Green, Healthy and Eat Meat?

A mixed methods investigation into how meat is used and viewed by meat-eaters in Australia.

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Foreword

It’s 2009 and I’m walking towards a climate change rally on the lawns of Parliament House in Canberra. My family and I have arrived by bike. I’m wearing my shoes made from recycled tyres and my bamboo underwear. We have homemade (mostly organic) snacks packed in reusable containers. As I approach the rally, a young girl hands me a brochure. She’s representing the Vegetarian Society and the top of the brochure reads, ‘Think you can be green and eat meat, then think again!’

Initially, I dismiss the brochure. I don’t eat large amounts of red meat and I buy organic wherever possible. That’s enough. Isn’t it?
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Thanks to all those who participated in this research. I appreciate your time and interest. You definitely made this project interesting.

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Abstract

Meat is a central feature in the diets of many Australians. It is highly desired and can make an important, though not essential, contribution to nutritional intake. While a small to moderate intake of meat is recommended to meet nutritional requirements, consuming meat in excess is related to health risks. In addition, the production of meat has a significant environmental impact, most noticeably via greenhouse gas emissions. This impact is further exacerbated when meat is wasted (discarded without being eaten).

There are calls to reduce global meat consumption. However, investigation of meat consumption in the Australian context is limited. Consequently, a health and sustainability lens was used to explore the way meat is used and viewed by meat-eaters. A mixed methods approach using weighed food records, interviews, a survey and recipe audit was involved.

This thesis provides evidence that some Australians waste meat by over-consumption and discard. Weighed food records from 29 adults indicated that typical meat consumption for females was between 802 g/week (Q1) and 1408 g/week (Q3). Typical intake for males was between 1022 g/week (Q1) and 1394 g/week (Q3). Just under four-fifths of males (79%, n=11) and approximately half of females (53%, n=8) consumed more than the recommend 455 grams of red meat per week (NHMRC 2013a). A survey of approximately 600 respondents indicated male respondents typically selected 150-200 gram portions of cooked steak and females 100-150 gram portions. Approximately, half the households in Phase One of this study were identified as discarders, throwing out between 200-1875 grams of meat per household in a one-week period.

Participants in this investigation were unaware and/or unconcerned about the environmental credentials of meat and the health risks associated with excess consumption. Many were observed to be ‘happily disconnected’ from the way meat is produced in Australia and to have ‘blind trust’ in Australian meat production. Meat was identified as a highly desired food and there was resistance to modifying meat consumption. However, there was some indication that participants could reduce the frequency of meat consumption and make small (~50 gram) reductions to portion sizes.

In order to move towards more healthy and sustainable meat consumption, there is a need to improve awareness of the way meat is produced, improve the composition and communication of dietary guidelines for meat, and improve aspects of food literacy.
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Chapter 1- Introduction

1.1 Introduction to Chapter

Chapter one introduces the overarching rationale, purpose and significance of this research project. It broadly explains the need for investigating the way meat is used and viewed by Australian meat-eaters. It identifies that current understanding of purchasing, consumption and discard practices for meat is inadequate. This thesis is significant as it uses a unique research approach to investigate a relatively unexplored area. Better understanding of the way meat is used and viewed will help to inform the development of future research directions, nutrition policy and education approaches. A brief roadmap of the thesis is provided to guide the reader through the document.

1.2 Rationale for Thesis

Following the United Nation’s Millennium Summit in 2000, the Millennium Development Goals were officially established. In addition to goals about hunger, health, education and development, the seventh goal is to ‘ensure environmental sustainability’ (United Nations Development Programme 2012). There is growing awareness that the environmental impact of food choice is just as important as the nutritional properties of the foods eaten (Friel et al. 2009, Harmon & Gerald 2007, Horton 2009, NHMRC 2013a). In the past decade, the New Nutrition Science project has challenged nutrition experts to rethink the scope of nutrition. Supporters of this project prepared the Giessen Declaration in 2005, calling for nutrition to move beyond a biological dimension to also incorporate social and environmental dimensions (The Giessen Declaration 2005). The declaration calls for a focus on planetary health, in addition to personal and population health (The Giessen Declaration 2005).

The Food and Agricultural Organisation of the United Nations offers the following definition of sustainable diets:

Sustainable diets are those diets with low environmental impacts which contribute to food and nutrition security and to healthy life for present and future generations. Sustainable diets are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable; nutritionally
adequate, safe and healthy; while optimising natural and human resources (FAO 2012a, page 7).

The specific composition of a sustainable diet is currently under discussion. However, there is good agreement that wasting and eating less meat needs to feature strongly in sustainability guidelines (Buttriss & Riley 2013, Garnett 2011, Hoogland et al. 2005, Macdiarmid 2013, McMichael et al. 2007, PHAA 2009, SDC 2009). Meat has a high environmental impact in terms of land use, water, greenhouse gas emissions and other environmental markers (Steinfield et al. 2006). In addition, the known health implications of consuming meat excessively mean there are strong synergies between health and environmental goals regarding meat (Riley & Buttriss 2011). More evidence needs to be collected. However there is a sufficient argument to justify investigating the amount of meat consumed and wasted by Australians.

Currently, understanding of meat consumption practices in Australia is inadequate. Knowledge largely stems from the 1995 National Nutrition Survey (95NNS) (ABS 1997). Updated data will be available from the 2011-13 Australian Health Survey in early 2014 (ABS 2013). However, the use of 24-hour recall methodology in this survey means that a limited picture of meat consumption will be provided. A direct investigation of meat consumption in Australian households is required to add to the picture gleaned from national survey data.

The need to address meat consumption is apparent in the literature (Cribb 2010, Macdiarmid et al. 2012, McMichael et al. 2007, Riley & Buttriss 2011). However, the pathway for influencing behaviour change in this area is unclear. Some literature has explored attitudes and behaviours relevant to meat, but largely from a vegetarian versus non-vegetarian perspective. There is a need to better understand the forces that influence the way meat-eaters use meat. There is also a need to specifically explore understanding and perceptions of the link between the environmental impact of meat production and meat consumption.

1.3 Problem Statement

Meat consumption and discard has been identified as a key priority in the move towards a more sustainable diet. Meat is a food that needs to be consumed thoughtfully. It is wasteful and potentially harmful to consume meat in excess of public health recommendations. It is
further wasteful to discard uneaten meat. Understanding of meat purchasing, consumption and discard practices in Australia is limited. While there is considerable interest in reducing meat consumption, there is little insight into appropriate ways to facilitate this at the household level. There is a need to further explore the way meat is used and viewed by meat-eaters in Australia.

1.4 Aim of Thesis

The intention of this research is to use a health and sustainability lens to explore the way meat is used and viewed by a sample of meat-eaters in Australia. It aims to identify factors that influence meat-eaters to use meat in healthy and sustainable ways. The two key research questions for this thesis are:

1. What influences the type and amount of meat procured, consumed and discarded by meat-eaters in Australia?
2. How do meat-eaters in Australia view approaches to healthy and sustainable consumption of meat?

1.5 Significance of Thesis

This thesis contributes to the field by using a novel research approach to investigate a relatively unexplored area. Influenced by a pragmatic worldview, a variant of an exploratory sequential research design is used (Creswell & Plano Clark 2011). Qualitative data from interviews are integrated with quantitative data from weighed food records, a web-based survey and an audit of recipes in food magazines. The use of this mixed methods approach provides a full exploration of the multiple dimensions of the research topic. The use of weighed food records to quantify meat consumption provides rich data that is currently unavailable in Australia.

There is an urgent need to better understand meat consumption in Australia and explore pathways to more healthy and sustainable consumption. This exploratory study documents meat-consumption and discard practices and identifies influences on behaviour. It provides important preliminary data to inform future action in nutrition strategies that are environmentally mindful.
1.6 Overview of Thesis

This thesis is structured in five chapters. It proceeds with a background (chapter two) describing important literature and justifying the need for this research. Chapter two provides evidence that consumption of excess meat has important environmental and health impacts. There is a call to reduce global meat consumption but understanding of the way meat is used and viewed by meat-eaters in Australia is limited.

Chapter three explains the methodological approach and describes the methods used. The three research phases used in this research are justified and explained. The three phases include:

- Phase One – In-depth exploration of influences on procurement, consumption and discard in 29 households
- Phase Two – Quantitative web-based survey of influences on meat consumption with approximately 600 respondents
- Phase Three – Targeted quantitative audit of recipes in food magazines

Chapter four presents integrated findings from all stages of this mixed method research. Findings are combined and presented under four key topic areas:

1. Procurement
2. Consumption
3. Discard
4. Reducing meat consumption

Chapter five discusses the key findings in context with current literature and provides recommendations for future action. It identifies that meat is wasted by over-consumption and discard. Meat-eaters in this study were largely unaware or unconcerned about the environmental and health credentials of meat. There was resistance to modifying meat consumption in any way. However, there is optimism that there is some potential for change.

1.7 Chapter Summary

Chapter one has laid the foundation for this thesis. It provided a rationale for the study, articulated the problem statement and research aim and identified the significance of the study. The following chapter will review literature relevant to the way meat is used and viewed by meat-eaters in Australia.
Chapter 2 - Background

2.1 Introduction to chapter
Chapter two reviews literature relevant to the scope of this thesis. It justifies the need to address both environmental and health concerns associated with excess meat consumption and discard. Current recommendations for meat consumption are described and existing data on meat consumption and discard in Australia are summarised. This chapter identifies gaps in the existing literature and demonstrates that there is a need to investigate the way meat is used and viewed by Australian meat-eaters.

2.2 Meat – Definition
This thesis is about meat. Although ‘meat’ is a commonly used term, various definitions and classifications are available to define exactly what this term means. This work draws on the definitions put forward by the World Cancer Research Fund and American Institute for Cancer Research (2007). Generically, meat refers to all animal flesh apart from fish, seafood and eggs. Meat is further described as red, white, ruminant and processed.

**Red meat** is flesh from animals that have more red than white muscle fibres (WCRF/AICR 2007), e.g. beef, lamb, pork, veal, goat, venison and kangaroo. In Australia, the term ‘red meat’ often excludes pork (Baghurst et al. 2000, MLA 2013a). This might be because its lower myoglobin content imparts a lighter red colouring compared with beef and lamb (Ginger et al. 1954). However, it is more likely to stem from the fact that cattle, sheep and goats fall under Meat and Livestock Australia’s umbrella whereas pork is supported and promoted separately by Australia Pork Limited. In most other literature, pork is included as red meat. There are health and environmental arguments for considering pork as a red meat (Wiedeman et al. 2010, WCRF/AICR 2007), hence it is included as red meat in this thesis.

**White meat** is flesh from animals with more white than red muscle fibre. This effectively includes meat from chickens, turkeys, ducks and other birds.

**Ruminant meat** refers to the flesh of animals that have a four-compartment stomach, including a rumen. Most commonly this includes beef, lamb and goat. Meat produced from ruminant animals is associated with greater greenhouse gas production than other types of
meat (Carlsson-Kanyama & Gonzalez 2009), hence there is good reason to consider this type of meat separately.

**Processed meat** typically refers to meat that has been preserved by smoking, curing, salting, or the addition of preservatives (WCRF/AICR 2007). Ham, bacon, salami and luncheon meats are generally agreed to be processed meats.

### 2.3 Meat – Impact on the Environment

In 2007, the Intergovernmental Panel on Climate Change concluded there is now unequivocal evidence that climate change is occurring and that action needs to be taken to mitigate its effects (IPCC 2007). Increasingly, researchers and policy makers are examining the environmental impact of food production. Many experts recognise that immediate action is required to ensure a sustainable global food supply for future generations (Cribb 2010, GO-Science 2011, Riley & Buttriss 2011). The global food system faces the challenge of producing more food with fewer resources, such as land, water and energy, to feed the world’s growing population, while at the same time lessening the impact of food production on the environment (Riley & Buttriss 2011).

Of course, achieving a sustainable food supply is a complex and multifactorial issue. No single approach is likely to meet all the complex challenges that face the global food system. The overall impact of the total diet will be more important than the impact of any one food. However, in order to progress understanding in this area it is useful to start by considering individual foods. *Livestock’s Long Shadow* (report released by the Food and Agricultural Organisation (FAO) in 2006) intensified the spotlight on the environmental impact of meat production (Steinfield et al. 2006). Since then, concern for the environmental impact of meat production has grown. Meat production impacts heavily on the environment through land use, greenhouse gas emissions, soil, water and biodiversity depletion (Steinfield et al. 2006). *Livestock’s Long Shadow* identified the livestock sector as one of the ‘top two or three most significant contributors to the most serious environmental problems, at every scale from local to global’ (Steinfield et al. 2006). It further identified the livestock sector as one of the leading focuses for environmental policy (Steinfield et al. 2006).

#### 2.3.1 Land

Globally, the livestock sector is identified as the single largest anthropogenic (resulting from
human activity) user of land (Steinfield et al. 2006). According to Livestock’s Long Shadow, livestock production accounts for 70 per cent of all agricultural land and 30 per cent of the land surface of the planet. Expansion of livestock production is a key factor in deforestation, especially in Latin America where the greatest amount of deforestation is occurring. About 20 per cent of the world’s pastures and rangelands, with 73 per cent of rangelands in dry areas, have been degraded to some extent, mostly through overgrazing, compaction and erosion created by livestock action. When land is overgrazed the combination of vegetative loss and soil trampling can lead to soil carbon losses and the release of carbon dioxide (Abril et al. 2005).

It is frequently argued that meat production uses land very inefficiently. In essence, growing cereals to feed animals that are then eaten by people is inefficient since more nutrition can be generated per given quantity of land if crops are eaten directly (Garnett 2008). Cereals are a major source of nutrition for pigs, poultry, and beef cattle in intensive systems. It is estimated that, globally, around one-third of the cereals grown are used to feed livestock (Steinfield et al. 2006). Comparisons of the resources required to produce meat-based versus plant-based diets consistently indicate that a meat-based diet requires significantly more land than a plant-based diet (Pimentel & Pimentel 2003, Reijnders & Soret 2003). For example, Reijnders and Soret (2003) estimate that meat production requires 6-17 times more land compared with soy to produce a similar amount of protein. These comparisons are largely theoretical exercises. They tend to compare diets in terms of energy content or protein content, which provides a limited view as the provision of other nutrients is not considered. They also neglect to account for the fact that some land is not suitable for plant agriculture. However, such research helps to demonstrate clear differences in the land resources required to produce different foodstuffs.

Currently, there is limited Australian data on the land impact of meat production. The area of grazing land operated by beef cattle/sheep businesses is estimated to be more than 336 million hectares – over 40 per cent of the total area of Australia (Barson et al. 2011). Triple bottom line analysis is a form of analysis that quantifies the financial, social and environmental impact of a sector or industry (Foran Lanzen & Dey 2005). Triple bottom line analysis conducted in Australia has indicated that while meat production makes a significant contribution to the Australian economy it carries a heavy environmental load. The environmental indicators per dollar of final demand show land disturbance attributed to the livestock sector in Australia is 58 times the average land disturbance (Foran, Lanzen & Dey 2005). About 21 per cent of Australia’s more intensively managed grazing land is thought to
have a high risk of soil acidification and a further 17 per cent a moderate risk (Barson, Mewett & Paplinska 2011). Very acid soils are unlikely to support good ground cover, increasing the risk of soil loss through wind/water erosion and reducing input to soil carbon (Barson, Mewett & Paplinska 2011). In addition, feed production capacity in Australia may already be at its limits. A Department of Agriculture Fisheries and Forestry (DAFF) report on feed grains in Queensland identifies supply of feed grains as an important issue for the intensive livestock industry in Queensland (DAFF 2012). Beef feedlots, and pig and poultry industries, have grown over the last decade, which has increased demand for feed grains (Hirad et al. 2007). The cereal grain surplus has been declining in Australia as the livestock industries continue to grow (GRDC 2007). Already, some feedstock such as soybean meal is imported into Australia and the need to do so is expected to increase (Hirad et al. 2007).

Certainly, land used for meat production is a concern. However, it needs to be acknowledged that some of the dialogue about land use for livestock is over simplistic. Not all land used by livestock is suitable for arable farming (Garnett 2008). This is true in parts of Australia where cattle graze primarily on native grasses and plants rather than improved pasture (MLA 2006). It can also be argued that maintaining established grasslands is beneficial to the environment (Garnett 2008). Livestock give grassland a monetary value and therefore prevent it from being used for other purposes (e.g. growing plant food, construction) that could disrupt the soil and release stored carbon to the atmosphere (Garnett 2008). The cost versus benefit of land used by livestock needs careful consideration. However, the heavy use of land for growing feed crops and housing livestock persists as an important environmental concern.

### 2.3.2 Greenhouse gas emissions

Greenhouse gases such as carbon dioxide (CO₂), nitrous oxide (N₂O) and methane (CH₄) allow sunlight to enter the atmosphere freely. When sunlight strikes the Earth’s surface, some of it is reflected back towards space as infrared radiation (heat). Greenhouse gases absorb this infrared radiation and trap the heat in the atmosphere (AAS 2010). Carbon dioxide is the most abundant of the gases responsible for warming the earth’s atmosphere. Other greenhouse gases such as nitrous oxide and methane are present in the atmosphere in smaller quantities but have a much larger global warming impact. To reflect the differences in global warming impact, greenhouse gases are measured in carbon dioxide equivalents (CO₂-e). Over 100 years, carbon dioxide has a global warming potential of one, whereas the global warming potential of methane is 21 to 25 and the global warming potential of nitrous oxide is 296 to
The non-carbon dioxide gases account for a large portion of the global warming impact of meat production (Garnett 2008).

It is difficult to accurately quantify the greenhouse gas emissions resulting from meat production. Different methodology, different farming practices and different climatic conditions all contribute to the variability in the figures reported in the literature. Methane emissions from livestock can vary by time of year, according to the type of feed the animals eat, and the quality of the pasture they graze on (Garnett 2008). Time of year, soil wetness and soil porosity cause nitrous oxide emissions to fluctuate (Oenema et al. 1998). Some calculations (e.g. *Livestock’s Long Shadow*) more fully account for greenhouse gas emissions by including the carbon dioxide released from livestock-related land degradation and deforestation, whereas other estimates do not. Irrespective of the actual numbers, the growing literature in this area consistently indicates that the greenhouse impact of meat is significant (Casey & Holden 2006, Cederberg & Stadig 2003, Foster et al. 2006, Garnett 2013, Lang & Barling 2013, Macdiarmid 2013, Meier & Christensen 2013, Nordgren 2012).

Globally, estimates of greenhouse gas emissions from the livestock sector range from 10-51 per cent (Herrero et al. 2010). The FAO determined that the livestock sector is responsible for 18 per cent of global greenhouse gas emissions (Steinfield et al. 2006). According to the FAO, the livestock sector accounts for 9 per cent of anthropogenic carbon dioxide emissions. The largest share of this derives from land-use changes – especially deforestation – caused by expansion of pastures and arable land for feedcrops. The sector emits 37 per cent of anthropogenic methane with most of that from enteric fermentation by ruminants. It emits 65 per cent of anthropogenic nitrous oxide, the great majority from manure. Greenhouse gases are produced across the whole of the meat supply chain. However, for meat, the majority of emissions are generated at the agricultural stage rather than processing, transport, storage or disposal (Garnett 2008). There are some emissions due to the use of fossil fuels to power farm machinery and manufacture fertilisers. More importantly changes in land use contribute more significant quantities of carbon dioxide. These result from soil carbon losses due to ploughing and through the conversion of pasture, savannah or forest land to tilled agriculture. The production of methane from ruminant livestock and nitrous oxide from both arable and livestock systems is also significant.

The Australian government aims to reduce greenhouse emissions by 80 per cent compared with 2000 levels by 2050 (DCCEE 2013c). It is taking action on a number of levels in order
to meet this target (DCCEE 2013b). Determining the extent of emissions associated with meat production in Australia is complicated. There is a range of production environments and management practices that characterise agriculture, plus there are definitional issues over what constitutes an agricultural emission (Browne et al. 2011). Broadly, agriculture in Australia contributes 16 per cent of national greenhouse gas emissions, with enteric methane and nitrous oxide contributing 10.4 per cent and 2.8 per cent of national emissions, respectively (Browne et al. 2011). This is largely due to emissions of methane and nitrous oxide from enteric fermentation in livestock, manure management, rice cultivation, agricultural soils, savanna burning and field burning of agricultural residues (DCCEE 2013a).

In Australia in 2007, greenhouse gas emissions from livestock were responsible for about 11 per cent of the national inventory total emissions (DCCEE 2009). Triple bottom line analysis conducted in Australia has indicated that the environmental indicators per dollar of final demand for livestock show greenhouse gas emissions are 26 times the economy-wide average (Foran, Lanzen & Dey 2005).

Australian meat production differs somewhat from other parts of the world. It is sometimes argued that Australian agricultural practices are not as environmentally burdensome as those of other countries. Currently, there is limited data available on the environmental impact of meat production in Australia. Even for the existing data, it is difficult to make comparisons between different production systems. Problems with comparing lifecycle analyses are well documented (Bengtsson & Seddon 2013, Finnveden 2000, Roy et al. 2009). Nevertheless, lifecycle assessment of three meat supply systems in Australia found that, when compared with data from international studies, Australian systems are either on par or have a higher impact (Peters et al. 2010). A farm and feedlot system for producing beef in New South Wales in 2004 was allocated a carbon footprint of 15.4 kg CO$_2$-e/kg of HSCW (Hot Standard Carcass Weight). This compares with 10.4 kg CO$_2$-e/kg of HSCW attributed to an American feedlot system for producing beef. The carbon footprint for production of sheep meat in Western Australia was found to be 10.2-10.8 kg CO$_2$-e/kg of HSCW.

Russell and Ferrie (2008) demonstrate the magnitude of greenhouse gas emissions from Australian meat production by comparing emissions from beef with emissions from driving a 4WD car. Using figures provided by the Australian Greenhouse Office (AGO) they calculate that a person eating 130–400 grams of red meat per day will, each year, generate between 3504 kilograms and 12 580 kilograms of greenhouse gas emissions. By comparison, driving a
two tonne 4WD Ford Territory 200 kilometres each week for a year generates 3120 kilograms of greenhouse gas emissions.

Lifecycle analysis of international pork production systems suggests that pork has a lower environmental burden in comparison with ruminant sources of meat such as beef, lamb and goat (Wiedemann et al. 2010). However, environmental impact is still considerable due to methane and nitrous oxide produced from waste streams and nitrous oxide emissions associated with feedcrop production. International data suggests greenhouse gas emissions for pork production can range from 2.3-11.2 kg CO$_2$-e (Wiedemann et al. 2010). A recent lifecycle analysis of two pork supply chains in southern Queensland and southern New South Wales calculated emissions to be 3.1-5.5 kg CO$_2$-e/kg of HSCW (Wiedemann et al. 2010).

Bengtsson and Seddon (2013) conducted a lifecycle assessment of chicken produced by Ingham Enterprises in Australia. Inghams is one of two major integrated companies supplying more than 70 per cent of Australia’s broiler chickens (ACMF 2011). The physical scope of the lifecycle assessment was cradle to retailer or quick service restaurant gate. This study calculated that Inghams’ average emissions were 2613 kg CO$_2$-e/t. Lifecycle assessment studies of poultry production throughout the world indicate that liveweight chicken emissions range between 2000 and 5480 kg CO$_2$-e/t. This suggests that Australian poultry production is comparable to international production. Energy (electricity and gas) consumption and ammonia emissions were responsible for the bulk of greenhouse gas emissions in Inghams’ assessment.

There is a need for additional lifecycle assessment of meat production in Australia. However, the existing evidence overwhelmingly indicates that meat is greenhouse intensive. Beef and lamb are associated with the highest greenhouse gas emissions, followed by pork then chicken.

2.3.3 Water
The availability of adequate, clean, fresh water is a global environmental concern. It is estimated that 64 per cent of the world’s population is expected to live in water-stressed basins by 2025 (Steinfield et al. 2006). According to the FAO, the livestock sector is a key player in increasing water use, accounting for over 8 per cent of global human water use, mostly for the irrigation of feedcrops (Steinfield et al. 2006). Additionally, it is probably the largest sectoral source of water pollution, contributing to eutrophication, “dead” zones in coastal areas, degradation of coral reefs and human health problems (Steinfield et al. 2006).
The major sources of pollution are from animal wastes, antibiotics and hormones, chemicals from tanneries, fertilizers and pesticides used for feedcrops, and sediments from eroded pastures (Steinfield et al. 2006). Livestock also affect the replenishment of freshwater by compacting soil, reducing infiltration, degrading the banks of watercourses, drying up floodplains and lowering water tables (Steinfield et al. 2006).

Calculations of water attributed to various foodstuffs vary enormously. There is disagreement as to how water should be counted. Some data only counts the amount of water directly consumed by an animal. Other data attempts to fully count all the embedded water costs of a foodstuff. Regardless of methodology, meat production is associated with significant water usage. For example, compared with soy protein, production of meat protein requires 4.4–26 times more water (Reijnders & Soret 2003). Triple bottom line analysis conducted in Australia indicates that meat production uses water extensively. The environmental indicators per dollar of final demand show water use is 18 times the economy average (Foran, Lanzen & Dey 2005). Australian estimates of virtual water for meat production range from 17 112L/kg for beef, 6947 L/kg for sheep meat, 5909 L/kg for pork and 2914 L/kg for chicken meat (Wiedemann et al. 2010).

Work is needed to more accurately quantify the amount of water used in meat production. There is a need for consistent methodology so that accurate comparisons can be made. However, sufficient evidence indicates that meat production is associated with considerable water use.

2.3.4 Biodiversity

Biodiversity is the variety of life, including variation among genes, species and functional traits (Cardinale et al. 2012). There is now unequivocal evidence that biodiversity loss reduces the efficiency by which ecological communities capture biologically essential resources, produce biomass, decompose and recycle biologically essential nutrients (Cardinale et al. 2012). A monopoly by one grazing species on a particular area can create a landscape with limited biodiversity. In the United Kingdom, overgrazing has been one of the main contributors to organic soil degradation, accounting for 36 per cent of all reductions in soil quality (Garnett 2008). The FAO propose that the livestock sector may be a leading player in the reduction of biodiversity, since it is the major driver of deforestation, as well as one of the leading drivers of land degradation, pollution, climate change, sedimentation of coastal areas and facilitation of invasions by alien species (Steinfield et al. 2006). The Australian
rangelands have been subject to considerable modification by livestock. Grazing damage to native ecosystems has contributed to the extinction of at least twenty species of mammals (Lunney 2001) and continues to threaten around one-quarter of the plant species listed as endangered (Beeton et al. 2006).

Conversely, Garnett (2008) points out that grazing livestock can play an important role in sustaining biological diversity, provided land is not over-grazed. The constant nibbling, chomping and stamping of livestock can help to control dominant or invasive species, allowing other less robust plants to thrive. In addition, different livestock species graze in different ways and at different levels, which benefits species diversity. Hence land that is grazed by different kinds of livestock, providing it is not over-grazed, can achieve a varied and diverse biological landscape. The extent of grazing is the key factor.

### 2.3.5 Impact will Worsen as Demand for Meat Increases

Meat production has a significant impact on land, greenhouse gas emissions, water utilisation and pollution. The environmental impact of meat production will magnify if meat production continues as projected. Across many cultures meat is regarded as a desirable food; therefore an increase in meat consumption is expected to occur as countries transition to a more prosperous economy (McMichael & Bambrick 2005, York & Gossard 2004). At the commencement of this thesis, total annual global demand for meat was projected to double from 228 million tonnes in 2000 to 459 million tonnes in 2050 (FAO 2006). This was partly because the world’s population is expected to increase from 6 billion to 9 billion in this time period. However, it was also anticipated that intake of animal-derived foods would increase. Most of the increase in demand for meat is projected to occur in low or middle-income countries (McMichael & Bambrick 2005). Production and consumption of meat generally rise as available income increases (WCRF/AICR 2007). A more recent report from the Organisation for Economic Cooperation and Development and the Food and Agriculture Organization of the United Nations (OECD/FAO) indicates that world meat consumption continues to enjoy one of the highest rates of growth among major agricultural commodities, however meat production growth is projected to slowdown to 1.6 per cent per annum, compared to 2.3 per cent per annum in the previous decade (OECD/FAO 2013). In Australia, meat production is currently stable (ABS 2013) but some reports project production to double over the next 50 years, partly due to population increase but also due to increased demand, including that for exported meat (Foran, Lanzen & Dey 2005).
2.4 Meat – Impact of Waste

Clearly, meat production carries a significant environmental cost. This cost is amplified when meat is wasted. Edible food (including meat) is lost at every stage of the food system (Kantor et al. 1997). At the household level, meat is considered to be wasted if it is consumed beyond need and/or discarded when it could have been eaten. This section will focus on avoidable discard of meat. Subsequent sections will address over-consumption. Wasting meat is problematic. Firstly, discarding meat that could have been eaten wastes all the embedded resources and emissions associated with its production, processing, transport, retailing and preparation. Secondly, there are environmental costs associated with the removal of discarded meat and its decomposition in landfill. There is growing awareness of the need to address household food waste. However, the current evidence base is very limited. There is an urgent need to better understand the extent and causes of food waste. As meat is a high environmental impact food, it is arguably even more important to address wastage of meat than other foods.

2.4.1 Avoidable Meat Waste Defined

Studies conducted within this doctoral work focus on avoidable meat waste at the consumer level in the food supply chain. The definition used in this thesis is influenced by definitions put forward by the United Kingdom’s Waste Resources Action Program (WRAP 2007b). ‘Avoidable meat waste’ refers to meat that could have reasonably been eaten at some point in time but instead was thrown away. It might have passed its best before date, been leftover at the end of a meal or been burnt during cooking. Regardless of the reason for discard, ‘avoidable meat waste’ represents meat that could have been eaten at the time of discard or at some point prior to discard. This thesis is not concerned with the unavoidable waste that arises from meat consumption: e.g. bones and trimmings.

2.4.2 Justification for Addressing Household Food Waste

identify reduction of food waste as an important action (NHMRC 2013a). The Department for Environment Food and Rural Affairs (Defra) in the UK identified five key behaviour goals to address a household’s food impact on climate change. One of the key goals was to waste less food (Owen, Seaman & Prince 2007). The Sustainable Development Commission (SDC) in the United Kingdom assessed how a range of food and dietary consumption behaviour changes would impact on health, environment, the economy and reducing social inequities. Three changes likely to have the most significant and immediate impact on making diets more sustainable were identified. One of these was reducing food waste (SDC 2009).

A Senate report on Australia’s waste streams recommended that measures be taken to reduce the quantity of organic material going to landfill (SCECA 2008). At the time, one source estimated that food waste comprised 15 per cent of the 20 million tonnes of waste that goes to landfill in Australia each year (SCECA 2008). Data from the Australian Bureau of Statistics (ABS) at the time broadly estimated that in 2002-03 6.2 megatonnes of municipal waste went to landfill in Australia. Nearly half (47%) of this municipal waste was thought to be food and garden waste (ABS 2007). In 2005 and 2009, The Australia Institute investigated food waste in Australian households and called for the government to address the growing problem of food waste (Baker, Fear & Denniss 2009, Hamilton, Denniss & Baker 2005). According to Baker and colleagues (2009), ‘while food waste may be an individual and household phenomenon, the collective impact of these decisions means that it is a substantial policy problem.’

Waste strategies in Australia and throughout the world follow the waste management hierarchy (DECCEW 2011, WRAP 2007b). Figure 2.1 visually represents the waste management hierarchy where reduction is better than reuse and reuse is better than recycling or composting, and all of them are better than disposal. Put simply, reducing food waste at the household level is important (Gentil & Poulsen 2012, Smil 2003-04).
2.4.3 Extent of Food Waste – Globally

Globally, food is wasted throughout the supply chain from initial agriculture production down to final household consumption (Gentil & Poulsen 2012, Gustavsson et al. 2011, Hall et al. 2009). The FAO broadly estimate that one-third of food produced for human consumption is lost or wasted globally, amounting to 1.3 billion tons of wasted food each year (Gustavsson et al. 2011). Others propose that the amount of food wasted globally through all avenues could be as high as 50 per cent (Gentil & Poulsen 2012, Smil 2003-2004).

Although food is wasted across the supply chain, collective losses at the household level are significant. In the USA, consumer and food service waste is identified as the single largest source of food loss in the food marketing chain, accounting for 26 per cent of the edible food available for human consumption in the USA (Kantor et al. 1997). The Waste Resources Action Programme (WRAP) in the UK has conducted considerable research into food waste since its establishment in 2000. WRAP estimates that around 5.3 million tonnes of avoidable food waste is produced in UK households annually (Quested et al. 2011). An average household in the UK produces 210 kilograms of avoidable food waste each year, at a cost of £480 (Quested et al. 2011). Eurostat data indicates that households in EU27 countries waste about 48 kilograms per person per year, corresponding to about 21 per cent of total waste.
generation across all sectors (Gentil & Poulsen 2012). The wide variation in figures provided for the amount of household waste are reflective of the variation in methodology and classification of waste. While there is uncertainty about the exact quantity, it is clear that a lot of food is wasted.

### 2.4.4 Extent of Food Waste – Australia

Information on waste generation in Australia is available through sources such as landfill operators, government waste audits and direct research. Overall, there is a lack of reliable, comprehensive and contemporary waste information in Australia (Mason et al. 2011, SCECA 2008). Waste is frequently classified in various ways; hence drawing out information specific to food waste is difficult. The Australia Institute has conducted two studies of food waste in Australian households. In these surveys, over 1600 respondents were asked to estimate their expenditure on food that is thrown out (Baker, Fear & Denniss 2009, Hamilton, Denniss & Baker 2005). In 2004 it was estimated that Australians threw out a total of $5.3 billion on all forms of food (Hamilton, Denniss & Baker 2005). In 2009, The Australia Institute determined that the average Australian household threw out an estimated $616 worth of food each year, equivalent to $239 per person (Baker, Fear & Dennis 2009).

As this doctoral research progressed, two major surveys addressing food waste were implemented. In 2010, Sustainability Victoria surveyed just over 1200 Victorian households. Survey participants were asked to estimate the cost of food their household throws away each year. Average food waste was estimated at just over $2000 per year (Sustainability Victoria 2011). Across Victoria, this adds up to $3.8 billion each year. Sustainability Victoria estimates that food constitutes about 40 per cent of waste that is thrown out by Victorian households. The Food Waste Avoidance Benchmark Study 2009 asked similar questions of 1200 residents in New South Wales (NSW) (OEH 2011). It was estimated that NSW households throw away $2.5 billion or 800 000 tonnes of edible food each year. The average value of food waste by a typical NSW household was found to be $1063 per year.

### 2.4.5 Extent of Meat Waste

Food waste scholarship indicates that all types of food are wasted. It is difficult to determine the extent that meat is wasted as food is frequently categorised in different ways in food waste studies. Nevertheless, it does appear that the extent of meat waste is significant. The FAO notes that, for meat and meat products, losses in industrialised countries are most severe at the consumer end of the supply chain. Their investigations determine that waste at the
consumption level makes up approximately half of total meat losses and waste (Gustavsson et al. 2011). Kantor estimates that 16 per cent of the edible food supply for red meat and 16 per cent of the edible food supply for poultry was lost at the retail, food service and consumer level in the USA in 1995. A study of Swedish households found that significant amounts of meat and meat products were wasted both after storage and after meals (Sonesson et al. 2005a). Data from WRAP indicates that, in terms of weight, ‘meat or fish meals’ are the fourth most wasted food in UK households (Ventour 2008). On a weight basis, just over 13 per cent of all avoidable household waste is meat and fish. This figure is higher if all sources of meat (e.g. mixed meals such as lasagne) are included in the tally. In terms of cost, ‘meat or fish meals’ are the highest wasted food. Of the avoidable meat and fish waste generated, 35 per cent is uncooked, 26 per cent is ready to consume when bought and 23 per cent has been cooked/prepared at home.

In 2009, The Australia Institute determined that fresh meat and fish were one of the food groupings where significant waste occurred (Baker, Fear & Denniss 2009). It identified that $872.5 million worth of fresh meat and fish is thrown out in Australia each year (Baker, Fear & Denniss 2009). A major limitation of this study was that it required respondents to estimate the dollar cost of discarded food. The study therefore provides a broad estimate of the extent of food waste only.

### 2.4.6 Environmental Impact of Meat Waste

Food waste has both direct and indirect environmental impacts. Direct impacts include the migration of nutrients and leachates out of landfill sites and into groundwater reserves and waterways (OEH 2011) and the generation of greenhouse gas emissions when food waste decomposes anaerobically in landfill (Baker, Fear & Denniss 2009, Lin, Huang & Wahlqvist 2009, Productivity Commission 2006). Although the extent of greenhouse gas generation from food waste in Australia has not been accurately quantified, it is likely to be considerable (Mason et al. 2011). The 2008 Senate Inquiry into Australia’s waste streams identified that the waste sector represented 3 per cent of the national total greenhouse gas emissions (not including emissions from the transportation of waste) (SCECA 2008). The largest contributor to the waste sector greenhouse gas emissions is the decomposition of organic waste in landfill, including paper and cardboard, food and garden organics, and wood and timber (SCECA 2008). Food is estimated to constitute a significant portion of this waste (Productivity Commission 2006). In 2009, Baker and colleagues conservatively estimated that decomposition of household food waste was responsible for emitting 5.25 MtCO₂-e — a rate
of pollution comparable with the total emissions involved in the manufacture and supply of iron and steel in Australia (Baker, Fear & Denniss 2009). In New South Wales it has been estimated that, for every tonne of food waste diverted from landfill, 0.9 tonnes of CO\textsubscript{2}-e is saved (OEH 2011.) Technological improvements such as anaerobic digestion systems and gas harvesting from landfill can minimise the direct environmental costs of food waste. However, the first step of the waste hierarchy is to reduce waste from occurring in the first place (see Figure 2.1).

More concerning than the direct environmental impact of food waste is the indirect impact. When all embedded costs of food production are fully accounted for, these indirect costs are significant (Baker, Fear & Denniss 2009, Gustavsson et al. 2001, OEH 2011). Wasting food invariably means that all the resources used in food production are used in vain, and that the greenhouse gas emissions arising from food production are generated unnecessarily. Food waste represents a waste of land, water, energy and inputs and leads to unnecessary greenhouse gas emissions associated with transport, processing and refrigeration (Baker, Fear & Denniss 2009). Wasting food means that the lion’s share of the environmental impact has already occurred (Sonesson et al. 2005a). WRAP estimates that the greenhouse gases emitted to produce, process, transport, store, prepare and dispose of all food wasted in UK households are equivalent to 20 million tonnes of carbon dioxide (Quested et al. 2011). Preventing one tonne of food waste avoids 4.2 tonnes of CO\textsubscript{2}-e emissions being generated (WRAP 2009). In Scandinavia, it is estimated that, if an efficient scheme for reducing food waste is implemented, greenhouse gas savings equivalent to about 20 per cent of the carbon footprint of the average European Union citizen could be achieved (Gentil & Poulsen 2012).

Simplistically, it can be argued that if we didn’t waste so much food, we wouldn’t need to grow, process, transport and retail so much food. Hence, the environmental costs of food production would decline. Garnett (2008) cautions that the relationship between consumption and production is unlikely to be so straightforward. If people wasted less food, they might use the money saved to ‘upgrade’ to more expensive foods with potentially higher environmental costs (Garnett 2008). As this is currently speculative, an argument remains to further investigate food waste. The argument is strengthened when the potentially harmful economic and social impacts of food waste are considered. These are outside the scope of this thesis. However, in summary, collecting, transporting and treating food waste places an economic burden on existing waste disposal systems (Baker, Fear & Denniss 2009, Mason et al. 2011, SCECA 2008). Money spent on food that is thrown away could be redistributed to other
areas, such as paying for household electricity bills or paying down credit card debt. Food Security is widely recognised as a major concern throughout the world. The United Nations estimates that food production will need to increase by about 70 per cent from 2005-07 average levels to feed the projected world population of 9.3 billion by 2050 (DAFF 2011). The amount of food estimated by FAO to be wasted is enough to feed the present world population of 7 billion people (Thomas 2011). One of the first means to fight imbalances and reduce tensions between the necessary increase in consumption and the challenging increase in production is to also promote food loss reduction (Gustavsson et al. 2011).

2.4.7 Why is Meat Wasted?

This investigation aims to build on existing understanding of causes of food waste and see if these also apply to meat. Making sense of causes for food waste within the household is complex. At the commencement of this thesis, research largely stemmed from organisations such as WRAP in the United Kingdom. In WRAP’s consumer study (2007a), consumers identified 33 reasons for throwing away food (WRAP 2007a). In their review of WRAP’s research prior to 2011, Quested and colleagues conclude that the generation of food waste is not a behaviour in itself, but results from the interaction of multiple behaviours relating to planning, shopping, storage, preparation and consumption of food (Quested et al. 2011). Further work needs to be done to better understand causes of food waste. However, key influences identified so far include:

- Insufficient purchase planning
- Buying too much
- Stringent adherence to best before dates
- Can afford to waste
- High quality standards
- Cooking too much
- Deskilling in the kitchen
- High sensitivity to food safety
- Change of plans
- Unaware or don’t care

Little attention has been given specifically to why meat is wasted. However, there are potentially different reasons for throwing away different types of foods. Some evidence suggests that fresh fruit and vegetables are primarily thrown away because they are not used in time (go off or pass a date label), whereas meals (containing meat) are primarily disposed of after either preparation or serving (WRAP 2007a). Van Garde and Woodburn (1987) used a quantitative survey to assess reasons for wasting food. Respondents were offered a choice of eight categories. Primary reasons given for discarding meat/fish/poultry were ‘storage time’, ‘leftover’, ‘plate waste’ and ‘do not consume’. A criticism of this approach is that the use of predefined categories was not revealing enough. This study also reported that expensive meats did not seem to be as disposable as some of the other food categories. Perhaps the higher cost of meat deters wastage? In the UK population, the most common reason for throwing away fresh meat and fish that could have been eaten is that the food date has expired (35%), or they are leftover after being prepared and served (26%) (Ventour 2008).

At this stage there is no clear approach to addressing food waste. Experts call for further research to better understand the extent and causes of food waste (Gustavsson et al. 2011, Lin, Huang & Wahlqvist 2009, Mason et al. 2011, Sonesson et al. 2005a). When assessing the greenhouse gas emissions associated with the avoidable waste of different types of food and drink, meat waste becomes increasingly important. Clearly, more research is required to understand the extent and causes of meat waste in Australia.

### 2.5 Support for Reduced Meat Consumption

Reducing the amount of avoidable meat waste at the consumer level is important to lower the environmental impact of meat utilisation in Australia. However, it is also argued that meat is wasted when it is consumed beyond need. The composition of a sustainable diet continues to be discussed and challenged. Currently, there is no simple set of principles that consumers can apply, in all cases, to identify foods that are more sustainable than others (Riley & Buttriss 2011). However, a large body of literature now proposes reduced consumption of meat as an important environmental strategy (Cribb 2010, Fairlie 2010, Gerbens-Leenes & Nonhebel 2002, Gold 2004, Reijnders & Soret 2003, Riley & Buttriss 2011). Dr Rajendra Pachauri, chairman of the United Nations Intergovernmental Panel on Climate Change, (2008) recommends that reducing meat consumption offers individuals the most effective way to reduce their carbon footprint (Jowit 2008).
McMichael and colleagues (2007) reviewed the relationship between livestock production, climate change and health and concluded that urgent attention needs to be paid to finding ways of reducing the demand for animal products. They proposed a contraction and convergence policy as the most politically feasible model for restricting emissions rising in relation to consumption of meat and dairy products. In this approach, the prime objective is to reduce consumption of animal products in high-income countries, thus lowering the ceiling consumption level to which low-income and middle-income countries would then converge. They propose an international target of a maximum of 90 grams of meat per person per day (50 grams red meat per person per day) in all countries.

Various researchers have compared the environmental costs of plant and meat-based diets. For example, Carlsson-Kanyama (1998) compared four sample diets in terms of nutritional value and greenhouse gas emissions and concluded that a domestic (Swedish) vegetarian diet produced the lowest level of emissions for the highest level of nutrients. Weber and Matthews (2008) concluded that shifting less than one day per week’s worth of calories from red meat and dairy products to chicken, fish, eggs or a vegetable-based diet achieves more greenhouse gas reduction than buying all locally sourced food. Stehfest and colleagues (2009) used a modelling method to explore the potential impact of dietary change on climate change. A reference scenario based on current FAO per capita consumption of meat throughout the world was compared with a ‘Healthy Diet’ scenario. The ‘Healthy Diet’ involved partial substitution of meat with plant protein from pulses and soybeans. Average daily per capita intake consisted of 10 grams beef, 10 grams pork and 46 grams chicken meat and eggs. Transitioning to the ‘Healthy Diet’ scenario between 2010 and 2030 was estimated to reduce crop area by 135 Mha, pasture area by 1360 Mha and greenhouse gas emissions by approximately 10 per cent compared with the reference scenario. Inherently these modelling activities have many weaknesses and limitations. Production systems vary throughout the world; hence most of these comparisons have limited relevance to Australian meat. However, they consistently indicate that a shift to eating less meat can lower the environmental impact of dietary consumption.

In the policy space, reduction of meat consumption has been identified as important by some groups. The Sustainable Development Commission (SDC) is the UK Government’s independent watchdog on sustainable development. The Department for Environment, Food and Rural Affairs (Defra) commissioned the SDC to examine how changes in UK food consumption patterns could deliver positive sustainability outcomes. This report prioritised
the changes likely to have the most significant and immediate impact on making diets more sustainable. Reducing consumption of meat and dairy products was given the highest priority followed by reducing consumption of food and drink of low nutritional value and reducing food waste (SDC 2009). In Australia, the Public Health Association of Australia recommends development of public health recommendations that reduce total consumption of animal products, reduce reliance on ruminant meat and promote sustainable proteins like legumes, eggs and chicken (PHAA 2009).

Convinced that there is a need to reduce meat consumption, research is now turning to the most appropriate way to achieve this. United Kingdom researchers have investigated whether it is possible to achieve a diet that meets UK dietary recommendations as well as targets for reduction in food related greenhouse emissions (Macdiarmid et al. 2012). Dietary modeling was used to develop a diet that was likely to be acceptable to consumers, met dietary requirements and reduced greenhouse gas emissions by 36 per cent. The resulting diet for adult women included 20 grams of ham, 85 grams of cooked beef, 85 grams of cooked pork and 182 grams of cooked chicken in a week. The amount of meat in the sustainable diet was 60 per cent of the current intake of all meat for women in the UK and 48 per cent of the intake of red meat. This research indicates that it is possible to consume a healthy diet with lower greenhouse gas emissions provided relatively small quantities of meat are consumed.

2.6 Criticism of Reduced Meat Consumption

For some population groups, a call to reduce meat consumption needs to be considered carefully. Meat provides a useful source of iron and some literature cautions that lower meat consumption may be associated with lower iron intakes (Baghurst et al. 2000). Dietary modeling was conducted to inform the recent revision of the Australian Dietary Guidelines (NHMRC 2011). The modeling process identified that for pregnant women, iron was limiting in the diets as modeled (NHMRC 2011). However, this did not result in recommendations for increased meat consumption. Rather pregnant women are advised to seek advice about iron supplementation (NHMRC 2011). Although concerns are expressed about the impacts of low meat consumption in some groups, it is not necessary to consume meat. It is the position of the American Dietetic Association that ‘well-planned vegetarian diets are appropriate for individuals during all stages of the life cycle, including pregnancy’ (Craig et al. 2009).
Australian Dietary Guidelines provide nutritionally adequate scenarios for those who chose not to eat meat (NHMRC 2013a).

Successfully mitigating climate change is an enormous challenge that requires action on multiple levels. Some might question the value of pursuing individual behaviour change, arguing instead that political agreements and technological advances will do more to tackle climate change than anything an individual could achieve. There is certainly technological potential for reducing the impact of meat production (Friel et al. 2009, Garnett 2008, Hegarty et al. 2007, McMichael et al. 2007). Livestock’s Long Shadow supports the need for technological change, arguing that increased productivity in livestock production and in feedcrop agriculture can reduce greenhouse gas emissions from deforestation and pasture degradation (Steinfield et al. 2006). In addition, methane emissions can be reduced through improved diets to reduce enteric fermentation, improved manure management, and capture of biogas (Steinfield et al. 2006). Nitrogen emissions can be reduced through improved diets and manure management (Steinfield et al. 2006). Table 2.1 provides examples of technological and management strategies aimed at reducing the environmental impact of meat production.
Table 2.1: Examples of technological and management strategies to reduce the environmental impact of meat.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed Composition</td>
<td>Providing feed that is more easily digested (e.g. optimal protein, higher sugar content) can reduce methane emissions.</td>
</tr>
<tr>
<td>Genetics</td>
<td>Animals can be bred with desirable genetic traits e.g. capacity to develop more muscle quickly, emit lower levels of methane, be suitable for multiple purposes (e.g. meat and milk)</td>
</tr>
<tr>
<td>Supplements and Vaccines</td>
<td>Modify gut flora and reduce methane production</td>
</tr>
<tr>
<td>Intensive Farming</td>
<td>Housing animals in concentrated areas to reduce use of land</td>
</tr>
<tr>
<td>Feedstock</td>
<td>More efficient use of nitrogenous fertilisers to reduce NO₂ emissions.</td>
</tr>
<tr>
<td>Farm Management</td>
<td>Restore organic carbon to degraded pastures. Use of mixed systems to optimize animal-plant nutrient cycling</td>
</tr>
<tr>
<td>Manure Management</td>
<td>Anaerobic digestion of manure</td>
</tr>
<tr>
<td>Renewable Energy</td>
<td>Biomass, heat, solar, wind etc used for heating and powering housing etc.</td>
</tr>
</tbody>
</table>

Sources: McMichael et al. 2007; Garnett 2008

In Australia thus far, the main focus has been on technological improvements in meat production. In 2009, Federal Minister for Agriculture, Tony Burke, announced the investment of $26.8 million into research seeking to reduce methane emissions from the livestock sector (AFP 2009). Meat and Livestock Australia has teamed up with various industry groups (Cattle Council of Australia, Sheepmeat Council of Australia, Australian Meat Industry Council, Australian Lot Feeders Association, Australian Meat Processing Corporation) to launch its ‘Target 100’ campaign. This campaign aims to demonstrate the red meat industry's environmental credentials by showcasing 100 initiatives the industry is undertaking to deliver sustainable cattle, sheep and goat production (MLA 2013b). The initiative focuses on
‘harnessing the latest technology and science to reduce our footprint’ (Target 100 2013). The 100 initiatives all focus on technological changes and good management practice to improve efficiency. Reducing meat consumption is not mentioned.

Many researchers recognise that technological changes are important but insufficient to address the environmental costs of meat production. Reductions in consumer demand are also needed (Audsley et al. 2009, De Bakker & Dagevos 2012, Garnett 2009, Gerbens-Leenes & Nonhebel 2002, Gold 2004, Koneswaran & Nierenberg 2008, McMichael et al. 2007, Michaelowaa & Dransfeld 2008, Pimentel et al. 2008, Stehfest et al. 2009). For example, Garnett (2008) argues that by 2050 people in the developing world are projected to consume only around half as much meat as developed world populations consume today. Even if technological and managerial approaches were to deliver an extremely optimistic 50 per cent cut in global livestock-generated greenhouse gases by 2050, the benefits would be cancelled out by the increase in demand. Similarly, Friel and colleagues (2009) modelled the impact of strategies for reducing GHG emissions for the UK food and agriculture sector. This analysis determined that a 30 per cent reduction in all UK livestock production would be needed, in addition to technological changes to achieve the UK’s targets for greenhouse gas emissions for 2030. De Bakker and Dagevos (2012) argue that ‘putting all our eggs in the basket of technology’ underestimates the possibility that technological innovations may happen too little, too late, or not at all. It also underestimates the role of individual consumption. While technological action will be necessary and useful, it will not be enough without concurrent changes in consumption.

From a big picture perspective, the impact of reducing meat consumption in some countries such as the United Kingdom, is likely to be relatively small. Garnett (2008) demonstrates that the UK contributes 2 per cent to the world’s greenhouse emissions and, if UK residents managed to reduce food related emissions by 50-70 per cent tomorrow, world greenhouse emissions would only fall by less than a quarter of a per cent (0.2-0.25%). In the context of massive growth in emissions from India, China and other rapidly developing countries, the overall effect on world emissions would be minimal. Alcott also questions whether more frugal lifestyles in the developed world would actually lower overall global environmental impact (Alcott 2008). He cautions that, if we consume less, demand drops and price drops. This allows other people, elsewhere, to take up and consume what was saved. While Alcott agrees that changes in consumption are necessary, he cautions that voluntary behaviour change will achieve no more than to shift around the patterns of consumption. Gossard and
York (2003) are also sceptical that consumers are the answer to reducing meat consumption. They argue that production of meat cannot simply be explained as a direct response to consumer demand, since production is affected by government subsidies and industry groups such as the beef and pork councils. According to Gossard and York (2003), the economic elite control consumer preferences through means of social, psychological and cultural manipulations – for example by the use of advertising. Therefore production may generate consumption because producers, processors and marketers have cultural hegemony, or control over the values and beliefs of a culture.

Others argue that promoting sustainable behaviour is a critical part of society’s response to climate change (Corner & Randall 2011, Cribb 2010, De Bakker & Dagevos 2012, GO-Science 2011, Riley & Buttriss 2011). Consumers have a responsibility to make sustainable food choices and to practise food citizenship. This is the practice of engaging in food-related behaviors that support the development of a sustainable food system (Wilkins 2005). Although changes in people’s diets can appear small, at a population level and over time, small changes can equate to large improvements that can reduce pressure on the global food system (Riley & Buttriss 2011). Individual sustainability is also important as it paves the way for broader social change (Manning 2009). Encouraging people to live and consume more sustainably can help to shift public opinion, which in turn can prompt governments to be bolder in their policy making (Garnett 2008). Motivating change at the consumer level is challenging; however, voluntary measures undertaken by individual consumers are vital in order to put pressure on politicians, retailers and food marketers (De Bakker & Dagevos 2012). Consumer behaviour alone is unlikely to fully address food sustainability. However, in conjunction with technological innovations and policy action, individual consumers can play an important part in triggering change by forthrightly and relentlessly making small decisions (Wilkins 2005).

### 2.7 Synergies with Health Goals

The argument to encourage reduced consumption of meat is strengthened when health considerations are added to environmental considerations. There are important synergies between the goals of reducing food greenhouse gas emissions and improving nutritional health (Garnett 2008, Macdiarmid 2013, McMichael et al. 2007).
Meat can contribute valuable nutrients such as protein, iron, zinc, omega-3 fatty acids and vitamin B₁₂ to the nutritional intake of Australians (Baghurst, Record & Leppard 2000). Some evidence suggests that dietary intakes of zinc and iron are at risk when no or little meat is consumed (Baghurst, Record & Leppard 2000). Currently, one of the Australian Dietary Guidelines is to enjoy a variety of foods from the five food groups each day, including lean meats and poultry, fish, eggs, tofu, nuts and seeds and legumes/beans (NHMRC 2013a). Meat, however, is not essential. It is possible to meet nutritional needs with an appropriately planned vegetarian diet (Craig and Mangels 2009). There is a strong body of evidence that indicates that abstaining from meat may be associated with many health benefits (Dominique Ashen 2013, McEvoy, Temple & Woodside 2012, Zhang et al. 2013).

In the past decade, major meta-analyses have found a statistically significant association between colorectal cancer risk and intake of red meat (Larsson & Wolk 2006, Norat et al. 2002, Sandhu, White & McPherson 2001). For example, in a meta-analysis of prospective studies, Larsson and Wolk (2006) reported a relative risk (RR) of 1.28 (95%CI=1.15-1.48) for colorectal cancer for the highest intake of red meat compared with the lowest intake. A dose-response was observed with an estimated summary RR of 1.28 (95% CI = 1.18-1.39) for an increase of 120 g/day of red meat. In another comprehensive review, the World Cancer Research Fund and American Institute for Cancer Research (WCRF/AICR) concluded that there is convincing evidence that red meats and processed meats are a cause of colorectal cancer (WCRF/AICR 2007). The mechanism remains to be determined and there is debate as to whether fresh, lean red meat carries the same risk as processed or charred meat (Ferguson 2010). Nevertheless, the WCRF/AICR recommend that adults who choose to eat red meat consume less than 500 grams a week, very little, if any, of which should be processed.

Since the WCRF/AICR report, further support for an association between meat and colorectal cancer has been published. Chan and colleagues (2011) updated the WCRF/AICR with a meta-analysis of an additional ten prospective studies published after the report. Their analysis concluded that red and processed meat intake was associated with increased colorectal cancer risk. The summary relative risk of colorectal cancer for the highest versus the lowest intake was 1.22 (95% CI=1.11-1.34) and the relative risk for every 100 g/day increase was 1.14 (95% CI=1.04-1.24). Non-linear dose-response meta-analyses revealed that colorectal cancer risk increases approximately linearly with increasing intake of red and processed meats up to approximately 140 g/day, where the curve approaches its plateau. The associations were similar for colon and rectal cancer risk. When analyzed separately,
colorectal cancer risk was related to intake of fresh red meat (RR for 100 g/day increase=1.17, 95% CI=1.05-1.31) and processed meat (RR for 50 g/day increase=1.18, 95% CI=1.10-1.28). Similar results were observed for colon cancer, but no significant associations were observed for rectal cancer. Some research questions this association between red meat and colorectal cancer, arguing that the summary associations are weak in magnitude and there are methodological weaknesses in some analyses (Alexander et al. 2011). However, the overall evidence supports limiting consumption of red and processed meat in order to prevent colorectal cancer (Aune et al. 2013, Bastide, Pierre & Corpet 2011, Magalhães, Peleteiro & Lunet 2012, Smolińska & Paluszkiewicz 2010, Xu et al. 2013).

Evidence also exists for a relationship with red meat intake and all cause mortality and cardiovascular disease risk (Sinha et al. 2009). A prospective cohort study with approximately half a million men and women aged 50-71 years at baseline found that men in the highest (~68 g/1000kcal) versus lowest (~9 g/1000kcal) quintile of red meat intake had elevated risks for overall mortality (HR 1.31, 95%CI 1.27-1.35), cancer mortality (HR 1.22, 95%CI 1.1.6-1.29) and cardiovascular disease risk (HR 1.27, 95%CI 1.20-1.35). Findings were similar for women. A position statement by the National Heart Foundation of Australia indicates saturated fat is linked to cardiovascular disease and that total saturated fat intake should be limited to 7 per cent of total energy intake (NHF 2009). One strategy for achieving this is to limit meat consumption to small serves of lean meat (NHF 2010). Studies of vegetarians consistently indicate lower incidence of cardiovascular disease (Crowe, Appleby et al. 2013, Huang et al. 2012, McEvoy et al. 2012). Obviously absence of meat is not the only factor at play here but it is hypothesized to be influential.

A recent investigation focused on type 2 diabetes concluded there is an association between high protein intake and risk of type 2 diabetes (HR 1.27 for highest vs lowest quintile, 95%CI 1.08-1.49, p for trend = 0.01) (Ericson et al. 2013). Intakes in the highest quintile of processed meat were also associated with increased risk in this study. Ericson and colleagues’ paper advocates replacing sources of protein such as meat with fibre-rich breads and cereals (Ericson et al. 2013).

Further support for reduction of red meat intakes comes from obesity research. There is evidence that food portions are increasing (Rangan et al. 2009, Smiciklas-Wright et al. 2003). An increase in portion size is one of a range of factors that has been implicated in the rising rates of overweight and obesity (Rolls, Roe & Meengs 2007, WHO/FAO 2003).
rates of obesity in Australia indicate a mismatch between consumption and requirements of all sorts of food, including meat.

A reduction in meat consumption is anticipated to have positive population health outcomes. Reducing meat consumption would very likely lead to a reduction in the incidence of colorectal cancer (McMichael et al. 2007). Some literature estimates that that the risk of colorectal cancer decreases by about a third for every 100 gram per day reduction in consumption of red and processed meat (Norat et al. 2002, Norat et al. 2005). Australian research estimates that reducing red meat consumption to a mean of 50 g/day (350 g/week) for adults could prevent just under 11 per cent of cases of colorectal cancer in Australia (Butler et al. 2010). Reduced consumption of red meat could also lower the risk of other cancers, including breast cancer (Cho et al. 2006, Taylor et al. 2007). Improvements in population cardiovascular health are also predicted (Friel et al. 2009, Lock et al. 2010).

Harnessing the nutrition and sustainability agendas provides two drivers for dietary change, with the opportunity for sustainability messages to be built on top of current public health nutrition messages (Riley & Buttriss 2011). There is a potential ‘win-win’ opportunity for the environment and for public health by moderately reducing population intake of meat.

2.8 Guidelines for Meat Consumption – Dietary

The Educator Guide that accompanies the 2013 Australian Dietary Guidelines recommends that adults consume two to three serves from the ‘lean meats and poultry, fish, eggs, tofu, nuts and seeds, and legumes/beans’ category each day (NHMRC 2013b). Exact recommendations for males and females of various ages are shown in Table 2.2.
Table 2.2: Recommended average daily number of serves for the ‘lean meats and poultry, fish, eggs, tofu, nuts and seeds, and legumes/beans’ food group as specified in the 2013 Australian Guide to Healthy Eating (NHMRC 2013a)

<table>
<thead>
<tr>
<th>Age</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>19-50</td>
<td>3</td>
<td>2.5</td>
</tr>
<tr>
<td>51-70</td>
<td>2.5</td>
<td>2</td>
</tr>
<tr>
<td>70+</td>
<td>2.5</td>
<td>2</td>
</tr>
</tbody>
</table>

According to the Educator Guide (NHMRC 2013b) a ‘serve’ of meat is:
- 65g cooked lean meat (about 90-100g raw weight of beef, veal, lamb, pork, kangaroo or goat)
- 80g cooked poultry (about 100g raw weight of skinless chicken or turkey)

It is understood that the two to three serves from the ‘lean meats and poultry, fish, eggs, tofu, nuts and seeds, and legumes/beans’ category be composed of a variety of choices within the category. Ideally, Australians should choose some meat, some fish and some of the plant foods within the category rather than consume all two to three serves as meat. The guidelines further recommend ‘a maximum of 455g of lean, cooked, red meat per week’ (NHMRC 2013a).

Maximal weekly intakes for meat recommended in the 2013 Australian Dietary Guidelines can be assumed to be as follows:
- Adults males – maximum of 1680 grams of cooked meat per week (3 serves x 80g poultry x 7 days) with no more than 455 grams of red meat per week
- Adult females – maximum of 1400 grams (2.5 serves x 80g poultry x 7 days) of cooked meat per week with no more than 455 grams of red meat

It is not clear whether the Australian Dietary Guidelines recommend a maximum quantity of meat that should be consumed on any one day. The guidelines report level B evidence (probable association) that consumption of greater than 100-120 grams of red meat per day is associated with an increased risk of colorectal cancer (NHMRC 2013a). However, the
guidelines and the accompanying Educator Guide give conflicting information about suitable daily consumption. According to the guidelines, portions of red meat should be limited to 65 grams per day:

To enhance dietary variety and reduce some of the health risks associated with consuming meat, up to a maximum of 455 grams per week (one serve [65g] per day) of lean meats is recommend for Australian adults. (NHMRC 2013a, page 52).

However, the Educator Guide suggests that servings of meat can be accumulated:

Some people might like to eat meat and poultry in larger serve sizes than the sample serves (stated). This is easily accommodated by adjusting serve sizes or numbers of serves over the week. For example, instead of a 65g cooked serve of lean meat each day, 130g cooked weight could be included every second day. (NHMRC 2013b, page 17).

It would make sense for Australians to eat a couple of serves of red meat a few times per week, as opposed to a 65-gram portion every day. However, the Australian Dietary Guidelines lack clarity on this issue.

2.9 Guidelines for Meat Consumption – Sustainability

The Australian Dietary Guidelines were primarily developed with a goal of achieving a nutritionally adequate diet and reducing risk of chronic disease (NHMRC 2013a). There was some effort to address environmental sustainability within the guidelines (NHMRC 2013a). For example, weekly red meat consumption was capped based on health and environmental arguments (DAA 2010). However, in general, dietary guidelines in Australia focus on health rather than the environmental properties of food.

An alternative approach is to base recommendations for consumption on the amount of meat that can sustainably be produced. McMichael and colleagues’ (2007) contraction and convergence approach previously discussed recommends an international target of 90 grams of meat per person per day in all countries, with 50 grams of this from ruminant meat. Researchers from the UK have modeled a dietary intake that meets nutritional requirements but also lowers greenhouse gas emissions (Macdiarmid et al. 2012). The resulting diet included 190 grams of red and processed meat per week. Danish researchers have also undertaken some preliminary modeling of a diet that gives consideration to environmental sustainability (Mithril et al. 2012). Their model includes 85-100 grams of ‘free-range’ meat per day.
Garnett (2008) argues that, in order to avoid a rise in livestock-related greenhouse gas emissions, per capita consumption of meat in the UK would need to be as low as 25 kilograms a year. This equates to half a kilo of meat per person per week. However, Garnett (2008) cautions that even these very low levels of consumption may not actually be sustainable given projected population increases. If consumption was constrained within the limits of ecological capacity, it is possible that even less meat would need to be consumed (Garnett 2008). Concrete recommendations for sustainable consumption of meat are currently lacking. However, it is frequently assumed that intake needs to be lower than our current dietary guidelines recommend.

2.10 How Much Meat is Currently Consumed?

Understanding of the amount of meat consumed by Australians is currently inadequate. There is a lack of recent data collected by direct measurement. Until such data becomes available it is necessary to piece together a picture of Australian meat consumption from a small selection of sources.

Consumer research conducted by Meat and Livestock Australia indicates that meat is an important fixture in Australian meals. The ‘Last Night’s Dinner’ survey was conducted in 2009 (MLA 2009). Telephone interviews were conducted with 1421 Australians aged 18-65 years. This survey concluded that Australians prepare meals at home 5.9 nights per week and 90 per cent of these meals include meat, poultry or fish. ‘Beef steak and vegetables’ was the most frequently consumed meal. Half of the top ten popular dishes involved beef or lamb and another four involved chicken. This research provides evidence of the popularity of meat and the frequency of consumption but does not address the amount of meat consumed at meals.

Estimates of overall meat consumption are available from apparent consumption data. However this tells a limited story. Apparent consumption data is estimated by adding domestic production and imports, subtracting exports and dividing the total by the population. This data represents the amount of meat available for consumption rather than the amount actually consumed. The Australian Bureau of Statistics stopped reporting apparent consumption data for foodstuffs in 2000 (ABS 2012a). The last available data indicated that there was approximately 71 kilograms of meat available for consumption per capita in 1998-99 (ABS 2000). The Australian Bureau of Agriculture and Resource Economics and Sciences (ABARES) used estimates of apparent consumption to report that Australians ate more
chicken in 2012-13 than any other meat (ABARES 2013). In 2012-13, Australians ‘ate’ an average of 44.6 kilograms of chicken meat per person, 32.8 kilograms of beef, 9.5 kilograms of lamb and 26.0 kilograms of pig meat (ABARES 2013). Consumption of beef and lamb is expected to remain steady in the period to 2017-18, consumption of pig meat is forecast to increase slightly to 27 kilograms per person and consumption of chicken is predicted to increase to 47.1 kilograms per person (ABARES 2013). How closely such apparent consumption data matches actual consumption is unknown.

When updating the Australian Dietary Guidelines, Foundation Diets were modeled to determine the least amount of food that would meet the Recommended Dietary Intake (RDI) for ten key nutrients as well as minimal energy requirements (DAA 2010). The Foundation Diet was compared with FAOSTAT data from 2001-2003, representing food available in Australia. This comparison indicated that while 1628 tonnes per year of red meat was available for the Australian population in 2001-2003, only 550 tonnes per year was required to comply with the Foundation Diet (DAA 2010). Of course there are many limitations with this type of raw comparison. However, the data suggests that production exceeds need.

Understanding of actual meat consumption in Australia is limited. The most recent data is from the 1995 National Nutrition Survey (95NNS). This data clearly indicates that Australia is a nation of meat eaters. Only 2.6 per cent of participants (n=13 800) aged 19 years and over self-reported to be vegetarian in the 95NNS (4.9% females, 3.7% males). Mean daily consumption of meat, poultry and game was 200 grams for men and 120 grams for women (ABS 1999). Mean daily intake of red meat on the day of the study was 88 grams (cooked weight of meat, as eaten) for males and 45 grams for females (Baghurst, Record & Leppard 2000). Red meat was considered to be beef, veal and lamb but not pork or cured pork items such as ham and bacon. In these calculations, non-meat eaters were included in the calculation of mean figures; hence intake per omnivore is likely to have been slightly underestimated. Coding decisions meant that mixed dishes were coded as a single food. Therefore foods such as pies, lasagne and commercial hamburgers were coded as ‘Cereal-based Products and Dishes’ rather than ‘Meat, Poultry and Game Products and Dishes’. It is likely that this caused meat consumption to be under-estimated.

Comparisons of food intake data from the 95NNS with the Foundation Diet described above concluded that Australian males could consume 20 per cent less red meat and still meet dietary requirements (DAA 2010). The same comparison found that 40 per cent more from
the ‘meats (minus red meat) and alternatives’ would need to be consumed. Whether or not this needs to come from meats such as pork and chicken or from plant alternatives is not clear.

Meat consumption can also be examined in terms of portion size. A portion can be defined as the total amount of food in grams that a person consumed at a particular eating time. The portion size of foods consumed has a significant impact on nutrient intake and overall energy intake (Rolls, Roe & Meengs 2007). An increase in portion size is one of a range of factors that has been implicated in the rising rates of overweight and obesity (WHO/FAO 2003). Data from the United States of America (USA) indicates significant increases in portion size between national surveys in the USA from 1989-1991 to 1994-1996 (Smiciklas-Wright et al. 2003). Australian evidence is limited but suggestive of a similar trend (Rangan et al. 2007). Further analysis of 95NNS data has concluded that for males aged 30-49 years (n=276) median portion sizes of beef steak were 140 grams (IQR 86-207) and for females (n=182) 90 grams (IQR 58-126) (Rangan et al. 2007). Again there are limitations with this data. The 95NNS was based on the recall of foods consumed at each eating occasion in the previous 24 hours. Participants used aids such as household measures, grids and pictures of foods to quantify portions. The estimation of large portion sizes compared with small portions is deemed particularly difficult (Young & Nestle 1995). People demonstrate wide variations in their perception of ‘small’, ‘medium’ and ‘large’, which can result in inaccurate portion size estimates (Young & Nestle 1995). When shown pictures of foods, some studies suggest that people view any portion they eat as ‘medium’, regardless of its actual size (Smith 1991). The coding of food in the 95NNS as previously described poses further limitations.

Clearly, understanding of the amount of meat consumed by Australians is limited. There is a need for recent direct measurement of meat consumption. Dietary intake data has been collected in the recent National Health Survey (ABS 2013). When released, this will update the 24-hour recall data collected in the 95NNS (ABS 1997). It would be useful to add to this data with some direct measurements of meat intake as measured by weighed food records.

2.11 Influences on Meat Consumption

In addition to understanding how much meat is consumed it is important to understand the influences on meat consumption by meat-eaters in Western culture. Cuisine and meat consumption culture vary widely throughout the world. This thesis does not aim to explore the cultural basis for why different types of meat are consumed or not consumed. Rather it
aims to investigate the influences on those people living in Australia who already choose to eat meat. Over time, a body of research has investigated influences on meat consumption in Western culture. This research is considered limited for three reasons. Firstly, research largely focuses on whether meat is consumed or not consumed. This provides interesting insight into the characteristics of vegetarians and drivers of vegetarianism but less insight into meat-eaters. At the commencement of this thesis there was only a small body of research that investigated trends and influences on meat consumption by meat-eaters (Lea & Worsley 2001, Verbeke & Viaene 1999, Verbeke & Vackier 2004, Verbeke et al. 2010). There is a need for more research on the motives of meat consumption by meat-eaters (Becker, Kals & Frohlich 2004).

Secondly, most research originates from Europe or the United States. It is unknown how relevant findings from these studies are to the Australian context. Meat production and retail markets are different within different countries. For example, Australian beef, lamb and chicken is produced domestically, whereas in European countries imported meat is available. European consumers have been subject to health scares such as bovine spongiform encephalopathy (BSE) and foot-and-mouth disease, whereas Australia has largely been untouched by such scares. It is possible that this has drawn more attention to food safety and animal husbandry issues than in Australia.

Thirdly, recent research is lacking. Attitudes to food change over time. For example, saturated fat and cholesterol were prominent nutrition concerns in the eighties and nineties. More recently, whether deserved or not, messages about the benefits of higher fat and higher protein diets have gained traction.

The available literature on the influences of meat consumption indicates that meat is embedded in the culture of Western countries (De Boer 2006). Historically, meat has been a scarce and highly palatable foodstuff associated with strength, power and masculinity (Twigg 1984). Fiddes (1994) describes how meat is endowed with a unique status in Western culture. This stems from deep-rooted beliefs by which individuals are taught to see the world. He traces this belief system around meat back to Aristotle who said that ‘other animals exist for the sake of man’ and describes how scientific status was given to meat in the 1840s when the ‘protein myth’ popularised notions that animal food was more nutritious than plant foods. At this time, meat was glorified as the essential source of material to replenish muscular strength (Fiddes 1994). As a result of complex influences such as culture’s cosmology, tacit
assumptions, philosophical premises and spirituality, meat has become a food valued above others (Fiddes 1994). Others support Fiddes view, describing how historically meat has played a central role as a symbol of wealth and higher social class and hence has a high status (Kubberod et al. 2002). Throughout history, meat has been associated with power and privilege (Ruby & Heine 2011).

Comparisons of vegetarians and non-vegetarians from various countries provide insight into reasons for avoiding and consuming meat. Such research indicates that reasons for avoiding meat are generally multi-dimensional. However key motives include health, moral concerns, environmental concerns, animal welfare concerns, disgust for the sensory qualities of meat and social influences (Beardsworth & Keil 1991a, Fox & Ward 2008, Kenyon & Barker 1998, Lea & Worsley 2001, Povey, Wellens & Conner 2001, Richardson, Shepherd & Elliman 1993, Rozin, Markwith & Stoess 1997, Santos & Booth 1996). Reasons for choosing to eat meat include sensory properties (taste and texture), nutrition, health, social and cultural influences, and convenience (Anderson & Shugan 1991, Bredahl, Grunert & Fertin 1998, Grunert 1997, Kenyon & Barker 1998, Latvala et al. 2012, Lea & Worsley 2001, Richardson 1994, Richardson, Shepherd & Elliman 1993, Shearer, Burgess & English 1986, Verbeke et al. 2010). Teasing out the relative weight of influences is not easy. Especially as some research indicates that there is ambivalence to meat – i.e. having both positive and negative evaluations towards a behaviour (Berndsen and & Van der Plight 2004). People who are ambivalent to meat have mixed feelings about meat. For example, they might like the taste and iron provided by meat but worry that meat is fattening or cruel to animals. Over time, attitudes associated with meat have changed. In the 1940s and ’50s, price and availability were important factors influencing meat purchase whereas more recently stronger influences include convenience, ethics, nutrition, ecology, use of additives/hormones/antibiotics and risk of food poisoning (Bansbeck 1995, Latvala et al 2012, McCarthy et al. 2004, Richardson 1994, Verbeke 2010).

al. 2002). However for ‘meat appreciators’, hedonic factors play an important role in meat consumption (Richardson 1994, Rousset et al. 2005). A powerful belief against eating vegetarian meals is the belief that they are boring or bland (Povey, Wellens & Conner 2001).

Some European research indicates that consumers may place more importance on food safety than taste (MacBean 1996). Over the last decade media coverage has highlighted health and safety scares. Consequently consumers have become more aware of hazards such as antibiotic residues, bovine spongiform encephalopathy (BSE) and hormones (McCarthy et al. 2004). This has caused some to see meat as a potential carrier of dangerous contaminants that may lead to various diseases (Fiddes 1991, Kubberod et al. 2002). A UK study found that declines in the safety of meat would predict a reduction in future meat consumption (Richardson, Shepherd & Elliman 1993). Whether or not this applies to Australian consumers is uncertain.

Literature consistently indicates that health goals influence meat consumption. However, the direction of the influence can vary. Meat consumers typically view meat as an important provider of protein and iron and therefore consider meat essential for health (Kubberod et al. 2002). However, other research indicates that concerns about cholesterol and saturated fat discourage meat consumption (Richardson 1993). For example, a survey of over 1000 UK residents about influences on meat consumption found that changes in the nutritional value of meat would predict a change in future meat consumption (Richardson, Shepherd & Elliman 1993). Respondents would eat more meat if the fatty acid profile were more favourable (more polyunsaturated fat and less saturated fat). This was at a time when messages about red meat and saturated fat were prevalent. Whether this remains as a strong influence is unknown. A recent study of Finnish consumers identified that a small proportion (13%, n=1623) of meat consumers had recently shifted their consumption to more vegetables and less meat (Latvala et al. 2012). Healthiness was the most salient reason stated for this change in consumption.

One cross-sectional survey of 415 Australian residents examined consumers’ readiness to change to a plant-based diet (Lea et al. 2006a). This study identified that participants already eating a plant-based diet (in action/maintenance stage of change) perceived there to be weight and health benefits of consuming a plant-based diet, whereas those in pre-contemplation did not recognize these benefits (Lea et al. 2006a). Further research is required to understand if health concerns influence meat consumption in Australian consumers.

Animal welfare and environmental considerations are also cited as influences on meat consumption (Beardsworth & Keil 1991b, Harrington 1991, Latvala et al. 2012, Lindeman &
Vaananen 2000, Povey, Wellens & Conner 2001). Terminology to describe these influences varies and in some studies they are combined as one influence. Concern for animal welfare may be higher for some types of meat than others. For example, an Irish study found that animal welfare was a significant determinant of attitude in the case of pork but not poultry (McCarthy et al. 2004). Various literature predicts that environmental and animal welfare concerns will become more critical factors for meat consumption in the future (Lea & Worsley 2003, Lindeman & Vaananen 2000). However, evidence of this actually occurring is limited. Fessler and colleagues (2003) conducted a web-based survey of 945 adults in the United States and asked those who ate meat less frequently for reasons for not eating meat. In this survey ethical and environmental reasons were most often selected, more so than health and sensory reasons (not liking the taste). A study by Verbeke and colleagues (2010) investigated pork-related consumption patterns and attitudes in five countries (Belgium, Denmark, Germany, Greece and Poland). They found that both environmental and animal welfare issues were gaining increasing importance among European consumers with 15 per cent of participants identified as ‘environmentally conscious citizens’ and 11 per cent as ‘animal welfare conscious citizens’. However, the authors also noted that the association between attitudes and actual consumption behaviour was not very strong. While it is speculated that environmental concerns will impact on Australian meat consumption, current evidence for this is lacking.

In order to move meat consumption in a more sustainable direction it will be necessary to understand current forces that influence meat consumption in Australian meat-eaters. Rather than focus on why some people choose to eat meat and others choose to be vegetarian, it is important to understand what influences the type and amount of meat consumed by meat-eaters. To date, only a small body of research has focused on influences on the amount of meat consumed by meat-eaters and on consumer willingness to eat a more plant-based diet (De Boer & Aiking 2011, Elzerman et al. 2011, Gossard & York 2003, Latvala et al. 2012, Lea, Crawford & Worsley 2006a, Lea, Crawford & Worsley 2006b, Schösler, de Boer & Boersema 2012, Wansink 2002). There is a need for investigation of influential factors on Australia meat consumers in order to move towards more sustainable consumption.
2.12 Approaches to Sustainable Meat Consumption

This section summarises current ideas for consuming meat in a more environmentally sustainable way. Scientific literature, policy documentation and the popular media have informed this section. Many of these ideas are in their infancy and considerable evidence is required to strongly support the environmental cost/benefits of some approaches. The full nutritional impact of some approaches also needs to be fully investigated. For example, it will be important to model the likely impact of a reduction in consumption of meat on micronutrient changes to ensure that change in policy does not exacerbate the problem of low micronutrient intake in some population groups (Riley & Buttriss 2011). Rather than waiting until further evidence is accumulated, it is important to understand consumer views of dietary choices considered to be more sustainable and the level of acceptability of some of these ideas.

2.12.1 Simply Eat Less Meat

Meat consumption can be reduced if individuals either consume smaller portions or consume meat less frequently. This is an obvious statement. However, it is useful to consider if one strategy might be more or less preferable than the other. Thus far, communication has mainly focused on eating meat less frequently. For example, the chairman of the United Nations Intergovernmental Panel on Climate Change (2008) has urged people to have one meat-free day a week initially, then go on and reduce meat intake further from there (Jowit 2008). Meat Free Monday (also called Meatless Monday) is a social marketing campaign initiated by Sir Paul McCartney in 2009 (Rigg 2011), which is now active in over ten countries including the USA, Britain and Canada. In 2010, Meatless Mondays Australia commenced operation in Australia. The organisation invites people to pledge to give up meat at least one day per week (MMA 2013). This message has now infiltrated popular media with food magazines and food websites featuring ‘meat-free’ specials. Some groups have taken the message further, challenging consumers to be a ‘weekend vegetarian’ or ‘weekday vegetarian’ (Grundy 2011).

An alternative option to changing the frequency of meat consumption is to allow consumers to retain their typical meal patterns but reduce the portions of meat consumed. The Educator Guide that accompanies the Australian Dietary Guidelines describes recommended quantities of meat to eat in a healthy diet (NHMRC 2013b). However, it is unclear whether these recommendations are being followed. Currently, there is little evidence to inform if a preferable strategy is to provide education regarding the frequency or quantity of meat consumed.
2.12.2 Replace Meat with Plant foods
Substantial modelling evidence demonstrates that replacing meat with plant foods can reduce the environmental footprint of the diet while continuing to meet nutritional goals (Carlsson-Kanyama & Gonzalez 2009, MacDiarmid et al. 2012, Pimentel & Pimentel 2003, Reijnders & Soret 2003). For example, Pimentel and Pimentel (2003) compared the resources required to produce isocaloric meat-based and plant-based diets in the USA and concluded that the meat-based diet required significantly more land, water and fossil energy than the plant-based diet. Reijnders and Soret (2003) calculated that a diet based on vegetables, cereal, and legumes instead of meat requires 6–17 times less land, 4.4–26 times less water, 6–20 times less fossil fuel, and 7 times less phosphate rock (Reijnders & Soret 2003). Macdiarmid and colleagues (2012) used a modelling approach to produce a diet that met the dietary requirements of an adult woman (19–50 years) while minimizing greenhouse gas emission. Acceptability constraints were incorporated into the model to include foods commonly consumed in the United Kingdom in sensible quantities. These researchers were able to produce a sustainable diet that met dietary requirements for health and was associated with 36 per cent less greenhouse gas emissions. It was not necessary to forgo meat completely in this model. However, the final diet included 372 g/week of meat (190 g/week red meat). Additional plant foods were included in the diet to meet dietary requirements. Similar findings are reported in other comparisons of omnivorous and vegetarian diets (Marlow et al. 2009). A plant-based diet, therefore, offers a promising solution for mitigating climate change and improving environmental sustainability (Chiu & Lin 2009). Unfortunately, there is a lack of this type of work specific to the Australian diet but it is reasonable to expect similar findings if this evidence was available.

2.12.3 Eat Lower on the ‘Meat Hierarchy’
Another approach to reducing the environmental impact of meat consumption is to choose different types of meat. It is evident that some types of meat have less impact on the environment than others. Ruminants emit more greenhouse gas than non-ruminants (Reijnders & Soret 2003). There are also differences in ‘feed conversion efficiency’ for different animals, with some animals emitting more greenhouse gases or requiring greater feed and water inputs for a given quantity of nutritional output (Garnett 2008). For example, Pimentel and Pimentel (2003) compared the resources required to produce different foodstuffs. While only 2.3 kilograms of grain was required to produce 1 kilogram of broiler (poultry), 5.9 kilograms was required to produce 1 kilogram of swine (pork), 13 kilograms of grain plus 30
kilograms of forage was required to produce 1 kilogram of beef and 21 kilograms of grain and 30 kilograms of forage was required to produce 1 kilogram of lamb. Water, land resources and fossil energy requirements were also much higher for beef, lamb and pork compared with chicken. Similarly, Swedish researchers identified red meat as having a higher environmental impact than other food sources (Carlsson-Kanyama & Gonzalez 2009). In this research nitrous oxide emissions for poultry were calculated to be low at 0.26 kg CO$_2$-e/kg carcass and methane emissions were almost nil. In contrast, combined nitrous oxide and methane emissions for pigs was 2.75 kg CO$_2$-e/kg carcass and 10.43 kg CO$_2$-e/kg carcass for cattle.

Garnett (2008) points out that these comparisons can be over simplistic. As discussed previously, ruminants in some production systems consume grass and fibrous by-products that cannot be eaten directly by humans. While monogastrics (pigs, poultry) produce less methane than ruminants, they are more dependent on cereals. Pigs and poultry consume grains that humans could eat directly and therefore they are inherently more implicated in land use change and the subsequent carbon dioxide impacts. Nonetheless, the feed conversion ratio does vary between different types of animals. Beef and lamb typically require more input than pork and poultry. Poultry and pigs are much more efficient converters of plant energy into animal energy and they produce much less methane emissions. Hence some researchers support moves to encourage a preference for poultry and pork over beef and lamb (FAO 2009, Garnett 2008, McMichael et al. 2007, Weber & Matthews 2008).

There is also an argument for making greater use of other types of animals. Kangaroo is an obvious one in Australia. Kangaroos are abundant in the temperate Australian rangelands where cattle and sheep are raised. The kangaroo population in Australia is estimated around the 25 million mark (similar to the national beef herd) (KIAA 2013, MLA 2013a). Each year the National Parks Authorities in each state survey kangaroo populations and set quotas for culling. Kangaroos are considered to compete with livestock in dry times and hence are labeled a pest by many livestock producers (Wilson & Edwards 2008). Typically, about 15-20 per cent of the total kangaroo population is identified for culling each year (KIAA 2013). Carcasses are processed to human-consumption standard and some kangaroo meat is currently exported and sold in Australia to the food service industry and retail outlets. However, primarily the meat is sold as pet food or discarded (Kelly 2005).

Kangaroos are frequently cited as having a lower impact on the environment than cattle. There are several reasons behind this argument. Firstly, kangaroos are ‘nonruminant
forestomach fermenters’ that produce less methane than cattle (Wilson & Edwards 2008). Direct measurement of one kangaroo species (*Macropus rufogriseus*) indicates the amount of methane produced is between 25 and 33 per cent of what is expected from ruminants fed the same diet (Madsen & Bertelsenj 2012). It has been estimated that if livestock were reduced on the rangelands where kangaroo harvesting occurs and kangaroo numbers were increased to produce the same amount of meat, Australia’s greenhouse gas emissions could be reduced by 16 megatonnes (3 per cent of Australia’s annual emissions) by 2020 (Wilson & Edwards 2008). It is also argued that reducing livestock in favour of kangaroos could significantly reduce emissions of nitrous oxide created from production of livestock feed and animal waste (Isaac 2008).

In addition, the padded feet of kangaroo cause less damage to topsoils than the hooves of introduced species such as cattle and sheep. Replacing hard-hoofed livestock with kangaroos is anticipated to reduce damage to riparian environments (land surrounding water sources), improve soil conservation and increase the capacity of vegetations to respond after drought (Wilson & Edwards 2008). Kangaroos have evolved to survive in the Australian landscape with very little water, as opposed to livestock that require large amounts of supplemental water (Isaac 2008). Direct observation of kangaroos in one study indicated they used just 13 per cent of the water used by sheep (1.5 L/day for kangaroos vs 12 L/day for sheep) (Munn, Dawson & McLeod 2010). A lower requirement for water also means that kangaroos are not water-focused in their grazing patterns; hence their impact on the rangelands is more broadly spaced (Munn, Dawson & McLeod 2010).

An argument could also be made to encourage a preference for rabbit or even guinea pig. These smaller animals are capable of breeding and growing quickly (Taylor & Kruger 2006). They use feed efficiently and, collectively, they are capable of producing substantial quantities of meat in a short time period (Dalle Zotte 2002). In other parts of the world, these animals are consumed to a much greater extent than in Australia. Global rabbit production is in the vicinity of 1.1 million tonnes of carcass meat, or approximately 857 million rabbits (Eady 2008). Europe and China are the main global producers (Eady 2008). Meat rabbit farming in Australian is a new and relatively recent industry, being established over the last 10-15 years. The CSIRO has developed a commercial rabbit-breeding program using the Crusader rabbit and is supporting expansion of the commercial rabbit industry in Australia (CSIRO 2013). A key barrier to rabbit consumption is that rabbit does not appeal to younger people because of the way it has been traditionally presented (whole carcass with head on)
and the time required for preparation (Eady 2008). Changes such as selling rabbits without heads and marketing rabbit as portions and cuts that can be cooked quickly are occurring in Europe (Eady 2008). A report from the Rural Industries Research and Development Corporation (RIRDC) recommends that similar strategies be introduced in Australia to encourage greater rabbit consumption (Eady 2008).

Commercially, rabbits are typically bred in intensive operations similar to chickens. Environmental considerations include energy to run temperature control and ventilation systems, water use for cleaning and management of manure (Taylor & Kruger 2006). Extensive data on the environmental impact of rabbit meat production is lacking. However, there are good reasons to speculate that the impact would be significantly less than for ruminant meat.

Insects are another source of meat that sit favourably on the meat hierarchy. Throughout the world many people eat insects out of choice. They provide a valuable source of protein and other nutrients and have an established place in local food cultures (DeFoliart 1999). Environmental pressures and issues such as food security have triggered some to propose a greater focus on insects as a source of food. The FAO released a report in 2013 exploring the use of edible insects (Van Huis et al. 2013). This report highlights the environmental benefits of using insects for food, including the high feed conversion efficiency, the capacity to rear insects on organic side-streams such as human and animal waste, the lower greenhouse gas emissions compared to cattle and pigs and lower requirements for resources such as land and water (Van Huis et al. 2013). While the idea of eating insects is unpalatable within most Western countries, some argue that this needs to change (Van Huis et al. 2013). Insect rearing for food is currently in its infancy. However research into innovation in mass-rearing systems has begun in many countries. Research and development is also under way to develop more palatable ways of consuming insects. There might be resistance to consuming insects whole. However, consuming insects in a ground or paste form or as a protein extract might be more acceptable, especially if incorporated into well-known convenience foods (Schösler, De Boer & Boersema 2012, Verkerk et al. 2007, Vogel 2010). More work needs to be done in this area. In the meantime, it is important to explore attitudes to eating insects in an Australian population.

Potentially there are other sources of meat available in Australia that would be given a lower rank on the ‘meat hierarchy’. For example, emu, crocodile and alpaca meat is marketed in
Australia and research and development is occurring to expand these industries (RIRDC 2006). Currently it is not possible to compare the environmental costs of these meats with more familiar choices such as beef and lamb. However, it is useful to gauge consumer acceptance of replacing commonly consumed meats with some of these potentially lower impact meats.

2.12.4 Organic Meat

Meat that is produced organically is often promoted as environmentally preferable to meat produced by conventional production systems (FAO 1999). Organic farming means farming in a way that cares for the environment, without relying upon synthetic chemicals and other unnatural interventionist approaches (AO 2013). In organic systems, animals must be fed certified organic feeds, cannot be fed or treated with growth promotants or antibiotics during their lifetime and must be able to roam and graze freely, performing their natural behaviours (AO 2013). Organic farming of feed crops places an emphasis on building soil fertility through the addition of organic inputs and the use of legumes. This helps sequester carbon in soils and reduces reliance on energy intensive synthetic fertilisers (Garnett 2008).

There are mixed views on the environmental impact of organic farming (Gomiero, Paoletti & Pimentel 2008). For some indicators, such as energy use, organic farming tends to score more favourably than conventional farming (Tuomisto et al. 2012). However, for other areas, conventional farming is considered to have a lower impact. A meta-analysis of European research concluded that organic farming practices generally have positive impacts on the environment per unit of area, but not necessarily per product unit (Tuomisto et al. 2012). Organic livestock systems are typically associated with greater greenhouse gas emissions than conventional farming systems (Casey & Holden 2006, Peters et al. 2010, Thomassen et al. 2008), primarily because livestock reared organically take longer to reach slaughter weight (Peters et al. 2010). There are also differences in the digestibility of commercial versus organic feed. Once accustomed to a commercial, grain-based diet, cattle produce less methane when fed commercial feed (McMichael et al. 2007). In addition to questions about the environmental credentials of organic meat, there are concerns about the capacity of organic agriculture to adequately feed the population (Fairlie 2010).

Consumers purchase organic food for a number of reasons including health, environmental concerns and quality (Hughner et al. 2007, Lockie et al. 2002, Pearson, Henryks & Jones...
Currently, consumer understanding of the environmental credentials of organic meat and the extent that this influences purchasing is largely unknown.

**2.12.5 Meat Alternatives**

Replacing meat with ‘meat alternatives’ has been proposed to help to reduce the environmental burden of food production systems (Aiking, De Boer & Vereijken 2006, Elzerman et al. 2011, Helms 2004, Hoek et al. 2004, Hoek et al. 2011, Jongen & Meerdink 2001, Smil 2002). Meat alternatives are protein-rich products made from pulses (mainly soy), cereal protein or fungi (Hoek et al. 2011). They are also known as novel protein foods, meat substitutes, meat replacers or meat analogues. Tempeh and tofu are arguably the most commonly known meat alternatives. These products originate from soybeans. A range of soy-based sausages, burgers and chunks are also available in Australia. In 2010, Quorn™ products were introduced to Australian supermarkets (Marlow Foods 2013). Quorn is produced from the fungus *Fusarium venenatum* (O’Donnell, Cigelnik & Caspar 1998). Quorn products are available in a range of pre-made products and meals.

Some evidence indicates that some meat alternatives have preferable environmental credentials to some meat (Aiking, De Boer & Vereijken. 2006, Jongen & Meerdink 2001, Zhu & Van Ierland 2004). For example, Zhu and Van Ierland (2004) used lifecycle analysis to compare pork and novel protein foods. Their data indicates that replacing pork protein with plant protein can reduce environmental pressures. The pork supply and consumption chain contributed 61 times more to acidification, 6.4 times more to global warming, 6 times more to eutrophication and required 3.3 times more fertiliser, 1.6 times more pesticide, 3.3 times more water and 2.8 times more land. The Dutch Sustainable Technological Development (STD) research program is backing a conversion from meat to meat alternatives (Beekman 2000). Meat alternatives are considered to have an environmental impact that is lower than meat by a factor of five to thirty (Beekman 2000). Consequently, the STD is aiming for a 40 per cent conversion from meat to meat alternatives by 2040 in Denmark (Beekman 2000). Others caution against the use of meat alternatives, warning that the use of imported products can be associated with significant emissions from transportation and that the production of soy analogues might lead to deforestation to make way for farmland (Audsley et al. 2009). Data comparing the environmental impact of meat and meat alternatives available in Australia is lacking.
A well-known limitation to consumption of meat substitutes is the unfavourable sensory characteristics (Beekman 2000, Hoek et al. 2004, Hoek et al. 2011, McIlveen, Abraham & Armstrong 1999). A preferable alternative may be artificial meat. Artificial meat, also called in vitro meat, synthetic meat, and cultured meat is now being grown experimentally in several laboratories around the world (Datar & Betti 2010). A range of techniques are currently under investigation, including culturing and differentiating stem cells of animal species to produce skeletal muscle cells, organ printing and scaffolding techniques where skeletal muscles cells are grown on mesh (Haagsman, Hekkingwerf & Roelen 2009, Hopkins & Dacey 2008). This work is currently experimental and artificial meat has not yet been released commercially for human consumption. Supporters argue that artificial meat will offer many environmental benefits to meat produced by current means, including reduced water, energy and land requirements (Datar & Betti 2010). One group estimates that average energy use, greenhouse gas emissions, land use and water use is significantly lower (45-98%) for artificial meat (Haagsman, Hekkingwerf & Roelen 2009). Potentially, artificial meat can allow humans the pleasure of eating meat without animal suffering or environmental damage (Hopkins & Dacey 2008). Incorporation of genetic engineering techniques could also see new qualities of meat produced that are healthier (higher omega-3, lower saturated fat) and tastier than conventional meat (Hopkins & Dacey 2008).

Australian consumer views of the use of artificial meat are currently not documented.

2.12.6 Waste Less – Eat Tongue-to-Tail
A stroll down the meat section of any supermarket in Australia will indicate that Australians have a preference for purchasing meat as boneless, quick-cook fillets. There will be a few products with bones, such as chops and drumsticks, and a smattering of offal. However, many edible components of animals won’t be available for sale. Some argue that Australians should be more adventurous and eat ‘tongue-to-tail’ or ‘nose-to-tail’ (Ethical Eats 2013, Maurer 2005, Ripe 2008). This essentially means eating all edible components of an animal. Fergus Henderson, author of *The Whole Beast: Nose to Tail Eating* (2004), is arguably the ‘poster boy’ for tongue-to-tail eating. His infamous book demonstrates how to cook and eat an entire pig. Henderson is renowned for saying, ‘If you’re going to kill the animal it seems only polite to use the whole thing’ (*The Age* 2012). Others who share Henderson’s views have labeled pork as the ‘ultimate sustainable meat’ as it is possible to eat the entire animal (Tuffey 2012).
From a sustainability perspective, tongue-to-tail eating is about wasting less meat. Theoretically, eating more meals from one animal would mean that fewer animals would need to be reared overall. Whether or not this is a legitimate sustainability argument remains to be determined. Some meat that is not eaten by humans in Australia is utilised as pet food or exported to Asian countries. Australian beef and veal offal exports during January to April 2012 hit a new high for the first four months of a calendar year, reaching 38,809 tonnes swt (MLA 2012). An increase in consumer demand for different cuts of meat and offal might just cause a redistribution of supply, rather than a reduction in production.

The nutritional viewpoint on eating some types of meat is unclear. The Australian Dietary Guidelines recommend consumption of ‘lean meats and poultry’ (NHMRC 2013a). This definition of meat does not include offal (organ meats) or higher fat cuts of meat such as lamb neck, osso bucco and shanks. The guidelines identify offal as a source of valuable omega-3 fatty acids (NHMRC 2013a). However, readers are left wondering how offal and other sources of ‘non-lean’ meat such as shanks, neck and tail should be included in a healthy diet.

Some literature describes changes in preferences for different types of meat over time (Sexton 1995). Time pressure, changes in food literacy and increasing availability of preferred food choices are possible explanations (Banwell et al. 2012, Beshara, Hutchinson & Wilson 2010, Vileisis 2008). The validity in promoting a return to some disappearing consumption practices in a bid to influence sustainability is currently unexplored.

2.13 Chapter Summary

This chapter has summarised a range of literature relevant to the multiple dimensions of this research project. It demonstrates that there are strong health and environmental arguments for reducing meat consumption in industrialised countries. Current understanding of the amount of meat used and discarded by Australian meat-eaters is inadequate. Strategies for encouraging more sustainable use of meat are emerging. However, there is limited, if any, understanding of consumer acceptance of these ideas in Australia. In order to inform best practice in the healthy and sustainable use of meat, there is a need to better understand the way meat is used and viewed by meat-eaters in Australia. The following chapter will explain the methodological approach used to explore this topic.
Chapter 4 - Findings

4.1 Introduction to Chapter

Chapter four presents findings from the three phases of research undertaken for this doctoral study. As discussed in chapter three, mixed methods research aims to integrate findings arising from different research methods (Johnson & Onwuegbuzie 2004). Hence, rather than present the findings from each phase separately, data from all phases has been synthesised and presented under four key topic areas:

- Procurement
- Consumption
- Discard
- Reducing meat consumption

A final synthesis of the most important findings across these four topic areas is also included.

Using Creswell’s approach to mixed methods research, the qualitative findings from Phase One have priority (greatest influence) in this research design (Creswell & Plano Clark 2011) and therefore provide the basis for this chapter. Findings from Phase Two and Phase Three are integrated into the chapter where relevant.

Comments from participants in Phase One have been included throughout this chapter to illustrate concepts raised. Participants have been given pseudonym names. They are further described by age and either reported meat consumption per individual per week or according to whether or not they were identified as discarders or non-discarders.

Comments from Phase Two survey respondents are described by gender and age where demographic data was available.

4.2 Procurement

Fifteen households participated in Phase One (food records and qualitative interviews). Within these households, meat was procured in a variety of ways, including supermarkets, butchers, home delivery services, specialty providers, farmers’ markets, own produce and hunting. Appendix E shows the procurement methods for each household. Most households
obtained meat weekly. Some purchased meat as required and others obtained meat less frequently in bulk amounts. Regardless of the method of procurement, Phase One participants prioritised sensory properties such as taste and texture as key influences on procurement. The desire for safe meat also had a strong influence with participants particularly seeking meat that was perceived to be ‘chemical-free’. The way meat is produced influenced participants to differing extents and for different reasons. Health and environmental characteristics were less important. Findings from Phase Two (quantitative survey) support the qualitative findings from Phase One. The only area where the two sets of data diverged was on the issue of the financial cost of meat. Survey findings indicate that cost of meat was a significant consideration when choosing meat. This was not the case for the participants in Phase One.

4.2.1 Participants seek meat that is tasty and tender

When asked, ‘What is important to you when buying meat?’, Phase One participants universally identified taste and texture as the most important considerations. Meat was described as a ‘tasty’ and ‘satisfying’ food with sensory characteristics unmatched by other foods.

I like my meat. Nothing else really tastes as good. And I guess it’s the texture too. Other foods aren’t as satisfying to me. Lara (41 years, 960 g/week)

This is clearly supported by results from the Phase Two survey. Just under 600 survey respondents indicated the importance of various characteristics when choosing meat. Figure 4.1 summarises the results. Nearly all survey respondents (96%, n=573) identified that taste was important or very important when choosing meat.
Phase One participants could clearly identify that they sought tender, flavoursome meat. However, when asked how they select meat with these characteristics, participants were unsure. Visual markers such as colour and presence of fat were identified. For example, some participants indicated that red meat with a bright red colour was considered fresher and hence likely to have a better flavour and texture.

Well colour would be first up if I’m talking about beef. I guess that’s about freshness. I also don’t want something that’s as tough as old boots. It has to taste good and if it looks good it’s likely to taste good. Jane (39 years, 1040 g/week)

Visually, the presence of fat was also seen as an indicator of tender meat.

I guess I choose based on texture and probably taste. I look at the sinew and fat and stuff to see if it’s more tender. Liam (21 years, 1750 g/week)

Mostly participants indicated that through trial and error they had found a supplier of meat that reliably provided tasty and tender produce.

I only buy meat at the Supabarn or the butcher at the market. I always get good meat there. Occasionally, I go to Coles or Woolies but it’s never as good. Tanya (47 years, 800 g/week)

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*Centred Count Views have been provided for data obtained from questions using 5-point Likert scales. Neutral responses are not shown in order to highlight important/unimportant responses.*
4.2.2 Participants seek meat that is safe

Interestingly, safety was a prominent consideration when choosing meat. Safety was described in terms of freshness and absence of food-borne pathogens. However, the most prevalent safety concern related to the presence of unwanted chemicals.

I mean, you can get bad things from meat. I know they can spray all sorts of things on it to keep meat red. Once I was cooking some mince and it had a weird smell and that made me think well they’re putting chemicals in this to make it look good. Tanya (47 years, 800 g/week)

This concern about safety was also apparent in the Phase Two survey findings. Figure 4.1 indicates that approximately two-thirds of respondents indicated that they sought meat that was chemical-free (77%, n=460) and hormone-free (75%, n= 448). The terms ‘chemical-free’ and ‘hormone-free’ are surrogates for more technically correct terms such as ‘additive-free’, ‘pesticide-free’ or ‘preservative-free’. These original terms arose from interviews and were used as they are more familiar to the general public. Phase One participants frequently referred negatively to the presence of ‘chemicals’ and ‘hormones’ in meat. As indicated in chapter three, Coles supermarket launched a ‘hormone-free’ meat campaign during Phase One, which may have heightened the interest in ‘hormone-free’ meat.

Access to ‘safe’ meat was a key factor in determining where Phase One participants obtained meat. However, participants had differing ideas about where safe meat could be found. Some felt that the butcher was the best option.

I prefer to buy a fresh piece of meat sitting in a chiller than pre-packaged meat at the supermarket. It’s fresher at the butcher. When it’s sitting in Woolies you don’t know when it was cut or packed. At the butcher you know that you’re fairly close to having it on the shelf when he cuts it. I don’t want to get sick and it doesn’t taste good when it’s all old and dry. Adam (32 years, 1050 g/week)

Others had similar motivation but thought the supermarket was a better option.

I buy my meat at Coles. I’m happy with Coles. It’s a big name so they’re not going to do dodgy things. So it’s confidence that you’re getting what you pay for. With small vendors, you hear lots of stories about dodgy practices and you just don’t want to risk that for your family or yourself. At Coles I feel like I can trust them so I don’t feel like I have to worry. I know the stock is replenished all the time. Such a high volume of people go through it that it’s not going to be sitting for days. It gives me confidence that it will be safe to eat. Nadine (35 years, 870 g/week)
4.2.3 Participants seek meat that is produced ‘naturally’

Few Phase One participants spontaneously identified that meat production methods influence their decision-making when procuring meat. However, when probed, many participants revealed that production is important. There was an overwhelming desire that meat is produced as ‘naturally’ as possible.

I think it would be better if we could get natural animals I suppose, or wild animals. The more wild and natural the food the better I think. Glenda (58 years, 1960 g/week)

Leon thinks I’m stupid but I buy the free-range type chicken and like some organic stuff … I don’t know why. I just don’t like the idea of things being genetically modified and all that sort of thing. It just doesn’t seem natural. Sarah (30 years, 880 g/week)

Some Phase One participants wanted meat that was produced ‘naturally’ because it was thought to have better sensory characteristics such as taste and texture.

I imagine that the cow gets to roam free and is fed nicely and gets a cuddle. I think if the cow has a happy life it will create happy meat. I’m hoping it will taste better and it will be less tough because it’s had a happy life. Kate (34 years, 1400 g/week)

Mum actually said this week that Coles has got this new meat that’s killed nicely. I haven’t seen it but she said you could definitely taste the difference in the flavour. I’d be interested to try that … Your normal killed meat, they’re under extreme stress when they’re slaughtered … so it does affect the quality of the meat. Whereas your organic meat which is slaughtered completely differently, the animal is calm when it’s killed. Nadine (35 years, 870 g/week)

Some participants wanted ‘naturally’ produced meat because they believed it had better health properties.

I prefer the grass-fed because that’s closer to the animal’s natural life. You see, most food that’s sold in America and an increasing proportion in Australia is feedlot meat. That’s basically couch potato animals and they’re almost on the verge of animal diabetes. Because they’re fairly sick, they have an unhealthy range of fats in them. Whereas sheep from the farm that I go to are just fresh on grass – that’s all they’ve ever eaten. They are healthy animals and I want to eat healthy meat. Kevin (61 years, 2975 g/week)

‘Natural’ meat was also desired because of concerns about humane treatment of animals.

It’s just awful the way they treat pigs and you know in the feedlots for beef. It’s not natural to torture animals and treat them badly. Glenda (58 years, 1960 g/week)
You drive past farms and you actually see one lonely tree in the paddock and those poor cattle trying to all go under the tree. It doesn’t seem natural. Nadine (35 years, 870 g/week)

Phase Two survey respondents also indicated a desire for meat that was produced humanely. Just over 70 per cent (71%, n=360) of respondents indicated that humane treatment of animals was important or very important (see Figure 4.1). In addition, approximately two-thirds (66%, n=394) of survey respondents indicated that free-range meat was important or very important. The survey findings do not provide any insight into why these factors are important. However, it does support the view that there is a desire for meat that is produced ‘naturally’.

4.2.4 Procurement is less affected by environmental considerations

Procurement of meat was not largely influenced by environmental issues. Awareness of the environmental impact of meat production varied among Phase Two participants. However, even the most environmentally aware did not consider environmental impact when purchasing meat. Kate had some awareness that red meat is associated with high greenhouse gas emissions. However, this knowledge did not influence her purchasing.

I’m aware that beef and lamb is associated with higher greenhouse gas emissions and all that but it hasn’t yet convinced me not to buy it ... Meat’s such a staple part of the Australian lifestyle that that doesn’t convince me not to buy it. Kate (34 years, 1400 g/week)

Similarly, Liam described himself as being quite environmentally aware and concerned. However, meat was considered such an essential part of his diet that environmental issues didn’t have any impact.

I like meat so as long as it’s produced I’ll eat it. Liam (21 years, 1080 g/week)

Jack had a very good awareness of environmental issues and actively took many measures to reduce his environmental footprint. Jack had been a vegetarian for many years before reintroducing meat to his diet. He was very aware of the current dialogue about the environmental impact of meat but felt that other actions were more important to lower environmental impact.

To be honest we probably could do more for the planet rather than give up meat. We could probably do more by only eating locally grown vegies and things so that you don’t have the transport effect. Jack (70 years, 590 g/week)

This finding that environmental issues are less important when procuring meat is echoed to some extent in the Phase Two survey findings. Just over 40 per cent (43%, n=257) of survey
respondents indicated that the environmental impact of meat is important or very important (see Figure 4.1). While this value is just under half of the survey respondents, it is significantly less than the number of respondents who indicated that characteristics such as taste (96%, n=573), chemical-free (77%, n=460) and hormone-free (76%, n=454) are important.

Even Phase One participants who shopped in what could be considered ‘environmentally friendly’ ways were not doing so for environmental reasons. For example, Glenda shopped at the local farmers’ market and preferred free-range produce and (to some extent organic) products. However, her purchasing was motivated by personal health.

> My reason for buying [free-range and organic] is not environmental. If that was the only benefit I wouldn’t bother. I think free-range animals are healthier and that’s better for me.

Glenda (58 years, 1960 g/week)

Several Phase One participants purchased organic meat at least some of the time. Organic meat is often considered to be a more ‘environmentally friendly’ option by consumers than meat produced by mainstream methods (Lockie et al. 2002, Nelson et al. 2004). However, participants did not identify that organic meat was procured for environmental reasons. Rather, organic meat was chosen because ‘it’s more natural’, ‘it tastes better’ and ‘I don’t like chemicals in my meat’.

Some Phase One participants totally rejected environmental concerns about meat production. Jane is a beef producer who uses conventional farming methods. While she was aware that cattle generate greenhouse gases, she was frustrated that beef is targeted as an environmental concern. Jane does not consider environmental issues when procuring meat for her own family.

> All that talk about cows being bad for the environment gives me the shits. I just think of all the people that drive cars every day … How can they suddenly turn around and point the finger at all us farmers and say, ‘It’s you people with the cows that are the problem’. So I take it with a grain of salt. Jane (39 years, 1040 g/week)

Margaret and Bill expressed a similar view. This couple produces heritage beef on a small-scale and sells their produce directly to the public at a farmers’ market. Their cattle are pasture-fed and ‘product integrity’ is very important to them. Margaret and Bill are interested in giving their animals a good life and reject the push to ‘fatten’ beasts as quickly as possible. Margaret and Bill describe their cattle as ‘not officially organic’. However, they follow ‘the
same principles and ideas’. Margaret and Bill choose to produce on a small scale and to feed their animals ‘naturally’, rather than feedlot. Bill feels that to a large extent ‘we have lost the plot with beef production’. However, Margaret and Bill reject the idea that beef is bad for the environment. Margaret argues that ‘animals have been belching for several billion years’ and that ‘methane is part of a perfectly natural cycle’. Margaret and Bill prefer to use their own meat rather than meat produced by conventional farming. However, they reject the idea that environmental factors are at play – rather the desire for a ‘natural’ product is the main influence.

Grain-feeding cattle to us is not a natural way to produce meat at all. Bill (55 years, 2090 g/week)

**Participants trust that Australian meat production is ‘natural’**

Overall, Phase One participants indicated considerable trust in the way meat is produced in Australia. Many participants spoke negatively about production methods in America. However, there was a viewpoint that meat was produced differently in Australia. Australian production was considered to be more ‘natural’.

I think it’s not quite as horrific as the American situation. Well certainly there doesn’t seem to be the same sort of contamination issues that the Americans have with E. Coli and other bugs that have been passed around because of the way they farm. And I don’t think we have the climate that means you’ve got to put a farm indoors in winter as well, so at least we’ve got outdoor things. Glenda (58 years, 1960 g/week)

The Americans grow their meat in … what do you call them? Stock yards or feedlots. They feed them on grain, ah maize. To a large extent our beef, our cows run around the countryside and eat grass … Our stock is basically over on ground that isn’t foodstuff ground, where you couldn’t grow food anyway. Jack (70 years, 590 g/week)

Adam’s trust in Australian production meant he did not need to think about production or environmental issues to any great extent. As long as the meat was Australian, no further thought was required.

I’ve got a lot of faith in the Australian farmers. Adam (32 years, 1050 g/week)
Many participants are happily disconnected from the way meat is produced in Australia

Many Phase One participants had low awareness of how meat is produced in Australia. Participants freely used terms such as grass-fed, grain-fed, feedlot and factory farming but, when probed, many revealed a poor understanding of these terms.

We haven’t really thought about grain versus grass-fed beef. The only thing we tend to think about is with eggs whether they’re cage or free-range ... Yeah, it is important that the animals are well cared for. You wouldn’t want them corralled up and standing in one spot like chickens. Mark (42 years, 1275 g/week)

Grass fed as far as I know they just wander around the paddocks eating to their hearts content until they’re considered big enough to sell. Grain fed? I’m not sure how you would stop them eating grass. I envisage that they’re still wandering around the paddocks but they’re fed like daily from a grain bin. I can’t imagine that they’re kept locked up like battery hens and only fed grain. Liam (21 years, 1080 g/week)

Some participants were influenced by marketing statements about aspects of production but were unsure why. For example, Kate recognised that she would choose grain-fed beef from a restaurant menu but grass-fed beef from the supermarket.

I think grain-fed beef would taste better and have a better texture. Because it’s ... No. Hang on. I think happy green pasture. That means grass-fed should be better. But the restaurants all say that grain-fed is the really good stuff. It seems like a bit of a contradiction. I’m confused. Kate (34 years, 1408 g/week)

About one-third of participants articulated that they did not want to think about how meat is produced. They were happy not knowing. They were happily disconnected.

Not knowing works for me so I don’t want to know ... If I’m kept in the dark I’m OK ... I’m happy to go to the supermarket and buy the meat that’s nicely cut up and not have to think beyond that. Anja (39 years, 680 g/week)

I don’t like thinking about where it comes from. I suppose that’s why I shop at Coles because it’s all in nice plastic packages and I don’t have to think any more about it. Lara (41 years, 960 g/week)

It comes to this. As far as we’re concerned it grows and goes into packages. If we had to slaughter animals ourselves we would probably be vegetarian. Mark (42 years, 1275 g/week)
4.2.5 Procurement is less influenced by health considerations
Phase One participants gave little mention to health issues when discussing meat procurement. Other than a desire for ‘natural’ meat because it was less likely to contain unwanted substances, health characteristics were rarely mentioned. The Phase Two survey findings indicate that just under 70 per cent (69%, n=412) of survey respondents felt that low fat meat was important or very important (see Figure 4.1). However, this was not apparent in Phase One. The presence of fat was discussed as beneficial to texture and flavour. Grass-fed meat was identified as having healthier fats than feedlot beef by two Phase One participants. However, low-fat meat was not sought by any Phase One participants.

4.2.6 Procurement is less influenced by financial considerations
Just under three-quarters (74%, n=442) of survey respondents indicated that cost was important or very important when selecting meat. However, cost did not emerge as an influence from the qualitative data in Phase One. Phase One participants seemed to accept that meat was a higher cost food and they were willing to pay for quality meat within reason. Rhoda had a very modest income and had to be very careful about how she spent her money but she preferred to pay a bit extra for good quality meat and cut back on spending elsewhere. Most other Phase One participants were quite well resourced and could afford to buy the meat they desired with little consideration to cost.

4.2.7 Procurement – Summary
Qualitative and quantitative data indicate that meat procurement is largely influenced by a desire for tasty, tender and safe meat. There is a strong desire for meat that is produced ‘naturally’. However, this appears to relate more to a desire for tasty, tender, safe and humanely produced meat than for meat that has a low environmental impact. There is varied awareness about the environmental impact of meat production but even the most environmentally aware had low concern about the environmental cost of meat production. Qualitative data did not identify health or financial issues as being particularly influential on meat procurement. Limited quantitative data suggests these characteristics are less important than taste and safety but more important than environmental characteristics.

4.3 Consumption
This section presents data on meat consumption practices of Phase One participants and Phase Two survey respondents. Phase One involved the collection of weighed food records from 29
adults for 7 days. Phase Two involved approximately 600 survey respondents. This section also identifies influences on consumption. It will demonstrate that many participants consume meat in excess. A poor understanding of recommendations for meat consumption is apparent. Rather, meat consumption is driven by other factors including the availability of meat at point of purchase and individual satiety. Health and environmental concerns have less influence on meat consumption.

4.3.1 Frequency of Meat Consumption

Figure 4.2 indicates the frequency of meat consumption for the 29 adults in Phase One. Over half (55%, n=16) of the Phase One participants consumed some type of meat every day of the week. Approximately, one-quarter (25%, n=7) consumed meat six days per week. The remaining participants consumed meat four (10%, n=3) or five (10%, n=3) days per week.

![Figure 4.2: Frequency of meat consumption for Phase One participants (n=29)](image)

Figure 4.3 indicates how frequently meat is consumed for different eating occasions (breakfast, lunch, dinner, snacks). Weighed food record data from the 29 participants in Phase One is shown alongside self-reported data from 595 survey respondents in Phase Two. Figure 4.3 indicates that typically meat is consumed infrequently (< weekly) for breakfast and snacks.

As expected, meat is frequently consumed for the evening meal. Nearly three-quarters (72%, n=21) of Phase One participants consumed meat five or six days per week for the evening.
meal. Phase One survey respondents indicated just over one-third (37%, n=11) consume meat three or four days per week and approximately another third (37%, n=11) consume meat five or six days per week for the evening meal.

Meat is also consumed for lunch by many participants but the frequency varies. Most typically the frequency of meat consumption for lunch was in the 1-2, 3-4 and 5-6 days per week categories.
Meat consumption data provided by the Phase One participants was examined to determine the number of meat meals consumed per day (see Figure 4.4). The 29 Phase One participants each provided seven days of meat consumption data to give a total of 203 days of meat consumption data. For just over half of these days (51%, n=104) meat was consumed for one
meal only. For approximately one-third (34%, n=69) of the 203 days, meat was consumed for two meals per day. Only 11 per cent of the 203 total days were classified as meat-free where no meat was consumed at all during the day. Unfortunately, data on the number of meat-free days was not collected in the Phase Two survey.

Figure 4.4: Number of meat meals consumed per day by Phase One participants

4.3.2 Quantity of Meat Consumption – Weekly Intake

Data for weekly meat consumption originates from the seven-day weighed food records kept by 29 Phase One participants. Table 4.1 displays weekly intakes of total, red and ruminant meat for all participants.
Table 4.1: Weekly intake of total, red and ruminant meat for Phase One participants (n=29)

<table>
<thead>
<tr>
<th>Meat Type</th>
<th>n</th>
<th>Meat Intake (g/week)</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Q₁</th>
<th>Q₃</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Median</td>
<td>Min</td>
<td></td>
<td>Max</td>
<td>IQR</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Meat</strong> (beef, lamb, pork, kangaroo, poultry)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>14</td>
<td>1111</td>
<td>589</td>
<td>2974</td>
<td>372</td>
<td>1022</td>
<td>1394</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>15</td>
<td>958</td>
<td>549</td>
<td>1963</td>
<td>606</td>
<td>802</td>
<td>1408</td>
<td></td>
</tr>
<tr>
<td>All Participants</td>
<td>29</td>
<td>1045</td>
<td>559</td>
<td>2974</td>
<td>483</td>
<td>874</td>
<td>1357</td>
<td></td>
</tr>
<tr>
<td><strong>Red Meat</strong> (beef, lamb, pork, kangaroo)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>14</td>
<td>885</td>
<td>150</td>
<td>2974</td>
<td>412</td>
<td>589</td>
<td>1001</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>15</td>
<td>525</td>
<td>214</td>
<td>1492</td>
<td>885</td>
<td>285</td>
<td>1170</td>
<td></td>
</tr>
<tr>
<td>All Participants</td>
<td>29</td>
<td>702</td>
<td>150</td>
<td>2974</td>
<td>631</td>
<td>423</td>
<td>1053</td>
<td></td>
</tr>
<tr>
<td><strong>Ruminant Meat</strong> (beef, lamb)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>14</td>
<td>489</td>
<td>0</td>
<td>2126</td>
<td>570</td>
<td>323</td>
<td>892</td>
<td></td>
</tr>
<tr>
<td>Females</td>
<td>15</td>
<td>356</td>
<td>0</td>
<td>1084</td>
<td>450</td>
<td>220</td>
<td>670</td>
<td></td>
</tr>
<tr>
<td>All Participants</td>
<td>29</td>
<td>406</td>
<td>0</td>
<td>2126</td>
<td>471</td>
<td>240</td>
<td>711</td>
<td></td>
</tr>
</tbody>
</table>

The distribution of weekly intakes of total, red and ruminant meat in this sample of 29 adults were positively skewed (see Figure 4.5). For **total meat**, half the participants reported weekly intakes of 1045 g/week (median) or more. Typically the weekly intakes of total meat were between 874 g/week (Q₁) and 1357 g/week (Q₃), with half the values falling in this interval. Figure 4.6 compares intake of total meat for males and females. The distribution of weekly intakes of total meat were positively skewed for females and males. Males consumed more total meat than females. Half of the male participants reported weekly intakes of 1111 grams (median) or more, compared with 958 grams (median) for females. Typically the weekly intakes for females were between 802 g/week (Q₁) and 1408 g/week (Q₃), with half the values
falling in this interval. Typically the weekly intakes for males were between 1022 g/week (Q₁) and 1394 g/week (Q₃), with half the values falling in this interval. Three males reported very high intakes of total meat, above 1700 g/week. The variability in weekly intake of total meat was greater for females (IQR 606 g/week) than for males (IQR 372 g/week).

Figure 4.5: Distribution of weekly intakes of total, red and ruminant meat for Phase One participants
For **red meat**, half the participants reported weekly intakes of 702 g/week (median) or more (see Figure 4.5). Typically the weekly intakes of red meat were between 423 g/week ($Q_1$) and 1053 g/week ($Q_3$), with half the values falling in this interval. Males consumed more red meat than females (see Figure 4.7). Half of the male participants reported weekly intakes of 885 grams (median) or more, compared with 525 grams (median) for females. Typically the weekly intakes for females were between 285 g/week ($Q_1$) and 1170 g/week ($Q_3$), with half the values falling in this interval. Typically the weekly intakes for males were between 589 g/week ($Q_1$) and 1001 g/week ($Q_3$), with half the values falling in this interval. Two males reported very high intakes of red meat, above 1900 g/week. The variability in weekly intake of total meat was greater for females (IQR 885 g/week) than for males (IQR 412 g/week). The distribution of weekly intakes of total meat were positively skewed for females and negatively skewed for males.

Figure 4.6: Comparison of distribution of weekly intake of total meat between male and female Phase One participants.
For ruminant meat, half the participants reported weekly intakes of 406 g/week (median) or more (see Figure 4.5). Weekly intakes for ruminant meat were typically between 240 g/week (Q₁) and 711 g/week (Q₃), with half the values falling in this interval. The distribution of weekly intakes of ruminant meat was positively skewed for females and negatively skewed for males (see Figure 4.8). Males consumed more ruminant meat than females. Half the male participants reported weekly intakes of 406 g/week (median) or more, whereas half the female participants reported weekly intakes of 356 g/week (median) or more. Typically the weekly intakes for males were between 323 g/week (Q₁) and 892 g/week (Q₃), with half the values falling in this interval. Two males recorded very high intakes of 1804 g/week and 2126 g/week. For females, the weekly intakes of ruminant meat were typically between 220 g/week (Q₁) and 670 g/week (Q₃). The variability in weekly intake of ruminant meat was greater for males (IQR 570 g/week) than for females (IQR 450 g/week).
Comparison of weekly meat intake with guidelines

Weekly intakes of different types of meat were compared with guidelines for meat consumption (see Table 4.2). In this sample of 29 adults, just under one-third of males (29%, n=4) and females (34%, n=5) consumed more than the maximal amount recommended by the Educator Guide that accompanies the Australian Dietary Guidelines (NHMRC 2013b). It must be recognised that Table 4.2 potentially over-represents the amount of meat recommended in a healthy adult diet. The Educator Guide recommends that Australian adults consume 2-3 serves of foods from the ‘lean meat, poultry, fish, eggs, nuts, seeds and legumes/beans’ category (NHMRC 2013b). It is intended that a variety of foods is selected within this category. The figures used in Table 4.2 assume that all serves are either lean meat or poultry.

The majority of male (86%, n=12) and just under two-thirds of female (60%, n=9) participants consumed more red meat than recommend by the Australian Dietary Guidelines. Just under two-thirds of male (59%, n=8) and female (64%, n=10) participants consumed more ruminant meat than the 350 g/week recommend by McMichael and colleagues (2007) for environmental sustainability. Nearly all participants consumed more total meat than the 630 g/week recommended by McMichael et al. (2007).
### Table 4.2: Proportion of Phase One participants exceeding selected guidelines for meat consumption

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<tbody>
<tr>
<td></td>
<td>Guideline for Meat Intake (g/week)</td>
<td>Participants Exceeding Guideline (%)</td>
<td>Guideline for Meat Intake (g/week)</td>
</tr>
<tr>
<td><strong>Total Meat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males (n=14)</td>
<td>1137-1680*</td>
<td>29%</td>
<td>NA</td>
</tr>
<tr>
<td>Females (n=15)</td>
<td>910-1400*</td>
<td>34%</td>
<td>NA</td>
</tr>
<tr>
<td><strong>Red Meat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males (n=14)</td>
<td>455</td>
<td>86%</td>
<td>500</td>
</tr>
<tr>
<td>Females (n=15)</td>
<td>455</td>
<td>60%</td>
<td>500</td>
</tr>
<tr>
<td><strong>Ruminant Meat</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males (n=14)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Females (n=15)</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
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</table>

* Based on recommended daily serves for the lean meat, poultry, fish, eggs, nuts, seeds, and legumes/beans category and specified portions for lean meat (65g) and poultry (80g). It is intended that a variety of food choices are consumed within this category. These values represent the absolute maximum.

### 4.3.3 Quantity of Meat Consumption – Typical Portions

Seven-day weighed food records provided by Phase One participants were used to examine the size of typical meat portions consumed for the evening meal. All evening meals where meat was a major ingredient were included, with 121 meat portions meeting the inclusion criteria. Portions were recorded as cooked, edible portion only. The distribution of meat portions from these 121 evening meals was positively skewed (see Figure 4.9). For half of the meals, the portion size was 152g or more. Typically, meat portions were between 120g ($Q_1$) and 200g ($Q_3$) per serve with half the values falling in this interval.
Of the 121 meat portions consumed for the evening meal, 59 were consumed by males and 62 by females. The distribution of meat portion sizes was positively skewed for males and females (see Figure 4.10), with portion sizes larger for males than females. For males, the portion size for half of the meals was 180 grams (median) or more. In comparison, for females, the portion size for half of the meals was 149 grams (median) or more. Typically, meat portions for males were between 120 grams (Q₁) and 210 grams (Q₃) per serve with half the values falling in this interval. One male consumed a very large portion of meat at 400 g/serve at a restaurant. For females, typically portions were between 104 grams (Q₁) and 175 grams (Q₃) per serve with half the values falling in this interval. One female consumed a very large portion of meat at 300g/serve. The variability in portion size was larger for males (IQR 90) than for females (IQR 71).

The average portion size of meat consumed by males ($\bar{x} = 184$, s = 68) was larger than that consumed by females ($\bar{x} = 145$, s = 46). An independent samples t-test found this difference to be significant, $t(101)=3.660$, $p<0.001$, 95%CI for the mean difference (17.8, 60.2).
The Educator Guide (NHMRC 2013b) specifies different serve sizes for ‘lean’ meat (beef, pork, lamb, venison, kangaroo) and poultry. For lean meat, the specified serve size is 65 grams whereas for poultry the serve size is 80 grams. There was no discernible difference between portion sizes of different types of meat consumed by the Phase One participants (see Figure 4.11). For red meat (equivalent to ‘lean’ meat), median portion was 160 grams (IQR 80). For poultry, median portion was 150 grams (IQR 90). An independent samples t-test confirmed there was no significant difference in sample means (p=0.4).
Table 4.3: Meat Portions (cooked, edible portion only) consumed for evening meals (n=121) by Phase One participants

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Median</th>
<th>Minimum</th>
<th>Maximum</th>
<th>IQR</th>
<th>Q₁</th>
<th>Q₃</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Portion Size (g/serve)</strong></td>
<td></td>
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<td></td>
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<tr>
<td>All Meat</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Males</td>
<td>59</td>
<td>180</td>
<td>60</td>
<td>400</td>
<td>71</td>
<td>120</td>
<td>210</td>
</tr>
<tr>
<td>Female</td>
<td>62</td>
<td>149</td>
<td>60</td>
<td>300</td>
<td>90</td>
<td>104</td>
<td>175</td>
</tr>
<tr>
<td>All Participants</td>
<td>121</td>
<td>152</td>
<td>60</td>
<td>400</td>
<td>80</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>Red Meat (beef, lamb, pork, kangaroo)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>All Participants</td>
<td>77</td>
<td>160</td>
<td>60</td>
<td>400</td>
<td>80</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>Poultry</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All Participants</td>
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<td>150</td>
<td>80</td>
<td>300</td>
<td>90</td>
<td>110</td>
<td>200</td>
</tr>
</tbody>
</table>

Figure 4.11: Comparison of distribution of meat portions (cooked, edible portion only) consumed for evening meals for ‘lean’ meat vs poultry
The Phase Two survey provides further insight into typical portion sizes for meat. Survey respondents were shown images of different sized portions of steak. The images are shown in Figure 4.12. Survey respondents were asked to select the portion of steak that was closest to the portion typically consumed.

Figure 4.12: Images of meat portions used in Phase Two survey

Males selected portions ranging from 50 grams to 450 grams. Most commonly, males selected 150 gram (22%, n=50) or 200 gram (30%, n=68) portions (see Figure 4.13). Females selected portions ranging from 50 grams to 300 grams. Most commonly, females selected 100 gram (36%, n=126) and 150 gram (36%, n=126) portions (see Figure 4.13). In order to determine if
a relationship exists between meat portion currently consumed and gender, meat portions were classified into small (100 grams or less), medium (150-200 grams) and large (250 grams or greater), and a chi-square test was used to determine if a relationship existed between gender and portion of meat commonly consumed. This classification was chosen based on the spread of data and knowledge of serves used in NHMRC guidelines (NHMRC 2013a). This chi-square test of 575 respondents revealed that this relationship between portion and gender was significant, $\chi^2(2)=83.4$, $p<0.001$. Portion of meat typically consumed was related to gender.

![Figure 4.13: Portion size of steak typically consumed by Phase Two survey respondents (n=575)](image)

**4.3.4 Influences on Meat Consumption – Poor Awareness of Consumption Guidelines**

During the qualitative interviews in Phase One, participants were asked about their understanding of how meat should ideally be included in a healthy, adult diet. It was very apparent that Phase One participants had a very poor awareness of dietary recommendations for meat consumption. Data from the Phase Two survey supports this finding.

**Perception of how often meat should be consumed**

Some Phase One participants responded loosely in terms of frequency of intake.
Umm I don’t know how much meat we should have in terms of exact quantities but we should have some meat every day, like one meaty meal, you know what I mean? Liam (21 years, 1079 g/week)

I wouldn’t be able to tell you how much meat we should ideally eat. I mean we normally have a couple of nights of red meat, a couple of nights of white. But as far as how much we should have, I couldn’t tell you. Lara (41 years, 960 g/week)

In order to further explore perception of how frequently meat should be consumed Phase Two survey respondents were asked, ‘In your view, how many times a week should meat be consumed in a healthy adult diet?’ 611 people responded to this question.

![Figure 4.14: Perception of how frequently meat should be consumed in a healthy adult diet (Phase Two survey respondent’s n=611)](image_url)

Over half (57%, n=349) the survey respondents identified that meat should be consumed 3-4 times per week in a healthy adult diet (see Figure 4.14). Approximately equal amounts of respondents identified that meat should be consumed 1-2 times/week (16%, n=98) and 5-6 times per week (17%, n=104). A small proportion of respondents indicated that meat should be consumed every day (7%, n=43).

**Perception of how much meat should be consumed**

Some Phase One participants demonstrated some awareness of dietary recommendations relating to the quantity of meat recommended in a healthy diet. They were able to say that adults are supposed to eat ‘a palm-sized amount, ‘a fistful’ or ‘no more than the size of your
palm’. When asked where this knowledge originated from, Phase One participants had mixed views. Some had consulted with dietitians or sports trainers. Others remembered it from school and others felt that it had come from the media. Phase One participants were typically unable to give gram amounts for the amount of meat recommended in a healthy adult diet. When pushed, they typically guessed ‘about 150-250 grams’.

To further explore awareness of the quantity of meat recommended in a healthy diet, Phase Two survey respondents were asked, ‘In your view, what quantity of meat is considered a healthy serve for a normal healthy adult?’ 603 people responded to this question. Responses were given in an open-text field. Over two-thirds (66%, n=398) of participants gave a response in gram amounts, one-third (33%, n=199) responded with descriptors and the remainder did not know. Some respondents gave multiple responses. For the 201 respondents who used descriptors to describe portions of meat, the most common descriptors were:

- 69% - palm of hand or fist
- 23% - pieces of meat, e.g. 2 thigh fillets
- 10% - proportion of meal e.g ¼ of plate

Other descriptors were cups, deck of cards, matchbox and proportion of the length of the forearm.

Several survey respondents indicated that a ‘palm-size’ amount was recommended, then clarified this with a gram amount. These responses indicate there is considerable variability in what equates to palm-sized.

The serve size should be the same size as your palm – normally 100g. (female, 22 years)

A serving roughly the size of your palm or around 150-200g. (female, 24 years)

For the 402 survey respondents who listed gram amounts, serve sizes ranged from 50-500g grams. The distribution of responses was positively skewed with outliers for both males and females (see Figure 4.15). The median serve size was 200 grams for males (n=169) and 150 grams for females (n=233). Typically the portions specified by females were between 100 grams (Q₁) and 200 grams (Q₃), with half the values falling in this interval. Typically the portions specified by males were between 150 grams (Q₁) and 250 grams (Q₃), with half the values falling in this interval. Two females and one male specified very large portions. The highest portion specified by both a male and female was 500 grams. The variability in
portions was equal between females (IQR 100g) and males (IQR 100g). The most common portion specified (mode) was 200 grams (see Figure 4.16).

In this sample of 169 males and 233 females, the average portion of meat considered a healthy serve by males ($\bar{x}=212.2$, $s=85.1$) was larger than that specified by females ($\bar{x}=169.4$, $s=80.1$).
An independent samples t-test found this difference to be significant ($t(297)=5.499$, $p<0.001$, 95% CI for the mean difference (27.4, 58.0)). The portion of meat considered a healthy serve by males on average was greater than that specified by females.

**Perception of guidelines for meat consumption**

The Australian Dietary Guidelines currently states, ‘to enhance dietary variety and reduce some of the health risks associated with consuming meat, up to a maximum of 455g per week (1 serve or 65g per day) of lean meat is recommended for Australian adults’ (NHMRC 2013a). Lean meat refers to beef, lamb, pork, kangaroo and venison. Nearly all portions (98%, n=119) of ‘lean’ meat consumed for the evening meal by Phase One participants exceeded 65 grams.

During interviews, Phase One participants who had some awareness of recommendations for meat consumption quickly dismissed recommended quantities as being unreasonable.

I’m supposed to eat, sort of, you know, [laughs] the palm-sized amount, but I usually eat more than that. I don’t find that’s enough to be satisfied. Glenda (58 years, 1963 g/week)

I did actually go to a nutritionist at one point and she told me I should eat a fistful of meat. At the time, I’m like, ‘Oh my God, how am I going to live on that amount [laughs]?’ I did try and base it on a fistful but now I just estimate what feels right. Or I guess, I just follow recipes. We probably eat more than we should. Sarah (30 years, 879 g/week)

I’ve been told that you should have no more than the size of your palm of your hand but my reaction to that is, ‘that’s only when you’re dieting’ rather than the norm. Kate (34 years, 870 g/week)

Phase One participants were shown a 65-gram serve of cooked red meat and asked for their opinion. All participants strongly indicated that this quantity of meat is too small.

That’s not worth eating. Mark (41 years, 1275 g/week)

There’s not too many people I know who would be happy eating that. Margaret (50 years, 1307 g/week)

It seems very small to me. Lorna (65 years, 559 g/week)

In order to further explore acceptance of a 65-gram serve of lean meat, Phase Two survey respondents were shown an image of a 65-gram portion of cooked steak and asked, ‘How do you feel about this portion for yourself?’ 594 people responded to this question. Figure 4.17
displays the response to this question. Most males (89%, n=209) indicated that the portion of meat shown was too small or much too small. Just over two-thirds of females (66%, n=237) had a similar view.

![Image](image_url)

Figure 4.17: Acceptability of 65-gram portion of steak (Phase Two survey respondents n=594)

### 4.3.5 Influences on Meat Consumption – Quantity Influenced by Satiety

Rather than base their consumption on dietary recommendations, Phase One participants identified that they ate whatever amount was satisfying.

> I don’t have strong feelings about how much people should eat, just what I like and need [to feel satisfied]. Tanya (47 years, 800 g/week)

> I think you need a portion that makes you feel OK. That I’ve had enough. That I’m satisfied for that meal. Nadine (35 years, 870 g/week)

Similar comments were made by Phase Two survey respondents when asked, ‘What quantity of meat is considered a healthy serve for a normal healthy adult?’ It was common for respondents to comment that serve size should correspond to appetite.

> I think a serve size is whatever you feel like at that meal. (female, 62 years)

> A good size steak, couple of chicken breasts – depends how hungry you are. (male, 47 years)

Phase One participants typically described learning what a satisfying amount was over time.

> I know it’s meant to be some sort of fisty, hand, small amount but I don’t know if that’s adults or kids. I think you just learn, ‘Oh, I made too much of that so next time I’ll have to lessen it.’ Anja (39 years, 879 g/week)
200g is probably enough for myself. I guess I learnt it from doing the shopping with mum as a kid and learning to cook with her and things like that. I’m really not sure how much meat we should have. It’s either really high or really low [laughs]. Adam (32 years, 1050 g/week)

Experience, practice, just what I’ve done in the past, what I feel like, adjusting whether I feel hungry or not. Kevin (61 years, 2974 g/week)

4.3.6 Influences on Meat Consumption – Quantity Influenced by Recipes

Some Phase One participants identified that recipes influenced the quantity of meat they consumed, at least initially. Liam recently moved away from the family home and is now cooking for himself (and two other adult males) for the first time. Liam indicated that he uses recipes to give him an initial idea of how much meat to look for in the supermarket. He then chooses a quantity that closely matches the recipe. Liam has found that the quantity of meat typically specified in recipes provides a satisfying meal.

This is the first year that I’ve cooked so I’ve found that a lot of recipes or sachets that I use say to have 500 grams or a kilo. We basically just get whatever comes in a package that’s about 500 grams or a kilo and it usually suits our needs. Liam (21 years, 1079 g/week)

Nadine is an experienced and confident cook. She also uses recipes as a guide to the amount of meat to cook for her family of five. She has found that her family typically eats the amount that is listed in most recipes.

I think recipes influence me most. With something like mince, most recipes seem to say 500 grams and that works for us. Nadine (35 years, 960 g/week)

In order to further explore the potential for recipes to influence perception of portion size and quantity of meat consumed, an audit of recipes in popular food magazines was conducted in Phase Three (see chapter three). In a sample of 1508 recipes, 753 recipes included some type of meat (beef, lamb, pork, poultry) as the main ingredient. Figure 4.18 indicates the frequency of portions of various sizes. There was considerable variation in the portion of meat specified per serve in these recipes. The most common serve (mode) specified was 125 grams (see Figure 4.18).
Figure 4.19 indicates the distribution of portion sizes for different types of meat in the 753 recipes. The median serve for all meats was 135 grams (IQR 62). While there was considerable variability in the portion sizes listed in recipes, there was no discernible difference in the portions listed for different types of meat.
4.3.7 Influence on Meat Consumption – Portions Available at Point-of-Purchase

Many Phase One participants identified that portions available at the point of purchase impacted on how much meat was consumed. This sentiment was most apparent with supermarket shoppers but was also expressed by participants who obtained meat via other means. Essentially, participants purchased whatever amount was available and then consumed whatever amount was purchased.

I have to buy two packets of steak because they only come in threes. So my husband and I end up having an extra steak each. I guess we probably end up having about 300 grams. That’s a lot isn’t it? But one wouldn’t satisfy us. Kate (34 years, 1408 g/week)

We’ve got it all packaged out there so just get it out and think, ‘Oh well I’m not going to put this much back in the fridge. It’s not really worth it. I might as well cook it and just put more on my husband’s plate’. Maybe I need to tell my butcher to pack it in smaller packaging so we don’t eat as much perhaps? Jane (39 years, 1040 g/week)

I buy the amount and use the amount that I buy. If I have a recipe and it says 300g of this and I find a pack with 430 grams, I will go ahead and use the 430 grams anyway. Ann (61 years, 1489 g/week)
4.3.8 Influences on Meat Consumption – Ambivalence about Health Consequences of Over-consuming Meat

Health factors seemed to have little impact on how much meat was consumed by Phase One participants. Participants had limited awareness of any health implications associated with eating excess meat. There was a strong sense that too little meat was problematic but too much meat was not a concern.

I don’t really know too much about it. I’m sure it’s not good for your levels, like iron-wise and that kind of stuff. And you need foliage in terms of your digestive system but other than that I’m not really clear. Jane (39 years, 1040 g/week)

I think it can cause heart problems. I don’t know much more than that. Anja (39 years, 879 g/week)

I don’t really know what happens if we eat too much meat. I would have thought lack of it would be more of a problem than eating too much. Liam (21 years, 1079 g/week)

Phase Two survey respondents also demonstrated a mixed awareness of health risks linked to eating excess meat. 625 people responded to a question about their awareness of health risks associated with eating meat. In a free-text field, respondents were asked to list as many health risks as possible. Responses were grouped into categories based on inductive coding (see Figure 4.20). Just over 15 per cent (16%, n=100) were not aware of any health risks linked to eating excess meat. Just over half the respondents (55%, n=344) identified cardiovascular disease as a risk and only one-quarter (26%, n=163) identified cancer as a risk. More respondents (34%, n=213) identified food poisoning as a health risk than cancer or obesity.
Most Phase One participants acknowledged that they probably eat more meat than ideal. However, there was ambivalence about this.

Yeah it’s possible that I do eat a bit more meat than I think is the right amount just because I enjoy it and I’d be happy to eat a bit more than a bit less. But as I said, I don’t really know the correct amount to have. Adam (32 years, 1050 g/week)

It’s until I’ve had enough really. I don’t have any guidelines so I probably eat too much because you always stop eating after you should have done. Ann (61 years, 1489 g/week)

Phase One participants were typically unconcerned or rejected any health implications of eating more meat than recommended.

Umm eating for my health – would it be unhealthy to have another slice off that roast? I don’t think that way. We eat what is a satisfactory amount for us. Meat’s not the big danger. Nobody’s saying eat 20kg of meat a week. That’s going to kill you. So will three cases of Coca-Cola. Bill (55 years, 2089 g/week)

You know that stuff about red meat and colon-rectal cancer? I think it’s bunkum science or sort of put out there by the vegetarians I guess. Like a lot of them rely on that China study which is just false. I’ve got a history of colon-rectal cancer so I’m particularly concerned about it and I read a lot. I have colonoscopies every three years and the last time my doctor said my colon was pristine! Glenda (58 years, 1963 g/week)
Similarly, free-text comments by Phase Two survey respondents indicate scepticism about health risks associated with eating excess meat.

- It’s linked to giving people cancer but everything says that! (female, 23 years)
- I’ve heard of there being health risks with eating too much red meat but I’m not certain that it’s true. (female, 25 years)

Survey respondents were asked to indicate their level of agreement with the statement, ‘I would eat less meat to improve my health’. In a sample of 602 respondents, just under three-quarters (73%, n=439) agreed or strongly agreed with this statement (see Figure 4.21), which indicates that survey respondents would hypothetically eat less meat if they were convinced there was a health need. Accompanying free-text comments suggest that many survey respondents do not identify a health need to reduce their meat intake. Many respondents made comments along the lines of ‘I would eat less meat if I had to but I don’t have any reason to at the moment’.

![Figure 4.21: Level of agreement with the statement, I would eat less meat to improve my health’ (Phase Two survey respondents n=602)](4.3.9)

4.3.9 Influences on Meat Consumption – Environmental Concerns Have Minimal Impact

Similarly, environmental issues had little impact on meat consumption. The previous section on procurement presented evidence that environmental issues had little impact on the type or quantity of meat procured by Phase One participants. There was mixed awareness and often confusion about the links between meat and the environment.

The Phase Two survey further supports these findings. In an open-text field, survey respondents were asked to list ways to eat meat in more environmentally friendly ways. Responses were coded into categories using inductive coding. Figure 4.22 summarises the
findings. Over one-quarter of respondents (28%, n=170) were not aware of any ways to eat meat in an environmentally friendly way. Approximately one-third of respondents (31%, n=188) listed sustainable farming methods such as organic or biodynamic farming as an option. Buying free-range or grass-fed meat was listed by nearly one-quarter (24%, n=146) of respondents and 19 per cent listed buying locally produced meat as an option. Other options listed by smaller numbers of respondents were eating lower impact meats such as kangaroo, eating less meat, reducing waste, buying meat with less packaging and using lower energy cooking methods. Interestingly, ten respondents listed grain-fed meat as a more environmentally friendly option.

![Figure 4.22: Factors associated with eating meat in environmentally friendly ways as identified by Phase Two survey respondents (n=608)](image)

As previously presented, Phase One participants had conflicting or confused views about how to procure environmentally friendly meat. Free-text comments from Phase Two survey respondents echo these findings.

Free-range I guess but eating caged birds would mean you could have more chickens in a smaller area and you wouldn’t need to affect as large an area of the environment. (male, 25 years)
In some cases buying organic, although I would argue that the non-organic beef farm that I grew up on was better managed and more sustainable than the organic farm the neighbour had. (female, 25 years)

One might argue that free-range is better than feedlot but I think that such arguments are one-sided and don’t take in the complexity of the situation. (female, 54 years)

Phase One participants indicated that environmental issues were not important enough to influence meat procurement. Similarly, environmental issues were not strong enough to influence consumption. There was a strong sentiment that other action would be more worthwhile.

I’m not interested in reducing my consumption of meat to prevent climate change ... I discussed this with someone the other day and I said to them, ‘Look your physiology hasn’t changed. What’s healthy for your body is still the same. It doesn’t matter what’s going on in the climate, the human body needs certain foods.’ ... What goes on in the climate doesn’t affect my health ... I make my own reduced impact on the environment in other ways, rather than compromising on the sort of food that is optimal for my body. Kevin (61 years, 2974 g/week)

Phase Two survey respondents were asked to indicate their level of agreement with the statement, ‘I would eat less meat to protect the environment’. In a sample of 602 respondents, just under half (47%, n=283) agreed or strongly agreed with this statement (see Figure 4.23). This is substantially less than the 73 per cent of respondents who indicated they would eat less meat to improve their health (see Figure 4.21)

Figure 4.23: Level of agreement with the statement, I would eat less meat to protect the environment’ (Phase Two survey respondents n=602)
4.3.10 Consumption – Summary
Direct measurement via weighed food records and self-reported intake reported via surveys indicates that participants in this study typically consumed meat frequently (most days of the week). Over 60 per cent of females and over 80 per cent of females in Phase One consumed red meat in excess of consumption guidelines for health. Nearly all male and female participants consumed meat in excess of guidelines for sustainability (McMichael et al. 2007). The available data indicates that males consumed more meat in total and larger portions than females. Portions of meat consumed by both males and females were typically larger than the serves recommended in the Australian Dietary Guidelines. Interview and survey responses indicate that awareness of consumption guidelines was poor. Typically, participants who were aware of consumption guidelines indicated that they considered the recommended amounts unsatisfying. Participants identified satiety as an important influence on the amount of meat consumed. Recipes and portions available at point-of-sale were further identified as influences. Health and environmental factors were identified as having less influence on consumption.

4.4 Household Discard
This section describes the quantity of meat discarded in a seven-day period in the 15 households participating in Phase One of this doctoral study. It also identifies factors that influence discard. Some households discarded large quantities of meat, while others discarded very little. Factors that influence discard include level of concern about food waste, family experiences and practices, meal planning and food handling skills. Participants tended to indicate being more concerned about discarding meat than over-consuming meat. However, the data available from this small group of participants suggests that meat was more typically wasted via over-consumption than via discard.

4.4.1 Quantity of Meat Discarded
Figure 4.24 summarises the quantity of meat discarded in the 15 households participating in Phase One of this research project. Only avoidable meat discard was recorded. This refers to meat that could have potentially been eaten at some stage. As described in section 3.9.3, participants noted whether the recorded weight referred to cooked or raw meat. In order to amalgamate date, all values were converted to raw weights using known or experimentally determines weight loss factors for cooked meat (Matthews & Garrison 1974).
Nine out of 15 households discarded less than 50 grams of meat (raw weight) in the seven-day period and were identified as ‘non-discarders’. Six households discarded more than 50 grams of meat (raw weight). Participants in these households were identified as ‘discarders’. Of these, four households discarded 200-350 grams of meat, one household discarded 605 grams of meat and one household discarded 1875 grams of meat (all values refer to raw weight). These discard values were compared with procurement records and interview responses in an attempt to identify any under-reporting. The discarded meat included a variety of beef, pork, chicken, kangaroo and processed meat. Approximately one-half was cooked meat that was not eaten because too much had been cooked. The rest was uncooked meat that was considered to be past the use-by date or was no longer desired.

Initially it seems that while some households discarded large quantities of meat, other households discarded very little. However, these results are somewhat misleading. During qualitative interviews, some participants acknowledged that they were more aware of their practices during the study period and therefore discarded less than normal.

I think there’s probably a bit of a Hawthorne effect as well. Normally I do, I do waste a bit.

Glenda (58 years, non-discarder)
For others, the study period was not long enough to fully capture meat discard. Some admitted that they would probably discard some meat once the seven-day period was finished. It was just being held temporarily in the refrigerator.

I have some leftovers in the fridge that I haven’t thrown out yet. Most likely I will throw them out now that this is over. Sarah (30 years, non-discarder)

This is an inherent limitation of weighed food records (Biro et al. 2002). A longer period of data collection would have been useful but would have increased the burden on participants. Ultimately, there was a compromise between obtaining accurate data and influencing usual behavior of participants. Interviewing participants about their discard records was useful to determine the true extent of discard.

Interviews further revealed that there is ‘hidden waste’ or delayed discard of meat. Several participants identified that leftover meat is often put in the refrigerator or freezer with the intent that it will be eaten at some point in the future. However in reality, the meat is never eaten and eventually discarded.

The freezer is a black hole. Things go in but nothing ever comes out. Glenda (58 years, non-discarder)

There’s a fifty-fifty chance that leftovers will sit in the fridge in Tupperware containers and get ditched when I eventually get around to it. Sometimes I freeze leftovers but it becomes mystery meat in the freezer which I discard later. I’ve got a whole carcass of lamb in my freezer in the garage that I don’t want to touch anymore. It’s been there for more than six months because I don’t want to touch it, so I’ll throw that in the bin. Kate (34 years, discarder)

This suggests that for some participants, discard may be greater than indicated by the weighed discard records.

4.4.2 Discarders and Non-discarders Have Different Concerns

Concern about discarding meat varied among Phase One participants. Non-discarders demonstrated a strong dislike of wasting food and wasting in general. Although they found it difficult to articulate exactly what concerned them about wasting. For some it was a complex mix of humanitarian concerns, financial concerns and environmental concerns. Within this complex interplay, family values and practices emerged as a strong influence. Many participants discussed childhood experiences where wasting was not tolerated.
It’s not entirely thriftiness. I don’t consciously think about humanitarian issues but it has occurred to me before because my husband and myself have done quite a bit of travelling in third world countries. Like I was recently in Burma for five months and of course poverty there is really great and people don’t have enough to eat. I think in general that contributes to not wanting to waste stuff but having said that I think it’s probably got to do with certain family values. Connie (32 years, non-discarder)

Nadine had a strong dislike of waste of any sort. She was very careful to minimise any food waste and, during the seven-day period, ensured that all leftovers were used up. For example, half a sausage was saved and added to a pizza the following day. This behaviour was common practice in Nadine’s home. The environmental and financial cost of food waste concerned Nadine. However, she identified that her food management practices were largely influenced by her parents. She had adopted behaviour that she had observed when growing up.

I worry about the amount of energy that’s put into producing it for us in the first place. If we all took the attitude of whatever, who cares, we’ll soon use up all our resources so I think we have to be conscious ourselves of the way we live. However, I really believe that it’s probably from growing up. Mum and dad were very conscious about not throwing out food and being creative the next day and having it for leftovers. I think it’s probably an upbringing thing. I just hate wastage. I can’t stand it. I just can’t stand wastage. I guess growing up with parents who were conscious of money and stuff as well, we just didn’t have a lot to throw around, so you were just careful with what to eat. Nadine (35 years, non-discarder)

Jack also identified that his childhood experiences had a strong influence on his dislike of food waste. He could remember post-war rationing where some foods were scarce and his mother had to be very careful and creative with meal preparation. Jack spoke quite emotionally about an experience where he had witnessed a disregard for food waste. It was simply unimaginable to Jack that good food would be thrown out.

I suppose one of the things is that I can remember rationing. I was 11 or 12 when rationing ceased in Britain so you always did think about how things were going to go around. I can remember my mum beating up egg powder and things like that to make butter substitutes and what not. I think we discard almost nothing. In fact we went to a large BBQ. Towards the end the hostess took all these T-bone steaks – a great pile of them – and fed them to the two great Big Danes – just threw them to them. It shook us, it really shook us. Jack (70 years, non-discarder)
Some of the discarders also indicated unease about throwing away meat. A sense of guilt was apparent. However, there was also a sense that it was inevitable that some meat would be thrown away.

I don’t like it. I don’t like discarding food at all. I think wasting food is completely inappropriate. Because there are so many people in this country that would eat it. I despise the way the Americans waste and I don’t want to be like that. I try not to waste food but I guess sometimes it can’t be helped. Adam (32 years, discarer)

I think it’s terrible because A, I’ve paid for it so it drives me insane because I think I’ve just ditched a good portion of what I’ve just bought. Secondly, I think it’s that whole wanting to teach the kids that there are people around the world who are starving, yet here I am ditching perfectly good food, but if I was more creative I probably could have reused that meat in another way the following day. Kate (34 years, discarer)

Other discarders were quite ambivalent about discarding meat. Some expressed mild discomfort from a financial perspective but this was not strong enough to influence discard practices. There was a sense that although the cost was annoying it could be absorbed.

I guess we worry about wasting meat a little bit. The fact that someone else could have eaten it or the animal liberation thing. There’s less animals you could kill. Yeah but I guess primarily it’s a financial sort of thing. You think I’ve spent money on that but didn’t eat it. Mark (42 years, discarer)

Well I sometimes think, ‘Oh my God that cost 12 or 15 dollars for the turkey and I’ve just chucked half of it out.’ So probably from a dollar point of view it bothers me more than from any other. So I think about the waste of money rather than from any further impact. I honestly don’t think about it too much. Anja (39 years, discarer)

4.4.3 Non-discarders are Good Planners
Planning was a key factor that contributed to low levels of discard. Participants who discarded very little meat planned their meals carefully, shopped according to a weekly meal plan and incorporated ways to use leftovers into the weekly meal plan. Jack and Lorna planned their meals in detail each week. During the qualitative interviews, Jack showed me a folder with years of meal plans. Each week, Jack looked through recipe books and prepared a weekly meal plan. He checked the cupboard and wrote a shopping list. Each week, Jack and Lorna set one day aside to use up leftovers.
On Friday evenings I sit down and write the menu for the week with all the things you need to put in it. Then on the Saturday morning I go and buy them all. And Fridays tend to be you know whatever is left over. Towards Fridays there’s quite likely to be two or three little dishes of leftovers in the fridge and failing that there’s always omelette. Jack (70 years, non-discarder)

Bill and Margaret didn’t plan their meals to quite the same extent as Jack and Leonie but they did plan their meals to ensure that leftover meat was utilised.

We budget our week. If you go back to our roast beef. We’ll have a roast say on Thursday night. Now if it’s big enough, we’ll do a stirfry with some of it on Friday night and then use it up for sandwiches over the weekend. Bill (55 years, non-discarder)

4.4.4 Discarders Identified Limitations to Food Handling Practices

Participants who discarded meat identified limitations to their food handling skills. In particular, discarders described uncertainty about how to use leftovers.

My mum is really good at using up leftovers but I don’t really have that skill. Anja (39 years, discarder)

I guess I should use it up but I don’t really know what to do with leftovers so I end up throwing them out. Kate (34 years, discarder)

Adding to this was a dislike of eating leftovers. Phase One participants were either concerned about how safe it was to eat leftovers or simply did not like the idea of it. Adam was uncomfortable with the idea of wasting food. However, he was also uncomfortable eating leftover meat.

I have a fear of leftover meat. I guess it’s a food safety thing [laughs]. I don’t know why. The next day is fine, but I definitely don’t like keeping meat in fridges. There’s too much bacteria and things like that can possibly cause issues. Adam (32 years, discarder)

Anja was unconcerned about wasting food. Leftovers were rarely eaten in her household. The idea of eating most leftovers was unappealing. Anja preferred to get rid of any excess food and prepare a new meal the following day.

I’m a bit of a pop it in the bin sort of person because I know we won’t eat it [leftovers]. Like for a stirfry, I think, ‘Yuck, can’t eat that the next day, it’s not going to last very well’. Anja (39 years, discarder)
Phase One participants who discarded meat were also less likely to use the freezer than non-discarders. Some were uncertain about how to use the freezer safely.

I’m not really sure how long things can stay in the freezer. I worry that it might not be any good. Kate (34 years, discarer)

Others didn’t like to eat meat that had been frozen.

I just don’t like to eat frozen meat. I don’t think it tastes good. If there’s a packet of sausages in the freezer or spending 20 minutes driving to the shops and waiting in line – I drive to the shops. Adam (32 years, discarer)

4.4.5 Over-purchasing Can Lead to Discard when Food Handling Skills are Limited

Many Phase One participants, particularly those shopping at the supermarket, recognised that they buy more meat than they ideally require. Kate discarded the most meat during the seven-day period.

I’ll buy that package because it appears to be good. Even if something’s more meat than we really should have, I’ll still cook it for that meal and then we’ll discard what we don’t eat. Kate (34 years, discarer)

Many of the non-discarders chose to shop at the butchers or farmers’ market to reduce over-purchasing.

One of the reasons I shop at the butchers is because I can say, ‘I want that bit’. I get a much better chance of deciding how much I’m going to have. The supermarket isn’t very interested in the idea of putting 300g of meat on their little things. Jack (70 years, non-discarer)

I prefer to shop at the farmers’ market. There’s only one of me so if I shop at the supermarket I often have to buy two pieces of meat when I only want one. There’s more choice at the market. Glenda (58 years, non-discarer)

Other non-discarders agreed that they often had to purchase more meat than was ideal but had strategies for dealing with this.

I often come home and repackage it to put in the freezer or I might put in into quantities that would suit us. I’m not sure when it happened but the mince packages have suddenly gone from around half a kilo to sort of 600-700 grams. That’s a bit harder to manage because it’s just a bit extra. Sarah (30 years, non-discarer)
Well most things are too much for me because I live on my own but I manage. If I bought a kilo of mince then I’d make some sort of bolognese mix or something and put it into small containers and freeze it. Rhoda (58 years, non-discarder)

4.4.6 Waste by Overconsumption

Nearly all participants recognised that they were more likely to consume meat than discard it. It could be argued that meat is wasted by both the consumption of excess meat and discarding uneaten meat but participants did not perceive eating excess meat as wasteful. Meat was only wasted if it was discarded in the bin.

I have a ready dustbin over there [points to her husband]. Ann (61 years, non-discarder, 1489 g/week)

The males in my house are more likely to eat it rather than throw it out. Sarah (30 years, non-discarder)

We sometimes eat at The Central Café. You go and have a chicken schnitzel and it’s almost the size of your dinner plate. For breakfast you get about 8 rashers of bacon – short ones – on your plate. It’s a pub meal type of thing but the portions are huge. It’s just amazing and that’s what they’re known for – their large meals for $14. Anyway, you look down and you’ve only had half of it but you think I can’t waste it … so you keep going. Mark (42 years, discarer, 1275 g/week)

One participant articulated a different perspective.

If you put a plate of food in front of me and I have a choice between finishing it or to throw maybe half of it away, I will choose the latter because by choosing the latter I know I am wasting food but also I know there’s no point stuffing all the food in me because in the end it is just going to be harmful to me. Connie (32 years, non-discarder, 995 g/week)

4.4.7 Summary – Discard

There was a distinct divide between those who wasted meat by discarding meat and those who did not discard meat. Childhood experiences influenced concern about food waste. Non-discarders had good meal planning and food handling skills. Discarders were less confident with food handling and preparation. Participants viewed wasting meat by discard as different to wasting meat by overconsumption. When excess meat was purchased and prepared, it was more likely to be eaten rather than discarded.
4.5 Healthy Sustainable Meat Consumption

In order to use meat in a healthy and sustainable way there is a need for many people to eat less and to eat differently. This section demonstrates attitudes to eating less meat and to eating different types of meat. Data from all three phases of research are included in this section.

4.5.1 Eating less meat – resistance

Phase One participants in this doctoral study were largely uninterested in the idea of eating less meat. There was large variability in weekly meat intake and many participants consumed more than the recommended amount of meat. Yet all Phase One participants indicated that they were happy with the amount of meat that they consume and did not see any need to change. Phase One participants strongly expressed that meat is an important and desirable food. Bill found it difficult to consider why he would eat less meat.

We’re an omnivore. We have canine teeth. We’ve always eaten meat. Bill (55 years, 2090 g/week)

Similarly, Liam considered meat a staple and entrenched part of the diet. He was doubtful that anyone would eat less meat.

People enjoy meat so it’s going to be hard to make people change their habits. Humans have been eating meat for as long, well maybe not for as long as they’ve existed, but close to it … I think that meat has always been a staple. Liam (21 years, 1080 g/week)

Phase Two survey respondents were asked to indicate their level of agreement with various attitudinal statements relevant to meat. 602 people responded to this question. Figure 4.25 indicates that just under three-quarters (74%, n=446) of survey respondents agree or strongly agree with the sentiment that humans are meant to eat meat.

![Figure 4.25: Level of agreement with the statement ‘humans are meant to eat meat’ (Phase Two survey respondents n=602)](image-url)
4.5.2 Eating less meat – acceptable portions

Phase One participants were asked if they would prefer to eat smaller portions of meat more regularly or larger portions of meat less frequently. There was reluctance to do either. However, participants were slightly more in favour of eating meat less frequently in order to allow more satisfying portions.

Probably preferable to me would be eating it less often – as long as it’s not weeks without steak. I could eat lots of other things in between times but for each portion I want enough to be satisfied because I generally enjoy what I’m eating. I don’t want to be halfway through a meal, have all the meat gone and wish I had more. Liam (21 years, 1080 g/week)

Phase Two survey respondents were asked, ‘If you were to reduce the amount of meat that you eat, how likely are each of the following options?’ In a sample of 592 respondents, both these options were equally likely (see Figure 4.26).

![Figure 4.26: Likelihood of eating smaller portions and eating meat less frequently (Phase Two survey respondents n=592)](image_url)

When probed, most Phase One participants accepted that they could reduce their portions to a small extent. However, there were limits. There was a viewpoint that there is a certain amount of meat that is satisfying and it was not worthwhile to eat less than this.

If I have to lessen the quantity of meat to such an extent that it’s only there as an accompaniment to the meal then it’s not worth having. The meat is the satisfying thing.
That’s what I like about it. A watered down meat meal would not be satisfying and then you’d probably eat more carbs. I would bulk it out with potato and potato is not a good thing to bulk it out with. Kate (34 years, 1400 g/week)

Like if we have lamb cutlets we would normally have three or four cutlets. You wouldn’t want just one. No. If you couldn’t have three it’s not worth having them. Lara (41 years, 960 g/week)

In order to further explore this notion of a minimal satisfying amount, Phase Two survey respondents were shown a series of images of cooked steak (see Figure 4.12). They were asked to indicate the smallest amount of steak that they would be satisfied to eat for a single meal. 590 people responded to this question. Figure 4.27 indicates the responses for males and females.

![Figure 4.27: Minimum portion of steak that Phase Two survey respondents would be satisfied to eat (n=590)](image)

Male survey respondents (n=216) specified that they would be satisfied to eat portions of steak ranging from 50 grams to 350 grams. Most commonly, males indicated they would be satisfied with 100-gram (38%, n=82) or 150-gram portions (30%, n=65). Female survey respondents (n=349) indicated they would be satisfied to eat portions of steak ranging from 50 grams to 250 grams. Over half the females (53%, n=185) would be satisfied with portions of 100 grams. In order to determine if a relationship exists between satisfying meat portion and gender, meat portions were classified into small (100 grams or less), medium (150-200 grams) and large (250 grams or greater). A chi-square test of 575 respondents revealed that
this relationship between portion and gender was significant, $\chi^{2(2)}=70.6$, $p<0.001$. Portion of meat that is satisfying is related to gender.

In two separate questions, survey respondents indicated the portion of steak they currently eat (see Figure 4.13) and the portion of meat they would be satisfied to eat (see Figure 4.27). Responses to these two questions were compared and categorised into four categories: ‘no difference’, ‘willing to eat 50 grams less’, ‘willing to eat 100 grams less’ and ‘willing to eat 150 or more grams less’. Figure 4.28 displays the results.

In a sample of 216 males and 349 females, 80 per cent of males and 60 per cent of females indicated they would be satisfied with eating a smaller portion of steak than they currently eat. Over half (52%, $n=181$) the females would be satisfied with 50 grams less than they currently eat. Just under half (44%, $n=95$) of males would be satisfied with 50 grams less and 28 per cent of males would be satisfied with 100 grams less than they currently consume.

4.5.3 Eating less meat – how often ‘meat-free’?

The seven-day weighed records from Phase One participants indicated that they consume meat regularly. Only 11 per cent of the days where Phase One participants provided intake data ($n=203$) were classified as meat-free where no meat was consumed at all during the day (see Figure 4.4). When interviewed, Phase One participants indicated some willingness to eat
meat less often. Typically, participants indicated that they could eat ‘meat-free’ one or two days each week. This was largely based on their repertoire of usual meals.

We sometimes have burritos and they don’t have meat so I guess we could do that. Adam (32 years, 1050 g/week)

I suppose we could have gnocchi and we could do risotto. We could do a couple of nights a week I suppose. Lara (41 years, 960 g/week)

We like fish so we could eat that more often. About two days is OK. Anja (39 years, 680 g/week)

Phase Two survey respondents were asked how often they would be willing to eat meals/snacks that do not contain meat. Figure 4.29 shows how often survey respondents would be willing to eat ‘meat-free’ for the entire day. Just over one-quarter (27%, n=160) of survey respondents were willing to eat meat-free less than weekly. Approximately one-third (36%, n=404) indicated they could eat meat-free 1-2 days per week and just under one-quarter (24%, n=143) were willing to eat meat-free 3-4 days per week. Few respondents were interested in eating meat-free more frequently then 3-4 days per week.

With regards to different meals, just under 70 per cent of respondents indicated they would be willing to eat meat-free every day for breakfast. Approximately one-third of respondents would be willing to eat meat-free every day for lunch. However, one-quarter of survey respondents were only willing to eat meat-free for lunch 3-4 days per week. Respondents were less willing to eat meat-free for dinner. Just over 40 per cent of respondents indicated they were willing to eat meat-free for dinner 3-4 days per week. A further 29 per cent were willing to eat meat-free for dinner 1-2 times per week.
Figure 4.29: Frequency Phase Two survey respondents are willing to eat meat-free for different eating occasions and the entire day (n=594)

4.5.4 Eating less meat – barriers

Phase One participants found it difficult to imagine what they would eat if they had more meat-free meals each week. As presented previously, Phase One participants valued the unique taste and texture provided by meat (see Section 4.1.1). Phase Two survey respondents were asked to identify factors that would make it difficult to eat less meat. Responses were given in a free-text field and coded using inductive coding. Figure 4.30 displays their response. Over half the survey respondents (53%, n=299) indicated that they would find it difficult to eat less meat because no other food is as tasty or satisfying.
Free-text comments by survey respondents echo the sentiment expressed by Phase One participants that meat offers unique flavours and satiates more than any other food.

I don’t know what else to eat that will provide the same feeling of fullness and energy. (female, 29 years)

Other foods are not as filling or satisfying. When there is a meal without meat, I am left feeling hungry. (male, 32 years)

I don’t see a meal as complete unless it has some form of meat with it. I like it too much. I wouldn’t know what else to eat. (female, 24 years)

I would only eat less meat if there was some magic foodstuff that could equal meat’s advantage in taste, nutrition and satiety. And that ain’t nut-meat my friend. (male, 39 years)

For some Phase One participants, the idea of eating meat-free was completely foreign.

I wouldn’t know what to eat. Anja (39 years, 680 g/week)

Figure 4.30 indicates that one-fifth (20%, n=113) of Phase Two survey respondents also feel that they would not know what to eat if they had to eat less meat.

Phase One participants also expressed concern that nutritional intake would be compromised if less meat was consumed.
I don’t know if I could get enough protein and iron [with less meat]. We obviously need it (meat). Tanya (47 years, 800 g/week)

I really think we need to eat meat for iron. I think I get too tired without it. Connie (32 years, 1050 g/week)

Just under one-quarter (23%, n=130) of Phase Two survey respondents shared this concern (see Figure 4.30).

Some Phase One participants indicated that they enjoyed vegetarian meals but were dettered because they were often time-consuming too make.

I quite like lentils and we really should eat more of them. It’s just that it’s a bit of an effort to make. It takes a bit of time. Lorna (65 years, 560 g/week)

Occasionally I have thought maybe I should become vegetarian but I wouldn’t last doing that ... It’s because the vegetarian options like lentils and beans and chickpeas are difficult. Probably because I’m a lazy cook. Rhoda (58 years, 580 g/week)

A small proportion of Phase Two survey respondents (9%, n=5) shared this view (see Figure 4.30).

Many Phase One participants were concerned about what they would substitute for meat if they reduced the meat in their diets. Typically, they anticipated that they would eat more carbohydrate-based foods such as bread, pasta, rice and potato. Female participants viewed this as undesirable.

I think if you try to reduce the amount then you tend to eat other things that might not be as good for you to get satisfied and end up filling up on things like rice or whatever. Glenda (58 years, 1960 g/week)

I would be hungry. I would have to substitute with pasta or potato or something to have that same full feeling. Anja (39 years, 680 g/week)

In order to further explore this, Phase Two survey respondents were asked about their likelihood of replacing beef, lamb and pork with a variety of other foods. Figure 4.31 indicates that most survey respondents indicate that would be likely or very likely to replace these meats with chicken (91%, n=537), fish (84%, n=496), vegetables (80%, n=472), eggs (74%, n=437) and carbohydrate sources such as bread, pasta, rice and potato (67%, n=395). Fewer survey respondents are likely to replace beef, lamb and pork meat with lentils (52%,

138
n=307) and vegetarian alternatives (43%, n=254). Few survey respondents are likely to replace beef, lamb and pork with kangaroo (34%, n=201) or rabbit (16%, n=94).

<table>
<thead>
<tr>
<th>Food</th>
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<th>Very Likely</th>
<th>Likely</th>
<th>Very Likely</th>
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</thead>
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<td>31%</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Kangaroo</td>
<td>29%</td>
<td>23%</td>
<td>22%</td>
<td>12%</td>
</tr>
<tr>
<td>Vegetarian Alternatives</td>
<td>21%</td>
<td>22%</td>
<td>27%</td>
<td>16%</td>
</tr>
<tr>
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<td>15%</td>
<td>20%</td>
<td>35%</td>
<td>17%</td>
</tr>
<tr>
<td>Bread/Pasta/Rice/Potato</td>
<td>8%</td>
<td>17%</td>
<td>42%</td>
<td>25%</td>
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<tr>
<td>Eggs</td>
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<td>11%</td>
<td>45%</td>
<td>29%</td>
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</tr>
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<tr>
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</tbody>
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![Bar graph showing likelihood of replacing Phase Two survey respondents replacing beef, lamb and pork with alternative foods (n=590)](image)

**Figure 4.31: Likelihood of replacing Phase Two survey respondents replacing beef, lamb and pork with alternative foods (n=590)**

### 4.5.5 Eating less meat – facilitators

Phase One participants were largely uninterested in eating less meat. They indicated that until they were given a convincing reason they would be unlikely to alter their meat consumption. Appealing recipes was about the only thing that would encourage some participants to eat less meat.

If I had some good vegetarian recipes I might eat less meat. I have a couple of vegetarian cook books and I often buy Good Taste magazine but there don’t seem to be many vegetarian recipes that appeal to me. Nadine (35 years, 870 g/week)

I don’t really have any vegetarian recipes. Sometimes I buy that Healthy Food magazine [Australian Healthy Food] or I look at that AIS [Australian Institute of Sport] cook book when I want to eat better. But the recipes mostly have meat in them. Kate (34 years, 1400 g/week)

Phase Two survey respondents were asked to indicate factors that would help them to eat less meat. Responses were given in a free-text field and coded inductively. 557 people responded
to this question. Responses are summarised in Figure 4.32. One-third of survey respondents indicated that recipes/meal ideas would help them to eat less meat.

Figure 4.32: Facilitators to eating less meat as identified by Phase Two survey respondents (n=557)

To further explore the availability of meat-free recipes, popular food magazines were audited in Phase Three. In a sample of 1507 recipes, just over two-thirds (38%, n=573) included red meat (beef, lamb, pork) as the main ingredient (see Figure 4.33). The remaining recipes were distributed equally among meat-free (22%, n=332), seafood (21%, n=317) and poultry (19%, n=285). This data suggests that meat-free recipes are available but it does not give any insight into the appeal of the meat-free recipes. Further work is warranted to explore this issue.
Other facilitators identified in the Phase One survey mirror previous findings. Figure 4.32 indicates that less than one-fifth (18%, n=100) of survey respondents would eat less meat if there was an alternative food that matched the flavour characteristics of meat. Approximately one-tenth (11%, n=61) of survey respondents indicated they would need a convincing reason to eat less meat (e.g. health or environmental). Interestingly, one-tenth (9%, n=50) of survey respondents indicated they would eat less meat if foods such as vegetables were cheaper. This is an interesting finding as it was thought that meat would be regarded as a higher cost food than vegetables. One free-text survey comment provided further insight.

I would eat less meat if vegetables were less expensive. I understand that meat is not cheap either but for $20 I can get meat that will last more for 2 or even 3 weeks whereas vegetables are only good for a few days and I hate frozen veggies. (female, 33 years)

### 4.5.6 Eating different meat – lower impact meats

Meat originating from animals such as kangaroo, rabbit, guinea pig and myriad other small creatures has been proposed as a preferable option (in terms of environmental impact) to meat originating from large, ruminant animals such as cows and sheep (see chapter 2). Phase One participants were split between those who supported the idea and those who could not fathom it. Figure 4.31 indicates some concurrence with an approximately equal split between Phase Two survey respondents likely and unlikely to eat kangaroo. Fewer survey respondents were likely to eat rabbit.
For some Phase One participants, there was nothing that would convince them to eat different types of animals. The thought of it was completely unacceptable.

I couldn’t do it. I mean it’s been around in the media but I just couldn’t. The visual to me would be like eating, not a rat, but think they’re cute and I just couldn’t. Anja (39 years, 680 g/week)

Lara described herself as an animal lover. She spoke about being squeamish about handling any type of raw meat. Lara accepted eating ‘normal’ farm animals. However, found the idea of eating other animals confrontational.

I won’t eat anything that isn’t the norm. To me that means that they’re grown and they’re slaughtered for our purpose of eating. The difference is that they’re raised for that. They are raised as beef cows and that’s what their purpose is I suppose. Whereas bunnies have got fluffy tails and lovely ears (laughs). Lara (41 years, 960 g/week)

Mark agreed that there was a clear delineation between animals that should and should not be eaten.

These animals are made for eating and these ones are made for cuddling. Mark (42 years, 1050 g/week)

Some Phase One participants were comfortable with the idea of eating meats such as kangaroo and rabbit but did not eat it because they did not enjoy the taste.

I find kangaroo a bit strong. It’s a gamey sort of meat. Price-wise it’s OK. I think you have to cook it that much longer for it to be edible so that you’re not eating rubber. It tends to be fairly tough. Lorna (65 years, 560 g/week)

Other Phase One participants supported the idea of eating different types of meat. These participants all had some familiarity with eating foods such as kangaroo or rabbit. Many had families with farming experience.

I regularly eat kangaroo so I think that’s a good option. I think if we could get sort of natural animals I suppose or wild animals then the more wild and natural the food the better. Glenda (58 years, 1960 g/week)

Jane was a beef producer and considered eating kangaroo to be a practical way to deal with excess kangaroo on her property. Margaret, a fellow beef producer, shared Jane’s view.
I quite like kangaroo and if we had a gun that actually fired straight it wouldn’t be a problem [laughs]. A couple of our neighbours do occasionally have barbequed kangaroo and I quite like it. I actually wish it was promoted a bit more because we’ve got so many of them and it’s so lean. Particularly in the drought we had to get the local shooter to come out because we were inundated with them. It just seems such a waste not to be eating them. Jane (39 years, 1040 g/week)

I go along totally with utilising kangaroo because it’s a very ignored meat and yes utilise the rabbits because they’re a pest. Margaret (50 years, 1300 g/week)

Liam lived on a farm when younger. He had eaten kangaroo and rabbit in the past and enjoyed it. For Liam, the acceptance of different meats all came down to taste.

If there was evidence that came to the fore that said we’re doing terrible damage to the planet but we’ve got all these alternatives, I wouldn’t have any problem with eating different animals. As long as I enjoy eating it and it’s available. Liam (21 years, 1080 g/week)

Although there was support for eating different meats in principle, most Phase One participants admitted that they ate meats such as kangaroo and rabbit infrequently and other types of meat were not eaten at all. Only one household consumed kangaroo during the study period. Several reasons were given to explain why these foods are not consumed more regularly. Limited availability was frequently cited as a barrier.

I don’t know where you get rabbit from except for your specialty meat places but what’s the cost? I don’t know what the cost is compared to other meats. Nadine (35 years, 870 g/week)

So I think I am open to trying rabbit and kangaroo … I think we don’t eat it now because we don’t see it very much in the supermarket aisles. Connie (32 years, 995 g/week)

Phase One participants also spoke of uncertainty about how to cook alternative meats.

I’m not very confident at cooking the actual kangaroo meat. I’ve actually enjoyed it but I don’t have the confidence to use it in different ways that I would use other meat. With chicken you know you can do butter chicken or savoury mince with the mince but I don’t know about kangaroo. Nadine (35 years, 870 g/week)

I’m open to those things but I’ve never found a way to cook kangaroo without it going dry. Rhoda (58 years, 580 g/week)
Some participants supported eating alternative meats but they preferred to eat meats such as beef, lamb and chicken. While other types of meat are readily available there is little motivation to eat meats such as kangaroo, rabbit and others.

I would be happy to eat kangaroo definitely and I would be happy to buy it as well. I suppose it’s similar to steak … Although, while I’ve got a freezer full of steak I’m not going to buy it. Jane (39 years, 1040 g/week)

I like kangaroo. I sometimes buy the mince but when there’s plenty of beef mince in the supermarket there’s no real reason to buy it. Nadine (35 years, 870 g/week)

### 4.5.7 Eating different meat – tongue-to-tail

Tongue-to-tail eating has been proposed as an environmentally friendly way to use meat (see chapter 2). This essentially refers to eating all parts of a carcass and thereby reducing waste. A minority of Phase One participants supported this idea.

I think we should eat the whole beast. If we’re going to take up the land to feed large numbers of people, grazing animals then we’ve got to eat all of it. Glenda (58 years, 1960 g/week)

There was little support for the use of offal. Many participants were completely resistant to the idea of eating offal. They spoke negatively about the taste, texture and general idea of eating offal.

It’s partly the idea too but you can get over that sort of stuff but no I just never liked the taste or texture. Rhoda (58 years, 580 g/week)

Others were comfortable with eating offal but found it difficult in practice because it ‘takes a lot of work’. There was a sense that eating offal was a thing of the past. While some participants enjoyed eating offal occasionally, there was no motivation to eat it when more preferable cuts of meat were readily available.

When I was a kid we ate everything. Us kids used to always fight over the brains – we love the brains. But to be honest for us I don’t really keep any offal from the cows. I don’t even keep the tail. The butcher did ask me once if I wanted it for soup and I said, ‘No, just make it into mince or keep it for the dog’. Jane (39 years, 1040 g/week)
Phase One participants were more open to making use of some of the less utilised cuts of meat than to eating offal. They supported the idea of eating cuts such as lamb neck, oxtail and shank. However, barriers were preparation time and lack of knowledge about how to prepare less familiar cuts.

Well that’s the thing that’s hard when I get the meat from the farm there were some neck rosettes in there and I think, ‘What am I going to do with them?’ Tanya (47 years, 800 g/week)

I don’t want to have to prepare those things and they do need to be prepared in a certain way, so that’s the painful thing. Whereas the cuts available now are very easy to do something simple with. Kate (34 years, 1400 g/week)

4.5.8 Eating different meat – meat alternatives

Meat alternatives are being proposed as a solution to future predicted shortages in meat availability (see chapter two). A minority of Phase One participants had a pragmatic view of this and expressed that as long as the flavour and texture was acceptable they would eat meat alternatives.

I guess it would come down to the flavour and the taste. Sarah (30 years, 880 g/week)

As long as it tasted good and the texture was good I’d eat it for sure. But tofu, for example, I don’t like at all because of the texture mainly and it doesn’t seem to have much taste. If it does, it’s a bit ordinary so I don’t eat tofu. Liam (21 years, 1080 g/week)

Most Phase One participants had little interest in this option. For many this was based on negative past experiences. They had tried foods such as tofu and vegetarian sausages and found them unpleasant.

I think the vegetarian sausage people need to really look at what they’re doing because they look atrocious. There’s nothing appetising or appealing about them. The other week, I cooked some Angus sausages and some vegetarian sausages. We wanted to try some. The children looked at them, nope, no interest whatsoever. If it looked more like meat perhaps but at the moment in most instances it’s not. Kate (34 years, 1400 g/week)

I suppose it’s like that stuff that’s like bacon. It’s shaped like bacon, it’s coloured like bacon but when you go home and fry it up it doesn’t taste like bacon. Mark (42 years, 1275 g/week)

Other Phase One participants disliked meat alternatives because these products are unnatural. They disliked the processed nature.
I think processed foods are really bad. I think processed soy is right up there at the top of the list so substituting good healthy meat for something like that rubbish is an appalling step. Glenda (58 years, 1960 g/week)

Many participants expressed that they would be more likely to turn to ‘natural’ meat substitutes such as vegetables and lentils than use ‘artificial’ meat alternatives.

I am quite open to trying new things but to me the flavour is the most important. It has to be appetising and hopefully it doesn’t look too unnatural. Some packaged foods like the vegetarian sausages – I would never buy because it is just weird to me. Why do I want to deceive myself that I am eating sausage which should be meat. If I want to try to eat more vegetables then I should just go and do that. Connie (32 years, 995 g/week)

We don’t like tofu. It’s got no taste has it? But I think lentils can be very tasty and I have used them successfully. I’d like to use them more. Lorna (65 years, 560 g/week)

I would go for the natural. I’d rather eat earthworms than eat soy tofu. Kevin (61 years, 2975 g/week)

4.5.9 Eating different meat – organic meat

Approximately one-third of Phase One participants purchased organic meat at least some of the time. ‘Organic meat’ was a term used voluntarily by participants. When asked to explain this term, participants typically expressed that organic meat was ‘chemical free’, ‘produced naturally’ and ‘free range’. Participants identified organic meat by package labeling or the fact that it was purchased from a specialty organic provider. In general there was support for the use of organic meat but there were deterrents. Some found the price prohibitive.

Once in a blue moon we buy organic meat but it’s a massive cost difference. It’s a dollar thing primarily. Otherwise I wouldn’t hesitate. Kate (34 years, 1400 g/week)

It’s definitely important that animals are cared for well but unfortunately for us it’s a dollar driven thing. The bottom line comes down to if we can afford it, and we can’t. We’ve started at least with eggs. I will not buy any other eggs than free-range eggs. So we’ve started there. Nadine (35 years, 870 g/week)

Other Phase One participants were willing to pay more for organic produce provided it was authentic.

I’m happy to pay more if it’s real. Glenda (58 years, 1960 g/week)
I don’t mind paying more for organic produce as long as it’s really organic. Tanya (47 years, 800 g/week)

However there was widespread scepticism about the authenticity of organic produce.

I’m a bit dubious about some of these things. I’m a bit suspicious about how organic these things are. The question is whether they’re really organic. Jack (70 years, 590 g/week)

I’m never quite sure what they mean by organic chicken – whether that just means that they’ve fed them organic grains or whether they’ve been reared differently ... I’m not quite sure what the organic chicken means ... What I’m looking for is the grass fed sort. I don’t want them to be feeding them certified organic grains in the shed. But it’s hard to tell with some of that labelling. Glenda (58 years, 1960 g/week)

There was also scepticism about who was benefitting most from the sale of organic produce. Adam felt that the supermarkets benefitted most from the sale of organic produce and that it was a marketing ‘ploy’.

I’d be prepared to pay more [for organic or free-range] if the extra money’s going to the farmer. You find that Woolies can say it’s organic and just pick up an extra dollar or two – it’s not going to the farmer. Adam (32 years, 1050 g/week)

4.5.10 Summary – Healthy and Sustainable Meat
Participants and respondents in this study were largely uninterested in reducing their consumption of meat, primarily because they were unconvinced there was a need to eat less meat. Meat was viewed as an important food that was difficult to replace. Yet evidence indicates there is some scope for participants and respondents to eat less meat by both reducing the size of meat portions and eating meat less frequently. For each individual there is a perceived minimum amount of meat that is required for a satisfying meat-eating experience. Knowledge about how to eat satisfactorily with less meat was limited. There was mild interest in making greater use of lower impact meats and a wider variety of meat cuts, at least in theory. Support for meat alternatives was poor.

4.6 Integration of Findings
Figure 4.34 provides an affinity diagram that summarises the KJ analysis used to identify opportunities to encourage meat-eaters to consume meat in more healthy and sustainable ways. Section 3.12 outlines the KJ analysis undertaken to generate the affinity diagram. In
summary, the KJ analysis involved standing back and looking at all findings identified in this project. Brainstorming was used to identify ‘problems’, ‘contributors’ and ‘opportunities’ within the findings with the purpose of integrating findings across all research phases. This analysis identified that meat is wasted by over-consumption and discard. Key factors contributing to this problem are resistance to eating less meat, disconnect from meat production, poor awareness of dietary guidelines and limitations in food literacy.
PROBLEM
Meat is wasted by over-consumption and avoidable discard.

CONTRIBUTOR
Meat is strongly desired. The sensory properties of meat are highly important. Satiation is a key driver of consumption. There is resistance to eating less meat.

CONTRIBUTOR
Consumers are disconnected from meat production and unconcerned about the environmental credentials of meat. They want ‘safe’ and ‘natural’ meat.

CONTRIBUTOR
Consumers are unaware or unconvinced by dietary guidelines for meat consumption. Awareness of the health risks associated with excess meat consumption is poor.

CONTRIBUTOR
Poor food literacy impacts on consumption and discard. Limitations in food planning, food handling and meal ideas increase the likelihood that meat is over-purchased, over-consumed and discarded.

OPPORTUNITY
There is scope to:
1. Encourage small (~50g) reduction in meat portions
2. Encourage more frequent consumption of meat-free meals especially for lunch.

OPPORTUNITY
There is scope to connect the desire for ‘natural’ meat to some messages about the environmental credentials of meat.

OPPORTUNITY
There is opportunity to improve the nature and communication of dietary guidelines relevant to meat.

OPPORTUNITY
There is opportunity to improve knowledge and skills in meal planning and food handling.

Figure 4.34: Affinity diagram of contributors and opportunities to address the problem of meat waste by over-consumption and avoidable discard
4.7 Chapter Summary
This chapter has presented an integrated analysis of data from all three phases of this mixed methods research. Key findings are:

- Meat is wasted by overconsumption and avoidable discard.
- Meat is a unique food that is highly desired. There is resistance to eating less meat and making use of leftover meat.
- Many participants are observed to be ‘happily disconnected’ from meat production. There is a desire for ‘natural’ rather than ‘low impact’ meat.
- Participants are typically unaware or unconvinced by dietary guidelines for meat consumption.
- Poor food literacy impacts on consumption and discard of meat.

The following chapter will discuss the implications of these findings and provide recommendations for future action.
Chapter 3 - Methodology:

3.1 Introduction to Chapter

Chapter three outlines and explains the methodological approach used in this doctoral study. A pragmatic worldview influenced this project. The multifaceted nature of the research problem required a mixed methods approach to fully address the research questions. A variant of an exploratory sequential research design was used (Creswell & Plano Clark 2011). Qualitative data from interviews was integrated with quantitative data from weighed food records, a web-based survey and an audit of food magazines. This chapter declares and discusses my over-riding worldview or philosophy, identifies my pre-existing knowledge, justifies the methodology and research design chosen, describes the methods used and discusses how I have addressed issues of validity.* An overview of my methodological approach is shown in Figure 3.1.

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* Various sections of this chapter are written in the first person. There is debate as to whether academic research should be written in the first person or more neutral third person (Webb 1992). Qualitative research tends to be written in the first person whereas quantitative research tends to use the third person (Holloway & Wheeler 2009). In keeping with a pragmatic worldview, I have chosen to use the first person where it is seen as the best epistemological fit.
3.2 Philosophy and Worldview

It is recommended that researchers make explicit the philosophical ideas they hold when conducting quality research (Creswell 2009). Whether the terminology be ‘worldview’, ‘paradigm’ or something else, the central idea is that the researcher’s basic beliefs shape the research process, and therefore should be articulated to give greater meaning to the research. Research has more meaning to the reader when elements such as the researcher’s ontology
Ontology refers to our assumptions about how the world is made up and the nature of reality (Denzin & Lincoln 2003). To come to terms with my understanding of my ontology it was helpful to ask, ‘Is reality real and can this reality be known, or is reality always in construction, and ever changing?’ (Campbell 2012).

Epistemology refers to how we gain knowledge of what we know (Creswell & Plano Clark 2011). It has to do with how we believe we might discover knowledge and what constitutes knowledge. How do we know the world? What is the relationship between the inquirer and the known? (Campbell 2012).

To enhance validity in mixed methods research, the researcher is encouraged to reflect on personal understandings and experiences and declare how these influence a researcher’s perceptions (Beach, Becker & Kennedy 2006, Dellinger & Leech 2007, Onwuegbuzie & Johnson 2006). I have been a dietitian for 18 years. My discipline has a strong grounding in human biological sciences. Hence, I am very familiar with a positivist way of viewing research. I appreciate that for some research questions objectivity is desirable and in some circumstances reality can be known. However, as a dietitian, I also work within the complexity of human behaviour. For me, an empirical approach to research is too narrow on its own. I value the viewpoints and experiences of individuals and agree that some meaning can be constructed in social situations (Crotty 1998, Flick 2007) and, as a result, I also appreciate elements of social constructivism. Constructivism recognises the unique experience of individuals and that each person’s view of making sense of the world is valid and worthy of respect (Crotty 1998). It contends that multiple-constructed realities abound and that the knower and known cannot be separated because the subjective knower is the only source of reality (Guba 1990).

It intuitively makes sense to me to collect quantitative and qualitative data to gain a more complete understanding of food-related behaviour. I value a practical approach to research where the researcher employs the methods that best work to address a research question. I believe that both objective and subjective knowledge are valuable and can give better meaning to an issue when used appropriately. The phenomenon of how much meat is eaten during a specific timeframe has a singular reality and warrants a structured research approach. On the other hand, when trying to understand why that quantity of meat is eaten, multiple realities are possible and a more open approach where I get closer to participants is required. Thus my current worldview can best be described as pragmatic.
Pragmatism is a philosophical stance that embraces multiple viewpoints of a research problem (Halcomb, Andrew & Brannen 2009). It is widely regarded as a good philosophical partner for mixed methods research (Creswell & Plano Clark 2011, Johnson & Onwuegbuzie 2004, Tashakkori & Teddlie 2003). For the pragmatist, the nature of reality can be both singular and multiple (Creswell & Plano Clark 2011). Pragmatism endorses eclecticism and pluralism and contends that different perspectives can be useful to gain an understanding of people and the world (Johnson & Onwuegbuzie 2004). Within pragmatism, knowledge is viewed as both constructed and based on the reality of the world we experience and live in (Johnson & Onwuegbuzie 2004). Practicality is an important characteristic of the pragmatist’s epistemology (Creswell & Plano Clark 2011). Fundamental to pragmatism is that the research questions are the impetus for choosing research methodology and design (Halcomb, Andrew & Brannen 2009). It is not contradictory to claim that both quantitative and qualitative research are useful – rather they are complementary and enable the researcher to fully see his or her world (Onwuegbuzie & Johnson 2006). The researcher uses the method that best addresses the research question. Depending on the research question, this could require distance and impartiality, closeness, or a combination of both (Creswell & Plano Clark 2011).

Researchers are encouraged to be transparent about the biases they bring to research (Creswell & Plano Clark 2011). Throughout this research process, it has become very apparent that both participants and audiences want to know about my own relationship with meat. Hence, I feel it is important to acknowledge that I am a meat-eater. To me, meat is a delicious food that provides a great range of nutrients. I accept slaughtering an animal for food provided it is done as humanely as possible. I hope that generations to come can continue to enjoy meat. However, I do not believe that it is essential to eat meat and I am willing to limit my intake of meat to reduce my personal environmental impact. I believe that we need to value and honour where our food comes from and make our food choices responsibly. I recognise that my prior knowledge, beliefs and values influence my perception of the research problem addressed by this thesis. I have not put my prior knowledge aside, nor have I let it dictate the interpretation of my research findings. Rather my approach has been to capitalise on my pre-existing knowledge and use it to extract new knowledge from my findings. This aligns with the work of Dellinger and Leech (2007).

Prior to commencing this project, I has observed clients both consuming large quantities of meat and changing meat consumption motivated by environmental and health concerns. I had
observed increasing amounts of information about the environmental impact of meat appear in the popular media alongside alternative viewpoints from organizations such as Meat and Livestock Australia. Organisations such as ‘Love Food Hate Waste’ and ‘Meat Free Monday’ had commenced activity. Farmer’s Markets were growing in popularity but so too were food retailers promoting ‘supersize’ meat portions. I was hopeful that my research would find people making food choices on both health and environmental lines but I really did not know what to expect. In the true spirit of exploratory research, I set out with an open-mind about what I would find. Rather than formulate a hypothesis and check for confirming evidence, my goal was to start with a broad exploration and develop my research approach from findings as they emerged.

3.3 Research Purpose
The intention of this investigation was to use a health and sustainability lens to explore the way meat is used and viewed by Australia meat-eaters. It further aimed to identify factors that influence meat-eaters to use meat in healthy and sustainable ways.

3.4 Research Questions
Two overarching research questions guided this project.

1. What influences the type and amount of meat procured, consumed and discarded by Australian meat-eaters?
2. How do Australian meat-eaters view approaches to healthy and sustainable consumption of meat?

3.5 Methodology
This doctoral study used a mixed methods research approach. Mixed methods research is now a popular and widely recognised methodology in many disciplines (Bergman 2011, Johnson & Onwuegbuzie 2004). A central premise of mixed methods research is that it combines quantitative and qualitative methods to provide a better understanding of a phenomenon than
would be possible with either approach on its own (Creswell & Plano Clark 2011, Tashakkori & Teddlie 2003). The rationale for mixing quantitative and qualitative data is essentially that neither quantitative nor qualitative methods alone are sufficient to fully capture the trends and details of a situation (Ivankova et al. 2006). Mixed methods research aims to draw from the strengths and minimise the weaknesses of both quantitative and qualitative research by integrating them into a single piece of research (Johnson & Onwuegbuzie 2004). When done well, mixed methods research can provide better breadth and depth of understanding to a research issue (Johnson, Onwuegbuzie & Turner 2007).

This study set out to understand influences on meat utilisation. To achieve this it was important to understand both what participants do and why participants act. Quantitative methods were useful for documenting procurement, consumption and discard practices. Qualitative methods were useful for understanding why this behaviour occurred. This research was exploratory as it was indentified that there was an inadequate understanding of factors influencing meat utilisation in Australia. Qualitative exploration allows for the collection of broad, rich data in natural settings (Harris et al. 2009). It is useful to scope and identify key issues. However, a limitation of qualitative methodology is that concentrating on a small number of participants limits the findings (Brannen 2009). Incorporating quantitative methods into this project allows an assessment of whether findings resonate with a larger sample.

### 3.6 Research Design

This project used a variant of an exploratory sequential mixed methods research design (Creswell & Plano Clark 2011). This design essentially begins with a qualitative phase of research and is followed by a quantitative phase. My design differed from the traditional approach in two ways. Firstly, it embedded quantitative data collection within the initial qualitative phase. Secondly, the qualitative phase was followed by two quantitative phases rather than the standard one. The research design allowed for a flexible, emergent approach where different methods were used to address different facets of my research problem. Each phase built on what was learned previously to add more depth and understanding of the research issue (Creswell & Plano Clark 2011). Figure 3.2 provides a visual summary of the research design.
The mixed methods literature uses numerous terms to describe reasons for mixing research. Greene and colleague’s (1989) descriptors are used to explain my approach.

**Phase One** (In-depth exploration of influences on procurement, consumption and discard in households) was a qualitative phase with an embedded quantitative component. Understanding of the way meat is used in Australia was limited at the commencement of this research, so initial exploration was required to investigate practices and attitudes within Australian households. Quantitative food records were used to investigate the type and quantity of meat being purchased, consumed and discarded. Qualitative interviews were used to explain behaviour. The quantitative and qualitative data provided ‘complementarity’ where the quantitative data helped to elaborate, illustrate, enhance and clarify the qualitative findings (Greene et al. 1998). Essentially the quantitative data demonstrated what participants bought, ate and discarded and the qualitative data explained this behaviour.
Phase One provides a detailed case study of meat consumption and discard practices in a free-living environment. Data stemming from this case study is limited by sample size and characteristics. However, this is a pivotal stage to identify issues worthy of further investigation.

**Phase Two** (Quantitative web-based survey of influences on meat consumption) was a quantitative phase. It used a web-based survey to further explore findings arising from Phase One and to determine if these findings resonated with a larger and broader sample. Phase One provided a general picture of the research problem. It explored the ‘dimensionality of the phenomenon’ (Bergman 2011). Identified and prioritised dimensions were then incorporated into questionnaire items. Sequencing this quantitative phase after the qualitative phase allowed for ‘development’ of a more relevant survey instrument (Greene et al. 1998).

Integrating the data collected from Phase One and Phase Two allowed for ‘confirmation’ or ‘triangulation’ of qualitative findings (Greene, Caracelli & Graham 1998, Mertens & Hesse-Biber 2012). Combining the data sources added greater strength to the research findings.

**Phase Three** (Quantitative audit of recipes in food magazines) involved a targeted quantitative investigation of the way meat is represented in recipes. Frequency of meat versus meat-free recipes was investigated as well as typical portion sizes recommended in recipes. Phase One and Two identified that some participants used recipes as a guide to suitable meat portions. Lack of meat-free recipes was also cited as a barrier to reducing meat consumption, so a third phase was employed to allow for ‘expansion’ of findings. Expansion refers to expanding the breadth and range of inquiry by using different methods for different inquiry components (Greene, Caracelli & Graham 1998).

Mixed methods researchers are encouraged to consider the priority given to quantitative and qualitative strands in mixed methods research (Creswell & Plano Clark 2011). The qualitative data collected in Phase One had priority in this research design. It was considered the most important strand as it provided in-depth explanations and informed the development of the subsequent quantitative phases.

Quality mixed methods research requires more than employing a range of different methodologies. Consideration needs to be given to the way different types of data are analysed and integrated (Creswell & Plano Clark 2011). Integration refers to the stage or stages in the research process where quantitative and qualitative data are mixed (Ivankova,
Analysis was ongoing throughout this project so that one stage could inform subsequent stages. All findings were collectively synthesised at the completion of all three stages in order to integrate data. The method for integration is described in section 3.12.

### 3.7 Ethics Approval

The University of Canberra Committee for Ethics in Human Research provided ethical approval for all aspects of this project (Project No. 10-61) on 7 April 2010 (see Appendix A). Standard procedures relating to disclosure, confidentiality, informed consent and storage of data applied to this project. Samples of Participant Information Sheets and Consent forms are provided in Appendices B, C and G. Where relevant, strategies to ensure ethical conduct are described within the methods section of this thesis.

### 3.8 Validity

In any research it is important for the reader to be able to judge the quality of the findings. Validity serves the purpose of checking on the quality of the data, the results and the interpretation (Creswell & Plano Clark 2011). It ensures the research is defensible (Onwuegbuzie & Johnson 2006). There is no clear path to approaching validity in research. The research literature provides a vast number of terms for validity and multiple ways of defining validity (Dellinger & Leech 2007). For mixed methods research use of the term ‘validity’ is most supported (Creswell & Plano Clark 2011, Tashakkori & Teddlie 2003).

Issues of validity tend to be treated differently in quantitative and qualitative research. Validity in quantitative research incorporates elements such as the ability of research to measure what it intends to measure and design-related issues (Dellinger & Leech 2007). In qualitative research, validity is less about the inherent ‘truthfulness’ of the results but more about the ‘trustworthiness’ of the data collection and analysis (Gibson & Brown 2009). For mixed methods research, the concept of validity has been addressed sparingly and has yet to be clearly delineated (Dellinger & Leech 2007). Currently, there is no clear way or specific set of standards to ensure validity in mixed methods research (Giddings & Grant 2009).

Historically, validity issues for the qualitative and quantitative components of mixed methods have been treated separately. However, there is also a need to address validity issues relevant
to the mixing of data (Dellinger & Leech 2007). Overarching strategies for increasing validity in mixed methods research include being aware of and disclosing influences such as the researcher’s philosophy, prior understanding of a phenomenon under study and potential biases. Choosing methods that align with the research questions and clearly articulating reasons for mixing and integrating data is also advised. These strategies have been addressed in previous sections of this thesis. Specific strategies to enhance validity of the qualitative and quantitative components of this project are addressed separately in the relevant method sections of this thesis.

3.9 Method for Phase One – In-depth Exploration of Influences on Procurement, Consumption and Discard in Households

Phase One was an exploratory stage designed to gain an in-depth understanding of:

1. meat procurement, consumption and discard practices of meat-eaters within free-living households;
2. influences on meat procurement, consumption and discard practices; and
3. awareness of and attitudes to using meat in sustainable and healthy ways.

Figure 3.3 summarises the research design used in Phase One.
In order to fully explore influences on procurement, consumption and discard, it was important to both quantitatively describe practices in households and qualitatively explore influences on practice. Households collected quantitative records of household meat procurement, individual meat consumption and household meat discard for one week. The household member/s who made the majority of decisions about procurement and meal preparation then participated in face-to-face interviews. These two data sets were viewed as complementary – together they allowed a broader, deeper and more comprehensive understanding of the way meat was used and viewed by the study participants (Greene, Caracelli & Graham 1998).

### 3.9.1 Sampling and Participants

This phase aimed to include residents of the Australian Capital Territory (ACT) and surrounding region who consume meat. To be eligible, participants had to be aged 18 years or older, consume meat, be capable of completing written records and be free of any medical condition that required a specialised diet that influenced meat consumption (e.g. low protein diet due to kidney disease). A maximal variation sampling strategy was employed. This
involves purposively selecting diverse individuals who are expected to hold different perspectives on the research phenomenon (Creswell & Plano Clark, 2011). Previous research identifies some demographic and social differences associated with meat consumption and food waste. For example, males tend to eat more meat than females (ABS 1999, Latvala et al. 2012), shared households of unrelated adults waste more food per person than other households (Ventour 2008), income and education were negative predictors of whether meat is considered ‘unhealthy’ (Lea & Worsley 2002). Based on existing literature, criteria for maximal variation included age, gender, household income, education, cultural background, number of household occupants and sources of procuring meat.

Participants were initially invited to express interest in the project via advertisements (see Appendix B) within workplaces, community organisations and community noticeboards. Interested participants were provided with a Participant Information Sheet (see Appendix C). Those who were interested in proceeding with the study were asked to confirm that they met eligibility criteria and to provide some basic background information about age, gender, household income, education, cultural background, number of household occupants and methods used to procure meat. Eligible participants were then purposively selected to ensure variation in these key characteristics. The initial recruitment strategy did not capture a shared household of unrelated adults. Previous research indicates that this might be an important group in terms of food waste (Ventour 2008). Hence, snowballing (identifying further participants from an initial participant) was used to find a household of adults living in a shared arrangement. All participating households were offered a $100 gift voucher in appreciation of the time and effort required for this project.

Six households were initially recruited. Recruitment continued until the researcher was satisfied that no new information was found and the research questions had been adequately explored. Some describe this as reaching ‘saturation’ in ideas and concepts raised by participants (Caelli, Ray & Mill 2003, Mason 2010). The final number of households was 15. Key characteristics of adult participants are shown in Table 3.1. Participating households also encompassed 10 children aged between 2 and 16. These children contributed to data collected on household procurement and discard. Individual consumption data of children is not within the scope of this thesis. Characteristics of participants are described in further detail in Appendix E.
Table 3.1: Characteristics of adult participants in Phase One

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. Adult Participants</td>
<td>29</td>
</tr>
<tr>
<td>• males</td>
<td>14</td>
</tr>
<tr>
<td>• females</td>
<td>15</td>
</tr>
<tr>
<td>Age Range (years)</td>
<td>18-70</td>
</tr>
<tr>
<td>No. Occupants in Household</td>
<td>1-5</td>
</tr>
<tr>
<td>Household Locations</td>
<td></td>
</tr>
<tr>
<td>• urban</td>
<td>13</td>
</tr>
<tr>
<td>• rural</td>
<td>2</td>
</tr>
<tr>
<td>Household Income (p.a before tax)</td>
<td>&lt;$30 000 - &gt;$150 000</td>
</tr>
<tr>
<td>Education</td>
<td>Year 10 – Postgrad</td>
</tr>
<tr>
<td>Country of Birth</td>
<td>Australia, Singapore, Netherlands, England, Greece, Serbia</td>
</tr>
<tr>
<td>Primary Place of Meat Procurement</td>
<td>Supermarket, Butcher, Farmer’s Market, Direct Delivery (e.g. Aussie Direct), Own Produce</td>
</tr>
</tbody>
</table>

Recruitment and data collection for Phase One took place between July 2010 and February 2011. It is recommended that researchers describe the broader context in which research takes place (Creswell & Plano Clark 2011). This involves identifying any external influences that may have been at play during the research process. In January 2011, Coles supermarket (one of the two major supermarkets in Australia) launched its ‘No Added Hormones in Coles Beef’ campaign. Participants interviewed after this period might have been more likely to consider the issue of hormones in meat more than those interviewed prior to the launch.

3.9.2 Quantitative Data Collection

Participants were advised that the purpose of the study was to explore usual practices relevant to meat use in households. They were advised to live as usual and try to avoid modifying
behaviour during the study. Participants were trained to keep the following records within their own household:

- 7-day record of household meat procurement
- 7-day weighed food record of individual meat consumption
- 7-day weighed food record of household meat discard

Weighed food records are a well-established method for quantifying food consumption (Biro et al. 2002, Willet 1990). This method has the advantage of providing highly accurate data that is not affected by the participants’ ability to estimate or describe quantities (Rutishauser 2005). The main disadvantage is that behaviour can be affected as participants are more focused on behaviour, or are motivated to represent themselves in a certain way, or change their behaviour to make weighing and recording easier (Tucker 2007). Weighed food records are considered to provide an accurate reflection of actual intake during the record-keeping period, although the method may not reflect habitual intake (Rutishauser 2005).

The main criticism of weighed food records is that they are quite burdensome for participants (Tucker 2007). However, familiarity with digital scales with the ability to automatically tare weights is likely to lower this burden. Nearly all participants in this study already owned digital scales and were familiar with using them. In this study, participants only had to weigh and record meat. This is significantly less burdensome than having to account for all foods consumed and discarded. Weighed food records are considered appropriate when the study period is relatively short (1-7 days) (Willett 1990). In this project, a seven-day period was considered suitable to capture the weekly variation in meat consumption typically seen in Australian households without overburdening participants.

To enhance validity, participants were provided with standard collection sheets and calibrated Salter digital scales, accurate within 2 grams. Participants were given instruction about collection procedures and alerted to possible causes of error. A representative from each household was contacted after 24 hours to ensure compliance with data collection. Follow-up interviews and cross-referencing of records of procurement, consumption and discard allowed any discrepancies or omissions to be identified. Most follow-up interviews took place in the homes of participants. This allowed food products and household measures to be directly checked where warranted.
Participants were instructed to record both cooked and uncooked weights where possible. Where only raw weights were provided, the weight was converted to cooked weight using known or experimentally determined weight loss factors for cooking (Matthews & Garrison 1974). Participants were instructed to record plated and uneaten weights so that the actual weight of meat consumed could be determined by difference. Where meat was consumed as part of a composite dish such as a casserole, the weight of all ingredients prior to cooking, the total weight of the cooked composite dish, and the weight of the cooked portion consumed was recorded. This allowed the proportion of meat consumed within each serve to be determined. Where processed products were consumed, food labels were used to identify the proportion of meat within each product. For meals consumed outside the home, participants were asked to estimate portions as best they could plus describe portions using household measures. Food models and images of meat portions were used to assist with portion estimation. Where possible, foods were photographed using mobile phones to assist with verification of portion estimation. One participant (male, 21 years) described a very large portion of meat that was provided by a restaurant. The restaurant was contacted to verify the participant’s estimation.

Food discard has been quantified using methods such as food records, archaeological investigations (direct excavations of rubbish bins), surveys where discard is self-estimated and direct collections of discard (Baker, Fear & Denniss 2009, Quested et al. 2011, Van Garde & Woodburn 1987, Wenlock et al. 1980). Weighed food records are viewed as the best method for accurately quantifying food discard and for capturing food discarded via all routes (Baker, Fear & Denniss 2009, WRAP 2009). Participants were asked to weigh and record all avoidable meat waste. This refers to all meat that potentially could have been eaten but was not. Inedible components, such as bones, gristle and fat trimmings, were not included in the weighed record. Meat discarded by all routes (garbage bin, pets, compost etc.) was included.

3.9.3 Quantitative Data Analysis

Weighed food record data was primarily collected in Phase One in order to describe and understand consumption and discard habits of Phase One participants and thereby give better context to the subsequent qualitative interviews. However, very little is known about meat consumption practices in Australia. Current knowledge of meat consumption primarily stems from 24-hour recall or food frequency methods. Such methods provide important broad information about dietary intake of the Australian population. However give little insight into
weekly patterns of meat consumption. The weighed food record data collected in this project is limited by sample size and sample characteristics, hence cannot be generalized to a wider population. However, the data provides important insight into the consumption patterns of the participants in Phase One. This enhances the qualitative data collected in Phase One and better informs interpretation of the qualitative data collected at interview. Consequently, detailed analysis of this unique set of data was warranted.

**Individual Meat Consumption**

Data collected from 7-day weighed food records for 29 adults was entered into an excel database (Excel ver 2007; Microsoft Corporation) and reported as total daily consumption (in grams/d) of all beef, pork, lamb, poultry and other meat (e.g. kangaroo, venison). ‘Total consumption’ included all sources of meat in that food product. For example, a 100 gram sausage that contained 80 percent beef and 13 percent pork (as per information on the nutrition label) was entered as 80 grams of beef and 13 grams of pork on the database. All data was entered independently by the researcher and was rechecked two weeks after the initial data entry to eliminate data entry error. The statistical software package used was IBM SPSS Inc. software (Version 19.0). Data in the text, tables and all figures is expressed as the mean ±standard deviation (S.D.) for normally distributed ratio data. Medians (Interquartile range) are reported for non-normally distributed data. A student T-test was used to test for significant differences in normally distributed ratio data. Non-normally distributed data were log transformed prior to analysis. Categorical data are expressed as percent of total, and Chi-squared analysis used to test for associations. Statistical significance was accepted at $P < 0.05$.

**Meat Portions Consumed for Evening Meal**

Data collected from 7-day weighed food records was used to quantify the portion of meat typically consumed for the evening meal. All evening meals where meat was a major ingredient were included. Meals where small quantities of processed meat were used as flavourings were excluded – e.g. handful of bacon bits on a salad. Portions were recorded as cooked, edible portion only. Inedible bones and trimmings were not included in the portion size. In total 121 meals were considered in this data analysis. Descriptive (median, mean, percentage) and bivariate (independent samples t-test) statistics were used to analyse meat portions. Statistical significance was defined as the conventional $p<0.05$ level.
**Household Meat Discard**

Participants noted whether the recorded weight referred to cooked or raw meat. In order to amalgamate data, all values were converted to raw weights using known or experimentally determined weight loss factors for cooked meat (Matthews & Garrison 1974). Total weekly meat discard for 15 households is reported. No statistical analysis was warranted for this data set due to the small sample size.

3.9.4 **Qualitative Data Collection**

Following the 7-day period of quantitative data collection, in-depth, face-to-face interviews were conducted with the household member/s who made the majority of decisions about procurement and meal preparation. In-depth interviews are commonly used in qualitative research. They are seen as a useful method to gain an understanding of a participant’s point of view and experience. As Kvale said, ‘If you want to understand how people understand their world and their life, why not talk with them?’ (Kvale 2009, p1). Interviewing is a skill that needs to be developed in order to optimise data collection (King & Horrocks 2010, Kvale 2007). I have developed interview skills throughout my professional career as a dietitian. In addition, I attended qualitative research skills courses to further develop my skills prior to commencing this project. This increased the likelihood that quality data would be captured.

I conducted an initial trial interview to develop my interview strategy. This trial interview was very open and unstructured. It was terminated after 95 minutes despite the fact that some topics were not sufficiently covered. This initial interview produced volumes of interesting information but some topics were not fully covered and much of the content was not directly relevant to the research questions. After reflecting on the trial interview I decided to use a hybrid semi-structured and structured approach to ensure that topics were covered in a reasonable time frame and the interviewee did not suffer from unnecessary ‘interview fatigue’. This revised interview approach was tested on an initial participant and, as it was successful, was employed for all subsequent interviews.

The first part of the interview employed a semi-structured approach. A topic guide was prepared and potential probes identified (see Appendix F). The topic guide was flexible. Its purpose was to guide the interview and provide prompts if necessary, but it did not explicitly control the direction of the discussion. Rather, the flow of the interview was directed by the nature of the conversation. Broad open questions were used initially to allow participants to spontaneously bring up factors of influence when choosing and consuming meat without any
suggestion on my part. The broad, open nature allowed perspectives to arise that I had not previously considered. The interview concluded with a set of structured questions to gauge the participant’s response to specific strategies to reduce meat consumption. Participants were asked to imagine that they had decided to eat less meat, regardless of their current consumption. They were presented with five scenarios and asked how they felt about each of these scenarios.

Fifteen interviews were recorded in total. Most involved one member of the household. However, for two households, two members were jointly interviewed as they shared shopping and meal preparation duties. Participants chose the location of the interview in order to ensure they were as comfortable as possible. All participants, except two, chose to be interviewed in their own home. Interviews ranged in duration from 40 to 80 minutes with most lasting just under one hour.

An ethical issue that arose during interviewing was that participants invariably wanted feedback on whether or not they were eating the ‘right’ amount of meat. This was anticipated when designing this research project and seeking ethical approval. Participants were advised that this research did not aim to assess the nutritional adequacy of the dietary intake of participants. They were offered a copy of the Australian Guide to Healthy Eating (DoHA 1998) and provided with details about how to arrange formal dietary assessment by an Accredited Practicing Dietitian if desired.

3.9.5 Qualitative Data Analysis
Transcripts of interviews, my journal notes and secondary dialogue arising from follow-up emails and phone conversations with participants were used as qualitative data. Participants were assigned pseudonyms in order to maintain confidentiality. Interviews were recorded digitally and transcribed verbatim. I transcribed the majority of interviews (10) as this is recommended to enhance familiarity with data (Creswell & Plano Clark 2011). Due to time constraints, five interviews were transcribed by a transcription service. I checked all transcripts provided by the transcription service for accuracy and re-listened to these interviews multiple times to enhance my familiarity with the data. All transcripts were sent to participants so that they could check them for accuracy and clarify or amend any content if desired.
Thematic analysis was used to analyse data. Thematic analysis is defined as a search for themes that are important to the description of the phenomenon (Daly, Kellehear & Gliksman 1997). It is essentially a way of categorising or coding qualitative data in order to make sense of it. Thematic analysis was chosen because it is a flexible, intuitive and uncomplicated technique that can be used across a range of epistemologies and research questions (Braun & Clark 2006). Thematic analysis can align with different epistemologies and disciplines and therefore sits well with my pragmatic approach to research (Aronson 1994, Haste 2008). Thematic analysis is also considered a more accessible form of analysis, particular for those with no previous experience of qualitative research. Although I attended many qualitative analysis courses prior to undertaking this research, this was my first formal attempt at qualitative research. Thematic analysis seemed to be an intuitive method of analysis and therefore engendered the most confidence that I could use it to meet my research objectives.

Although thematic analysis is widely used in research, detailed guidelines for carrying out thematic analysis are scarce. My approach was influenced by the work of Boyatzis (1998) and Braun and Clarke (2006), as well as my experiences at qualitative analysis courses. Essentially, my process involved becoming very familiar with my data, then grouping related data under codes, and finally integrating the coded data into themes.

Audibility is a key component of validity in qualitative analysis (Giddings & Grant 2009). In order to provide a clear account of the process used to analyse my data, I have endeavoured to provide a detailed description below. Linearly, my process was as follows:

- While conducting interviews, relistening to interviews and reading written transcripts of my interviews multiple times, I recorded my initial observations, thoughts and ideas about the nature of the data.
- I then loaded transcripts of interviews, research notes, records of phone conversations and emails from participants into NVivo 8 (QSR International 2008).
- I adopted an inductive approach to coding where I identified codes from my experience with the raw data. For me, a code was understood to be a label used to identify and group similar or related information.
- I systematically worked my way through each source of data, identifying and assigning codes using the Free Node option in NVivo.
Names and descriptions of codes were documented using the features available in NVivo. I endeavored to provide detailed descriptions of the codes in order to ensure that the origin for each code remained clear and the code was grounded in the data.

Once all data sources were coded as Free Nodes, I reviewed my codes and eliminated any duplication. For example, a code for ‘confusion about environment’ was identified to be a duplicate for a code for ‘uncertainty about environment’. A code for ‘guilt’ was relabeled as ‘desire to buy guilt-free products’ and collapsed with a code for ‘want to do the right thing’.

Next I connected related codes using the Tree Node features available in NVivo. Tree Nodes allow information to be connected in a hierarchical structure.

I then reviewed all codes to identify pertinent themes. For me, a theme refers to a pattern of experience or viewpoint shared by participants that explains phenomenon relevant to the research question. It is different from a code in that it is more interpretative and specifically links the data to the research questions.

At this point I found that using NVivo was causing me to feel disconnected from my data and analysis. Consequently, I printed hard copies of all data relating to a theme from NVivo and re-examined my analysis manually. I found this helped me to retain a stronger connection with the data.

The nature of my research questions influenced me to reorganise the identified themes under four categories: ‘Procurement’, ‘Consumption’, ‘Discard’ and ‘Healthy Sustainable Meat’.

Next, I prepared a coding map. This was essentially a document that listed all the codes, a description of the meaning of each code and an example of a piece of data that represented each code. A sample is provided in Appendix G.

At this point, I set my analysis aside for a period of approximately two months while I worked on other commitments. I found it useful to put some space between myself and the data to improve the clarity of my analysis.

After two months, I reviewed my coding map and had a final look at all sources of data to check that all coding aligned with my map. I found it useful to ask myself:

1. Does this theme truly represent this data?
2. Is there another way to interpret this data?

I made some minor adjustments at this point. I uncoded some data as I felt the link between the data and the theme was not sufficiently strong.
Finally, I compared themes with other sources of data collected as part of this thesis and with the published literature.

For simplicity, my analysis process has been described linearly above. However, in reality, the process was not linear but iterative. A key feature of qualitative research is that it involves a moving back and forward between data collection and analysis (Braun & Clarke 2006). Analysis was occurring as data was being collected. Potential themes were identified during the interview process, between interviews and throughout the research process. In thematic analysis, it is possible to generate themes deductively from theory and prior knowledge or inductively from reading the raw data (Boyatzis 1998). The intention of inductive coding is to identify themes directly from the data rather than trying to fit the data into pre-determined themes and patterns. However, Braun and Clarke (2006) acknowledge that it is difficult to truly identify themes without the influence of the researcher’s preconceptions. Some researchers use a combination of inductive and deductive coding (Fereday & Muir-Cochrane, 2006). Crabtree and Miller (1999) identify unintentional fabricating of evidence as a common problem in the process of interpreting qualitative data. This can occur when the researcher unconsciously ‘sees’ data that the researcher expects to find (Crabtree & Miller 1999).

Although, ideas about themes occurred at various stages of my research, I endeavoured to start coding from a clean slate to see if my early ideas about themes would persist. Using an inductive approach to coding and giving myself some space before conducting a final review of my analysis were helpful to ensure that identified themes are grounded in the data.

Essentially, I conducted all stages of the thematic analysis independently. It has been suggested that more rigorous thematic analysis might be achieved if multiple perspectives from a variety of people with different expertise and experience are involved in the analysis (Fereday & Muir-Cochrane 2006). Some qualitative projects involve multiple people conducting the coding, audits of coding accuracy and collaboration to identify themes (Kurasaki 2000). However, for this small data set, multiple coders were unnecessary. Giddings and Grant (2009) identify ‘expert critique’ as a way to enhance validity in qualitative analysis. This involves asking others to examine the data and comment on decision-making and conclusions. My academic supervisors have provided feedback at various stages throughout this research and I have discussed elements of thematic analysis with my research peers. I also used member checks to support my analysis. Member checking involves taking summaries of findings back to participants and asking them whether the
findings accurately reflect their experience (Creswell & Plano Clark 2011). After conducting the initial coding of each transcript, I went back to my participants and invited comment. Some participants were not particularly interested in engaging in this process. Their attitude was essentially, “It sounds reasonable to me. Let me know when you’ve finished”. Others (approximately half) were quite interested to see how their comments were perceived and provided valuable feedback. The member checks gave me confidence that my interpretation was consistent with the views of participants.

Examining disconfirming evidence is also encouraged to enhance validity in qualitative analysis (Giddings & Grant 2009). When finalising my analysis, I checked contrary perspectives. I have endeavoured to report any disconfirming evidence that was not resolved in the findings sections of this thesis.

3.10 Method for Phase Two – Quantitative Web-based Survey of Influences on Meat Consumption

Phase Two used a web-based survey to further explore prioritised findings from Phase One and to determine if these findings resonated with a larger and broader sample. The questionnaire used in this phase was developed from findings in Phase One. I decided to prioritise consumption of meat for further investigation. Two reasons influenced this decision. Firstly, Phase One indicated that overconsumption of meat was a greater concern than meat discard. Secondly, I became aware of three large investigations into food waste in Australia and decided that further research on meat consumption would make a more useful contribution to the research environment.

Phase Two aims to explore and describe influences on meat consumption in ACT residents. The objectives of the survey are to explore:

1. awareness of health impacts of eating excess meat, environmental cost of meat production, guidelines for meat consumption;
2. attitudes to consuming meat;
3. current meat consumption behaviour; and
4. future meat consumption behavior.
3.10.1 Choice of Survey Method

A cross-sectional, quantitative, web-based survey was used. For web-based surveys, a questionnaire resides on a website and respondents visit the site by clicking on a hyperlink in an email message (Sue & Ritter 2007).

Web-based surveys are an established research tool (Duffy et al. 2005, Evans & Mathur 2005, Menachemi 2011, Saunders 2012, Shih & Fan 2008, Wright 2005). They offer several advantages. For example, they are cheap to administer, can easily reach large numbers of respondents and offer faster response times (Brannen & Halcomb 2009, Jansen, Corley & Jansen 2007). In addition, they are an environmentally friendly option as the use of paper is eliminated (Schuldt & Tooten 1994). Web-based surveys can also incorporate high quality images easily (Sue & Ritter 2007). This was important for my survey as I intended to include a number of images to assess attitudes to portion size. As web-based surveys are self-administered there is no interviewer bias (Ma & McCord 2007). Data capture and analysis is better than with other survey methods as data is directly captured into a database, thus eliminating data entry errors (Dixon & Turner 2007).

Web-based surveys offer complete anonymity to participants as email addresses are not linked to survey responses (Brannen & Halcomb 2009, Jansen, Corley & Jansen 2007). This may result in better response to sensitive questions (Ma & McCord 2007). Rowe and colleagues (2006) propose that electronically administered surveys may elicit less biased, more truthful responses than other types of surveys because the relative anonymity reduces respondents’ concern with presenting themselves in a good light. This is relevant when collecting data about meat consumption, as the tendency for respondents to under-report food intake is well known (Macdiarmid & Blundell 1998). In addition, respondents are less likely to leave blank responses in electronic surveys, and responses to open-ended questions are likely to be longer and more detailed (Kwak & Radler 2002, Roberts 2007, Schaefer & Dillman 1998).

While there are strong arguments to support the use web-based surveys, there is also criticism. Criticism primarily focuses on response rate and the limited capacity of samples to represent populations. Views on response rates for web-based surveys are mixed (Dixon & Turner 2007). Although they can offer large numbers of responses very quickly, it is often difficult to know how many people could have potentially responded. Some suggest response rates for web-based surveys are much lower than mail surveys (Diment & Garrett-Jones 2007). Others argue that, in populations where web access is widespread, web-based surveys can achieve
very good response rates (Ma & McCord 2007). A major limitation of web-based surveys is that they are limited to respondents with internet access and the technical proficiency to complete electronic surveys (Jansen, Corley & Jansen 2007, Roberts 2007). Internet users and non-users differ in aspects such as education, income, race and ethnicity (Ye 2007). Currently, research indicates that online questionnaires are more likely to attract a representative sample in terms of the ratio of men to women but may possibly discriminate against older respondents (Diment & Garrett-Jones 2007, Rowe, Poortinga & Pidgeon 2006). As internet use increases these differences are shrinking (Sue & Ritter 2007). At the end of December 2011, there were 11.6 million internet subscribers in Australia (ABS 2011d), which represents an annual growth rate of 11 per cent and an increase of just over 6 per cent since the end of June 2011 (ABS 2011d). In 2008-09, three-quarters of people in Australia aged 15 years and over had used the internet in the previous 12 months (ABS 2011d). However, much lower rates of internet use were reported among older age groups (31% for people 65 years and over) (ABS 2011d). Self-selection bias is also a limitation of web-based surveys (Evans & Mathur 2005). Most online surveys get replies from self-selected samples. Only people with an interest in the survey topic respond. A further limitation of web-based surveys is that they are not usually interviewer-administered. This means that the respondent could potentially be influenced by other people or information sources when completing the survey.

3.10.2 Sampling
Web-based surveys typically employ convenience sampling methods because there is no general population email list and no internet equivalent to random digit dialing (Sue & Ritter 2007). The non-probability samples that can be easily selected for internet surveys do not provide representative data but are appropriate for exploratory research or as part of a multimethod approach (Sue & Ritter 2007, Ye 2007). Web-based surveys are most suited to research populations where participants are part of an easily accessible database list (Wilson & Laskey 2003). For well-defined groups of people, web-based surveys are suitable as long as recruitment takes place ‘selectively’ (participants chosen according to affiliation with a particular organisation or group) and ‘actively’ (respondents get an invitation to respond) (Beidernikl & Kerschbaumer 2007).

As this was an exploratory survey, a non-probability sampling method was suitable. The sample frame was students and staff at the University of Canberra. This population was chosen as there was potential to reach a large group of people with diverse demographic
characteristics. In 2011, there were 1130 staff (60% female, 40% male) employed at the University of Canberra and 13 235 enrolled students (57% female, 43% male). Age groups between 21 and 60 were most strongly represented in this population. It was recognised that some groups of people (e.g. elderly, less educated) would be less likely to be part of this sample. Meat-eaters make up a large proportion of the Australian population (ABS 1997) so data from a large sample with diverse characteristics is interesting even if not representative of the Australian population. Students were included in order to reach younger people with potentially lower household incomes. It was recognised that students would be less likely to respond to the survey as ‘survey fatigue’ is known to particularly affect this group (Sid Nair et al. 2012). However, it was hoped that the use of a financial incentive would help motivate response. All participants were given the opportunity to enter a $100 prize draw upon completion of the survey.

A saturation sampling method was used (Sue & Ritter 2007). This involves sending an email invitation to all members of the target population. This method eliminates coverage error (when the sampling frame does not completely represent the population of interest) but non-response error (selected respondents choose not to participate) remains a limitation (Sue & Ritter 2007). To be eligible to participate in this survey, respondents had to be aged 18 years or older and had to consume meat.

3.10.3 Survey Instrument

Quality surveys need to address issues of measurement validity. A survey with strong measurement validity will have characteristics such as meaningful content, capacity to measure different opinions, and be easy to understand and complete (Fink 2009, Giddings & Grant 2009). Measurement validity was enhanced in this survey by developing the content from a prior qualitative phase of research and through strong pre-testing.

Findings from Phase One informed the development of the questionnaire used for this survey. Developing questions from a preceding qualitative stage increases confidence that the content is meaningful and suitable options are provided to respondents (Brannen & Halcomb 2009). Language originating from participants in the qualitative phase was used and key terms were clearly defined to enhance validity (Fink 2009). An online software program called Qualtrics was used to write and host the survey. As part of the licensing arrangement, a design template was specifically created for University of Canberra staff. In order to enhance the usability of
the survey, I opted to minimise the content displayed on each screen and include a progress bar to encourage survey completion.

The questionnaire consisted of 20 questions (see Appendix J) and was divided into five sections: awareness, attitudes, current behaviour, future behaviour and demographics. Participants were given a clear explanation of the focus of each section to enhance understanding. The questionnaire was structured so that respondents moved logically through the five sections. Demographic questions were scheduled at the end of the questionnaire as survey design literature suggests leaving the easiest questions to last (Fink 2009). The questionnaire was limited to 20 questions to ensure a reasonable completion time and to increase the likelihood that people would respond. There are mixed views on optimal length for online surveys (Deutskens et al. 2004) but willingness to complete online surveys has been shown to be highest when surveys are relatively short (Bosnjak & Batinik 2002, Sue & Ritter 2009).

Open questions were used to assess components of awareness and barriers/limitations to reducing meat consumption. It was expected that diverse responses would be given to these questions. I considered it was important to allow participants to express their response to these questions in their own words without any pre-empting. Closed questions were used where the scope of expected responses was narrower. For most questions 5-point Likert scales were used to capture responses. Two questions were designed to assess portions of meat currently consumed and portions of meat that would be satisfying to consume. These questions used six images of steak, displayed in 50-gram increments ranging from 50 grams to 450 grams. Quantification of portion size is historically difficult (Young & Nestle 1995). When shown pictures of foods, some studies suggest that people view any portion they eat as ‘medium’, regardless of its actual size (Smith 1991). I anticipated that providing a larger range of possible options would enhance the ability of respondents to indicate portion size.

It is possible to force respondents to answer all questions in web-based surveys. This results in more complete data collection for each survey but can cause some people to exit the survey if they do not want to answer a particular question (Sue & Ritter 2007). Some researchers view forced responses as coercive and unethical as it violates the ethical principles of autonomy or respect for individuals (Fink 2009). Forcing responses can also cause respondents to give meaningless answers just to be able to move on to the next question, which threatens validity (Bosnjak & Batinik 2002). Participants in my questionnaire were
forced to answer three preliminary questions pertaining to informed consent and eligibility. Response to all other questions was voluntary. Participants could answer as many or as few questions as desired and could exit the survey at any point. It was hoped that the use of strong design features would encourage participants to complete the survey.

3.10.4 Pre-Testing of Survey

Pre-testing a survey is important to optimise understandability and operationability and thereby enhance validity. An initial draft of the questionnaire was reviewed by my academic supervisors. In addition, I consulted with colleagues experienced with survey design and attended courses where elements of my survey were discussed with research peers. This helps to give ‘face validity’ to the survey (Giddings & Grant 2009).

A paper version of the questionnaire was then piloted with six people in order to identify any problems with understandability. These participants were purposively selected based on characteristics such as age, gender, education and ethnicity. The ‘talk aloud’ approach was used (Alaimo, Olson & Frongillo 1999). This involves participants voicing their understanding of each question and articulating how they will respond as they work through the questionnaire. Some minor errors were identified and the wording for one question was changed based on this process.

Next a web-based version of the questionnaire was pilot tested on 20 participants. This stage primarily aimed to assess operationability of the survey. Again participants were purposively selected to ensure variability in characteristics such as age, gender, education, and ethnicity. The survey was tested in Mozilla Firefox, Internet Explorer, Google Chrome and Safari as surveys can appear and function differently in different web browsers (Ma & McCord 2007). Data from the pilot test was eyeballed to test for the ability to get a range of responses (Fink 2009). All participants completed the survey in less than 20 minutes. No adjustments were deemed necessary after this pilot test.

3.10.5 Administration

Direct email invitations were sent to all staff and students at the University of Canberra (see Appendix H). The main threat to internal validity in this research design is self-selection bias – only people interested in the survey will respond (Beidernkl & Kerschbaumer 2007, Sue & Ritter 2007). In order to maximise response to this survey, several strategies were employed. Firstly, the email invitation was sent to staff directly from the Dean of the Faculty of Health
and to students from the Assistant Manager of Student Services. It has been suggested that response is better when potential participants recognise the person sending the email (Fink 2009). The invitation was emailed on a Monday morning. Ma and McCord (2007) suggest that response to surveys distributed in workplaces is highest from Monday to Thursday. The invitation was short and included clear information about the purpose of the study. Response is better when potential participants are given motivation to participate (Sue & Ritter 2007). Some people are deterred from completing online surveys due to concerns about privacy (Sue & Ritter 2007). The participant information reassured participants that all data would be treated confidentially and anonymously. The software did not link email addresses to data. Internet Protocol (IP) addresses were not matched to responses. Incentives are commonly used to encourage participation in surveys. For web-based surveys, vouchers and lotteries are considered the strongest incentives (Deutskens et al. 2004). All participants were offered the opportunity to enter a prize draw to win a $100 gift voucher. Participants who opted to enter the prize draw were directed to a separate data entry screen to preserve anonymity.

The survey was live between 22 August 2011 and 8 September 2011. A reminder to complete the survey was emailed on 29 August 2011 – one week after the initial invitation. There are mixed views on the optimal timing for follow-up from web-based surveys (Deutskens et al. 2004) but Dillman (2000) suggests follow-up after one week.

In May 2011 Four Corners (current affairs television program) aired an episode on treatment of livestock in Indonesian abattoirs (ABC 2011). Live exports to Indonesia were temporarily suspended following this report and significant media coverage of the issue was aired. It is possible that this external activity placed humanity issues relating to meat consumption at the forefront of participant’s minds.

3.10.6 Response

An accurate response rate was not able to be calculated for this survey as technical issues did not allow the exact number of people who received the email invitation to be known. Further it was not possible to know what proportion of people who received the email invitation were meat-eaters and hence eligible for the study. Broadly, approximately 1100 staff and 13 200 students could have been invited. Completion data indicates that 698 people entered the survey and 653 people met the eligibility criteria and provided informed consent. This suggests a very low overall response rate. Over 90 per cent of respondents answered all questions in the questionnaire. Fewer people (82%) opted to respond to a demographic
question about household income. Two open-ended questions about barriers and facilitators to eating less meat had lower responses than other questions (86% and 85%).

As expected, the majority of responses were collected on the first day of the survey (Ma & McCord 2007). Responses trickled in over subsequent days until the survey was closed. The average completion time was 22 minutes.

### 3.10.7 Participants

Participants were staff and students at the University of Canberra who consume meat. Characteristics of participants are summarised in Table 3.2. Demographic data from the Australian population is provided for comparison. I do not intend to make inferences about representation based on this data. However, it is interesting to see how the survey sample compares with the Australian population.
Table 3.2: Demographic characteristics of survey participants with comparison to the Australian population

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Survey Sample</th>
<th>Australian Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>38%</td>
<td>49%*</td>
</tr>
<tr>
<td>Female</td>
<td>62%</td>
<td>51%*</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-24 years</td>
<td>16%</td>
<td>7%*</td>
</tr>
<tr>
<td>25-54 years</td>
<td>70%</td>
<td>42%*</td>
</tr>
<tr>
<td>55-64 years</td>
<td>11%</td>
<td>12%*</td>
</tr>
<tr>
<td>65 and older</td>
<td>3%</td>
<td>14.0%*</td>
</tr>
<tr>
<td>Median age</td>
<td>39.0</td>
<td>37.0*</td>
</tr>
<tr>
<td>Household Income</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under $20 000</td>
<td>5%</td>
<td></td>
</tr>
<tr>
<td>$20 000-$59 999</td>
<td>11%</td>
<td></td>
</tr>
<tr>
<td>$60 000-$99 999</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>$100 000+</td>
<td>53%</td>
<td></td>
</tr>
<tr>
<td>Highest level of education attained</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No schooling to secondary schooling</td>
<td>14%</td>
<td>21%*</td>
</tr>
<tr>
<td>Trade, certificate, diploma</td>
<td>15%</td>
<td>17%*</td>
</tr>
<tr>
<td>Degree or higher</td>
<td>69%</td>
<td>24%*</td>
</tr>
<tr>
<td>Country Grew Up In</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Australia</td>
<td>79%</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>17%</td>
<td></td>
</tr>
</tbody>
</table>

* 2011Census QuickStats (ABS 2012c)
` 6227.0 - Education and Work, Australia, May 2011 (ABS 2011c)

More females than males completed the survey. Participants ranged in age from 18 to 84 years with a median age of 39 years. Most respondents were in the 25-54 age group.
Participants with varied income and education demographics were included. However, more than half the sample had an annual household income above $100,000 and nearly 70 per cent had completed or were in the process of completing tertiary education. The majority of participants grew up in Australia. The 17 per cent of participants who grew up elsewhere originated from 41 different countries. Overall, participants can be described as young to middle aged, above average education and with higher than average household income.

### 3.10.8 Analysis

Survey data captured in Qualtrics was downloaded to Microsoft Excel 2007. The data was examined and cleaned and prepared for uploading into IBM SPSS 19. Responses to open questions were coded before being counted. Initial codes were identified using words originating in the responses. Categories were then renamed and collapsed. For example, question one asked respondents to list any health risks linked to eating excess meat. Initial codes included terminology such as ‘clogs arteries’, ‘cholesterol’, ‘heart attack’, ‘heart disease’ and ‘stroke’. These were later collapsed under a code for ‘cardiovascular disease’. Coding was rechecked two weeks after the initial coding. Fink (2009) suggests that a second coding about one week after the first coding is a reasonable way to ensure reliable data entry in small data sets. Direct transfer of electronic data from Qualtrics to Excel to SPSS eliminated potential for most transferral errors. Where manual data entry was required, data was checked two weeks after the initial data entry.

Survey data was analysed using descriptive (median, mean, percentage) and bivariate (independent samples T-test, chi square) statistics. Statistical significance was defined as the conventional p<0.05 level.

### 3.10.9 Limitations

The use of a non-random, self-selecting sample limits the generalisability of data collected in this survey. A key limitation is that the sample may over-represent people sufficiently interested in contributing views and experiences about meat-eating.

The survey included fixed response and open questions. The fixed response component means that issues covered were at the discretion of the investigator. Using a prior qualitative phase to inform development of the survey increased the likelihood that the survey has relevance.
3.11 Method for Phase Three – Targeted Quantitative Audit of Recipes in Food Magazines

In previous phases of this research project, participants identified that recipes influenced the quantity of meat procured and prepared. While some participants used recipes as an indicator of portion size, it is unknown if portions of meat specified in recipes correspond to portions recommended for health and sustainability. Further, a lack of meat-free recipes was frequently identified as a barrier to reducing meat consumption. It is unclear if lack of meat-free recipes is a real or perceived barrier. This final phase of research aimed to:

- quantify meat portions commonly used in recipes; and
- assess the frequency of meat and meat-free recipes available in popular food magazines.

It is possible to access recipes via a variety of sources. In 2011, Lenard’s Chicken and Pacific Magazines conducted the ‘What’s for Dinner?’ survey, which involved 2535 Australians who play a key role in meal preparation for the household. Magazines (83%) and websites (54%) were identified as the top two sources of inspiration when looking for meal ideas (unpublished report by Pacific Magazines, 2011). Food magazines are viewed as a good source of recipes reflective of current food trends in Australia.

3.11.1 Sample

This phase included recipes from the March 2011, May 2011, July 2011, September 2011, November 2011 and February 2012 editions of the following food magazines:

- Recipes+
- Master Chef
- Australian Healthy Food Guide
- Super Food Ideas
- Australian Good Taste
- Australian Good Food
- Delicious

These magazines were chosen because they have strong circulation figures (NDD Marketing 2009), focus solely on food, have a focus on ‘every day’ meals and are commonly available in supermarkets. High-end magazines such as Gourmet Traveller were excluded because they
have a focus on entertaining as opposed to everyday meals. Donna Hay magazine was excluded as it releases only seven editions each year and was not available for all months sampled. The editions were selected to cover a range of seasons. Christmas editions were avoided as these tend to place more focus on food celebrations rather than everyday meals.

3.11.2 Data Collection

The audit included all recipes intended to be eaten as a main meal. Recipes in advertisements, promotional booklets attached to the magazine and recipes labeled as ‘sides’ or ‘accompaniments’ were excluded. A total of 1508 recipes were included.

Meat Portions

For meals containing meat, the quantity of boneless, uncooked meat per serve was recorded. Only recipes where the magazine specified the intended number of serves were included. Where recipes specified a range of serves (e.g. ‘serve 4-6’), the median point of the range was used to determine recommended serve size. Where more than one type of meat was included in a recipe, the combined weight of all meat was listed under the weight of the main meat. For example, a recipe with 400 grams of chicken plus 200 grams of pork was listed as 600 grams of chicken. No instances occurred where two types of meat occurred in a recipe in equal amounts. The majority of recipes provided a weight for meat. Where a description was provided instead of a weight (e.g. 2 chicken breast fillets), the weight of the median portion available in a supermarket on a random day of observation was used. For cuts of meat containing bone, weights for the boneless portion were obtained from direct measurement of an equivalent portion of meat. Any cooked weights were converted to uncooked weights using known or experimentally determined weight loss factors for cooking (Matthews & Garrison 1974).

Recipe Frequency

Each recipe was classified as beef (included veal), lamb, pork, poultry, processed meat (e.g. bacon), seafood or meat-free. Recipes that included multiple sources of meat were classified under the largest portion of meat in the recipes. Meat-free recipes were recipes that did not contain any meat or seafood. They were not necessarily vegetarian recipes as they could contain animal products such as eggs, dairy products, animal stocks etc.
All data was recorded in an Excel spreadsheet. The edition of the magazine, page number and notes about any assumptions made were recorded to leave a clear audit trail. All data was independently entered by the researcher. In order to check the accuracy of data entry, approximately 10 per cent of the entered data was randomly checked prior to analysis.

### 3.11.3 Data Analysis

Clean data was uploaded from Excel to SPSS 18. Data was analysed using descriptive (median, mean, percentage) statistics.

### 3.11.4 Limitations

This data represents the amount of meat recommended to be consumed per serve. It does not provide any information about the amount of meat actually eaten by users of these recipes. This data provides some indication of the availability of meat-free recipes. However, further qualitative information would be useful. It was observed that many meat-free recipes were soups. It is possible that some people might not consider a soup to be a ‘meal’. It was also observed that some types of meat-free recipes (e.g. vegetarian lasagne, vegetarian curry) tended to be repeated fairly regularly within magazines. Each occasion of a recipe was counted in this data. This may imply a greater diversity of meat-free recipes.

This audit was limited to the food focused magazines described on page 77. It could be argued that the inclusion of additional popular magazines such as Australian Women’s Weekly would add to the data collected. The Australian Women’s Weekly was not originally included as it covers a broad range of topics and has only a small recipe section. It is not expected that inclusion of this magazine would change the reported findings. However, it would have provided a more complete coverage of monthly magazines with a focus on ‘everyday’ recipes.

### 3.12 Integration of Data

Mixed methods research aims to integrate findings arising from different research methods (Johnson & Onwuegbuzie 2004). While the importance of integration is widely discussed in the literature, the best path to achieve integration is unclear (O’Cathain, Murphy & Nicholl 2010). As previously described, analysis was ongoing throughout this research so that one
stage could inform subsequent stages. Findings from all stages were then integrated under four key topic areas:

- Procurement
- Consumption
- Discard
- Healthy Sustainable Meat

Some literature describes this approach as ‘following a thread’ (Moran-Ellis et al. 2006). Findings under these topic areas are reported in the following chapter.

This research approach generated extensive data relevant to the way meat is used and viewed by meat-eaters. A final stage of integration was required in order to best address the second part of the research question: ‘What influences meat-eaters in Australia to use meat in healthy and sustainable ways?’ This final step involved the use of the Kawakita Jiro (KJ) method to identify the most important findings amongst the data. The KJ method is a well-known brainstorming technique that can be used to draw conclusions from qualitative data (Scupin 1997). The method was first described in the 1950s and various versions have subsequently evolved (Scupin 1997). Essentially, the method involves generating ideas by brainstorming, sorting ideas into themes and organising themes into broad/meaningful categories (MT 2013).

Typically, use of the KJ methods results in the development of an affinity diagram — a hierarchical diagram that visually demonstrates the linkage between ideas. Many other analysis tools are available to draw conclusions from mixed methods data. The KJ method was used because the goal was to identify and prioritise areas for action rather than demonstrate the complexity of the issue.

The specific steps in this process were as follows:

1. Brainstorming was used to identify ‘problems’, ‘contributors’, ‘opportunities’ and ‘challenges’ within the findings. Ideas were written on colour-coded sticky notes. The collection of sticky notes was reviewed to identify duplication and collapse, expand or better articulate ideas.

2. The sticky notes were sorted into linked ideas.

3. Barriers identified in the data were revisited and a decision was made on where they would most impact on opportunities. It is recognised that additional barriers are likely to be at play (e.g. resistance from retailers to modify quantities of meat available for
sale). However, this process was limited to barriers directly identified within the research data.

4. This process was initially conducted independently by the author. The process was then discussed with colleagues and supervisors before finalising the analysis.

Visual evidence of this process is shown in Appendix K. Findings from this analysis are presented in section 4.6.

### 3.13 Chapter Summary

This chapter has declared and explained the methodological approach used in this thesis. A pragmatic worldview influenced this mixed methods research. A variant of an exploratory sequential research design was used. This involved the use of three research phases. Phase One used food records to assess procurement, consumption and discard practices relevant to meat. In addition, qualitative interviews were used to better understand influences on these practices. Phase Two used a quantitative web-based survey to further explore and confirm findings from Phase One. Finally, Phase Three involved an audit of food magazines to explore the way meat is represented in present-day recipes. The following chapter will present integrated findings from the mixed qualitative and quantitative inquiry that constitutes this doctoral study.
Chapter 5 - Discussion

5.1 Introduction to Chapter

Chapter 5 discusses the key findings arising from this mixed methods research, considers the strengths and limitations of the study and identifies recommendations for future action. The intention of this thesis was to use a health and sustainability lens to explore the way meat is used and viewed by a group of Australian meat-eaters. It aimed to answer two research questions:

1. What influences the type and amount of meat procured, consumed and discarded by Australian meat-eaters?
2. How do Australian meat-eaters view approaches to healthy and sustainable consumption of meat?

The exploratory nature of this research design generated many findings. This chapter discusses the five key findings identified after integration of all data.

5.2 Finding 1 – Meat is wasted by over-consumption and avoidable discard.

At the commencement of this research project, there was limited published information on meat consumption and discard practices in Australia. This doctoral research is limited to a small section of the ACT population and is not representative of the Australian population. This research needs to be repeated in other communities in order to make any assessment about broader consumption and discard practices. However, the findings provide evidence that, within this sampling frame, meat was wasted by overconsumption and avoidable discard of meat.

As noted in section 4.3.1, those identified as discarders threw out significant quantities of meat (200-1875 grams per household one week). Some households binned more than enough meat to feed their family for an extra week. The quantity of meat discarded by some participants was sizeable. In addition, losses may have been higher than documented as the use of 7-day weighed records is thought to have underestimated meat discard. Interview data indicates that the 7-day collection period was not long enough to fully capture the discard of leftover meat in the refrigerator and meat ‘temporarily’ stored in the freezer. More work needs
to be done to fully profile the discard of meat in Australian households. However, this thesis demonstrates that avoidable discard of meat can be significant and warrants further attention.

This data adds to a limited evidence-base about the extent of meat discard in Australia. Food waste is increasingly being investigated in Australia and internationally (Al-Malicky & ElKhayat 2012, Koivupuro et al. 2012, OEH 2011, Oelofse & Nhaman 2013, Stefan et al. 2013, Sustainability Victoria 2010, Williams et al. 2012). However, data on avoidable discard of meat remains scarce as the specific composition of food waste is rarely documented, primarily because it is difficult research to complete. Although The Australia Institute surveyed Australians about food waste (Baker, Fear & Denniss 2009), it did not collect data on the weight of meat discarded. However, self-reported responses indicated that $872.5 million worth of fresh meat and fish is thrown out in Australian households each year. ‘Meat and fish’ were the most wasted food category after ‘fruit and vegetables’ and ‘restaurant and takeaway’ food. Data from WRAP indicates that ‘Meat and fish’ are one of the top five items of avoidable food waste in the UK (WRAP 2007b), with 278 800 tonnes of avoidable meat and fish waste occurring in UK households each year (Ventour 2008).

Researchers in South Australia are currently investigating food waste, focusing on the causes or generative mechanisms of food waste rather than quantifying food waste (personal communication Mavrakis 2013). However, an input-output analysis of waste streams in Australia estimates that, in 2008, an average of one kilogram of meat and meat products was discarded per week in Australian households (Reynolds 2013). Input-output analysis provides a theoretical estimation of overall food waste rather than a direct measurement. It differs from the data collected in this thesis as avoidable and unavoidable (bones, trimmings) meat waste was not separated.

To the author’s knowledge, this doctoral research is the only Australian research to directly measure the amount of meat discarded in households. It identifies that substantial quantities of meat were wasted by avoidable discard in some households. To add to this problem, further wastage of meat occurred via overconsumption. Section 4.3.6 indicates that excess meat was more likely to be eaten than discarded. It seems there is a perception that meat is not wasted if it is eaten (even if consumed in excess) – there is a difference between the human bin and the garbage bin! Participants in this thesis typically consumed meat in excess of dietary guidelines (see section 4.2.2). Data from weighed food records from 29 adults indicates that weekly intake of total meat was typically 874-1357 g/week. Approximately one-third (29% males, 34% females, n=10) of stage one participants consumed more total meat than the
maximum amount recommended by the current Educator Guide that accompanies the Australian Dietary Guidelines (NHMRC 2013a, NHMRC 2013b). For red meat, weekly intake was typically 423-1053 g/week compared with a recommended maximum of 455 g/week (NHMRC 2013a).

There is no clear consensus on the amount of meat that can sustainably be consumed now or in the future. However, the available literature suggests that participants in this current research consumed well beyond sustainability goal posts currently documented in the literature. McMichael and colleagues (2007) suggest a maximum of 630 grams of total meat per week to mitigate climate change. Most participants (93% males, n=13, 87% females, n=13) consumed more than this. Macdiarmid and colleagues (2012) modeled a healthy and sustainable diet for UK residents and included just 190 g/week of red and processed meat. This strongly suggests that participants in this research overconsumed meat from a sustainability perspective.

It is difficult to comment on how meat consumption observed in this study compares to other literature. As previously discussed, this study involved a small, unique sample. The most recent national dietary intake data stems from the 1995 National Nutrition Survey (95NNS) (ABS 1999). Mean weekly consumption of meat, poultry and game was estimated at 1400 grams for men and 840 grams for women (ABS 1999) compared with 1111 grams and 958 grams respectively in this study. The 95NNS estimated mean weekly consumption of red meat (beef, veal and lamb but not pork) at 616 grams for men and 315 grams for women (Baghurst, Record & Leppard 2000) compared with 885 grams and 525 grams respectively in this study. It is important to bear in mind that the 95NNS did not include pork in its definition of red meat whereas this thesis includes pork. Apparent consumption data estimates that in 2012-13 Australians ate 112.9 kilograms of chicken, beef, lamb and pork per person per year (ABARES 2013). Extrapolation of 7-day data collected in this thesis to yearly data would suggest that participants typically consumed 45-70 kilograms of total meat (boneless, edible portion only) per year. The differences in these figures are not surprising as it is well know that apparent consumption estimates have limited correlation to actual consumption. Updated national data on the dietary intakes of Australians is currently being collected as part of the Australian Health Survey (ABS 2013). It will be interesting to see if meat consumption has increased since the last national survey. While the meat consumption data described in the thesis is limited in size and characteristics it provides direct evidence of overconsumption of
meat in a 7-day period in a small group of households. It will be important to repeat this research in other communities to see if similar consumption patterns are observed.

Investigation of meat portions provides further evidence that meat is overconsumed. Section 4.2.3 indicates that meat portions measured by weighed food records were typically 120-200 grams. Subsequent survey data indicated that females self-reported to consume 100-150 gram portions of steak and males 150-200 gram portions. These portions are much larger than the serves (65 grams lean meat, 80 grams poultry) used in the Educator Guide that accompanies the current Australian Dietary Guidelines (NHMRC 2013a). However, they are comparable with other data. Analysis of the 95NNS indicated that portions of steak for those aged 30-49 years were typically 86-207g for males and 58-126g for females (Rangan et al. 2007). A Dutch survey used a similar approach to this thesis to investigate meat portions (Schösler, De Boer & Boersema 2012). Participants (n=1083) were shown three photos of a plate with a piece of meat that was 50, 100 or 150 grams. The most preferred portion size was 100 grams. A criticism of the Dutch study is that the use of only three categories of meat might have restricted responses. Some studies suggest that when shown pictures of foods, people view any portion they eat as ‘medium’, regardless of its actual size (Smith 1991). A greater range of portion sizes was used in this thesis to reduce the likelihood of such a situation. This could explain why larger portions were selected in this investigation than the Dutch study.

In this thesis, males typically consumed larger portions and more total meat each week than females. This was an expected finding as other literature indicates that meat consumption tends to be higher in men (ABS 1999, Baghurst, Record & Leppard 2000, Fessler et al. 2003, Latvala et al. 2012, Rangan et al. 2007, Rousset et al. 2005). There is no physiological reason for men to require more meat than women, other than the average differences for muscle mass (Gossard & York 2003). Some literature suggests the gender differences may be due to differences in the values placed on meat in the diet of men and women (Dietz et al 1995). For example meat is traditionally considered a ‘powerful’ and ‘masculine’ food (Adams 1990, Ruby & Heine 2011, Twigg 1984). A United States study suggests that differences in meat consumption can be explained by females having higher ‘disgust sensitivity’ for the ‘bloodiness’ of red meat (Fessler et al. 2003). Haverstock and Kirby Forgays (2012) suggest that weight concerns and dieting behaviour could be involved. Others suggest that the satisfying nature of meat (particularly beef) is more appropriate to a hearty male appetite (Santos & Booth 1996). Regardless of the reason, there is widespread recognition that meat is an archetypal food for men (Ruby & Heine 2011). This was clearly evident in a recent episode
of a popular cooking show (*Australia’s Greatest Bake Off*) on Australian television where contestants commented that quiche is for ladies but bacon makes it ‘man’s food’ and that ‘bacon is man’s chocolate’ (Channel 9, 2013).

While there were differences in the quantity of meat consumed by males and females, representatives from both genders were found to waste meat by overconsumption and discard. The findings of this thesis therefore support the movement to encourage a reduction in meat consumption and food waste.

**Recommendations:**

Further research is required to determine if the wastage and consumption practices observed in this research also occur in other communities.

In this community, action needs to be taken to reduce wastage of meat by overconsumption and discard.

**5.3 Finding 2 – Meat is a unique food that is highly desired.**

**Satiation is a key driver of consumption. There is resistance to eating less meat.**

A strong message arising from this research is that meat is highly desired by meat-eaters and viewed as an essential component of the diet. Meat offers desirable sensory properties such as taste, texture and the ability to satiate that are difficult to match. Satiation has a strong influence on the quantity of meat that is consumed. Participants are less influenced by nutritional properties, dietary guidelines, health concerns and environmental concerns. Rather, they eat an amount of meat that is satisfying. There is resistance to the idea of modifying meat consumption. However, given sufficient motivation, there is some indication that participants could eat meat a little less frequently and make small reductions to portions.

Participants in this research typically expressed the sentiment that humans are meant to eat meat. Meat was largely seen as natural and necessary. It was such an entrenched part of the diet that factors such as health, financial cost and the environment had little impact on meat consumption. Similar attitudes are apparent in the literature with statements such as ‘humans
have since the beginning always eaten meat’ typically featuring in qualitative studies (Kubberod et al. 2002). Fiddes (1994) is critical of this proclamation that humans are meant to eat meat because of our dentition or the form of our gastrointestinal tract or because we need it to grow strong or because it is somehow instinctive. He argues that instead cultural influences are at play. He points to the fact that some species eaten by some cultures are considered taboo by others to argue against the idea that we eat meat because we are ‘meant’ to. Meat has an important place in our diet because cultural forces have driven it that way. This suggests that it is possible to influence changes in meat consumption.

Meat appreciation features as a strong theme in both this research and the literature. Australian studies of barriers to vegetarianism and attitudes to meat, report that ‘meat appreciation’ or ‘enjoyment of meat’ strongly influence whether or not meat is consumed (Lea & Worsley 2001, Lea & Worsley 2003, Worsley & Skrzypiec 1998). A survey of just over 700 South Australian residents found that meat appreciation was also a strong predictor of frequency of meat consumption (Lea & Worsley 2001). Meat has traditionally held a central position in Western culture. Twigg (1984) identifies meat as the food with the highest status in the hierarchy of foods and the most highly prized food. There is debate around why meat has such status. However hedonic factors such as taste are frequently cited as important (Grunert, Bredahl & Brunsø 2004, Issanchou 1996, Povey, Wellens & Conner 2001, Richardson, Shepherd & Elliman 1993, Verbeke & Vackier 2004). This is apparent in the findings of a survey of Australian households. When asked about the factors affecting meal selection, taste was one of the strongest drivers of meal choice (MLA 2009). This thesis concurs that appreciation of meat has a strong influence on meat consumption. The desirability of meat strongly challenges action to reduce meat consumption. However, De Boer, Hoogland and Boersema (2007) are optimistic that there is potential to influence taste-oriented meat consumers. Their research indicates that taste-oriented consumers are interested in stories that add special qualities to the taste of a product. This can make them more interested in concepts such as ‘free-range’ and ‘slow-food’. Such interest can be used to develop an interest in more sustainable food choices. The motivation is taste but the outcome is more pro-environmental food consumption.

When quizzed about the influences on the quantity of meat consumed, participants reported choosing an amount that they anticipate will be satisfying, then eating until they are satisfied or satiated. There was no conscious thought about nutritional requirements, health issues or environmental credentials. Portions available at point-of-purchase and recipes had some
influence on the quantity of meat initially prepared. However satiation was the key driver influencing the quantity of meat consumed. Satiation refers to the process that causes one to stop eating (Benelam 2009). It is characteristically accompanied by a feeling of satisfaction. While satiation is influenced by physiological mechanisms, external factors such as palatability, portion size, social situations and distractions can cause individuals to override internal appetite controls (Benelam 2009). For example, when presented with a larger portion of food, most people will consume more food than when presented with a smaller portion (Ello-Martin, Ledikwe & Rolls 2005). Hence while participants in this thesis deemed that a certain amount of meat is required in order to satiate, it is possible that satiation could also be achieved with a smaller quantity.

Participants also spoke of the ability of meat to prevent hunger after a meal or to keep them ‘feeling full for longer’. When asked about eating less meat, participants feared that they would feel hungry after meals that did not contain meat. Satiety refers to the feeling of fullness that persists after eating (Benelam 2009). It is a common anecdote that meat is more filling than plant foods and that red meat such as beef is more filling than white meat such as fish and chicken. Interestingly, research on satiety does not necessarily support this perception. Satiety is difficult to measure objectively and the limitations in the available evidence on this topic are well known (Benelam 2009, Bendsten et al. 2013, Berti, Riso & Porrini 2008, Borzoei et al. 2006, Charlton et al. 2010, Hetherington et al. 2013, Wong et al. 2009). There is relatively consistent evidence that energy from protein, in a sufficient dose, has a greater effect on satiety than an equivalent amount of energy from carbohydrate or fat (Benelam 2009, Bendsten et al. 2013, Hetherington et al. 2013). However, comparisons of various foods thus far do not support the perception that meat is more satiating or that red meat is more satiating than other meats. Rather, fish has been found to have a stronger satiety effect than beef or chicken (Borzoei et al. 2006, Uhe, Collier & O’Dea 1992). Pork, beef and chicken have been found to have similar effects on acute satiety (Charlton et al. 2010). Meat preparations with more meat are not necessarily more satiating than those with less (Berti, Riso & Porrini 2008, Wong et al. 2009). Mycoprotein and tofu have been associated with a stronger satiety effect in comparison with chicken (Williamson et al. 2006). A Paleolithic diet with high meat content has been found to be more satiating per calorie compared with lower meat diets (Jönsson et al. 2010, Jönsson, Granfeldt & Lindeberg 2013) but subjectively assessed satiation was similar with both types of diets (Jönsson et al. 2010, Jönsson, Granfeldt & Lindeberg 2013). A recent review of the effect of meat on satiety concluded that it is not
possible to determine a relationship (Rebello et al. 2013). Overall, current evidence does not support the perception that meat is more satisfying than other foods when conditions such as protein content are standardised.

It is possible that the research has not yet sufficiently demonstrated the satiation and satiety properties of meat described by participants. Another explanation is that, when participants describe meat as satisfying, an alternative interpretation could be that it is palatable. Palatability refers to the pleasurable experience of consuming food (Benelam 2009). Typically, people consume larger quantities of more palatable foods (Drenowski 1998, Yeomans 1998). Palatability is largely a subjective characteristic (Yeomans 1998). Hence, there is potential to change consumption of highly palatable foods through strategies such as education and manipulation of portion size (Benelam 2009).

The desirability of meat will certainly challenge efforts towards lowering meat consumption. However it is not an absolute barrier. Fiddes (1994) describes how culture conditions our dietary behaviour. Rather than being innate, taste is culturally conditioned and governed by rule patterns. He describes how acceptability of food changes over time. For example, horse meat was once enjoyed widely throughout Europe but has become unacceptable more recently. The taste of horse meat has not changed but horses have become perceived more as social companions than as farm animals (Fiddes 1994). Becker, Kals and Frohlich (2004) write that consumers choose to express or deny taste by consuming meat. Typically consumers over-ride concerns about the disadvantages of high meat consumption by the desire to experience the pleasure of eating meat. However, it is possible to deny this experience given sufficient motivation. The ability to train the palate is well known by nutrition experts (Mattes 2006). It is utilised as a strategy to shape food consumption in healthier directions (e.g. acceptance of vegetables in children, acceptance of lower fat dairy products). Taste preferences are not static but amenable to shaping over time.

The idea of eating meals without meat seemed relatively foreign to many participants in this thesis. Meat features so strongly in the diet that many participants had difficult conceptualising what a meal without meat would look like. In qualitative interviews, participants were typically able to identify one or two meat-free meals that were known and acceptable but, beyond this limited meal repertoire, struggled to know how to construct a meat-free meal. Lea and Worsley (2001) also found that lack of knowledge about vegetarian eating was an important influence on meat consumption. Their body of research identified
meat as a central element of a meal in Australia and uncertainty about how to replace meat as a barrier to eating vegetarian meals (Lea & Worsley 2003) or to adoption of a plant-based diet (Lea, Crawford & Worsley 2006). According to Lea, Crawford and Worsley (2006), practical information on how to eat a plant-based diet needs to be more readily available to encourage the consumption of plant-based meals.

Participants in this thesis enjoyed eating meat. Meat was seen as essential in the diet and was considered to have an unmatchable taste, texture and ability to satiate. Participants typically reported feeling comfortable that they were eating a healthy amount of meat. They were largely unconcerned or unaware about health and sustainability dialogues about excess meat consumption. Consequently, there appeared to be resistance to modifying meat consumption in any way. Resistance to changing meat consumption has been reported in other Australian studies. For example, a survey of Victorian adults (n=415) found that lack of desire to alter current diet was a main barrier to the adoption of a plant-based diet (Lea, Crawford & Worsley 2006).

The strong resistance observed in the group studied in this thesis differs from some research emerging from Europe that indicates some willingness to reduce meat consumption. For example, a survey of Finnish adults (n=1623) found that about half the participants (48%) had established meat consumption patterns that they were not planning to change (Laatvala et al. 2012). This group of respondents was identified as ‘meat lovers’ who reported having both beef and pork over three times a week as a main course. However, the other half (52%) of respondents had either changed their meat-eating patterns during the past few years or were in the middle of an ongoing change. According to the authors, relatively few people were planning to completely stop eating meat; however, many were planning to cut down the amount of meat eaten or change the variety of meats eaten. These changes were related to concerns about health and weight management as well as debates around the sustainability and ethics of eating meat.

The strong appreciation of meat reported in this thesis could suggest that changing future meat consumption in this group of participants could be challenging. However, a recent article suggests that there is great potential to reduce meat consumption in developed countries (De Bakker & Dagevos 2012). It identifies that approximately 70 per cent of the Danish population can be classified as ‘meat reducers’. These are ‘part-time vegetarians’ or ‘flexitarians’ who restrict their meat consumption by having at least one meatless day each
week. De Bakker and Dagevos (2012) optimistically identify this group as offering potential for transforming meat consumption practices. Section 4.2.1 identifies that only 11 per cent of the 203 days worth of meat consumption data provided by participants in stage one could be classified as ‘meat-free’. Stage one and two participants typically consumed meat at the evening meal 5-6 days per week plus meat was also consumed at other times on some days. This doctoral study provides only a snapshot of a select sample. It does not claim to represent the wider Australian population. However, the findings from this thesis are not quite as optimistic as those presented by De Bakker and Dagevos (2012). It would be more appropriate to identify many participants in this thesis as ‘meat lovers’ who are resistant to eating less meat. Further research is required to determine if the resistance observed in this investigation extends to the wider Australian population.

When asked to imagine different pathways to eating less meat, Phase One participants indicated they were slightly more in favour of eating meat less frequently than reducing meat portions. Participants did not like the idea of eating small, unsatisfying portions of meat. They preferred to go without meat in order to allow for a larger portion of meat at a subsequent meal. Phase Two survey respondents indicated that if they had to eat less meat, both eating smaller portions and eating meat less frequently were likely pathways. Most survey respondents (80% males, 60% females) indicated they would be satisfied eating a smaller portion of meat than they currently consume (see section 4.4.2). Typically they could eat about 50 grams less. The minimum amount of meat deemed satisfying was typically 100 or 150 grams. Phase One participants indicated they could probably eat meat-free about one or two days each week. About one-third (36%, n=214) of Phase Two survey respondents agreed. A further quarter (24%, n=143) of survey respondents indicated they could eat meat-free three or four days each week. Survey responses indicate that dinner would be the most difficult meal to go without meat. However, there is scope to encourage a meat-free meal at lunch. Findings from this thesis suggest that both reducing frequency of meat consumption and meat portions are pathways to lower meat consumption. In particular, lunch could be targeted as a meat-free meal to allow capacity for a satisfying portion at dinner within the recommended meat ‘budget’. Dutch researchers agree that a focus on portion size could be one pathway to lower meat consumption (Schösler, De Boer & Boersema 2012). Their research identified that ‘reflective consumers’ were amenable to both eating smaller amounts of meat and eating meat less frequently each week.
If meat consumption is reduced, it is important to consider what (if anything) would replace meat. The Phase Two survey asked respondents to identify what they would eat if they reduced intake of red meat (beef, lamb, pork). Figure 4.31 indicates that beef, lamb and pork would be replaced with chicken followed by fish followed by vegetables followed by eggs. Lentils and meat alternatives are less likely substitutions. A survey of Dutch consumers reports a similar finding (Schösler, De Boer & Boersema 2012). Those who expressed willingness to substitute meat (n=204) were asked what they would eat in place of meat. Analysis revealed a gradient that ran from fish (73%), via eggs (49%) and cheese (34%) to meat alternatives (26%), lentils or other pulses (17%) and tofu (14%). The most popular meat substitutes were products of animal origin implying a hierarchy of foods where animal foods were valued above plant foods. According to Schösler, De Boer and Boersema (2012), one pathway to reducing meat consumption is to encourage incremental changes from meat to fish, eggs and cheese. The authors acknowledge that such substitution is not very promising from a sustainability perspective. However, such a pathway could be an intermediate step in a transition to lower meat consumption.

This thesis identifies that meat is a unique and highly desired food. There is resistance to eating less meat. However, when pushed, participants indicate some capacity to make small changes to the frequency of meat consumption and portions of meat consumed. Be that as it may, there is a limit to the extent that participants are willing to reduce portions.

**Recommendations:**

Action to encourage healthy and sustainable meat consumption needs to be mindful of the desirability of meat.

A pathway to healthy and sustainable meat consumption is to focus on frequency of consumption and size of meat portions.

Lunch can be targeted as a meat-free meal in order to contain overall meat consumption within current guidelines while allowing capacity to optimise meat portions in evening meals.
5.4 Finding 3 – Participants appear ‘happily disconnected’ from meat production. There is a desire for ‘natural’ and ‘safe’ rather than ‘low impact’ meat.

Findings from this investigation indicate there is limited awareness and concern about the way meat is produced in Australia (see section 4.1). Although participants regularly shopped for and consumed meat, they were largely disconnected from the path meat had travelled before ending up sliced, packaged and plastic-wrapped in the meat section of the supermarket. Some participants openly spoke of not wanting to think about meat production. In other words, they were ‘happily disconnected’ from the meat production system. Consumer disconnect from meat production is widely discussed and criticised in the literature. For example, Allen and Baines (2002) describe how the connection to killing and slaughtering makes people uneasy towards meat. To cope with this unease, many individuals attempt to dissociate meat from the living animal. This dissociation is facilitated by advertisers rarely showing where meat originates or the slaughtering process, abattoirs moving out of public view and consumers favouring animal parts that least resemble the living animals. Similarly, Hopkins and Dacey (2008) discuss how sterile supermarket practices make it easy for consumers to detach from any discomfort associated with eating meat. They point out that most people have difficulty with slaughtering animals but, when flesh is provided sliced, neatly wrapped and brightly lit, all sense of horror is muted. Certainly, similar sentiments were expressed in this investigation. Participants were squeamish about the slaughtering of animals. They liked to buy meat in ‘nice plastic packages’ and did not want to think ‘beyond that’.

It is easy to understand why consumers avoid thinking about slaughtering when procuring meat. However, participants in this thesis were also disconnected from the production path leading up to slaughter. Many participants had given little thought to factors such as what animals ate or how they were housed. Those that had were uncertain about which practices they preferred. Disconnection from agricultural practices is also apparent in the literature. For example, Vermeir and Verbeke (2006) despair that consumers often have limited knowledge of agriculture and its production processes and a lack of insight into the implications of their food purchase decisions on the food supply chain. Hoogland, De Boer and Boersema (2005) speak of the loss of production practices from social consciousness in Western countries where food ‘simply comes from the supermarket’ and there is little thought to how it got there. Gone are the days where most Australians had some connection to a farm, at least
through an uncle or grandparent. In fact, a survey of residents in Australian cities found that less than half had ever visited a working farm (Landline 2006). It seems that knowledge of agricultural practices is diminishing in Australia and participants in this research were largely unconcerned by this knowledge gap.

Published literature prior to the studies reported in this thesis speculated that environmental concerns would have a strong impact on future meat consumption (Fiddes 1994, Lea & Worsley 2003). However evidence for this development in Australia was lacking. Interviews conducted in this investigation revealed that participants were largely uninterested in the environmental credentials of meat when procuring (section 4.1.4) and consuming (section 4.2.9) meat. Even those participants who were actively engaged in environmental issues did not see reducing meat consumption as an important area of action. Survey responses support this finding. Figure 4.1 indicates that fewer respondents were concerned about the environmental impact of meat compared with other characteristics such as taste. Figure 4.23 shows that just under half the sample (47%, n=283) agreed that they would eat less meat to protect the environment. While this suggests some interest in the environment it is substantially less than the proportion of respondents who would eat less meat to improve their health (73%, n=439) (see figure 4.21). In addition, the survey indicates limited awareness of strategies to eat meat in a more environmentally friendly way (see figure 4.22).

These findings indicate that concern for the environmental impact of meat is consistent with earlier Australian research. For example, a survey of approximately 600 Australians found that 22 per cent of respondents agreed that a vegetarian diet would help the environment and 35 per cent were unsure (Lea & Worsley 2003). A survey of 415 Victorian residents found respondents were largely unaware of the environmental benefits to be gained from eating a plant-based diet (Lea, Crawford & Worsley 2006). In this survey, almost half of respondents were unsure whether there were environmental benefits associated with plant-based diets. A small (n=223) survey investigating Australians’ food-related environmental beliefs and behaviours in 2008 found that lower meat consumption was seen as least likely to help the environment (Lea & Worsley 2008). Awareness of the impact of meat production on the environment was found to be low even among those who were already found to believe that food-related actions were important to help the environment.

International research indicates a similar picture. Verbeke and Vackier (2004) describe how meat consumers are mainly hedonic-oriented when making consumption decisions. Others
agree that meat consumers are largely driven by sensory aspects and less by a concern about methods of meat production (Grunert 1997, Issanchou 1996, Richardson, Shepherd & Elliman 1993). Vermeir and Verbeke (2006) note that in general about 30 per cent of consumers have a positive attitude towards sustainable consumption. A study of meat consumers in ten countries found that about 15 per cent of the sample were ‘environmentally conscious citizens’ who placed a high emphasis on maximising efforts at the farm level to protect the environment (Verbeke et al. 2010). The bulk of the sample (54 %) was classified as ‘weak attitude citizens’ who were driven by convenience, habit, value for money and personal health concerns rather than environmental concerns (Verbeke et al 2010). Similarly, a government commissioned report in the United Kingdom, into the extent to which people might be prepared to consume more sustainably, reveals that willingness to voluntarily change meat consumption to achieve a more sustainable intake is low (Owen, Seaman & Prince 2007).

A recent Swiss study involving over 6000 respondents, investigated consumers’ beliefs about ecological food consumption and their willingness to adopt ecologically positive behaviours (Tobler, Visschers & Siegrist 2011). This study found that consumers were less aware of the environmental impacts associated with meat production than other strategies such as avoiding excessive packaging. Furthermore, consumers assessed reducing meat consumption as the least environmentally friendly of all consumption patterns. A survey of Finnish adults (n=1623) identified a small segment of consumers (8%) who had changed and intended to change their meat consumption patterns particularly for environmental and animal welfare reasons (Latvala et al. 2012). The authors see this as an indication that some consumers are over-riding taste preferences and taking a more thoughtful approach to meat consumption. However, it could also be seen as evidence that only a small segment of the population is concerned about the environmental properties of meat. As documented in this thesis, the environmental credentials of meat are less concerning than other aspects of food. On the whole, consumers want a healthy, tasty, safe, trustworthy and high-quality food product (Vanhonacker & Verbeke 2009). They are less interested in the environmental credentials of meat.

Rather than ‘environmentally friendly’ meat, participants in this doctoral study expressed a greater desire for ‘safe’ meat. In particular, they wanted their meat to be ‘chemical free’, ‘hormone free’ and ‘pesticide free’. This finding is consistent with a vast body of literature that identifies food safety concerns linked to meat (MacBean 1996, McCarthy & Henson 2005, Montossi et al. 2013, Shearer, Burgess & English 1986, Richardson, MacFie &
Shepherd 1994, Verbeke & Vackier 2004). Some of this concern arises from a concern about microbial pathogens such as *Salmonella* and *Escherichia coli* (Montossi et al. 2013, Richardson, MacFie & Shepherd 1994, Ruby & Heine 2011). Some concern, especially in Europe, is linked to contamination scares such as Bovine Spongiform Encephalopathy (BSE), foot and mouth disease and dioxin contamination (MacBean 1996, Montossi et al. 2013). Other food safety concerns are related to fear of residues such as antibiotics, pesticides and hormones (Richardson, MacFie & Shepherd 1994).

Compared with Europe and the United States, Australian markets have been largely untouched by major food safety scares linked to meat. Despite this difference, this thesis indicates that food safety concerns are also prominent among participants. Other research indicates similar concerns about the safety of Australian food. For example, a national telephone survey of a representative sample of 1200 adults identified that 45 per cent of Australians were concerned about the safety of food (Williams et al. 2004). The most common potential hazards identified were additives and chemical residues followed by food processing/handling/freshness. This survey looked at all food rather than meat in isolation but it adds support to the finding that consumers are concerned about the presence of undesirable substances in their food.

The extent that food safety concerns influence meat consumption seems to wax and wane. For example, there is evidence that European meat consumption decreased after the BSE outbreaks in the eighties and nineties (Richardson, MacFie & Shepherd 1994, MacBean 1996). However, more recently, safety concerns are thought to be having less influence on European meat consumption (Verbeke et al. 2010). According to Montossi and colleagues (2013), under normal conditions food safety fears about meat are in a latent state. Therefore, when the meat supply is unchallenged, food safety concerns do not affect meat consumption. Participants in this investigation expressed a strong desire for safe meat and made procurement decisions based on the likelihood that the meat would be safe. However food safety concerns did not influence them to eat less meat. Participants had confidence that, by choosing their retailer carefully, safe meat could be obtained and therefore they could safely consume whatever amount they deemed satisfying.

In addition to safe meat, participants in this study expressed a strong desire for ‘natural’ meat. This is consistent with other literature that indicates consumer preference for food products that are natural (Dornblaser 2013, Lockie et al. 2004, Rozin 2005, Rozin, Fischler & Shields-
Argelès 2012). In this group of participants, the term natural was not tightly defined. However, it seemed that natural meat was produced using traditional farming practices where animals were treated humanely. Animals were fed a natural diet so the resulting meat was free of unnatural substances such as pesticides and hormones. Cross-cultural studies indicate a similar conceptualisation of the term natural. For example, Rozin, Fischler and Shields-Argelès (2012) found that residents in France, Germany, Italy, Switzerland, the United Kingdom and the United States defined natural principally by the absence of negative features such as additives, pesticides, synthetic components and human intervention. Natural also referred to the ‘original’ status of things and the absence of intrusion of technology into basic traditions. Similarly, focus groups with meat consumers across nine European countries found that consumers associated healthy meat with natural production systems (Verbeke et al. 2010). Natural production systems were linked to a romantic concept of the traditional farm (‘like my uncle’s or grandparents’ farm’) where cattle were raised outdoors and fed grass and natural food. Natural meat was produced without additives and hormones.

This doctoral study found that while the desire for natural meat was apparent across nearly all participants, the motivation for natural meat differed. Some viewed natural meat as being healthier. Others considered it to be more flavoursome. Some preferred natural meat as it originated from animals that were treated more humanely. Some desired natural meat simply because ‘that’s the way meat should be produced’. Similarly, Rozin, Fischler and Shields-Argelès (2012) found that a preference for natural foods could be based on varied reasons – the natural choice is healthier, more pleasing in flavour and appearance or kinder to the environment. It could also be based on the ideational position that natural is inherently better. Other literature indicates that consumers have a preference for natural production methods as it impacts on the quality attributes of meat. For example, research on lamb indicates that consumers have a preference for lamb from grass-based production systems over lamb from concentrated feed (Font i Furnols et al. 2011). Grass production systems are considered to produce more natural lamb and thus the meat is expected to be healthier and tastier (Font i Furnols et al. 2011). Similarly, Swedish research indicates that meat produced by animal friendly husbandry practices is perceived as being more natural and of higher quality than that reared intensively (Pan-Huy & Fawaz 2003). Consumers who choose higher welfare poultry products consider these products to be more natural and associated with product attributes like health, taste and quality (Vanhonacker & Verbeke 2009). It seems that there is a consistent finding that natural meat is desired. However, the reasons for desiring natural meat can differ.
For some it relates to product attributes, whereas for others it seems to have more of an ideological theme.

This notion of natural meat warrants further investigation. It is possible that a desire for more natural meat can be used to generate interest in more sustainable meat consumption behaviour. Some research indicates that consumers already associate naturalness with sustainability (Verhoog et al. 2003). Furthermore, consumers’ willingness to consume food that has been produced in an environmentally friendly manner has been found to be increased if consumers attach importance to their food’s naturalness (Tobler, Visschers & Siegrist 2011). Food manufacturers are using the desire for natural products to influence purchasing behaviour (Dornblaser 2013). It is possible that public health approaches could also legitimately tap into this desire.

Participants in this investigation placed a high importance on naturalness and much lower importance on environmental credentials when consuming meat. This suggests that technological approaches to reducing the environmental impacts associated with meat production are unlikely to be popular with consumers. Lifecycle analysis suggests that intensive farming can reduce greenhouse gas emissions compared with conventional or organic farming (Peters et al. 2010). However, participants in this thesis indicated they were not interested in using intensive farming to lower greenhouse gas emissions. They did not seem to want low emission meat. Rather they expressed a desire for meat that originates from animals that are reared in a natural way. Other literature indicates that consumers may be resistant to the adoption of new agricultural practices or technological innovations that are perceived as immoral, unnatural or unethical (Bredahl, Grunert & Fertin 1998, Frewer et al. 2005, Montossi et al. 2013).

The desire for natural meat can also partly explain why participants seemed largely uninterested in the use of meat alternatives as a more sustainable option than meat. Consistent with other research, the unfavourable sensory properties and the processed nature of these products were main barriers. Taste is frequently cited as a key reason for poor acceptance of meat alternatives (Elzerman et al. 2011, Hoek et al. 2004, Hoek et al. 2011). Even those who identify meat substitutes as being more ethical than meat, choose not to consume meat substitutes as they make a trade-off between attributes such as taste against environmental friendliness (Hoek et al. 2011). Some argue that the lack of appeal for meat alternatives can be overcome (Beekman 2000, Elzerman et al. 2011). They point out that meat substitutes are
chosen by some meat-eaters because they are cheap, convenient and easy to prepare (Elzerman et al. 2011). Consequently, promoting objective qualities of meat substitutes such as being healthy, better for the environment and easy to prepare could increase the uptake of these products (Beekman 2000). In this doctoral study, participants strongly communicated that taste was a very strong barrier to the use of meat alternatives.

In addition, there were also objections to the way meat alternatives are produced. Participants in this thesis viewed meat alternatives as being ‘artificial’, ‘processed’ and ‘unnatural’. Lack of processing has been identified as an important feature of the concept of natural (Rozin, Fischler & Shields-Argelès 2012). Other literature concurs with the finding that the unnatural nature of meat alternatives is a barrier to their uptake (Hopkins & Dacey 2008). For example, a Finnish study found that both consumers and experts had a negative view towards the development of meat substitutes and saw laboratory grown meat as the least likely factor that would influence future meat consumption (Vinnari & Tapio 2009). Focus groups with European meat-eaters also found that consumers were sceptical about novel food technologies and that a preference for natural meat dominated group discussions (Verbeke et al. 2010). There was strong criticism for excessive intervention and manipulation in food and a strong desire to keep food processing to a minimum and as simple as possible. Findings from this thesis suggest that the use of meat alternatives is not a promising pathway to reducing meat consumption – primarily, because the sensory properties are not liked, but also because they are viewed as an unnatural alternative to meat. This supports the argument that technological developments are not a complete solution for coping with the growing meat consumption demand (De Bakker & Dagevos 2012, Garnett 2013, McMichael et al. 2007, Vinnari & Tapio 2009).

The desire for natural meat documented in this thesis could suggest that options such as choosing organic meat, substituting high impact meats (e.g. beef) with low impact meats (e.g. kangaroo) and eating a wider variety of meat cuts (i.e. tongue-to-tail) could have potential in the move to more sustainable meat consumption. However, support for these options is considered lukewarm at best. In this investigation, there was support for organic meat and approximately one-third of participants actively purchased what they considered to be organic meat at times (see Section 4.5.9). However, key deterrents were the higher cost and scepticism about the authenticity of such products. These are well known deterrents to the purchasing of organic products (Lea & Worsley 2005, Lockie et al. 2002, Padel & Foster 2005, Pearson & Henryks 2008). The use of lower impact meats appealed to some
participants. It was seen as more natural to eat meat such as kangaroo and rabbit, particularly if obtained from the ‘wild’. Conversely, others considered it unnatural to eat such meats as they were not ‘farm animals’ or ‘made for eating’. Similarly, some participants were comfortable with the idea of making better use of a variety of different cuts of meat, whereas others simply could not fathom the idea of eating unfamiliar cuts. This demonstrates that the notion of natural is not concrete and well defined. Rather, it has different meanings for different people. According to Rozin and colleagues (1984), by early adulthood, individuals adopt a culturally based set of beliefs and attitudes about the edibility of objects (Rozin, Fallon & Mandell 1984). It seems that parents are particularly influential on whether food elicits a ‘disgust’ response or is considered edible. For those who are comfortable with the naturalness of eating meat such as kangaroo, rabbit or oxtail there is potential to promote this as a sustainability strategy. However, there will be barriers to overcome such as availability, convenience and lack of cooking knowledge. For others, the unnaturalness of this approach means there is little likelihood that this strategy will be adopted.

While there is some potential to influence the types of meat consumed, findings documented in this thesis suggest that there is greater potential to influence the quantity and frequency of ‘regular’ meat consumption. However, for consumers to make such change, they need to be convinced of the need to do so. This investigation found that while there was interest in safe and natural meat, awareness of meat production and the environmental credentials of meat was limited. Participants were typically unconcerned about the quantity and type of meat consumed. This is consistent with literature that concludes that consumers know little about the environmental implications of what they eat and, even if they do, they do not much care (Garnett 2008). The obvious step from here is to conclude that ‘awareness raising’ or ‘consciousness raising’ is required to inform and motivate consumers to make pro-environmental changes to meat consumption. Other Australian research has reached a similar conclusion (Lea & Worsley 2008).

Many take the view that consumers are interested in making sustainable food choices but there is a discrepancy between what consumers deem valuable and their purchase decisions (Montossi et al. 2013, Verbeke & Viaene 1999). This ‘attitude-behaviour gap’ where concern for the environment does not necessarily translate into corresponding food choices is well documented in the social sciences (Hoogland, De Boer & Boersema 2005, Jacobsen & Dulsrud 2007, Te Velde, Aarts & Van Woerkum 2002, Vermeir & Verbeke 2006). A recent example demonstrates this attitude-behaviour gap in some Australians. In 2011, the
Australian Broadcasting Commission aired an investigation into the treatment of live cattle exported to Indonesia. Intense coverage of animal cruelty linked to live export continued in the Australian media for subsequent weeks. A small survey (n=157) of the Australian public was conducted following the media coverage (Tiplady, Walsh & Phillips 2012). The survey found that, while over a quarter of respondents stated they were determined to take action to stop live export, relatively few had chosen to act. A possible interpretation (in this small non-representative sample at least) is that some Australians have limited and passive concern about animal welfare and meat production.

There is a large body of work that explains the attitude-behaviour gap by discussing the notion of the consumer versus the citizen. For example, Grunert (2006) writes about the distinction between the roles of individuals as consumers and citizens when it comes to meat production. In their role as consumers people buy, prepare and consume meat products. In their role as citizens, they form attitudes to meat production. The two roles are not necessarily closely related. For example, as citizens, people may be critical of intensive chicken-rearing practices. However, as consumers, they buy conventionally-produced chicken because it is widely available and cost-effective. Research on meat consumption suggests that even though people as citizens express environmental and animal welfare-related concerns in relation to meat production, they do not demonstrate their concern in the choices they make as consumers. For example, Verbeke and colleagues (2010) found weak relationships between citizens’ attitudes and consumers’ behaviour. In their research, a cluster of participants who were more critical of pork production did not include more non-pork-eaters than other clusters. The attitude-behaviour gap is often explained by the dominance of other product attributes over concerns for the environment or animal welfare, the nature of the buying process, the fact that consumers are a heterogenous group of individuals, or the inadequacy of information provision (Vanhonacker & Verbeke 2009).

Lack of information is a common explanation for the gap between attitude and behaviour (Harper & Henson 2001, Hoogland, De Boer & Boersema 2005). It is argued that consumers do not make sustainable choices because they do not know the options for choice and/or the true consequences of their actions (Jacobsen & Dulsrud 2007). Consumers often have limited knowledge and awareness of agriculture and its production processes, and consequently lack insight into the implications of their food purchase decisions on the food supply chain (Vanhonacker & Verbeke 2009). By providing more or better information about food production, individuals will be able to act as ‘citizen-consumers’ (De Tavernier 2012,
Jacobsen & Dulsrud 2007). These are consumers who are sustainably aware and conscious and use their purchasing power to influence institutional or market practices. Providing consumers with the information they need to act as citizen-consumers has dual benefits. Firstly, consumers make better choices and, secondly, their consumer demands can trigger producers and retailers to change the system of meat provision (Frewer et al. 2005).

It makes sense that better informing participants in this thesis about the environmental cost of meat production might change their consumption practices. However, another explanation for the behaviour-attitude gap is that consumers trust that the meat they procure is congruent with their values relating to meat production. The importance of trust as a determinant of consumer acceptance of other aspects of food production has been demonstrated previously (De Jonge et al. 2007, Frewer & Salter 2002). Similar to European consumers, participants in this study indicated high trust in meat production (Verbeke et al. 2010). Participants voiced concerns about intensive production practices used in the United States, but expressed strong trust in Australian farmers. Trust in retailers was selective and extended to certain retailers only.

Other researchers have also found that there are differences in trust for different food chain actors. Some research indicates that farmers are more trusted than the government, which is more trusted than the supermarkets (Frewer et al, 2005). Other research indicates that upstream actors (production and processing) are less trusted than downstream actors (retailers and butchers) for beef production (Verbeke et al. 2010).

Participants in this investigation expressed that they typically trusted that Australian meat was produced appropriately. Yet interview and open-text survey comments indicated there was confusion about meat production in Australia. Hence, this trust in Australian production was viewed by the researcher as ‘blind trust’ rather than informed trust. A European study also found incomplete or confused knowledge about meat production (Holm & Mohl 2000). In-depth qualitative interviews with 20 Danish consumers identified concern about meat production as a major theme. Participants viewed the living conditions and welfare of animals in modern industrialised agriculture as undermining the gastronomic and health quality of meat. However, the researchers noted that, although concern was expressed about production, interviewees had little knowledge about production processes. Rather much of their narrative concerned suspicions and anecdotes about what goes on in the food industry. This finding closely mirrors observations documented in this thesis. While concern was expressed, knowledge about Australian meat production was incomplete and inconsistent. It is possible
that greater information provision would erode some of the trust in meat production expressed in this thesis.

It must be acknowledged that there is criticism of the impact of information provision to close the consumer attitude-behaviour gap. There is a substantial consumer segment that hardly considers issues such as animal welfare and the environment when purchasing animal products (Vanhonacker et al. 2007). They just do not care (Garnett 2008). Consequently, some view modern consumers as weak actors who let hedonic desires rule their consumption behaviour (Bauman 2009, De Bakker & Dagevos 2012). They argue that sustainability is a niche market with only a small section of the population interested.

Others take a more sympathetic view of consumers. Consumers are not necessarily weak or ill-informed but caught in decision-making dilemmas where they have to make trade-offs or ‘consumer compromise’ between different attributes and benefits, such as taste or convenience against environmental friendliness and animal welfare (De Jonge & Van Trijp 2013, Grunert, Bredahl & Brunsø 2004, Hoek et al. 2011, Napolitano et al. 2010). Jacobsen and Dulsrud (2007) point out that not all consumers are active, conscious consumers who make deliberate, considered choices once fully informed. Rather, food purchase is a process that is strongly influenced by habit and other forces (Martin & Morich 2011, Vanhonacker & Verbeke 2009). Jackson (2005) identifies that consumer motivations are embedded in a variety of ordinary, routine and habitualised behaviours that are influenced by social norms and practices and constrained by institutional contexts. Consequently, consumers often find themselves ‘locked in’ to specific consumption patterns. Similarly, Holm and Kildevang (1996) point out that purchasing decisions are often entangled in overlapping and conflicting moral expectations, care and power relations, economic concerns, nutritional concerns, taste, preferences and various practical considerations. Consequently, non-reflective, ordinary consumption comprises the bulk of consumption (Jacobsen & Dulsrud 2007). The greater part of everyday consumption is mundane, heavily habitualised, time-pressed, information-overloaded and dominated by practicality (De Jonge & Van Trijp 2013, Jacobsen & Dulsrud 2007). As a result ethical concerns often lose out to other forces.

When the complexity of shopping is taken into account, it is easy to feel disheartened that providing additional information will have any impact. De Bakker and Dagevos (2012) convey this most eloquently when they write that the call that people should be better informed about the moral complications of their meat consumption and be urged to adopt a
more sustainable lifestyle ‘seems like a voice crying in the wilderness of our supermarkets’. For some consumers, passive approaches to sustainability might be more useful than awareness raising or information provision. For example, Dutch researchers identify the use of low-meat convenience products as a pathway to lower meat consumption (Schösler, De Boer & Boersema 2012). They recognise that meat alternatives have low appeal. However, there is potential that convenience-oriented consumers will accept a meal such as pizza made with a combination of familiar ingredients and plant or even insect protein. Well known farmer and television personality, Jimmy Doherty, has employed such tactics in the United Kingdom where he has worked with Tesco supermarkets to create products such as chicken kievo and sausages from previously wasted meat sources such as rose veal and broiler hens (Channel 4, 2013). This passive approach is consistent with what De Bakker and Dagevos (2012) call ‘sustainability by stealth’. Such strategies are likely to work for some participants in this study provided the products are consistent with expectations for taste, cost and naturalness.

Others argue that it will not be enough to simply better inform consumers or develop new products. Rather much wider social and policy action will be required to influence meat consumption behaviour. For example, Garnett (2008) writes that it is unrealistic to expect people to ‘do the right thing’ and voluntarily change behaviour. She argues that strong policy actions are required to influence the economic and social context and drive change. Similarly, Jackson (2005) identifies that a concerted strategy is needed to promote pro-environmental behavioural change. Social change is needed to make it easy to behave more sustainably: ensuring that incentive structures and institutional rules favour sustainable behaviour, enabling access to pro-environmental choice, engaging people in initiatives to help themselves and exemplifying the desired changes with government policy and practices. Various strategies such as more informative labelling, choice editing of options available in the supermarket, increasing the price differential between high and low emission foods, greater emphasis on technological solutions and eco-taxes are suggested to influence meat consumption (Beekman 2000, Garnett 2008, Singer 2009, Nordgren 2012, Wirsenius, Hedenus & Mohlin 2011).

known. Of course, broad action will be required to influence behaviour and different types of action will be required for different types of consumers. However, this thesis identifies gaps in knowledge and awareness. It concurs that there is a need for clear communication about food production and sustainability (De Jonge & Van Trijp 2013, Jacobsen & Dulsrud 2007, Montossi et al. 2013, Vermeir & Verbeke 2006). The extent and nature of research originating from Western European countries and North America indicates that the topic of meat consumption has been given considerably more attention elsewhere than in Australia. In conjunction with a wide range of strategies, there is a need to raise awareness and improve knowledge in order to engage Australian consumers in sustainable meat consumption.

Australian consumers have the right to know about these issues and nutrition professionals are well placed to help raise awareness. On its own awareness raising is unlikely to have a large impact. However, it will be an important component in the move towards more sustainable meat consumption in Australia.

There are various examples that demonstrate that information provision can influence meat consumption behaviour, at least temporarily. For example, several studies show that access to information about animal welfare significantly influences behavioural willingness to purchase higher welfare products (Napolitano et al. 2010, Toma et al. 2012). Hoogland, De Boer and Boersema (2005) found that some consumers (those with universalistic values) are sensitive to reminders of meat’s animal origins. When reminded of the animal origin of meat, people react by decreasing their meat intake or preferring meat from an animal-friendly production system. Hoogland, De Boer and Boersema (2005) argue that this provides evidence that transparency of the food production system should be one tool used in the move towards sustainable development. At the very least it would allow consumers to make better informed choices. Similarly, Allen and Baines (2002) exposed consumers to salience manipulation (informing individuals that previous research had found that people who consume more meat endorse hierarchy and dominance values) and found that people who reject hierarchy and dominance decreased their liking of red and white meat (at least temporarily).

This thesis identifies the need to better inform consumers about sustainable meat consumption. A future step will be to examine the most effective way to go about this. In this investigation environmental concerns on their own were not identified as being strong. Neither were concerns about animal welfare. However, participants did desire meat from animals that were reared in a natural way. This suggests that it might be useful to proceed with a broad view that emphasises the links between naturalness and sustainability rather than
distinguish between environmental motives, animal welfare motives and other motives. De Bakker and Dagevos (2012) share this recognition that different people have different motivations when it comes to meat and that is not useful to strictly define whether motivations are environmental, related to the treatment of animals, political or other. Gjerris and colleagues (2011) also acknowledge the intersection between climate ethics and animal welfare ethics by warning that a focus on greenhouse gas emissions could see a leaning towards technological solutions to mitigate climate change (e.g. intensive animal rearing). This could be at the expense of animal welfare conditions and in opposition to a consumer preference for ‘natural’ meat. By tapping into the commonality between sustainability, humaneness and the desire for naturalness there is potential for working together when promoting any one of these issues and thereby achieving a critical mass of support (Appleby 2005).

**Recommendations:**

Action is needed to increase awareness of the way meat is produced in Australia and the impact of different production systems.

The connection between naturalness, animal welfare and sustainability could be used to generate interest in modifying meat consumption.

### 5.5 Finding 4 – Participants are unaware or unconvinced by dietary guidelines for meat.

Participants in stage one of this doctoral study typically considered their current level of meat consumption to be healthy, despite the fact that many consumed more meat than recommended in the current Australian Dietary Guidelines (NHMRC 2013a). Section 4.2.4 indicates that participants were largely unaware of the quantity of meat recommended in a healthy diet. When quizzed about healthy portions, stage one participants and survey respondents cited quantities ranging from 50 to 500 grams. The median serve considered healthy was 200 grams for male survey respondents (n=169) and 150 grams for female respondents (n=233). Participants who had any awareness of dietary recommendations for meat typically dismissed the recommended quantities as being insufficient to satiate.
Meat was considered to be an important, if not essential, inclusion in a healthy diet. Participants were more concerned about eating too little meat than too much. In particular, participants were concerned about missing out on sufficient protein and iron if too little meat was consumed. This is a common theme in literature relating to meat consumption. For example, Lea and Worsley (2001) found that concern about lack of iron and protein was a strong predictor of frequency of meat consumption. Focus group research with meat-eaters across nine European countries found that participants in all countries thought that meat was an important component of a healthy diet and were most aware of its nutritional role as a source of protein and iron (Verbeke et al. 2010).

Awareness of any health risks associated with high meat consumption was poor in participants in this investigation. Figure 4.20 shows that just over 15 per cent of survey respondents (n=625) were unable to identify any health risk associated with eating meat and only one-quarter (26%, n=163) identified cancer as a risk. Interview comments provide further evidence of lack of awareness of health risks associated with eating meat. Other research on meat-eaters supports this finding. For example, Lea and Worsley (2002) found that the majority of South Australian residents did not think meat was unhealthy. European research indicates that meat-eaters in a variety of countries have low awareness of the potential adverse health conditions associated with the frequent consumption of certain types of meat (Verbeke et al. 2010). One Australian study found a high awareness of the potential benefits of eating a plant-based diet, with approximately three-quarters of respondents agreeing that plant-based diets offered benefits such as decreased saturated fat intake, increased fibre intake and disease prevention (Lea, Crawford & Worsley 2006). However this knowledge was not sufficient to encourage dietary change from a meat-based to a plant-based diet (Lea, Crawford & Worsley 2006). This study used fixed responses and, therefore, might have elicited a different response than the open questioning documented in this thesis. The differences in the two findings might also indicate that consumers see a plant-based diet as healthy but do not necessarily view a meat-based diet as unhealthy.

Researchers in the United States found that consumers had some knowledge about the health properties of different types of meat (Guenther et al. 2005). Guenther and colleagues’ identified that survey respondents with higher education consumed less beef and processed pork products and more chicken. However dietary knowledge had less influence on amounts of meat consumed than on the probability of eating specific meats. De Bakker and Dagevos (2012) report that most consumers in the Netherlands are unaware of the fact that they eat...
much more animal protein than they actually require. Meat is viewed as healthy and consumers are uncertain about whether a diet in which less meat is eaten is healthy and ‘balanced’. There is no common knowledge that consumers can easily cut down on meat without putting themselves at nutritional risk. The lack of awareness of the health risks associated with eating excess meat observed in this study and also reported in the literature is seen as a significant obstacle to reducing meat consumption. Additional research is required to determine if the lack of awareness of health risks indicated in this doctoral study extend to other populations within Australia.

Australian Dietary Guidelines and accompanying educational tools such as the *Australian Guide to Healthy Eating* have been available in Australia for many decades (Turrell 1997), and were updated by the National Health and Medical Research Council in early 2013 (NHMRC 2013a). The dietary guidelines and accompanying food guides form the basis of best practice nutrition advice for government, industry and health practitioners. They are also intended to directly inform consumers. Participants in this thesis were largely unaware of the recommendations for meat consumption provided in the dietary guidelines. This finding is disappointing but not surprising as it is well known that consumer awareness of and subsequent compliance with dietary guidelines within Australia and internationally is poor (Ball et al. 2003, Bier et al. 2008, Blumfield et al. 2011, Crowe, Forbes-Ewan et al. 2013, Epstein et al. 2013, Worsley, Worsley & McConnon 1991). Many reasons are provided to explain this poor compliance. For example, the high volume of conflicting media coverage of nutrition or the complexity of food decision-making creates confusion for consumers (Bier et al. 2008, Fineberg & Rowe 1998).

Another common criticism is that dietary guidelines and accompanying food guides are not meaningful or useful for consumers (Crowe, Forbes-Ewan et al. 2013, Keenan, AbuSabha & Robinson 2002, O’Neil 2000, Pérez-Rodrigo & Tseng 2013). The complexity involved in developing dietary recommendations that are relevant to a heterogeneous population is acknowledged. In developing the revised dietary guidelines the NHMRC drew upon an extensive body of evidence that was obtained through rigorous, best practice investigation. A full description of the extensive body of work involved in formulating the dietary guidelines and accompanying resources are outside the scope of this thesis. However, readers are directed to the document *Australian Dietary Guidelines – Providing the Scientific Evidence for Healthier Australian Diets* for full details (NHMRC 2013a). Of particular relevance to this thesis is the Food Modelling System investigation that was commissioned by the NHMRC.
between 2008 and 2010 (NHMRC 2013a). This modeling process determined a range of combinations of amounts and types of foods that can be consumed to meet nutritional needs with the least amount of energy for the smallest and least active people within an age and sex group (DAA 2010). The modeling system was pivotal in guiding recommendations about the amount of meat recommended in the Educator Guide that accompanies the dietary guidelines. There is no question that this modeling process was extensive and conducted with rigour and according to best practice. The author is not critical of the significant work conducted in the development of the dietary guidelines. However, there are problems with the way the current Educator Guide (NHMRC 2013b) delivers messages about meat consumption.

Firstly, the guide suggests that males aged 19-50 years consume three serves from the ‘lean meats and poultry, fish, eggs, tofu, nuts and seeds and legumes/beans’ category each day. This could be interpreted as saying that it is reasonable to consume up to 195 grams (3 x 65 gram serves) of red meat each day or 1365 grams per week. However, the NHMRC recommend that no more than 455 grams of lean red meat should be consumed per week (NHMRC 2013a). Furthermore, advice about recommended portions of meat is confusing. It is not clear whether the guidelines recommend that a maximum of 65 grams of ‘lean meat’ should be consumed each day or if it is reasonable to consume larger portions less frequently. The Australian Dietary Guidelines report level B evidence (probable association) that ‘consumption of greater than 100–120 grams of red meat per day is associated with an increased risk of colorectal cancer’ (NHMRC 2013a). However, advice about limiting daily consumption of red meat is not clearly and prominently incorporated in the Educator Guide.

The food modelling document that informed the development of the Educator Guide recommended a 20 per cent decrease in red meat consumption for adult males (DAA 2010). The decision to limit red meat consumption to 455 grams per week is said to be a response to the call to consider sustainability in the dietary guidelines (DAA 2010). However, the Educator Guide recommends 2.5-3 serves from the ‘lean meats and poultry, fish, eggs, tofu, nuts and seeds and legumes/beans’ group for adult men and 2-2.5 serves for adult women (NHMRC 2013b). This is an increase from the 1-2 and 1-1.5 serves recommended respectively for males and females in the previous Australian Guide to Healthy Eating (DoHA 1998). It could be argued that the increased servings in the current Educator Guide encourage increased consumption of some of the plant sources within the group such as legumes. Unfortunately, the recommendation to cap red meat consumption and make up the additional serves from plant-based protein has not been clearly articulated.
In the author’s view, it is erroneous to combine plant and animal foods in the one food group (‘lean meats and poultry, fish, eggs, tofu, nuts and seeds and legumes/beans’). Separating the plant and animal components could help to inform consumers of the guideline to limit red meat consumption to 455 grams per week and to make greater use of plant sources of protein to achieve a more favourable balance. Of course, the use of plant alternatives as an alternative to meat should still be indicated to those who choose not to eat meat. The benefits of separating plant and animal sources of protein in food guides are acknowledged by Reedy and Krebs-Smith (2008). They compared different food guides available to American consumers and noted the Harvard Healthy Eating Pyramid was seen as preferable to the MyPyramid (since replaced with MyPlate) resource produced by the United States Department of Agriculture. The Harvard Healthy Eating Pyramid has three protein groups to direct intake away from red meat and encourage consumption of fish, poultry, eggs, nuts and legumes, whereas MyPyramid includes protein options such as meat and beans within the one group. Other evaluation of the Dietary Guidelines for Americans concludes that consumers prefer specific advice such as ‘substitute red meat with chicken or fish’ rather than general advice about food consumption (Keenan, AbuSabha & Robinson 2002).

A further problem with the Educator Guide is that recommended serve sizes are out of touch with the usual consumption patterns observed in this study. The Educator Guide lists a 65-gram serve for cooked lean meat and an 80-gram serve for cooked poultry (NHMRC 2013b). Section 4.2.3 reports that participants in this research typically consumed between 120 grams and 200 grams of cooked meat per serve and there was no difference in portion sizes for different types of meat. The Educator Guide does allow for more than one serve of meat in a day but the use of small serve sizes creates confusion and causes consumers to discount dietary recommendations. For example, participants in this investigation who were aware of the 65-gram serve size dismissed it as being too small or ‘only suitable when dieting’ (see section 4.2.4). The data from this thesis are not representative of the wider Australian population. However, this snapshot of a select population indicates deviation from the advice in the Food Guide. Additional research is warranted to see if this finding extends to the wider Australian population.

The literature supports the view that servings in food guides are not well understood (Abramovitch et al. 2012, Britten, Haven & Davis 2006). One explanation for this difficulty is that serving size definitions in food guides have remained constant while portion sizes available in restaurants, at home and in the supermarket have steadily grown (Abramavitch et
al. 2012). Consequently, serving size reference amounts are no longer analogous to actual portion sizes of foods consumed (Nielsen & Popkin 2003, Rolls 2003, Young & Nestle 1995, Wansink & Van Ittersum 2007). Abramovitch and colleagues (2012) point out that the Canadian Food Guide uses 75-gram serves for steak with a maximum of three serves (225g) recommended per day. In comparison, portions of steak served in Canadian restaurants are typically much larger (220-380%). It has been suggested that larger serving sizes should be used in food guides to help consumers make decisions about the quantity of food to consume (Harnack et al. 2004). Significantly, more work needs to be done to investigate the best way to give messages about meat consumption to consumers. However, an improvement on the current recommendation might be that ‘120 grams of red meat can be consumed up to a maximum of four times per week’.

Given the typical pattern of meat consumption where a variety of meats are consumed over a week and there is a preference for medium to large portions of meat, it might be more meaningful to provide recommendations in terms of weekly intake. In the United Kingdom the principal public health tool for communicating information about eating for health is the Eatwell plate, a pictorial representation of how different foods contribute towards a healthy balanced diet (FSA 2013). An Eatwell Week resource has been developed (Leslie et al. 2013) to give better quantitative guidance to individuals. This provides a practical example of a seven-day menu. Such an education approach might be a preferable approach for meat.

There are problems with the way dietary guidance for meat consumption is provided in Australia. This is before any attempt to tackle sustainability has been made. Dietary recommendations will need further development if sustainability messages are to be incorporated. Researchers around the world are working to develop health guides that better incorporate both health and sustainability concerns. For example, Macdiarmid and colleagues (2012) have modeled a healthy diet that is acceptable to consumers and lowers greenhouse gas emissions. A development to watch is the way the New Nordic Diet is communicated to Scandinavian citizens. The New Nordic Diet is a prototype regional diet that takes palatability, health, food culture and the environment into consideration (Mithril et al. 2012). It is characterized by a high content of fruit and vegetables (especially berries, cabbages, root vegetables and legumes), fresh herbs, potatoes, plants and mushrooms from the wild countryside, whole grains, nuts, fish and shellfish, seaweed, free-range livestock and game (Mithril et al. 2012). Preliminary modeling includes a recommendation for 85-100 grams of
free-range meat per day. Such developments will give better insight into ways of communicating both health and sustainable goals for meat consumption.

Recommendations:

Additional research is recommended to confirm whether findings from this study extend to other populations.

Participants in this study would benefit from:

- Clear guidelines for sustainable meat consumption
- Action to raise awareness and understanding of dietary guidelines for meat consumption, including underlying health reasons
- Improved dietary guidelines for meat consumption with:
  - Separate guidelines for meat and plant proteins.
  - Recommended serves that are more consistent with portions typically consumed.
  - Guidance for weekly meat consumption in addition to daily consumption.

5.6 Finding 5 – Poor food literacy impacts on consumption and discard of meat.

Some participants in this investigation tightly planned their food purchasing and consumption and were highly skilled in the kitchen. However, the following narrative describes a more typical chain of events observed when interviewing participants for this thesis.

Kate drops into the supermarket on her way home from work with her son in tow. She wants to get through the supermarket as quickly as possible so she can pick up her daughter on time and have dinner before it gets too late. Kate always chooses the meat first because a meal isn’t a meal without meat. She doesn’t really know how much meat her family members need. Sometimes she uses a recipe as a guide but tonight she grabs whatever amount is packaged in the supermarket.

There are three people in Kate’s family. She could choose a packet of two steaks but that doesn’t seem enough so she buys the packet with
four steaks.

Once home, Kate recognises that she doesn’t really need four steaks. She knows she could freeze some of the steak but she already has a freezer full of bits of meat that she’s unlikely to use. Kate cooks all the steak. Once it’s cooked, she eats a bit more than she really feels like but the meat tastes good and she’s been feeling a bit tired lately so thinks she could probably use the extra iron. Her children only nibble on their meals so there are some leftovers at the end of the meal. Kate puts the leftovers in the fridge.

The next night, Kate thinks about using the leftover meat. However she doesn’t really like the idea of eating leftovers. They don’t look very appetizing. She worries about food poisoning and she feels like something different tonight. Last night they made some meatballs on MasterChef so Kate heads back to the supermarket. This time she has a recipe that asks for 800 grams of mince. Kate can buy a pack with 500 grams or one kilogram of mince. She’s not sure if the recipe will work with 500 grams so she chooses the kilogram pack …

Participants were unaware of dietary guidelines for meat and hence did not base their meat purchasing on nutritional needs. Rather they bought the amount that was conveniently available in the supermarket. They cooked the amount they bought and ate the amount they cooked. When there was a big discrepancy between the amount purchased and appetite, some leftovers were put in the fridge or freezer for another meal. Often these leftovers were later thrown out because they were unappealing or there were concerns that they might not be safe or there was a lack of knowledge about how to make use of them for another meal. Participants therefore headed back to the supermarket and the cycle started again.

The complexity of food provisioning is well known. Convenience, the abundance of cheap and easily obtained food, time pressures, advertising, marketing forces, food availability, consumer knowledge and motivation are just some of the factors at play (De Jonge & Van Trijp 2013, Jackson 2005, Jacobsen & Dulsrud 2007, Popkin, Duffey & Gordon-Larsen 2005). It is recognized that numerous factors contribute to the overconsumption and discard
of meat and there is no easy fix to this phenomenon. However, this thesis identifies that limitations in food literacy are one area for action.

Food literacy is an emerging term that identifies the need for both knowledge and capacity in order to make the best use of food. According to Kolasa and colleagues (2001) food literacy is ‘the capacity of an individual to obtain, process and understand basic information about food and nutrition as well as the competence to use that information to make appropriate health decisions’. While food literacy is increasingly cited as a contributor to poor food choices, the term is currently under discussion (Vidgen & Gallegos 2010, Smith 2009). Vidgen and Gallegos (2011) recently completed research with food experts to reach consensus on a definition of food literacy. They concluded that the most popular definition was ‘the relative ability to basically understand the nature of food and how it is important to you, and how you are able to gain information about food, process it, analyse it and act upon it’. Essentially, food literacy is about having both the knowledge and the ability to use food well. It incorporates elements such as knowledge of food needs as well as food skills such as planning, preparation, cooking and storage.

It is anticipated that improving the food literacy of some of the participants in this research could help to reduce some of the overconsumption and discard of meat documented in this thesis. Previous sections of this thesis have discussed the need for improved knowledge about the impacts of meat production and improved awareness of how much meat to consume. In addition, the development of skills in meal planning, food storage and food preparation could help participants manage the mismatch between the amount of meat available at point-of-purchase and the amount required for consumption. Improved food literacy could also help participants make greater use of leftover meat and to prepare more low-meat or meat-free meals.

As discussed in the previous section, participants typically consumed more meat than recommended but did not realise they were overconsuming. A lack of awareness about how much meat to consume meant that procurement decisions were largely influenced by the quantities available at point-of-purchase or were guided by recipes. However, findings from stage three (see section 4.2.6) indicate that recipes are not consistent with recommended meat serves. Once excess meat was procured, many participants were unable to manage the mismatch between the quantities available at point-of-purchase and need. A couple of
participants coped with this mismatch by freezing unwanted quantities. However, more typically the excess meat was cooked and either consumed beyond need or discarded.

Food waste scholarship consistently identifies buying too much as a contributor to general food waste (Evans 2011, OEH 2011, Sustainability Victoria 2011, Quested et al. 2011, WRAP 2007c). Reasons for overpurchasing include overestimating requirements, being tempted by supermarket specials and neglecting to plan (OEH 2011). In addition, overprovisioning is linked to the size of food portions and packages being too large (OEH 2011, Sustainability Victoria 2011). Consumer research in the United Kingdom found that bigger packs are a temptation that can lead to increased food waste (WRAP 2007a, WRAP 2007b). An ethnographic study in the United Kingdom found that overprovisioning of food typically occurred when a particular item of food was purchased for a specified purpose but the volume in which it could be purchased exceeded the volume required (Evans 2011).

Retailers could help to alleviate this tension by choice-editing the portions of meat available for sale. However, it is doubtful that retailers would act so simply for the good of the consumer or for the planet. The profits of food retailers are contingent on the amount of food sold rather than the amount of food consumed (Baker, Fear & Denniss 2009). In addition, there is a risk that, if retailers are asked to ‘down-size’ portions, the cost per unit will increase and this will subsequently deter consumers from purchasing the smaller quantities. Bigger quantities are often more economically attractive to consumers (WRAP 2007b). A more realistic solution is to help consumers develop the knowledge and skills needed to procure appropriate quantities. Others share the view that education approaches that help meal planners determine and purchase appropriate portions sizes is important to reduce food waste (Kantor et al. 1997, OEH 2011).

Theoretically, if consumers have a clear understanding of the amount of meat they require, they can plan their intake and shop accordingly. This will help to reduce overprovisioning. In this study, participants identified as non-discarders implemented good food planning. In contrast discarders typically did not plan their meals or shop using a list. The literature indicates that meal planners might be the minority. A survey of Australian households found that respondents typically plan their evening meal on the day of cooking (MLA 2009). Insufficient purchase planning is frequently cited as a cause of general food waste (Gustavsson et al 2011, WRAP 2007a). More thoughtful pre-shop preparation, including menu planning, checking of what ingredients are in stock and compiling (and sticking to) a
shopping list, contributes to less food being wasted (WRAP 2007c). Nevertheless, just over 60 per cent of United Kingdom households check their cupboards, refrigerator and freezer to establish what items need to be purchased and only one-third of households normally plan meals for their household in advance. A survey of New South Wales households found that only 35 per cent of respondents ‘mostly’ or ‘always’ plan meals in advance (OEH 2011).

Improving literacy around meal planning, shopping to a list and buying suitable portions is anticipated to reduce both overconsumption and discard of meat. General food waste scholarship supports this viewpoint (OEH 2011, Quested et al. 2011, WRAP 2007b). Furthermore, there is evidence that such action appeals to consumers. The Australia Institute found that consumers favoured a focus on food brought into the house as the best way to reduce food waste (Baker, Fear & Denniss 2009). Sustainability Victoria (2011) found that 63 per cent of participants were willing to buy only food that is needed and 47 per cent were willing to write a shopping list based on a meal plan (Sustainability Victoria 2011). Hence, it seems there is consumer willingness to improve shopping behaviour. The first step towards this is to help consumers develop an understanding of how much meat is required. Once armed with this knowledge, consumers can take action, such as shopping at a specialty supplier like a butcher, or requesting that staff in supermarkets repackage meat into smaller quantities. Experience shows that supermarkets will readily do this at no extra cost. However, participants in this investigation were unaware or doubtful about the practice.

In addition to buying too much, cooking too much has also been identified as a contributor to food waste (OEH 2011, Sustainability Victoria 2011, WRAP 2007c). In this study, cooking too much contributed to both overconsumption and discard of meat. Victorian meal providers indicated they find it difficult to estimate how much to cook per person and they prefer to serve too much food than not enough (Sustainability Victoria 2011). Similarly New South Wales (NSW) residents indicated that they cook too much food because it is preferable to serve too much than not enough and it is difficult to know how much to cook per person (NSW Government OEH 2011). WRAP (2007c) identified cooking too much food as a major factor contributing to food waste. One of the reasons for overcooking was a lack of knowledge about ideal food portions per person.

Some participants in this research were able to manage when excess meat was procured or prepared by making good use of leftovers and the freezer. However, other participants lacked the desire or capacity to do so. It was common for participants to express a dislike of eating
leftovers and using frozen meat. High quality standards are one explanation for this observation. For many Australians, food is cheap, abundant and conveniently available. Hence it can be just as easy and more appealing to source a brand new meal than use leftovers or frozen meat. High quality standards have been cited as a contributing factor to food waste. In a study of American households, younger householders in particular identified food quality as a very important factor in their discards (Van Garde & Woodburn 1987). Similarly, Evans (2011) found that United Kingdom residents tended to view frozen foods as undesirable and to favour fresh foods. Although participants in Evans’ research had the knowledge and ability to save ingredients from wastage, they were unlikely to put their ideas into practice. This was often because the meal provider felt that ‘improvised’ meals did not constitute a ‘proper meal’ and were unlikely to be accepted by family members. Consequently the meal provider was most likely to opt for a ‘tried and tested recipe’ over something that would use up excess ingredients. In an age where myriad food is available, 24-hours a day at low cost, there is little incentive to make use of leftovers or use up bits and pieces in the home.

Food safety concerns also contributed to failure to make use of leftovers and frozen meat. Participants reported storing meat temporarily in the fridge or freezer but then throwing it out when they were unsure if it was still safe to eat. Inadequate knowledge, misconceptions about food safety or high sensitivity to food safety have been identified as key contributors to food waste (Evans 2011, OEH 2011, WRAP 2007b, Van Garde & Woodburn 1987). It seems that confident, accurate estimations of food safety are not the norm among householders. Approximately one-quarter (22%, n=264) of New South Wales households held the attitude that cooked leftovers that had been in the fridge for more than one day were unsafe to eat (OEH 2011). Other food waste literature indicates that consumers typically demonstrate stringent adherence to ‘best before’ and ‘use-by’ dates (Quested et al. 2011). This is partly because householders lack the confidence to make judgments about food safety. According to Evans (2011), discourses of food safety tend to ‘win out’ over any anxieties about wasting food. Education about food safety and criteria for evaluating whether or not food can be safely eaten is one strategy recommended to reduce all forms of food waste (Van Garde & Woodburn 1986, WRAP 2007c, Lin et al. 2009). Such action is anticipated to be useful to reduce the meat waste observed by participants in this study.

In addition to reducing food safety sensitivity, there is a need to improve kitchen skills. All households included in this doctoral study had at least one occupant who was capable of cooking on a regular basis. However, the ability to creatively use leftover meat and manage
excess meat was limited in many households. More developed food handling skills would empower participants to freeze, batch cook and recreate meals. Concern about the loss of cooking skills in developing countries is widely expressed in the literature (Begley & Gallegos 2010, Caraher et al. 1999, Dixon, Hinde & Banwell 2006, Engler-Stringer 2010, Hartman, Dohle & Siegrist 2013, Hickman 2009, Lang & Caraher 2001, Lichtenstein & Ludwig 2010). A deskilling in the kitchen is also frequently cited as a contributor to food waste (Kantor et al. 1997, Sustainability Victoria 2011, OEH 2011, WRAP 2007c). Direct evidence of a decline in cooking skills in Australia and other developed countries is currently lacking (Begley & Gallegos 2010, Engler-Stringer 2010, Lyon et al. 2011). However it is speculated that cooking skills are declining due to factors such as changes in the school curriculum, a decline in the intergenerational transmission of basic cooking skills in the home, the increasing availability of convenience and takeaway foods and time-scarcity causing people to change their meal provisioning (Begley & Gallegos 2010, Dixon, Hinde & Banwell 2006, Jabs & Devine 2006, Lichtenstein & Ludwig 2010, Lyon et al. 2011, Williams 1994).

WRAP (2007a) found that those who felt more confident in food handling and cooking skills reportedly threw away less food. Similarly, a representative survey of New South Wales residents identified that 19 per cent of respondents identified they were unsure about how to use leftover ingredients (OEH 2011). Improving food handling skills could help to improve the usage of leftover and excess meat in the household.

Lack of confidence with using the freezer was particularly noted as problematic in this investigation. Many participants expressed uncertainty about how to freeze and make use of frozen meat. Shove and Southerton (2000) comment on how the use of the domestic freezer has changed since its heyday in the 1970s. Although it is the norm for households to have a freezer, the role and purpose of freezers has changed. There has been a rapid decline in the range and availability of specialist freezer cook books. Shove and Southerton (2000) speculate that this is because such specialist knowledge is now redundant. Freezers are now less commonly used to manage regular household provisions. Rather they are a store for convenience products such as icecream and ready-frozen products. Improving the capacity to use the freezer could help to reduce wastage of meat by both overconsumption and discard.

Improving cooking skills could also increase the likelihood that more low-meat and meat-free meals are consumed. The findings in this thesis indicate that the practice of eating meat-free meals is relatively foreign to many participants. Many participants simply do not know what they would eat if they had to cut back on meat (see Figure 4.30). Figure 4.31 indicates that
participants would most likely replace red meat with chicken or fish if they had to cut back on red meat. However, the likelihood of plant for meat substitutions was much lower. Concerns about the sustainability of the fish supply are well known (FAO 2012b, Pauly et al. 2002). In terms of sustainability, advice to lower meat consumption could result in problem-swapping if consumers are not well informed about how to make plant-based substitutions.

Section 4.4.5 shows that recipes influence consumption and participants identify access to more meat-free recipes as the action most likely to be useful in a move towards lower meat consumption. There is an extensive variety of foods such as beans, pulses, nuts and whole grains that provide high-quality plant protein. Such foods are not entirely foreign to consumers so it should be possible to encourage substitution of these foods for meat (Schösler, De Boer & Boersema 2012). However Lea and colleagues (2006) point out that some nutritional knowledge, some knowledge of preparation and an adjustment of personal food habits are required to use such foods. Hence, use of the large variety of plant protein sources is limited (Lea, Crawford & Worsley 2006). Participants in this study viewed the use of foods such as lentils as preferable and more natural than options such as meat alternatives. However, factors such as preparation time and lack of knowledge were cited as barriers to the use of such foods.

The recipe audit conducted in Phase Three of this investigation indicates that meat-free recipes are available in popular food magazines. In a six-month period, 22 percent (n=332) of recipes were classified as meat-free (see section 4.4.5). While this suggests that recipes are available, it does not provide an indication of the acceptability of recipes. When conducting the analysis, it was also apparent that there was quite a bit of repetition of recipes such as vegetable lasagne and vegetable curry. Participants in this research spoke of barriers to preparing meat-free meals such as the extra time involved. For uptake of meat-free meals to increase, there is a need for access to meat-free recipes that are quick, convenient, cost-effective and family friendly. A future research direction could be to work with consumers to assess the acceptance of recipes that make vegetables the hero of meals. Encouragement of low-meat meals such as stirfries and pasta dishes, where the role of meat is reduced rather than the centerpiece of the meal, may also prove to be a way forward (Schösler, De Boer & Boersema 2012).

The argument to focus on improving food literacy of the consumer is likely to attract criticism. Some might argue that such an approach attributes too much ‘blame’ or
responsibility to the consumer and fails to take into consideration the complexity involved in food provisioning. For example, Evans (2011) is doubtful that strategies such as providing advice on meal planning will have much impact on preventing food waste. For Evans, such advice is not sensitive to the ‘temporal dynamics of everyday life’. Despite the best of intentions and carefully considered plans, unexpected events sometimes impact on meal provisioning. Invitations to dinner, late meetings and/or change of appetite can all mean that planned meals are uneaten. This is compounded by the fact that so much of our food is now purchased fresh. Hence the shelf-life is too short to accommodate disruptions to household provisioning routines. Researchers from WRAP (2007b) agree that developing meal planning literacy will not completely resolve the situation. Consumers do not go out shopping with the express intention of throwing food away; all food is purchased for a reason and is intended to be consumed. However, circumstances that appear to be outside the respondents’ control mean that the food items are not eaten. For example, if at the time of food preparation the food item is no longer fancied something else is selected. Therefore, it would seem that householders are of the mind that they do not ‘waste’ food, they just dispose of it when unforeseen circumstances make it unfit for eating.

The findings reported in this thesis demonstrate that participants are typically unconcerned about their level of meat consumption and about half are unconcerned about wasting meat. There is widespread evidence that, while environmental and altruistic concerns act as a deterrent to food waste for some consumers, more typically consumers are unconcerned about food waste in general (Baker, Fear & Denniss 2009, OEH 2011, WRAP 2007c). Research by WRAP (2007c) found that 40 per cent of people thought that food thrown away is not an issue because it is ‘natural and biodegradable’ and 25 per cent say that food waste is unavoidable. It seems that food waste is frequently seen as unavoidable and inconsequential. According to a FAO report on all food waste, one of the most important reasons for waste at the consumption level in rich countries is that people can simply afford to waste food (Gustavvson et al. 2011). This is echoed by Clive Hamilton, Chief Executive of the Australia Institute, who oversaw the first national analysis of food waste in 2005. Speaking in the Age, after the release of the first survey on waste, Hamilton commented, ‘in terms of income, food is still relatively cheap and people’s attitudes are that is better to have too much than too little’ (The Age 2008). WRAP (2007c) points out that UK households have become more affluent while food has become cheaper in real terms (accounting for just 10 per cent of disposable income today, compared with 15 per cent ten years ago). As food loses economic value consumers worry less about
wasting it. The economic motivation to be careful with food, even for the less affluent households among us, has been eroded. Even though meat is often a higher cost food, financial concerns did not appear to impact on meat waste in this research.

Such a view could limit the impact of any strategy to improve the food literacy of consumers. Even if knowledge, awareness and skills such as meal planning and food handling are improved, consumers might continue to overconsume and discard meat. According to Evans (2011), it is overly simplistic to suggest that an attitudinal or awareness change will be effective in changing food waste behaviour. Participants in Evans’ ethnographic study were not found to have a careless or callous disregard for the food they end up wasting. Rather food waste arises as a consequence of households negotiating the contingencies of everyday life. According to Evans, a better understanding of the way in which domestic food practices are socially organised is required, as opposed to an attitudinal change (Evans 2011).

Some hold the view that cooking skills are not necessarily declining in developed countries. Rather skills have adapted to suit the current food supply. Lyon, Colquhoun and Alexander (2003) acknowledge that there is an increasing reliance on pre-prepared foods in the United Kingdom. However, this is not necessarily due to a loss of cooking skills. They describe how people growing up in the economically grim 1930s were ingenious in creating meals from scratch and ‘making do’. However this was due to necessity rather than superior cooking skills. The availability of convenience products means that it has been possible to transfer meal preparation from the domestic kitchen to the industrial estate. However, there has not been a loss of interest in the cooked meal as an objective. Lyon, Colquhoun and Alexander (2003) point to the popularity of cooking shows, celebrity chefs and cook books as evidence that the creativity of cooking continues to fascinate. A recent investigation did not find evidence of a difference in cooking skills between younger and older women (Lyon et al. 2011). Changed working lives and social curricula are influencing when cooking is practised but cooking skills are not necessarily in decline (Lyon et al. 2011). People are not cooking because they cannot cook. Rather other reasons are at play, such as lack of time or lack of interest (Short 2003).

Some might argue that rather than asking the consumer to take responsibility for acting to reduce overconsumption and discard of meat, a more realistic solution is to make it easier and more convenient for consumers to use meat according to guidelines. An example might be to increase the uptake of pre-prepared or ready-meals. A lifecycle analysis of homemade, semi-
prepared and ready-to-eat meals has found that all three meals have relatively similar environmental impacts (Sonesson et al. 2005b). It is possible that such meals could result in more favourable meat consumption. They tend to limit meat portions in order to be cost-effective and can also incorporate technological adaptations such as the incorporation of plant-protein substitutions. Hence, in theory, the use of ready-to-eat meals could contribute to an overall reduction in meat consumption and waste.

Such an approach has similarities with the argument for ‘sustainability by stealth’ discussed previously. There are certainly some valid considerations to such an argument, especially for some consumer groups. However, the nutritional credentials of ready-to-eat meals are often problematic with these products tending to have higher sodium and fat contents than home-prepared meals (Carahe et al. 1999, James 2008). The use of ready-to-eat meals is also in opposition to the strong desire for natural food observed in this study. Furthermore, such an approach makes consumers beholden to food manufacturers and retailers (Lyon, Colquhoun & Alexander 2003). An important element of food literacy is to empower citizens to make healthy (and sustainable) choices (Vidgen & Gallegos 2010). For these reasons, strategies to improve food literacy are seen as worthwhile and important. Such an approach will not fully resolve all of the behaviour documented in this thesis. However, it will at least give consumers the potential to make better choices and the capacity to reduce meat wastage by overconsumption and avoidable discard.

**Recommendations:**

For many participants in this study, action needs to be taken to improve food literacy relevant to meat, in particular:

- Awareness of the amount of meat required.
- Ability to plan meals and shop according to need.
- Ability to make use of the freezer.
- Ability to make use of leftover meat.
- Ability to prepare more low-meat and meat-free meals.
5.7 Strengths and Limitations of the Study

This thesis has investigated an important and relatively unexplored topic. The mixed-methods approach has allowed different dimensions of meat procurement, consumption and discard to be explored. Consistent with the nature of exploratory research, this investigation has identified many more questions that need to be answered. However, it has also produced unique data from surveys and weighed food records. As a result, it is possible to confidently identify that attention needs to be directed to meat consumption and discard. This is an important first step in the move towards more healthy and sustainable use of meat.

The findings in this thesis represent a single temporal snapshot of a relatively small group of participants. Phase One involves a sample of 29 diverse adults. Phase Two involves a sample that over-represents younger people and under-represents older people compared to the general Australian population. The sample also has higher than average household income and above average education. Consequently, the findings are not necessarily representative of the wider Australian population. Furthermore some of the features reported in this document may have changed by the time of publication.

Particular aspects of the research design used in this thesis could benefit from refinement. For example, a longer period of observation might have better captured the wastage of meat temporarily stored in the freezer. Some researchers would criticise the use of bipolar scales ranging from ‘strongly agree’ to ‘strongly disagree’ used to measure attitudes to meat in some survey question in this investigation (Berndsen & Van der Plight 2004, Povey, Wellens & Conner 2001). Such scales might be problematic for people with ambivalent attitudes because they cannot adequately express their feelings, which include both positive and negative evaluations. However, the integration of quantitative and qualitative data has helped to overcome this issue.

This research has focused on the environmental aspects of sustainability. To fully consider sustainability, the social and economic dimensions need to be considered in greater detail. Sampling frameworks targeted a broad selection of people living in Australia who consume meat. Participants from varying cultural backgrounds were included. However, detailed investigation of social, cultural and religious influences on meat consumption are outside the scope of this work.

Consumers have been the focus of this research. Recommendations are specifically focused on action that can be taken to influence the voluntary behaviour of consumers. Complex
problems require action at multiple levels. Consideration also needs to be given to action by government, producers, retailers, marketing bodies and other actors.

5.8 Conclusion
Meat has a heavy environmental impact and the health implications of consuming meat in excess are well established. Consequently, this research set out to use a health and sustainability lens to explore the way meat is used and viewed by some meat-eaters in Australia. It aimed to identify factors that influenced meat-eaters to use meat in healthy and sustainable ways.

This is the only known research to use a mixed methods approach to investigate current consumption and discard practices for meat. The integration of data collected from weighed records, interviews, a survey and a recipe audit has provided important insight into the way meat is used and viewed by some meat-eaters in Australia.

This thesis concludes that participants typically waste meat via overconsumption and avoidable discard. Many participants in this project consumed meat in excess of dietary guidelines for health and emerging guidelines for environmental sustainability. Awareness of the health and environmental costs associated with excess meat consumption was poor. Meat was highly desired and important to meat-eaters in this study and resistance to eating less meat was identified.

Some meat-eaters in this study responded positively to ideas about using sources of meat with potentially lower environmental footprints. However, more typically, participants were observed to be disconnected from the link between meat consumption and the environment. Participants were, however, interested in the idea of natural meat. If this finding applies more broadly, the desire for natural meat could potentially be harnessed to move consumption towards some of these sources. Most meat-eaters in this study indicate some capacity to eat smaller portions of meat and to consume meat less frequently, provided they are given sufficient incentive.

The findings in this thesis do not necessarily extend to the wider population. However, findings from this non-representative sample suggest that improving knowledge, awareness and skills will be an important component of any move to more healthy and sustainable meat consumption. For participants in this research, there is a need to:
• Increase awareness and understanding of the way meat is produced in Australia. The desire for ‘natural’ meat can be used to generate interest in sustainability.

• Increase awareness and understanding of the amount of meat to consume. Improved guidelines that integrate health and sustainability are required. Guidelines need to clearly distinguish between animal and plant protein. Serve sizes need to be more consistent with actual consumption. Weekly guidance is likely to be more useful than daily guidance.

• Improve food literacy relevant to meat – particularly meal planning, storage of excess meat, usage of leftover meat, preparation of low-meat and meat-free meals.

This thesis has documented meat consumption and discard practices and identified influences on these practices. Future research directions need to focus on specific ways to encourage lower meat consumption, including:

• investigation of the acceptability of meat-free recipes;

• investigation of education programs to improve specific food handling skills such as use of the freezer;

• investigation of the optimal composition of dietary guidelines for meat; and

• dietary modeling to develop guidelines that provide better guidance on sustainability.

Australia is a lucky country with an abundance of good quality, safe meat. However, the environmental costs of meat production make current and future predicted consumption practices unsustainable. If findings from this investigation extend to other communities, there is a need to arm consumers with the knowledge, skills and incentive to make better use of meat. Meat needs to be recognised as a high impact food, to be enjoyed occasionally and in small quantities. Further research and effort by consumers with support from influences such as health authorities, marketers, health educators and retailers is required. However, this thesis identifies some potential means for participants to be green, healthy and indulge in meat.
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Appendix A
Ethics Approval

7th April 2010

COMMITTEE FOR ETHICS IN HUMAN RESEARCH

Project number 10-61

APPROVED

Mrs Michelle Minehan
Faculty of Health
University of Canberra
ACT 2615

Dear Mrs Minehan,

The Committee for Ethics in Human Research has considered your application to conduct research with human subjects for the project entitled *How to be green, healthy and eat meat - an investigation into procurement, consumption and wastage of red meat.*

The Committee made the following evaluation:

**Approval is granted until 20/12/2011 the anticipated completion date stated in the application.**

The following general conditions apply to your approval. These requirements are determined by University policy and the *National Statement on Ethical Conduct in Research Involving Humans* (National Health and Medical Research Council, 2007).

1) **You must immediately report to the Committee anything which might warrant review of ethical approval of your project, including:**
   (a) serious or unexpected adverse effects on participants; (b) proposed changes in the protocol; and (c) unforeseen events that might affect continued ethical acceptability of the project.

2) **Monitoring:** You, in conjunction with your supervisor, must assist the Committee to monitor the conduct of approved research by completing and promptly returning project review forms, which will be sent to you at the end of your project and, in the case of extended research, at least annually during the approval period.

3) **Discontinuation of research:** You, in conjunction with your supervisor, must inform the Committee, giving reasons, if the research is not conducted or is discontinued before the expected date of completion.

4) **Extension of approval:** If your project will not be complete by the expiry date stated above, you must apply in writing for extension of approval. Application should be made before current approval expires; should specify a new completion date; should include reasons for your request.

5) **Retention and storage of data:** University policy states that all research data must be stored securely, on University premises, for a minimum of five years. You and your supervisor must ensure that all records are transferred to the University when the project is complete.

6) **Changes in contact details:** You should advise the Committee of any change of address during or soon after the approval period including, if appropriate, email address(es).

Please add the Contact Complaints form (attached) for distribution with your project.

Yours sincerely
Michaela Dalgleish Secretary
Appendix B
Phase One – Text for Advertisement

Do you eat meat? Are you interested in participating in a research project?

I am conducting a PhD project to investigate meat eating in ACT households. I need you and members of your household to be involved. The project runs for seven days. During this time, all members of your household who eat meat will be required to:

- Record all meat that is obtained for your household
- Weigh and record all meat that each household member eats
- Weigh and record all meat that the household discards

In addition, the member/s of the household who makes the majority of decisions about food purchasing and preparation will need to do a face-to-face interview about meat. The interview will take about 30-60 minutes and be digitally recorded.

In order to participate in this study, at least one member of your household must eat meat. All members of the household who eat meat and are aged 18 years or above, will need to provide consent to participate in this study. Parents/guardians will need to consent to provide information about the amount of meat children in the household eat.

Each participating household will be given a $100 gift voucher in appreciation of your time and effort, once all components of data are collected.

If you are interested and want further information, please contact:
Michelle Minehan
Lecturer Nutrition and Dietetics
University of Canberra
6161 2997
michelle.minehan@canberra.edu.au
Appendix C
Phase One - Participant Information Form

Project Title:
An investigation into procurement, consumption and discard of meat in ACT households.

Researcher:
Ms Michelle Minehan
Lecturer Nutrition and Dietetics/ PhD Candidate
BAppSc, MND, APD
Faculty of Health
University of Canberra

Project Aim:
This project aims to investigate meat procurement, consumption and discard practices of ACT residents.

Benefits of the Project:
This project will help the researcher better understand the way that meat is used in Australia. It will directly assist in the development of a survey that is to be administered to a wider population. Findings from this project may influence several groups. For example, the way retailers provide meat, the way health professionals develop education strategies or the way policy makers address health and environmental issues.

General Outline of the Project:
This project will involve an in-depth investigation of approximately 10 ACT households. Participants must eat meat and must not follow any particular dietary regime that impacts on meat consumption (e.g. low protein diet due to kidney disease). Food records and face-to-face interviews will be involved. Data from this project will be published in academic journals and presented at conferences. A summary report will be made available to participants if desired. This project is funded by the researcher’s PhD stipend.

Participant Involvement:
This project requires the involvement of all members of the household who consume meat. A household representative will be required to attend a training session at the University of Canberra or a convenient location negotiated with participants. The training session will take approximately 15-30 minutes. Once training is completed, participants will collect the following data in their own homes for a seven day period

- record of household purchasing of meat
- weighed record of household discarding of meat
- weighed record of individual consumption of meat

Data collected on day one will be reviewed by the researcher in order to ascertain that data is being collected according to protocol and to allow feedback on the data collection method to be provided.
In addition, a face-to-face interview will be conducted with the person/s in the household who makes the majority of decisions about purchasing and preparation of food. Interviews will be held at the University of Canberra or a convenient location negotiated with participants. The interview will discuss influences on purchasing, consumption and discard practices. It will take approximately 60 minutes and will be digitally recorded. Transcripts will be made available to participants before data is analysed.

This is a low risk project and is not expected to cause any discomfort or hazard. Keeping weighed records can be tiresome hence commitment is required from participants.

Participant in this project is voluntary. Participants may withdraw from the project at any time without providing an explanation. Participants may refuse to answer a question at any time. In order to reimburse participants' time and effort, a $100 gift voucher will be given to each household at the end of the data collection period. This reimbursement will only occur when all components of the data collection are completed.

Confidentiality:
Information provided by participants will be treated as confidential. It may be necessary to discuss the analysis of data with the researcher’s PhD supervisors. However, in such cases, all information will be deidentified.

Anonymity:
The principal researcher will be able to identify some data collected from participants. For example, face-to-face interviews are involved. However, anonymity will be maintained when data is shared or findings are published. When findings are presented, pseudonyms or generic descriptors will be used.

Data Storage:
During data analysis, data will be stored as password-protected files on the principal researcher’s computer. Files will be backed up on disc. These will be stored in a locked cabinet. After completion of the project, data will be stored on disc in a locked cabinet at the University of Canberra. All files will be destroyed after a period of five years. All paper copies will be shredded.

Ethics Committee Clearance:
This project has been approved by the Committee for Ethics in Human Research of the University of Canberra.

Queries and Concerns:
Queries or concerns regarding this project can be raised with the principal researcher, Michelle Minehan. If you prefer to speak to someone other than Michelle, please contact Associate Professor Catherine Itsiopoulos.
Appendix D
Phase One - Consent Form

**Project Title:**
An investigation into procurement, consumption and discard of meat.

**Consent Statement:**
I have read and understood the information about the research. I am not aware of any condition that would prevent my participation, and I agree to participate in this project. I have had the opportunity to ask questions about my participation in the research. All questions I have asked have been answered to my satisfaction.

Name…………………………………………………………………………………………
Signature…………………………………………………………………………………….
Date ………………………………………………………………………………………。

A summary of the research report can be forwarded to you when published. If you would like to receive a copy of the report, please include your mailing address below.

Name…………………………………………………………………………………………
Address……………………………………………………………………………………
………………………………………………………………………………………………
Email…………………………………………………………………………………………
## Appendix E

### Phase One - Description of Participants

<table>
<thead>
<tr>
<th>Household</th>
<th>Occupants</th>
<th>Location</th>
<th>Income</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1         | 1 adult   | urban    | middle | Glenda, female, 58 years, POB Australia, retired public servant
|           |           |          |        | Meat procured at farmers’ market and supermarket |
| 2         | 2 adults  | urban    | high   | Connie, female, 32 years, POB Hong Kong, professional
|           |           |          |        | Duy, male, 34 years, Chinese, born Hong Kong, professional
|           |           |          |        | Meat procured at supermarket |
| 3         | 2 adults  | urban    | middle | Jack, male, 70 years, POB UK, retired public servant
|           |           |          |        | Lorna, female, 65 years, POB Netherlands, retired public servant
|           |           |          |        | Both vegetarian for ~20 years before reintroducing meat to diet
|           |           |          |        | Meat procured at butcher |
| 4         | 1 adult   | urban    | low    | Rhoda, female, 58 years, POB Australia, charity worker
|           |           |          |        | Meat procured at farmers’ market and supermarket |
| 5         | 2 adults  | urban    | middle | Kevin, male, 61 years, POB Australia, semi-retired professional
|           |           |          |        | Ann, female, 61 years, POB UK, semi-retired professional
|           |           |          |        | Both have had experience with vegetarianism and Palaeolithic eating in past
|           |           |          |        | Meat procured at specialty provider (biodynamic butcher), supermarket and via hunting |
| 6         | 2 adults  | urban    | high   | Anja, female, 39 years, POB Serbia, professional
|           | 2 children|          |        | Nico, male, 36 years, POB Greece, professional
|           |           |          |        | Meat procured at supermarket |
| 7         | 5 adults  | urban    | middle | Lara, female, 41 years, POB Australia, professional
|           |           |          |        | Mark, male, 42 years, POB Australia, professional
|           |           |          |        | Ann, female, 65 years, POB UK, retired
|           |           |          |        | Bree, female, 18 years, POB Australia
|           |           |          |        | Paul, male, 21 years, POB Australia
<p>|           |           |          |        | Meat procured at supermarket |</p>
<table>
<thead>
<tr>
<th></th>
<th>Adults</th>
<th>Rural/Urban</th>
<th>Income Level</th>
<th>Details</th>
</tr>
</thead>
</table>
| 8 | 3 adults| urban       | low-middle   | Adam, male, 32 years, POB Australia, public servant  
|   |         |             |              | Luke, male, 22 years, POB Australia, student  
|   |         |             |              | Sam, male, 24 years, POB Australia, tradesman  
|   |         |             |              | Meat procured at supermarket |
| 9 | 2 adults| urban       | high         | Dan, male, 49 years, POB Australia, professional  
|   | 3 children|             |              | Tanya, female, 47 years, POB Australia, vegetarian for ~10 years before reintroducing meat to diet  
|   |         |             |              | Meat procured at butcher and supermarket |
| 10| 1 adult | urban       | middle       | Kate, female, 34 years, POB, Australia, professional  
|   | 2 children|             |              | Meat procured via Aussie Farmers Direct and supermarket |
| 11| 2 adults| rural       | high         | Bob, male, 42 years, POB, Australia, public servant + farmer  
|   | 2 children|             |              | Jane, make, 39 years, POB Australia, stay-at-home mum + farmer  
|   |         |             |              | Meat procured via own production |
| 12| 1 adult | urban       | middle       | Liam, male, 21 years, POB Australia, paid student  
|   |         |             |              | Meat procured at supermarket |
| 13| 2 adults| rural       | middle       | Bill, male, 55 years, POB New Zealand, farmer  
|   |         |             |              | Margaret, female, 50 years, POB Australia, farmer  
|   |         |             |              | Meat procured via own production |
| 14| 2 adults| urban       | middle       | Leo, male, 29 years, POB Australia, tradesman  
|   | 1 child |             |              | Sarah, female, 30 years, POB Australia, professional  
|   |         |             |              | Meat procured at supermarket |
| 15| 2 adults| urban       | middle       | Nadine, female, 35 years, POB Australia, stay-at-home mum  
|   | 3 children|             |              | Phil, male, 35 years, POB Australia, tradesman  
|   |         |             |              | Meat procured at supermarket |

*POB = place of birth*
Appendix F
Phase One - Interview Topic Guide and Probes

Procurement:
- How do you shop for meat?
- How do you decide how much to buy?
- Are you able to buy the amounts that suit your family?

Consumption
- How do you decide how much meat to eat?
- How do you think meat fits within a healthy diet?
- Do you have any ideas about how much meat people should eat?
- Do you think the amount that you eat is healthy?
- Do you think that eating too much meat can cause any health problems?

Discard
- What influences you to discard/not discard meat?
- Does discarding meat bother you? – financial, environmental, social justice
- Can you think of any changes that would reduce the amount of meat that you discard?

Production
- How do you imagine a meat such as beef is produced in Australia?
- Differs from USA?
- Grass-fed vs grain-fed?
- Organic/biodynamic
- Is there any more information you would like to know about your meat?
- Who’s responsibility it is?

Environment
- Would you say that you are concerned about environmental issues such as climate change?
- Practices
- Are you aware of any ideas about how eating meat impacts on the environment?

Attitudes to Health and Environmental Arguments
- Some scientific evidence suggests a link between eating a lot of meat and colorectal cancer. How do you feel about this information?
- Some groups are asking for us to reduce our intake of meat, in particular red meat, as they consider it to have a high environmental impact. Meat production uses a lot of water and land, and produces a lot of GHG emissions. Various authorities are saying that we will not be able to consume meat at the same levels as we do now especially as population continues to increase. How do you feel about this information?
Reducing Meat
If you were convinced that it was important to change the way you consumed meat how do you feel about the following options?
- Vegetarian
- Same quantity but less frequently
- Same frequency but less quantity
- Swap red meat with other types of meat (chicken, fish, rabbit, kangaroo)
- Tongue-to-tail eating
- Greater use of meat alternatives (e.g. Quorn)
## Appendix G
### Phase One – Sample of Coding Map

<table>
<thead>
<tr>
<th>Category</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
</table>
| Procurement               | Disconnect | I don’t know much about how meat is produced  
I can’t imagine they’re kept locked up like battery hens and only fed grain |
|                           | Don’t want to know | I don’t want to know how meat is produced  
I don’t like thinking about where it comes from … |
|                           | Natural    | I want my meat to be natural  
I think it would be better if we could eat natural animals I suppose…. |
|                           | Confusion  | I’m not sure about some elements of production  
But the restaurants all say that grain-fed is the really good stuff. It seems like a bit of a contradiction. I’m confused. |
|                           | Trust in Australian production | Australian meat is OK  
I think it’s not quite as horrific as the American situation… |
|                           | Ambivalence | I know about meat production but I don’t care  
To be honest we cold probably do more for the planet than give up meat… |
|                           | Concern    | I don’t like how meat is produced  
Grain-feeding cattle to us is not a natural way to produce meat at all… |
Appendix H
Phase Two – Text for Advertisement

Do you eat meat? Are you interested in participating in a research project?

My name is Michelle Minehan and I am an academic and PhD student at the University of Canberra

I am conducting a PhD project to investigate meat eating in ACT households. I am using an online survey to collect information about how Australians use meat and think about meat. The survey consists of 25 questions and should take approximately 15 minutes to complete. To participate, you must consume meat and must not be following any dietary regime that influences meat consumption (e.g. low protein diet due to kidney disease). You can withdraw from the survey at anytime. At the end of the survey you will be asked to agree to a statement of consent before submitting your responses. All responses will be confidential and anonymous.

All respondents who complete the survey will have the opportunity to win a $100 gift voucher via a random draw. If you wish to be included in the draw and/or receive a summary of findings from this research, you will be asked to provide your contact details in a separate screen. This information will be separated from your survey responses. Your contact details will not be shared with any other party. Once the draw is complete, contact details will be destroyed.

If you have any questions or concerns, please contact:
Michelle Minehan
Lecturer Nutrition and Dietetics
Faculty of Health
University of Canberra
0435 054 760
michelle.minehan@canberra.edu.au

To take part in this survey, please click the following link and follow the prompts:
http://canberrahealth.az1.qualtrics.com/SE/?SID=SV_3lOx8f7Z193rOle

The survey is open from 22 August 2011 to 8 September 2011
Appendix I
Phase Two - Survey Participant Information Sheet

Project Title:
How to be green, healthy and eat meat – an investigation into procurement, consumption and wastage of meat.

Researcher:
Ms Michelle Minehan
Lecturer Nutrition and Dietetics/ PhD Candidate
BAppSc, MND, APD
Faculty of Health
University of Canberra

Project Aim:
This survey is part of a PhD project that aims to investigate meat procurement, consumption and discard practices of Australians. Specifically, this survey aims to examine the way meat is used and viewed by consumers in order to identify ways to encourage reduced meat consumption.

Benefits of the Project:
This project will help the researcher better understand the way that meat is used in Australia. Findings from this project may influence several groups. For example, the way retailers provide meat, the way health professionals develop education programs or the way policy makers address health and environmental issues.

General Outline of the Project:
This is an online survey. You will be asked questions about your knowledge, attitudes and behaviors related to meat. This project is funded by the researcher’s PhD support grant.

Participant Involvement:
To participate you will need to complete an online survey. You must be aged 18 years or older and must eat meat. The survey has 20 questions and will take approximately 20 minutes to complete. Participation in this project is voluntary. You may refuse to answer any question and may withdraw from the survey at any time by selecting ‘exit this survey’. In appreciation of your time and effort, you will have the opportunity to enter a random draw to win a $100 gift voucher at the end of the survey.

Confidentiality and Anonymity:
Your responses will be anonymous. IP addresses will not be stored. If you choose to participate in the draw for the gift voucher, you will be directed to a separate screen. Your contact details will be separated from your survey responses. Contact details will not be shared with any other party. They will be destroyed once the prize is awarded.
**Data Storage:**
During data analysis, data will be stored as password-protected files on the principal researcher’s computer. Files will be backed up on disc. These will be stored in a locked cabinet. After completion of the project, data will be stored on disc in a locked cabinet at the University of Canberra. All files will be destroyed after a period of five years. All paper copies will be shredded.

**Ethics Committee Clearance:**
This project has been approved by the Committee for Ethics in Human Research of the University of Canberra (Project No. 10-61)

**Queries and Concerns:**
Queries or concerns regarding this project can be raised with the principal researcher, Michelle Minehan. If you prefer to speak to someone other than Michelle, please contact my supervisor, Associate Professor Catherine Itsiopoulos.

Ms Michelle Minehan  
Lecturer Nutrition & Dietetics/PhD Candidate  
Faculty of Health  
University of Canberra  
Bruce ACT 2601  
Ph: 0479 047 729  
Email: michelle.minehan@canberra.edu.au

Assoc Prof Catherine Itsiopoulos  
Head of Department of Dietetics  
Faculty of Health Sciences  
Latrobe University  
Victoria, 3086  
Ph: 03 9479 6032  
Email: c.itsiopoulos@latrobe.edu.au

PLEASE KEEP THIS INFORMATION SHEET FOR YOUR OWN RECORDS
Appendix J
Phase Two – Survey Questions

Consent: I have read and fully understand the participant information sheet. I understand that my participation is voluntary. By clicking below, I am indicating that I agree to participate in this study.

| Statement Ticked | Skip logic – proceed to question 1 |
| Statement Not Ticked | Skip logic – proceed to message – In order to participate in this survey you must read the Participant Information Sheet and agree to the consent statement – back to Participant Information Sheet |

ELIGIBILITY

1. Are you 18 years or older?
   - Yes
     - Skip logic – proceed to Q2
   - No
     - Skip logic – proceed to message - I’m sorry but you need to be aged 18 years or over to participate in this survey. Thank you for your interest.

In this survey the term ‘meat’ refers to beef, lamb, pork, chicken, turkey, duck, kangaroo, rabbit, veal and venison. It also refers to products made from meat e.g. sausages, burgers, ham, bacon, salami, cold cuts. The term ‘meat’ does not include fish or eggs.

2. Do you eat meat?
   - Yes
     - Skip logic – proceed to Q3
   - No
     - Skip logic – proceed to message - I’m sorry but you need to eat meat to participate in this survey. Thank you for your interest

SURVEY

A: Awareness
This part of the survey aims to assess awareness of links between meat, health and the environment.

1. Are you aware of any health risks associated with eating too much meat? Please list as many as you can think of.
2. Are you aware of any ways to eat in a more environmentally friendly way? Please list as many as you can think of.


3. In your view how many times a week should meat be consumed in a healthy adult diet?
   - Never
   - 2 or less times a week
   - 3-4 times a week
   - 5-6 times a week
   - Everyday

4. In your view what quantity of meat is considered a healthy serve for an average adult?


B. Attitudes
The following questions aim to find out how you feel about meat, health and the environment.

5. Please rate your level of agreement with each of the following statements:

<table>
<thead>
<tr>
<th></th>
<th>1 Strongly Agree</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humans are meant to eat meat.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat satisfies me more than other foods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meat is the most enjoyable part of the meal.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vegetarian diets do not provide enough nutrients.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meals without meat do not taste good.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I like to know as much as possible about how the meat I eat is produced.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would eat less meat to protect the environment.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I would eat less meat to improve my health.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
6. To what extent are the following important to you when choosing meat?

<table>
<thead>
<tr>
<th></th>
<th>1 Very Important</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 Not Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taste</td>
<td></td>
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<tr>
<td>Cost</td>
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<tr>
<td>Convenience</td>
<td></td>
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<tr>
<td>Environmental impact</td>
<td></td>
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<tr>
<td>Humane treatment of animals</td>
<td></td>
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<tr>
<td>Chemical-free</td>
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<tr>
<td>Hormone-free</td>
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<tr>
<td>Produced locally</td>
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<tr>
<td>Organic</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Free-range</td>
<td></td>
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<td></td>
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<tr>
<td>Low fat</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Other (open field)</td>
<td></td>
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</tbody>
</table>

C. Current Behaviour
The following questions ask about the way that you currently consume meat.

7. How frequently do you eat meat for the following meals?

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>2 or less times a week</th>
<th>3-4 times a week</th>
<th>5-6 times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evening meal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snacks</td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

8. The following image shows a 65g portion of meat. (image inserted) How do you feel about this portion size for yourself?

- Much too small  
- Too small  
- Suitable  
- Too large  
- Much too large  
- Image did not display
9. The following images show different portions of steak. What is the smallest amount of steak you would be satisfied to eat for a single meal?

<table>
<thead>
<tr>
<th>50g (image inserted)</th>
<th>100g (image inserted)</th>
<th>150g (image inserted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200g (image inserted)</td>
<td>250g (image inserted)</td>
<td>300g (image inserted)</td>
</tr>
<tr>
<td>350g (image inserted)</td>
<td>400g (image inserted)</td>
<td>450g (image inserted)</td>
</tr>
<tr>
<td>Images did not display</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

D. Future Behaviour
The following questions ask you to imagine that there is a need for you to eat less meat.

10. If you felt there was a need to eat less meat, how frequently would you be willing to eat meat-free for the following meals?

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>2 or less times a week</th>
<th>3-4 times a week</th>
<th>5-6 times a week</th>
<th>Daily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breakfast</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lunch</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Evening meal</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Snacks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11. If you felt there was a need to eat less meat, how many days each week could you go without eating any type of meat for the entire day?
- Never
- 2 or less times a week
- 3-4 times a week
- 5-6 times a week
- Daily

12. If you were to reduce the amount of meat that you eat, how likely are each of the following options?

<table>
<thead>
<tr>
<th></th>
<th>1 Very Likely</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 Very Unlikely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eat meat-free meals more frequently</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eat smaller portions of meat</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Be a ‘Day Time Vegetarian’ (i.e. eat meat for dinner only)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Be a ‘Weekday Vegetarian’ (i.e. eat meat on weekends only)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
13. What would make it difficult for you to eat less meat?

14. What would help you to eat less meat?

15. If you were to eat less beef, lamb or pork how likely would you be to replace these meats with the following?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Likely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not Likely</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Kangaroo</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Rabbit</td>
<td></td>
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<tr>
<td>Vegetarian meat alternatives e.g. tofu, vegie burgers</td>
<td></td>
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<tr>
<td>Lentils</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbohydrate foods such as pasta, potato or rice</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Vegetables other than potato</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Other (open field)</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

16. Are you?
- Male
- Female

17. What is your year of birth
- Open field
- prefer not to say

18. What is your yearly household income before tax?
- Up to $15 600
- $15 600 – $26 000
- $26 001 - $36 400
- $36 401 - $52 000
- $52 001 - $78 000
- $78 001 - $100 000
- over $100 000
- Prefer not to say
19. Which country did you grow up in?
   • Open field

20. What is your highest level of education?

You have now completed the survey. If you would like to make any comments about this survey, please make them here.

If you wish to be entered into the draw to win a $100 gift voucher, please select the link below. You will be directed to a new screen to provide your contact details. It will not be possible to link your survey responses to your contact details. Your contact details will not be shared with any other party. They will be destroyed once the prize is awarded.

<table>
<thead>
<tr>
<th>Do you wish to enter the draw for a $100 gift voucher?</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Yes</td>
</tr>
<tr>
<td>Skip logic – proceed to Contact Details Screen</td>
</tr>
<tr>
<td>• No</td>
</tr>
<tr>
<td>Skip logic – proceed to message – You have indicated that you do not wish to enter the draw for a $100 gift voucher. Thank you for participating in the survey.</td>
</tr>
</tbody>
</table>
Appendix K
Photographic Record of KJ Analysis

1. Problems, contributors, opportunities and challenges identified.

2. Contributors collapsed, combined or expanded.
3. Problems, contributors, opportunities, challenges sorted into linked ideas.

4. Influence of barriers incorporated