



Sense of Place: Perth Community Attitude Towards Places of Significance on the Gnangara Groundwater System

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Description: Aerial view of Perth's northern suburbs

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The GSS is a Western Australian state government initiative which aims to provide a framework for a whole-of-government approach to address land use and water planning issues associated with the Gnamagara groundwater system. For more information go to www.gnamagara.water.wa.gov.au

EXECUTIVE SUMMARY

In order to address some knowledge gaps identified in the CSIRO's report on Economic and Social Values of Land and Water Uses on the Gngangara Groundwater System, the CSIRO conducted a Sense of Place survey with representatives of the broader Perth community. This survey was designed with the objective of identifying community attitudes and values toward different types of land uses on the Gngangara Groundwater System (GGS). Factors such as geographical significance, aesthetic qualities, recreational uses and intrinsic (bequest and existence) values are examined.

'Sense of place' refers to the emotional and physical bond that an individual has towards a place. Individuals are shaped by their physical surroundings through the experiences they have had there (McAndrew 1998). Sense of place shows most clearly in the way the community feels about, and uses, the landscape (Seddon *et al.* 1972).

The Sense of Place survey was carried out in September 2008. Internet survey invitations were emailed to randomly selected adults, aged 18 years or over, that live in the Perth metropolitan area as shown by their postcodes. A total of 414 questionnaires were completed, resulting in a response rate of approximately 25%.

Descriptive statistics suggest that the five localities in which respondents had recently visited or felt most strongly about on the GGS were the Swan Valley, Whiteman Park (including Bennet Brook), Lake Monger, Yanchep National Park (including Yanchep caves) and Herdsman Lake. Respondents found urban wetlands such as Lake Monger and Herdsman Lake more important than peri-urban wetlands such as Lake Gngangara and Jandabup Lake, and they rated Wanneroo horticultural farms low in importance relative to other places on the GGS.

Respondents were presented with 13 statements related to food security, water security, housing security, job security and environmental conservation. When asked to choose the five they felt were most important, statements relating to groundwater conservation received the highest ratings. Maintaining the pine plantation for recreation received the least amount of support. Despite this, half the respondents indicated that they undertook some recreational activities in and around the Gngangara pine plantation. The most popular activity was enjoying the pine view as they drove by. Exempting pines with road frontage from being harvested may help prevent social welfare impact (i.e. community displeasure) from the lost visual amenity associated with pine harvesting.

Despite the small number of people indicating that they felt strongly about Wanneroo horticultural farms, consuming locally grown fruit and vegetables was ranked as one of the top five most important issues. It is suggested that, should the Wanneroo horticultural precinct be rezoned urban, consideration be given to establishing a new precinct with close proximity to Perth to replace Wanneroo's horticultural function. The authors suggest that future studies be undertaken on the community's willingness to pay, and preference for locally grown fruit and vegetables.

Results from the Sense of Place analysis confirm that people's connection to places on the GGS is related to behavioural and emotional bonds, and that some groups display stronger bonds than others. This suggests that intrinsic values associated with places on the Gngangara are worthy of consideration. Various localities on the GGS are considered inspirational places, historically important and iconic to Perth, and aesthetically pleasing. Further, many people feel a strong emotional connection with these places. In terms of use value, respondents feel that 'places on the GGS provide recreational experiences that are second to none' and are good places for families to get together.

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1. INTRODUCTION

As part of the Gngangara Sustainability Strategy (GSS), the CSIRO is currently developing a GIS-based decision support tool (DST) for the management of land and water uses of the Gngangara groundwater system (GGS). Decisions need to be made about the most appropriate course of action needed to respond to changing resource conditions on the GGS, and evolving community demands for land, water and the environment. It is intended that such a tool will help the Western Australian government achieve the objectives identified under the GSS. One component of the DST is the assessment of social and economic impacts of land use and land management decisions. The CSIRO is identifying and evaluating social and economic values associated with land uses and environmental amenities of the GGS to be incorporated into the DST.

An extensive literature review of social values associated with geographical features on the GGS indicates that there are additional social values – particularly those associated with the pine plantation, horticulture precinct, native bush and conservation areas – that warrant further evaluation. Knowledge gaps that have been identified include the emotional bonds people have to places, intrinsic values or non-use values attached to places, social values associated with the feeling of connection to nature, and recreational values that promote community well-being (J. McDonald, pers. comm. 2008).

1.1. Study Objective

To address the gaps identified above, the Sense of Place survey of community attitudes toward places of significance on the GGS was carried out during August–September 2008. The objective of the survey was to ascertain the attitudes and views of the broader community toward different land uses of the GGS. Potential factors influencing these attitudes were explored, including geographical significance, aesthetical qualities, recreational uses, intrinsic (bequest and existence) values, and reasons for having or not having certain types of land uses. Bequest value is the value that arises from an individual knowing that a resource will still be available for their children and their children's children (Krutilla 1967). Existence value is the value that arises from an individual knowing that a resource will continue to exist in the future regardless of whether or not they will be using it.

Specifically, the current study aims to identify

- places of public importance on the GGS,
- recreational activities performed in and around the Gngangara pine plantation,
- community understanding of issues relating to groundwater, and
- human–environmental relationships through a multidimensional conception of ‘sense of place’.

The overarching goal for the abovementioned study objectives is to identify the value preferences held by the community, specifically for the non-market goods and services the GGS provides. By their nature, non-market values are difficult to monetise and thus were analysed in this study using survey methods. While findings from this report will help improve the understanding of community preferences for land, water and the environment on the GGS, they do not necessarily indicate the community’s willingness to pay to achieve their demands. Findings from this study were not designed to be interpreted in an economic

framework; instead they serve as a complement to the cost-benefit findings produced by the DST.

Sense of place refers to the emotional and physical bond that an individual has towards a place. Psychological sense of place is a theoretical construct that assesses an individual's attachment, dependence and identity associated with a specific location. Sense of place has been shown to be an important factor of intended protective behaviour for sites of environmental significance (Tucker et al., 2006). In the current research, sense of place provided the most appropriate framework for understanding attitudes and values towards the varied geographical spaces on the GGS, and therefore statements in the attitudinal questionnaire were intended to reflect the components of the construct. Sense of place as a methodology is discussed in more detail in Section 2.1.

The 'environment' in this context refers to the places of significance on the GGS, such as parks and wetlands, that were identified through community surveys and focus groups. The validity of the multidimensional relationships will be demonstrated theoretically with reference to attitude theory, and shown empirically through path modelling of community survey responses. This is adapted from a modelling technique published by Jorgensen and Stedman (2001).

Prior to undertaking the survey, it was thought that public knowledge of the GGS could be poor, as suggested by a previous community survey (see DoW 2008). It was hypothesised that most preferences would be directed towards preserving use values, such as recreation and visual amenity, and locations with higher-use value would be given a higher preference by the community. For example, the community may have a preference for urban wetlands over peri-urban wetlands because they recreate around urban wetlands more often. There were *a priori* expectations that the Gngangara pine plantation and Wanneroo horticulture precinct would receive lower preference than the Swan Valley and Yanchep National Park because those areas have low recreational values.

1.2. Study Site: The Gngangara Groundwater System

The Gngangara Groundwater System (GGS) is situated in the southwest region of Western Australia (see Figure 1 for indicative land use), covering an area of approximately 214,896 ha. The distance from the most western point of the GGS area to the most eastern point is approximately 84 km. The distance from the most northern point of the GGS area to the most southern point is approximately 52 km (A. Belouardi, pers. comm. 2008).

Approximately 1.6 M people (76% of the total Western Australian population) are currently living in the Perth–Mandurah area (WAPC 2005). Aided by the mining boom in Western Australia, the Perth population is growing at the rate of about 22,500 people per year. The Australian Bureau of Statistics (ABS) has projected that an additional 61,700 households will be formed in Perth over the period from 2006 to 2011, equating to an extra 12,340 homes required each year (WAPC 2006) to accommodate population growth. The urban and urban-deferred area (area allocated for future urban expansion) is approximately 40,743 ha, comprising 37,174 ha of urban and 3,569 ha of urban-deferred (A. Belouardi, pers. comm. 2008).

Other land uses on the GGS include 69,000 ha of native woodlands and 22,000 ha of commercial pine plantation. There are also approximately 20,600 ha of Commonwealth Department of Defence and Unallocated Crown Land (UCL) on the eastern and northern sections of the GGS, and 2,500 ha of agricultural and horticultural land.

There are over 50 wetlands on the GGS, some of which are naturally wet, dry or artificially maintained through supplementation. Wetlands provide social and ecological services to the community, such as habitat for flora and fauna, and places in which to relax and recreate.

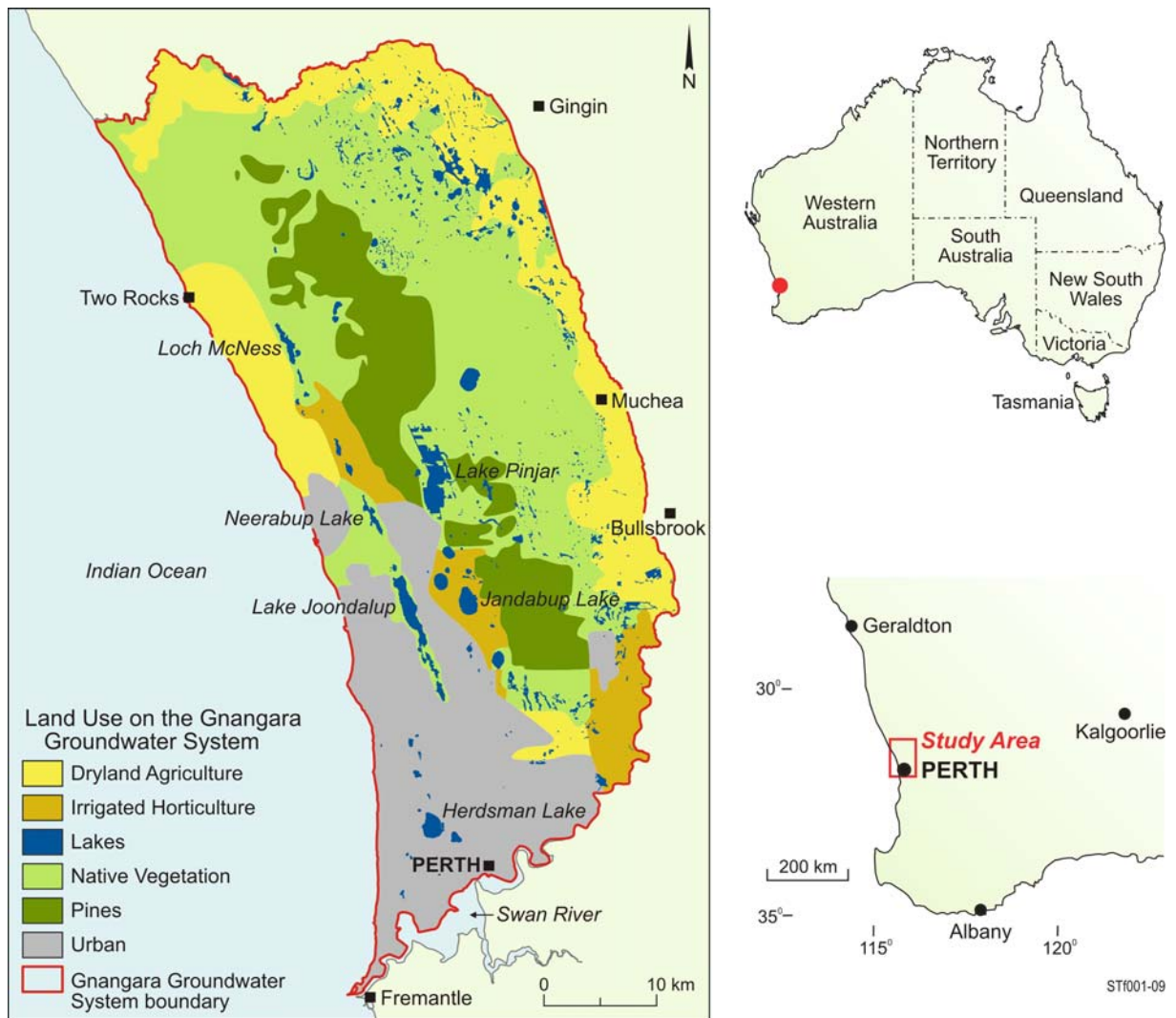


Figure 1 The Gngangara Groundwater System, Western Australia
 (Source: Dept of Water, 2008 and CSIRO, 2008)

The GGS is the main source of the drinking water supply for Perth, providing around 165 GL a year for residential and commercial use. This is equivalent to 65% of total urban water consumption each year. Urban residential users are currently the highest users of groundwater, thereby contributing the most to aquifer depletion. The continuing drier conditions, extraction for public and private purposes, and reduced recharge has resulted in groundwater storages in the upper and mid parts of the GGS declining by about 20 GL per year between the late 1980s and late 1990s, and by about 45 GL per year since the late 1990s (D. McFarlane, pers. comm. 2008). Figure 2 shows the changes in groundwater storage for the GGS from 1979 to 2007. Groundwater levels have declined by up to 5 m in some areas, resulting in wetlands drying and being replaced by terrestrial vegetation (D. McFarlane, pers. comm. 2008).

The Western Australian government has been investigating increasing groundwater recharge through changes in land use and land management practices on the GGS that will allow for increased rainfall recharge into the aquifer and decreased groundwater extraction. The result would be future changes in the landscape above the GGS that may permanently alter the aesthetic qualities, number of native species, type and number of industries, and recreational activities.

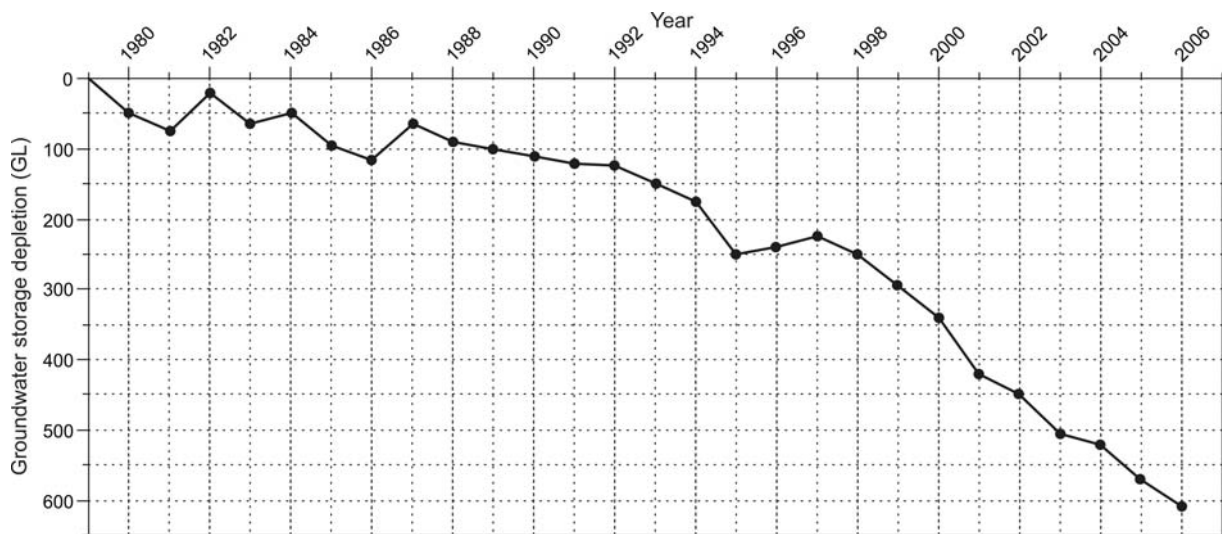


Figure 2 Changes in groundwater storage on the GGS

(Source: Dept of Water, 2007)

1.3. Social Values on the Gngangara

Social values, in the context of this study, can be thought of as feelings of attachment to places or objects – for example, environmental goods like wetlands and groundwater dependent ecosystems (GDEs) – that embody meanings important to a community (Johnston 1992). Places of social value would be expected to be those that provide a spiritual or traditional connection between past and present, tie the past affectionately to the present, provide an essential reference point in a community's identity or sense of itself, or have shaped some aspect of community behaviour or attitudes (Johnston 1992). Therefore, social values do not necessarily have to be use values. People can derive a feeling of satisfaction from the good without having to use it. These values can be considered intrinsic.

Wetlands perform both ecological and social functions. In the case of the GGS, wetlands support GDEs that have important flora and fauna. These flora and fauna include banksia woodlands, tuart trees, migratory waterfowl and microscopic vertebrates. A number of urban wetlands on the GGS have surrounding green space with playgrounds, picnic and barbeque facilities, and walking tracks on which people can recreate. Other wetlands, such as Loch McNess in Yanchep National Park, have been opened for water sports such as canoeing. Wetlands also have non-use values, and can provide a sense of well-being to people even though they may never use the place. These values are usually intrinsic, such as existence or bequest values.

Beckwith (2006) has summarised social values of wetlands on the GGS, namely Neerabup Lake, Lake Nowergup, Lake Jandabup, Lake Mariginiup, Lake Gngangara, Lake Pinjar, Lake Gwelup, Lake Claremont, Lake Monger, Herdsman Lake, Perry Lakes, Lake Jualbup and Jackadder Lake, as having the following in situ values:

- aesthetic values,
- Aboriginal heritage values,

- European heritage values,
- birding/nature observation values,
- recreational values, such as picnic, walking, running and cycling,
- education and research values, and
- complementary land uses values, such as parks and pathways.

In early 2008 the Department of Agriculture and Food Western Australia (DAFWA) commissioned a report called the Horticulture Precinct Feasibility Stage 1, which focused on the strategic and economic advantages and disadvantages of an intensive horticulture precinct in close proximity to Perth. As part of the report, social values were also evaluated. The reported social advantages of preserving horticultural land include the preservation of a horticultural 'feel' near the city; the preservation of jobs for about 1,000 people currently employed by the precinct; enabling small farmers and their families to have easy access to education for their children by being in close proximity to the city; and securing fresh, locally grown fruit and vegetables for Perth. The social disadvantages included precluding urbanisation in the precinct area despite increasing pressure for more urban land; the possibility that crops grown in the precinct could be grown elsewhere; and the need for buffer zones to prevent odour, dust, noise and spray drifting into the adjacent housing area.

2. METHODOLOGY

Sense of place, considered an elusive concept, is now finding a home in ecosystem management (Williams and Stewart, 1998). This perceived elusiveness could stem from its openness to multiple interpretations. Despite this, the concept offers great potential to ecosystem management by bridging the gap between the science of ecosystems and their management (Mitchell *et al.* 1993 as cited in Williams and Stewart, 1998). In social science research, interpretation of sense of place is relatively well established in attitude research; attitude theory is used to provide a basis for conceiving of sense of place (Jorgensen and Stedman 2001).

2.1. Sense of Place

Sense of place refers to the emotional and physical bond that an individual has towards a place. Individuals are shaped by their physical surroundings and through the experiences they have had there (McAndrew 1998). Sense of place shows most clearly in the way the community feels about and uses the landscape (Seddon *et al.* 1972). A 'place' can be described in terms of many multidimensional physical and psychological attributes, such as the physical size of the environmental asset, and the symbolic influence it has on an individual through personal, cultural and social processes (Pretty *et al.* 2003). Hence, a place does not always have to be a physical location.

An attitude can be defined as a response to an exogenous event, object or stimulus; places may therefore serve as attitude objects (Fishbien and Ajzen, 1975; Jorgensen and Stedman 2001). Sense of place is consistent with the concept of attitude; thus attitude theory can provide a theoretical framework for organising the relationships between people and place (Jorgensen and Stedman 2001).

In this study, the places in question are the localities and features of environmental significance on the GGS.

The three sense of place constructs that are commonly evaluated in the environmental psychology literature are *place identity*, *place dependence* and *place attachment* (Jorgensen and Stedman 2001).

Place identity is the relationship between personal dimensions (e.g. ideas, beliefs, preferences, feelings, values, goals and behavioural tendencies) and the physical environment (Proshansky 1978 as cited in Jorgensen and Stedman 2001). In other words, place identity refers to a mixture of feelings about specific physical settings and how they provide meaning and purpose to life (Proshansky *et al.* 1983, as cited in Brown and Raymond 2007).

Place dependence relates to the strength of the relationship between an individual and specific places, as perceived by the individual (Stokols and Shumaker 1981 as cited in Jorgensen and Stedman 2001). It is an activity-based connection that reflects the importance of the place in providing conditions that support an intended use, such as recreation or timber harvesting (Schreyer *et al.* 1981, as cited in Brown and Raymond 2007).

Place attachment is a positive emotional bond that develops between the individual and their environment (Altman and Low 1992, as cited in Jorgensen and Stedman 2001). It has been shown through research that older people and people from lower socio-economic classes develop stronger attachments to their home places or neighbourhoods than younger people and people in higher socio-economic classes (McAndrew 1998).

The literature suggests that sense of place is multidimensional, with each dimension representing the different dimensions or components of an individual's attitude (Jorgensen and Stedman, 2001). Therefore, one can differentiate between place attachment, identity and dependence: place attachment is the affective or emotional component of attitude; place identity is the cognitive component that reflects the individual's sense of self; and place dependence is the 'conative' component of attitude in which an individual's dependence to their surrounding is relative to their behaviour performed at that place (see e.g. Moore & Graefe, 1994 as cited in Jorgensen and Stedman, 2001).

In the context of the Gngangara, the Sense of Place analysis will be used to evaluate people's feelings and the strength of those feelings toward different localities on the GGS and the associated land-use attributes (e.g. recreation, aesthetic, intrinsic).

2.2. The Community Forums

During May and June 2008, the Gngangara Sustainability Strategy (GSS) organised four community forums around the GGS area to provide the community with information on issues related to groundwater management and land use in the GGS. The purpose was to identify and understand the community's feelings and attitudes toward the trade-offs related to groundwater management. The forums took the form of facilitated workshops and required attendees to respond to a series of focused questions (Sands 2008), including questions on social values and sense of place attached to land uses and amenities in the GGS. Seventy-one community representatives and 66 other representatives, including state government, attended the forums (Sands 2008).

A number of geographical features, located on the GGS, were identified in the forums, as well as supporting reasons detailing why these features were considered important. Findings from the forums were used to design the scoping survey.

More information on the participant–recruitment process and demographics can be found in Sands (2008).

2.3. The Scoping Survey

The purpose of the scoping survey was to confirm that the issues raised from the forums were also issues of concern to the broader public (as opposed to issues that may be of concern to certain interest groups only). The scoping survey also served to identify other issues that may not have been raised during the forums. A total of 55 people participated in the survey and statistical results largely confirmed findings from the community forums. An internet survey was conducted, with the respondents consisting of Perth residents aged 18 and over. Lakes, native vegetation (e.g. banksia woodlands and seasonal wetlands) were identified as the geographical features on the GGS most important to the respondents. Conversely, pine trees and horticulture farms were identified as the two least important geographical features. These findings are consistent with a ranking question regarding the geographical feature respondents were most willing to let go of or see disappear first. Results suggested that respondents were willing to let go of the pine trees first and were willing to let go of lakes, streams and brooks, seasonal wetlands and caves ponds last. Nonetheless, nearly 42% of respondents indicated that they enjoyed the view of the pines when they drove pass the forest. The most commonly cited reason for identifying lakes and seasonal wetlands as important was that these environments helped ensure the survival of native fauna. The respondents considered native vegetation important because it was a part of the natural landscape and needed to be conserved.

In terms of significant localities on the GGS, the Swan Valley and Whiteman Park were two places that respondents had visited the most in the past two years. By contrast, 75% of respondents reported that they had not visited Jandabup and Nowergup Lakes before.

2.4. The Survey Stage

The Sense of Place survey was carried out in September 2008, with the internet chosen as the survey mode (discussed below). The target population was households in the Perth metropolitan area as they are the scheme water users who will be impacted by the policy recommendations of the GSS through future security of groundwater supply and landscape changes.

2.4.1. The Internet Survey and Sampling

The internet has the potential to reach a large audience at relatively low cost. Although not everyone has access to the internet, the most recent statistics from the ABS (2006) show that the number of households with home internet access in Western Australia has increased dramatically from only 34% in 2000 to 66% in 2006. Considering the magnitude of the growth of home internet usage in the past couple of years, an internet survey was chosen as the best mode of obtaining responses as it is has the potential of reaching a wider proportion of the population and is very cost effective.

To achieve access and coverage of the true Perth metropolitan population, a panel of respondents was sought through an independent survey company. A random sampling technique was used to select adult respondents, aged 18 years or over, based on their postcodes within Perth. Responses from each survey were automatically saved in a database file, which helped reduce non-sampling bias from inaccurate data input.

2.4.2. The Questionnaire Design

The questionnaire consisted of four main sections:

Section 1: Background Information and Questions to Elicit Respondents' Knowledge of the GGS.

In order to evaluate whether respondents have correct knowledge of the issues surrounding the GGS, they were asked two questions in the form of a multiple-choice quiz. These questions were: *What do you think is Perth's largest source of scheme water supply?* and *What do you think is the current condition of Perth's groundwater resource?*

After each question, respondents were provided with background about the GGS, specifically related to each question. The background information included: location of the GGS, the types of land uses on the GGS, the GGS flow and interaction with surface water, the main users of the GGS groundwater, a time series of the GGS groundwater table, and the current issues surrounding the declining groundwater level of the GGS. The purpose of this section was to help respondents have a better understanding of the GGS and the seriousness of the declining groundwater situation. Respondents were also informed of the trade-offs between land use and groundwater recharge. This information was provided with the intention of emphasising the inter-linkages between land use and groundwater.

Section 2: Importance and Meaning of Places on the GGS

The second section consisted of sense-of-place questions. Respondents were asked to select five out of 12 locations on the GGS they had previously visited or felt strongly about, and to rank the importance of each location against the others. They were then asked to complete an importance rating on a Likert scale indicating how difficult they believed those places would be to replace. The respondents then stated the number of visits they had made to each place in the previous two years.

The locations presented in the questionnaire were:

1. Whiteman Park (including Bennet Brook)
2. Yanchep National Park (including the caves)
3. Swan Valley
4. Lake Gnangara
5. Wanneroo horticultural farms
6. Herdsman Lake
7. Perry Lakes
8. Ellenbrook catchment
9. Lake Monger
10. Yellagonga Regional Park (including Lake Joondalup)
11. Gnangara Pine Plantation
12. Jandabup Lake

These places were chosen for two reasons. Firstly, they were identified by participants from the community forums and respondents of the scoping survey as localities that are significant on the GGS. Secondly, they are places that may be impacted by the government's land use and land management strategies in the future.

Respondents were then presented with a set of 16 statements outlining the range of 'meanings' associated with places of significance on the GGS. In order to avoid 'respondent fatigue', they had only to complete the 16 statements for the five locations that were most important to them, instead of all 12 locations. They were then asked to rate whether they agreed or disagreed on a five-point scale ranging from 1 (*strongly disagree*) through to 5 (*strongly agree*). These statements have been adapted from a Sense of Place study in the Hawkesbury-Nepean region by *Tucker et al.* (2006).

Response ratings from the 16 statements will be used as observed variables in the Sense of Place analysis to determine the three latent variables: *place identity, attachment and dependence*. Figure 3 shows sense-of-place 'meaning' statements as viewed by the internet survey respondents.

In addition, respondents were asked to rank the importance of each location against the others and assign an importance rating on a Likert scale for the location by itself (see Figures 4 and 5). The locations presented in the questionnaire were the same 12 locations as above.

The **Whiteman Park (including Bennet Brook)** on the Gngangara groundwater system is... *

	Strongly Disagree	2	3	4	Strongly Agree
One of the most beautiful parts of Perth	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Important to the State's revenue	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Beneficial to the natural environment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provides employment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Provides recreational experiences that are second to none	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Is a Perth icon	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Historically important to Perth people	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The best place for doing the things that I enjoy most	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Aesthetically pleasing	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Vital for the lifestyle I enjoy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A good place for families to get together	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A good place to get away from everyday stress	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An inspirational place	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An important part of my childhood memories	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A place that I feel a strong connection with	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A place I care a lot about	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 3 Original scale items from the questionnaire

Section 3: Activities In and Around the Gngangara Pine Plantation

The third section included questions to ascertain the activities that people do in and around the Gngangara pine plantation. This was to determine whether the pines have public-use benefits, such as motor recreation, and to ascertain the proportion of the sampled population that did these activities. Tick boxes were used so respondents could choose more than one option if they participated in multiple activities. Alternatively, they could choose the option *I don't use the pine plantation* if applicable.

Section 4: Ranking of Issues and Attributes Related to the GGS

A section was included with 13 general statements related to food security, water security, housing security, job security and environmental conservation. Respondents were asked to choose five statements that were most important to them. The purpose of this section was to compare the importance of water security to other issues people faced. Respondents were informed that selecting the appropriate type of land use would help increase groundwater recharge and could reduce groundwater demand at the same time; and that their responses would help the GSS better understand their values and views of land-use decisions related to the area covering the GGS.

Section 5: Socio-economic Information

The fourth section comprised socio-economic questions, such as age, gender, income, education and household unit of the respondent. Respondents were also asked to state their postcode and how long they had been living in Perth. It was hypothesised that those that lived on the GGS and those that had lived in Perth for a longer period of time could have a stronger attachment to the geographical places on the GGS.

Please rank the following places in order of importance to you (where 1 = most important to 12 = least important) *

Whiteman Park (including Bennet Brook)	<input type="text"/>
Yanchep National Park (including the caves)	<input type="text"/>
Swan Valley	<input type="text"/>
Lake Gnangara	<input type="text"/>
Wanneroo horticultural farms	<input type="text"/>
Herdsmen Lake	<input type="text"/>
Perry Lakes	<input type="text"/>
Ellenbrook catchment	<input type="text"/>
Lake Monger	<input type="text"/>
Yellagonga Regional Park (including Lake Joondalup)	<input type="text"/>
Gnangara Pine Plantation	<input type="text"/>
Jandabup Lake	<input type="text"/>

Figure 4 An example of the ranking between localities

Using the following scale, how important are each of the places on the Gngangara groundwater system to you?*

	I don't know this place	Very Unimportant	Unimportant	Neutral	Important	Very Important
Whiteman Park (including Bennet Brook)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yanchep National Park (including the caves)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Swan Valley	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lake Gngangara	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Wanneroo horticultural farms	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Herdsmen Lake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Perry Lakes	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Ellenbrook catchment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Lake Monger	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Yellagonga Regional Park (including Lake Joondalup)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Gngangara Pine Plantation	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Jandabup Lake	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 5 An example of rating of importance of each locality

3. ANALYSIS

To analyse the relationship between the community and its attachment to places of significance on the GGS, a statistical modelling technique was used to test and estimate causal relationships between variables. In other words, modelling is a method used to analyse changes in variables that may be related to, or caused by, changes in other variables. As such, it is a way of testing theories and predicting changes and outcomes. The section below describes the modelling technique in more detail.

3.1. Structural Equation Modelling

Structural equation modelling (SEM) is a form of statistical analysis that takes a confirmatory approach to the examination of a structural theory of a given phenomenon (Byrne 2006). It represents a causal process that generates observations on multiple variables (Bentler 1988, as cited in Byrne 2006). The term SEM conveys the fact that the causal process is represented by a series of structural regression equations. This series of equations is derived from theory and each equation purports to describe a particular aspect of the problem (Greene 2003). As long as the number of equations is equal to or greater than the number of variables, the structural equation model is identified; in other words, the variables can be estimated.

In the behavioural sciences, researchers are often interested in theoretical constructs that are not directly observable through traditional methods (such as questionnaires). These constructs are called latent variables or factors (Byrne 2006). Latent variables or factors consist of multiple observed variables that can be obtained through questionnaires. Various theoretical models can be tested using SEM on how sets of variables define constructs and how these constructs are related to each other (Hair *et al.* 2005).

Unlike traditional regression analysis, SEM is capable of estimation based on latent variables. It can estimate the strength and direction of relationships between variables (both

observed and latent) as well as estimate the variance within a dependent variable that is accounted for by the independent variables.

Since this study requires the estimation of a model with latent constructs, SEM is the most suitable methodology to use. The sense of place latent constructs in this study are *place identity, place dependence and place attachment*.

3.2. Multivariate Analysis

The technique used for SEM is multivariate analysis. Multivariate analysis refers to all statistical techniques that simultaneously analyse multiple measurements on individuals or objects under investigation (Hair *et al.* 2005). Structural equation modelling is an extension of multivariate techniques such as factor analysis and multiple regression analysis (Hair *et al.* 2005). It is necessary to use multivariate analysis for SEM because a number of theories containing multiple equations that have relationship dependence are being analysed simultaneously. Statistical software packages that can perform multivariate analysis of SEM include LISREL, AMOS, GLAMM (in STATA) and MPLUS.

4. RESULTS

This section presents a summary of findings of the descriptive statistics and SEM. Descriptive statistics were performed in EXCEL, STATA and SPSS. SEM was performed with AMOS 16.0.

4.1. Descriptive Statistics

4.1.1. Demographics

A total of 414 adults aged 18 years or over and living in the Perth metropolitan region participated in the survey. Over 73% of respondents lived in the suburbs of the GGS while the others lived in other areas, such as the metropolitan area south of the Swan River. On average, respondents had been living in Perth for 29 years, with a minimum living time in Perth of six months and a maximum of 86 years. The survey gender ratio was 43% female and 57% male. The ABS 2006 census showed 51% female and 48% male adults, hence the survey had fewer female adults than the actual population. The average age of the respondents was 48 years (stdev 15.03), slightly different from the ABS 2006 census, which showed the average age of adults over 18 years to be 46 years (stdev 19.71). The average gross annual individual income was between \$50,000 and \$75,000 a year, while the ABS was around \$78,122 (stdev 47,813). Educational attainment among participants was reasonably high, with around 37% having university qualifications and 35% having trade or technical qualifications. ABS statistics, on the other hand, showed a lower percentage of Perth people with university qualifications (19%) and trade or technical qualifications (20%). This could suggest that the average survey respondent had a higher education than the Perth average. A summary of demographics statistics is presented in Appendix 1. The response rate was approximately 25%.

4.1.2. Overall Community Knowledge of the GGS Issues

The questionnaire commenced with questions designed to ascertain respondents' knowledge of the GGS and its current condition, followed by background information related to each question. The internet survey settings allowed respondents to use the 'back' button to change their answers after they had read the correct information if they chose to do so. Consequently, the findings in this section may suffer from information bias and results may be skewed. However, it was agreed by the CSIRO and the GSS that findings from the survey would prove more beneficial to the GSS's decision-making process if respondents made choices based on informed decisions.

The majority of respondents correctly answered questions about GGS groundwater issues. Nearly 73% of respondents answered correctly that Perth's largest source of scheme water supply is groundwater. However, roughly 20% of respondents still believed that surface water from the Perth hills was the largest source of scheme water. This suggests that a significant proportion of people have incorrect knowledge and understanding of the major source of Perth's water supply.

Approximately 81% of respondents answered correctly that Perth's groundwater resource is overused. The remaining 19% were evenly distributed among the three other answers: *I don't know*, *It's being used sustainably* and *Its use could be further increased*.

4.1.3. Places of Importance

Respondents were asked to select five out of 12 locations on the GGS they had visited lately or felt strongly about. As mentioned previously, the 12 locations presented in the questionnaire were Whiteman Park (including Bennet Brook), Yanchep National Park (including the caves), Swan Valley, Lake Gngangara, Wanneroo horticultural farms, Herdsman Lake, Perry Lakes, Ellenbrook catchment, Lake Monger, Yellagonga Regional Park (including Lake Joondalup), Gngangara Pine Plantation, and Jandabup Lake.

The five most selected locations (in the order of most to least) were:

1. Swan Valley (selected by 57% of respondents)
2. Whiteman Park including Bennet Brook (selected by 45% of respondents)
3. Lake Monger (selected by 38% of respondents)
4. Yanchep National Park including the caves (selected by 33% of respondents), and
5. Herdsman Lake (selected by 32% of respondents).

Swan Valley, Whiteman Park and Yanchep National Park are tourist destinations, while Lake Monger and Herdsman Lake are neighbourhood wetlands used for recreation. The locations that received the least amount of responses were Jandabup Lake, Wanneroo horticultural farms and Ellenbrook catchment, with only 2%, 5% and 6% of respondents respectively indicating that they had visited these places lately or felt strongly about them (see Appendix 2 for vote and ranking summaries).

Swan Valley

Around 57% of respondents said they had visited, or felt strongly about, the Swan Valley. Most respondents (82%) indicated that this area was an important to a very important place on the GGS. Respondents had, on average, visited the Swan Valley 6.6 times in the previous two years, making it the most frequently visited place on the GGS out of the 12 locations

presented in the questionnaire (see Table 1). One possible factor contributing to the popularity of the Swan Valley is ease of access. Nearly 77% of respondents indicated that the Swan Valley was either easy, or very easy, to visit, despite more than half (60%) of the respondents living over 20 km away. Respondents also nominated the Swan Valley as the most difficult place to be replaced. In other words, they believed it would be extremely difficult to get the same benefits provided by the Swan Valley from another location.

Whiteman Park (including Bennet Brook)

Approximately 45% of respondents indicated that they had visited or felt strongly about Whiteman Park (including Bennet Brook). Around 63% of respondents said that the park was an important to a very important place on the GGS. On average, respondents had made 1.7 visits to the park in the previous two years, making it the seventh most visited place (out of the 12 locations) on the GGS. Around half of respondents 50.5% indicated that they lived more than 20 km away from the park, while 25% lived 10–20 km away. Compared to the Swan Valley, Whiteman Park was closer to participants but received fewer visitations. Respondents suggested that the park would be the third most difficult place to be replaced by alternative locations.

Lake Monger

Nearly 39% of respondents voted for Lake Monger as the place they visited or felt strongly about. Many respondents (69%) also indicated that Lake Monger was an important to a very important place on the GGS. The majority of respondents (67%) said that Lake Monger was easy or very easy to visit, despite 40% of respondents living over 20 km away. Lake Monger was the third most frequently visited place (out of the 12 locations) on the GGS, with an average of three trips per person over the previous two years. It was ranked fourth in terms of places that would be difficult to replace, trailing Swan Valley, Yanchep National Park and Whiteman Park.

Yanchep National Park (including the caves)

Yanchep National Park was the fourth most selected place (out of the 12 locations) that respondents had visited or felt strongly about. Around 77.5% of respondents suggested that the park was an important or a very important place on the GGS. The majority of respondents (nearly 85%) lived over 20 km away, hence the relatively low average visitation of 0.9 trips per person in the previous two years (see Table 1). Due to unique characteristics, such as the caves, respondents considered Yanchep National Park the second most difficult place (after the Swan Valley) to be replaced by an alternative location.

Herdsmen Lake

Herdsmen Lake yielded very similar responses to Yanchep National Park in terms of visitation and strength of feelings (Yanchep 33% and Herdsmen Lake 32%). It was considered to be an important to very important place on the GGS by 64% of respondents, and was the fourth most frequently visited place (out of the 12 locations). Around 2.5 trips per person were made to Herdsmen Lake in the previous two years. Despite 47% of respondents stating that they lived over 20 km away, the majority found Herdsmen Lake easy or very easy to visit.

Worth noting is the Gngangara pine plantation, which was the fifth most frequently visited place on the GGS, with around 1.8 trips made on average in the previous two years. The least visited place was Jandabup Lake, with only 0.1 trips per person made in the previous

two years (see Table 1). A table of average visits to each location in the previous two years is displayed below.

Table 1 Average number of visits per person in the previous two years

Rank	Place	Average no of visits
1	Swan Valley	6.6
2	Yellagonga Regional Park (including Lake Joondalup)	3.1
3	Lake Monger	3.0
4	Herdsman Lake	2.5
5	Gnangara Pine Plantation	1.8
6	Perry Lakes	1.7
7	Whiteman Park (including Bennet Brook)	1.7
8	Yanchep National Park (including the caves)	0.9
9	Wanneroo horticultural farms	0.6
10	Ellenbrook catchment	0.4
11	Lake Gnangara	0.3
12	Jandabup Lake	0.1

Jandabup Lake and the Wanneroo horticultural farms were ranked the lowest in terms of places that respondents had visited or felt strongly about. They were also ranked the two easiest places to be replaced by other locations. Wanneroo horticultural farms were also low on the list, with an average visitation of 0.6 trips per person per year. This may indicate that the Wanneroo horticultural farms are not perceived as tourist destinations when compared to other destinations on the GGS and hence have minimal recreational value.

The correlation between visitation frequency and importance ranking (places respondents had visited lately or felt strongly about) revealed that all correlations were negative. This meant that the more frequently the person visited the place, the higher the ranking they gave the location (the highest ranking was 1; the lowest ranking was 12). With all locations that were neighbourhood wetlands, namely Lake Monger, Herdsman Lake, Perry Lakes and Joondalup Lake (part of Yellagonga Regional Park) there was a significant correlation between frequency of visit and ranking. There was no significant correlation between frequency of visit and ranking for Swan Valley and Yanchep National Park. This may be because Swan Valley and Yanchep National Park are perceived as icons of Perth and people may feel strongly about them even though they do not visit the places as often. See Appendix 2 for a full summary of statistics.

4.1.4. Activities of Importance In and Around the Pines

When responding to questions about activities in and around the Gnangara pine plantation, respondents were directed to choose five out of the nine activities provided, with the option of specifying additional activities not on the list. The most popular activity was *Enjoying the view of the pines from driving by*, which is considered an indirect-use activity. This result was also consistent with findings from the scoping survey. This raises some interesting policy implications, given that retention of pines with road frontage would mean that people could still enjoy the view of the pines and thus prevent social welfare loss associated with this activity. Only four respondents chose the *Enjoying the view from my house* option. If pine trees with road frontage were exempted from harvesting, this small group of people would also remain unaffected.

Bushwalking and picnicking were the second and third most popular activities. If the pines were clear felled, it is possible that benefits derived from these two activities could also be gained from other similarly accessible areas. Given that the pine plantations were not selected as places of high importance it is likely that this is the case; however, more information would be beneficial.

The Gnangara pine plantation may provide unique opportunities for people that enjoy horseriding, birdwatching, dirt-bike riding and other motor-recreation activities, and thus clear felling of the pines would affect these people the most. However, only 11% of respondents undertook these activities. The remaining 70% said they do not do any activities at all. Proportionally, respondents living in the Gnangara suburbs recreate in and around the Gnangara pine plantation more than respondents that do not live in Gnangara suburbs.

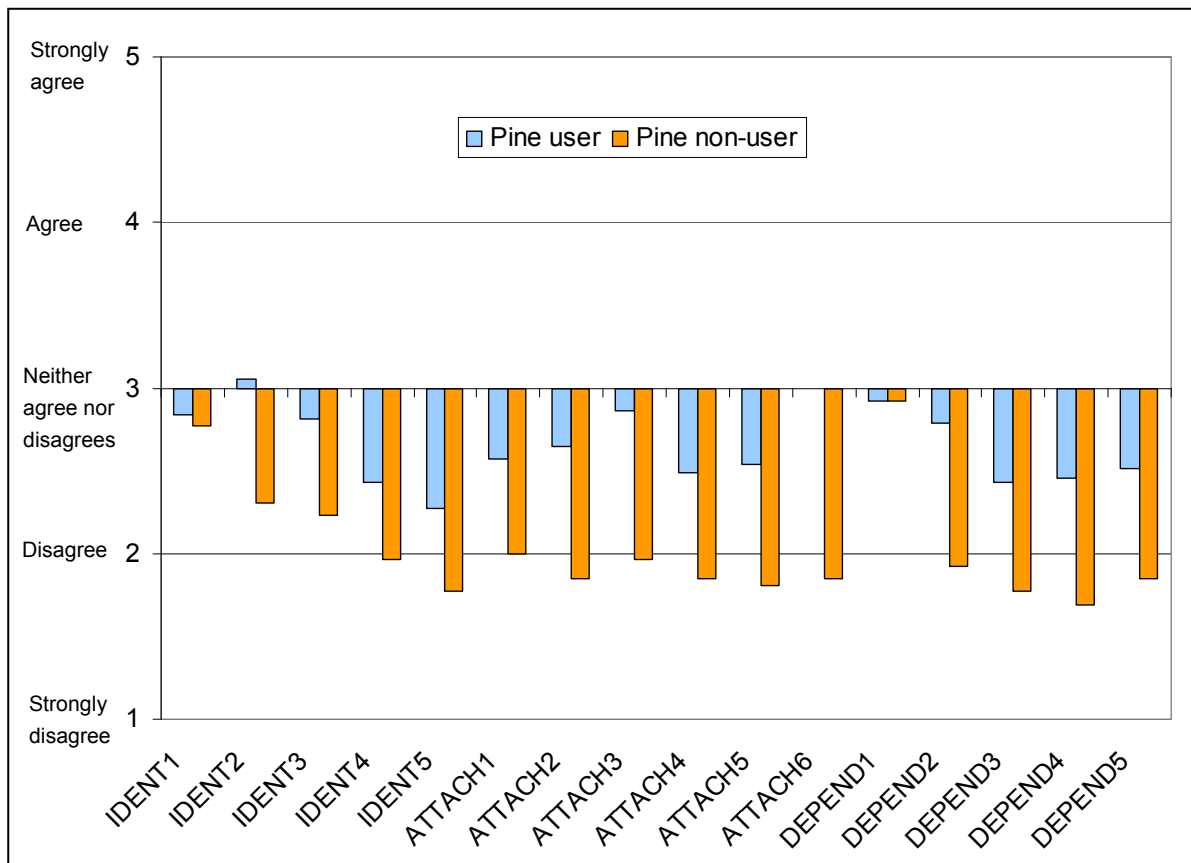
A summary of activities and frequencies is presented in Table 2.

Table 2 Ranking of responses for activities performed in and around the Gnangara pine plantation

Rank	Activity in and around the Gnangara pine plantation	No. of responses
1	Enjoy the view from driving by	74
2	Bush walking	45
3	Picnicking	34
4	Motor recreation	21
5	Dirt bike riding	12
6	Bird watching	8
7	Horse riding	5
8	Enjoy the view from my house	4
9	Other, please specify	3

Other activities that were specified in an open-ended question included scouting, organising safety courses and organising working-dog trials. However, these activities received only one vote each.

Specifically, for respondents that chose the Gnangara pine plantation as one of the places on the GGS they had recently visited or felt strongly about, Figure 6 compares the place-meaning rankings of the two groups. Group 1 were respondents that recreated in around the pines, including enjoying the view as they drove by (pine user). Group 2 were respondents that selected *I don't use the pine plantation* option (pine non-user).



Variable description
IDENT1 Important to the state's revenue; **IDENT2** Beneficial to the natural environment; **IDENT3** Is a Perth icon; **IDENT4** Historically important to Perth people; **IDENT5** An important part of my childhood memories
DEPEND1 Provides employment; **DEPEND2** Provides recreational experiences that are second to none; **DEPEND3** The best place for doing the things that I enjoy most; **DEPEND4** Vital for the lifestyle I enjoy; **DEPEND5** A good place for families to get together
ATTACH1 One of the most beautiful parts of Perth; **ATTACH2** Aesthetically pleasing; **ATTACH3** A good place to get away from everyday stress; **ATTACH4** An inspirational place; **ATTACH5** A place that I feel a strong connection with; **ATTACH6** A place I care a lot about

Figure 6 Responses to statements of meaning about the Gngangara pine plantation

As expected, results in Figure 6 indicate that pine non-users had a lower level of identity, attachment and dependence than pine users bar one item: **DEPEND1** *Provides employment*. The responses for the two groups were the same. Both users and non-users neither agreed nor disagreed that the plantation provides employment, which indicates that **DEPEND1** is least likely to be influenced by the use value of the pine plantation.

4.1.5. Issues of Importance to Perth Residents

Respondents were presented with 13 statements relating to food security, water security, housing security, job security and environmental conservation, and were asked to choose the five that were most important to them.

The statement chosen most frequently was *Securing Perth's drinking water supply*, followed by *Saving wetlands from drying out*, *Preventing the loss of flora and fauna* and *Increasing*

groundwater level. *Keeping the pine plantation for recreation* received the lowest number of responses. Statements related to groundwater were expected to receive particular attention from the respondents because the survey was focused on issues surrounding the groundwater and wetlands on the GGS and the information provided in the first section was directly related to these statements. Hence, information bias may have played a factor in the importance of selected statements. Table 3 lists the rankings of responses to general statements relating to the GGS.

Table 3 Ranking of responses for general statements related to the GGS.

Rank	Statements	No. of responses
1	Securing Perth's drinking water supply	353
2	Saving wetlands from drying out	263
3	Preventing the loss of flora and fauna	260
4	Increasing groundwater level	237
5	Eating fruit and vegetables grown in Perth	236
6	Keeping the pine plantation for aesthetic qualities	126
7	Increasing the area of native vegetation	126
8	Preventing bush fires	118
9	Being able to work near where I live	108
10	Having low cost housing	107
11	Pricing residential water to reflect its scarcity	48
12	Having more neighbourhood parks	21
13	Keeping the pine plantation for recreation	10

Worth noting also is the statement ranked at number five, which indicates the respondents' desire to eat what they personally perceive as locally grown fruit and vegetables. Approximately 57% of respondents chose this statement as one of the five most important statements from the list. Despite the fact that the survey is about land use and groundwater, respondents gave this statement a high level of importance. A variety of fruit and vegetables, including strawberries and lettuces, are currently grown in the Wanneroo horticulture precinct. If the precinct were to be rezoned to urban, it is worth considering establishing a new precinct to replace Wanneroo.

4.1.6. Place Meanings

The respondents were presented with a set of 16 statements outlining the range of 'meanings' associated with the GGS on a Likert scale ranging from 1 (*strongly disagree*) through to 5 (*strongly agree*). The set of statements, along with the summary of responses, are presented in Appendix 3. Respondents were also able to choose the option *I don't know this place*. Ratings above 3 indicate agreement and ratings below 3 indicate disagreement. Figure 7 presents a summary of average responses to the meaning (or attitude) statements separated into the responses of those living in the GGS area and those living outside the GGS area. The values were derived from averaging the responses of all locations that were chosen as the most important place on the GGS for each respondent. Table 4 provides the corresponding item descriptions and details of the means and standard deviations of each statement.

Overall, there were strong and positive attitudes amongst respondents regardless of whether they lived on the GGS or not, with the only exception IDENT5 *An important part of my childhood memory*. Regardless of whether they lived inside or outside the GGS area, all respondents had a stronger sense of identity and attachment than dependence. This suggests a stronger 'emotional' and 'sense-of-self' component towards the GGS as

compared to the behavioural component, which may imply stronger intrinsic value as opposed to use value.

Variable description
IDENT1 Important to the state's revenue; IDENT2 Beneficial to the natural environment; IDENT3 Is a Perth icon; IDENT4 Historically important to Perth people; IDENT5 An important part of my childhood memories
DEPEND1 Provides employment; DEPEND2 Provides recreational experiences that are second to none; DEPEND3 The best place for doing the things that I enjoy most; DEPEND4 Vital for the lifestyle I enjoy; DEPEND5 A good place for families to get together
ATTACH1 One of the most beautiful parts of Perth; ATTACH2 Aesthetically pleasing; ATTACH3 A good place to get away from everyday stress; ATTACH4 An inspirational place; ATTACH5 A place that I feel a strong connection with; ATTACH6 A place I care a lot about

Figure 7 Responses to statements of meaning about the GGS

For ATTACH5 *A place that I feel a strong connection with*, the average response for respondents living in the GGS area differed significantly from respondents living outside the GGS area. The average response for those living in the GGS area indicated agreement with the statement; those not living in the GGS area indicated disagreement with the statement. This is somewhat intuitive, as one would expect to feel a strong connection (or bond) with a place that one is more familiar with. Other variables that differed significantly between those respondents that lived in the GGS area and those that did not included DEPEND3 *The best place for doing the things that I enjoy most*, DEPEND4 *Vital for the lifestyle I enjoy* and ATTACH6 *A place I care a lot about*.

Further analysis suggests that gender, as well as length of residence in Perth, also affected responses to place-meaning statements. Variables significantly different between men and women were DEPEND2, DEPEND3, DEPEND5, ATTACH3 and ATTACH5 (please refer to Table 4 for the statements associated with each variable), with women voting a significantly higher score than men for all of these items. Hence, on average women felt a stronger emotional bond and had a stronger sense of dependence on the places on the GGS than men.

Interestingly, variables that were significantly different between respondents that have lived in Perth for longer than 20 years and respondents that have not were IDENT3, IDENT4 and IDENT5. These are all variables that reflect the cognitive component or sense of self. This suggests that the longer an individual has lived in Perth the more influence the GGS has on their meaning and purpose to life. See Appendix 3 for comparison of place-meaning statements of gender and length of time the respondents had been living in Perth.

Table 4 Item means and standard deviations

Factor	Item label	Item description	Mean	Stdev
Place identity (IDENTITY)	IDENT1	Important to the state's revenue	3.37	1.13
	IDENT2	Beneficial to the natural environment	4.13	0.86
	IDENT3	Is a Perth icon	4.07	0.87
	IDENT4	Historically important to Perth people	3.94	0.89
	IDENT5	An important part of my childhood memories	2.68	1.38
Place attachment (ATTACHMENT)	ATTACH1	One of the most beautiful parts of Perth	4.04	0.84

The affective or emotional component of attitude	ATTACH2	Aesthetically pleasing	3.85	0.85
	ATTACH3	A good place to get away from everyday stress	3.93	0.88
	ATTACH4	An inspirational place	3.51	1.02
	ATTACH5	A place that I feel a strong connection with	3.19	1.17
	ATTACH6	A place I care a lot about	3.76	0.97
Place dependence (DEPENDENCE)	DEPEND1	Provides employment	3.63	0.99
The conative component of attitude in which an individual's dependence to his or her surrounding is relative to his or her behaviour performed at that place	DEPEND2	Provides recreational experiences that are second to none	3.80	0.88
	DEPEND3	The best place for doing the things that I enjoy most	3.40	1.00
	DEPEND4	Vital for the lifestyle I enjoy	3.35	1.04
	DEPEND5	A good place for families to get together	4.03	0.85

Also in Appendix 3 are responses to statements of meaning to the 12 locations on the GGS compared. The bar charts showed distinctly low ratings of place identity, attachment and dependence for the Gngangara pine plantation and the Wanneroo horticultural farms compared to other locations. However, the Wanneroo horticultural farm was rated noticeably higher than the Gngangara pine plantation for IDENT1 *Important to the state's revenue* and DEPEND1 *Provides employment*. The average rating for IDENT1 for the Swan Valley was also quite high, averaging at 4 (agree). Over 55% of respondents had lived in Perth 30 years or less, while the average age of respondents was 48 years. This could explain the overall low ratings for IDENT5 *An important part of my childhood memories*, where all 12 locations were rated below 4 (agree) because the majority of the respondents may not have spent their childhood years in Perth.

Looking at the Wanneroo horticulture precinct specifically, a test of differences in the average response for place identity, attachment and dependence revealed that there were significantly higher ratings for place identity than place attachment and place dependence. In other words, for people who chose the Wanneroo horticulture precinct as one of the five places they had visited lately or felt strongly about, their level of feelings about specific physical settings – and the ways in which those settings provided meaning and purpose to life (place identity) – was stronger than their bond with the surrounding environment (place attachment) and the activity-based connection that reflects the importance of the place (place dependence).

4.2. Structural Equation Modelling

After listwise deletion of missing values and no-knowledge responses, a total of 294 cases remained. Statistical software (AMOS 16.0) was used to perform the SEM. The purpose of this analysis was to confirm whether the community attitude toward places on the GGS followed a tripartite or a unidimensional model, instead of making predictions related to intended behaviour. A tripartite (three-factor) model and a unidimensional (one-factor) model were compared. The tripartite model represents place identity, attachment and dependence latent variables (or constructs) as three distinct, correlated constructs. The unidimensional model assumes that place identity, attachment and dependence latent variables (or

constructs) are perfectly correlated and indistinguishable from one another and thus can be collapsed into one latent variable called 'sense of place'. Appendix 4 illustrates the conceptual relationship design between the observed and the latent variables for the tripartite and unidimensional models.

Results from the analysis confirm the significance of the tripartite model and lack significance thereof for the unidimensional model. Goodness-of-fit statistics¹ for the tripartite model are presented in Table 5. Statistical significance of the tripartite model supports the theory that place identity, attachment and dependence are unique constructs that cannot be reduced or collapsed into a single factor. In other words, respondents divided the three different components of their attitudes towards the places on the GGS into emotional, cognitive (sense of self) and conative (behavioural) components. This confirms that respondents had an emotional bond (intrinsic value) to the places on the GGS.

Table 5 Tripartite model goodness-of-fit statistics

Fit statistics	Obtained value	Recommended value
Satorra-Bentler Chi-squared (df)	13.8 (11), p-value=0.244	p-value>0.05
CFI	0.997	≥ 0.9
GFI	0.987	≥ 0.9
RMSEA	0.029	≤ 0.05

Variables that were significant in the tripartite model include:

IDENTITY

- IDENT3 Is a Perth icon
- IDENT4 Historically important to Perth people

ATTACHMENT

- ATTACH2 Aesthetically pleasing
- ATTACH4 An inspirational place
- ATTACH5 A place that I feel a strong connection with

DEPENDENCE

- DEPEND2 Provides recreational experiences that are second to none
- DEPEND5 A good place for families to get together

Other observed variables that were considered unreliable (analysed using Cronbach's Alpha reliability statistics) or did not contribute significantly (statistically) to improving the model's predictive power were removed from the analysis. Regression weights for the tripartite model are presented in Table 6. All observed variables were significant at the 1% level.

¹ **Model fit indices:** **Chi-square** is a test of differences in frequencies that can be used to estimate the statistical significance (validity) of conclusions about the differences between groups. It also can be used as a measure of the goodness of fit (the extent to which a derived modelling solution can reproduce the original data). As a measure of goodness of fit, a non-significant or smaller chi-square indicates a good fit, while a large value indicates a poor fit. **CFI** (comparative fit index), **GFI** (goodness of fit index) and **RMSEA** (Root Mean Square of the Errors of Approximation) are further statistics associated with goodness of fit. Goodness of fit indices measure the extent to which the derived model approximates the original data. A good fit is one that explains the data well. These indices need to be within a certain limit to indicate a good fit. More detailed information can be found in structural equation modelling references such as Diamantopoulos and Siguaw (2000).

Table 6 Regression weights, standardised regression weights and correlations

Item label			Standardized estimate	Estimate	S.E.
IDENT3	←	IDENTITY	0.862	1.036***	0.079
IDENT4	←	IDENTITY	0.817	1.000	
ATTACH2	←	ATTACHMENT	0.846	1.006***	0.093
ATTACH4	←	ATTACHMENT	0.834	1.187***	0.110
ATTACH5	←	ATTACHMENT	0.614	1.000	
DEPEND2	←	DEPENDENCE	0.789	1.053***	0.077
DEPEND5	←	DEPENDENCE	0.771	1.000	
ATTACHMENT	←	IDENTITY	0.640		
ATTACHMENT	←	DEPENDENCE	0.920		
DEPENDENCE	←	IDENTITY	0.800		

n=294

*** Significant at the 1% level

Figure 8 depicts the path diagram of the tripartite model. It shows the observed variables that had a significant relationship with the three sense of place constructs. In the path diagram, circles represent the sense-of-place constructs (latent variables) and rectangles represent the items (observed variables). The numbers on each arrow are estimates of the standardised regression weights and represent the strength and direction of the relationship between the observed variables (rectangles) and the latent variables (circles). The standardised regression weights vary from -1 to +1, where -1 indicates a strong *negative* relationship between the latent variable and the observed variable, and 1 indicates a strong *positive* relationship between the latent variable and the observed variables. The interpretation can be expressed as follows: DEPEND2 is one of the two significant attitudinal statements intended to measure 'place dependence' and it has a strong (0.80) positive relationship with 'place dependence'.

Figure 8 Path diagram of the sense-of-place tripartite model

The relationships between the latent variables are represented by the estimates of the correlation. The correlation between the three latent constructs is relatively strong, with all three correlations > 0.8. This means that the respondents' attitudes towards place identity, place dependence and place attachment are interlinked and influence one another quite significantly.

5. CONCLUSION AND RECOMMENDATIONS

The objective of this report is to present findings from the Sense of Place study on Perth community attitudes toward places of significance on the GGS. The places of significance on

the GGS were Whiteman Park (including Bennet Brook), Yanchep National Park (including the caves), Swan Valley, Lake Gngangara, Wanneroo horticultural farms, Herdsman Lake, Perry Lakes, Ellenbrook catchment, Lake Monger, Yellagonga Regional Park (including Lake Joondalup), Gngangara Pine Plantation and Jandabup Lake.

Findings from this study complement the cost-benefit findings produced by the DST, which will help improve the understanding of community preferences for land, water and the environment on the GGS. As the Sense of Place study is an attitudinal survey, the findings should not be interpreted in an economic framework. Alternatively, the findings should be used to justify the importance of conducting economic valuation of environmental assets on the GGS. Recommendations have been made in this section on which land and water attributes should be further analysed within an economic framework so the information can be used in future cost-benefit analyses.

Overall Community Knowledge of the GGS Issues

A test of background knowledge on groundwater and sources of drinking water supplies indicated that the majority of respondents were aware of our main source of supply and its condition. However, around 20% of respondents still believed that surface water from the Perth hills was the largest source of scheme water. This demonstrates the need for a public education program to correct existing misunderstandings. Therefore, it is recommended that there should be more public information programs that provide information about the GGS in terms the public can easily understand.

Overall Community Knowledge of the GGS Issues

Apart from the findings reported in Section 4.1.3, results from the community ranking of recent visitation and strong feelings about the GGS indicated that respondents found urban wetlands such as Lake Monger and Herdsman Lake more important than peri-urban wetlands such as Lake Gngangara and Jandabup Lake. This may be a result of the accessibility nature and recreational services of urban wetlands that are reflected in the value of surrounding property prices (Tapsuwan *et al.* 2008). Respondents also gave very low levels of importance to the Wanneroo horticultural farms relative to other places on the GGS.

Activities of Importance In and Around the Pines

Approximately 50% of respondents stated that they undertook activities in and around the pines. The most popular activity was enjoying the view as they drove by, indicating passive recreation. Only 8% of respondents stated that they performed motor-recreation activities in the pines. Two main observations can be made from these findings. Firstly, only a small proportion of respondents performed motor recreation in the Gngangara pine plantation, and secondly, if the pines with road frontage were exempted from being harvested people would still be able to enjoy the view of the pines and there would be no social welfare loss associated with this activity.

Issues of Importance to Perth Residents

When respondents were presented with 13 statements relating to food security, water security, housing security, job security and environmental conservation, and were asked to choose the five that were most important, statements related to groundwater conservation received the most attention. This outcome was expected because the survey was about the issues surrounding the groundwater. The other issue that received significant attention was the desire to consume what they personally perceived as locally grown fruit and vegetables. If the Wanneroo horticultural precinct were to be rezoned to urban, then consideration should be given to establishing a new precinct local to Perth to replace Wanneroo.

Since the ranking of these statements does not reflect the size and direction of the tradeoffs inherent in the choices, it is advised that a separate study be conducted in the future to capture these tradeoffs through the use of non-market valuation techniques such as choice modelling. Choice modelling is an economic survey technique used to elicit people's willingness to pay for an environmental improvement or to prevent undesirable changes. The decision about whether to preserve the Wanneroo horticulture precinct would be facilitated by a study of community willingness to pay to keep the precinct there. It is worth noting that people's tendency to 'free ride' may bias the response of the rankings. Basically, people gave a low ranking to a particular issue because they felt that the issue has already been 'taken care of' by the government.

Place Meanings

Results from the Sense of Place analysis confirmed the significance of the tripartite model. This supports the theory that place identity, attachment and dependence are unique constructs that cannot be reduced or collapsed into a single factor. In other words, people distinguish between the three different components of their attitudes towards places on the GGS by an emotional component; a cognitive, or sense-of-self, component; and a conative, or behavioural, component. Women displayed stronger levels of place dependence and attachment than men. Respondents that had lived in Perth for more than 20 years displayed stronger place identity, with regard to GGS influences on meaning and purpose to life, than those that had not lived in Perth for that length of time.

Worth highlighting is the discovery that people connected with places on the GGS on the basis of behavioural (use value) and emotional bonds (non-use value), with some groups displaying stronger bonds than others. This suggests that intrinsic values associated with places on the Gngangara are worthy of consideration. Various localities were considered inspirational places, historically important and iconic to Perth, and aesthetically pleasing. Further, many people felt a strong emotional connection with these places. In terms of use value, respondents felt that places on the GGS provide recreational experiences that are second to none and are good places for families to get together.

Future Directions

This study has established the preliminary measures of the localities the community regarded as important, and has identified the types of values and attitudes people have for places of importance on the GGS. Sustainable land- and water-use policy decisions for the GGS should not be made solely on ecological or economic grounds, as there will be inevitable societal consequences. In order to prevent social backlashes, it is important to have better understanding of community preferences towards places of significance on the GGS, irrespective of the ecological or economic significance, as there may be important social preferences for such places. Adverse social impact of land- and water-use decisions may end up outweighing the benefits gained from enhancing ecological or economic gains.

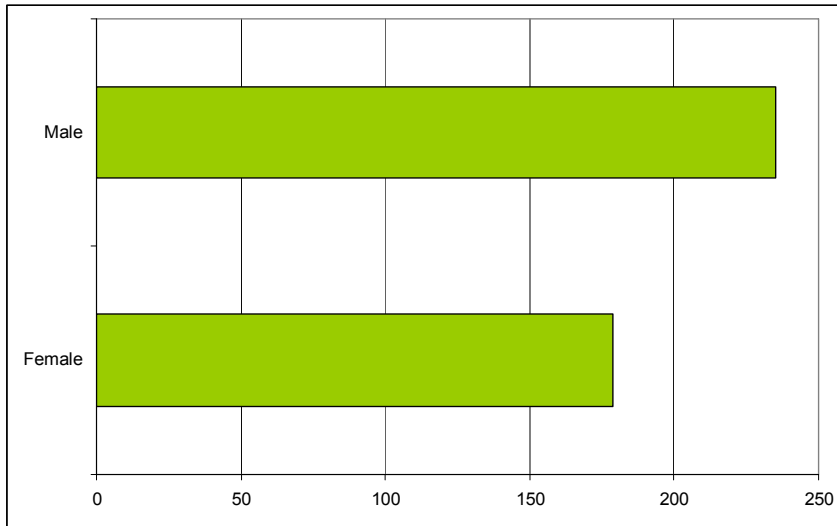
In situations where evaluating the economic value of preserving a particular land use is not appropriate, a sense-of-place survey can be used to predict intended behaviour to protect a particular location. The intended behaviour will be obtained through a yes/no survey format and would be estimated (or regressed) against the three sense-of-place constructs (identity, attachment and dependence) derived from observed values obtained from attitudinal Likert scale-type survey.

Finally, it is recommended that a more detailed study of the tradeoffs that people are willing to make between different land and water uses should be considered for future studies. In particular, focus should be given to the policy impacts of land- and water-use changes in the future with regard to whether such changes will deprive the community of both use and non-use enjoyment of these places. Community groups that are directly affected by the changes

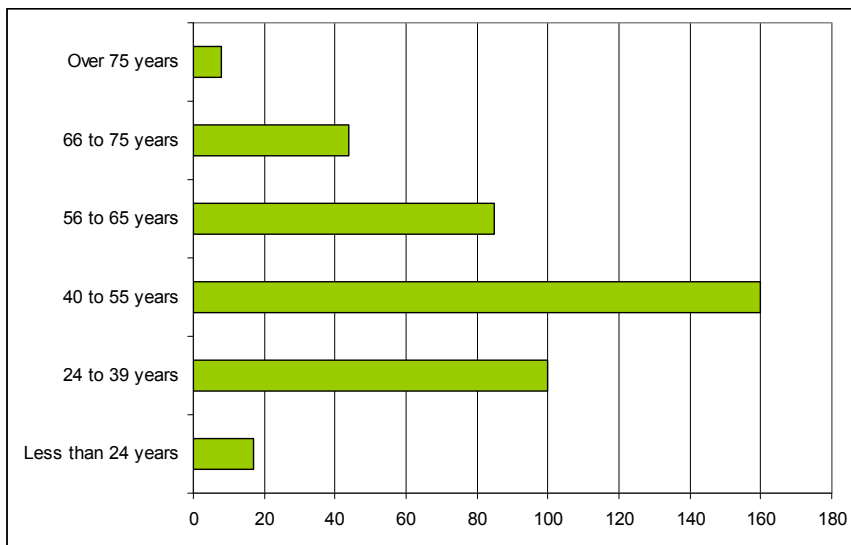
may be willing to pay to prevent such changes or willing to accept some form of compensation to forego future use.

APPENDIX 1 DEMOGRAPHICS

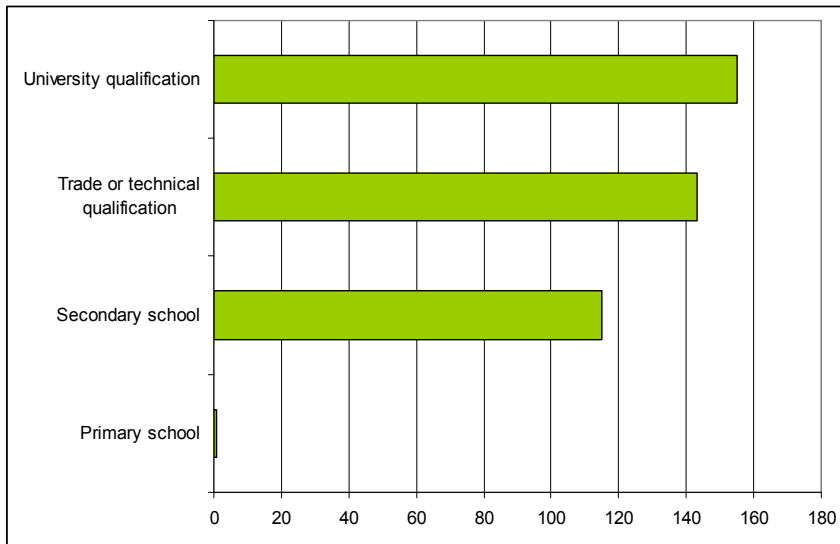
Gender	Coding	Freq.	Percent	Cum.
Female	0	179	43.24	43.24
Male	1	235	56.76	100
Total		414	100	



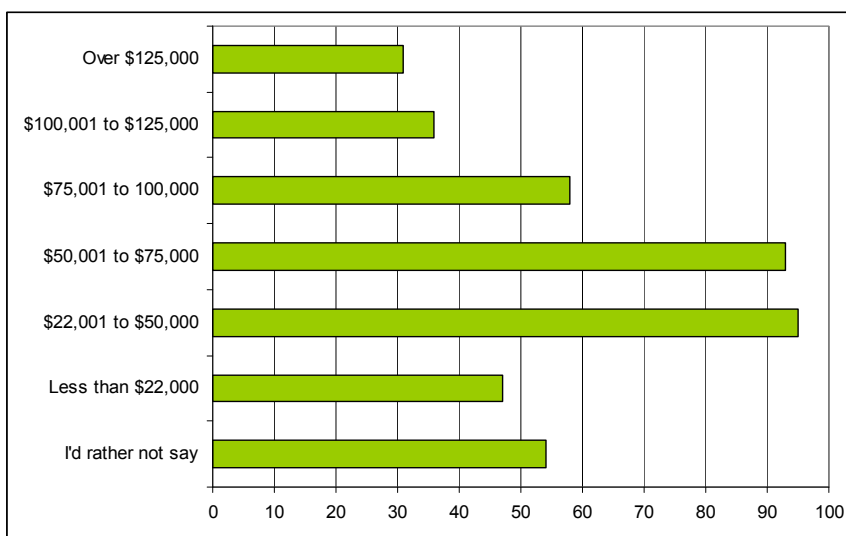
Age	Coding	Freq.	Percent	Cum.
Less than 24 years	1	17	4.11	4.11
24 to 39 years	2	100	24.15	28.26
40 to 55 years	3	160	38.65	66.91
56 to 65 years	4	85	20.53	87.44
66 to 75 years	5	44	10.63	98.07
Over 75 years	6	8	1.93	100
Total		414	100	



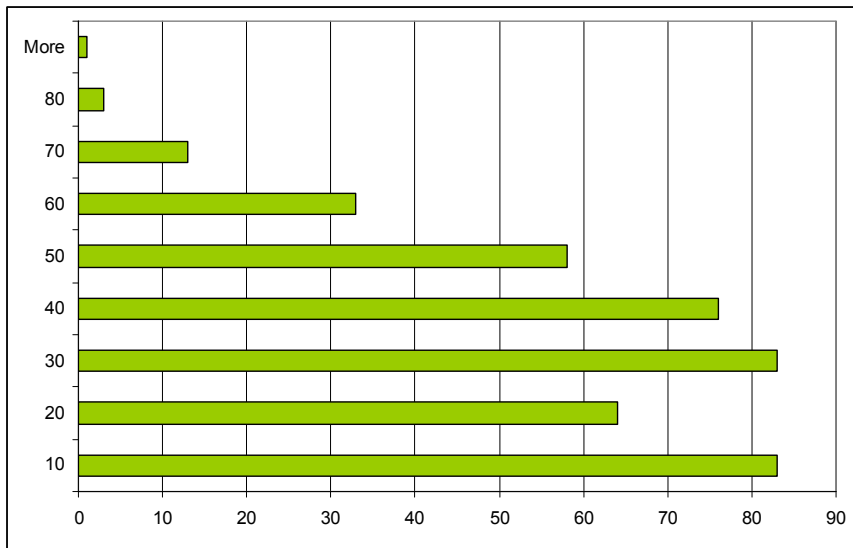
Education	Coding	Freq.	Percent	Cum.
Primary school	1	1	0.24	0.24
Secondary school	2	115	27.78	28.02
Trade or technical qualification	3	143	34.54	62.56
University qualification	4	155	37.44	100
	Total	414	100	



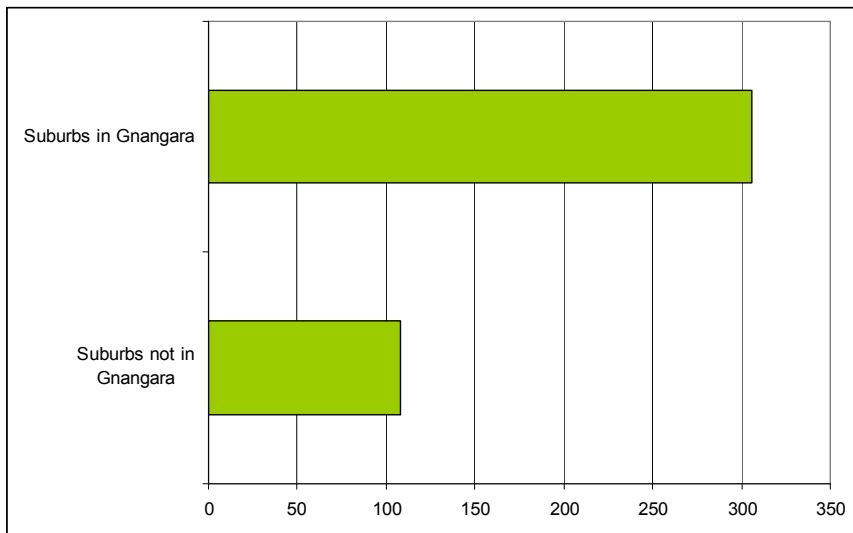
Income	Coding	Freq.	Percent	Cum.
I'd rather not say	0	54	13.04	13.04
Less than \$22,000	1	47	11.35	24.4
\$22,001 to \$50,000	2	95	22.95	47.34
\$50,001 to \$75,000	3	93	22.46	69.81
\$75,001 to 100,000	4	58	14.01	83.82
\$100,001 to \$125,000	5	36	8.7	92.51
Over \$125,000	6	31	7.49	100
	Total	414	100	



Years in Perth	Coding	Freq.	Percent	Cum.
≤10		83	20.05	20.05
11-20		64	15.46	35.51
21-30		83	20.05	55.56
31-40		76	18.36	73.91
41-50		58	14.01	87.92
51-60		33	7.97	95.89
61-70		13	3.14	99.03
71-80		3	0.72	99.76
>80		1	0.24	100.00
Total		414	100	

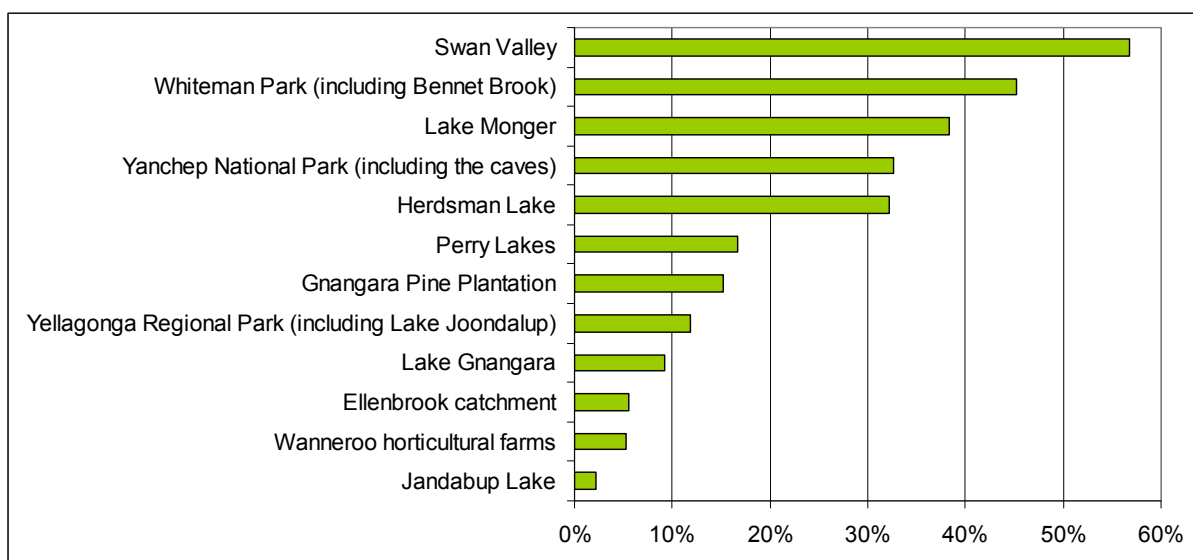


Income	Coding	Freq.	Percent	Cum.
Suburbs not in Gnangara	0	108	26.09	26.09
Suburbs in Gnangara	1	306	73.91	100
Total		414	100	



APPENDIX 2 PLACES OF IMPORTANCE

Rank	Locations that have been visited or respondents felt strongly about	No of times selected	%
1	Swan Valley	235	57%
2	Whiteman Park (including Bennet Brook)	187	45%
3	Lake Monger	159	38%
4	Yanchep National Park (including the caves)	135	33%
5	Herdsmen Lake	133	32%
6	Perry Lakes	69	17%
7	Gnangara Pine Plantation	63	15%
8	Yellagonga Regional Park (including Lake Joondalup)	49	12%
9	Lake Gnangara	38	9%
10	Ellenbrook catchment	23	6%
11	Wanneroo horticultural farms	22	5%
12	Jandabup Lake	9	2%

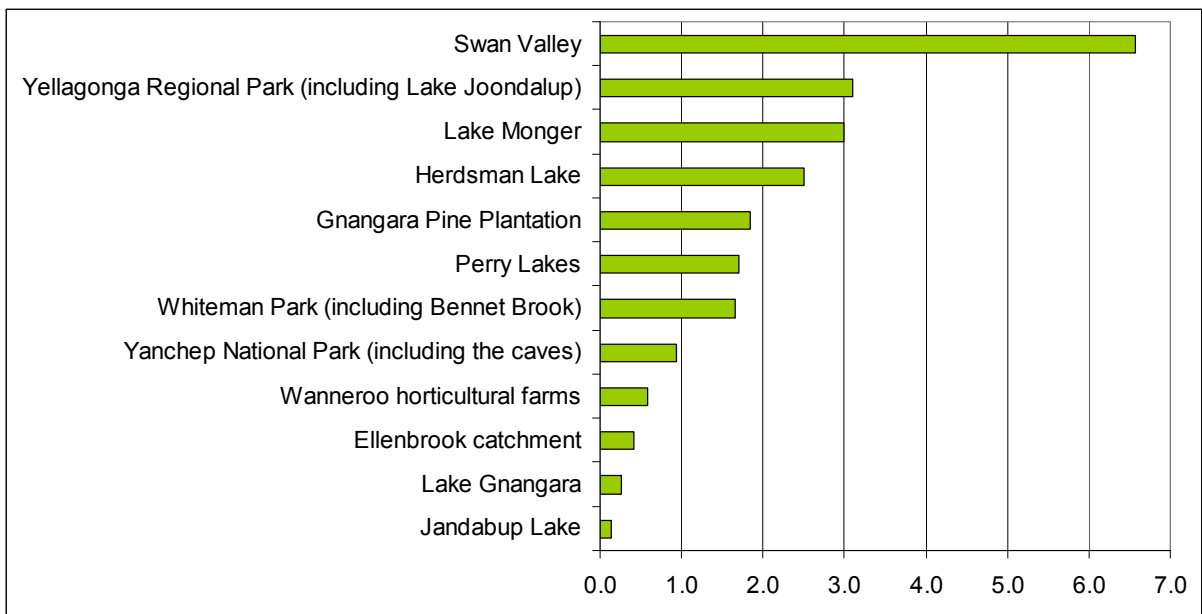


Correlation coefficient and correlation significance between ranking and visitation frequency

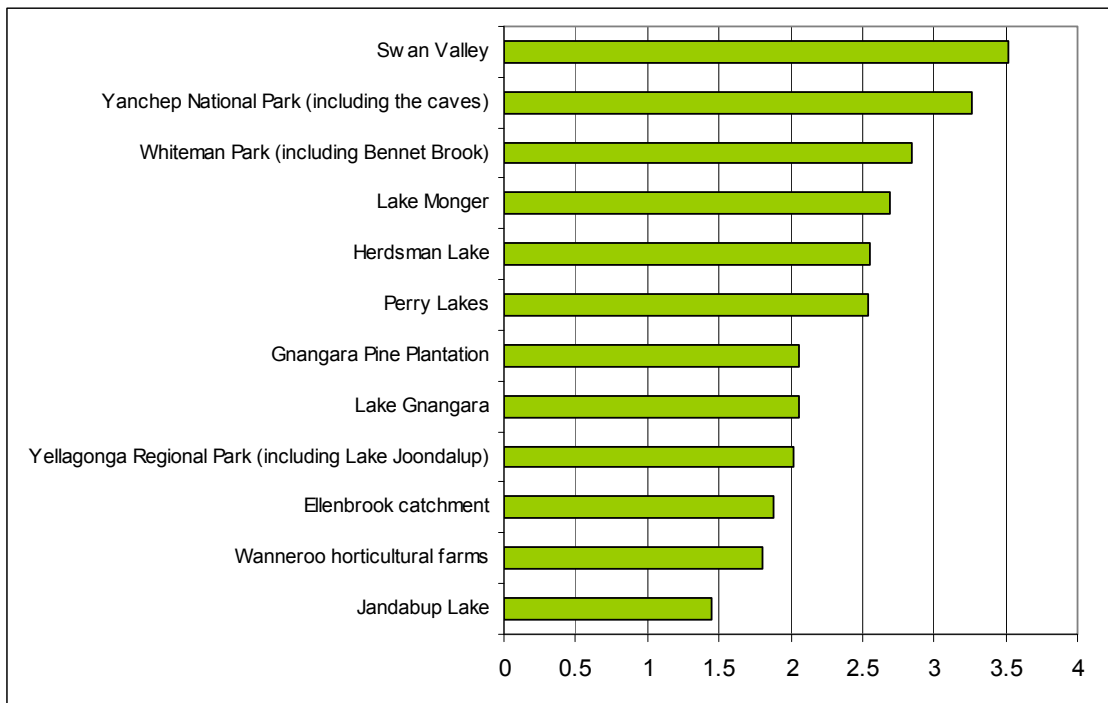
Locations	Corr Coeff	Sig
Swan Valley	-0.0658	0.1816
Whiteman Park (including Bennet Brook)	-0.2727	0.0000
Lake Monger	-0.1958	0.0001
Yanchep National Park (including the caves)	-0.0653	0.1848
Herdsmen Lake	-0.1889	0.0001
Perry Lakes	-0.2241	0.0000
Gnangara Pine Plantation	-0.0076	0.8779
Yellagonga Regional Park (including Lake Joondalup)	-0.1443	0.0033
Lake Gnangara	-0.0512	0.2991
Ellenbrook catchment	-0.1467	0.0028
Wanneroo horticultural farms	-0.1027	0.0370
Jandabup Lake	-0.2644	0.0000

Note: **Corr Coeff** is the correlation coefficient between respondent's visitation frequency and the importance ranking of that location. **Sig** is the significance level of the correlation coefficient. Using a two-tailed test, the correlation coefficient is significantly different from zero (indicating significant relationship) if Sig < 0.025.

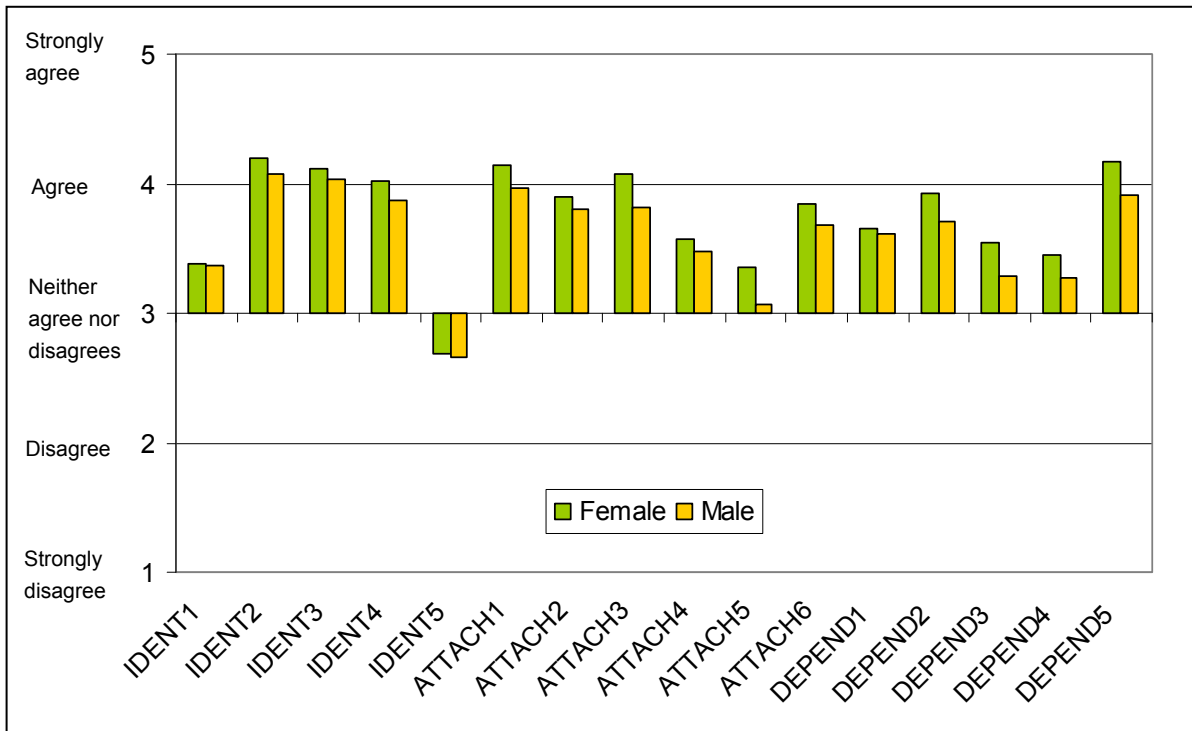
Locations visited in the past two years	Average no of visits
Swan Valley	6.6
Yellagonga Regional Park (including Lake Joondalup)	3.1
Lake Monger	3.0
Herdsman Lake	2.5
Gnangara Pine Plantation	1.8
Perry Lakes	1.7
Whiteman Park (including Bennet Brook)	1.7
Yanchep National Park (including the caves)	0.9
Wanneroo horticultural farms	0.6
Ellenbrook catchment	0.4
Lake Gnangara	0.3
Jandabup Lake	0.1



Average scoring of places that would be difficult to replace <i>(High score indicates most difficult to replace)</i>	Mean
Swan Valley	3.51
Yanchep National Park (including the caves)	3.27
Whiteman Park (including Bennet Brook)	2.85
Lake Monger	2.70
Herdsmen Lake	2.55
Perry Lakes	2.54
Gnangara Pine Plantation	2.06
Lake Gnangara	2.05
Yellagonga Regional Park (including Lake Joondalup)	2.02
Ellenbrook catchment	1.88
Wanneroo horticultural farms	1.80
Jandabup Lake	1.45



APPENDIX 3 PLACE MEANING

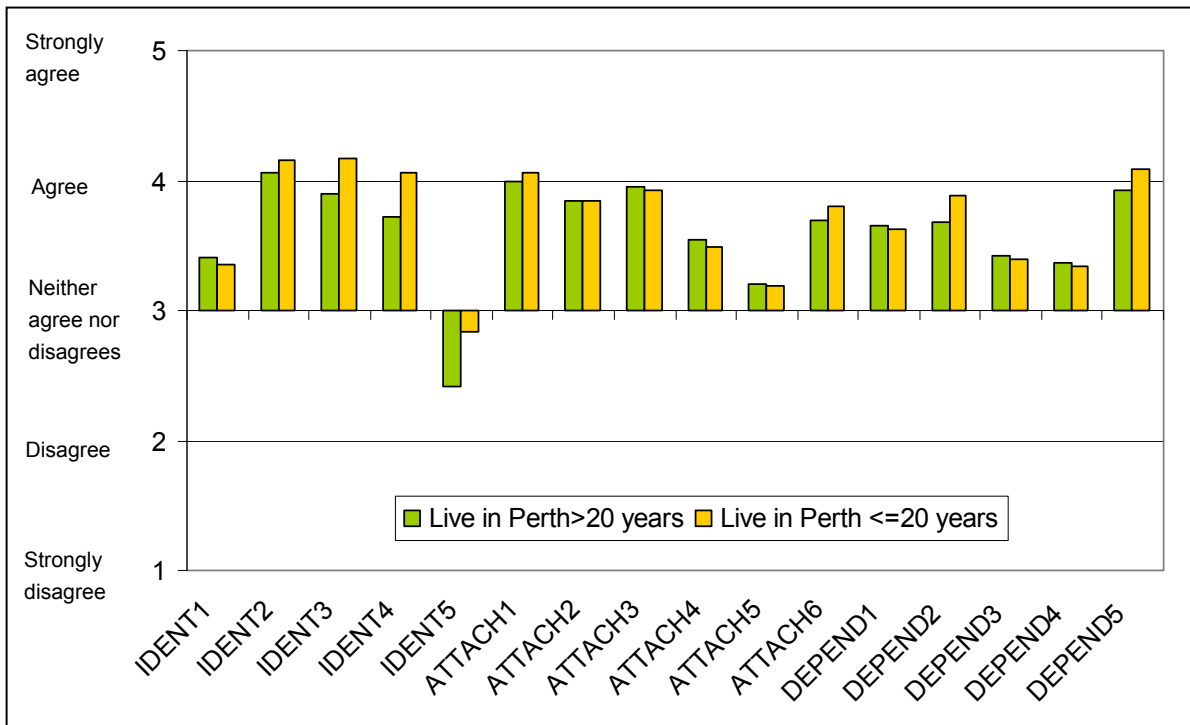


Variable description

IDENT1 Important to the state's revenue; **IDENT2** Beneficial to the natural environment; **IDENT3** Is a Perth icon; **IDENT4** Historically important to Perth people; **IDENT5** An important part of my childhood memories

DEPEND1 Provides employment; **DEPEND2** Provides recreational experiences that are second to none; **DEPEND3** The best place for doing the things that I enjoy most; **DEPEND4** Vital for the lifestyle I enjoy; **DEPEND5** A good place for families to get together

ATTACH1 One of the most beautiful parts of Perth; **ATTACH2** Aesthetically pleasing; **ATTACH3** A good place to get away from everyday stress; **ATTACH4** An inspirational place; **ATTACH5** A place that I feel a strong connection with; **ATTACH6** A place I care a lot about

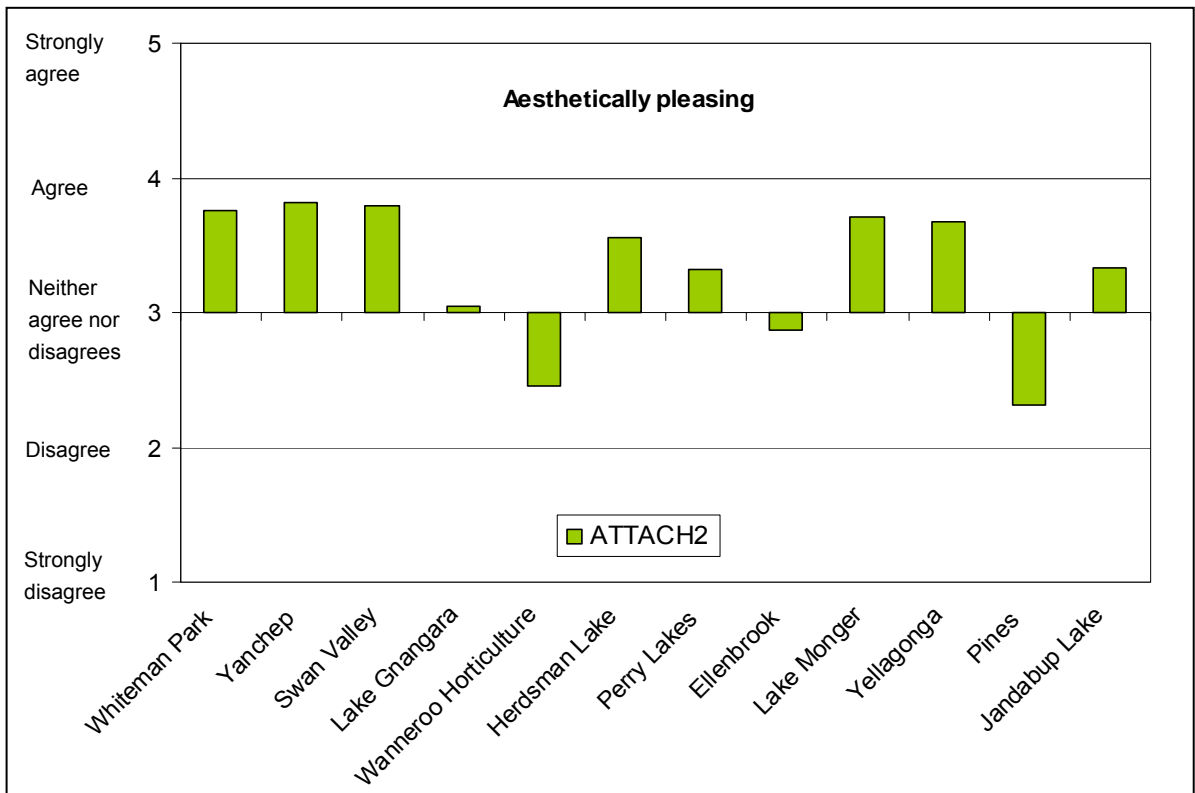
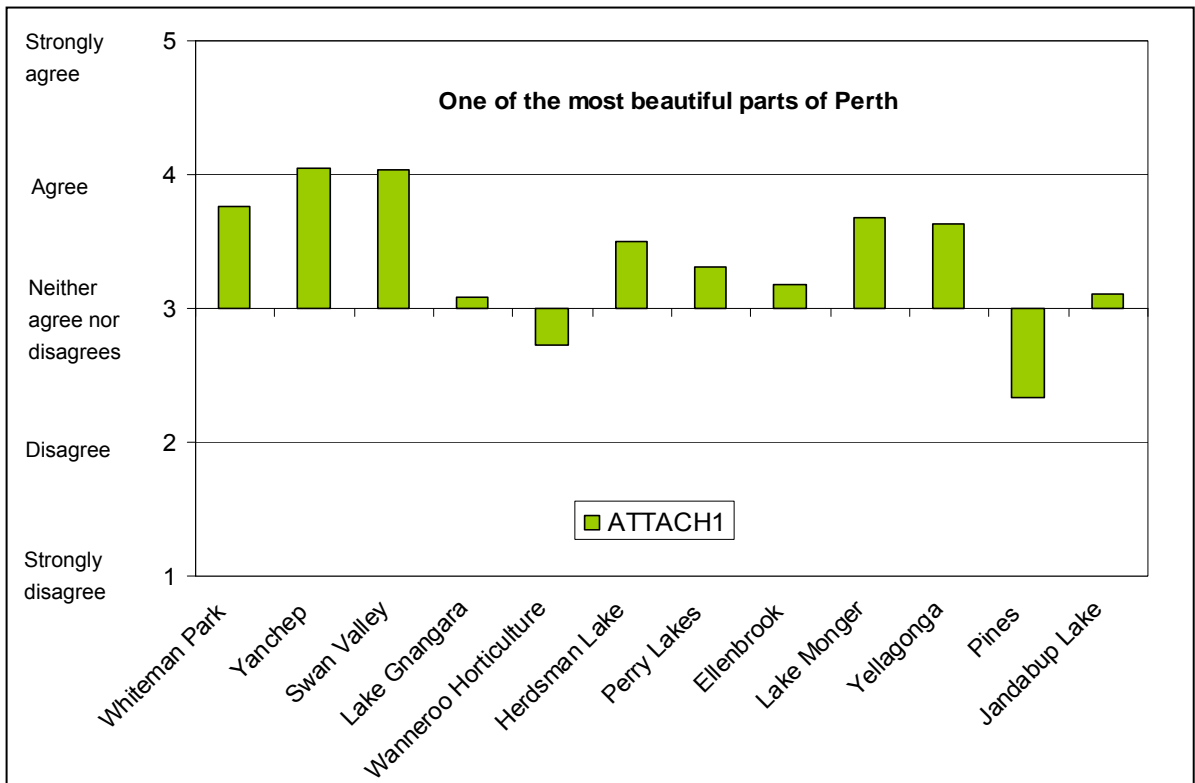


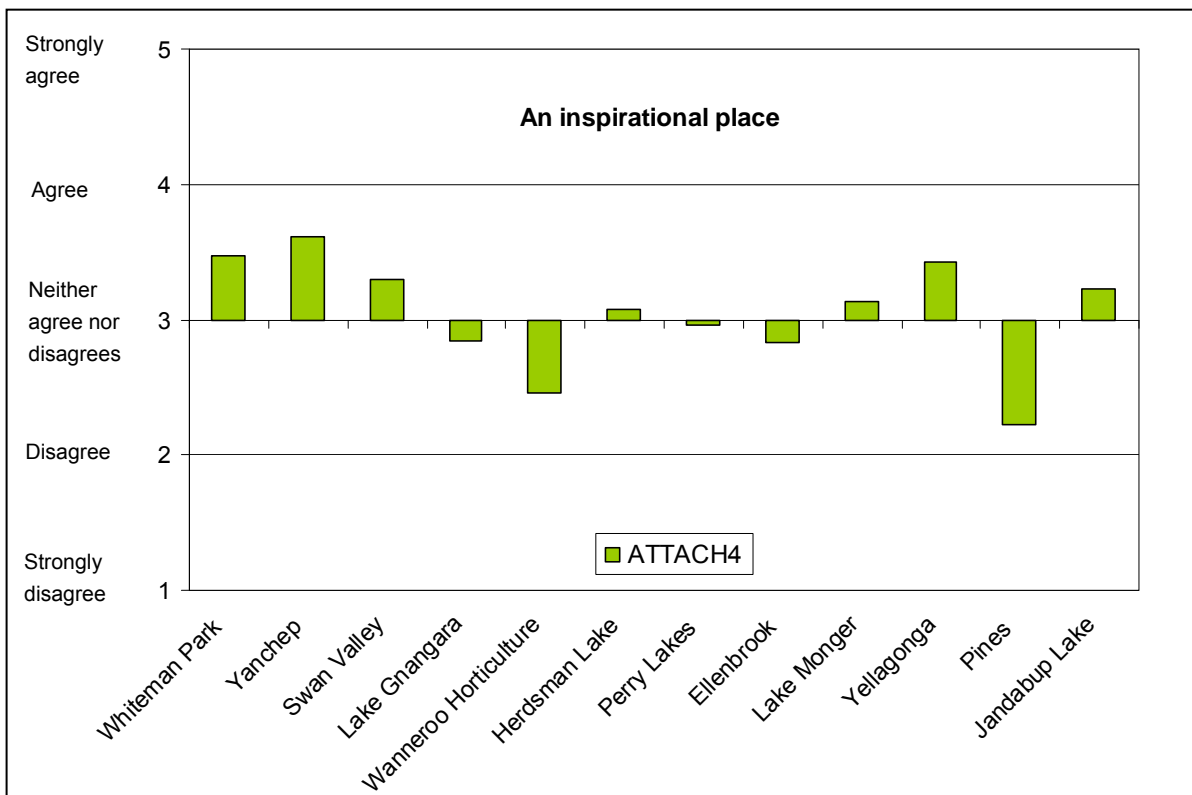
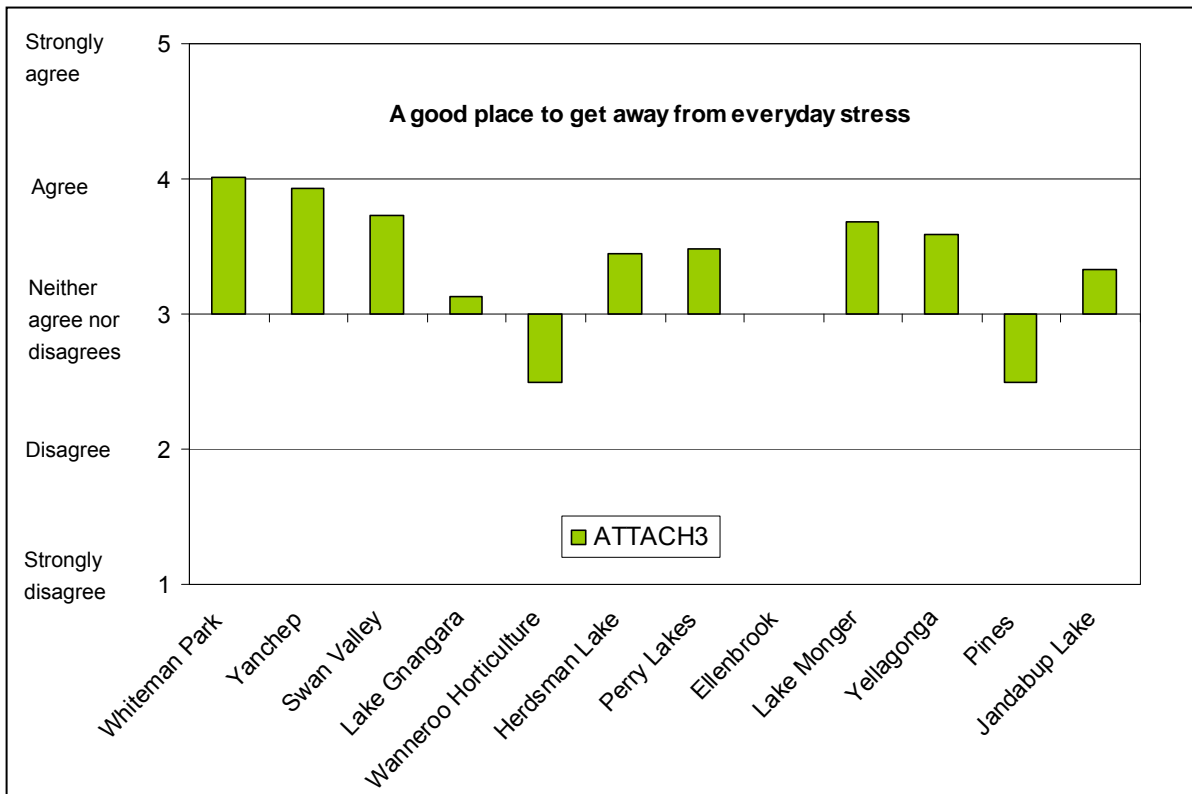
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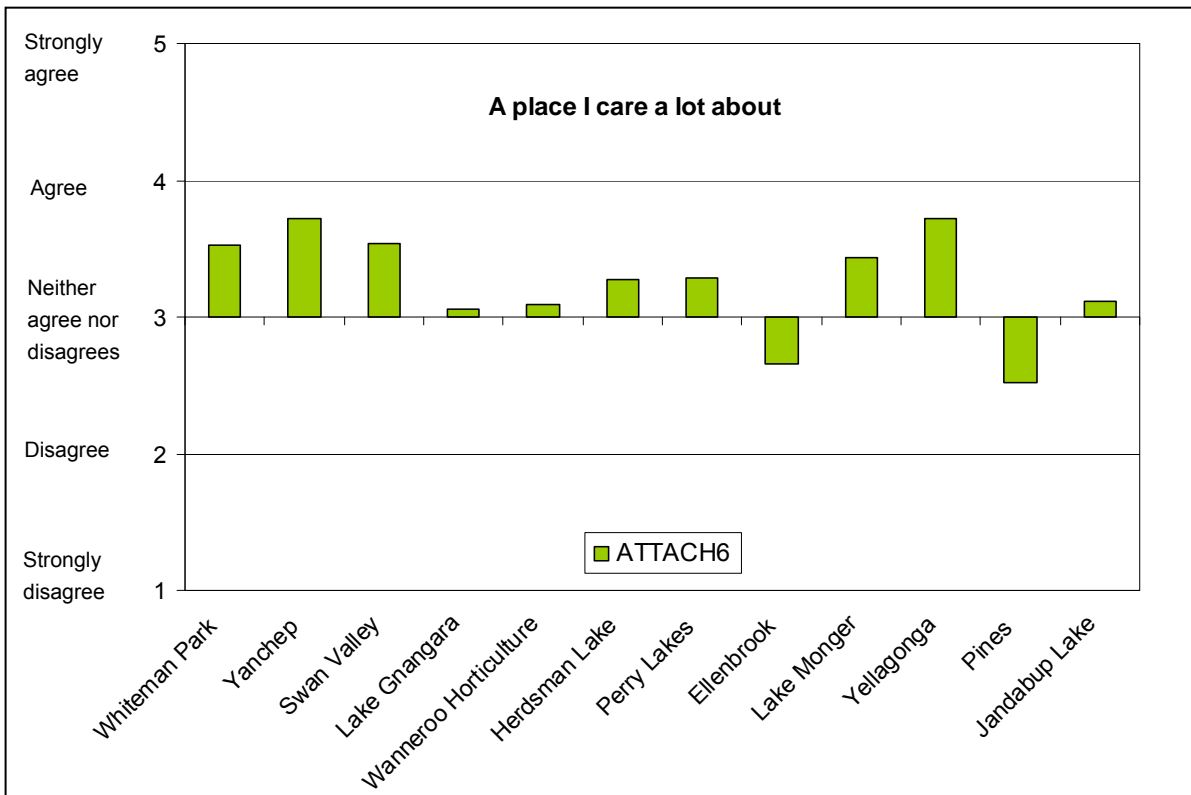
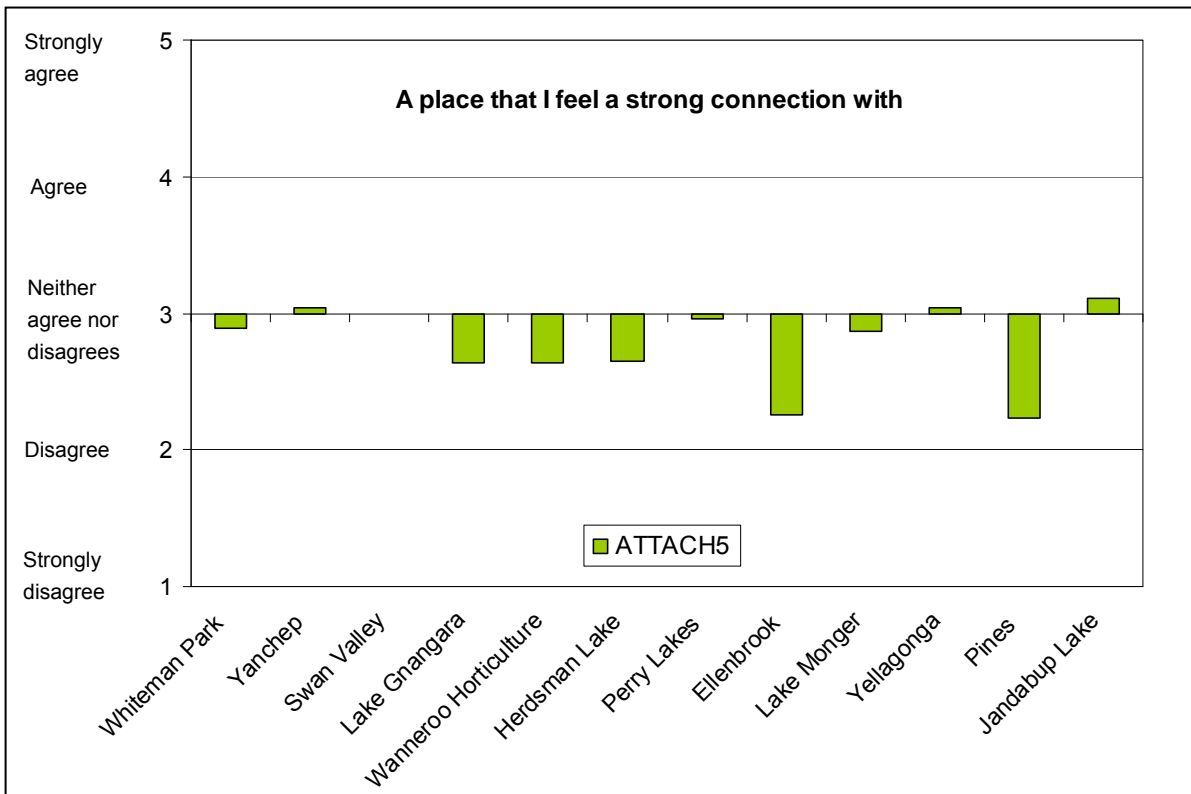
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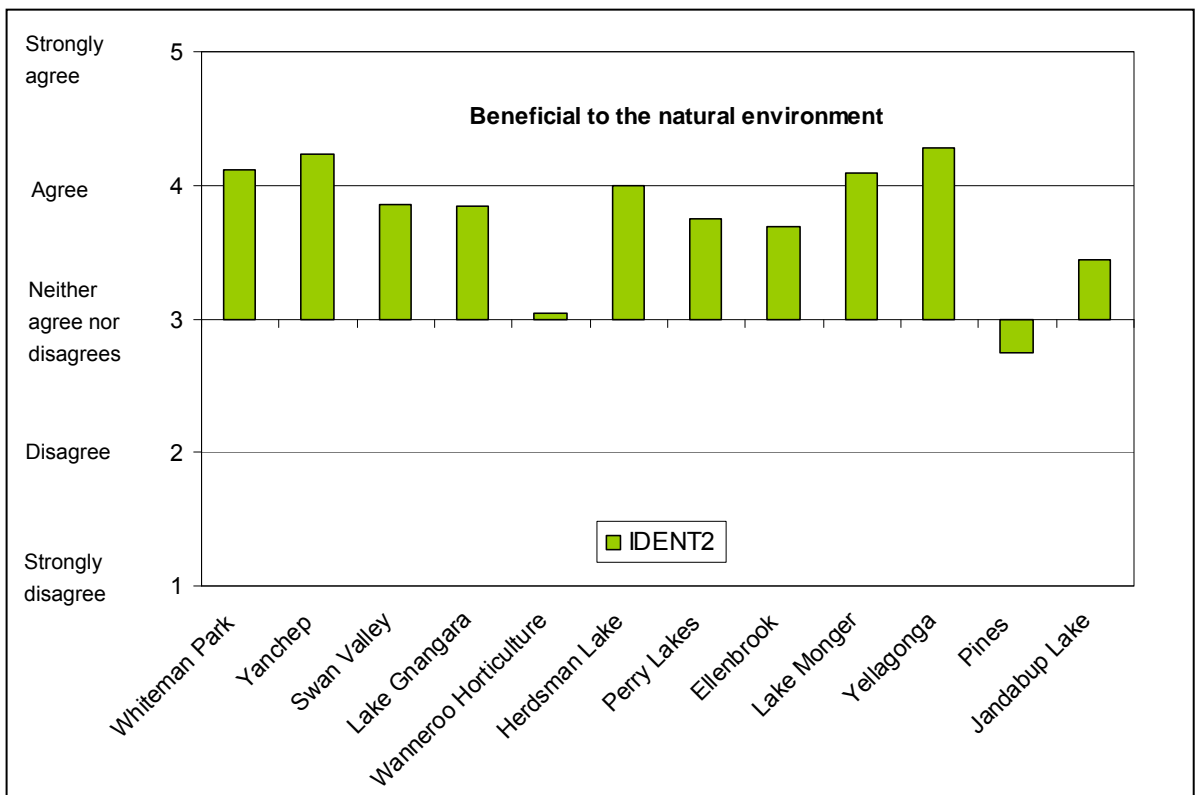
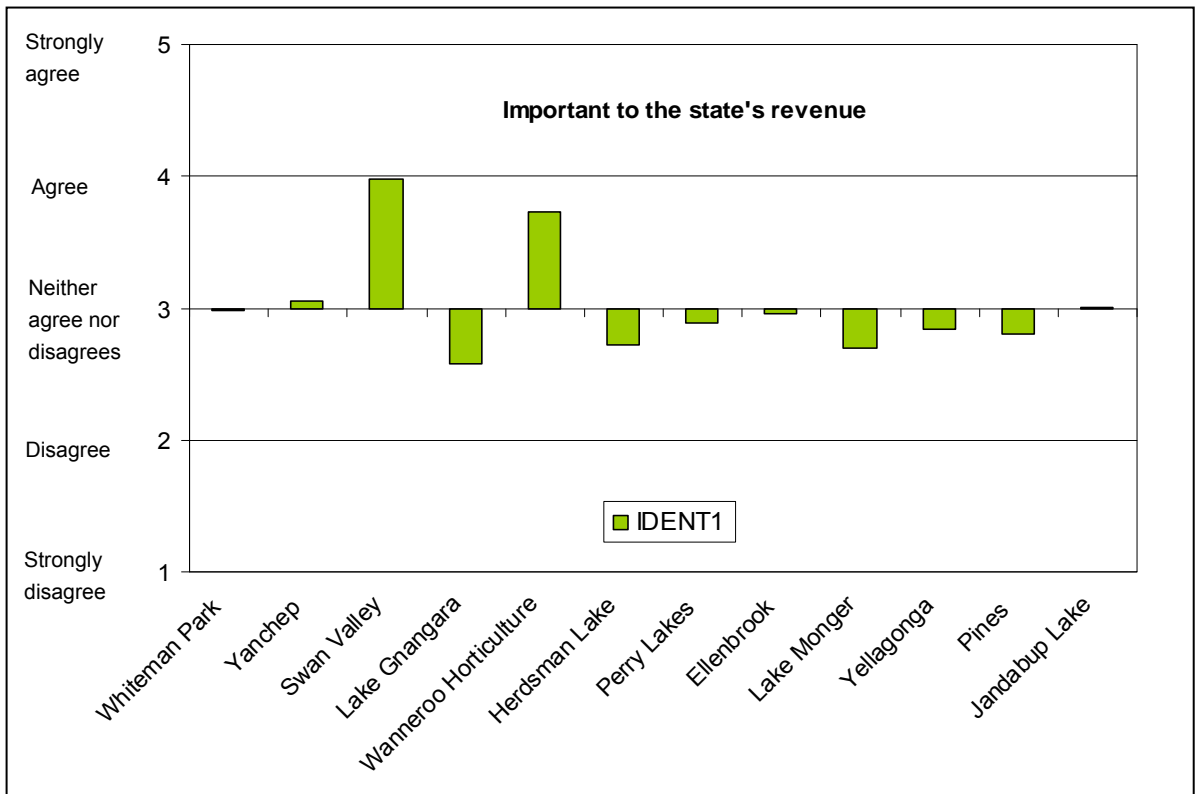
DEPEND1 Provides employment; **DEPEND2** Provides recreational experiences that are second to none; **DEPEND3** The best place for doing the things that I enjoy most; **DEPEND4** Vital for the lifestyle I enjoy; **DEPEND5** A good place for families to get together

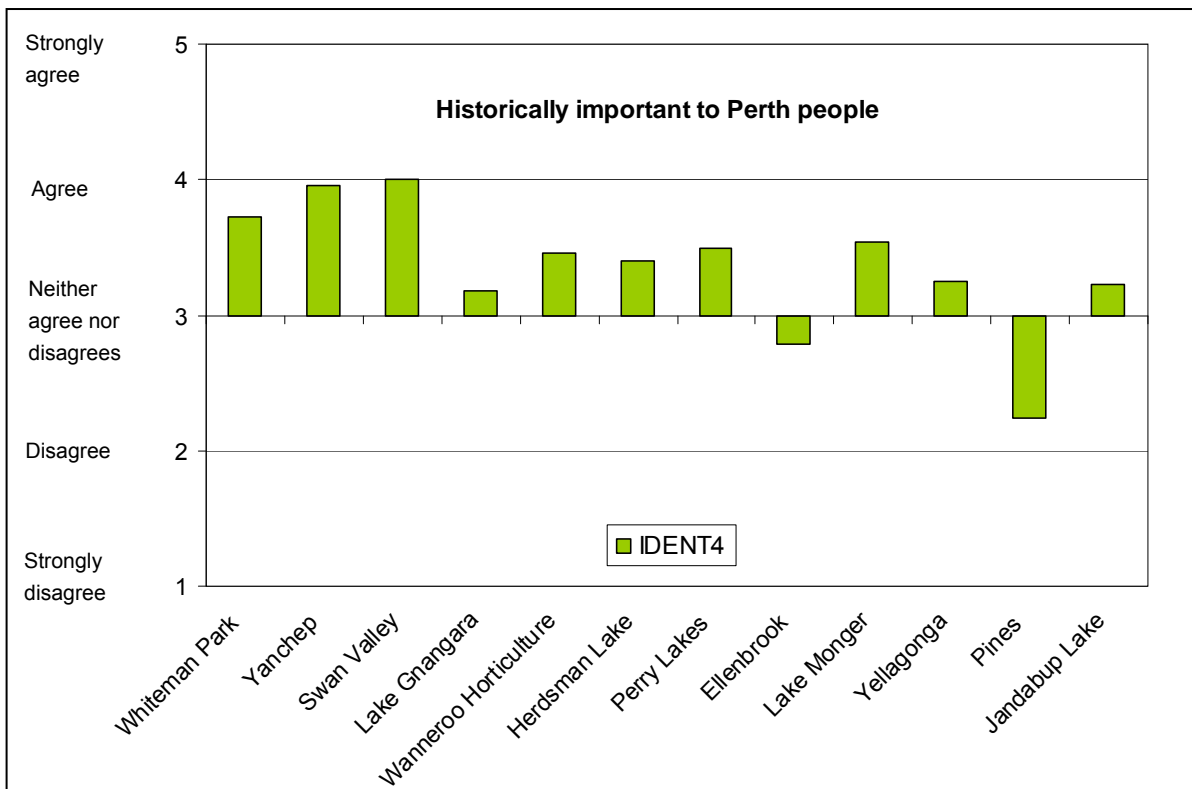
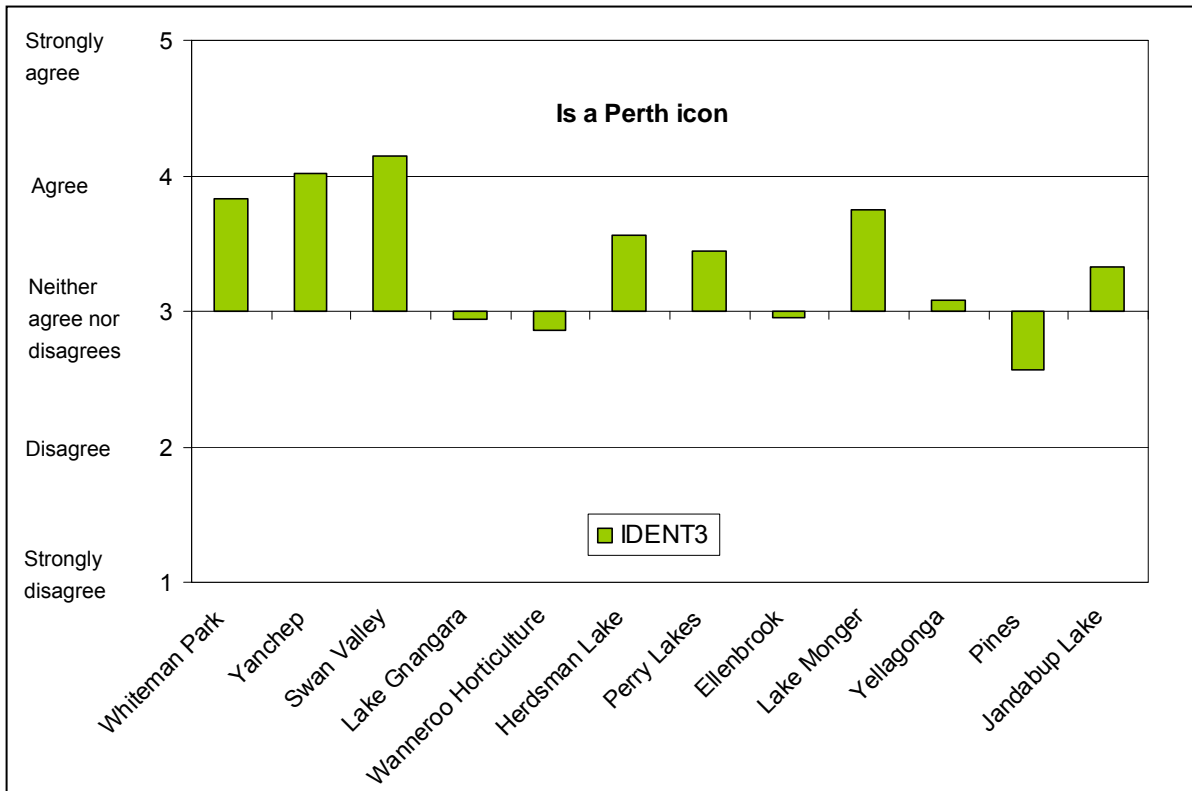
ATTACH1 One of the most beautiful parts of Perth; **ATTACH2** Aesthetically pleasing; **ATTACH3** A good place to get away from everyday stress; **ATTACH4** An inspirational place; **ATTACH5** A place that I feel a strong connection with; **ATTACH6** A place I care a lot about

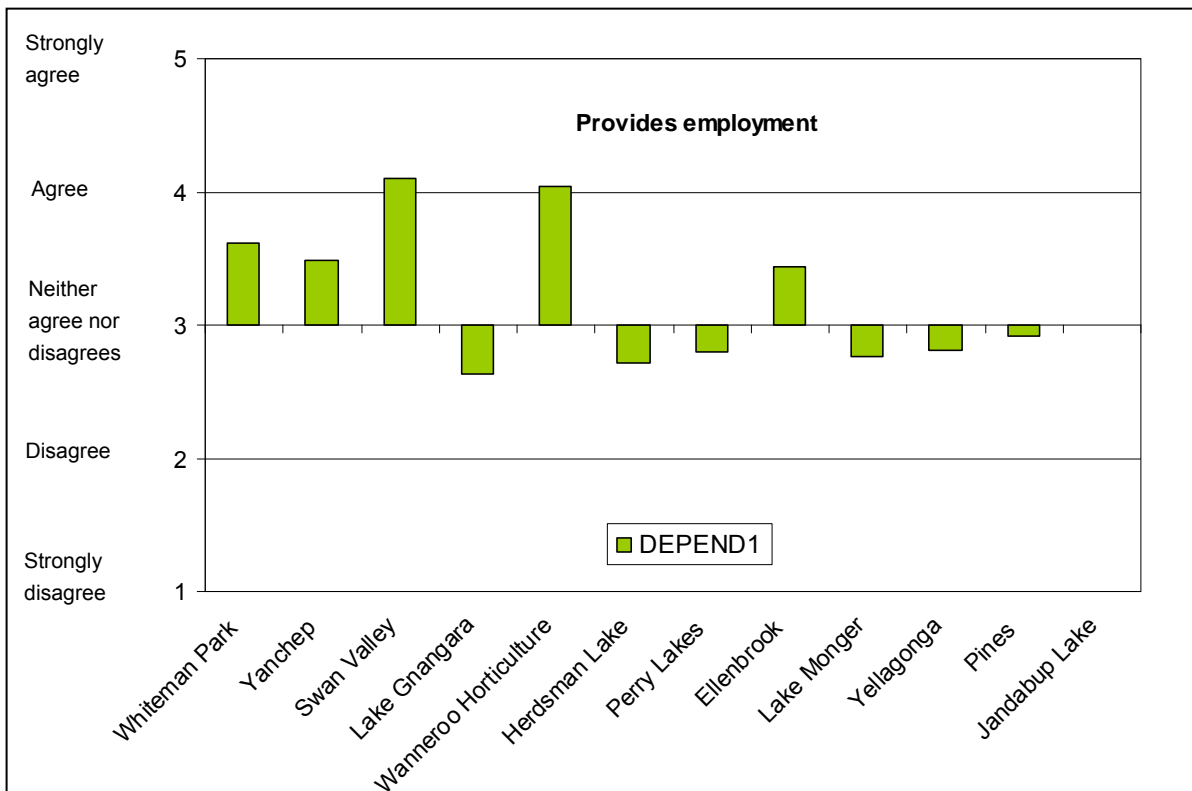
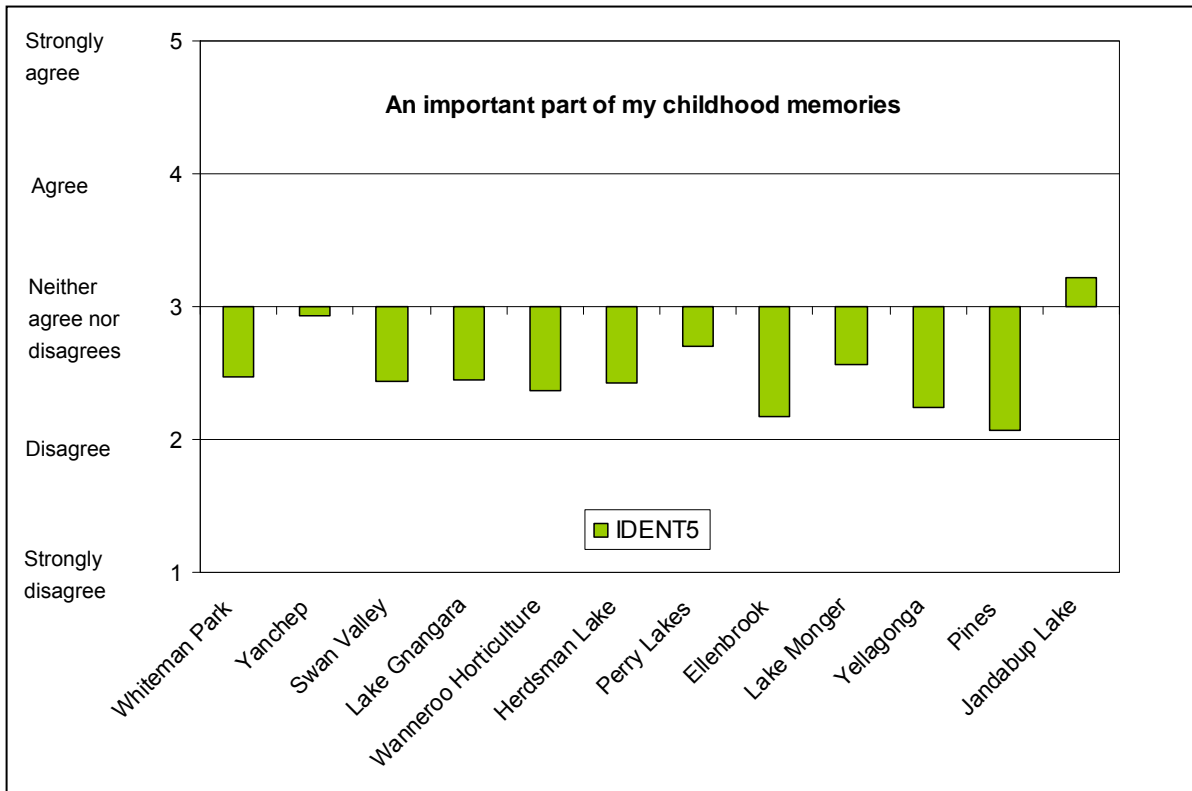


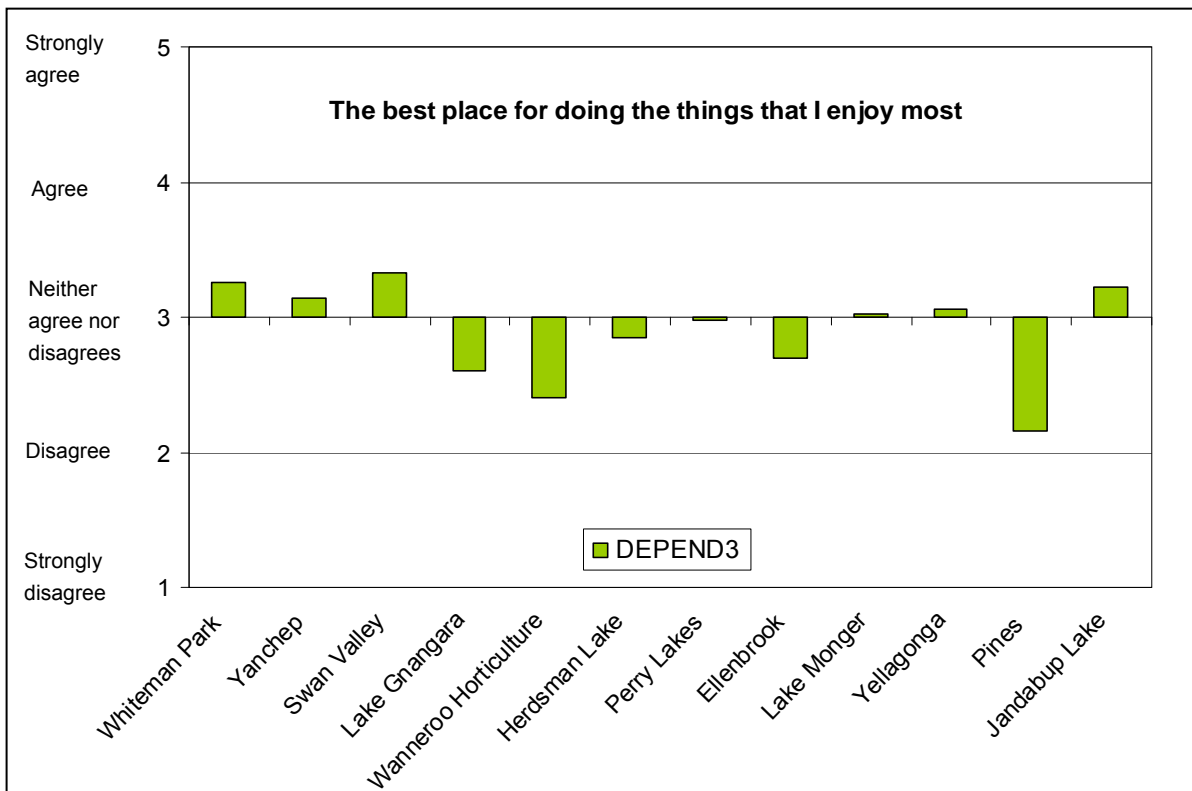
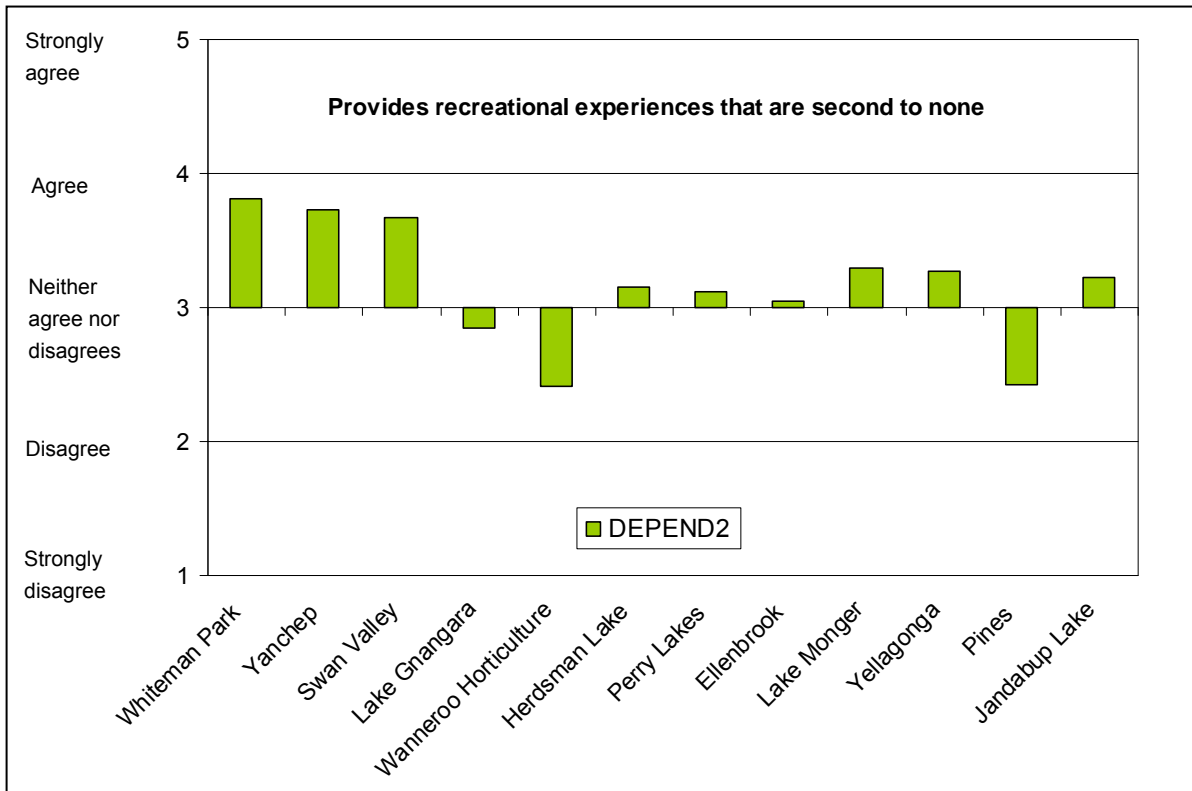


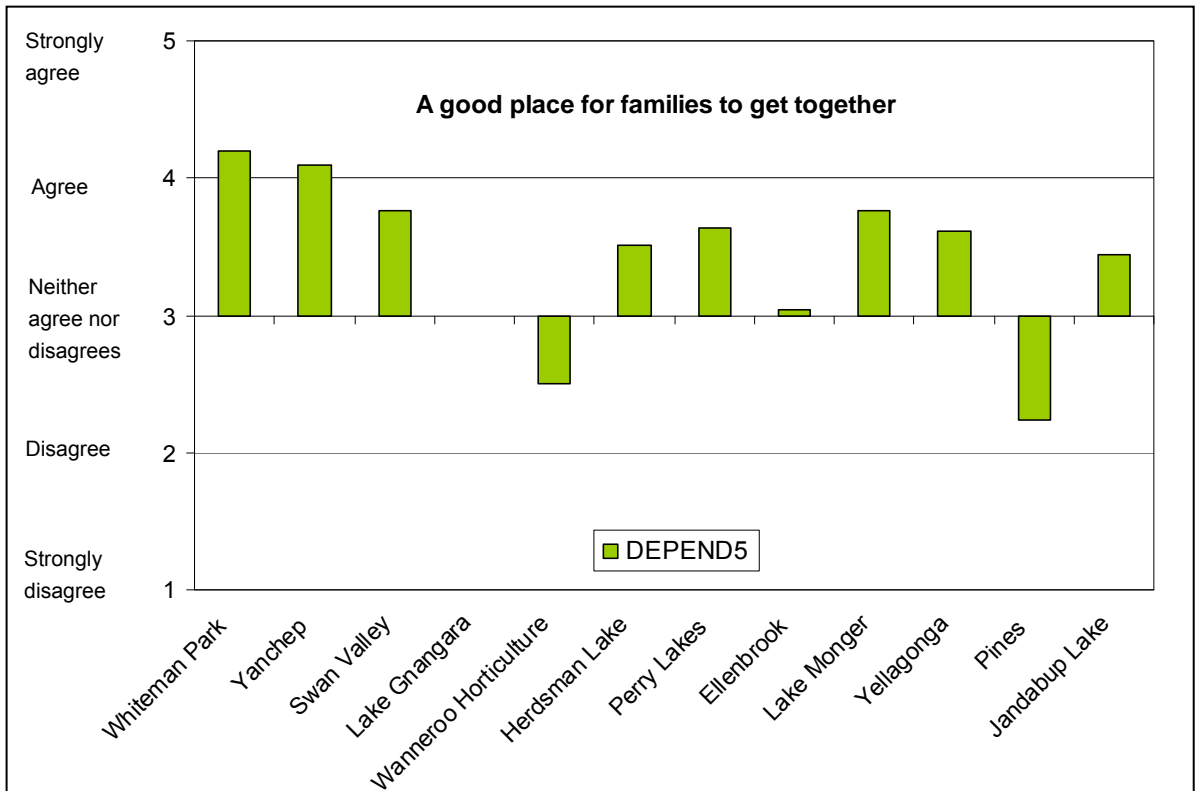
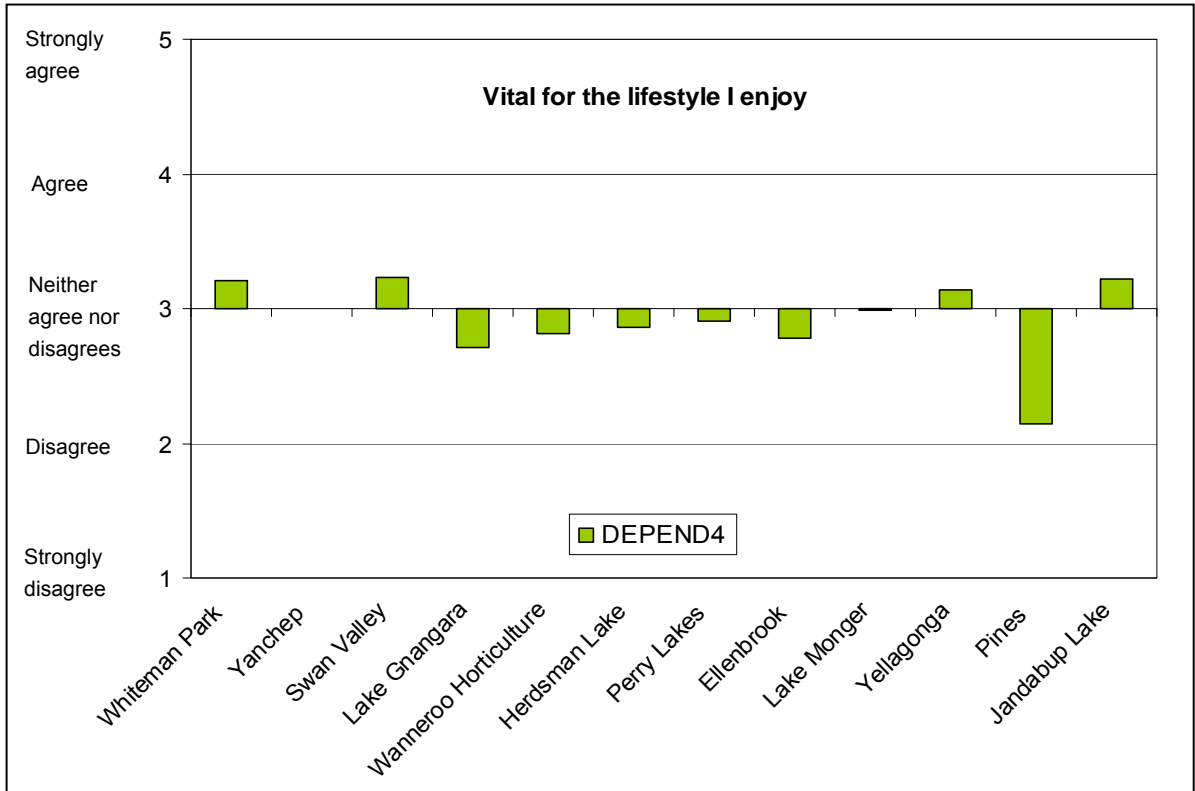












APPENDIX 4 SENSE OF PLACE MODEL

Tripartite (Three-Factor) Model
Unidimensional (One-Factor) Model

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