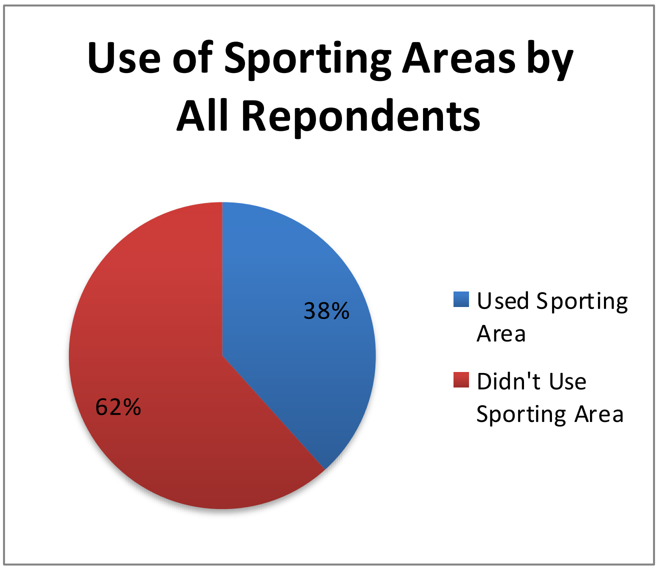


Figure 85: Use of sporting areas across users of both park areas

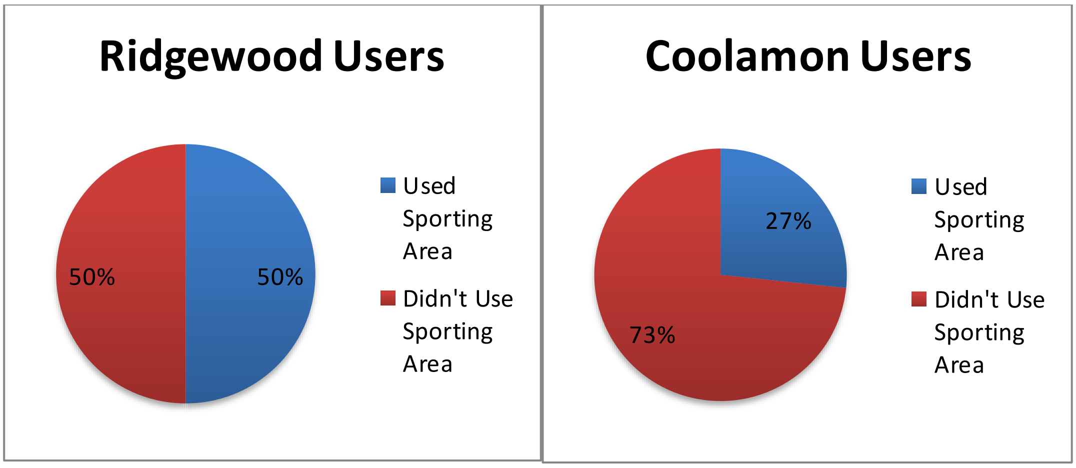


Figure 86: Use of sporting areas for users of each park area

The questionnaire responses suggest that the presence of organised sport is more likely to be a positive rather than a negative factor for non-sporting users. Question 14 asked users if the presence of organized sport had a positive, negative or no influence on their visits. As shown in Figure 87, overall more people surveyed said the presence of organised sport was a positive influence on their visits (36%) rather than a negative one (12%). The most common answer was that it had no influence on their visits (52%). Responses were fairly similar for each specific park area, as shown in Figure 88. The qualitative answers to this question provide extra insight into the exact influence of sport for these respondents. Several respondents cited sport as a form of inspiration to be active themselves, and that the activity and noise they provided were an enjoyable addition to the atmosphere of the park. The most common reason for organised sport being a negative influence was that it prevented the respondents from letting their dogs off the leash (cited three times for Ridgewood) or because it might cause the dogs to bark (twice for Coolamon).

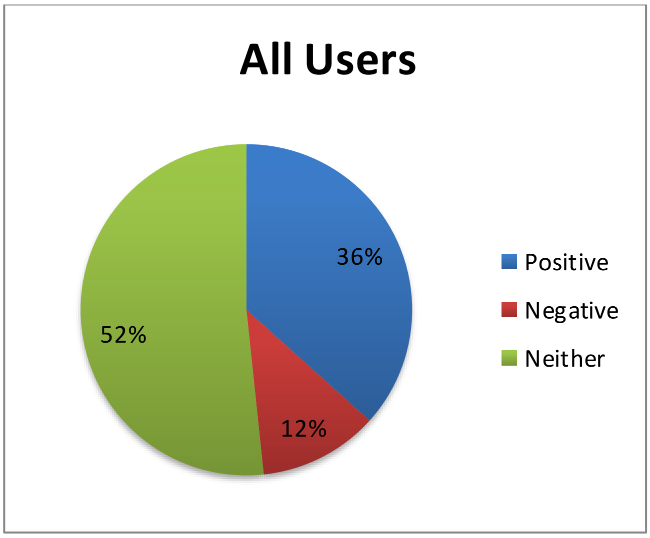


Figure 87: Influence of organized sport across users of both park areas

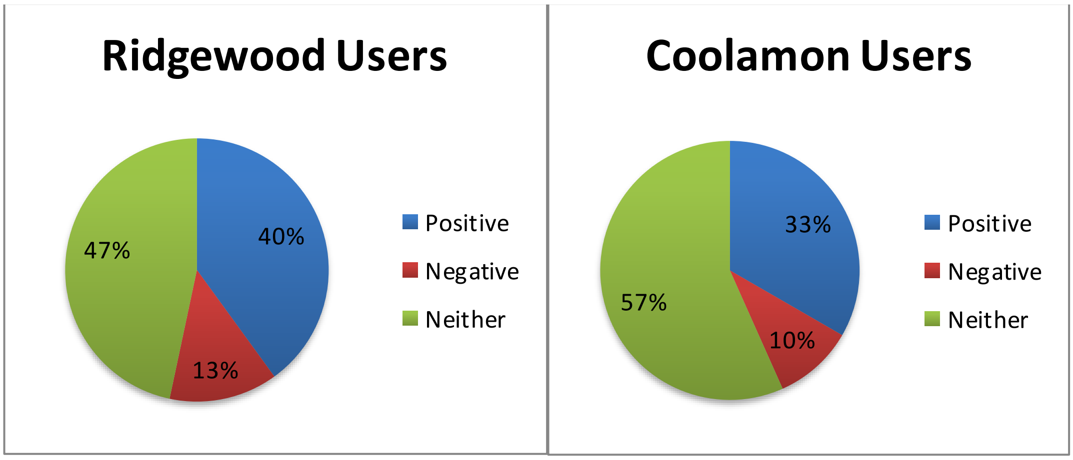


Figure 88: Influence of organized sport for users of each park area

A final point for discussion in this section came from observations of the non-sporting use of playing fields at Coolamon. The Coolamon playing field was observed several times being used for personal fitness sessions; booking for organized fitness activities is a now a common practice by LG's to make better use of playing fields during non-sporting times. The observed examples in Coolamon used only a small proportion of the playing field area, aside from warm up laps of the periphery, thus it could be argued these activities could also be held in smaller grassed areas. However, discussions with participants revealed that the presence of floodlights significantly facilitated fitness use, as it allowed for winter sessions both in the mornings and evenings despite fading light. This is an example for how the functionality of playing fields extends beyond formal organized sports, as well as an example of types of formal active and social recreation that isn't community sport.

7.2.5 Physical Activity

The following results suggest that the Ridgewood lake area represents a more active venue than the Coolamon dog exercise area, while Ridgewood Park as a whole represents a more attractive destination for neighbourhood walking.

The systematic observations clearly showed a higher proportion of 'active' activities within Ridgewood: 80% of users engaged in some form of active recreation, with 60% having this as their sole use, compared to 51% and 10% respectively for Coolamon. This was further support by the questionnaire results: as previously established, Ridgewood rated higher for the activities of 'walking' (8.3 to 6.7) and 'vigorous exercise' (3.3 to 2.1), as well as for the outcome of 'physical activity' (6.9 to 4.4). The overall higher value of responses related to physical activity by Ridgewood users is best summarised in Figure 89, which compares the combined average of both 'physical activity' activities ('walking' and 'vigorous exercise'), while also directly comparing the outcome of physical activity. As a final point, Coolamon also rated higher for the activity of 'sitting' (6.2 to 5.1), which indicates a preference against active recreation.

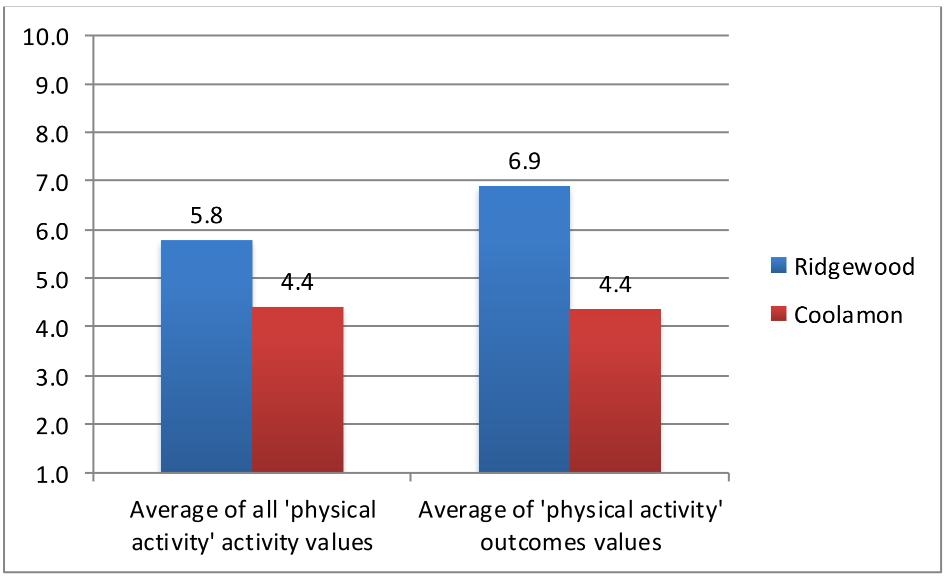


Figure 89: Comparison of combined value averages of 'physical activity' activities ('walking' and 'vigorous exercise') and outcome for each park area

Further support for the value of Ridgewood for physical activity also comes from the descriptive responses to open-ended questions. From the responses to the most valuable activity/outcome question shown in Figure 81, 37% of Ridgewood respondents mentioned 'walking' or 'exercise' as a main activity/outcome for their visit. In comparison, only 17% of respondents in Coolamon mentioned either walking or exercise. Further, looking back to the results in Figure 83, a greater percentage of residents intercepted also the lake as a destination for walking (63% to 20%).

Some preliminary comments can also be made here about the importance of walking as a form of park recreation and source of physical activity. When considering the results across both areas together, 'walking' was the highest rated activity (7.5). When further considering the low value placed on vigorous exercise (2.7, the least valued activity), it supports the hypothesis that a focus on neighbourhood walking represents a more effective approach for facilitating physical activity through local park planning. The value of the lake area for walking, along with its generally older demographic makeup as recorded through the observations (40% of users over the age of 50 compared to 23%), also supports the value of walking as a form of physical activity for older park users.

The fact that the Ridgewood lake was used more for walking challenges the hypothesis that dog parks might be of particular value for facilitating physical activity, specifically through walking. Not surprisingly, in the most valued activity/outcome responses shown in Figure 81, 67% of Coolamon respondents named dog exercise as the main reason for their visits, compared to 7% for Ridgewood. Yet this did not equate to a greater use for physical activity or as a destination for active transport – rather, it better supported the potential of dogs to act as 'social lubricants' as outlined by Graham and Glover (2014). One explanation for why increased use for dog activities did not equate to use for recreational walking is the uniqueness of the dog park within the broader Ellenbrook and Swan area. Several users noted that it was the only fenced dog park of its type in the area, making it likely to bring in users from outside the immediate walkable area, who would thus be more likely to arrive by car rather than active transport.

7.2.6 Mental Restoration

In Section 3.3.2, it was proposed that the value of a park for facilitating physical activity was likely related to its restorative value. In this context, and given the findings of the previous section, it might be hypothesised that Ridgewood lake would also have greater restorative value than Coolamon. This is largely born out in the following findings.

Assessing the restorative value of each area based on the activity values is difficult, as each listed activity might to some extent be expected to contribute to restorative outcomes. In this sense, the overall greater value of activities in Ridgewood (5.6 to 4.9; Figure 80 previously) would support its greater potential to facilitate restoration. It is also worth noting that Ridgewood rated comfortably higher for the two 'nature' activities ('observing nature' 7.2 to 4.8; 'interacting with nature' 6.1 to 3.4). Given the considerable literature linking contact with nature and mental restoration, this would also provide support for the above hypothesis.

A better guide is looking at the outcome value averages, which can be more confidently linked to each parks potential to facilitate mental restoration. These results are quite conclusive, with Ridgewood rated higher for the outcome of 'relaxing' (7.4 to 6.7), 'refocusing and recharging' (7.1 to 5.5) and 'escaping everyday life' (7.2 to 4.9). To this can also be added 'greater appreciation of nature' (7.7 to 4.9), given the relationship between natural environments and mental restoration. When the average of each of these four outcomes are calculated together, as shown in Figure 90, it clearly shows the higher restorative value of the Ridgewood lake area: 7.4 to 5.5. This reflects also the findings in Figure 81: with 'most valued' activities/outcomes within the restoration grouping representing 43% of Ridgewood users compared to 23% of Coolamon users.

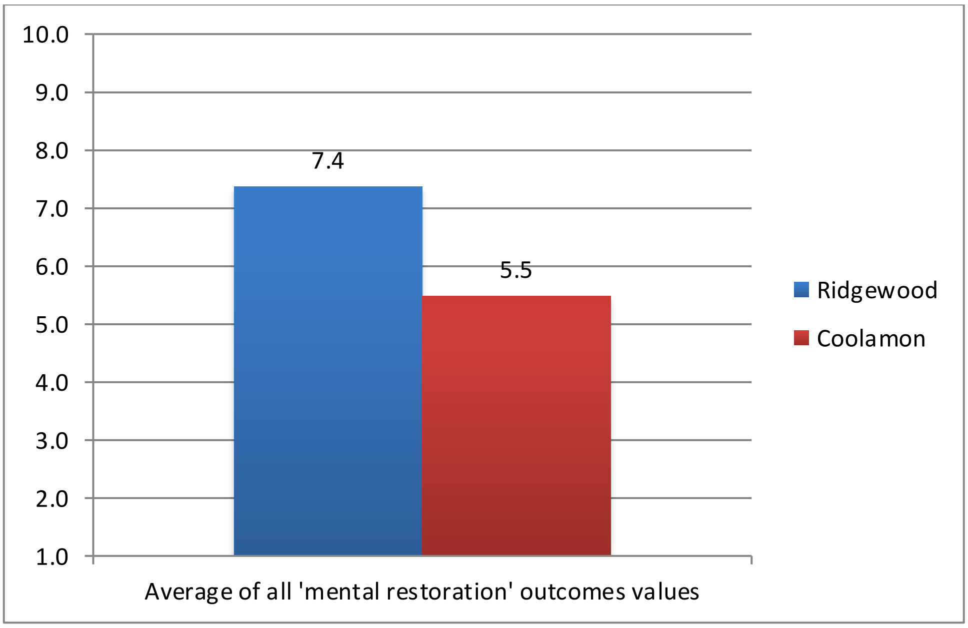


Figure 90: Comparison of combined value averages of 'mental restoration' outcomes for each park area

Some further insight on the restorative value of Ridgewood comes from the qualitative questionnaire responses relating to the physical features of each area most important for their most valued activities and outcomes. The Ridgewood lake was valued largely for features that might be more associated with a green space environment. 70% of respondents intercepted indicated either the lake, or more specifically the ducks in the lake, as a key physical feature. Vegetation such as trees and grass were also mentioned. In contrast, respondents of the dog exercise area were more likely to cite non-natural physical features. The most valued feature was clearly fencing and enclosure, cited by 70% of respondents. Beyond this, the size or openness of the area was the most frequently noted feature, cited by 27%. One user specifically noted their preference of an open grassed space for walking their dog instead of a natural environment. Built features such as seating, shade and drinking water were also noted. One interpretation of these findings is that the Ridgewood lake area has been planned as a *green* space environment and Coolamon dog exercise area more as an *open* space environment – with the former environment more effective at facilitating restorative outcomes.

Some more broader hypotheses on the value of mental restoration as a cultural ecosystem service can also be made from the results. Over both parks, the four outcomes relating to restoration ('relaxing' 7.5, 'escaping every day life' 6.7, 'refocusing and recharging' 6.8 and 'greater appreciation of nature' 6.8) were the most valued. This supports the proposition that restorative outcomes are the most valuable services that local parks can provide. This is also interesting when again considering that walking was the most valued *activity* across both parks. This suggests that people may engage in walking as much for its mental benefits as physical. Based on Bird's (2004) assertion that sustainable forms of physical activity are those in which exercise is secondary to other outcomes, this further supports the value of focusing on walking to increase overall levels of physical activity.

7.2.7 Environmental Education

Given the more natural environment provided by the Ridgewood lake area, it is not surprising that the results also suggest it has the greatest potential to facilitate different forms of environmental learning. 'Interacting with nature' was the second lowest rated activity across both parks (5.7). This was largely due to its low rating for Coolamon respondents however (3.4, higher only than 'vigorous exercise'), as it was actually the third highest activity for Ridgewood users. Similarly, 'greater knowledge and understanding of nature' was the equal lowest rated outcome across both parks at 5.1. Again, this was primarily due to it being clearly the lower rated outcome for Coolamon users (3.1), as it rated better for Ridgewood users (6.2) than both social outcomes.

As per the findings of Hartig, Kaiser and Strumse (2007), it also possible that parks can facilitate passive environmental learning through greater appreciation of nature. The activity of 'observing nature' (7.2 to 4.8) was higher for Ridgewood, as was the outcome of 'greater appreciation of nature' (7.1 to 4.9). This latter outcome was in fact the most valued outcome by respondents of the lake area. These combined activity and outcome value averages for environmental education are shown in Figure 91. Further, variations on 'contact with nature' was nominated as one of the most valued activities/outcomes by 20% of Ridgewood respondents, but no Coolamon respondents (excluding dogs, discussed further below). It is also worth noting that several users of the lake area voluntarily nominated the value of the adjacent bushland area when answering the questionnaires, even though the questionnaire was framed as looking at the lake area specifically. It is possible that this influenced the responses to the 'nature' questions to an extent.

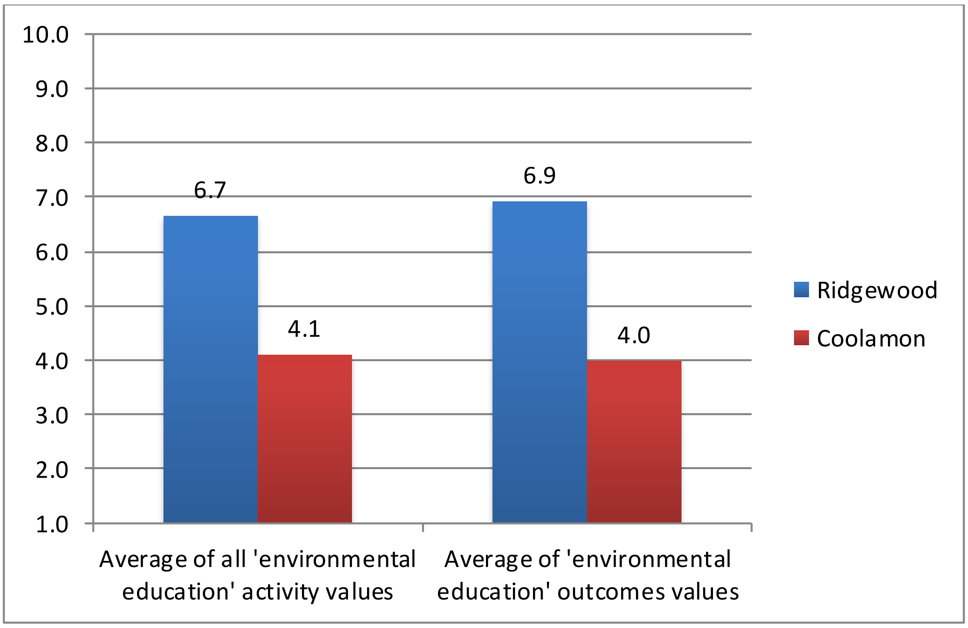


Figure 91: Comparison of combined value averages of 'environmental education' activities and outcomes for each park area

Much of this value for environmental education likely comes from the ability to interact with tame forms of wildlife around the lake. The ducks in Ridgewood lake were one of the main reasons for many respondents to visit the space, mentioned by 8 respondents (27%). It could be hypothesised that the opportunity to view these ducks in a relatively natural setting, to see their interactions both with humans and each other, and particularly the sight of vulnerable ducklings being protected by their mother, may evoke in many the need to ensure the protection of these and other wildlife in urban areas.

While the dog exercise area does not provide these same experiences, it does allow other unique opportunities to experience even more tame forms of nature. To date, this thesis has considered 'nature' from an ecological perspective, rather than as something that might be domesticated. However, as Kellert (2008) suggest, the benefits derived from companion animals can also be considered an example of human biophilic affiliations. Evidence suggests that companion animals may provide sources of resilience equivalent to other natural environments: restorative outcomes, decreased feelings of loneliness and improved educational outcomes for example (Kellert 2008). Several respondents noted that, as well as interacting with humans, they also valued the ability to watch and interact with other dogs. The fact that dogs might be perceived as a form of nature was not considered in the construction of the questionnaire method. Questions that specifically addressed this issue may have been able to gain further insights.

7.2.8 Social Interactions

In contrast to the previous sections, Coolamon clearly represented the area more likely to facilitate social interactions. Primarily, Coolamon rated equal or higher for both social activities ('observing other park users' 4.8 to 4.8; 'interacting with other park users' 6.6 to 4.6) and both social outcomes ('creating new friendships' 5.3 to 4.4; 'strengthening existing friendships' 5.1 to 5.3). 'Interacting with others' was the most valued activity by Coolamon respondents behind only 'walking', while both social outcomes rated only behind the outcome of 'relaxing' and 'refocusing and recharging'. When these social activities and outcomes are grouped together in Figure 92, it shows the overall greater value from users of Coolamon – albeit not by the same margin as the greater value of Ridgewood users for physical activity and mental restoration.

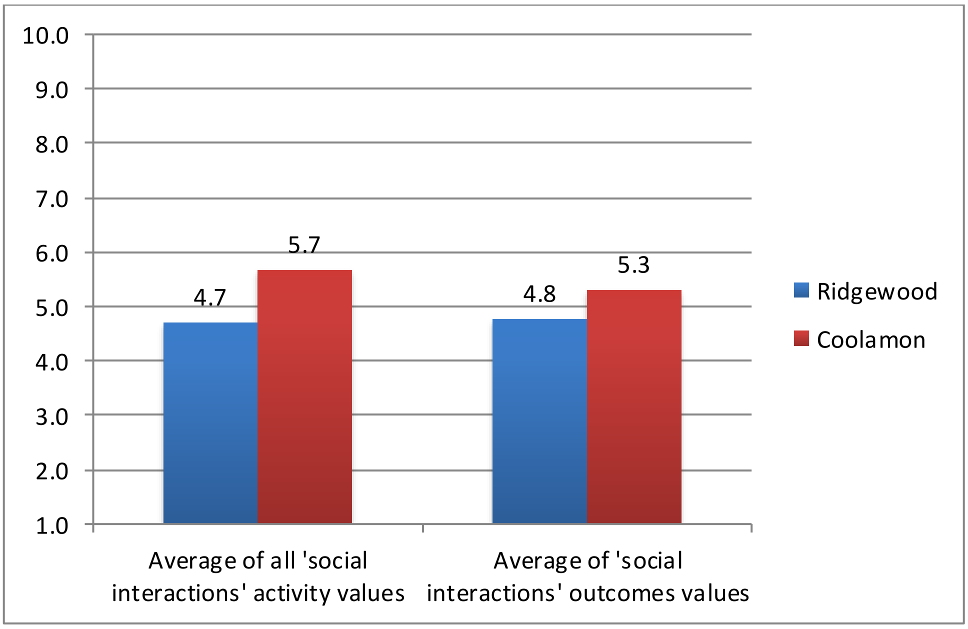


Figure 92: Comparison of combined value averages of 'social interactions' activities and outcomes for each park area

Other results more conclusively support the greater value of the Coolamon for social interactions. Referring back to Figure 81, most valued activities/outcomes grouped under 'social interactions' were cited by 37% of Coolamon respondents compared to only 10% of Ridgewood respondents. This is further supported by the responses to the preferred social environment question, shown in Figure 84. While the number of respondents who didn't care about the number of people in each park was slightly higher for Ridgewood (43% to 33%), there were clear differences in the other two options: more respondents from Ridgewood preferred no people (23% to 0%), while more respondents from Coolamon preferred some people (60% to 34%). Two users, or 7%, from Coolamon preferred a busy environment, with no Ridgewood users selecting this option.

Remembering the suggestion that social interactions are more likely to occur from longer time periods spent within public spaces, another factor that supports the value of Coolamon for facilitating social interactions is the greater average duration of visits. As shown previously in Figure 64, observed users of Coolamon clearly spent more time in the park for their visits than Ridgewood users. Similar were the self-reported visit durations of Coolamon users from the questionnaires, which were almost double that of respondents of the lake area (65 minutes to 42 minutes). The importance of length of stay within the park for social interactions became evident during the observations. During the heaviest period of use for Ridgewood between 8:00am and 9:00am, 10 different users were recorded. Yet, given the relatively short average duration of these visits (24 minutes), the number of people in the park at the same time peaked only at four. In contrast, out of a total of 17 users who arrived at Coolamon between 5:00pm and 6:00pm, 15 individual users over the age of 18 were observed in dog exercise area at 5:45pm. The average duration of these visitors was 48 minutes. Only one of these users was not engaged in passive activities around the central shade area at some period, with most of their time spent interacting while their dogs entertained themselves.

7.2.9 Summary

While only a preliminary investigation, these results suggest that the Ridgewood lake and Coolamon dog exercise area both represent examples for how distinct recreational areas sporting parks can provide unique and valued destinations to access health-promoting ecosystem services. The results provide some support for the hypothesis that cultural ecosystem services can be provided through distinct park environments, including both solitary/natural and social environments. Both the quantitative and qualitative data gained from the questionnaires, and supported by qualitative user observations, suggest that the Ridgewood lake area is more likely to facilitate mental restoration and physical activity, while the Coolamon dog exercise area is more likely to facilitate social interactions. Neither are likely to provide opportunities for active environmental learning but may provide their own unique opportunities for passive appreciation of nature through ducks and dogs respectively.

Based specifically on the value averages to the park outcomes questions, a rough hierarchy for each cultural ecosystem service can be proposed. This comes from calculating the averages of all of the outcomes related to each service: 'physical activity' the only outcome for the service of physical activity; 'relaxing', 'refocusing and recharging', 'escaping everyday life' and 'greater appreciation of nature' all grouped under mental restoration; 'greater appreciation of nature' also grouped under environmental education along with 'greater knowledge and understanding of nature'; and 'creating new friendships' and 'strengthening existing friendships' grouped under social interactions. As shown in Figure 93, across both parks, the cultural ecosystem service most likely to be facilitated was mental restoration, followed by physical activity, environmental education and social interactions. For Ridgewood, this hierarchy remains the same, although there is a greater gap between the service of social interactions and the other three. This hierarchy changes notably for Coolamon, with social interactions moving into second position, only slightly behind mental restoration.

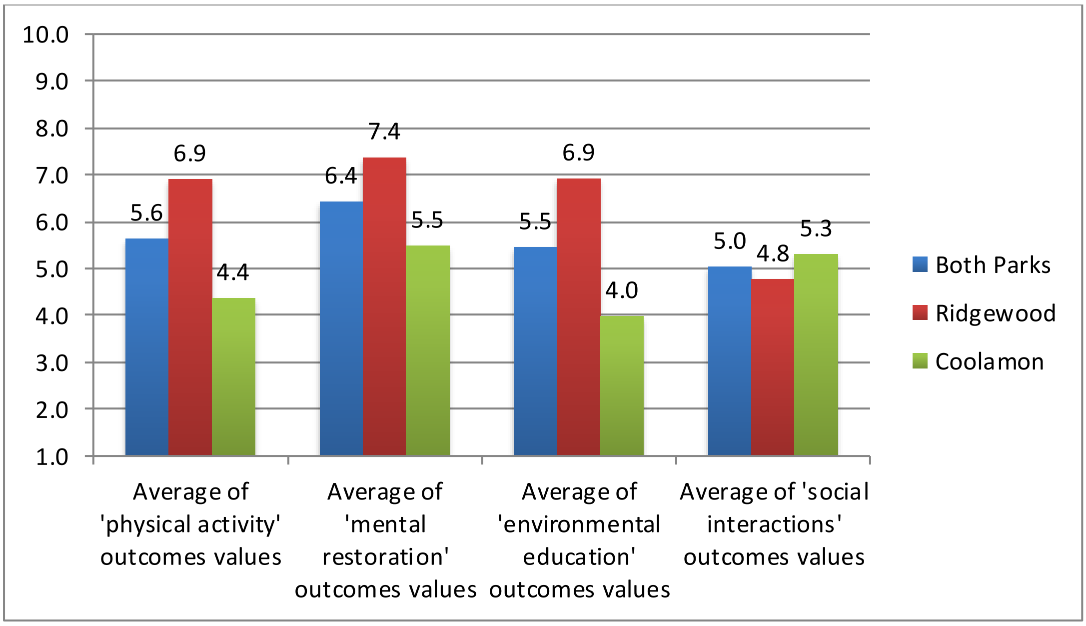


Figure 93: Comparison of combined value averages for the outcomes related to each ecosystem service across both parks and specifically for Ridgewood and Coolamon

Perhaps the most interesting outcome of this analysis is the relationship between social interactions and the other three cultural ecosystem services. By adopting the concept of ecosystem services, this thesis has placed focus on health-benefits from park recreation arising from contact with nature. The implication and perhaps limitation of this perspective is that social interactions might be understood more as an outcome of park recreation in the presence of nature, or where some degree of nature is a prerequisite for these outcomes. Instead, this investigation supports the findings of Cattell et al. (2008) that interacting with other people might be the primary motivation to visit a park for many; that health benefits can arise from activities in social environments that do not necessarily require aesthetic or 'ecological' nature. Indeed, the value of the dog exercise area as a recreational venue with value comparable to that of the lake area is supported by the observations: its greater number of users over a single weekday, the greater length of the visits of these users, and the greater proportion of users who identified as daily visitors. Thus, while organised sport may be the most notable example of social park activities, the Coolamon Park dog exercise area may be an example of how health-promoting social interactions can be facilitated through less formal activities.

Conversely, this conclusion is not so much born out in the questionnaire results. While Coolamon rated slightly higher for activities and outcomes that are likely related to the service of social interactions, this effectively came at the expense of the other three services, which were all clearly rated lower than Ridgewood. This could be attributed to a degree of incompatibility between these different services, in that a park that primarily provides a context for social interactions will be less facilitative to mental restoration, being physically active and learning about the natural environment. Alternatively, it could also be attributed to the shortcomings of the park environment, which provides the necessary fencing and wide-open space for dog exercise but largely lacks aesthetic and engaging natural elements. A comparison between the Coolamon dog exercise area and a more appealing park in this regard but with a similar function (if it exists currently) would allow for further investigation of this situation.

7.3 Synthesis and Findings

This final synthesis brings together the preceding results and discussion to provide conclusions on the potential of each of the four ecological landscapes to facilitate cultural ecosystem services in sporting parks in Perth. Along with the observation and questionnaire results, the following discussion also incorporates additional literature review along with insights from local planning policy and interviews with local park planners and managers. Each landscape is discussed in sequence: permanent water, seasonal drainage, remnant vegetation and community gardens. The first two discussions are draw more on the results of the previous section, while the latter two are more theoretical.

7.3.1 Permanent Water

The results for the Ridgewood lake area provide support for the hypothesis that permanent water areas can effectively facilitate mental restoration. In terms of attention restoration, both the lake and ducks – which were cited by 70% of respondents as features of the physical environment important to their visits – are likely to represent sources of fascination and hence to facilitate attention restoration. Further, the design of the lake area as a whole may be effective at providing the quality of 'being away': not just from the surrounding urban environment but also from the adjacent sporting area. Nordh et al. (2009) suggest that intelligent spatial design and use of natural features can allow even small green spaces to provide the perception of 'being away'. The Ridgewood lake area demonstrated this well. A ring of trees surrounded the lake and the surrounding walking path, providing a physical barrier from the sporting area. The lake area is also lowered below the level of the playing field, which could not be seen from many locations around the lake.

In terms of stress restoration, the Ridgewood lake may also be an example of how permanent water areas can satisfy the three dimensions most preferred by respondents seeking restoration from stress found by Grahn and Stigsdotter (2010): 'nature', 'rich in species' and 'refuge'. Water is strongly related to perceptions of nature, as established in Section 3.3.2, while the presence of ducks may satisfy the need for richness of species. Specifically, the Ridgewood lake may be an example of how well-planned permanent water areas can create the dimension of *refuge*: 'an enclosed and safe environment, where people can play or watch other people being active', which should include both the qualities of 'cozy' and 'child friendly' (Grahn and Stigsdotter 2010, 270). As well as the lake, the area also has an adjacent fenced playground, allowing children to play and view the lake and ducks with minimal supervision.

The restorative value of the lake may also explain its value for physical activity, and specifically walking. A paved path forming part of a broader path network around the playing field and bushland area for pedestrians and cyclists encircled the lake. Many users were observed completing several laps of the lake area, before continuing on with their walk through the park. This would suggest that the lake was an attractive destination or component of broader neighbourhood walking routes.

The Ridgewood lake area may also be an example of how a green space can provide both restorative and social ecosystem services simultaneously. As well as the playground, which was observed as a social space for many parents while their children played, the lake also has a BBQ and seating area for informal social gatherings. This may allow the area to act as both a more solitary space for appreciating nature, opposite the playground and BBQ areas, but also a space for social interactions facilitated by nearby nature. That said, social activities and outcomes were rated lower when compared to Coolamon.

Despite this potential to facilitate multiple cultural ecosystem services, the case of the Ridgewood lake also highlights the practical challenges of maintaining the quality of permanent water landscapes in Perth's climatic conditions, and the effect this could have on both their recreational and ecological functionality. Despite its value, the lake also presented potentially negative qualities for park users: the poor condition of the lake was cited as a negative feature by almost half (43%, or 13) of intercepted users.

Several of these respondents noted the recent deterioration of the water quality, and that use of the area appeared to have dropped accordingly. Several users were observed letting their dogs swim in the lake, which also raises safety issues. Such areas may be an example of the need for greater management of ecological areas by local citizens, rather than LG's whose resources are already stretched, with one respondent noting the need for a local user group to regularly clean the lake in the absence of the local authority.

Perhaps the greatest concern with permanent water areas is their ecological function, or lack thereof. Grose and Hedgcock (2006) discuss the ecological challenges of 'retention basins' in Perth. These features are typically created with the ambition of providing residents with year-round views of a water bodies. This is contrary, however, to the seasonal flux of natural wetlands in Perth, which are typically dry for long periods during summer. Maintaining permanent water all year is also at odds with indigenous vegetation species, which require seasonal variation and are not adapted to artificial water bodies (Grose and Hedgcock 2006). Thus, rather than serving recreational and ecological functions simultaneously, permanent water areas may in fact have little or in fact negative value in Perth parks.

Local Government planners interviewed for this thesis supported these concerns. To serve their recreational purpose, lakes have to be continually topped up. In the northern corridor however, where the new developments in north of Coastal Wanneroo in Alkimos will be located, there is hardly any water spare, with the proportion of irrigated turfed area in many new areas already limited due to these restrictions. If lakes also serve an ecological function, such as by assisting with iron filtration, then this can be tolerated. For purely aesthetic purposes, however, it is increasingly hard to justify. In fact, such is the issue in the City of Wanneroo, the LG now has policy in place that prevents the creation of permanent water areas in the parkland of new residential areas. Thus, despite the theoretical potential of permanent water areas to facilitate multiple ecosystem services when located in sporting parks, the practical challenges and ecological resources required to maintain these landscapes up to a suitable standard may make them unviable in Perth's climate.

7.3.2 Seasonal Drainage

The results relating to the Coolamon dog exercise area provide support for the hypothesis that a less aesthetic green space without engaging natural features – such as seasonal drainage basins – can still be transformed into well-used public green spaces. The previous findings suggested that the area had a greater level of use based on three key factors: a greater number of individual users over the 12-hour observation period, a higher average duration of visits across each of the users, as well as a higher proportion of 'daily' visitation frequencies from the questionnaires. While not so much supported by the rest of the questionnaire results, this level of use is nonetheless noteworthy considering that the area was originally planned only as a drainage basin before being transformed into a dog exercise area as an afterthought.

The results also suggest that seasonal drainage basins might be most effective as social spaces. The value placed on social activities and outcomes by questionnaire respondents was one of the most notable differences between the results from the two parks. Also emerging from the questionnaires and observations, it appeared that many of the interactions between users were facilitated through shared issues derived from dog ownership, reinforcing the 'triangulating' potential of dogs (Graham and Glover 2014). The capacity to keep these users in the park and interacting for longer is helped through the provision of various features that encourage users to stay longer and interact: including drinking water, seating and shade. Also adding to this value is the inclusion of some small trees: as well as providing some additional shade, trees were also observed being climbed by children and used for play. Further, many residents surveyed who used the area as a social space had prearranged meeting times with other residents. In this context, one way to understand the potential social value of these landscapes can be as 'interactional space', where a public space is taken over or territorialised to an extent by small neighbourhood groups (Skjaeveland and Garling 1997).

Coolamon dog park demonstrates both the positive and negative potential of such interactional park environments to facilitate positive outcomes. During the day, usage of the area was rarely above 10 people. Those who wished to interact with others through semi-formalised neighbourhood meetings centred on the shade and seating, while those seeking a more solitary or active experience utilised the open spaces and the limited shade provided by trees. Such times of low use may provide the ideal circumstances for socially-mediated restoration outlined by Staats and Hartig (2004):

the presence of companions allow for feelings of safety for those who might feel insecure in a public space, but not so many people to create feelings of being crowded. Out of each of the outcomes related to mental restoration, 'relaxing' was the highest and most comparable with Coolamon, suggesting that residents generally found it an effective space to unwind.

Based on the example of Coolamon, however, interactional spaces could also result in conflict during periods of peak use. Many residents said they specifically avoid using the park at certain times due to the likely presence of other groups. This included for minor issues relating to poor dog ownership such as failing to pick up 'dog poo'. In more serious cases, however, small dog owners would actively avoid those with large or aggressive dogs, citing examples of dogs being physically attacked – 6 different respondents raised the issue of vicious dogs or poor dog ownership as negatives of the area. This was primarily the case during peak usage times in the late afternoon and evening, when the area was used by upwards of 20 people and similar (sometimes larger) numbers of dogs. Rather than representing a truly public space, such instances likely leave many users unable to visit the park when they would like to, and feeling excluded from the park.

These periods of overuse indicate that seasonal drainage areas converted into dog parks may be of most value in facilitating cultural ecosystem services when they are planned as standard park landscapes rather than as novel elements. Several users suggested a second such facility in the area may help reduce this overcrowding, helping to spread use out during peak usage times. Making dog parks more common features of public parks would increase their accessibility and thus also increase their potential to facilitate walking, with dry drainage basins offering a common and underused park landscape in the case of Perth.

It should also be noted that the location of dog exercise areas in these ecological landscapes is not ideal, with the drainage areas also creating some additional risks for park users. During questionnaires, several users noted the loss of functionality for several days due to flooding after constant rain. Others gave examples of litter and unsafe objects coming out of drainage areas, which could be unsafe for dogs and children. There were also concerns about small dogs being able to fit through outer coverings of drainage areas. In total, 8 out of the 30 respondents cited an issue related to the drainage basins as a negative aspect of the area. Focusing the creation of dog parks in less intensive drainage areas could prevent the former, while better maintenance of these areas may help reduce these latter two risks. Some amelioration of negative aspects of the area could also be achieved through better design, including more shaded seating areas (mentioned by 4 respondents) that would also help to spread out users during peak periods.

7.3.3 Remnant Vegetation

Questionnaires of users of the bushland in Ridgewood would have been useful in testing the hypotheses outlined in Table 5: that remnant vegetation areas may be more likely to facilitate attention restoration rather than stress; are less likely to facilitate positive social interactions; and may have potential to represent negative landscapes for some individuals. However, the investigation was able to provide some support to the hypothesis that large areas of remnant bushland in sporting parks may have the most potential to facilitate physical activity and environmental education.

It was hypothesised that remnant vegetation areas may be of greatest value under the theoretical framework by increasing a park's attractiveness as a destination for neighbourhood walking. Indeed, the bushland area is likely to have been significant in the greater value of Ridgewood Park for the outcome of walking. Firstly, the extra size of Ridgewood Park (9.11 ha compared to Coolamon 7.04 ha) comes solely through the adjacent area of remnant bushland (measured at 2.64 ha, thus more than the difference in size between the parks). Several users were observed also using, or noted themselves that they also used, the bushland area as part of their broader walking route through the lake area. Thus, many users incorporated the bushland, lake area and playing field periphery as components of a varied green space neighbourhood walking route.

This potential for recreational walking will obviously be greater for those who perceive bushland areas as either of restorative or recreational value, rather than as potentially dangerous. The real or perceived threat of indigenous fauna such as snakes may be one such influence: one user noted that they preferred not to use the bushland area to walk their dog because of the danger of snakes. This suggests that bushland areas in Perth may offer the greatest recreational value during cooler months when snakes are less of a threat.

The most significant point of discussion arising from the case of the Ridgewood bushland is its potential as a venue for environmental learning. As well as providing explanatory signage permitting passive learning of local species and ecological processes, the bushland area has been 'adopted' by a local high school as part of the City of Wanneroo's 'Adopt a Bushland' program (City of Wanneroo 2014a). The program, launched in 2008, is described by the LG as an innovative environmental educational program aimed at children in years 3 to 7. It is comprised of eight different topics that each covers different aspects of bushland management. As well as directly educating students about bushland values and management, the program also has the objective of creating partnerships between the City of Wanneroo, schools and other community groups; involving young people in the ongoing management of bushland areas through hands-on, grass roots approaches (City of Wanneroo 2014a). It therefore represents an example of the 'civic turn' in local ecological green space management identified by Ernstson, Sorlin and Elmqvist (2008).

As well as educating local residents about ecological processes, the LG also suggested that the program goes further by producing tangible local ecological outcomes. Several high schools have also joined the program and adopted local bushland areas. Rather than simply utilising these areas for the educational material, they have actively improved the quality of the area through activities such as rubbish collection and hand weeding. These activities also link students to The Department of Parks and Wildlife's 'Bush Rangers' program: another youth-based educational and conservation program that aims to make young people more active in the conservation and management of the local natural environment (City of Wanneroo 2014a). The program can therefore be considered an example of mutually reinforcing and beneficial human-nature interactions discussed by Baldwin, Powell and Kellert (2011): where activities in nature simultaneously produce benefits both for humans and ecosystems.

Providing bushland within sporting parks co-located with local schools could help facilitate both physical activity and educational outcomes from the Adopt a Bushland program. Bird (2004) suggests that green space activities such as conservation work and gardening may provide alternative sources of physical activity for some children less likely to utilise sport for this outcome. Co-located bushland areas could therefore allow school-based sport and recreation to be directly linked to these more sustainable green space activities; physical education classes that typically involve sporting recreation could be widened to include ecological activities. Such practice would also offer valuable opportunities to counter the increasing 'extinction of experience' outlined by Miller (2005), and also to develop positive attitudes and behaviours towards green spaces later in life as outlined by Ward Thompson, Aspinall and Montarzino. (2008).

7.3.4 Community Gardens

From this investigation, little can be added to the theoretical potential of community gardens to facilitate cultural ecosystem services, as only 6 questionnaires were successfully undertaken in the garden. However, the previous discussion of formal environmental education programs in Perth could also be extended to discuss the potential role for community gardens. Another objective of the 'Adopt a Bushland' program is to make bushland education a formal part of school curricula. Creating community gardens in co-located sporting parks could further build on the potential of this program in making ecological activities a formal part of school curricula in a similar way that sport has become. Using the example of Stocker and Barnett (1998), community gardens have already been utilised as sites where a range of sustainable practices can be taught: bushland restoration practices but also gardening, food production and agricultural practices. Co-located community gardens may provide a mechanism for these outcomes to become more entrenched in school curricula.

What the investigation did reveal, however, are the significant governance challenges that might come with the widespread creation of community gardens: in general, but also when located within public land such as sporting parks. Many gardens become adopted and used regularly by only a small number of members – thus also being examples of 'interactional spaces' (Skjaeveland and Garling 1997) – and may also have to be locked to prevent theft and vandalism. As such, they effectively represent pseudo-public space, whose location within public parkland could be debatable. While located within a well-used public park, the community garden in Charlie Gregorini is located at the back of the park, away from the main recreational area. It could certainly have the potential to be perceived as pseudo-public space that is accessible for only a small group of residents.

Another challenge of community gardens is that they also require strong and organized community support to get off the ground and be sustained in the long term. Whilst LG's in the case study area generally acknowledged the potential of community gardens, they also had concerns that they could be left with non-functional land if community gardens were to lose support and the social networks underpinning them were to breakdown. This appears relevant for the Ellenbrook garden, with only a small group of gardeners regularly using the space, the majority of which were elderly. Further, these members suggested that many of those who used the garden did so mainly for food production purposes, and rarely engaged in organised social events of even informal interactions with others.

While not encountered in the interviews for this thesis, there are other issues that may come up in traditional planning institutions such as LG's in relation to community gardens. Allowing relative user autonomy of a garden within a park otherwise managed under formal planning processes may be problematic in practice, with incompatibility between these two alternate modes of green space governance already cited (Lawson 2005; Hou, Johnson and Lawson 2009). This is somewhat surprising given the potential benefits for these institutions of more widespread civic green space governance. Rosol (2010) found a gradual acceptance of such spaces in Berlin, with initial antagonism from formal planning institutions evolving into support over time. Much of this change was due to the economic benefits and reduced reliance on public expenditure that came with handing over parkland to local residents (Rosol 2010). Local planners spoken to seemed generally accepting of the concept of community gardens in local parks. To date however, the location of community gardens within public parkland is still rare in Perth. Charlie Gregorini appears the only current example in the case study area. The City of Wanneroo has developed a community gardens policy (City of Wanneroo 2014b), however there are no current examples in practice.

In summary, the potential of community gardens in sporting parks to facilitate cultural ecosystem services is still largely theoretical, and requires significant further research and practical case studies for this potential to be properly investigated.

8. Summary and Conclusion

This thesis has investigated planning theory and practice that can allow demand for space for organised community sport in Perth's outer suburbs to be provided for in a way that acknowledges and complements the fundamental ecological role of contemporary public parks. It achieved this aim by firstly outlining a theoretical framework for effective planning of the *ecological* functions of public parks, before identify current planning practice in Perth's outer northern suburb that allows the *sporting* functions of parks to be provided within this framework.

To address its first two research questions, Chapter 3 of this thesis combined insights from urban ecological and human health resilience theory as a framework for planning public parks to facilitate key regulating and cultural ecosystem services. The first research question related specifically to facilitating regulating ecosystem services under principles of urban ecological resilience theory:

How can public park planning facilitate regulating ecosystem services in suburban areas under urban ecological resilience theory?

Two key regulating services that parks in Perth can provide were firstly discussed: the conservation of biodiversity and the management of stormwater resources. Three overarching practices were identified from the literature for facilitating these services: spatial connectivity; adaptive management by civic social networks; and multi-functionality. It was also noted that urban ecological resilience theory was inadequate for incorporating the complex social factors at play when urban green spaces such as parks provide their immaterial cultural services to local residents. As such, the second research question investigated these cultural services specifically using insights from human health resilience theory:

How can public park planning facilitate cultural ecosystem services in suburban areas under human health resilience theory?

Four separate cultural services – mental restoration, physical activity, social interactions and environmental education – were discussed as different unique outcomes of park visits that can protect residents who are most at-risk to adverse health outcomes. There were three key outcomes of this discussion: that parks should be planned to specifically target these at-risk individuals and communities; the need to provide specific qualities of parks most meaningful to these residents rather than simply focusing on quantity of parkland; and the need for public participation in the creating and ongoing management of local parks.

The combined findings for this objective were provided in Figure 14, with the specific qualities most likely to facilitate each cultural ecosystem service summarised in Table 1, and are repeated here in Figure 94 and Table 6.

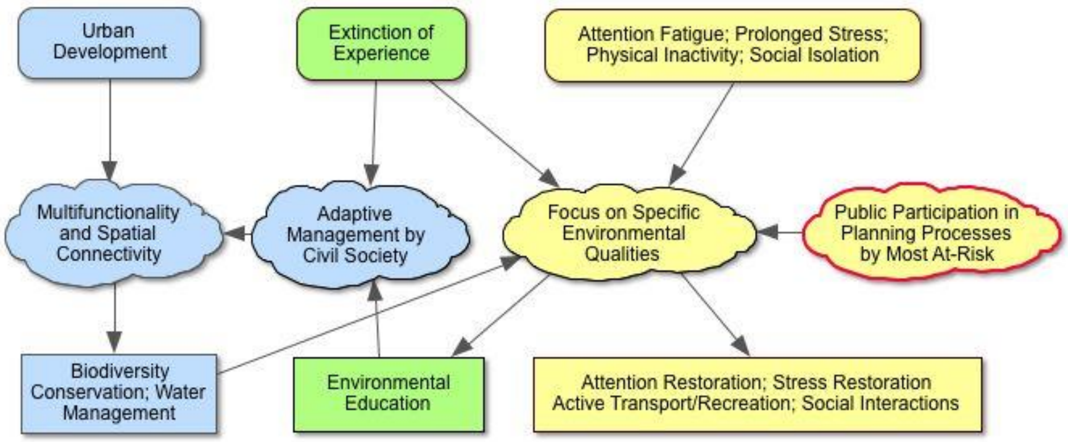


Figure 94: Flow chart outlining the theoretical framework of this thesis

Table 6: Summary of the park qualities identified from literature most likely to facilitate each cultural ecosystem service

Cultural Service	Facilitative Park Qualities
Attention Restoration	*Being away*; *extent*; *compatibility* (Kaplan 1995); *Fascinating* nature: vegetation and water (Nordh et al. 2009), *rich in species* (Grahn and Stigsdotter 2010); People for *hard fascination* (Herzog et al. 1997); People for safety (Staats and Hartig 2004).
Stress Restoration	Unthreatening nature: vegetation, water, some wildlife (Ulrich et al. 1991); *Refuge* e.g. safe, child-friendly (Grahn and Stigsdotter 2010); *Space* (Grahn and Stigsdotter 2010); Solitude i.e. no social (Grahn and Stigsdotter 2010)
Social Interactions	Vegetation (Kuo et al. 1998; Sullivan et al. 2004); Features for optional activities (Gehl 2011), on park perimeter (Gobster 1998); Play areas (Gobster 1998; Kazmierczac 2013); Maintenance and management (Gobster 1998; Kazmierczac 2013).
Physical Activity	Features (Giles-Corti et al. 2005; Kaczynski et al. 2008; Schipperijn et al. 2013); Restorative natural features: wooded areas, water (Kaczynski et al. 2008; Schipperijn et al. 2013); Trails in restorative environments (Kaczynski et al. 2008; Schipperijn et al. 2013); Size (Giles-Corti et al. 2005 and Schipperijn et al. 2013).
Environmental Education	Restorative nature for enhanced appreciation (Hartig et al. 2007); Ecological nature for explanation and demonstration (Cranz and Boland 2004); Ecological nature for learning in practice (Cranz and Boland 2004; Beatley 2011).

These theoretical insights were then applied in a case study of current planning practice in Perth, the format of which was introduced in Chapter 4. Applying the methodological approaches outlined in Chapter 5, Chapter 6 and 7 of this thesis investigated the location and design of sporting parks respectively. The location investigated two separate research questions:

What are the benefits and limitations of sporting parks co-located with local schools for facilitating ecosystem and sporting services under resilience theory?

What are the benefits and limitations of district sporting complexes for facilitating ecosystem and sporting services under resilience theory?

Using primarily a spatial mapping and analysis approach that compared the ecological and sporting park landscape provisions in the districts of Ellenbrook and Coastal Wanneroo, the potential for two alternate locations of sporting parks to help effectively meet demand for community sporting fields within ecological planning approaches was investigated. The findings for each research question are summarised in the tables below.

Table 7: Findings for school sporting park research question

Benefits of school sporting parks	• Adequate provision of playing fields at the local level *when utilised effectively* (i.e. Ellenbrook); • *Limited* potential for enhanced multi-functionality through use by students during weekdays; • *Limited* potential for enhanced benefits of school-time active recreation through exposure to ecological landscapes; • Rationalization of groundwater resources.
Limitations of school sporting parks	• Size often insufficient for senior organised sport; • Potential for unusable playing fields if school parcel left undeveloped and/or sold off for development.

Table 8: Responses to district sporting complex research question

Benefits of district sporting complexes	• Adequate provision of playing fields at the district level (i.e. Ellenbrook); • Better quality facilities for a range of organised sports (e.g. Kingsway Sporting Complex, Whiteman Park ROS); • *Theoretically* greater potential for social capital creation for sporting and non-sporting clubs; • More scope for synthetic playing surfaces.
Limitations of district sporting complexes	• Restrictions on available sites due to conservation policies; • No planning mechanism to secure playing fields in such ROS.

The design investigation explored four separate research questions:

What are the benefits and limitations of remnant bushland for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of permanent water for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of seasonal drainage basins for facilitating ecosystem services alongside sporting services under resilience theory?

What are the benefits and limitations of community gardens for facilitating ecosystem services alongside sporting services under resilience theory?

Using primarily an intercept questionnaire combined with the results of systematic and descriptive observations, the potential of each of these four different ecological landscapes to facilitate cultural ecosystem services when provided within sporting parks was investigated. The findings for each research question are summarised in the tables below.

Table 9: Findings for the permanent water research question

Benefits of permanent water	• Can facilitate stress restoration by providing the qualities of 'nature', 'rich in species' and 'refuge'; • Can facilitate attention restoration by providing fascinating landscape and wildlife and the quality of 'being away'; • Can facilitate physical activity when linked to broader neighbourhood walking routes; • Limited potential for facilitating social interactions.
Limitations of permanent water	• Regular cleaning required to ameliorate aesthetic and health concerns; • Ecological value questionable in Perth's climatic conditions.

Table 10: Findings for the seasonal drainage research question

Benefits of seasonal drainage	• Can be transformed into highly-used and occupied dog exercise areas; • Can be effective venues for facilitating social interactions; • Limited potential for facilitating mental restoration.
Limitations of seasonal drainage	• Potential to facilitate physical activity and environmental education minimal; • Can become unusable during times of high flooding; • Potential for health risks from contaminants in runoff.

Table 11: Findings for the remnant vegetation research question

Benefits of remnant vegetation	• Can facilitate physical activity when linked to broader neighbourhood walking routes; • Theoretical potential to facilitate mental restoration for some users; • Significant potential for hands-on environmental learning and ecological restoration physical activities.
Limitations of remnant vegetation	• Theoretically negative value for some users (e.g. women, minority groups); • Theoretically low potential to facilitate social interactions; • Present potential safety risks from wildlife, particularly during summer.

Table 12: Findings for the community garden research question

Benefits of community gardens	• *Theoretical* potential to facilitate each of the four cultural ecosystem services, particularly active environmental learning; • Can facilitate a degree of community ownership and governance of space; • Spatially efficient landscape for activating under-utilised parkland;
Limitations of community gardens	• Low regular use compared to other park landscapes; • Role of community in governance and maintenance potentially unsustainable; • Few examples of inclusion in parks in new residential areas.

By achieving its aim through addressing each of these research questions, this thesis has made significant contributions both to local planning practice and broader planning theory. At a local level, it has progressed the need to ensure adequate provision of community sporting facilities in Australian cities, but in a manner that complements the fundamental ecological role of contemporary public parks. At a broader theoretical level, it has continued interdisciplinary research in several identified areas: broadly between ecological and social science research; between resilience research both in the ecological and human health and development domains; and also in the identification of an overarching research agenda for the various dimensions of urban green spaces.

9. References

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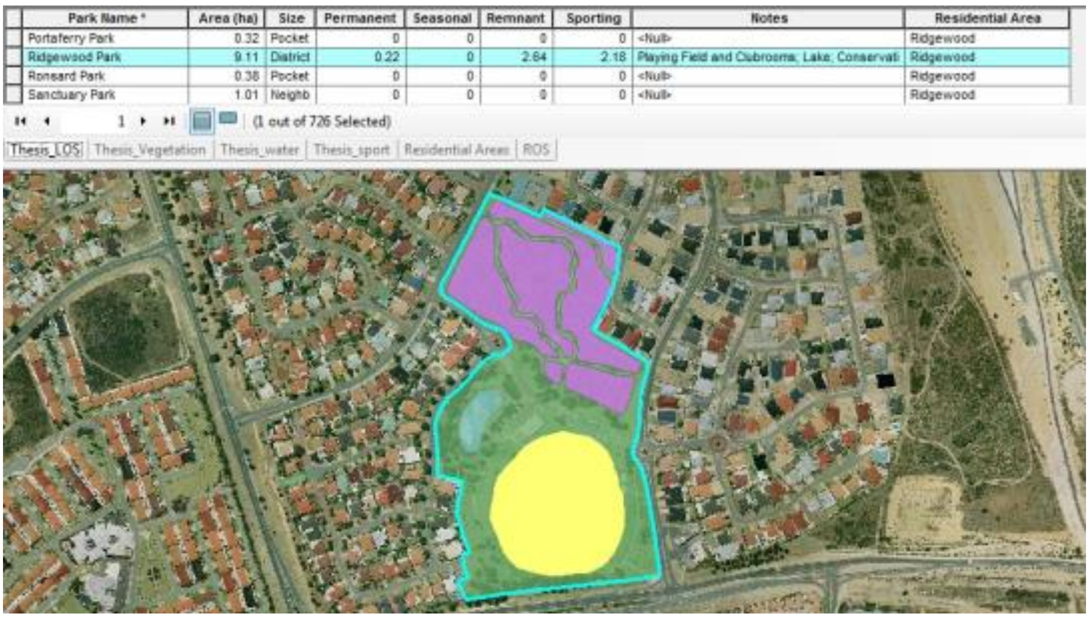
Appendices

Appendix 1: Spatial Indicator Calculation Method

The first step in converting the GIS data into indicative figures of different park landscapes was to arrange the tables within ArcGIS into a single dataset. The parks table was converted into an overarching table, where the total calculated area of every park was broken down into its respective landscape types. This was achieved by transporting the unique values created in each landscape patch table for each park into a cell within the corresponding row in the parks table. Thus, as shown in Figure 95, the main parks table contained a separate row for every different park. Each row then contained values for its total area, and also for the area of each different vegetation, drainage, permanent water and playing field patch. Along with this numerical data, text data was inputted manually that provided further information on the types of landscapes within each park.

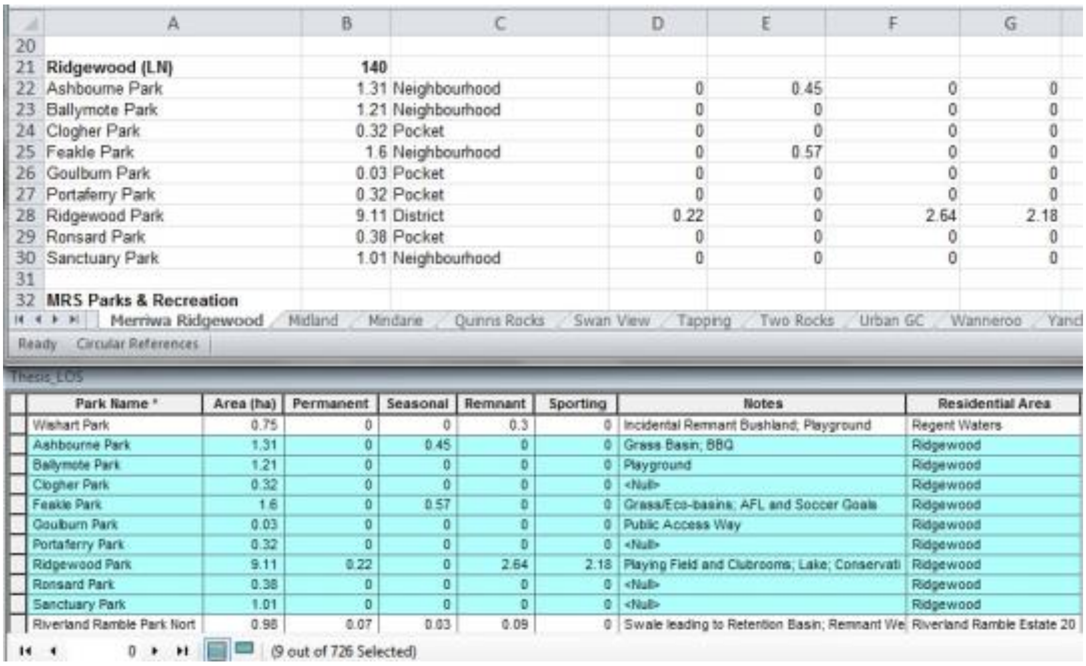


Park Name *	Area (ha)	Size	Permanent	Seasonal	Remnant	Sporting	Notes	Residential Area
Portaferry Park	0.32	Pocket	0	0	0	0	<Null>	Ridgewood
Ridgewood Park	9.11	District	0.22	0	2.64	2.18	Playing Field and Clubrooms; Lake; Conservati	Ridgewood
Ronsard Park	0.38	Pocket	0	0	0	0	<Null>	Ridgewood
Sanctuary Park	1.01	Neighb	0	0	0	0	<Null>	Ridgewood

Figure 95: Illustration of the numerical data underlying the spatial data within the biotope. The total area of the park (highlighted) as well as the area of individual landscapes within the park is each contained in the row corresponding to that park.

A Microsoft Excel workbook was then set up in a format appropriate to receive and analyse this GIS data. Within this workbook, a separate sheet was created for each residential *suburb* (Wanneroo) or *place* (City of Swan). These two scales were used as they represented the lowest level at which accurate population projections were provided. Each sheet contained column names that matched those within the parks table, as well as additional columns for sporting areas located outside of local parkland: school, district and total sporting. Within these sheets, data was further broken down to differentiate discrete residential areas. This additional step allowed any residential areas falling under different planning eras within the same suburb/place to be disambiguated. A cell for the total area of each residential area was also created, as were cells for predicted 2016 and 2021 populations for the whole suburb/place.

Within ArcGIS, each park had a cell containing the unique residential area that it belonged to. This allowed the data to be 'sorted', or arranged in a determined order, so that all parks from the same residential area were listed together. The data for each residential area was transferred from the parks table into its corresponding location within the workbook through a simple copy and paste, so that the exact numbers in ArcGIS and any manually inputted data were transferred into Excel (Figure 96).



	A	B	C	D	E	F	G
20							
21	**Ridgewood (LN)**	**140**					
22	Ashbourne Park	1.31	Neighbourhood	0	0.45	0	0
23	Ballymote Park	1.21	Neighbourhood	0	0	0	0
24	Clogher Park	0.32	Pocket	0	0	0	0
25	Feakle Park	1.6	Neighbourhood	0	0.57	0	0
26	Goulburn Park	0.03	Pocket	0	0	0	0
27	Portaferry Park	0.32	Pocket	0	0	0	0
28	Ridgewood Park	9.11	District	0.22	0	2.64	2.18
29	Ronsard Park	0.38	Pocket	0	0	0	0
30	Sanctuary Park	1.01	Neighbourhood	0	0	0	0
31							
32	**MRS Parks & Recreation**						

Park Name *	Area (ha)	Permanent	Seasonal	Remnant	Sporting	Notes	Residential Area
Wishart Park	0.75	0	0	0.3	0	Incidental Remnant Bushland; Playground	Regent Waters
Ashbourne Park	1.31	0	0.45	0	0	Grass Basin; BBQ	Ridgewood
Ballymote Park	1.21	0	0	0	0	Playground	Ridgewood
Clogher Park	0.32	0	0	0	0	<Null>	Ridgewood
Feakle Park	1.6	0	0.57	0	0	Grass/Eco-basins; AFL and Soccer Goals	Ridgewood
Goulburn Park	0.03	0	0	0	0	Public Access Way	Ridgewood
Portaferry Park	0.32	0	0	0	0	<Null>	Ridgewood
Ridgewood Park	9.11	0.22	0	2.64	2.18	Playing Field and Clubrooms; Lake; Conservati	Ridgewood
Ronsard Park	0.38	0	0	0	0	<Null>	Ridgewood
Sanctuary Park	1.01	0	0	0	0	<Null>	Ridgewood
Riverland Ramble Park Nort	0.98	0.07	0.03	0.09	0	Swale leading to Retention Basin; Remnant We	Riverland Ramble Estate 20

Figure 96: Data was transferred from ArcGIS (bottom, highlighted) to Excel (top) by simple copy and paste.

Because this overarching table only contained the landscapes located within local parks, it excluded any playing fields located outside of this provision, such as in Education land or ROS parks. Thus, these values had to be transferred separately from the playing fields table into their corresponding columns and cells. The calculated area for the polygon representing each residential area was also transferred into its corresponding cell. An example of the format of the data, once fully transferred into Excel, is given in Figure 97.

	A	B	C	D	E	F	G	H	I	J
1	**Name**	**Area (ha)**	**Size Classification**	**Permanent**	**Seasonal**	**Vegetation**	**Local Sport**	**School**	**ROS/Other**	**Total Sport**
2	**Beechboro (S-H)**	**360.38**								
3	Central									
4	Ottawa Park	2.83	Neighbourhood	0	0.36	0	0			
5	Platte Park	1.57	Neighbourhood	0	0.32	0	0			
6	Ribble Park	0.84	Local	0	0	0.31	0			
7	Rosmead Park	0.31	Local	0	0	0	0			
8	Sacramento Park	2.17	Neighbourhood	0.67	0	0	0			
9	Seine Park	2.92	Neighbourhood	0	1	0	0			
10	St Lawrence Park	7.04	District	0	0.15	5.73	0			
11										
12	East									
13	Hull Park	3.23	Neighbourhood	0	0	0	0			
14	Lanius Park	1.77	Neighbourhood	0.07	0	0	0			
15	Maguire Oval	4.68	Neighbourhood	0	0	0	2.84			
16	Thorburn Park	5.71	District	0.38	0	1.15	0			
17										
18	West									
19	Bluegum Park	1.54	Neighbourhood	0	0.48	0.43	0			
20	Figtree Park	2.15	Neighbourhood	0	0.25	0.85	0			
21										
22	**MRS Parks & Recreation**									
23	Altone Park								5.14	
24										

Figure 97: Example Excel sheet of numerical park data of the suburb of Beechboro in the district of Altone. It contains the areas of all local parks and their individual landscape patches, the area of playing fields within the ROS Altone Park (bottom right, classified as 'district' playing fields) and the total residential area of the suburb (top left). Note also that distinct residential areas within each suburb are also separated.

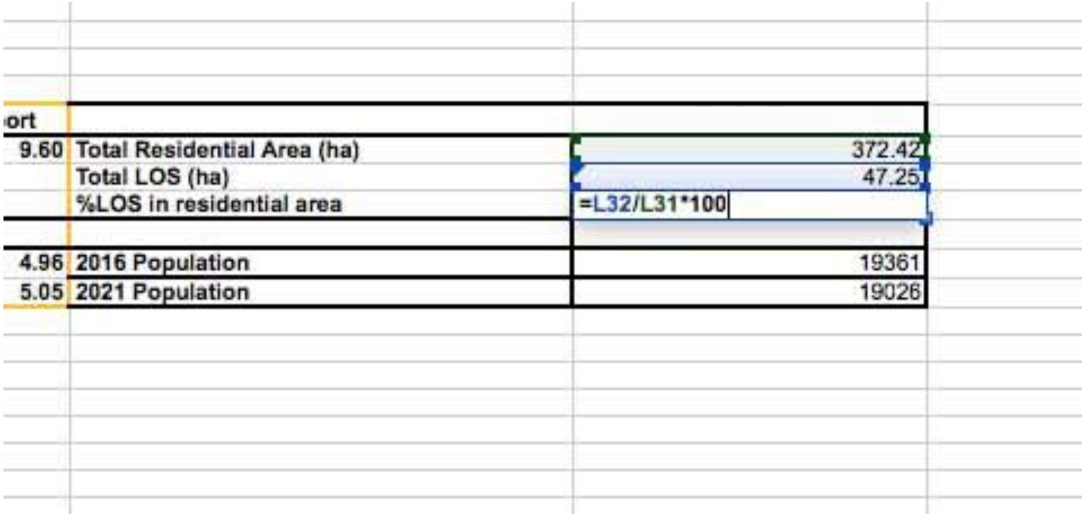
Having mapped and quantified the areas of each residential park and the individual landscape patches within them, the data was then analysed to determine park landscape proportions between old and new residential areas.

The Excel data was analyzed to create a series of unique values that were indicative of the proportions of total parkland and individual landscape patches within each residential area, hence allowing for any gaps between these areas to be determined. Firstly, the cumulative areas of the total amount of parkland in each residential area, and the areas of each landscape patch, were calculated. This was achieved simply using the sum function in Excel (Figure 98). These cumulative areas were then normalized, or scaled, using a range of values. As shown in Figure 99, the total percentage of local parkland within each area was calculated using the total residential area (i.e. local parkland/residential area), indicating how close to the 10% standard the proportion of local parkland fell. Next, the cumulative areas of drainage, permanent water, remnant vegetation and playing fields within local parks were scaled by the residential area, to produce a value indicative of the proportion of each landscape type relative to the residential area (% landscape/residential area).

SUM *fx* =SUM(D3:D28)

	A	B	C	D	E	F	G
1	Name	Area (ha)	Size Classification	Permanent	Seasonal	Vegetation	Local Sport
2	Girrawheen	372.42					
3	Allinson Park	0.2	Pocket	0	0	0	0
4	Althorne Park	0.19	Pocket	0	0	0	0
5	Bardsley Park	2.82	Neighbourhood	0	0	0	0
6	Bexley Park	0.21	Pocket	0	0	0	0
7	Blackmore Park	5.87	District	0	0	0.3	1.74
8	Casserley Park	2.32	Neighbourhood	0	0	0	0
9	Curtis Park	2.41	Neighborhood	0	0	0	0
10	Danbury Park	0.33	Pocket	0	0	0	0
11	Ferrara Park	6.99	District	0	0.09	0	2.9
12	Hainsworth Park	4.58	Neighbourhood	0	0.06	0	1.95
13	Hudson Park	6.23	District	0	0	0	1.83
14	Keeley Park	0.09	Pocket	0	0	0	0
15	Liddell Park	3.79	Neighbourhood	0	0	0	0.96
16	Manolas Park	0.09	Pocket	0	0	0	0
17	Mereworth Park	1.03	Neighbourhood	0	0	0	0
18	Montrose Park	6.52	District	0	0	4.76	0.22
19	Oldfield Park	0.11	Pocket	0	0	0	0
20	Roding Park	0.1	Pocket	0	0	0	0
21	Roydon Park	0.55	Local	0	0	0	0
22	Templeton Park	2.2	Neighbourhood	0	0.12	0	0
23	Tendring Park	0.53	Local	0	0	0	0
24	Warwick Park	0.09	Pocket	0	0	0	0
25							
26							
27	MRS Parks & Recreation						
28							
29							
30			Girrawheen Parkland	Permanent	Seasonal	Vegetation	Sporting
31			LOS (area)	=SUM(D3:D28)		5.06	9.60
32			% total LOS area	SUM(number1, [number2], ...)		10.71	20.32
33			% residential area	[illegible]	[illegible]	1.36	2.58
34			(% total Sporting area)				100.00
35			m²/resident 2016				4.96
36			m²/resident 2021				5.05
37							

Figure 98: Calculating the cumulative areas of permanent water in the suburb of Girrawheen using the sum function. The same function was used to calculate the cumulative areas of each landscape patch and the total area of local parkland in the suburb



ort		
9.60	Total Residential Area (ha)	372.42
	Total LOS (ha)	47.25
	%LOS in residential area	=L32/L31*100
4.96	2016 Population	19361
5.05	2021 Population	19026

Figure 99: Calculating % local parkland in residential area by dividing the total area of parkland by the total residential area.

Similar standards for each landscape type could also have been created using the total amount of local parkland, however these have less value for this investigation. Of these two values, the residential area standard generally represents the more appropriate value for analysing landscape trends within new suburbs. It indicates the total proportion of a developed area that has been dedicated to each specific landscape type; as opposed to the proportion of the local parkland within that developed area that has then been dedicated to each landscape type. While only a subtle difference, it nonetheless has the potential to distort the analysis if the proportions of local parkland change significantly from old to new residential areas. For example, an area with a decrease in total local parkland, but with the same amount of ecological landscapes, would produce a higher % local parkland figure even though the proportion of this landscape has remained the same.

Appendix 2: Questionnaire Instrument

Sporting Park User Survey Curtin University **Interviewee code** ______________

Park ________________________________ **Date** ________________

Park Zone ___________________________ **Time** ________________

I am a PhD Student at the Department of Urban and Regional Planning at Curtin University. I am carrying out a survey of users of different public parks used for organized community sport, to determine the way in which they are used for non-sporting forms of recreation.

The survey focuses on this specific (insert recreational zone) within the park, rather than the whole park. It covers the types of activities typically carried out in this zone, the main benefits that you receive from these activities, the physical features and social environments of the park that lead to these benefits, and the influence of organized sport on these benefits.

The survey will take less than 10 minutes to complete. It has ethics approval from the University and I will not ask you to provide you name. Are you willing to answer the survey? Thank you!

1. **Gender:** Male Female

2. **Can you please tell me what age bracket you fit into?**
   a. 18-24 c. 35-44 e. 55-64 g. 75-84
   b. 25-34 d. 45-54 f. 65-74 h. 85+

3. **How often do you visit this park?**

   Daily 2-3 a week Weekly Monthly Rarely

4. **What is the typical duration of your visits?** Hours ________ Minutes __________

5. **What is the main reason you choose to use this park?**

   Close to Residence/Work Organised Sport Visiting this specific area

   Other ____

6. **What is your usual mode of transport to visit this park?**

   Car Bus Walk Cycle Other

7. **Is this mode of transport one of your main forms of physical activity?**

   ____

8. Activity values

On a scale of 1-10, with 1 being the lowest and 10 the highest, how do you personally value this *(insert recreational zone)* for the following activities? Please include any additional comments.

a. Walking #__________

____

b. Vigorous Exercise #__________

____

c. Sitting #__________

____

d. Observing Nature and the Landscape #__________

____

e. Interacting with Nature and the Landscape #__________

____

f. Observing other park users #__________

____

g. Interacting with other park users #__________

____

Other ____

____

9. Outcome values

On a scale of 1-10, with 1 being the lowest and 10 the highest, how do you personally value this *(insert recreational zone)* for the following outcomes? Please include any additional comments.

a. Physical activity #___________

____

b. Relaxing #___________

____

c. Re-focusing and re-charging #___________

____

d. Escaping everyday life #___________

____

e. Greater appreciation of nature/landscape #___________

____

f. Greater knowledge and understanding of nature/landscape #___________

____

g. Creating new friendships with other park users #___________

____

h. Strengthening existing friendships with other park users #___________

____

Other ____

Thinking about these activities and outcomes you have just rated:

10. **What are the most <u>valuable</u> overall in terms of your visits to this ______________________?**

11. **What <u>features</u> (landscape, wildlife, infrastructure etc.) are most important to these favorite activities/outcomes you have just mentioned?**

12. **What is your preferred <u>social</u> environment for these activities/outcomes?**

No People   Some People   Busy   Don't care

13. **Are there any <u>negative</u> things associated with your visits to this ______________________?**

14. **Does the presence of <u>organized sport</u> during your visits influence these outcomes? If yes, is it a positive or negative influence?**

15. **Do you use the sporting area within this park during your visits? If yes, for what activities or outcomes?**

<u>Thank you for making the time to answer this survey!</u>

Appendix 3: Interview Questions

General Background

- Can you please explain your current or previous role(s) in public park planning within the LGA's of Swan or Wanneroo?
- Can you please explain the key planning processes that control the planning of public parks in these areas?
- How do these planning processes specifically control the planning of parks that provide opportunities for organised community sport (sporting parks)?

Location of Sporting Parks

- Can you please explain how the location (i.e. as part of 10% LOS, shared with a local school, within ROS) of a sporting park is typically determined?
- In your experience, what are the advantages and challenges of each of these different locations of sporting parks?
- What do you believe is the most effective way for sporting parks to be located to maximise benefits for the community?

Design of Sporting Parks

- Can you please explain how the design (i.e. size of the park, number or type of facilities, non-sporting recreational areas) of a sporting park is typically determined?
- In your experience, what are the advantages and challenges of designing sporting parks to provide opportunities for non-sporting recreation?
- What are the challenges in providing ecological landscapes (permanent water, seasonal drainage, remnant vegetation, community gardens) as recreational venues – both in sporting parks and in general?
- What do you believe is the most effective way for sporting parks to be designed to maximise benefits for the community?

Other Issues

- Aside from those just discussed, what are the main issues associated with the planning and management of sporting parks? (groundwater usage, ongoing maintenance costs?)
- What strategies may allow these issues to be addressed into the future?

Swan Location

- Processes that allowed Ellenbrook DOS to be successfully planned.
- Current progress and challenges in securing playing fields in Whiteman Park.
- Confirm future provision of playing fields in developing Ellenbrook estates: Woburn Park, The Vale…
- Progress in planning for DOS/ROS in Urban Growth Corridor.

Swan Design

- Background to Coolamon dog exercise area.
- Did LG have say in park design – location of playground. Do they agree that playground is better located next to dog park and the youth area further away?
- Any challenges encountered from creating recreation space in a drainage area specifically for the dog park.
- Background to Charlie Gregorini Park, and specifically the Community Garden.
- Challenges in governing community gardens from a LG perspective. Any other CG's in Swan area?

Wanneroo Location

- State of community sport in Coastal and South/Central Wanneroo: is there a current shortage?
- Confirm future local playing fields in Coastal Wanneroo: one in Catalina and one in North Jindalee.
- Progress or otherwise of securing additional sporting space for Coastal Wanneroo if there is a shortage. Any possible locations?
- Progress in planning for sporting ROS in Alkimos and North Wanneroo.

Wanneroo Design

- Background to Ridgewood Park, if any.
- Any specific challenges with maintaining the lake in Ridgewood.
- Thoughts on dogs being allowed to swim in lakes.
- Challenges with managing bushland area to maintain ecological values.
- Adopt a Bushland, in relation to environmental education and contact with nature. Challenges, participation rate