Chapter One

Literature review of sustainable urban travel concepts – problems, policy, planners, implementation and research.

This chapter outlines the environmental, social and resource depletion problems associated with high-level urban car use, then details some current planning responses. That leads to a theoretical analysis of the underlying behaviour and choices urban dwellers make, highlighting the importance of context, especially price signals. The final section of this chapter details reasons for the Cairns/Townsville urban travel study.

As reductions in petroleum supply draw near, prices will inevitably rise, causing social dislocation and diminished choice. To forestall this, and reduce some environmental impacts, governments globally are advocating principles of Ecologically Sustainable Development (ESD). As it relates to urban travel, ESD considers more integrated urban land use, greater reliance on public transport, and the facilitation of urban walking and cycling. In most countries there are now changing concepts and technology, infrastructure, land use and behaviour, all aiming to develop or nurture sustainable urban travel. These initiatives and planning efforts to meet needs locally may help reduce urban travel.

The urban travel necessary to support the widespread urbanisation in the past 50 years has been increasingly powered by petroleum. Since the early 1970s, environmental and quality of life concerns have lead to discussions about urban sustainability. This thesis focuses on personal urban transport energy use, motivated by the need to plan for the post-petroleum era. It considers whether urban dwellers are prepared to reduce solo car use through changing travel patterns and less travel-dependent service provision.

There is increasing global recognition of the need for a paradigm and behavioural shift toward principles of ecologically sustainable urban development (AMCORD 1995). Government policy is trending toward user-friendly cities with minimal reliance on

cars for personal mobility (Hamer 1994). Unfortunately, the actual trends of car and petroleum use are in the opposite direction (Bly 1996).

Newman and Kenworthy believe that "reduced automobile use is virtually certain to be a major issue for nations and cities in the future." (1989, p 5). It is now seen as a major issue in overarching policies of Ecologically Sustainable Development, a near-global planning requirement. Car-reduction strategies are now embedded in strategic planning goals, and otherwise expressed by planners and policy makers (TTSP 2000).

The context of evolving urban form and transport

The context for this thesis begins with the evolution of our species, our urges for mobility, settlement, communications and our ability to manipulate the environment. Geography is the study of humans in the landscape, considering time and space, and the emergence, behaviour and impacts of our species in relation to the rest of nature.

Humans emerged as a distinct species about three million years ago (Kates 1994) and have lived in cities of more than 50,000 people for less than 5,000 years (Cadman and Payne 1990). Our emergence as agricultural, urban and industrial agents has been rapid and spectacular; our global spread and impacts on prior natural systems profound. This matters because we need to acknowledge how our current situation so profoundly lacks precedent, that our social, environmental and urban evolution is so unknowable. A recent global desire for sustainability has been acknowledged (World Commission on Environment and Development 1987) and policy developed since then.

We began using electricity and petroleum about 100 years ago, enabling the rapid evolution of our current 'Westernised' food-provision, mobility patterns and urban form. At six billion now, human population is predicted to double by the year 2050 (Population Reference Bureau 1990), more than half in the urban setting. Increased life-style expectations demand increased liquid fossil fuel for transport use.

Until about 170 years ago, land travel was achieved by walking or animal power (eg Turton

1992). The first commercial stream trains ran in 1825, ' horse-less carriages' in 1885 (Williams 1992; 258) and electric trams in 1885 (Wells 1970). Car use only became widespread after World War II (Banister and Banister 1995), reducing urban density of Australian cities by half over the twentieth century (Manning 1984).

The following Section 1.1 considers the number of cars now in use globally and the hidden or external costs associated with their use. This section establishes a link between fuel prices and resultant levels of car use, then in turn links car use to issues of future inability to fully meet future fuel supply from depleting reserves, along with pollution concerns.

1.1 Problems with the current levels of car use

Many cars used often

Globally, about 130,000 new cars are produced every day, placing 25 million cars on British roads by 2000 (Williams 1992; 260). Because it is well documented, car dependence in Britain provides a good global example of the problems all countries are now facing. In Britain only about 20% of all private trips are journeys to work. About half of all journeys in Britain are done by car, using 90% of the total urban travel energy. Walking and bike riding use only 1% of total travel energy to make 40% of total trips (Banister and Banister, 1995). In Australia "our urban areas are now dominated by the private automobile, which has been the key transport technology this century and which today accounts for 90% of all motorised passenger movement in our capital cities" (AURDR, 1995a, p 29).

Costs of widespread car use

Direct costs of car use

The external and total costs of transport are large. For example, in the USA in 1989, transport costs made up 20% of the GDP: $700B/year, adding $50B to their 1990 trade deficit (Gordon 1991). In its extreme, "The American Dream" has encouraged the 12 million people in Los Angeles to own 8 million vehicles, driving 100 million miles every day (Gordon 1991; 264). Extensive analysis of fuel costs in different countries has found clear relationships between fuel costs, total per capita driving and fuel efficiency of cars: the cheaper the fuel, the more we drive, in less fuel efficient cars (Schipper *et al.*, 1993). In the US, there is an annual

increase of 2.6% in petroleum directly used for transport (Gordon 1991). Car use has massive direct costs as well as indirect costs.

Indirect costs of car use include issues of energy conservation, fossil fuel depletion and atmospheric build-up of carbon dioxide on a national and international level. These concepts developed after the 'oil crisis' of the early seventies. Our massive use of fossil fuels shows little regard for the rest of the biosphere (Nash 1989). Global output of gaseous pollution is more than 30 billion tonnes per year (Serpone *et al.*, 1992). To try to conceptualise the magnitude of our impact: people in the Brisbane growth corridor travel 45 million vehicle Kilometres every working day (Queensland Government 1996, p7), burning about 4.5 million litres of fuel per day.

Price of fuel

Part of the attraction of car use is that the full or ' external' costs of petroleum use such as road building, social dislocation, pollution and cost of collisions are not internalised (fully and directly paid for by users). The consequent low use costs are causing rapid resource depletion and environmental damage (Schipper *et al.*, 1995, Stern 1992). It is argued that prices should reflect the full economic costs of energy (Schmidheiny 1992, Neale 1995). Respondents in a 1993 domestic energy survey identified fear of electricity price rises as the most likely of eight events which would cause a reduction in energy use (Goudie 1995), converging with the literature on energy underpricing (eg Wall 1989; 18, Diesendorf 1992, Jarach 1989, Business Council 1991, Greene 1992).

Among Western nations, where the comparable price of petrol may differ by a factor of four, Schipper *et al.,* (1993) report a clear correlation between petroleum costs and per capita distances driven. This view concurs with economic theory of price reflecting the tension between supply and demand (Tientenberg 1992). There is a relationship between cost and use of motor fuels (Boyd and Uri 1994), where countries like Italy with very high petroleum prices use far less per capita than countries of low priced petroleum like the USA. This generalisation remains when otherwise similar countries are compared.

Globally, most planning theorists now see the great environmental, resource and social costs associated with our ' automobility' (Kuiper 1993). There is evidence that sections of the public, at least in the USA, are voicing resentment at ' external' costs of car-use among American residents. Hardwick (1994; 339) reports widespread dissatisfaction among some US citizens with the resultant car-based low density urban form. The development of cities present major environmental demands, best solved within cites (eg Gossop and Webb 1995; 129). Concern over global depletion of fuel reserves, accelerated through underpricing, is coupled with the effects of greenhouse gases we discharge into the atmosphere. (Vant- Hull 1992).

Greenhouse Gases

Analysis of polar ice core samples show that the atmospheric concentration of carbon dioxide since the beginning of the industrial revolution has increased from 280 to more than 360 parts per million at present, increasing exponentially (Staffelbarch 1991). The use of fossil fuels and the release of greenhouse gases is magnified because our per capita consumption of fossil fuels is increasing and the global population is increasing by 93 million per year.

If predicted global warming and major climate change caused by greenhouse gas emissions are to be avoided, the Intergovernmental Panel on Climate Change concluded that 'Carbon dioxide, nitrous oxide and CFCs would require immediate reductions of over 60% to stabilise their concentrations at today' s levels.' (NGAC 1991, p 30). The fossil fuel industry is becoming more efficient, so that the amount of useable energy recovered is maximised for each unit of fossil fuel consumed. Governments are attempting to reduce carbon dioxide emissions, but in 1990, 44% of the 276 million tonnes of the carbon dioxide emitted in Australia came from the production of electricity (Greene 1990). Of the greenhouse gases produced in Australia, 44% is carbon dioxide, with CFCs, methane and nitrous oxide each contributing about 20% (Walker 1990).

The most economically efficient way to link pollution with resource depletion is probably a carbon tax, based on the ' user pays' principle. "This approach, however, is unlikely to be adopted in the near future. The external cost of CO_2 emissions is not known and may be unknowable, so it is not possible to determine the tax level that would internalise the cost"

(IEA 1993, p 19). Further, reducing carbon dioxide emissions is politically difficult. Burning fossil fuel is linked to economic growth and greater personal freedom.

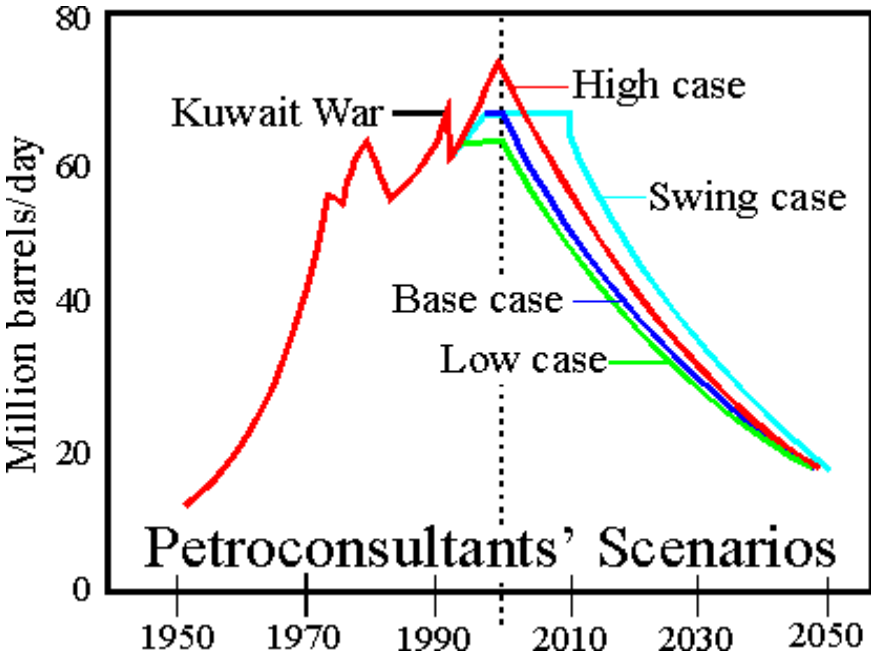
Some authors are alarmed that possible effects of climate change are largely ignored by more conservative policy makers (eg Azar 1994, Beder 1993, and Blowers 1995). International agreements and changes at national level are slowly addressing these entrenched problems, but research is needed to clarify publicly preferred change.

Australia's near-total dependence on petroleum for food and mobility makes it particularly vulnerable unless there are gross reductions in transport energy consumption.

Fuel depletion, urban behaviour and structures

From little use of petroleum 100 years ago, global energy production has increased 50% in the past two decades (World Resources Institute 1992). Energy use exemplifies long term issues of Ecologically Sustainable Urban Development. The total consumption of commercial energy in the developing countries tripled during the past 20 years (World Resources Institute 1992; 147). Petroleum is at the leading edge of unsustainable energy use.

Figure 1.1.1 Projected world oil production



From: http://dieoff.org/page116.htm Aug 2000.

There is wide disagreement about the length of time liquid fossil fuel extraction can continue, with most sources agreeing at around 40 years (Grob 1992, Williams 1993). A general consensus is that a gap between possible supply and likely demand will occur by about 2007 (Campbell and Laherrere 1998, Williams and Collins 1997, see Figure 1.1.1). Identifying when demand will outstrip supply has more meaning than fuel ' running out' , although both concepts are linked to price signals. An extreme view of the urgency to change from a 'business as usual scenario' is that it is anticipated that most petroleum will be burned within 20 years, while the wholesale conversion of coal to fluid fuel will see most coal used within 80 years (Serpone *et al.* 1992).

Some commentators believe that if current trends continue, only about 20% of recoverable fossil fuels will be left within 40 years (Holdren 1990). Other sources believe reserves will last for at least another 100 years (World Resources Institute 1992). All sources agree that current patterns of use of petroleum will not be possible within decades.

This review is focused on urban travel because petroleum is a non-renewable resource, with annual consumption rates increasing globally by about 3% (Banister and Banister 1995, Weirauch 1995). In Australia in 1990, petroleum-powered transport used 25% of all energy consumed (BTCE 1995; 13), releasing about 13 tonnes of carbon dioxide per household (AURDR 1995b; 42). Cars use 57% of all transport fuel (BTCE 1995; 14), about 14% of the total energy used in Australia (AURDR 1995b; 42).

This is why urban planners question " the ability of fossil-based oil and natural gas to energise a still-developing economic and social system ... past 2020 AD" (Williams, 1992, p 95). We are encouraged to develop "an ecologically sustainable transport system" (McNamara *et al.*, 1993, p 116) by reducing "our unsustainable dependence on car travel " (AURDR 1995a, p 3). Car travel accounts for 80 - 90% of energy used in urban trips (Pucher 1995; 100).

With no alternative fuel likely to be as easily gained as petroleum, many authors believe that petroleum will become scarce within 60 years (Grob 1992, Holdren 1990, Wall 1992, Kuwano 1992 and Serpone *et al.*, 1992). There is near-consensus that availability of petroleum will decline after 2025 (eg Black 1996). OECD countries use about 80% of current motor fuel consumption, but use in Asia is escalating (Serageldin 1996).

One difficulty in reducing car use is that acceptable strategies remain unclear. For example, it is not accurate to say that rail transport is always the most efficient form of mass travel, although it may be best suited to urban peak travel (Farrington 1992). A wide literature review shows that many political decisions are based on belief structures, or paradigms. This is why these core issues to our collective decision making behaviour are dealt with in detail later in this chapter.

Black (1996) defines sustainable transportation as "satisfying current transport and mobility needs without compromising the ability of future generations to meet these needs" (Black 1996, p 3). Black reports that the US government is committed to stabilising private vehicle use, and encouraging more transit oriented mobility.

The Australian government is grappling with the same issues, given that cars represent 84% of all road vehicles, with about 8.5 million cars on our roads, travelling 126 billion Kilometres in 1993 (BTCE 1996). Public transport provided about 8% of our total urban travel, with about 500,000 new passenger cars registered in Australia during 1995 (BTCE 1996). Solutions to petroleum dependence are multifaceted, from more efficient use and replacement fuels (Sinor 1996), changed urban form (Banister 1996), changed behaviour (Fox 1995), and fuel prices which "fully reflect external costs." (Serageldin 1996, p 21).

1.2 Global and Australian responses to high car dependency

Government policy and policy development have become very clear about aspects of sustainable urban development. The following passage provides one of many possible examples. "Firstly, policies must be directed to a long-term change in the urban structure of Australian cities, aimed particularly at reducing our unsustainable dependence on car travel. Secondly, we need to improve the environmental performance of different sectors of the urban economy including specific measures to improve air and water quality, increase energy efficiency, reduce solid waste, and minimise the impact of coastal urbanisation." (Australian Urban and Regional Development Review 1995a, p 3).

Globally, there is growing consensus on the need for ecologically neutral human systems and processes (Rodger 1995), mainly recognising the unbreakable links between price signals, urban land use (Drakakis-Smith 1995), resource provision and use, human attitudes and transport choices available (Stilwell 1993, Lienbach 1995).
The growth-based syndrome of the past is generally destructive to nature (Pucher 1995, Clarke *et al.,* 1995). Now, however, it seems quite likely that rapid changes may lead to "small-scale, convivial, caring society" (Rodger 1995; 57). Nearly all cultures embrace

extended mobility. In modern times, with the use of petroleum, "the introduction of faster transport generally results in people travelling further" (Manning 1984, p 8). There is also a clear link between individual life-style and mobility, with car ownership often linked with personal freedom (Town 1980; 16, Brindle 1995). By 1996 it was agreed that "the private car is one of the most dramatic developments of the current century" (Isaac 1996, p 51). This section shows what governments are doing, and how research is helping reduce petroleum dependence.

Burning fossil fuel has transformed our work, urban fabric and dynamics for the last two centuries. This is especially true of petroleum use for the last fifty years, providing the geographer's time frame for our rate of change and dependence. Urban transport is now viewed as inseparable from urban infrastructure (Turton and Knowles 1992; 82), environmental costs (OECD 1986, Kuiper 1993), lost open space (AMCORD 1995) and stressful social patterns (McNamara *et al.*, 1993;116). Urban transport is intimately linked with traffic congestion (Delle Site and Filippi 1995), traffic and communications technologies (Troy 1995), paradigms encompassing the political, planning and public arenas (Rodger 1995), mixed land use (Binning 1995) and changed urban behaviour (Williams 1992, McClintock 1992, IEA 1993). The advocacy of nearly all published planners now is for 'urban villages' (Troy 1990, Rodger 1995), variously called "more self sufficient local communities" (Stanley 1995, p 69), neotraditional neighbourhoods (Ryan and Mc Nally, 1995), or traditional urban development (DBIRD 1995b).

Until recently, car-based urban development was producing "World War II suburbs." (Ryan and Mc Nally 1995, p 101), because 'on-ground' decision-makers denied there is a problem (McKenna 1993). They were unable to accept the massive impact of "car mobility on the environment" (Kuiper 1993, p 82). The Cairns and Townsville urban travel research embraced the perspective that car use has greatly transformed urban design and behaviour.

Manning (1984) points out that although there are gains to individuals by increased use of cars, their *en masse* use may cancel out individual benefits through unacceptable congestion. This creates a dynamic tension between the public and private means of mobility.

Sociologists note that low mobility is only a problem where urban form limits access on foot or by bus (Town 1980). This implies that many of the ' transport disadvantaged' referred to below exist because their household location is remote from goods and services sought. This aligns with the view that urban travel is a derived demand (Fox 1995).

Because the spectre of petroleum depletion is a global issue, the British Department of Transport, for example, plans to double the price of petrol by 2005, and quadruple pushbike use in urban areas (Hamer 1994). By 2001, the UK Government had abandoned this goal because of public protest (Rye 2001 *pers. comm.)*, indicating the tenuous link between environmental concern and personal cost developed throughout this thesis. A core theme of this thesis is an exploration of the gap between environmental concern, policy and implementation, fully developed in Chapter 6.

The current view in Germany is that, "after the failed attempt of the 1960s to develop cities according to the need of the automobile, ... a division of tasks among different means of transport could look as follows: preference of bicycles and walking for short distances, (eg, within neighbourhoods), and preference of public transit in areas and at times of high travel demand" (Kirchhoff 1995, p 1). In less developed countries, rather than build more freeways and suburbs, policies now advocate for older urban areas to engage in "participation, restoration, and rehabilitation" (Lienbach 1995, p 338).

Social momentum - Australian urban development and travel.

The history of urban form and transport in Australia is a rich one. It involves a steady decline in the number of people per hectare, and per dwelling. There have been various government efforts to nurture, then often dismantle public transport systems (Manning 1984). Manning highlights how rapidly Australian cities have changed from walking to mechanised transport over the last hundred years, with the populations of Sydney and Melbourne increasing about 12-fold, but their areas increasing about 30-fold. In the 1880s, Melbourne "more than doubled" in area, population and number of dwellings (Manning 1984, p 73). Issues of declining densities, with their resource, social and transport implications will be considered in detail in following sections.

Sydney continued to grow in the 1890s, supported by the construction of comprehensive tram and railway networks. Manning (1984) believes that the first limits to fringe expansion for Melbourne and Sydney were reached by the 1930s, when the trade-off of home location and work travel (of more than an hour) was reached. Manning argues that a core issue of travel decisions is the time taken to travel, which must include the walk/wait time for public transport.

Australian Government urban policy

From Federal Government initiatives in 1990, Australia has engaged in a public participation process, developing concepts and implications of ecologically sustainable development, and how to implement them (Ecologically Sustainable Development Working Groups 1991a+b, DPIE 1992). This process has generated a large output of government policy on urban issues in Australia (eg AMCORD 1995, AURDR 1995a+b, BTCE 1995, FNQ2010 1998 and TTSP 1997, 2000).

The new urban paradigm is, perhaps, best expressed as : "Think globally, act locally, respond personally" (AMCORD 1995 PnP 3, p 1). From all decisions of urban development being in the hands of ' experts' (Davidson 1995), the government policy now is to develop a dialogue with local residents, through public participation (Ford 1993). The Australian Model Code of Residential Development (AMCORD, a Federal initiative born of a lengthy public consultation process, based on ESD principles, to define the parameters of sustainable urban settlement. State and local governments were required to adapt and adopt AMCORD) considers that, despite the prior dominant social paradigm, "there must be a response to the global issue of energy consumption, air and water quality, and species conservation" (AMCORD 1995 PnP 3, p 1).

The AMCORD approach recognises that the first barrier to ecologically sustainable urban development is an inability to fully embrace the quantum change needed to develop sustainability, by supporting the status quo. Strategies to counter this include "consciousness raising campaigns, public participation in decision-making, demonstration projects and

incentives and disincentives" (Rounsefell 1994, p 46). There is some evidence that the needed quantum shift is occurring with the beginnings of a move away from the "car oriented development in our cities" (Australian Urban and Regional Development Review 1995b, p 46).

Sustainability in Canberra

Canberra is a greenfields city, started from sheep country early in the twentieth century (NCDC 1984). A central Canberra design study in 1994, following three years preparation by the National Capital Planning Authority (NCPA), using processes of public participation, set out to create a model city (Prattley 1994). There was one fleeting reference to economically sustainable development in the public discussion document, but no mention of ecologically sustainable development. This section highlights the gap between clearly stated government policy, and how rarely it is translated into government action. 'AMCORD' developments appear to have little relationship to AMCORD principles of sustainability except the small lot sizes, often serviced by narrower, cheaper roads.

A report from the *Jerrabomberra Valley national ideas competition* (Canberra) outlines the major hurdles involved in putting ESD principles into urban practice, as indicated in the prior section (Rounsefell 1994; 46). This brief Canberra section will consider Gungahlin, an AMCORD development, in some detail. A variation to the Territory plan was passed in 1995 (ACT Planning Authority 1995a+b), helping to define Gungahlin, a greenfields development as an outlying node of Canberra. In a vast sea of dry sheep paddocks, there now exists a large patch of very dense and expensive housing, with one narrow road connecting it to the rest of the Australian road network.

In the general principles defining Gungahlin (Commonwealth of Australia 1989), there was an undertaking for the "public transport system to be an integral part of the structure" (ACT Planning Authority 1995b, p 14). A reserve was set aside linking the town centre with Civic, with the option of a light rail (tram) route (Commonwealth of Australia 1989). This route is referred to in further official documents (ACTPA 1995b). There was a widespread belief that the tramway would accompany the

initiation of house building in the newly designated town.

An academically credible and professionally produced booklet sported a detailed colour sketch of a multi carriage light rail, destined, according to its front notice, for Civic (Pinter and Ineson 1992). Costing had been done on every aspect of the tram's operation, including the ticket machines (p50) and a time schedule for the construction phases. At time of writing, nothing had been done. Anecdotally, the realistic price of $50 million was off-putting to the public authorities concerned, so there is great congestion in the peak surge in and out along the two lane road connecting Gungahlin with Canberra. Sustainability requires a whole system approach in space and time. Although 'integrated' is used in many of the literature titles on post-1990s urban planning, the development of housing and public transport do not yet appear integrated in Gungahlin.

Sustainability in Adelaide, Perth and Melbourne

Adelaide is an example of a planned settlement (Hall 1989), upgraded periodically, and conceived for many decades on the principles of nodal development (Hutchings 1993). Rail extensions have featured in recent times in Perth (James *et al.*, 1995), and the city centre has been revitalised to make it less freeway dominated, reintroducing development at the human scale (Hedgcock and Yifachel 1992).

Based, like Adelaide on a central grid, Melbourne then grew along the rail routes, tending to leave 'green wedges' between the growth corridors (Mc Loughlin 1992). Some research linking environmental quality to urban travel has been conducted in Melbourne (Troy 1972, 1982). Melbourne, since 1992, has undertaken extensive freeway extensions, linking through a major underground network near the city centre. There has also been some extension of the integrated tramway system.

Sustainability in Sydney

Sydney has embarked on a strategy of sustainable development (Moseley 1995, NSW Department of Planning, 1995), using social and growth indicators to try and manage growth by increasing the use of public transport, and making car use less attractive. The strategy

concedes that more provision for bicycles is needed, that major roads act as barriers to pedestrian traffic, and that Sydney has a bad record for pedestrian fatalities (South Sydney Council 1995). Like so many others (eg Urban transport strategy group 1971), this report stresses the "interrelationship between transport and urban planning" (SSC 1995, p 35).

The section on land use and transport has the goal to "develop a sustainable environment where-by activities are located close together and walking, cycling public transport and sharing private vehicles are the main modes of travel" (SSC 1995, p 75). This clearly embodies the theoretical concept to localise daily human activities. It is seen that enhanced pedestrian use will be fostered by shade trees in summer, seats, shelters, adequate lighting and water fountains, along with clear designation of pedestrian areas, and actively make ' vehicular transport less attractive' (p83).

Sustainability in Cairns and Townsville

The two study areas are engaged in ESD processes: Cairns with the Regional Strategic Plan (FNQ 2010, 1995, 1998, 2000). Townsville is undergoing a regional strategic plan (TTSP 1997, 1998, 2000), an inner urban renewal program, and efforts to designate 3000 Ha for future heavy industrial land (TILP 1997). All processes are ESD because economic, environmental, social, energy and transport considerations are ostensibly given equal weight. An urban hierarchy of nodes forms the basis for development in both centres. The TTSP has designated a "hierarchy of major centres to accommodate growth to 2011" (p16). It is necessarily developed from the existing urban form, with the CBD forming the regional centre, then the three existing major nodes are identified and designated as sub-regional centres. Three further 'district centres' are defined (not presently developed), finishing with 14 'neighbourhood centres'. This is a very explicit acceptance and expression of current urban theory of 'nodalist' urban form.

As 'proto-cities', Townsville and Cairns may become examples of changes to urban form, mobility and land use patterns. There is great scope for 'retro-fitting' suburbs so that many residents can achieve their private and work goals with less reliance on private automobiles. This retrofitting will generate abundant employment while fostering sustainable settlements. The challenge is to translate this belief into more sustainable urban structures and behaviour, knowing that only some of the elements of sustainable cities, listed in the following section, are now clear.

Both centres have released planning strategies in 2000 (Townsville – Thuringowa strategy plan and the Far North Queensland Regional plan), explicitly supporting reduced car use, and enhanced walking and cycling, along with improved public transport. For example the transport 'vision' for Townsville: "An efficient public transport system and an extensive network of safe pedestrian and cyclist routes linking residential areas, major centres and other high activity areas have developed and are strongly supported by the community" (TTSP 2000, p 26).

Australian paradigms in urban planning

Some Australian government review processes perceive a change in the urban planning paradigm (Australian Urban and Regional Development Review 1995a; 46). Because of the clear ecological degradation associated with the old paradigm of ' profit and growth at whatever cost' , there is the need for, and beginning of a paradigm shift in urban planning, Further, the mathematics of systems theory imply that new social paradigms may reach a critical stage, then produce rapid general change. Once clear implementation of ESD principles begins, it may proceed rapidly.

Environmentalism requires us to " protect biological diversity and maintain essential ecological processes and life-support systems" (AMCORD 1995, PnP 3, p 1). We need "to achieve a social system based on the principle that every part of nature and all natural systems have intrinsic value and rights that humans must accept; humans do not dominate nature, rather, they are a part of it" (Cutter 1994, p 217). ' Deep green" authors like Nash (1989) support this view, clearly part of a value system associated with the new environmental paradigm. Because humans have an often strong desire to dominate nature, the new paradigm argues the above value base to help nurture sustainability. The causal agents of the greatest bout of extinctions in 65 million years, we humans, are now starting to call for an integrative rather than dominant role with the rest of nature.

The inclusion of all external costs of production, use, disposal, and resource depletion is being quantified as life cycle analysis (Greene 1992). It is an attempt to redress the undervaluing of resources and natural systems. The underpricing of transport fuels is a strong determinant of their use. As the global ground-swell of environmental unease grows, critics of growth, which ignores external costs and intrinsic value, observe that unregulated market forces, driven to maximise corporate and personal profit, destroy environmental resources (Drakakis-Smith 1995; 667).

With major growth in suburban living in the 20$^{th.}$ century (Murphy 1995), appreciation of environmental damage directly attributed to our suburban life-style is also growing: "most modern cities have spread far beyond their ' carrying capacity' , and draw resources from very

wide areas. In return, the more immediate surrounding areas often received much of the waste and pollution from rapid urban growth in the form of contaminated water or air" (Drakakis-Smith 1995, p 661). Cities are seen as a massive environmental problem, where solutions must be forged (Gossop and Webb 1995; 129). Given the large resource, social and pollution costs associated with urban car use described in this paper, the following section considers ways to reduce car use, particularly single occupancy vehicles.

1.3 Alternatives to solo car use

Ecologically sustainable development helps define environmentally neutral urban solutions. The challenge is linking environmental concern to changed behaviour. Defining and demonstrating solutions or preferred directions is our own responsibility - "respond personally" (AMCORD 1995, PnP 3). In less developed countries, rather than build more freeways and suburbs, some authors now advocate "participation, restoration, and rehabilitation" (Lienbach 1995, p 338) of older urban areas. The following researchers have found that shaded, safe cycle paths (Wadhwa 1995, Hamer 1994, McClintock 1992, McClintock and Cleary 1996) and walkways (McClintock 1992, Williams 1992), and greater car-pooling (Pucher 1995) will reduce private car use. Like Banister and Banister (1995), Gordon (1991) reminds us that ride-sharing is usually more efficient than mass transit. It should be noted that there are now many sites on the internet which detail current car reduction strategies, from cycle promotion in Western Australia (http://sunsite.anu.edu.au/wa/bta/9805citw.htm) to car reduction laws in Britain (http://www.hmso.gov.uk/acts/acts1998/19980024.htm) or ways to effectively set up a car pooling scheme (http://www.mcclellan.af.mil/EM/TRIP/carpooling.htm#Tips%20for%20successful%20carpooling). To set the scene for the research, the following paragraphs outline efforts to reduce car use, while Chapter 6 develops some of the concepts and provides more examples.

Full pricing of car use

As indicated earlier, Banister reports that the British government was purposefully raising the price of fuel by 5% per year to curb demand (see also Mitchell *et al.* 1996) and to make alternatives to solo car use more attractive. Increased prices of tolls for single occupancy

vehicles and parking have been modelled as reducing commuter trips by about 10% in Washington State (Washington MPO 1996a +b). Mitchell *et al.* (1996) report on modelled effects of such changes as halving public transport fares, or doubling fuel costs in Britain, which may help inform the NQ study. In detailed studies of Dutch drivers, Rouwendal (1996) found a ' significant' (p13) link between fuel price and use.

Public transport

Although increased use of public transport and inducements to greater local walking and pushbike use are advocated by most developed countries, worldwide trends are toward greater car use (Newman and Kenworthy 1989, Pucher 1995). Walking and bike-riding use only 1% of total travel energy to make 40% of the total number of urban trips in Britain (Banister and Banister 1995). Research by such authors as Kirchhoff (1995), Pucher (1995) and Delle Site and Filippi (1995) has found that price, convenience (closeness of pick-up and set down points to own travel needs, and frequency of service), comfort and safety are major issues of public transport patronage. In older cities, the overcrowding of public transport has fuelled the change to private vehicles (Turton and Knowles 1992; 99), further confounding overall road congestion.

On demand and semi on demand public transport services are being tested in various centres to help cater for cross-town and non-work urban travel. This concept relies on modern GIS technology, mapping caller location and intended destination, then a central dispatcher sends an appropriately sized bus to best fit the destinations of callers in a given city sector. ' Dial-a-bus' services have recently been piloted in Germany, and considered for Australia, with trials for ' personal public transport' in Perth (AURDR 1995b; 104). Seeking public input to acceptable methods of increasing public transport use, walking and cycling are clearly part of urban policy and theory (eg AMCORD 1995). In future, more people may drive, cycle or walk to a bus or rail terminal, then mass transit to main nodes. This idea could be explored for the dispersed northern beach settlements of Townsville, where a nearby rail line already exists.

Although they have a vested interest in issues of urban mobility, the International Union of urban and regional public transport (Isaac 1996) advocate the use of public transport in the developing cities of SE Asia. They claim public transport provides mobility for the majority, that it is a very efficient use of space for the number of people moved, and that it has a low accident rate. Its general accessibility is coupled with low contribution to urban pollution.

Cycling and walking

The first practical bicycles were produced in 1839 (Williams 1992; 257), pushbikes are now owned by about half the population of India and China (Turton 1992; 73). While such countries increasingly use motor scooters and cars, Westernised countries are advocating greater bicycle and pedestrian travel (AMCORD 1995, Gordon 1991, Queensland Government 1996). Walking makes up about 35% of all trips in Europe (Turton 1992). Safety is a major issue for walking and cycling (Wadhwa 1995). If the urban planner's new strategy is to localise nodal development, linked by paths and public transport (TTSP 1997), the paths in the tropics need shade where possible. Bike storage at public transport stops should be covered and secure. Cairns has recently launched an integrated bikeway plan (Loder *et al.*, 1996), after this need was emphasised in the area strategic plan (FNQ2010 1995, 1998).

Detailed studies of urban cycling in Ghana have shown that there is a cultural aspect to cycling - it is more an accepted social norm in some cultural groups than in others (Turner *et al.* 1996). These authors cite the cultural acceptability of cycling in places like Holland to substantiate their Ghana findings, and document the conflict in some cultures between cyclists and the attitude of some other road users. Turner *et al.*, like earlier authors, call for more safety for cyclists. Research in Nottingham showed that conflict with cars using roads was a major deterrent to cycle use among surveyed factory workers (McClintock and Cleary 1996, Turner *et al.* 1996). In Washington state, a bicycle and pedestrian manager position was created to improve the attraction of those forms of urban mobility, recognising the state road network as a basic network for cycle use (Dornfeld 1996).

Ride-sharing

Like Banister and Banister (1995), Gordon (1991) reminds us that ride-sharing is usually more efficient than mass transit. Car pooling is proving successful in the USA and is the second most important form of commuting, used by one fifth of all commuters (Turton 1992; 74). Car pooling is often linked with high occupancy vehicle lanes (AURDR 1995b; 124). It can only work for commuters who have similar home and destination locations, and similar arrival and departure needs. As fuel costs increase in future, a Geographic Information System (GIS) based network may facilitate liaison of such urban travellers. With clear evidence that vehicle use is clustered by distance from central activity district (Gordon 1991), age and composition of the households (eg Brotchie *et al.* 1995), car pooling in the future may take the form GIS aided shared shopping trips, and journeys to school or work.

Telecommuting

As Brotchie *et al.*, (1995) report, currently 3.5% of employed Australians work from home (including ' teleworking'). Telecommuting is seen as a major growth area, relying on electronic contact to replace face to face dealings for some work-related transactions (Droege 1995). Telecommuting may generate subsidiary travel demands, but it is likely to reduce travel during congestion peaks (Brotchie *et al.*, 1995). Authors who advocate telecommuting assume that telecommuters use vehicles less than commuters. This needs to be tested. However, in Britain only about 20% of all private trips are journeys to work (Banister 1996), so telecommuting may have little impact on total urban travel.

For planning purposes, research is needed to establish any preference to work from home, and relate vehicle use from currently home-based employed to similar householders who commute. The social implications of increasing home-based work is receiving some attention, with some authors arguing the contentious view that having a work-place away from home may prove to be an historical anomaly (Little 1996). California was aiming to reduce passenger travel by 30 billion miles by the year two thousand, and some of that reduction will be achieved by greater telecommuting (3% in 1980 - Gordon, 1991). For computer based work it may be possible to work from home one day per week, cutting commuting for some by 20%.

Local service provision, and linking environmental concern with behaviour

There is a trend of increasing distance between homes and main urban destinations, causing more and longer urban journeys (Turton and Knowles 1992; 82). Peripheral shopping and leisure complexes compound cross-city travel, indicating the need for planners of public transport to include changing landuse patterns in forward planning (Turton and Knowles 1992; 83). Current government policy (AMCORD 1995, Binning 1995, Queensland Government 1996) favours more local service provision (convenience stores, home banking, local agencies for some government services), aiming to reduce people's use of cars to meet all their goods and service needs away from their own neighbourhood. Solutions to petroleum dependence are multifaceted (Wells 1970), and include more efficient use and replacement fuels (Sinor 1996), changed urban form (Banister 1996) and changed behaviour (Fox 1995). Solutions will be driven by fuel prices which fully reflect external costs (Serageldin 1996), or technological innovation, such as use of ultra-flywheels (Hunwick 1995), or solar cars (Storey 1995).

Choice of home location and environmental values may effect automobile use, but the link between our values (Cutter 1994) and behaviour is tenuous (Walmsley 1988; 109). Studies by Goudie (1995) show that although strong environmental concern and support for energy conservation was very high in a survey of two hundred Townsville households, their energy conserving behaviour did not generally reflect their concern. Theorists believe that "smaller, local companies handling local demands" (Waide 1993, p 90) will reduce overall travel needs.

Environmental concern permeates the current theory and government policy, encouraging medium density housing in the city centre, and at major infrastructure and transport nodes (Newman and Kenworthy 1989, Queensland Government 1996, TTSP 1997). The concept of localising our needs is also a core component of *Global Toyotaism*, which "localises more of the production process and therefore seems more conducive to local development in host nations" (Fujita and Hill 1995, p 19).

Mixed land use, nodal development and public transit links

As concepts of neotraditional neighbourhoods become fact, working to provide goods and services locally will require zoning and incentives for mixed land use (DBIRD 1995, Ryan and McNally 1995). If the plans of theorists outlined in this section are right, the dormitory suburbs developed in the 20th century will become increasingly alive with work-related activities. Urban nodes will consolidate with medium density centres, meaningful employment, including commerce, light industry fabrication and computer 'cottages' with many work stations linked to work headquarters through the internet. Walking and cycling will be safe. Theoretically, nodes will be linked by reliable, cheap, safe, clean, frequent and rapid public transport systems.

Long term studies of relocated workplaces in Oslo, Norway show that commuting to work on the less dense, urban fringe uses far more transport energy than equivalent workplaces near the more densely populated urban centre (Naess and Sandberg 1996). The consensus on causes of 'enhanced' urban travel is the cheapness, convenience and availability of car use, urban "densities and levels of land use mixture" (Cervero 1996, p 361).

Detailed analysis of the 1985 American Housing Survey showed that people living within 100m of retail outlets used cars less than the rest of the population. This was also true of residents in mixed landuse areas. Cervero, like Naess and Sandberg, found that urban density influences mode choice. Cervero found that in the US, urban density was a less important influence on use of motorised transport than close neighbourhood shops. Reutter and Reutter (1996) found strong correlation between land use and car ownership in Germany, with 46% of inner city, 32% of urban centre and 23% of fully suburban households not owning cars (p34).

Adding to earlier debate on urban density, Banister (1996) reports on studies which show that there is a "strong increase in petroleum consumption when population density falls below 29 persons per hectare" (p26). Banister argues, as do the many authors referred to earlier in this chapter, for mixed land use and "concepts of self containment" (1996, p 31).

Changing behaviour, especially work commuter patterns

Along with telecommuting, currently dominated by upper and middle management (UTM 1996), there is a growing concept of compressed work weeks (Hung 1996), strongly supported by this researcher. Congestion, costing up to 2 billion gallons of fuel , and 2 billion hours in the US each year (Hung 1996; 11), is the most obvious motivation for working longer hours per day in the usual workplace, but less days per week or fortnight. Congestion is a major future issue, with the vehicle-Kilometres (at present trends) in England likely to double in the next thirty years (Bly 1996).

With the many authors cited earlier, addressing the issues of a planning paradigm shift, Witherby (1996) posits the idea of eco-relational thinking to planning, because planners need a change of attitude to "the role of the motor car in society, [improving the] ' liveability' of our cities" (p14). Witherby parallels the slow response to the known negative aspects of smoking to the increasingly known negative effects of car use, such as the 500,000 people killed annually on the roads (Serageldin 1996).

' Localising' has all the solutions: urban villages.

Future urban form is likely to develop medium density urban nodes connected by simple group transit devices. Many of us may work from home one or two days per week. The ESD working group on energy use recommended urban consolidation rather than fringe growth, and mixed land use to reduce travel cost through developing more self-sufficient local communities. (Stanley 1995; 69). Troy (1990) proposes government policies to help local planting of fruit and other trees, and vegetables. This is seen as necessary, because almost all food consumed in cities is provided by farming and transport practices fully dependent on liquid fossil fuels. Like other authors (eg Cadman 1990), he believes we should develop local transport nodes, with local markets selling local produce (Troy 1990). A sustainable future may include ' urban villages', meeting most of their own needs for food, water, energy, employment, education, social interactions and recreation, based on a strong local social network.

Although not all the elements are directly related to urban sustainability, they all connect with fossil fuel reduction, and with urban sustainability. Land use, energy and food provision will become key urban issues, and represent some of the quantum shift in thinking and behaviour

needed to develop sustainable cities. This will follow the paradigm shift currently underway with the ESD philosophy generating laws such as the Queensland Integrated Planning Act (IPA 1998).

Figure 1.3.1 Possible elements of sustainable neighbourhoods

With the support of ESD policy from federal, state and local government, each 'neighbourhood' would aim to provide or encourage:

1. full consultation with residents at all stages
2. a whole system approach to planning, including all remaining ecosystem elements, through to local employment
3. most food, timber, energy, recreation needs, with local markets for local products.
4. renewable energy collectors and storage, and local energy efficiency, including methane digesters, reduced need for automobile use, and integration of vegetation and architecture for passive thermal comfort.
5. Localised water management and nutrient recycling, with frugal water use, use of rain water tanks, stormwater penetration/retention as close to rain impact as possible, using parks and drainage lines for water adsorption and storm water retention where possible.

Self-help suburbs

Most Australians live in suburbs, with practically all material and energy needs supplied from outside the suburbs and nearly all our wastes disposed of outside the suburbs. The beliefs which shape this section include the imperatives of urban sustainability, population stabilisation, and people providing for most of their daily needs on a local basis by the time petroleum supplies begin to dwindle (See Figure 1.3.1). Urban sustainability accepts the full resource worth of fossil fuels. Belief in technological solutions may be justified, but maybe not. The precautionary philosophy of ESD requires us to consider the travel needs of future generations, and act in a precautionary way to looming transport fuel shortages.

From the existing situation, planning deals through an historic base to focus on meeting future needs. Sustainability calls for a nurturing concern for that future. If petroleum proves to be the cheapest, easiest transport fuel which is 'universally' available, we need to soften the future impacts of reduced personal car use. With long lead times, government policy-makers and urban theorists ask explicitly that planning proceed toward reduced car use. Most

developers appear more used to car-based urban growth. These powerful and contradictory forces are as yet unresolved in the relatively permanent acts of urban growth.

Optimistically, much local activity and local responsibility will see urban form evolving into diverse nodes of activity, linked by rapid public transport operating from locally collected renewable energy. Food and timber production are included in sustainable urban planning because most things are consumed in the suburbs. More suburban self-reliance reduces pressure on the hinterland (farms, waterways and forests). As farming and transport fuels become more difficult to obtain, local food production may become an imperative. Pessimistically, we will drive ourselves, unprepared, into the near future of unobtainable transport fuel and suffer varying degrees of social breakdown.

This section has led from policies and strategies of planners to a logical synthesis of a future far less reliant on cars that the situation early in the third millennium. Our collective and individual behaviour may be modified by more than day-to-day

convenience. The problems of petroleum and car use have been outlined, and responses of planning and policy made clear. It is of some importance to understand our urban travel needs, choices and behaviour, invoking the theoretical framework, research values and methods of psychology and human geography.

1.4 Analysing the problem: a human geography approach

As urban planning undergoes a paradigm shift, science uses at least three distinct research paradigms or methodologies, derived from the positivist, interpretive and the critical perspectives. Each have their drawbacks (Sarantakos 1994; 35), from the rigidity of predicted normative behaviour, through consideration of people's internal space to the larger social context. Human geography behavioural research attempts to "understand how socially generated constraints influence virtually all forms of people-environment interactions" (Walmsley and Lewis 1993, p 6). The cheapness of petroleum now, and the resultant urban form may cause great social constraint in the future (Serageldin 1996). The 'constraints' of Walmsley and Lewis are parallel to the 'context' of Stern (1992), discussed later.

A critical theoretical approach (Sarantakos 1994), combining a record of overt behaviour patterns with stated perceptions of current and future urban travel, appears to offer the most meaningful methodology for urban travel research, although the normative approach, assuming different people act the same in the same situations, has been used successfully (Walmsley 1988). The current literature on urban development contains a number of hypotheses underlying the environmental paradigm shift (Stern *et al.,* 1995) in urban planning to neotraditional urban development (DBIRDa 1995).

Analysing environmentally significant behaviour is complex and multi-disciplinary (Stern 1992), and human geographers increasingly believe that 'value-free' research is unrealistic (Walmsley and Lewis 1993; 5, Sarantakos 1994). Researchers, attempting to understand and explain changing reality, necessarily carry values, and it would be deceptive to pretend otherwise. Geographers Waddell and Nunn (1993) consider the "delicate issue of detachment in scientific research", and have "the conviction that detachment is impossible" (p3), further claiming that their lack of detachment made them geographers in the first place. These researchers allow that the researcher has values, that there are moral and ethical aspects, even social or environmental obligations embedded in what you chose to study. Scientific methods usually prevail, but the researcher is allowed to care about the subject and usefulness of their research.

Research will always have much subjectivity, because there are many decisions made throughout the process. Because of this, investigators should be systematic. The admission of personal values is reassuring to researchers wishing to develop the philosophy and implementation of ecologically sustainable development. It is permissible for geographers to admit personal research preferences, to take up advocacy for sustainable planning.

This thesis has the philosophical base of ESD, and the values embedded in ESD, including public participation and dealing cautiously with uncertainty. Petroleum may be replaced by a sustainable energy source at equivalent or lower total costs, but we need to consider the changes needed in Westernised society if effective portable substitutes are not found.

These are not values of reductionist empirical science, they are values of responsibility for future generations. Intergenerational equity is a key principle of ESD, and energy planning is a key issue of intergenerational equity. How we use fossil energy now may have a profound effect on the choices people have within 10 years, when it is predicted that global demand for petroleum will, for the first time, outstrip supply (Williams and Collins 1997, Campbell and Laherrere 1998). Because energy use does not occur in isolation, the following section considers the larger social context of urban energy use.

Beliefs and values

Energy use, economics, and population growth are all intertwined (Starr 1993, Glantz 1988), leading some authors to advocate nuclear power, without necessarily addressing disposal of spent radioactive material, population stabilisation or the climatic repercussions of increasing carbon dioxide emissions. Such authors express (perhaps unconsciously) aspects of the dominant social paradigm, discussed below.

This world view is contrasted by writers like Waide (1993) who create plausible scenarios that exclude fossil fuel or nuclear energy. This shows that our values and beliefs may deeply effect the interpretation different people, in good faith, put on the same available information. It also shows that some fundamental long term decisions concerning our collective future may be made for tenuous reasons, within tenuous decision-making processes, perhaps driven by short-term political expedience, or firm faith in our inventiveness to substitute for petroleum use.

Different energy futures scenarios are depicted by various authors and groups, reflecting values. Greenpeace can clearly see a fossil-free future by 2050, relying on the economic inclusion of externalities to drive renewable energy sources into the mainstream (Waide 1992). Other sources (Queensland Government 1996, OECD 1993) see that changed behaviour, technological improvements in electric vehicles and use of hydrogen will help supplement use of petroleum. Planners generally believe our urban form and travel patterns

must fundamentally change from an overwhelming reliance on often solo car use (Newman and Kenworthy 1999).

There are clearly three distinct sets of beliefs at play, all dealing with a future. This researcher borrows from each perspective, believing provision of fuel used to move vehicles is unlikely to be as easy as drawing liquid energy from the ground. One reason humans have been so cavalier with petroleum may be that energy is too cheap (Turton 1993, AURDR 1995b). Until that changes, the advocacy of all governments for energy conservation has little impact on the increasing use of fossil fuel.

Models

A behavioural model of causality to describe urban activity systems (Walmsley 1988; 94, see figure 1.4.1) may be used to infer relationships between reported attitudes and actual behaviour. However, a more recent and complex model proposed by Kitchin (1996, p74), with the strength of explicitly including social and environmental interactions may be adapted and used. Kitchin's proposed model includes a person's 'working and long term' memory, and internal information is processed within 'real world' context, such as cost (Stern 1992, Rouwendel 1996), which may prove to be a larger determinant of travel behaviour than people's subjective reality.

More generally, Schwirian *et al.,* (1995) believe that urbanism (see following definition) can be modelled by four parameters: demographic indicators, along with economic, social and environmental stress. As defined by these authors, 'urbanism' appears to combine the worst features of overcrowded cities in fully humanised environments, a much narrower definition of urbanism than a description of the evolution of urban forms and behaviour described by Mumford (1974).

Figure 1.4.1 Possible determinants of activity patterns

from Chapman 1974 in Walmsley 1988.

Stern *et al.* (1995) have developed a simple and elegant model which includes a person' s position in a social structure, considers constraints and incentives as generators of values. This in turn lead to general beliefs, world view, specific beliefs and attitudes, generating intent, helping explains behaviour (Stern *et al.*, 1995; 727 - see Figure 1.4.2). This model may be further developed through research specific to values and urban travel behaviour.

The sociology of cities has long been studied (eg Kilmartin and Thorns 1978). Schwirian *et al.*, (1995) modelled stress associated with urbanism, using the term ' urbanites' (p203). They argue that urbanism produces large, densely populated cities which ' destroy the primordially based social supports [producing] social isolation and estrangement... Competition ... contributes to a systematic Darwinian-like struggle for existence in the urban ecosystem' (p 203). This potent imagery is being challenged by the ' systemic model' , where the "potentially negative effects of the urban environment on city dwellers may be mediated by interpersonal relationships ... participating in the life of available sub-cultures and small social worlds that urbanites establish" (Schwirian *et al.*, 1995, p 204).

Figure 1.4.2 Stern' s 1995 behavioural explanation model

Behaviour is explained by:
1. a person' s *position in a social structure*,
2. with *constraints and incentives* as generators of *values*, which in turn lead to
3. general *beliefs*,
4. *world view*,
5. *specific beliefs and attitudes*, generating
6. *intent*, which helps explains
7. *behaviour*.

Developed from Stern *et al.,* (1995; 727)

These authors also provide useful definitions: urbanism refers to the way of life in cities. Urbanism is "multi-dimensional with separate social, economic and environmental facets, and ... negative aspects of urbanism increase as the demographic scale of cities increases" (p205). These authors use the above context to describe extensive studies done on social indicators for many cities, and endorse the Zero Population Growth model of ten composite indexes based on a total of 70 different factors.

The list is included to show that transport is recognised as a determinate of urban well being. The composite indicators are ' ... population change and crowding, family economics, community economics, maternal and child health, crime, education, air quality, water resources, toxic releases and sewage, and energy and transport.' (p206). These authors also contribute to the urban density debate (see also Troy 1995), deducing that higher population density contributes to urban stress.

In an attempt to understand why ' traditional' urban development, destructive to social and natural structures, was allowed to continue, the following section considers paradigms, particularly the Dominant Social Paradigm and the New Environmental Paradigm. The meanings placed on these two world views are explored, showing how they help explain environmentally destructive or environmentally neutral human behaviour. The perceived shift

in planning paradigms is detailed, along with some of the likely changes in urban form and behaviour which will express the sustainable paradigm.

Paradigms

From a well developed theoretical base established earlier in this section, human geography attempts to "... understand how socially generated constraints influence virtually all forms of people-interactions ..." (Walmsley and Lewis 1993, p 6). This section considers changes in our social and political values which have favoured use of the automobile and urban fringe growth (Gordon 1991). Understanding socially generated constraints, and what may strengthen our sense of environmental stewardship is aided by an understanding of paradigms. Section 1.2 provided an exposition of forward urban planning theory and practice, showing that planners in Townsville and Cairns are re-aligning their values to fully consider long term social and environmental issues.

From Federal Government initiatives in 1990, Australia has engaged in a public participation process, developing concepts and implications of ecologically sustainable development, and how to implement them. Eight working groups were set up, two of which considered energy production and use (Ecologically Sustainable Development Working Groups 1991, DPIE 1992). They generated a large output of government policy on urban issues in Australia (eg AMCORD 1995, AURDR 1995a+b, BTCE 1995, and Queensland Department of local government and planning 1997). One cornerstone of AMCORD (AMCORD95) is the enhancement of housing choice, from purpose-built shared housing to cluster flats for the elderly, to provide a wide range of non-traditional housing options, preferably near a public transport node.

Illawarra has embarked on a healthy cities program since 1987 (Mowbray 1995), aiming to include social and environmental aspects in planning for change in the city. The project includes a focus on sustainable transport aimed at reducing car dependence. Like other state governments, the Victorian Government now requires a uniform approach to strategic planning from local governments, including issues of sustainability, concern for the environment and social aspects in planning (Frankston City Council 1997).

Changing values and roles

In an attempt to understand why we allow clearly destructive behaviour, the following section considers paradigms, particularly the Dominant Social Paradigm and the New Environmental Paradigm. The meanings placed on these two world views are explored, showing how they provide two categories which help explain environmentally destructive or environmentally neutral human behaviour. Using some aspects of Townsville as the focus, the perceived shift in planning paradigms will be shown, this chapter ends with likely changes in urban form and behaviour expressing the sustainable paradigm.

The small coastal cities of Townsville and Cairns are undergoing steady and projected growth. Cairns has recently undergone a strategic planning process, based on ESD principles (FNQ 2010 1995, 1998, 2000). In 1997, Townsville was engaged in three public consultation processes, each embedded in government policies of ecologically sustainable development. This section explores the contrasting growth and environmental paradigms, and the changes in planning caused by a paradigm shift.

Following clear evidence of this shift in planning values, this section considers a transition in Townsville planning, which may produce a fundamental move from unrestricted growth to a more future-oriented relationship with social and environmental issues. This section finishes with an indication of urban elements which may help prepare for the post-petroleum era, and an expanded view of the interlinking nature of ESD, if we truly wish to pursue it.

The Townsville city council conducted a public meeting in August 1997, seeking ‘visions’ for the ‘Townsville central area development strategy’. Along with this public consultation and planning process, the Townsville region is undergoing a regional strategic planning process (TTSP 1997), and a ‘Townsville industrial land project’, aiming to identify about 3,000 Ha suitable for major industry (TILP 1997, Goudie 1997). The strategic plan repeatedly refers to Ecologically Sustainable Development, as do almost all government planning documents since about 1993 (eg Queensland Government 1996).

The Townsville area has a population of about 130,000, is a port, government and university 'town' and hosts Australia's largest army base. The city sits on latitude 19 south, east of massive mineral reserves, and is expected to continue the steady growth experienced over the past two decades, because of the generally pleasant climate and expanding work base. The following section considers a philosophy of approach to sustainable urban development, focusing on urban travel, environment and land use issues. Like other centres mentioned in this Chapter, Townsville in November 2000 has the policies in place to pursue the new planning paradigm outlined below.

The value systems which underscore a society can be judged by the types of planning exercised by that society. If subjugation of nature brings financial reward and social status, elements in the ecosystem may be considered of no value until converted into financial gain. The value a society puts on nature depends on the way that nature is viewed (Nash 1989). Concepts of paradigms have been developed to help appreciate the societal values that underscore social choices. Exploration of paradigms is increasingly used in the literature, as outlined below, to help understand why we interface with nature the way we do, and how that interaction is conceptually changing the way we approach urban planning.

A paradigm may be defined as a clear and embracing pattern, a coherent world view, "a mental image of social reality that guides expectations in a society" (Dunlap and Van Liere, 978, p10). "The DSP (dominant social paradigm) refers to the world view or ideology which has become entrenched as a result of the structures of power in a society. It is diffused through society by hegemonic values [structural values where gross imbalances of power and wealth are accepted as normal] between societies' members, institutions and social processes and, in turn, is maintained and reproduced by them" (Fien 1992, p 23).

There is a chasm between the dominant social paradigm (expansionist or continual growth world view), the entrenched "structures of power in a society ... maintained and reproduced by them" (Fien 1993, p 23), and the new environmental paradigm. The growth view encourages increasing population to boost demand for land and the building industry (Fien 1993), barely acknowledging constraints to growth. Acknowledging those constraints, the

alternative urban development model aims to work toward low-impact, localised permanent settlements with minimal car use (Williams 1992, Rodger 1995, and Nash 1989). Government policy (AMCORD 1995) and current urban theory (Mc Namara *et al.*, 1993, Farrington 1992) now requires softening urban impacts on the environment. This is partly dictated by anticipated energy constraints (Holdren 1990).

Our current urban travel behaviour is best viewed within the mixed social messages of prior and current cheap energy prices, and an unstated assumption (unexpressed paradigm) that cheap energy is a permanently guaranteed way of life (Stern 1992, Stern *et al.*, 1995). As the ground-swell of environmental concern grows, critics of unrestrained growth become more articulate: "Unregulated market forces are undoubtedly destructive of environmental resources and creative of substantial problems, driven as they are by profit motives" (Drakakis-Smith 1995, p 667).

Dominant Social Paradigm - values

Since development of mechanised power, growth and innovation has brought wealth and technological benefits to increasing numbers of people. Unfortunately, it is largely based on growth and exploitation. An alternative world view exists: the new environmental paradigm. This sustainable world view includes long-term ecological and resource considerations, and accepts the urgent need to reduce human impact on surrounding resources and ecosystems. Both these world views are coherent (Munro 1995). The dominant paradigm does not attempt to include all of the 'external' costs of any human endeavour, while the environmental paradigm does attempt to cost resource depletion, pollution, health effects, and all other costs which are attributable to a particular behaviour.

The dominant paradigm is currently more powerful, but survival drive and forethought is causing governments and many multinational companies (Schmidheiny 1992) to consider external and long term costs in planning. There is growing global consensus on the need for ecologically neutral human systems and processes, recognising the unbreakable links between price signals, urban land use, resource provision and use, human attitudes and transport

choices (Stern 1992). The earlier, growth-based syndrome of the dominant social paradigm is generally destructive to nature.

When urban environmental activism gained widespread public expression in Melbourne in the early 1970s, it was partly in response to the domineering approach of the Victorian road planners at that time. They were part of "male-dominated, hard nosed, hierarchical organisations [advocating] massive resumptions of property, … ill-equipped to respond to the ecological and social concerns of the environmentalists" (Davidson 1995, p 40)

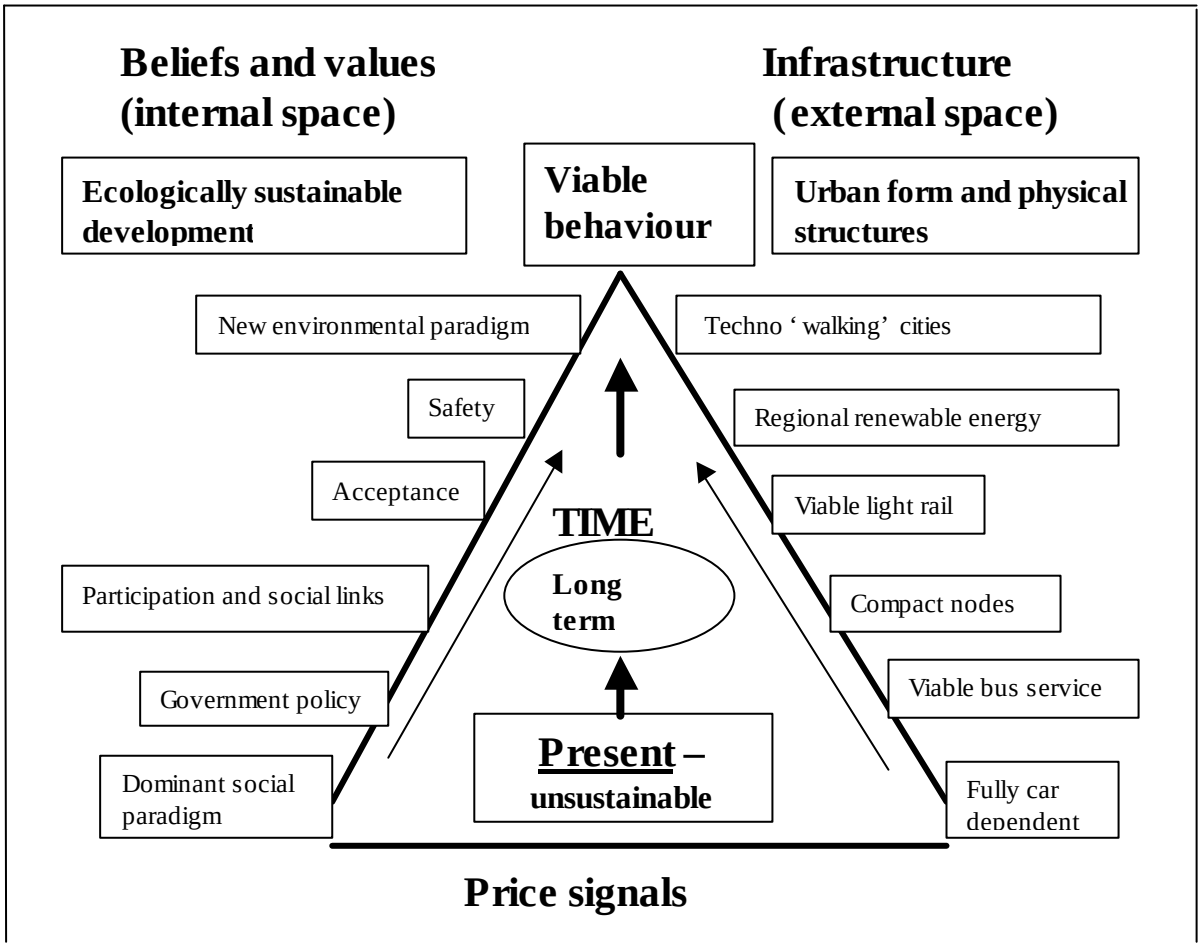
Ecologically sustainable development expresses a 'world view' or paradigm which is one of two major driving forces in our society. Australia may be on the threshold of a paradigm shift in urban design and function (the theory and government policy is certainly in place), which will greatly improve the long-term viability of cities. The remainder of this section provides a brief review of authors who embrace the paradigm concept in urban planning, and ample evidence that there is a shift in planning values toward acceptable environmental attitudes and behaviour.

The philosophies of ESD – equity, precaution, environmental and social responsibility, but mainly a long term view of what is most likely to work for us, are married in Figure 1.4.3 to refined issues of urban planning and behaviour. The conceptual model of Figure 1.4.3 draws on ESD philosophies and the convergent views of planning theorists and, indeed, many of the respondents.

The triangular hierarchy indicates a progression of human values and beliefs on the left, drawn from the work of Kitchin (1996) and Stern *et al.* (1995), whose models are also based on the belief that context largely determines our behaviour. Stern explicitly sees context as a greater behaviour determinant than values or beliefs, and certainly attitudes. Knowing there are over 500 definitions of 'attitudes' in the psychology literature (psychologists can not agree about what the word means), and there is scant evidence linking attitudes and behaviour (eg Goudie 1995), attitudes do not rate highly as a likely behavioural determinant.

Figure 1.4.3 stresses the importance of price signals in determining how people perceive their urban travel behaviour options. Beliefs and values behave interactively to cause greater or less facilitation of travel modes other than cars. Figure 1.4.3 shows the transformation of unsustainable automobile-based urban travel to viable technologically based cities with near-self-sufficient nodes, where most travel needs can be comfortably and safely met by rapid transit or walking. The model is fully developed in Chapter 6.

Figure 1.4.3 Closing the gap toward sustainable urban travel



Outcome of sustainability price signals: reduced car dependence with local meeting of most needs, especially energy and dense multinodal development linked by rapid rail.

Australian paradigms in urban planning

Some Australian government review processes perceive a change in the urban planning paradigm (Australian Urban and Regional Development Review 1995; 46). Further, the mathematics of systems theory imply that new social paradigms may reach a critical stage in development, producing rapid general change, leading to "small-scale, convivial, caring society" (Rodger 1995, p 57). These authors clarify the ESD paradigm as it relates to sustainable urban travel and design. There is the need for, and the beginning of, a paradigm shift in urban planning, because of the clear ecological degradation associated with the old paradigm of ' profit and growth at whatever cost.'

Environmentalism requires us to " protect biological diversity and maintain essential ecological processes and life-support systems" (AMCORD 1995, PnP 3, p 1). We need "to achieve a social system based on the principle that every part of nature and all natural systems have intrinsic value and rights that humans must accept; humans do not dominate nature, rather, they are a part of it" (Cutter 1994, p 217).

The inclusion of all external costs of production, use, disposal, and resource depletion is being quantified as life cycle analysis (Greene 1992). It is an attempt to redress the undervaluing of resources and natural systems. The underpricing of transport fuels is a strong determinant of their use. As the global ground-swell of environmental unease grows, critics of growth which does not factor in external costs and intrinsic value observe that unregulated market forces, driven to maximise corporate and personal profit, destroy environmental resources (Drakakis-Smith 1995; 667).

With major growth in suburban living this century (Murphy 1995), appreciation of environmental damage directly attributed to our suburban life-style is also growing: "most modern cities have spread far beyond their ' carrying capacity' , and draw resources from very wide areas. In return, the more immediate surrounding areas often received much of the waste and pollution from rapid urban growth in the form of contaminated water or air" (Drakakis-Smith 1995, p 661). Cities are seen as a massive environmental problem, and where solutions must be forged (Gossop and Webb 1995; 129). Given the large resource,

social and pollution costs associated with urban car use described in this section, the following considers ways to reduce car use, particularly single occupancy vehicles.

1.5 Researching acceptable policy implementation

This chapter has shown problems likely to result from our ubiquitous reliance on petroleum. Car use is the source of about 14% of all Australia energy-use greenhouse gases, while road expansions are costly and socially disruptive. The need for city centres at the human scale has been advocated by many researchers, but the global trend is toward greater car use. Increased car use in turn depends on petroleum use, but petroleum is likely to become scarce and very expensive before 2010.

The desire for sustainability includes environmental, social and economic elements. Reduced petroleum supply will place great stress on urban living unless our urban structures and behaviour are flexible and adaptive. The purpose of the North Queensland research is to elucidate how people in two small but vibrant population centres travel to fulfil their daily tasks. The research begins with the belief that much travel derives from the choice of home location in relation to usual destinations.

The instrument tests neighbourhood attachment, to gain some indication of people's willingness to move as a result of escalating transport costs. Respondents were asked how they felt about all modes of travel, asked to list the perceived strengths and weaknesses of each mode. This indicates people's willingness to sometimes forego use of their car. Mode switching for some journeys will alleviate some of the financial burden people will incur as fuel prices rise. There are likely to be reallocation of property values based on urban travel convenience, a magnification of the generally existent property price structure. Near term urban form will include mode interchanges, park and ride swap from car or bike to bus at "intermodal facilities" (FNQ regional plan 2000, p 245).

To make informed planning decisions, policy makers and planners need to know the detail of current urban travel behaviour, and the predisposition of the public to a large suite of possible car reduction policy implementations to help spread car use outside the existing peaks to

delay costly road expansions. Planners can use the following presentation of public travel behaviour and values, use this knowledge of public predisposition and perceived impediments, to bring in the easiest implementations first, changing away from gross reliance on car use.

This chapter has provided a comprehensive context for the research described in the following pages. Pollution, health costs, fractured communities and inequity between groups of people may be ignored, but petroleum is soon likely to become scarce. That will either cause major social dislocation, or we will have planned for that time. This thesis aims to learn of "decisions and behaviours which influence the arrangement" (Walmsley and Lewis 1993, p 6) of urban housing and travel, and is based on both quantitative and qualitative research methodologies (Richardson *et al.* 1995). Like researchers world wide, the Cairns/Townsville urban travel research hopes to contribute methodology and useful outcomes to reduce our reliance on single occupant vehicles powered by fossil fuels.

Chapter Two

Aims and methodology for Cairns and Townsville urban travel research

This research undertook clarification of what publicly acceptable changes in urban form, land use, mobility and access to services are likely to result from predicted petroleum scarcity. This chapter provides detail of the aims and hypotheses to be tested, the methodological approach of the research, rationale for the population sampling procedures and development of the questionnaire.

Aims

This research set out to develop a theoretical model to indicate socially sanctioned directions in more sustainable urban design and behaviour, focused on urban travel. It set out to achieve this by establishing residents' urban travel and their perceptions of current and future urban travel in Townsville and Cairns. The research also aimed to document why people chose their home location, and what residents perceived as inexpensive, easy and acceptable ways to reduce their car use. Along with establishing neighbourhood attachment and levels of environmental concern, expert input was used to develop strategies sanctioned by the public and experts to reduce private car use.

Hypotheses - what influences urban car use

The hypotheses, formulated *a priori,* are based on a survey of the literature, indicating that urban car use is affected by the price of petroleum and household distance from the Central Activity Area (CAA). Car use is also linked to suitability of urban travel independent of car use, or through shared car use, and that household location carries social and employment advantages and disadvantages.

The hypotheses set out to answer unresolved issues in the literature, particularly relating to household distance from the CBD. Developing and testing the hypotheses draws on both transport and psychology research techniques. Detailed links from the current literature to each hypothesis are given after the list of hypotheses presented below. By testing these

hypotheses, a theoretical model will be developed linking beliefs, constraints and objectives of more sustainable urban travel. Testing the hypotheses will help generate recommendations which are apparently acceptable to residents, and identified as likely to reduce car use.

Hypotheses

1	People will report that significant increases in the price of petroleum would cause them to reduce their car use.
2	Outer urban residents will drive the most – distance from the Central Business district will largely determine fuel consumption.
3	Outer urban dwellers will be employment disadvantaged.
4	Price, convenience (closeness, frequency), comfort and safety are major issues of public transport patronage.
5	Shaded, safe cycle paths and walkways, suitable public transport, and encouraging car-pooling will be reported as ways to reduce private car use.
6	Vehicle use will be clustered by household location and composition.
7	Travel records will show that telecommuters drive less than commuters.
8	Respondents will report that deliveries of items and providing sub-offices of some central-place services will reduce car use.
9	Householders with a high environmental awareness (knowledge of resource depletion, personal impact on the environment) will use cars less than people who believe current travel patterns can continue indefinitely.
10	The largest single predictor of urban car use is the stage in the household life cycle (from young and single, young family, teenaged children, retirees).
11	Residents will generally report that home use of information technology along with small changes in service provision, knowledge and values are each likely to reduce private automobile use.
12	Respondents will tend to support the New Environmental Paradigm.

2.1 Hypotheses and the literature

Price of fuel

Some authors believe that the link between car use and fuel price is so strong that the most economically efficient way to reduce car use and petroleum consumption is a carbon tax (IEA 1993; 19). More recently, the statutory requirement for cleaner petroleum means refinery costs will greatly increase, likely to produce substantial retail price increases (Blackburne 2000). The linkage between energy costs and consumption levels was shown with domestic electricity use. Respondents in a 1993 domestic energy survey identified fear of electricity price rise as the most likely of eight events that would cause a reduction in energy use (Goudie 1995). There are many examples in the literature linking energy wastage with structural

underpricing (eg Wall 1989 p18, Diesendorf 1992, Jarach 1989, Business Council 1991 and Greene 1992), as detailed in Chapter 1.
Overall, it is anticipated that respondents may report that significant increases in the price of petrol would cause them to reduce their car use (Hypothesis 1).

Among Westernised nations, where the real price of petrol differs by a factor of four, Schipper *et al*. (1993) report a clear correlation between petroleum costs and per capita distances driven. This view is shared by the British and Dutch governments (Hamer 1994, IEA 1993; 19). The Cairns/Townsville urban travel research tests how clearly people believe a major petrol price increase would affect their automobile use (question D7). Hypothesis 1 also concurs with economic theory, linking possible supply with likely demand and consequent supply (Tientenberg 1992).

Low density and distance from the Central Activity Area

It is anticipated that car use will correlate with the distance from the Central Activity Area (Davidson 1995, Town 1980; 14 and Pucher 1995), so that, on average, outer urban residents will drive more than demographically similar, inner urban residents (Hypothesis 2, Ryan and Mc Nally 1995). This normally unstated assumption also underscores much current urban policy and theory in planning, urban renewal and medium density housing (AMCORD 1995, AURDR 1995a).

In addition, urban planning theory includes the belief that outer urban residents are employment and ' transportation disadvantaged' (Hypothesis 3, Commonwealth of Australia 1992, Newman and Kenworthy 1989; 6), often making it harder to escape the poverty cycle, as travelling to work is sometimes impossible without use of a car (DBIRD 1995a). The Cairns/Townsville urban travel research tests if there is a relationship between urban density, correlated with distance from the CBD (Hypothesis 2), proximity to service and employment options (Hypothesis 3), family progress in life-cycle (Hypothesis 10, Commonwealth of Australia, 1992) and car use.

Alternatives to solo car use

Public transport, walking, cycling and car-pooling

Although increased use of public transport and inducements to greater local walking and pushbike use are advocated by most developed countries, worldwide trends are toward greater car use (Newman and Kenworthy 1989, Pucher 1995). Earlier research has found that walking and bike riding use only 1% of total travel energy to make 40% of total urban trips in Britain (Banister and Banister 1995).

If hypotheses 4 and 5 on alternatives to car use are accepted, respondents will generally report that price, convenience (closeness of pick-up and set down points to own travel needs, and frequency of service), comfort and safety are major issues of public transport patronage (Kirchhoff 1995, Pucher 1995, Delle Site and Filippi 1995). Further, shaded, safe cycle paths (Wadhwa 1994 and 1998, Hamer 1994) and walkways (McClintock 1992, Williams 1992), and greater car-pooling (Pucher 1995) will reduce private car use (see questions B3.2 to B10).

Australian cities are more like those of the USA than Europe (Newman and Kenworthy 1999). Car-pooling is proving successful in the USA (Turton 1992; 74). The research establishes base levels of car-pooling in the two study centres, and attempted to understand perceptions of current strengths and weakness of car pooling (Question B10). The data may also indicate different levels of car-pooling between the three stratified zones.

Seeking public input to acceptable methods of increasing public transport use, walking and cycling are clearly part of urban policy and theory (eg AMCORD 1995). Thus, this research asked what would actually help induce these behavioural changes, clarifying if, as hypothesised, more suitable public transport, cycle and walkways are likely to induce people from their cars by asking (Questions D5 – 7) what easy changes would help reduce current car use, addressing Hypothesis 8.

The hypothesis (6) that vehicle use will be clustered by distance from CAA (Gordon 1991), age and composition of the households (eg Brotchie *et al.*, 1995), and that telecommuters will use vehicles less than commuters (Hypothesis 7, Questions D5 - 7) are all tested by

comparing the car use of demographically similar householders who do, and do not walk, cycle or telecommute a great deal.

Telecommuting

As Brotchie *et al.* (1995) report, currently 3.5% of employed Australians work from home (including 'teleworking'). Telecommuting is seen as a major growth area (Droege 1995), likely to reduce urban travel, especially during peak hour congestion (Brotchie *et al.* 1995). The Research (hypothesis 7) indicates any preference to work from home, and relates vehicle use from currently home-based employed to similar households with members travelling to work. There is information that telecommuting is gaining favour overseas (http://www-cache.socs.uts.edu.au/~igorh/cscw/tools/busnets/telecom.htm, 2000), but little recent information in Australia.

Although it is current government policy (AMCORD 1995), residents may or may not perceive that more local service provision (Binning 1995) will reduce their car use (Hypothesis 8). Finally, the research tests if people with a high environmental awareness, including knowledge of, and concern over resource depletion will drive less than otherwise similar householders (Hypothesis 9, Questionnaire part C). The research shows if there is a clear link between our worldview and behaviour (Walmsley 1988, Stern 1992, Stern *et al.* 1995, and Cutter 1994). Hypothesis 11 combines some of the above, based on the theory that many changes in service provision and infrastructure and price signals are needed at one to render change (eg Newman and Kenworthy 1999).

Theoretical hypothesis

This research was undertaken because of the chasm between the dominant social paradigm (DSP), the entrenched " ... structures of power in a society ... maintained and reproduced by them" (Fien 1993, p 23), and the new environmental paradigm (NEP) detailed in Chapter 1.4. Such beliefs are measured in Part C of the questionnaire.

Beliefs and behaviour are both measured, so that links between these attributes can be explored. The Cairns/Townsville urban travel research is best viewed within the mixed social

messages of prior and current cheap energy prices, and a dominant social paradigm generating an assumption that cheap energy is a permanently guaranteed way of life (Stern 1992, Stern *et al.* 1995).

2.2 Methodology context

Human geographers increasingly believe that ' value-free' research is unrealistic, and that researchers should acknowledge the value base from which they operate (Walmsley and Lewis 1993; 5, Sarantakos 1994). Thus, the guiding philosophy of this research is the implementation of ecologically sustainable urban development principles (see Chapter 1), which emphasises public participation and dealing cautiously with uncertainty. This research aimed to learn of "decisions and behaviours which influence the arrangement" (Walmsley and Lewis 1993, p 6) of urban housing and travel, and is based on both quantitative and qualitative research methodologies (Richardson *et al.* 1995).

Human geography techniques of inductive logic, where data derived by survey of human behaviour and values is generalised into hypotheses (Walmsley and Lewis 1993; 7) were used to generate further hypotheses *a posteriori*. Positivist methodology in human geography is questioned, because it essentially assumes that "all members of society define reality in the same way" (Sarantakos 1994, p 34).

The Cairns/Townsville urban travel research used a critical theoretical approach (Sarantakos 1994), combining a record of overt behaviour patterns with stated perceptions of current and future urban travel, although the normative approach (Walmsley 1988) has been used to generate the listed hypotheses. The research tested a number of hypotheses underlying the environmental paradigm shift (Stern *et al.* 1995) in urban planning to neotraditional urban development (DBIRD 1995b).

This research recorded overt urban travel behaviour through quantitative means (Sarantakos 1994) and included ' attitude and preference' questions, partly drawn from Australian and overseas urban travel surveys outlined below. These questions tested hypotheses of significantly different car use of inner, middle and outer urban dwellers. Authors like De La

Barra (1989) assert that urban planning and transport modelling is convergent with urban geography, each now supporting the other.

Measuring attitudes in transport surveys

The meaning of 'attitude' was the subject of over 20,000 articles and books during the 1970's (Dawes and Smith 1985). A 1972 study found 500 different operational definitions for "attitude" (McGuire, 1985). It is generally accepted that the distinction between beliefs and attitudes is not clear (Babbie 1973, Ajzen and Fishbein 1980). Most writers after 1960 include three components of attitude: cognitive (knowing), affective (feeling) and behavioural (eg Pratkanis *et al.* 1989; 278, Cacioppo *et al.* 1989, Olson 1993), and may include perceived social norms (Cialdini *et al.* 1990, Scott and Willits 1994). To avoid endless definition, it is useful that "surveys are restricted to measuring *expressed* attitudes." (Airey 1984, p 7). Because there is a general consensus in the literature that the link between attitudes and behaviour is, at best tenuous (eg Walmsley and Lewis 1993), a belief reinforced by Goudie (1992, 1995), ' Attitudes' as such were not surveyed. Values and beliefs, according to the models presented in Chapter 1, appear to play a clearer role in the link between our ' internal' and ' external' space and behaviour. Language use describing our internal or mental processes is blurred. Perhaps using the language of ' how we think and feel' about particular issues provides greater clarity than does ' cognitive processes, values, beliefs or attitudes' .

Reliance on self reporting in surveys

The relationship between self-reporting of intent and consequent behaviour is tenuous, but self reporting produces meaningful results when respondents have time to properly consider their answers (White 1988; 37). White asserts that respondents try to give accurate responses, although people may partly respond to please the interviewer, or to give answers they expect conform to social norms. Interpretation of attitudes based on stated change or intent needs to be made with great caution.

For the above reasons, the survey instrument recorded overt urban travel behaviour through quantitative means (Sarantakos 1994) and included ' value-based' questions, drawn from

Australian and overseas urban travel surveys. Problems of a positivistic approach are reiterated by Fox (1995) when considering urban travel research. Fox states that ' human behaviour cannot always be explained through observed behaviour or aggregate statistical sources, [based on] certain ' economic man' assumptions - that people make rational decisions based on the desire to maximise the profit to be derived from any situation" (p105). Within the frame of human geography, Fox advocates the human activity approach developed and adopted for the Cairns/Townsville urban travel research, accepting that urban travel is a complex phenomenon, that travel is a derived demand. One Cairns respondent, away from home, reported walking for four Kilometres on a Friday evening because he had ' energy to burn' . A positivistic model cannot incorporate and reflect that kind of non-normative motivation to walk.

Another link between the Cairns and Townsville urban travel research method and transport survey methods being developed overseas is shown through the work of Curtis (1996). Aiming to lessen car-based travel in England, extensive research was undertaken to clarify links between land use (including household location) and travel. The study reported by Curtis showed that accessibility to work was the strongest criteria of residents near Oxford considering a change in household location (p60).

2.3 Prior transport surveys

Household transport surveys are used to record personal travel, within the context of environmental, resource and social trade-offs connected with that travel (Turton 1992; 67). British and US researchers generally ask for accurate travel details of the prior weekday (Lane *et al.* 1971; 37). This is preferable to diaries, which are too demanding on respondents (Brog 1985; 156), or mail-back surveys, which are biased through poor response (Ng *et al.* 1995).

A survey of about 1,100 households was carried out in Melbourne in 1970 (Troy 1972, 1982). It acquired demographic data, location choices (where you chose to live), travel mode, and trip duration. Troy asked residents to rank evaluations of convenience to such destinations as shops and friends (Troy 1982; 103). An Adelaide survey interviewed 20

households in depth (Jones *et al.* 1986), while a Sydney Home Interview Survey (Urban Transport Study Group NSW 1972, SSDA 1982) asked about type of parking and destinations.

Questions and lessons from these prior surveys have been incorporated into the Cairns/Townsville urban travel research instrument, circulated at an Urban Planning and Housing Program in Canberra in December 1995, and to local planners. It was then piloted in Cairns in June 1996, with much of the research methodology based on work by Richardson *et al.,* 1995. The instrument development also drew on the experience of Jones *et al.* (1986) whose small Adelaide household mobility study indicated the need for a sample of more than 100 households.

Further, a 1980 study in England found that 88% of all urban travel is for one or more of the following reasons: work, shopping, social, recreation, education and personal business (Town 1980). A 1996 Brisbane study found a slightly different order: shopping (31%), work (30%) recreation (10%) and education (8%) (Queensland Government 1996; 8). Respondents and household members were all asked to complete a one day travel diary, recording destinations, start times, modes distances and occupancy rates if travel was by car.

This thesis tests the hypothesis (2) that urban travel is intimately related to choice of home location. Thus travel is linked to what attracts and binds us to particular houses or flats. There is evidence that a sense of belonging to a particular location is linked to ' neighbourhood cohesion' (Buckner 1988).

Because consultation is part of the ESD process, before the fieldwork commenced, early drafts of the questionnaire received feedback from urban planners and theorists (Patrick Troy - Canberra, Bill Young - Melbourne, and Pat Mullins - Brisbane, supervisors David King and Tim Nevard, Joe Reser – JCU Cairns, Townsville Housing and Regional development public transport group meeting - 30.1.96, and Cairns City Council Infrastructure and strategic planning manager - 28.5.96). Drafts were tested in five face-to-face surveys in Cairns during March 1996, then piloted as 30 drop-off and pick up surveys in Cairns during June 1996.

2.4 Survey methodology

There were four distinct steps in the methodology of this research: (1) Initial trial of 30 household "drop-off and pick-up' surveys. (2) The refined instrument from that was distributed to 316 households each in Townsville and Cairns, (3) analysis and presentation, and (4) input from planners to help develop a Decision Support database.

Study sites and research context

Cairns and Townsville are two thriving coastal cities, about 400 Km apart, with populations of about 130,000. They are small but growing cities, currently very car dependent in structure and behaviour. They are dynamic, isolated microcosms, easily representing an excised portion of larger, more complex sets of travel inclinations, needs, nodes and networks. With three roads in or out, they are essentially closed urban systems with well-defined boundaries. For these reasons, they are ideal sites to study urban travel. They were both founded in the mid-late 1800's, and much of their growth has taken place since 1945, with much of that growth tied to automobile use. There are both very much 'auto cities' (Newman and Kenworthy 1999).

Pilot survey and analysis

The pilot survey was undertaken in Cairns in three Collector Districts (CDs – the base unit of sampling by the Australian Bureau of Statistics, comprising of about 120 households), randomly selected to represent inner, middle and outer suburbs. There was a 90% response rate from the 30 surveyed households, 10 selected from each zone of inner, middle and outer suburbs to fully test the instrument on the likely range of responding households. Respondents showed a high level of interest, often providing lengthy written responses to the draft instrument (see Appendix three).

Data gathering and construction of the analysis frame

One hundred and eight survey forms were delivered in each of the three urban zones, being 36 to each randomly selected Collector District. Collector Districts were chosen as the base unit of study, so that results could be tied to Australian Bureau of Statistics data gathered in

the 1996 Census. The survey aimed for at least 60 completed survey forms in each zone (Buckner 1988).

Although Buckner reports about 70% response rate (p778) for self-completion forms, the balance between time, costs and total number of surveys completed lead to the decision to use the self-completion method. This provided a statistically valid sample (compared to ABS data) to generalise any trends which emerged from the data. It can only be hoped that any sample bias through lower response rates (Richardson *et al*. 1995) is consistent across the groups under comparison.

Sample design: random selection of 650 households by zone

Starting with the 156 collection districts for Cairns used by the Australian Bureau of Statistics, the districts that were clearly in transition between the zones of 'inner', 'middle' and 'outer' suburbs were removed from consideration. Thus the three zones were defined by default. The remaining CDs were each given a number. A random numbers table was used to select three CDs (each of about 120 households) from each zone, providing enough households to get representative household types in Cairns. The same method was used in Townsville. Results of this selection process are shown in Figures 2.4.2 and 2.4.3. To remove the likelihood of surveying an atypical enclave in any one zone, survey forms were hand-delivered to 36 x 3 x 3 households, to every third household from the geographic centre (centroid) of each of three randomly selected collector districts (CDs).

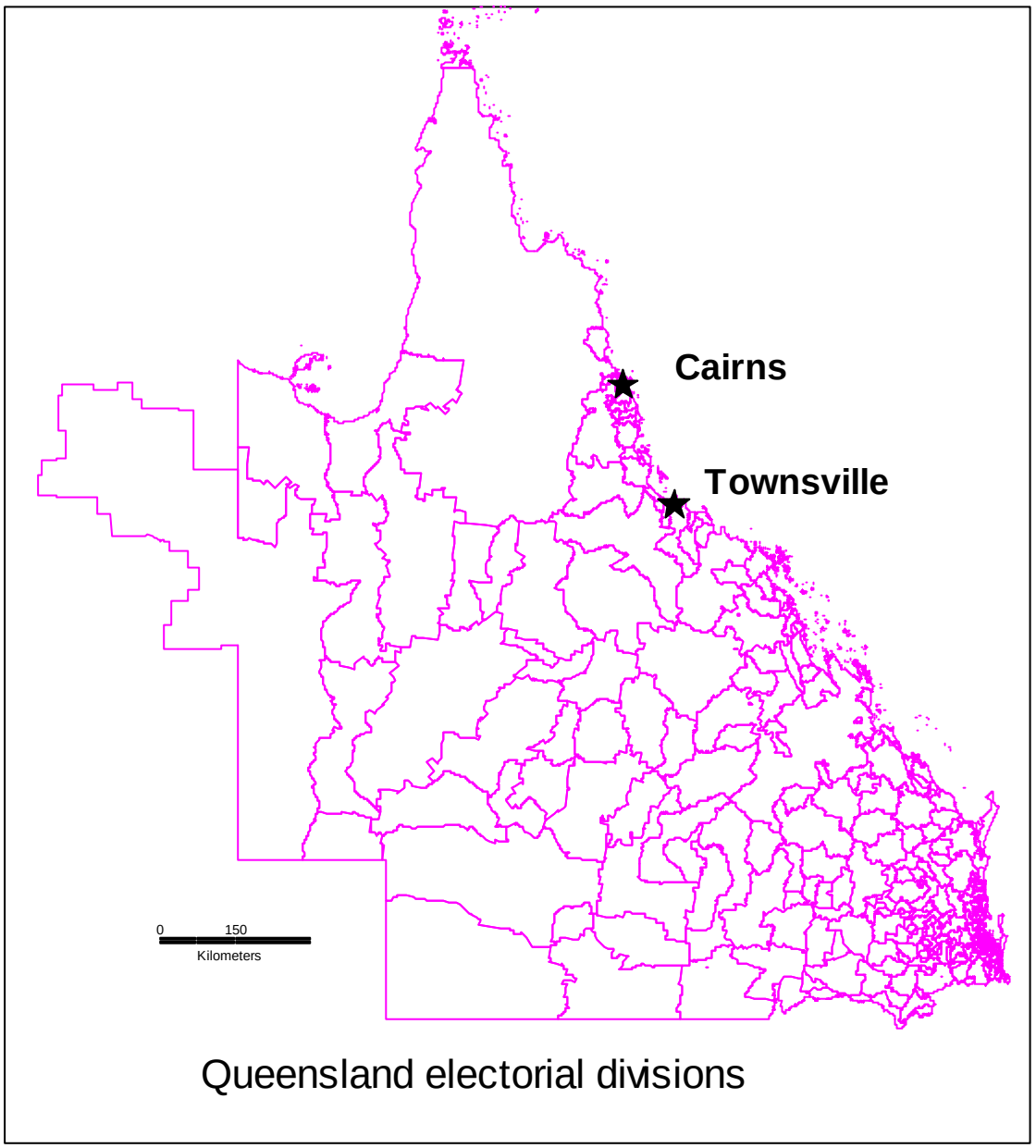


Figure 2.4.1 Queensland map locating Cairns and Townsville

Figure 2.4.2 Map of Cairns survey sites

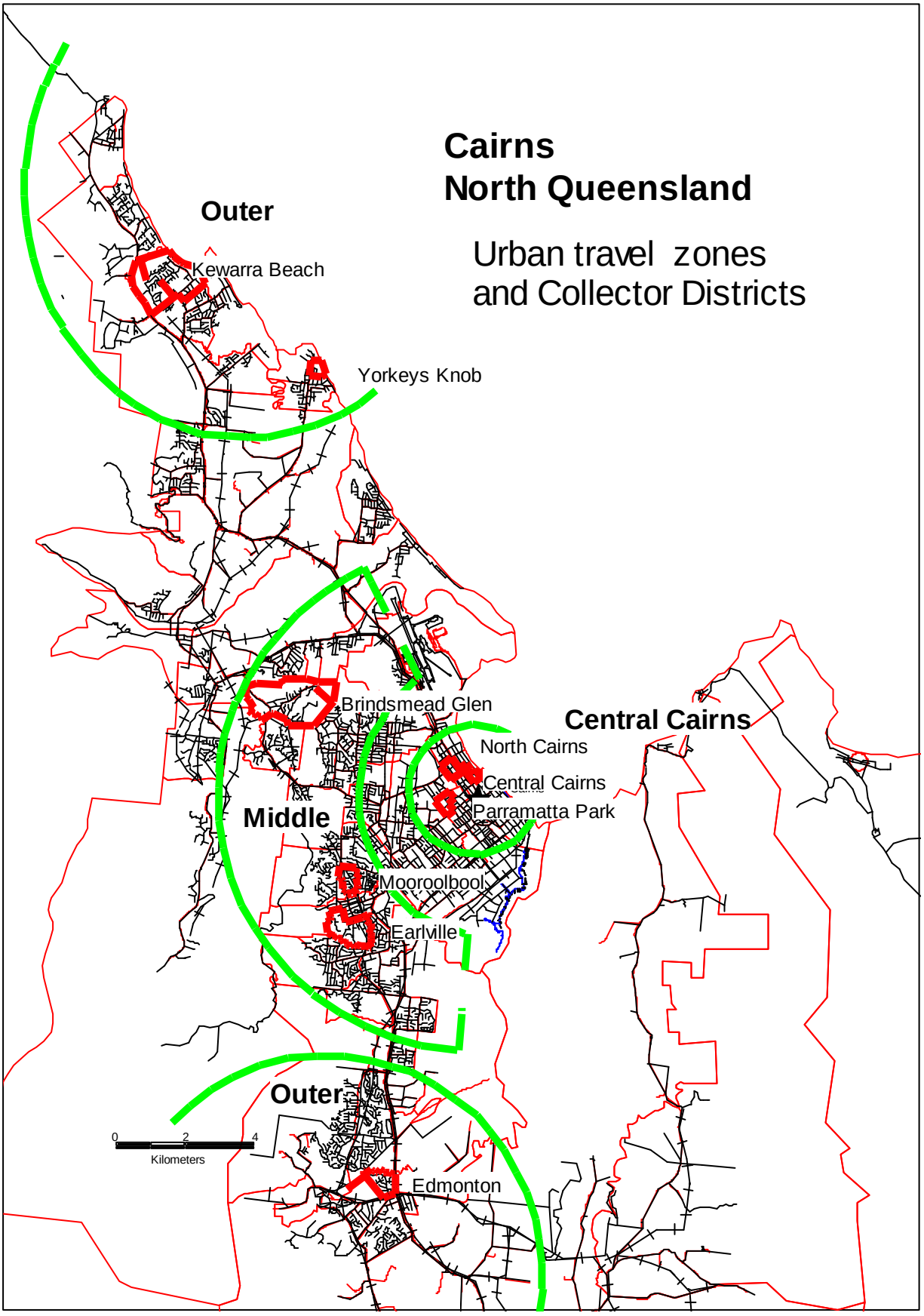
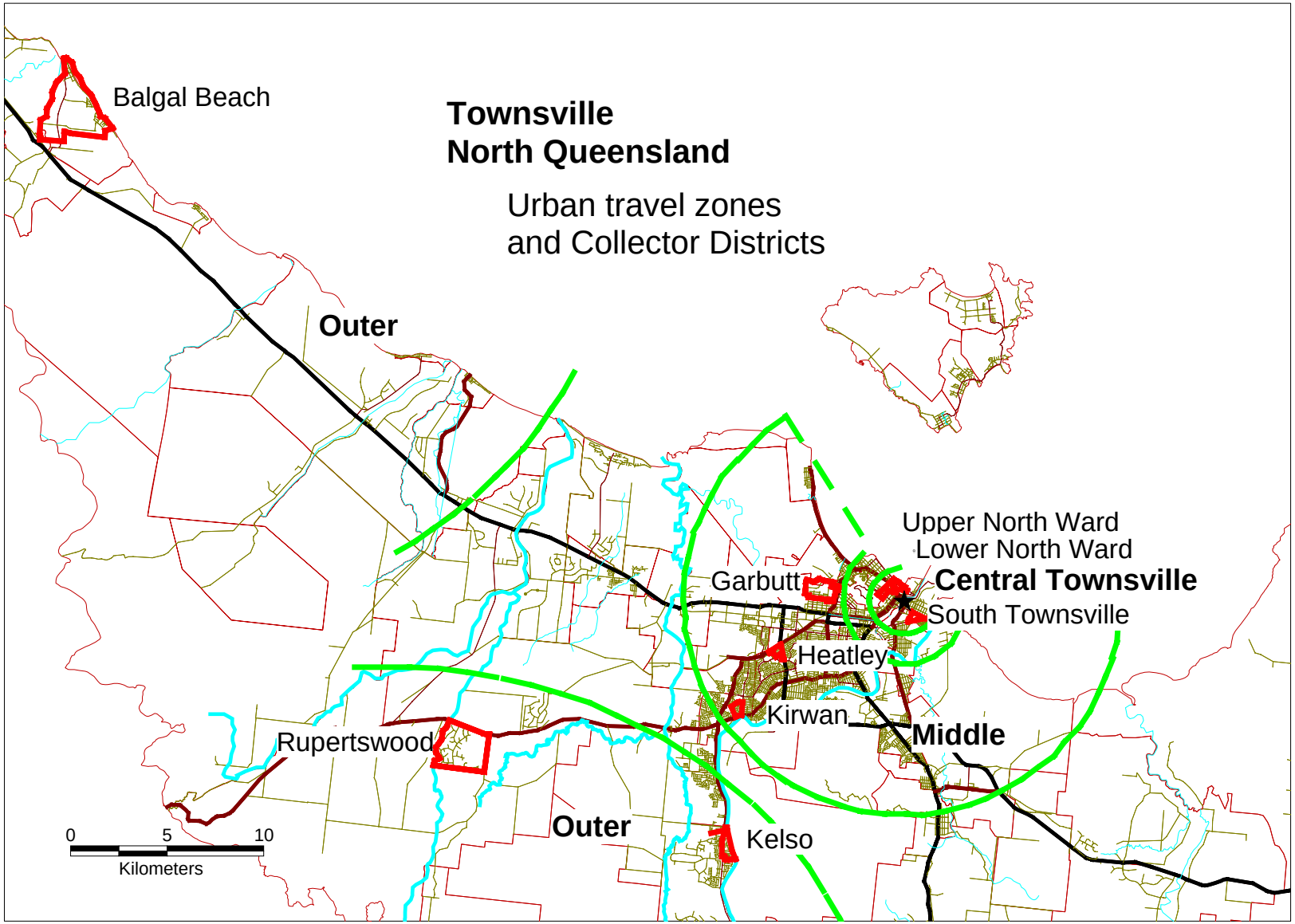


Figure 2.4.3 Map of Townsville survey sites



Seeking at least 60 completed household surveys from each zone, a form and cover letter (Appendix one) were given to an adult in every third household after gaining an undertaking from them to complete the form and place it in a pre-arranged pick-up place (usually their letterbox). This has provided stratified random sampling of every third household from three zones in two cities.

Detail of the research instrument

The survey and cover letter are provided as Appendix 1. The cover letter made clear that: "planners are also interested in the views of residents about the way [the city] is laid out", that the survey was being conducted "to learn details of current urban travel, and how people think and feel about that current travel. The research also aims to learn how people think and feel about future urban travel". Potential respondents read that: "Only 300 randomly selected households are being surveyed in [City], so that you and your household can make a meaningful contribution to planning.

The survey is about your household's current urban travel, how you think about that travel and your preferred urban travel patterns. The survey is being done in collaboration with the Centre for Tropical Urban and Regional Planning (JCU Cairns), and is endorsed with interest by Queensland Transport.

Participation in this survey is **voluntary** and all information will remain **strictly confidential**. This is an anonymous survey, but the general location of your house, along with others in the survey, may be included in general maps of journey and attitude patterns.

This gives **your household** a chance to represent people like yourself,
to express your views about the way urban movement is catered for in our urban area.

Taken step by step, I hope you find the survey questions
thought-provoking and interesting!

Yours

Douglas Goudie (JCU Urban Researcher, TESAG 077 814913).

This Questionnaire will be picked up from (eg letterbox)

.....

On the (date) .....

The survey was broken into sections covering choice of home location, travel details for each resident on the Friday of survey, car ownership and level of use, ease of getting to a list of usual destinations without a car, and what the main respondent felt were the main destinations for themselves and other household members, and their overall car dependence.

After describing the likely link between choice of home location and most consequent travel, the first survey question asked: "*please write why you chose to live at your current address (rather than anywhere else) starting with the main reasons*". Five numbered lines were left. This is another example where open-ended questions are more likely to get a meaningful response than a ' pick and tick' process from a list of pre-conceived ideas of housing choice. There were 33 response types in all, codified from the more common (near city, near shops) to the least mentioned (close to bus, near day care – see Appendix 4). With open-ended questions there is more work for the researcher, but a less imposed structure for the respondent. Few people would read through and properly consider a list of 33 options.

Respondents were asked to write about the strengths and weaknesses of each of the travel modes and complete Likert-based statements to indicate neighbourhood attachment and detail their reasons if they wished to move from their current location for travel related reasons. Questions on public transport established levels of use and perceptions of a range of attributes from comfort to convenience. A Likert-scale block of 10 environmental statements established respondents' environmental values, followed by perceptions, views, values and beliefs about current and future urban travel. Lined spaces were left for respondents to write answers to the following questions.

Questions on current and future urban travel

With three lines left for written responses, respondent were asked the following questions: "What connection, if any, do you see between the way that suburbs are laid out and the amount of driving you have to do? I would now like you to write a little on: .... **Your** perceptions of urban mobility now (what you think of the way we travel around at present): How **you** value and think about your current urban travel:

Your beliefs about mobility in the future: What easy changes would definitely help you or other household members to reduce your car use? Are there other things that you think we might use or do to **easily** reduce our use of petrol, diesel or gas (LPG)?
If you knew that petrol was going to sharply increase in price, what would you do, and what sorts of changes would you like so that your household needs could continue to be met?"

After a Likert-based indication of support or otherwise for light rail, respondents were asked a range of demographic questions, including vehicle details, number of pushbikes owned, and number used more than once per week. They were also asked to indicate the distance to their nearest convenience store.

Means of soliciting completion of questionnaires

In the pilot and main surveys, the interviewer approached the nominated households, seeking contact with a responsible adult. If an adult was not there, the interviewer proceeded to a household immediately adjacent, until contact was made, then proceeded to the next designated third household. This over-represented people who are more inclined to stay at home. The relative effect was minimised by approaching different zones across the ' drop-off" times - Friday afternoon from 3 pm until near dark, and Saturday and Sunday from 10 am until near dark.

People who are not home a lot may have been caught in this sweep over several weekends - if they were not home late Friday afternoon, a like householder may have been in late on Sunday morning. The tendency to over-represent people more inclined
to be at home was thus mitigated, and the effects distributed evenly over the three zones. Although there are many absolute measures in the research instrument, much of the analysis is comparative, so any weakness in the sampling technique was fairly evenly spread over the three zones.

With a refusal rate of less than one in ten, the interviewer returned two to three days later to pick up the completed form. If the form was not where arranged, the interviewer left a brief note (see Appendix 2) requesting the form be completed, with a new pick-up time within two

days. If, on the second return, there was no form, the interviewer left a stamped addressed envelope and a request to post the completed form (see Appendix two).

Method: 3 - Spatially referenced analysis

Data from the survey stage of the research was used to form two major urban mobility case studies from Cairns and Townsville. The final part of the data analysis compared and contrasted respondents' travel patterns, along with perceptions of that and future urban travel, including ways they believe are more likely to reduce their car use. This portion of the results is in a Microsoft ACCESS database on a CD (see disc in sleeve inside back cover), and, along with the written results and SPSS data files, forms an integral part of this submitted thesis. This portion of the methodology makes the data accessible to others, providing the possibility of further analysis by other researchers.

Method: 4 - Input from planners to clarify car reduction strategies

Interest in the project has been gained from some planners in Townsville, Cairns, Brisbane, Canberra and Melbourne. After input from the literature, analysis and mapping from the survey were sent to 36 selected planners or urban energy experts to elicit their ideas to reduce private use of petroleum in the two centres. The questionnaire took the form of 55 urban planning statements gleaned from public input and the urban planning literature. Responding experts, along with rating each statement from strongly agree to strongly disagree, were asked to rate what they considered as the ten most important statements in terms of effective and easy ways to reduce car use (see Chapter 5.6 and Appendix 26). The combined responses were developed into a simple guide to display what mixes of small and easy changes may, according to planners and planning academics in late 2000, produce the largest reductions in fuel use.

Method used to develop the research instrument.

The pilot survey results where used to simplify the draft questionnaire. It was found that all 26 respondents did not know the suburb at all before they began to live there. This finding, although interesting and tempting to confirm from a more representative sample, was dropped for the sake of removing the obvious (as established by the pilot).

A 90% response rate across the three zones from the pilot survey was higher than expected (Buckner 1988). There were four refusals from all households approached, about 85% acceptance. One in seven respondents had problems with QA6. The written parts of section D were left by one in five, but the 80% response rate to section D provides the material for multiple choice answers in the final instrument (See Appendix 1).

Otherwise, people willingly (and sometimes painstakingly) spent half to three-quarters of an hour filling out the forms, often involving other household members (see Table 2.4.1). Nearly all householders filled in their travel details. For the participating 514 residents in Cairns and 560 from Townsville, there were only 60 (5.5% of total householders) who did not. Members of group houses commonly did not complete travel diaries. I assisted four people from non-English speaking backgrounds with the survey. Three lived in the inner zone, and one household in the outer zone. Some pilot results are included as Appendix 3. Analysis of pilot results helped improve the ease of completion for the main instrument by streamlining or deleting some questions.

Table 2.4.1 Response rate from Cairns/Townsville survey

City	Zone	Surveys distributed	Surveys returned	Completion rate (%)
Cairns	Inner	108	61	58
	Middle	108	76	72
	Outer	108	65	62
Cairns total		**324**	**202**	**62**
Townsville	Inner	108	70	65
	Middle	108	68	63
	Outer	108	68	63
Townsville total		**324**	**206**	**64**
Full survey total		**648**	**408**	**63**

Analysis methods - codifying

Converting responses to 20 open ended questions from qualitative to quantitative results was a lengthy and meticulous process. All written results from two Collector Districts in Cairns (one inner, one middle suburb) were placed in each of twenty Word files. Common themes

were sought from those responses, as a first step to code all responses for the 60+ households in each of the 3 zones in the two cities studied. Quite a few extra response categories were added during the data entry phase of the analysis.

As an example, the themes that emerged as universal to urban travel, in rough order of frequency across the dominant travel modes were safety, cost and weather considerations. Subheadings emerged from these general headings, so that, for instance, safety included fearing poor drivers, afraid of being struck by a car, fear of assault, or unsafe surfaces (see Appendix 3 and 4).

Coding written travel details

There were many code compressions from the written travel diaries to the narrow range of codes for destinations and travel modes. Destinations were coded as follows:

Travel destination categories

1 work - centre	2 work - industrial
3 work - dispersed	4 work - tourism
5 other home based	6 University
7 TAFE	8 School
9 Preschool	10 Supermarket
11 Shopping	12 Socialising
13 Exercise	14 Home

The work sub-categories follow general convention in road planning (i.e. Queensland Transport, Cairns 1993). School, social and ‘ home’ were all seen as prominent destinations and included in the coding frame. ‘ Social’ included recreational, visits to friends, or eating out as a group. Drivers who made a trip to pick up some one else were also coded as having a ‘ social’ destination. Parents taking kids to school were coded as heading to school, then each subsequent leg of the journey coded according to the next destination. Work in the tourism group included food preparation, waitressing, as well as dive operators and more obvious tourist operators. That category took precedence over work- dispersed, as did work- industrial. Code values for all variables are provided in Appendix 4.

Trips were made on foot, for instance a round trip from home to home without an intermediate destination. These were coded as ‘ exercise’ , as were trips to the gymnasium or swimming pool. Shopping was broken into ‘ shopping - supermarket’ and ‘ shopping - other’ . “Shopping - other” included purchase or service provision, thus buying lunch, stopping to hire a video, or conducting banking were coded as general shopping. Some of the data entered was done by detective work, where trips as car passengers were embedded in the travel diary of the driver. People generally recorded departure times and other details with painstaking accuracy, displaying patience and perseverance to complete this section of the long and complex questionnaire.

Survey participants were explicitly encouraged to skip questions for which they had ‘ no particular answer’ . Statistical testing of the data sets is given in the following two sections, verifying that the data can be generalised to the CD level in all cases, and that there are statistical differences between zones.

2.5 Statistical testing - Cairns

Generalising sample results

This section outlines statistical tests performed to generalise data. Information collected from each CD was compared to 1996 census data, showing that samples were representative of the full population of each CD. Also, t-tests were conducted to establish that zones are statistically different for transport related data.

The following table provides average vehicle ownership for the sample from each collector district, then compares the sample mean with the population mean for that Collector District. The t-test statistic within the SPSS computer package was used to test if the sample mean fell within the 95% confidence limits for the CD population. Table 2.5.1 shows that the samples do statistically represent the CD population for the number of vehicles per household. This statistic was chosen because it is the one mobility variable shared between the research and ABS data.

For this statistical test, the null hypothesis (H_o) was that there was no statistically significant difference at the 5% level between the sample and the population means. Table 2.5.1 shows that in each of the nine CDs, the H_o is accepted because $p > .05$ (right hand column), and the confidence range straddles the zero value. This one sample t-test from the software package Statistical Package for the Social Sciences (SPSS) performs a 2-tailed significance test of the probability (p) that the sample is drawn randomly from the whole.

Table 2.5.1 Sample and population means for Cairns household vehicle ownership

Collector District	Sample veh./HH[1]	DF	SD	Std. Error	95% conf. interval	CD mean	2 tailed signif. (*p*)
1. Nth. Cairns	1.35	22	.98	.20	-.38 to .47	1.30	.82
2. Central Cns	1.00	17	.69	.16	-.53 to .15	1.19	.26
3. Parram. Pk	1.10	22	.62	.14	-.41 to .16	1.22	.37
4. Brins. Glen	1.64	27	.62	.12	-.47 to 1.38	1.87	.06
5. Mooroobool	1.83	22	.65	.14	-.12 to .45	1.66	.23
6. Earlville	1.69	25	.74	.14	-.35 to .24	1.75	.70
7. Kew. Bch.	1.36	24	.49	.98	-.28 to .12	1.44	.422
8. Yorkys Knob	1.53	14	.92	.24	-.94 to .92	1.12	.102
9. Edm/ton	1.60	24	.71	.14	-.36 to .22	1.67	.625

Note 1. Table 2.5.1 headings are: *Sample veh./HH* gives the average number of vehicles per household in the surveyed sample for each CD, *DF* is the number of degrees of freedom, one less than the number of households surveyed in each CD. *SD* is the standard deviation of the vehicles per household, *Std. Error* is the standard error of the mean, *95% confid. intervals* show the acceptable range between the CD and sample means, *CD mean* is the average number of vehicles per household for the whole CD population, and *2-tailed signif. (p)* is the probability that the sample is drawn randomly from the whole. In no cases is $p < .05$.

This statistical test illustrates the representative nature of the samples as they relate to a known mobility parameter, validating the generalisation of collected data to the CD level. The following section details proof of a significant difference between the three stratified sampling zones, justifying the sampling methodology.

Urban mobility zonal differences in Cairns

Table 2.5.2 presents results of General Linear Model (SPSS software program, 1998) testing within and between groups for collector districts and zones, using general factorial analysis. The Cairns data show statistically significant differences across zones for important variables, including resident numbers, building age (as expected), vehicle numbers, and some mobility attitudes and fuel use. The following Table precedes a summary of some tested variables showing zone-related characteristics of the two hundred households surveyed in Cairns.

Table 2.5.2 shows that for F-ratio values (between zone variance differences/ within zone variance differences, Ebdon, 1990) there were significant within zone similarities at the .05 confidence limit. A significance of $p < .05$ was set for rejection of the null hypothesis (H_o). There were significant differences between zones. The variables chosen were selected after

study of descriptive results, testing those that appeared to vary most between zones. The list is not exhaustive. We may be 99.8% confident (significant at the .002 level) that building age does vary with distance from the city centre. This statistic offers the reader an opportunity to see that the results of the factorial analysis are meaningful.

Table 2.5.2 Collector district comparisons within and between Cairns zones

Dependent Variable:	**Arithmetic means for the three zones**			**Sig. (*p*)**	**F**
	Central	**Middle**	**Outer**		
Approximate age of building	38	17	10	.002	20.869
Approximate fuel costs per week ($)	17	32	39	.006	13.104
Vehicles per household	1.2	1.7	1.4	.035	6.098
"Existing decision-making structures are satisfactory" (% disagree)	55	56	44	.046	5.162

Note: the analysis used type three sums of squares. Non quantitative values represent ranking of 1 to 5 on Likert scales.

Table 2.5.2 also shows that weekly fuel costs, number of vehicles per household, and one attitudinal question were zone dependent to a statistically significant degree. For these four tested variables, there was much more variance between zones than within zones. Other variables which show some clear results ($p < .1$) include how long respondents felt petrol would last (highest in the middle suburbs) and the number of residents per household (lowest in the central suburbs). The General Factorial Analysis provides rigour in differentiating means and variance within and between zones.

The use of one way ANOVAs to compare sample to population results is a powerful statistical test. Although the mean expenditure on public transport in the outer zone was about twice that of the inner and middle zones, the result is not significant because there was nearly as much variance within as between zones for these data.

The sample data are representative of the Collector Districts sampled and there is stratification of the survey sample by distance from the CBD. Because of the mass of data

gathered and analysed, it is least cumbersome to analyse the data on the basis of zone and totals, because of the sheer volume of data collected. However, before zonal comparisons are made, one CD is explored in detail and two less thoroughly to help make the fine detail of the data real to the reader.

2.6 Statistical testing - Townsville

Generalising sample results

The following Table 2.6.1 provides average vehicle ownership for the sample from each CD, then compares the sample mean with the population mean for that CD. The one sample t-test statistic within the SPSS computer package was used to test if the sample mean fell within the 95% confidence limits for the CD population. Table 2.6.1 shows that the samples do statistically represent the CD population for the number of vehicles per household. This statistic was chosen because it is the one mobility variable shared between the research and ABS data.

Table 2.6.1 Sample and population means for Townsville household vehicle ownership

CD[1]	Sample veh./HH	DF	SD	Std. Error	95% conf. Interval	CD mean	2 tailed signif. (*p*)
11. Upper Nth. Ward	1.25	19	.64	.14	-.37 to .23	1.32	.63
12. Lower Nth. Ward	1.04	23	.81	.16	-.29 to .39	.99	.75
13. South T/ville	1.12	24	.97	.19	-.46 to .34	1.18	.74
14. Kirwan	1.40	14	.63	.16	-.42 to .28	1.47	.68
15. Heatley	1.56	26	.74	.14	-6.2E to .6	1.32	.115
16. Garbutt	1.50	23	1.0	.21	-.28 to .58	1.35	.48
17. Balgal Beach	1.38	20	.67	.15	-.31 to .30	1.39	.95
18. Rupertswood	1.95	21	.65	.14	-.24 to .73	1.91	.75
19. Kelso	1.96	23	1.0	.21	-7.4E to .73	1.63	.11

Note 1: headings: *Sample veh. /HH* gives the average number of vehicles per household in the surveyed sample for each CD; *DF* is the number of degrees of freedom, one less than the number of households surveyed in each CD; *SD* is the standard deviation of the vehicles per household; *Std. Error* is the standard error of the mean; *95% confid. intervals* show the acceptable range between the CD and sample means; *CD mean* is the average number of vehicles per household for the whole CD population from Cdata 96; *2-tailed signif. (p)* is the probability that the sample is drawn randomly from the whole CD population.

From Table 2.6.1, the null hypothesis (H_o) is accepted (sample not different from population) because in each of the nine CDs, the probability that the sample is drawn randomly from the population $p > .05$ (Table 2.6.1), and the confidence range straddles the sample mean for each CD. This one sample t-test confirms the representative nature of the samples as they relate to a known population mobility parameter. These analyses validate the generalisation of collected data to the CD level. The following section details proof of a significant difference between the three stratified sampling zones, justifying the sampling methodology.

Urban mobility zonal differences in Townsville

Table 2.6.2 presents results of General Linear Model (SPSS software program, 1998) testing within and between groups for CDs and zones using general factorial analysis. The Townsville data show statistically significant differences across zones for important variables, including resident numbers, building age (as expected), vehicle numbers, and some mobility attitudes and fuel use.

Table 2.6.2 Statistical comparisons within and between Townsville zones

Dependent Variable:	**Arithmetic means for the three zones**			**Sig. (*p*)**	**F**	**Rank zone dependant**
Variable/ZONE	**Cent.**	**Mid.**	**Out.**			
Ease of mobility without a car[1]	2.43	2.00	1.18	.010	11.0	1
Households without a car (%)	21	6	0	.009	10.9	2
Approximate fuel costs per week ($)	20	27	40	.012	9.8	3
Average trip distance (Km)	3.37	5.11	19.00	.016	8.90	4
Approximate age of building	47	27	12	.021	7.8	5
Distance to nearest convenience store (Km)	.6	.9	3.3	.022	7.7	6
Vehicles per household	1.5	1.6	1.8	.023	7.4	7

Note 1: The analysis used type three sums of squares. Non quantitative values represent ranking of 1 to 5 on Likert scales.
Note 2: 1 = very difficult, 5 = very easy.

Table 2.6.2 shows that for F-ratio values there were significant within zone similarities at the .05 confidence limit. A significance of $p < .05$ was set for rejection of the null hypothesis

(H_o). There were significant differences between zones. The variables chosen were selected after study of descriptive analysis. The list is not exhaustive.

We may be 99% confident (i.e. significant at the .01 level) that perceived ease of mobility in Townsville is highly linked to distance from the city centre. Table 2.6.2 also shows that households without cars, weekly fuel costs, average trip distances and building age do vary with distance from the city centre:. The distance to the nearest convenience store and vehicles per household are also zone dependent. For these six travel-related variables, there was much more variance between zones than within zones. There is stratification of travel-related data for Townsville dependent on distance from the CBD.

2.7 Research analysis constraints

Decisions were made when coding the self-completion daily travel diaries. One of the first problems was to clarify who should be included. Children under four years of age do not have much independent mobility. They may travel with their parent(s) on a five-stage journey, but remain fully dependent, without their own mobility choices. The following results include all persons, but exclude trips made by children under four, unless it involved a playgroup, or a social visit. All other passengers on all other trips were included, no matter how passive their presence to the goals of that trip. If a parent picked up school children then did some banking on the way home, that trip (departure point to each clear destination in an overall journey) was included for the mother, and for each of the children from the time they became passengers.

At the other end of the dilemma coding the raw data from travel diaries were the many old people who did not travel on the Fridays surveyed. They have been included because, although they did not travel, staying at home is an option that may become more attractive to others, and we can learn something from those who do not travel extensively. A further note of caution stems from the travel diaries being only for Fridays (drop off surveys were distributed on Fridays and weekends only - when most people are home – and the prior week day was the most likely to be remembered). People tend to socialise and eat out more on Fridays than most other weekdays.

Finally, there are errors in the data provided. People from the same neighbourhood estimated quite different distances into the CBD. By scanning through the record sheets, in most cases the common destinations could have a ‘consensus’ distance attached. Some of the more obscure destinations were generally recorded as given, so the travel distances should be treated with some caution. In a worst case, one 44 year old living alone had noted his age elsewhere on the form as 45.

Having detailed the reasons, objectives and methods employed in this research, the following provides detailed results from Cairns in Chapter 3, Townsville results in Chapter 4, then the combined results in Chapter 5.

Chapter Three
Cairns results

This chapter presents results from the urban mobility study conducted in Cairns in February 1997. An initial overview of Cairns survey results shows general research outcomes. This is followed by results at the zonal level (inner, middle and outer) and aggregated Cairns outcomes, including reasons for choice of home location, perceived car dependence and trip details. Analysis of neighbourhood attachment and perceptions of bus and other travel modes are also presented. Environmental beliefs, along with the way people think and feel about urban travel now and in the future are also provided.

Understanding the physical transport infrastructure may aid the reader' s understanding of beliefs and choices made by respondents. Cairns, with its population of about 100,000 people in 1996, had extensive and expanding road infrastructure. CBD parking was at a premium, costing about $5 per day. In 2000, the whole approach to parking was being revised along sustainability policy guidelines – parking stations and better facilitation of cycling and pedestrian movement. Unlike Townsville, Cairns suffers major peak congestion, particularly to and from the major growth corridor south of the CBD. There were 34 x 27 seat buses, which serviced the city, mainly the outer suburbs. There are heavy gauge rail lines through the population centre, but no revival of commuter services at time of writing. The foregoing sets the scene for the following broad review of results.

3.1 Overview of results

These results show many of the primary similarities and differences within and between the nine Collector Districts (CDs) surveyed in Cairns. From 108 forms distributed to randomly selected households within each of central, middle and edge suburbs (324 in total), a completion rate of 62% of those approached returned 202 questionnaires (Table 2.1.1). Survey completion rates reflect interest in urban travel issues (Buckner 1988), so a completion rate greater than 60% indicates a strong interest about urban travel (Richardson *et al.* 1996) in Cairns. Residents of the more established middle suburbs seem to have the greatest interest (72% completion rate) in urban travel issues.

Zone-related results in Cairns[1]

Some surveyed traits were independent of zonal location, while many measured traits with one zone clearly different to the other two zones. Table 3.1.1 provides relationships of zone-independent and zone-dependent survey results for demographic, building characteristics, travel behaviour and some value-based responses. Location-independent variables include income, respondent age, education level, long distance annual journeys, age of main vehicle and average vehicle engine size. The percentage of mortgaged residences increased markedly from centre to edge, while the age of residential buildings decreased.

The inner suburbs had the highest proportion of tenants and the most people who felt that living without a car was or would be reasonably easy. Inner urbanites had the lowest car ownership rate, used the least amount of petrol and had the lowest number of people per household. The data also shows that inner urban dwellers were generally closer to convenience stores.

Mid urban dwellers tended to have the highest percentage of people born in Cairns, thus the longest average residency in Cairns. They showed the highest home ownership level, with the highest number of cars per household, the most with two vehicles, making the highest number of daily trips. They were the least interested in pushbike security. Outer urban dwellers paid the most for parking and public transport, owned the most push bikes per household and gave the clearest support for light rail.

This section shows that the three zones do have many distinct characteristics (Table 3.1.1), especially in relation to transport issues, confirming a central hypothesis that urban travel patterns are related to distance from the city centre. Having established an

[1] Details of the following data are presented in Appendix 5, where descriptive results are given for demographic information, housing, responses to blocks of questions on neighbourhood attachment, attitudes to buses and environmental values, transport and travel details. Some cognitive issues (how people think about certain things) are detailed in Appendix 6, including a summary of thoughts on planning issues provided by respondents. These data are later used as the framework for detailed analysis in Chapter 5 leading to recommendations in Chapter 6, aiming to reduce overall car use.

overview to the Cairns population sample, the next section considers respondent's 'internal space', that is, how they felt about and valued their urban situation, particularly in relation to urban travel.

Table 3.1.1 Selected data means across the Cairns zones

Zonal trait	Central	Middle	Edge	Total
Zone independent[1]	**Mean**			
Household income ($,000/yr)	34	38	36	36
Age of respondent (years)[1]	43	46	44	44
Education (year)	12	12	12	12
Car engine size (average # cylinders)	4.8	4.8	4.7	5
Age of main vehicle (years)	9	9	10	10
Number of long distance journeys per year	1.3	1.5	1.6	1.5
Decrease across zones				
Age of building (years)	38	17	10	21
Increase across zones				
Currently have mortgage	12	25	38	25
Weekly fuel costs ($)	17	32	39	30
Central different from mid and outer				
Paying rent (%)	**62**	25	34	38
People per household	**2.4**	2.9	2.8	2.7
Own a car	**83**	100	100	95
Drives more than 10x per week (%)	**37**	58	59	52
Answered Q on buses (%)	**23**	40	46	37
Perceived difficulty without a car (%)	**52**	84	79	73
Number of push bikes owned	**1.3**	1.6	1.6	1.4
Distance to nearest convenience store (Km)	**.3**	.9	1	.7
Middle suburbs different from inner and edge				
Born in Cairns (%)	13	**29**	8	17
Home ownership - outright (%)	26	**50**	27	35
Number of vehicles per household	1.2	**1.7**	1.4	1.5
Female respondents (%)	43	**58**	43	48
Two vehicles owned (%)	26	**50**	29	36
Vehicle provided by employer (%)	13	**18**	11	14
Want more push bike security	21	**11**	26	19
Outer suburbs different from central and middle				
Use public transport, main respondent (%)	10	11	**19**	12
Average weekly parking costs for users ($)	2.2	2.1	**3.7**	2.5
Cost of public transport ($/wk for users)	4.5	3.5	**8**	5
Drives 5 – 10 x per week (%)	23	23	**29**	25
Support light rail (%)	52	51	**74**	57

Note: in each of the variables where there was little difference between the zones, the Eta-Squared value was < .05. Eta-squared is interpreted as the proportion of the total variability in the dependent variable that is accounted for by variation in the independent variable. It is the ratio of the between groups sum of squares to the total sum of squares.

The value placed on cars by surveyed Cairns residents

Most people were satisfied with their current urban travel, while acknowledging their car dependency. Cars were seen predominantly as convenient (35%) and providing independence or freedom (30%). The second written response to the question: *What are the strengths and weaknesses of car use in Cairns?* showed that a major concern was the high cost, ranking ahead of the view that cars provided convenience, independence or speed.

By scrutinising the first, second, third and fourth set of responses before aggregating them, more detail of peoples' priorities emerges. Perceptions of car use are a good example of that, shown in the following Figures 3.1.1 – 3.1.7, where the fine detail of the sequence of responses to one question is given. Note the different emphases as respondents' thoughts and views about car use are presented. This series shows a step-by-step process where the trend of perceptions about strengths and weaknesses of cars are made explicit (Appendix 7).

Figure 3.1.1 First written perceptions of car use

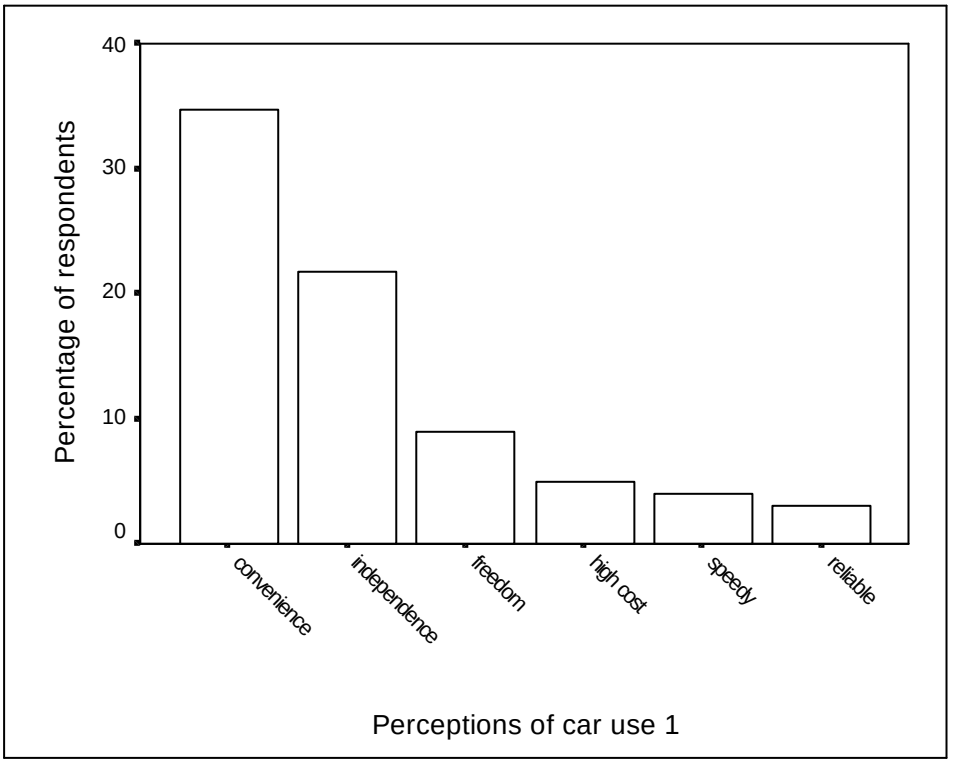


Figure 3.1.2 Second written perceptions of car use

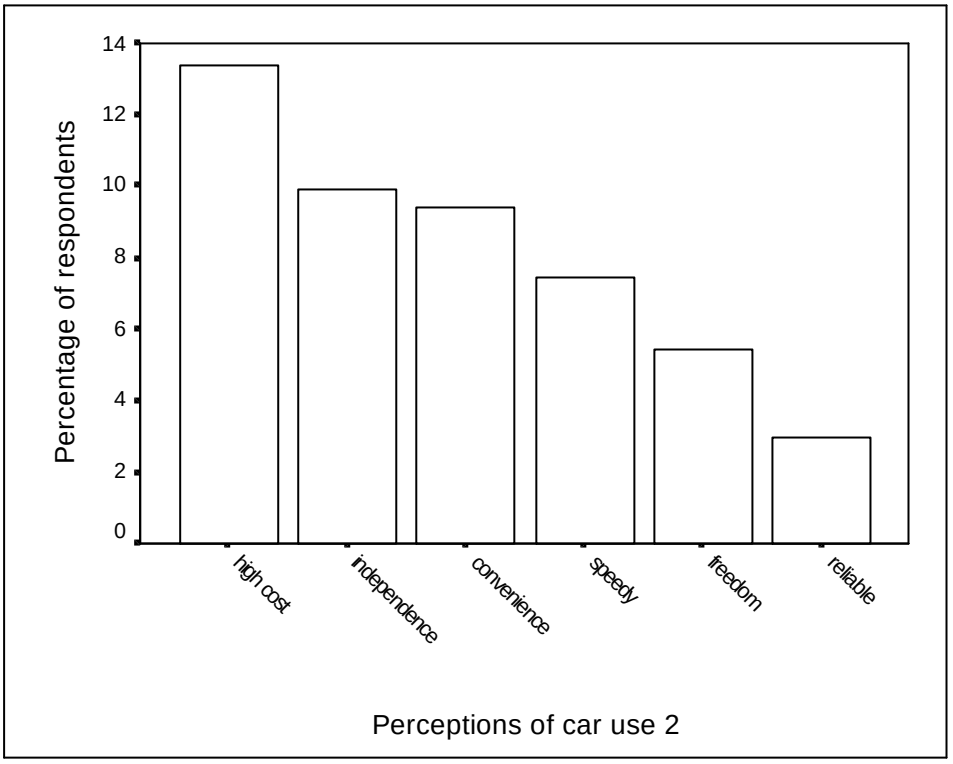


Figure 3.1.3 Third written perceptions of car use

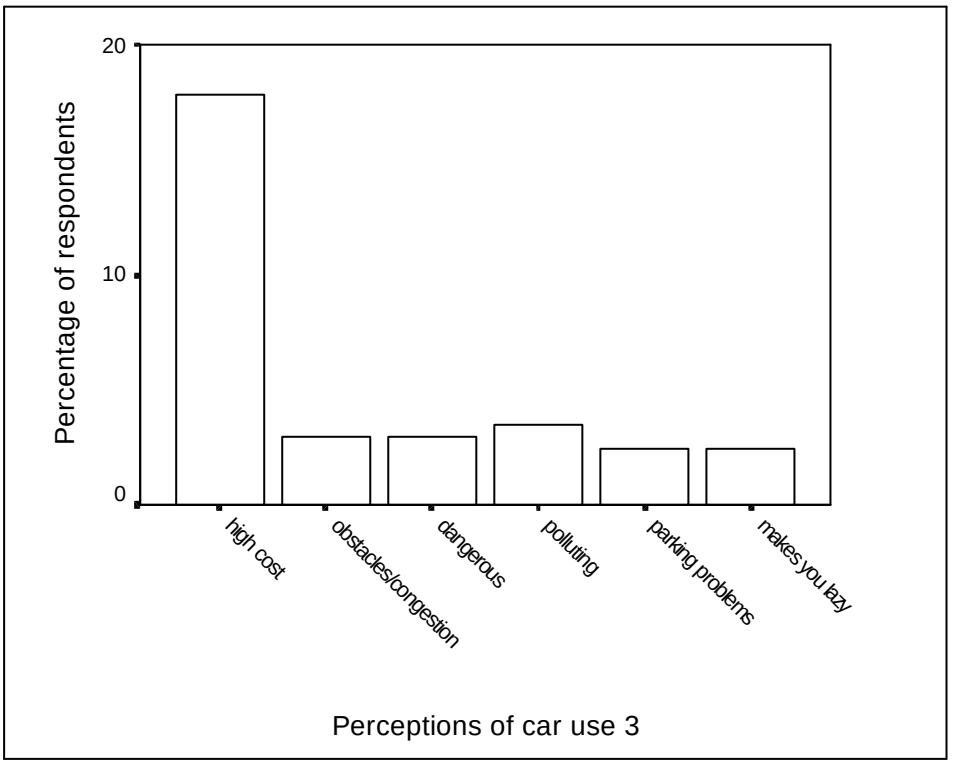
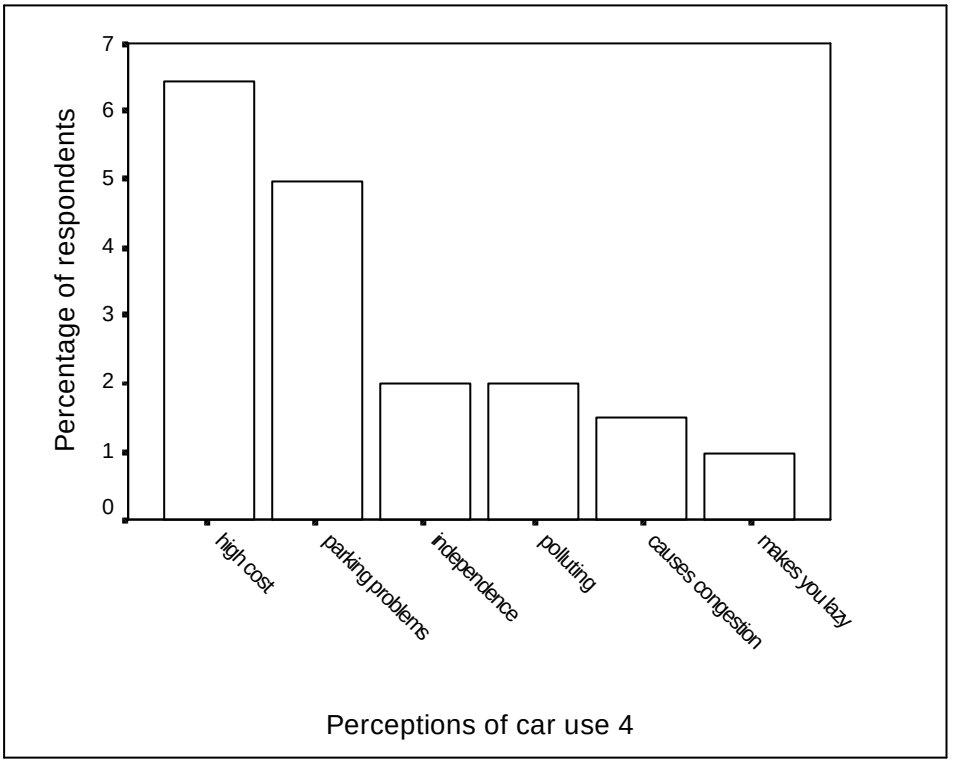


Figure 3.1.4 Fourth written perceptions of car use



The detailed sequence of Figures 3.1.1 – 3.1.4 shows the advantage of initial ‘ fine grained’ analysis, while the following Figures 3.1.5 – 3.1.7 show a summation of the 800 possible responses to this one open ended question on perception of car use. Throughout the rest of this chapter, only the results which most clearly show the similarities and differences of residents behaviour, values and beliefs are given (Appendix 8).

These figures have drawn on multiple written responses on the strengths and weakness of car use. There were 503 written entries from the 202 households. Figure 3.1.6 shows what many know already, that using a car is generally convenient, it provides independence and is speedy. Although it is expensive to own and use and there may be parking problems, cars are comfortable, carry loads and passengers, and are weatherproof. Figure 3.1.7 displays perceptions of car use at the zonal level, showing that people in the outer zone relished the freedom but disliked the high costs, while mid-dwellers appreciated the reliability that cars provide.

Figure 3.1.5 Total perceptions of car use

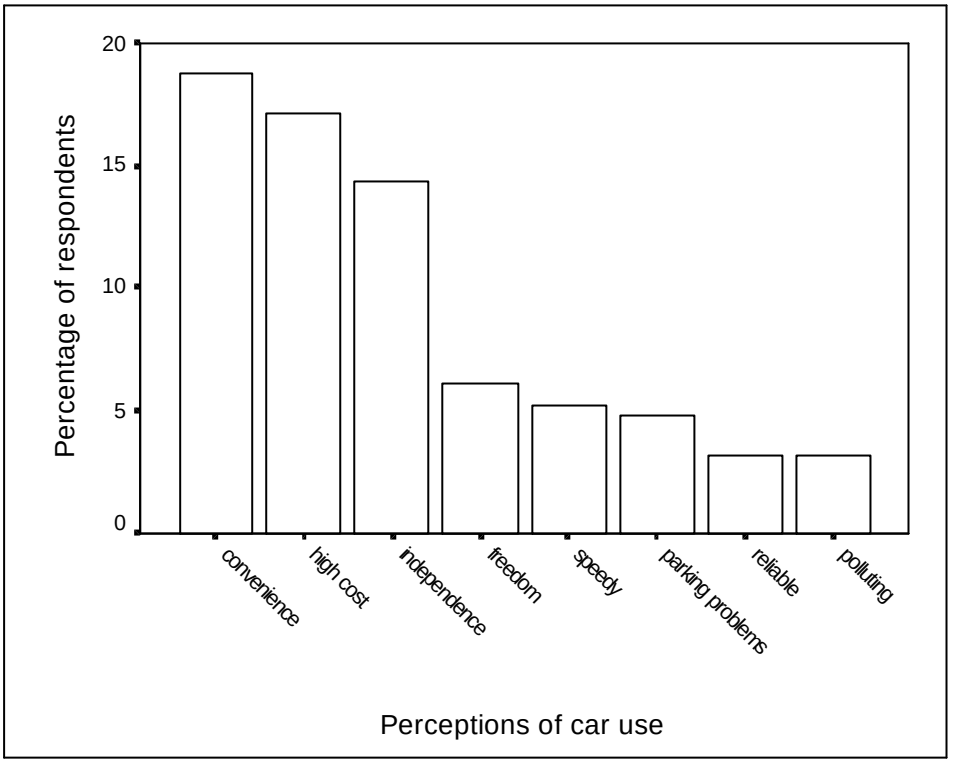


Figure 3.1.6 was gained by aggregating like traits, such as the five recorded ways that people experienced fear in car use, aggregated to ‘ dangerous’ .

Figure 3.1.6 Generalised perceptions of car use

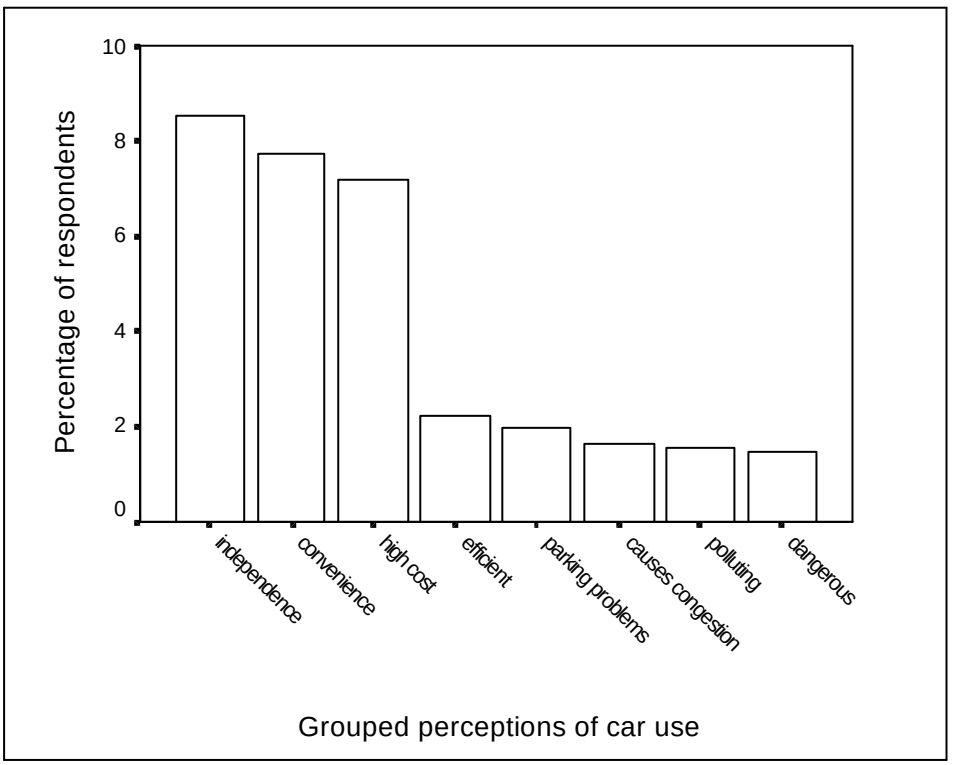
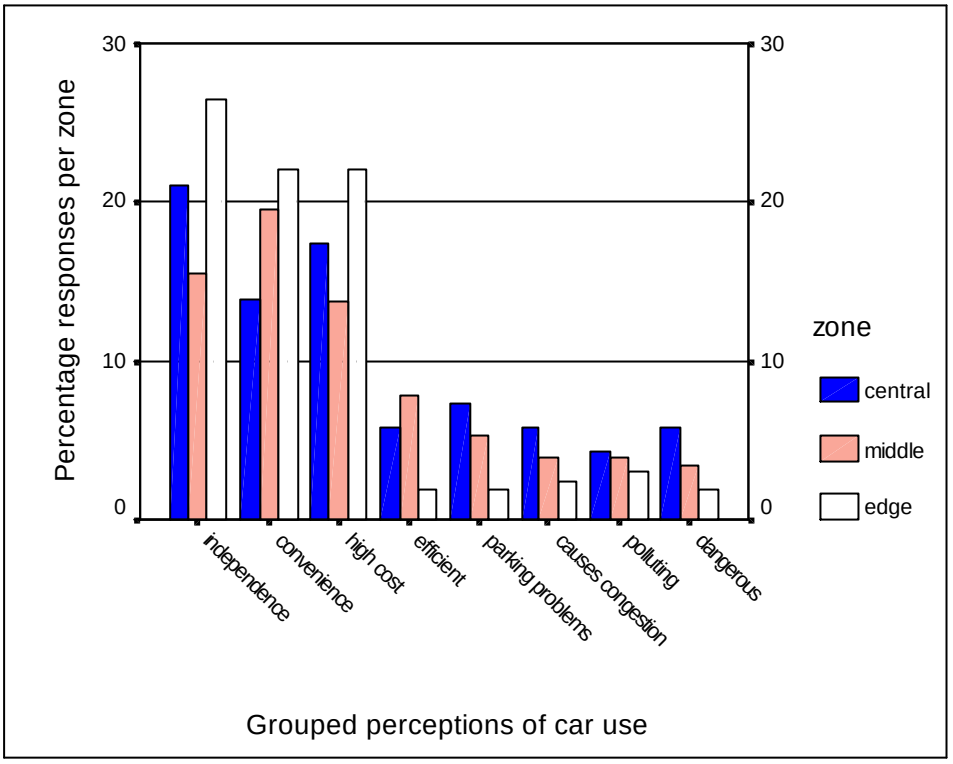


Figure 3.1.7 Zonal perceptions of cars



Although inner urban dwellers were the least car dependent overall, the above views are generally shared across the city zones. Running a car may seem to cost a lot, but the independence and convenience that goes with private car use is seen as paramount. Although reasonably efficient, car use may also incur parking problems, cause congestion, pollute and be used dangerously. Less frequent responses were that cars make you lazy and, but they are weatherproof, can carry loads, and are relatively cheap and comfortable.

In this overview of results, the next section identifies how people prioritised their travel destinations, why they chose their particular home location, provides views on light rail and gives some insight into environmental beliefs in Cairns.

Perception of destinations and travel modes

Nearly 60% of respondents nominated work as the most important travel destination. Going to the supermarket ranked second, seen as most important by about 18% of respondents. People were surveyed on all possible modes of travel or alternatives to travel. Walking and cycling were seen as good exercise and enjoyable, but dangerous

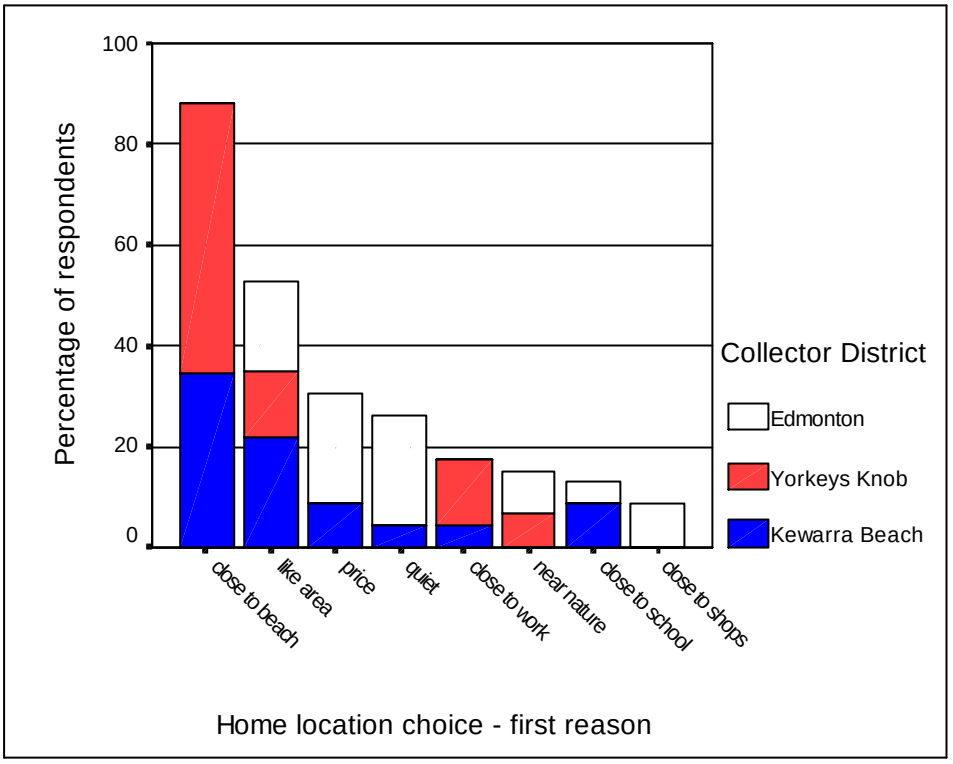
and needing more paths. Ride sharing was seen as a good way to reduce costs. Although supported by many for that reason, and because it would reduce congestion and save fuel, ride sharing was also seen as unreliable and dependent, and probably inconvenient. Working from home was seen about equally as either saving money or not being possible. Many supported the idea, because it would reduce congestion and save fuel, as well as being relaxing. Working from home or compressed working weeks (working ten hours per day, four days per week) may reduce peak congestion. Implications of using the internet instead of travelling to pay bills or do banking are detailed in Chapters 5 and 6.

Choice of home location dictates much of the consequent urban travel, with analysis of 1,700 recorded trips showing that people on the urban edge tend to travel most. With sixty percent of those surveyed either owning or in the process of buying their residence, there is a clear commitment to a particular residence. Location choice for this large investment is clearly important to residents, so the next section considers this in some detail.

Reasons for home location choice

Again to show the detail of analysis available with this urban travel data set, the following Figures indicate priorities in home choice for surveyed outer urban dwellers. Figure 3.1.8 shows that the beach was the dominant factor in choosing a home for respondents of two beachside suburbs surveyed. Location choice is also dependent on variations of ‘ liking the area’ . Price, quiet and nearness to work also featured as clear reasons for outer urban residents to chose those suburbs. Figure 3.1.8 also shows that zonal traits may be far from homogeneous. To further introduce results, the next section provides some insight into public views of using urban rail in Cairns.

Figure 3.1.8 Detail of the 3 outer suburb CDs – home location choice



Rail views

The largest single category of written response on the strength and weaknesses of urban rail use in Cairns was of support, followed closely by the sentiment that the setup costs would be very high. Rail use was seen as likely to reduce congestion, be speedy, reliable and noisy. A direct question on support for light rail produced the following results: Figure 3.1.9 shows there was overall support for light rail in Cairns, although there were many precautionary notes to the written responses to the strength and weaknesses of light rail (Appendix 5). Noise, cost and few relevant cane tram routes would impose great constraints on the use of rail except along existing heavy rail easements or arterial road use. Figures 3.1.10 and 3.1.11 on environmental beliefs show one of two anomalies in the results: people overall do not have much faith that technological improvements will provide for our continued well being, but there is a general belief that renewable fuels will fully replace motor fuels.

Figure 3.1.9 Cairns support for light rail

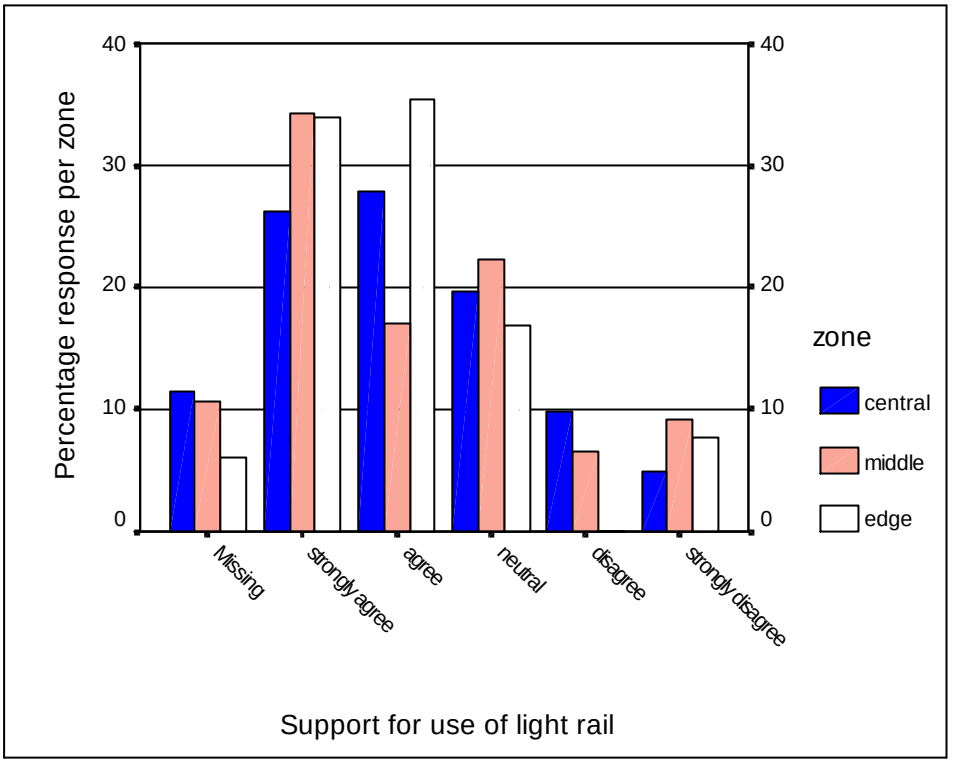


Figure 3.1.10 Faith that technology will continue to support our needs

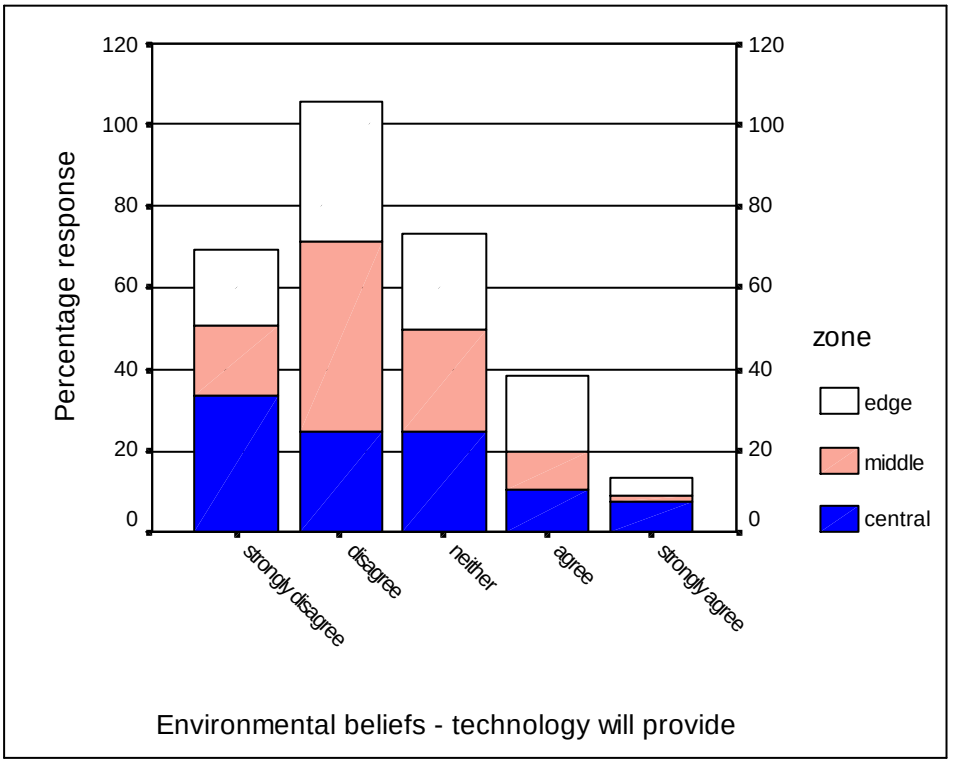
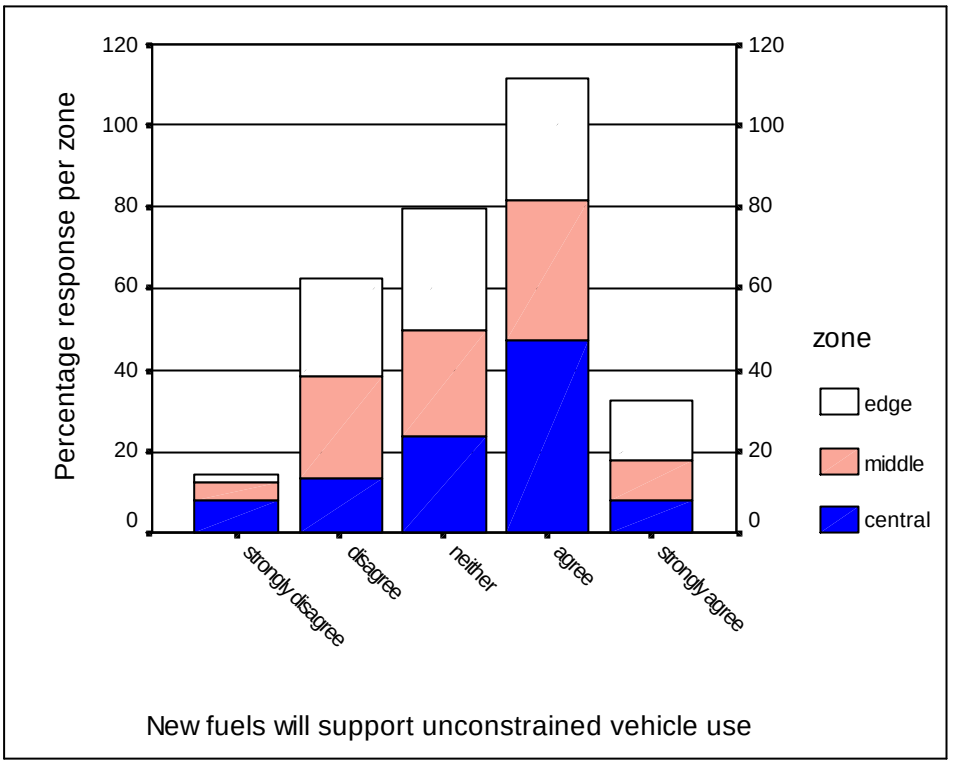


Figure 3.1.11 Belief that renewable fuels will allow unconstrained urban mobility



XXXXThe future

Beliefs about future urban mobility included expectations that there will be more public transport. Although many respondents felt that they will remain very car dependent, there will be alternative fuels and technological changes. Urban rail was seen as playing a part, and there was a perceived need for planning changes. When asked in a section on environmental beliefs if technology would allow the maintenance of our current life style, most thought not (Figure 3.1.10). There is, however, optimism that renewable fuels will probably allow us to continue using private motorised transport in the way we now take for granted (Figure 3.1.11).

After this initial exposure to some of the research outcomes and the detail contained in the data set, the following section provides results at the zonal and city level.

3.2 Cairns zone and total results

Choice of home location

Because most journeys begin and end at home, choice of home location may be a profound determinant of travel thereafter. Respondents were asked to list their reasons for choosing their current home, beginning with the most important. There was a 91% response to this block of questions, with written responses, grouped as follows. Figure 3.2.1 shows the dominant written reasons for choosing to " *live where you do …(rather than anywhere else)*".

Figure 3.2.1 Cairns total reasons for choice of specific residential location

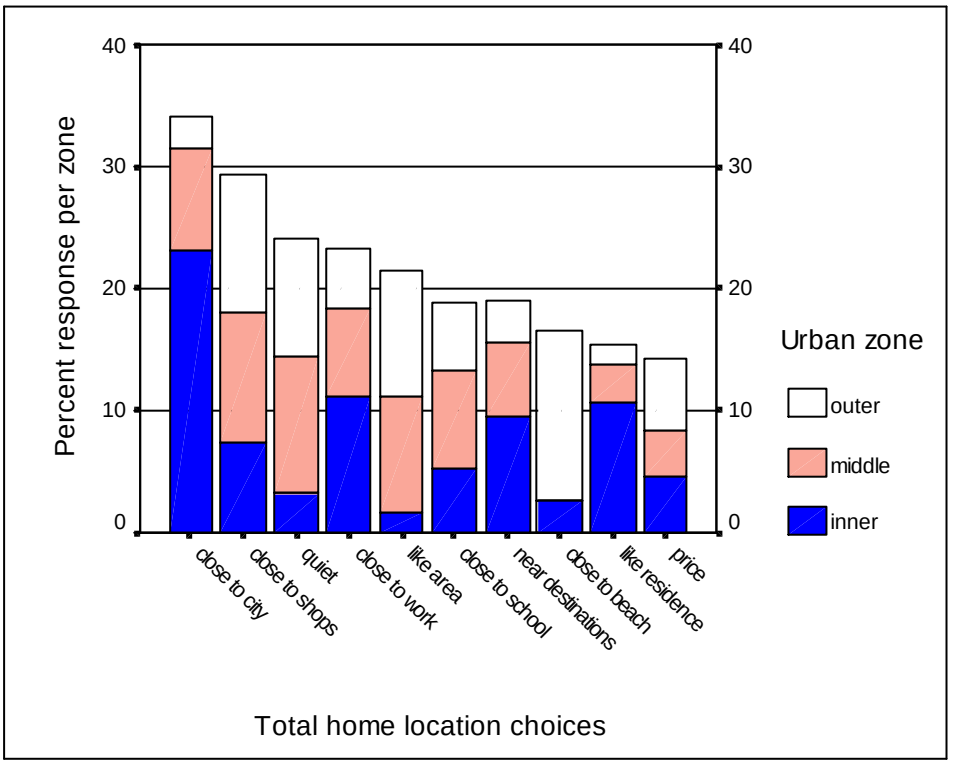
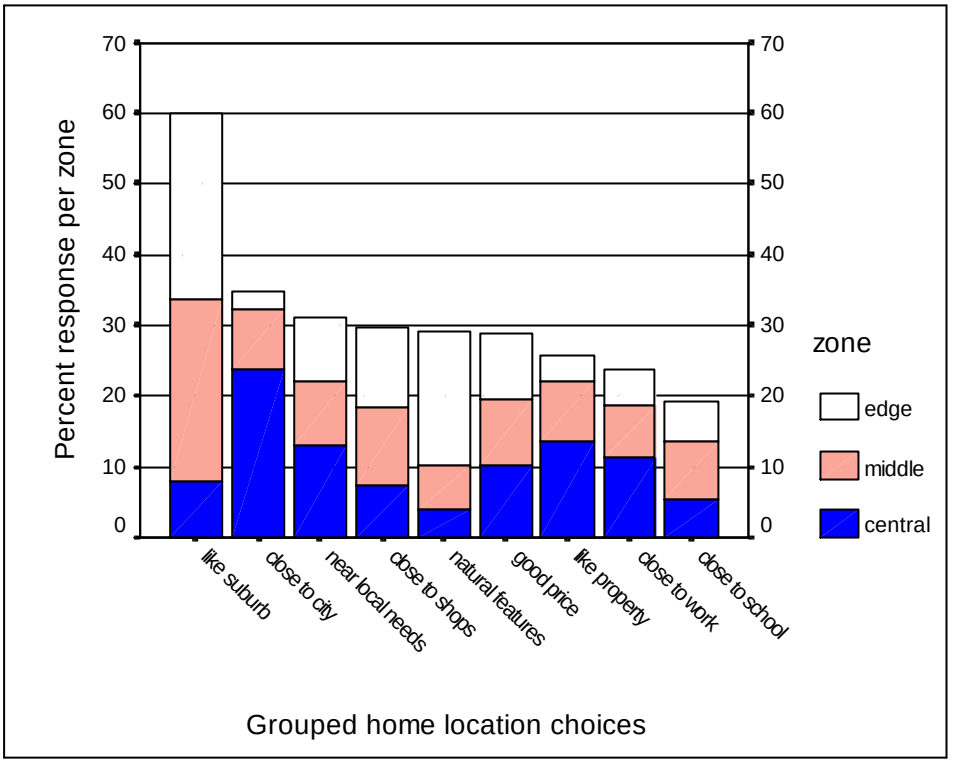


Figure 3.2.1 shows that closeness to the city was the dominant choice of home location in the Cairns sample, bolstered to the lead position by the inner urban dwellers, with closeness to shops also important. Quietness and closeness to work were also important. The ' totals' of the main coded categories give an accurate summary of what respondents wrote. The detail of the ' totals' is ' fine-grained' . The following Figure 3.2.2 shows the results when the coding categories for the written responses are grouped into more general categories (see Chapter 2 for coding details). By combining like categories, the grouped results give a clear overall result.

Figure 3.2.2 Grouped home choices by zone in Cairns

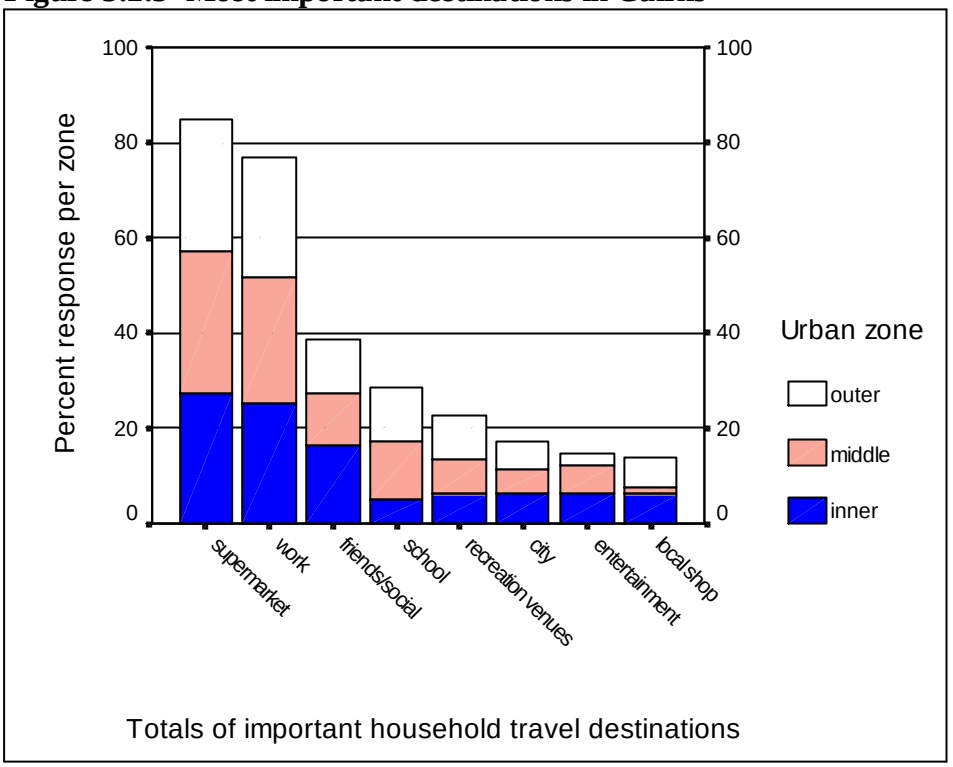


Note: percentages for the sum of the three zones are potentially equal to 300%.

By grouping like responses, it becomes clear from Figure 3.2.2 that the dominant general reason for choice of home location is the householder' s general attraction to a given area. Also, most central dwellers actively sought their centrality, and liked their property and its proximity to work. Mid urban dwellers chose their addresses because it was close to shopping, school and work. Outer urban dwellers often chose the natural attractions of their areas, which, in the sample CDs, usually included the beach, a preference for the area and an acceptable property price.

Figure 3.2.3 indicates the central importance of supermarkets as an urban travel destination. Supermarket shopping and work were clearly the most important destinations, followed by social visits, school and recreation venues. Analysis of xxxx respondents' listed second and third destinations reinforce this result. Synthesising these results, people in Cairns saw travel to supermarket as important and highly car dependent.

Figure 3.2.3 Most important destinations in Cairns



Note 1: listed destinations "public transport" and "recreation were removed, representing < 2% of responses.
Note 2: Percentages are >100 because the chart represents the sum of the three zones, a potential 300%.

Respondents were also asked to "*rate how easy it would be for you and other household members to get to each destination without a car*". Their responses used the following rating:

N/A = Not Applicable 1 = very difficult, 2 = difficult,
3 = neither difficult nor easy, 4 = easy, 5 = very easy.

The following results explore responses in some detail. Surveying how people are reliant on cars, and ways that people feel they could easily reduce that reliance is a central theme of this thesis.

Travel to work, travel to friends

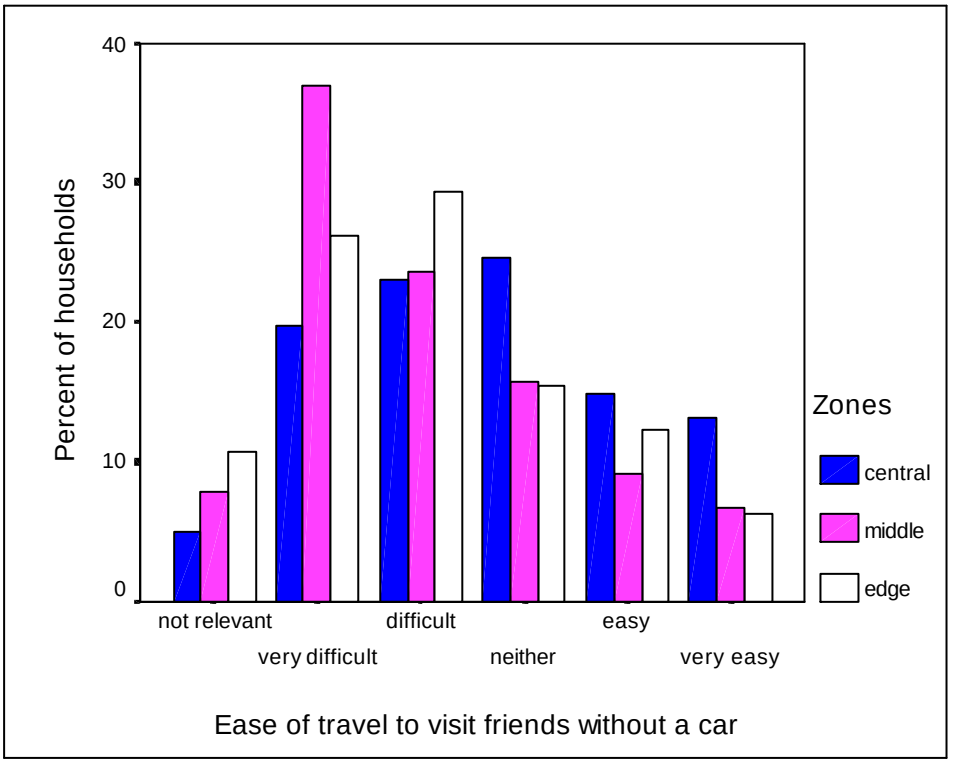
Travel to work is central to planning for peak road use, because of the possible need for costly expansion of the road system (Newman and Kenworthy 1999). Car dependence for travel to and from work increased as residents live further from the city centre. Most inner urban dwellers saw commuting as difficult without a car, compared to very difficult for mid and edge dwellers. To a significant portion of retired edge dwellers,

travelling to work is no longer relevant. People in the middle suburbs appear to have the greatest reliance on cars for social contacts, but most people appear reliant on cars to socialise (Figure 3.2.4). This link between destinations and distances travelled is further explored in the following multivariate analyses. Car dependence is a core life style issue where maintaining friendships often relies on car use.

Table 3.2.1 Ease of travel without a car, general total summary

Destination	Result summary of ease of access without a car
Local shop	Generally seen as easy by all zones
Supermarket	A fairly normal distribution centred on "neither" for all zones.
Work	More difficult for residents living further from the city centre.
City	Inner finds easiest, outer find hardest.
Schools	Although not relevant to about 40% of responding households, about 20% of those with school children in the middle suburbs found their car dependence for school travel to be about twice as high as central or outer urban dwellers. Outer urban dwellers saw getting to school without a car as relatively easy because school buses service the outer suburbs.
Public transport	Interested respondents found access to public transport easy without a car.
Friends/ social	There are marked differences, with outer urban dwellers being most car dependent for socialising, and inner urban dwellers least dependent
Recreation facilities	Middle urban dwellers consistently found this most difficult, while the inner and outer residents seemed fairly ambivalent.
Entertainment	Similar to recreation facilities.

Figure 3.2.4 Difficulties visiting friends without a car in Cairns



Car reliance indicators

This section considers results particularly related to autodependence (Newman and Kenworthy, 1989). A block of Likert rated questions on self-judged ease of travel without a car to main destinations was used as the starting point for some multivariate analysis. After detailing the approach and theory with the self-recorded link of car dependence to main destinations, more complex results are presented. The general statistical approaches used are factor and matrix analysis, then multivariate analysis of variance, using the SPSS software package.

Results show a robust support for these different analysis techniques. Although factorial analysis develops 'artificial dimensions (factors)' (Babbie 1990, p 313), factorial analysis of the following sets of data produced the same linked relationships among variables as hierarchical cluster analysis. To reduce the data, the three socially oriented destinations, friends, recreation and entertainment were collapsed into ' recreation' (the middle value), and the least car dependent destinations (public transport, local shop) were dropped, leaving column three in Table 3.2.2.

People saw supermarket shopping as their most car dependent behaviour, followed by the need to travel to the city, social pursuits, taking kids to school, and getting to work, in that order. The order of car dependence was maintained when the three top ranking factors (mall, city, and social) were subjected to a further factor analysis. The strongest indication of our car dependence is our reliance on the car to do the weekly shopping.

Table 3.2.2. Car reliance to main destinations in Cairns

Destination	**xxxx principal component**	**PC with five main destinations**	**Final ranking of car dependent destinations**
Entertainment	.79		
City	.70	.73	2
Recreation	.70	Social .70	3
Shopping mall	.70	.76	1
Visit friends	.66		
School	.59	.66	4
Work	.56	.61	5
Local shop	.53		
Public transport	.40		

Factor analysis component matrix.

This section has shown some detail of why people live where they live, what destinations are important to them, and that most residents rely on their car to get to most destinations. The next section provides detailed data and analysis on the way Cairns residents travel about, their travel times, destinations, modes and estimated distances.

3.3 Cairns travel details

This section focuses on travel patterns, particularly peaks, of central, middle and urban edge dwellers. Travel destination and mode are provided for the 1700 trips documented in the three Cairns zones. The zones show marked differences. In 1986 there were 3.07 urban trips per person (Queensland Transport 1993), rising to 3.37 by 1997, an increase of 10%. The current study shows that 79% of all 1731 trips were made in private cars, an increase trip share of 5% on 1986 car trip use. This section details travel modes, and concludes that mobility and car use are on the increase, but increases are reasonably age dependent.

Table 3.3.1 Overview of Cairns travel detail data

Zone	# of H/holds	# of residents	# of trips	Mean trip distance (Km)	Mean # residents/ Household	Mean trips/ person
Inner	64	140	445	3.4	2.4	3.2
Middle	73	200	722	5.8	3.0	3.6
Edge	66	174	564	10.6	2.8	3.2
Total	203	514 *(496)*	1731 *(1700)*	6.8	2.8	3.37 *(3.43)*
With the 41 non travellers removed						*3.73*

Note 1: value in brackets is with *children < 4 years of age removed from analysis*

Table 3.3.1 displays fundamental zonal differences in urban travel. Trip distances increased from central to peripheral residents, although the number of trips remained fairly constant. One striking feature of the three zones is the different departure patterns, as shown in Figure 3.3.1. Comparison of the three zones shows that of the 1700 trips detailed, more central residents moved around during the middle of the day, without distinct morning and afternoon peaks.

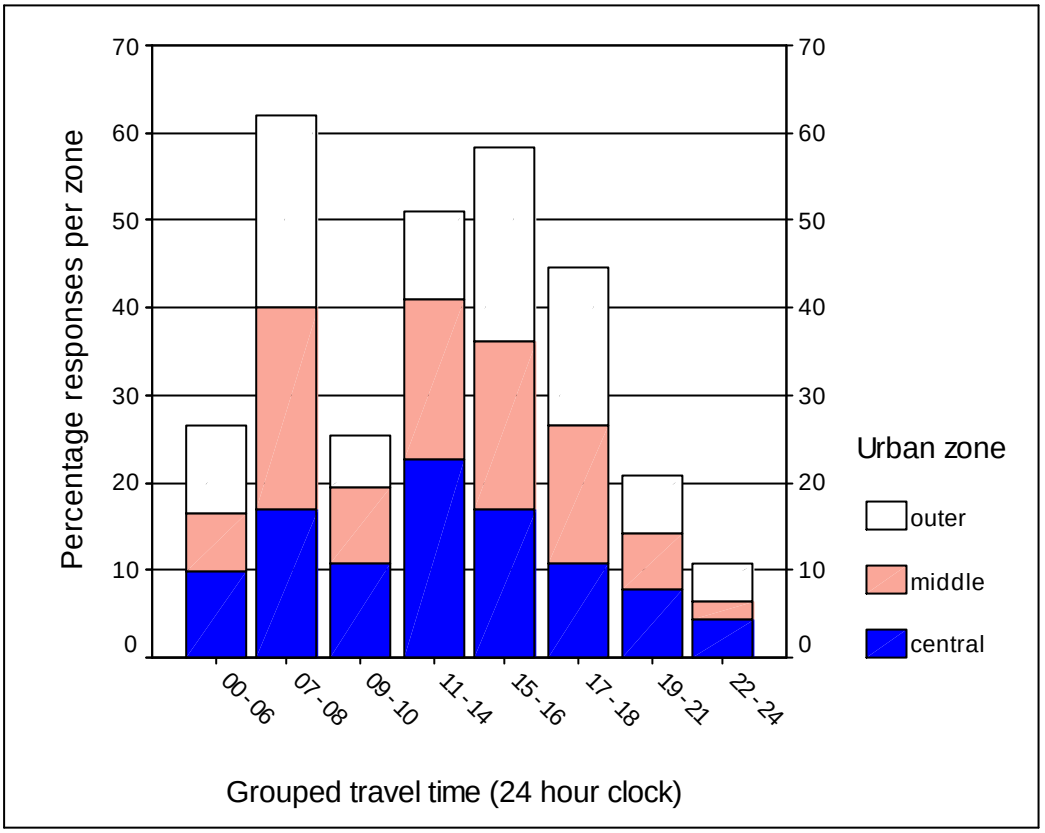
Although contributing to a distinct morning peak, mid urban residents tended to be mobile from 11 am to 6 pm as well. It is only in the outer urban sample of 564 trips that a ‘ classic’ morning and afternoon peak was pronounced. It has already been noted that

many sampled outer urban dwellers are retirees, so peak travel time, mode and destination is investigated further, with age also considered. Many of the peak trips may be discretionary (not essential to occur during the peak periods), and perhaps public education could encourage some of these trips to be made at a less congested time.

Figure 3.3.2 shows that shorter trips of one to four Km. were dominated by inner urban residents, while 4 – 7 Km. trips were dominated by residents from the middle suburbs. Greater distances were covered by outer zone residents, strongly supporting one of the *a priori* hypotheses that travel distances are zone dependent. Further analysis shows relationships between the general travel traits of time, distance, mode, destination, age and occupation. Figure 3.3.3 makes clear the dominance of the car, both by frequency of use and total distance travelled. Cars were used to travel about 10,200 Km. by 500 people on the day of survey, while all other modes accounted for about 1,200 Km., about 10% of the total.

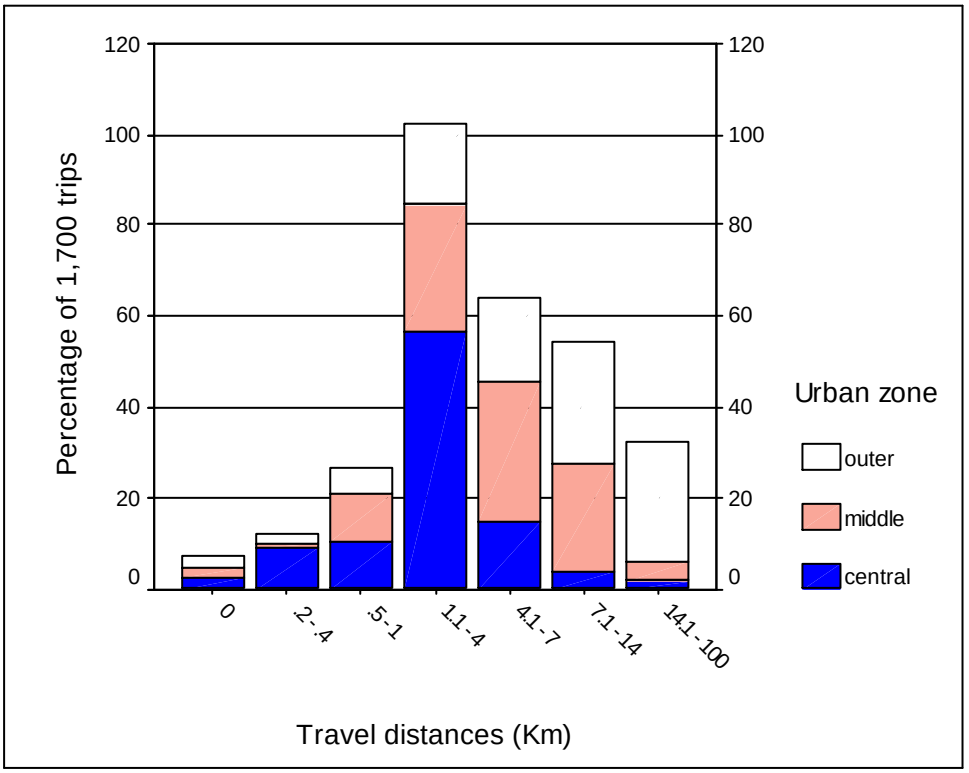
Figure 3.3.3 and 3.3.4 show that the different modes of transport (modal split) for Cairns is dominated by car use, both for percentage use and total distances achieved by each travel mode. Figure 3.3.5 shows that, as a percentage, inner urban dwellers travelling by car tended to be on their own more than the drivers from other zones. Walking, cycling and use of taxis was highest for inner urban dwellers. This probably reflects the lesser distances they tended to travel, and the fact that they had the highest proportion of households without a car. Mid urban dwellers had a relatively low use of pushbikes, and tended to use cars slightly more than other groups. Although low, outer dwellers had the highest bus use. Travel mode appears zone dependent for walking, cycling and, to a small degree, bus use.

Figure 3.3.1 Total Cairns travel departure times



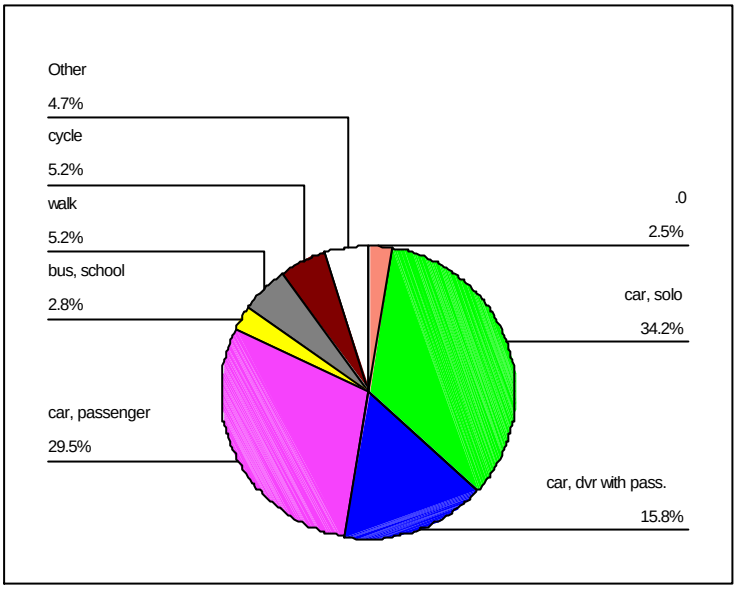
Note: percentages for the sum of the three zones are potentially equal to 300%.

Figure 3.3.2 Total Cairns travel distances



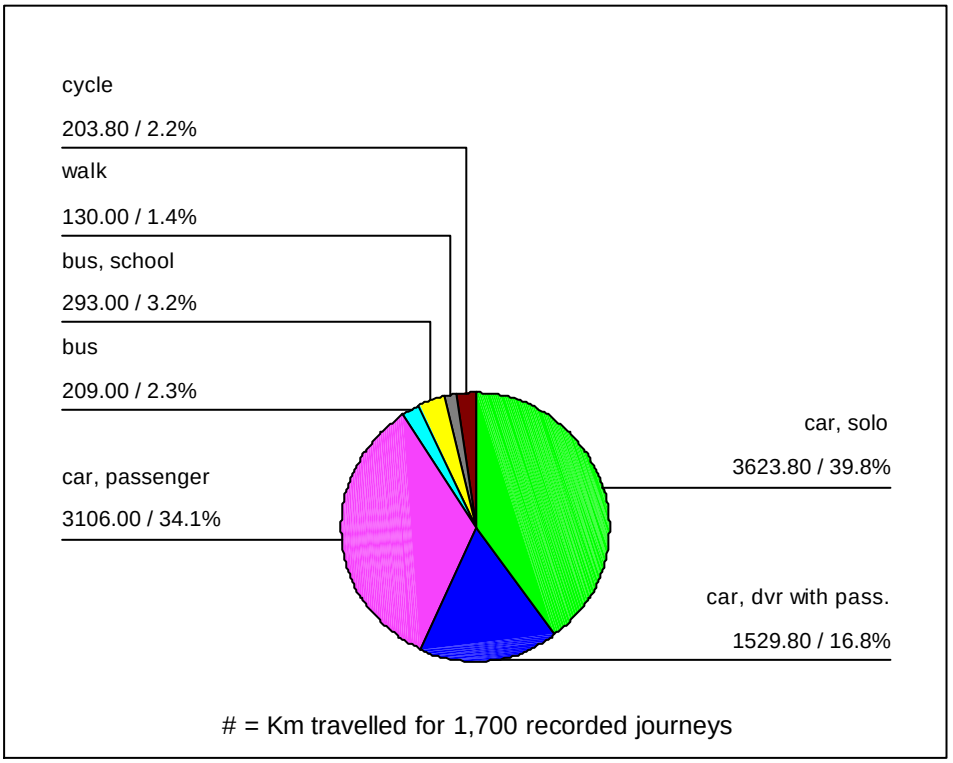
Note: percentages for the sum of the three zones are potentially equal to 300%.

Figure 3.3.3 Dominant modes of transport in Cairns (modal split)



Note 1: Modal split for 1,700 recorded trips.
Note 2: ‘ Other’ includes taxi, private bus and motor cycle.
Note 3: ‘ 0’ shows that 2.5% of the survey population did not travel on the day of survey.

Figure 3.3.4 Dominant modes of transport in Cairns by distance travelled



Not surprisingly, the destination ‘ home’ accounts for about 40% of total destinations and similar across zones. It has been excluded from the analysis. About 3% of people did not travel on the Friday of the survey and are shown in Figure 3.3.5. People living in inner Cairns tended to work there the most. For them, there appears to be a fairly close association between home and employment, reinforcing their stated reasons for home location choices. They also tended to dominate non-supermarket shopping, and work in tourism more than other residents. There were few preschoolers.

Figure 3.3.5 Cairns travel mode by urban zone

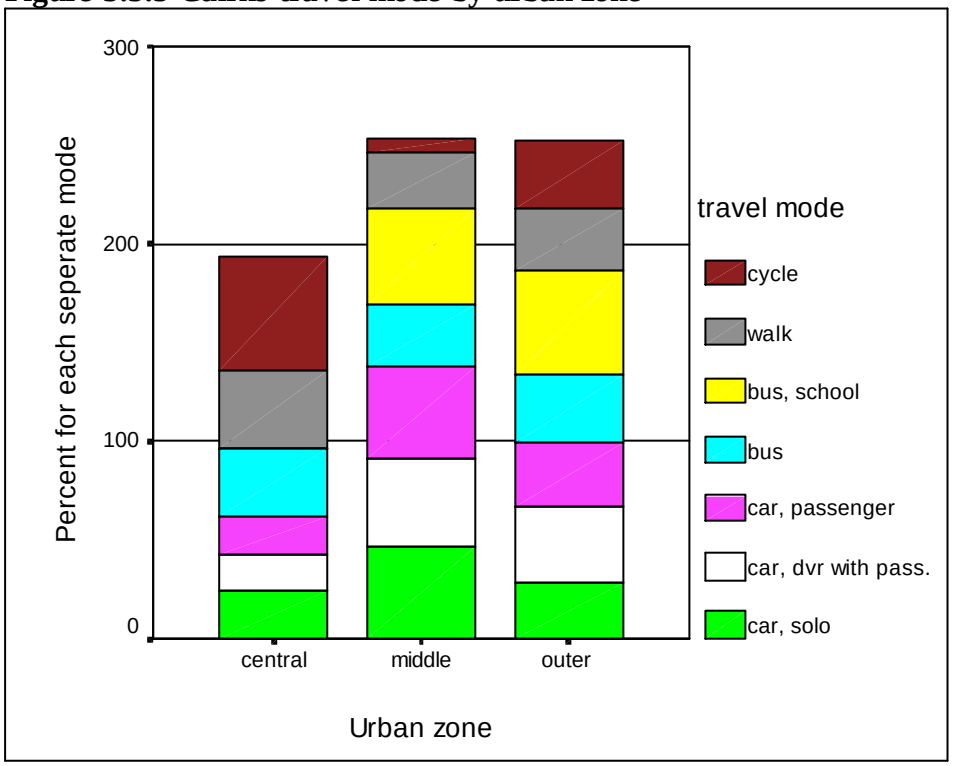
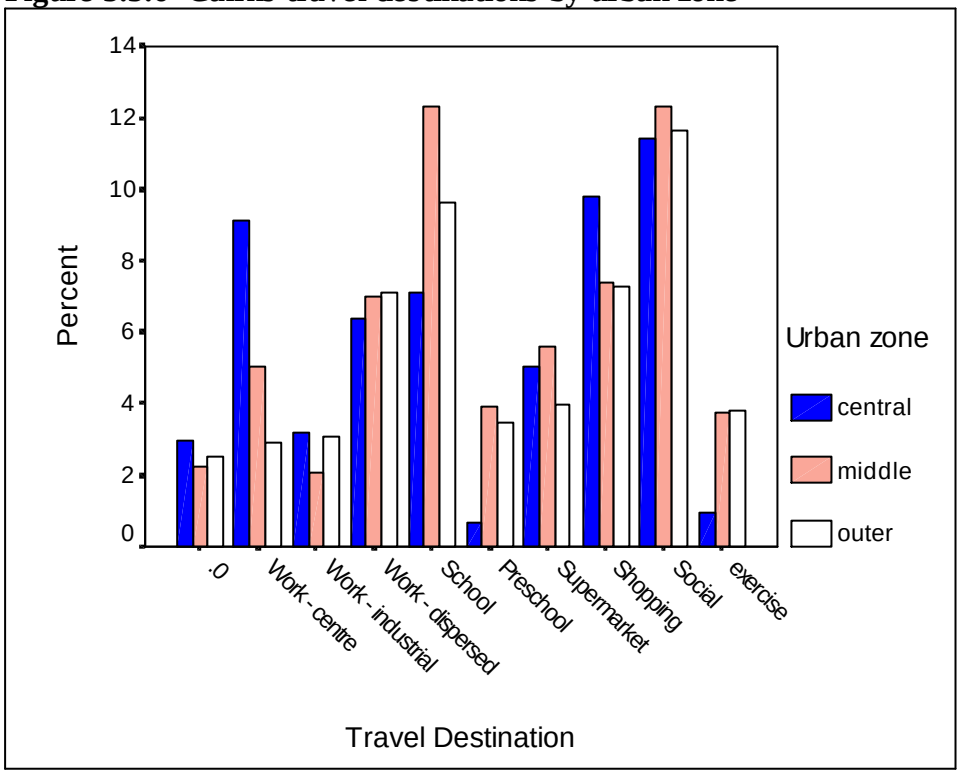


Table 3.3.2 Average distance achieved for each travel mode

	Average distances travelled (Km)			
Travel mode	**Central**	**Middle**	**Outer**	**Cairns totals**
Bus	4.33	6.50	18.00	9.73
Bus, school	-	6.04	9.04	7.60
Car, driver with passenger	5.02	5.83	8.72	6.78
Car, passenger	4.04	6.14	12.05	7.70
Car, solo	4.05	6.23	13.48	7.77
Cycle	2.09	3.67	3.48	2.68
Motor cycle	4.00	-	14.57	12.22
Private bus	3.00	-	-	3.00
Taxi	2.50	4.33	-	2.83
Walk	0.91	2.58	1.68	1.64
Total	**3.4**	**5.8**	**10.6**	**6.8**

Figure 3.3.6 shows that mid urban dwellers had the highest proportion of school children, and shared with outer urban residents, 4% of their trips for exercise. These trip figures are on the Friday of study, indicating inner urban residents have few preschool children. Edge dwellers worked least in central Cairns. Social trips, trips to the supermarket and dispersed work destinations appear to have been independent of home location.

Figure 3.3.6 Cairns travel destinations by urban zone



Note 1: Home, although the major destination (40%) is not show.
Note 2: At less than 2%, TAFE, home-based work and work – tourism are not shown.

Age related data from 496 householders who completed the one-day travel diary shows that middle aged people tend to travel the most. Also, that age group from the outer suburbs tend to travel the greatest distances (Figure 3.3.7 and Table 3.2.3), making them a possible target for some public education and involvement. Most trips were by car, and many may relate to chauffeuring children.

Table 3.3.3 shows the destinations for the 1700 recorded trips, displaying the average age for Cairns in total, and for each of the zones. The table makes clear that the elderly tend to travel less, younger people exercise, that social activity does not appear age or zone related, and that tourism workers are generally younger than the mean (34.5 year old, Standard Deviation 17, as a function of the number of journeys). There is a strong correlation between destination and age (-.74, significant at p <.01), and a strong correlation between age and distance travelled, shown in Figure 3.5.6 and Table 3.5.5.

Table 3.3.3 Average age of travellers to destinations by zone in Cairns

	Average age of Householder (years)			
Destination	**Central**	**Middle**	**Edge**	**Cairns total**
.0	47.00	56.00	57.14	53.65
Exercise	39.25	29.11	31.10	30.69
Home	36.78	33.78	32.50	34.11
Preschool	27.67	22.82	24.89	23.90
School	22.23	22.44	19.19	21.40
Shopping	35.12	39.23	39.35	37.96
Social	36.20	36.52	34.88	35.92
Supermarket	53.32	45.05	38.91	45.61
TAFE	37.25	37.00	69.00	41.71
Work – centre	36.63	39.67	37.13	37.90
Work – dispersed	42.89	38.24	36.49	38.77
Work – industrial	38.93	40.93	33.59	37.61
Work – tourism	30.00	26.50	37.00	31.87
Total	**33.52**	**36.08**	**33.03**	**32.09**

Note 1: Averages include such people as drivers who took children to school or preschool.
Note 2: All Standard Deviations of totals were ~ 20 years.
Note 3: ‘ 0’ shows the average age of residents who did not travel on the day of survey.

Some of the data provided in Table 3.3.3 includes people who drove to a pleasant place to walk, or walk the dogs (exercise). The figures were small (less than 200 Km) but are worth noting. Such discretionary trips contribute to urban traffic. This table shows the leaning of the outer suburbs to bus use for school or general travel. Of about 4,200 car passenger Km travelled by respondent householders on the day of survey travelling home from their various destinations, 2,269 passenger Km were covered by outer urban dwellers, just over 50% of all car travel to ‘ home’ .

Of the 318 Km travelled to convey children to and from preschool, every journey was by car, with virtually none from the inner suburbs. Surveyed trips to school included 180 Km by school bus in the 500-person sample, 470 by car, about 2.5 times the bus

total. Few cycled to school and fewer walked, again implying a fear, laziness, or a disconnection between home and chosen school.

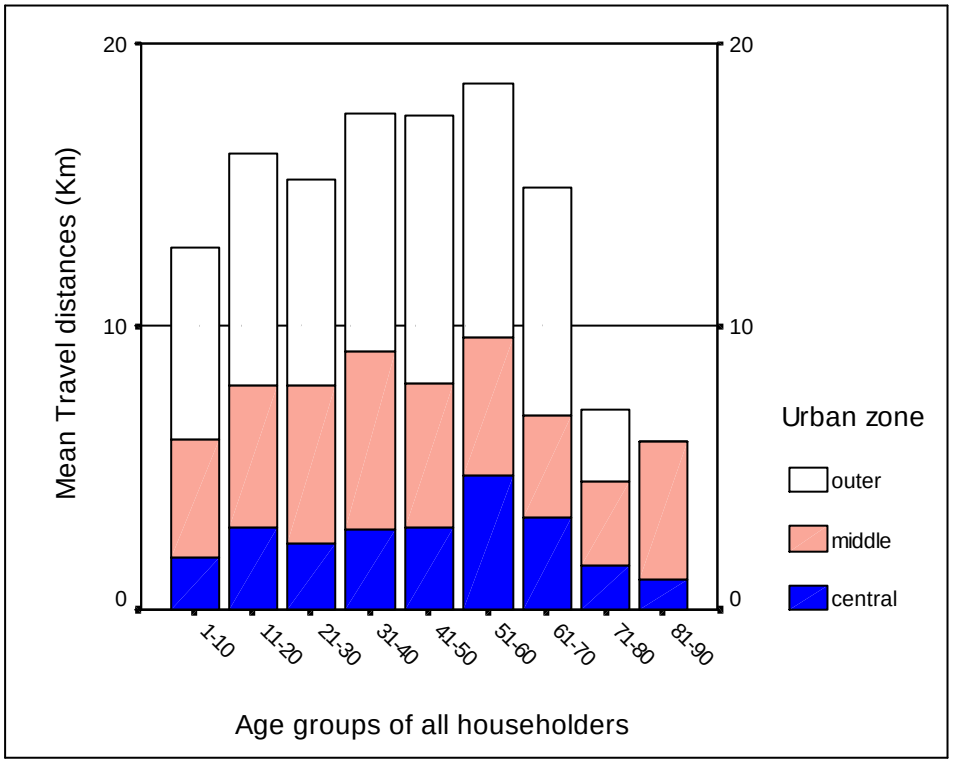
Further analysis showed that bus travel for shopping was only recorded as 40 Km from the outer zone, compared to about 460 Km by car on the Fridays of the survey period. The above table shows that nearly all socialising was done by car, often as a passenger. Travelling to work, both in the city centre and at dispersed work locations was dominated by solo car use. The overall solo car journeys to work were dominated by the outer suburbs, but total distances of such solo travel were similar to the city centre when comparing mid and outer zones. People mainly travelled to their tourism-based employment alone and by car.

Table 3.3.4 Average age of travellers by distance and urban zone

Gender	Age group (years)	Average distance travelled (Km)			
		Central	Middle	Outer	Total
female	1-10	2.50	5.49	7.00	5.49
female	11-20	2.56	5.70	8.14	6.07
female	21-30	2.41	6.38	6.71	5.27
female	31-40	4.48	6.44	10.83	7.78
female	41-50	3.92	5.64	12.04	6.11
female	51-60	4.82	4.46	9.67	6.41
female	61-70	2.53	3.32	10.67	4.90
female	71-80	1.71	2.33	0.80	1.67
female	81-90	1.08	9.00	0.00	2.72
male	1-10	2.71	4.19	8.10	5.43
male	11-20	3.50	6.37	12.32	8.28
male	21-30	2.99	5.50	10.20	6.21
male	31-40	2.97	8.41	13.48	7.68
male	41-50	3.34	5.72	15.25	8.49
male	51-60	11.75	6.45	12.54	8.93
male	61-70	7.00	6.08	9.00	7.61
male	71-80	1.86	5.00	5.20	3.14
male	81-90	1.60	1.33		1.50

Figure 3.3.7 clearly depicts the links between age, zone and travel distances. Outer urban dwellers covered the greatest distances. While few inner urban dwellers ventured further than 8 Km on any leg of a trip, 20 Km was common for outer urban dwellers. Table 3.3.4 shows that while outer urban dwellers travel more generally, edge dwellers of both genders between 40 and 60 years of age have the greatest average trip lengths.

Figure 3.3.7 Traits of age and distance travelled by urban zones in Cairns



Further analysis (Appendix 9) reinforces the result that travellers from the outer suburbs dominate mobility in virtually every age group, especially 30 – 60 year old residents. Mid urban preschoolers travelled the greatest distance with their parent/s mainly from the 30-40 age group, while school goers are often driven by their mainly 30 –40 year old parents if they live in the less central suburbs. One of the few destinations where inner urban dwellers match their less central equivalents is for shopping, but only for 30-40 year old residents. Twenty to thirty year olds from the middle suburbs tended to travel more for socialising than their inner and outer counterparts, while 30 – 50 year olds from the outer suburbs strongly dominated overall travel distances to supermarkets.

Thirty to 40 year olds dominated travel distances to central city employment, dispersed and industrial work. The above analysis shows the large role played by 30 to 40 year olds in use of urban travel infrastructure – a legitimate target for any efforts for mode switching, trip rationalisation or ride sharing.

Figure 3.3.8 and Table 3.3.5 show the deep reliance placed on cars. There were more non-travellers than general bus users. There was little reliance on cycling in the middle suburbs and much solo car use. Table 3.3.5 shows that bus use, walking and cycling each accounted for about 5% of journeys, but 80% of all trips were by car. Almost one third of all trips were by solo drivers.

This section has shown the great reliance placed on cars for urban travel in Cairns and the amount of road infrastructure generally used by outer urban residents. The next section provides the full Cairns results.

Figure 3.3.8 Percent of travel modes used in Cairns

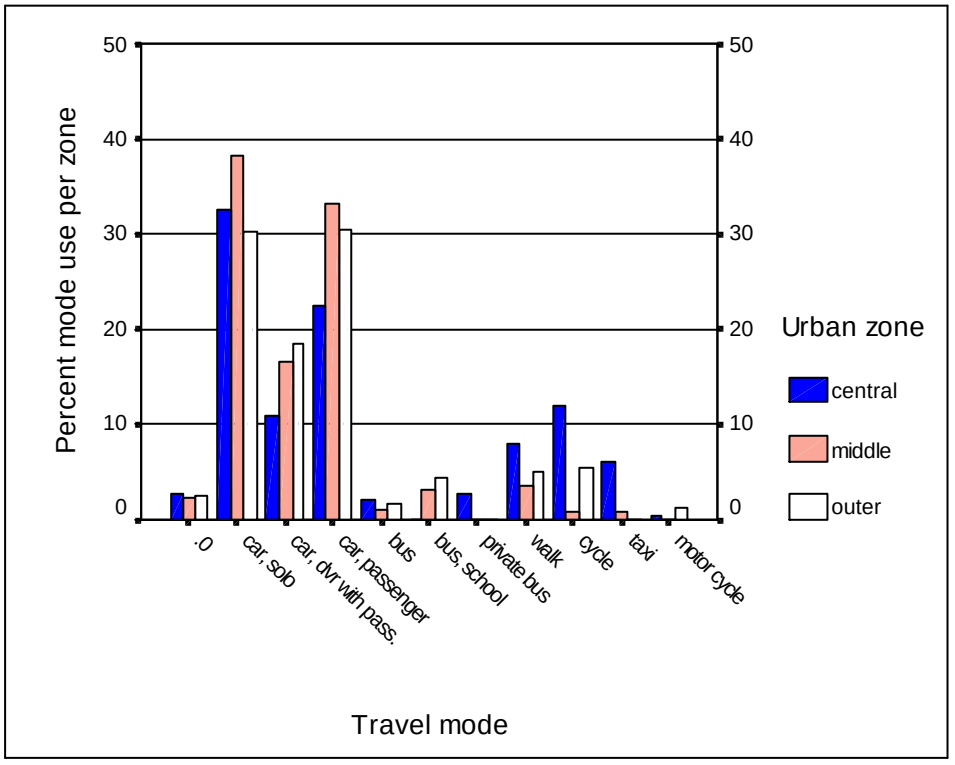


Table 3.3.5 Distribution of travel modes

Travel mode	Frequency	Percent
No travel	42	2.5
Car, solo	581	34.2
Car, driver with passenger	269	15.8
Car, passenger	502	29.5
Bus	26	1.5
Bus, school	48	2.8
Bus, private	12	.7
Walk	89	5.2
Cycle	89	5.2
Taxi	33	1.9
Motor cycle	9	.5
Total	1700	100.0

3.4 Full Cairns results

This section generally follows the questionnaire sequence, providing comparisons between central, middle and edge urban zones (Appendix 7). Testing relationships between travel and age. Results show that the age of the main household respondent was similar across the three zones, indicating that there is no age bias to the zone samples. There was a slight dominance of 20 to 29 years olds in the central suburbs, and 50 to 59 years olds in the middle suburbs. The 60 to 69 year-old group was most represented in the outer suburbs. Male and female were evenly represented in the record of trips provided by 515 householders. There were no units or flats in the Cairns middle suburbs survey, while flats and units were most dominant in the inner suburbs.

Important destinations

About 15% of people in the Cairns survey thought that travelling to the supermarket without a car would be very difficult. There is a normal bell curve distribution of results from very difficult to very easy, centred on neither difficult nor easy. Ease of getting to the city centre was zone dependent. Most inner urban dwellers believe that it would be easy or very easy to get to the city centre without a car. Residents from the middle suburbs believe that it would be most difficult, as the outer suburbs appear better serviced by buses. Getting to work without a car was seen as most difficult by middle urban dwellers. About 15 or 20% of respondents noted that they do not hold paid employment. Without use of a car, residents of the middle suburbs saw visiting friends as most difficult, however most people felt that visiting friends without a car

would be fairly difficult. Only about 20% indicated that visiting friends without a car would be easy to very easy, mainly from the inner suburbs.

Getting to school without a car was not relevant to about 35% of respondents, diminishing in importance from inner to outer suburbs. About 15% of middle urban dwellers believe getting to school without a car would be very difficult. Recreational destinations without a car were seen as difficult to very difficult by the great majority of people, predominantly from the middle suburbs. Getting to entertainment was also seen as either difficult to very difficult without a car.

Respondents were asked: '*of all of the proceeding, which is your most important household travel destination*.' Over 50% of respondents from all urban zones identified work as most important, increasing slightly from the inner through middle to outer urban dwellers. The reverse was true of the second most important destination, the supermarket. Twenty percent of inner urban dwellers identified the supermarket as their most important travel destination, decreasing to about 12% of outer urban dwellers. School was seen as the third most important travel destination.

The Cairns survey showed that people from the outer suburbs on average drove appreciably more than middle or inner urban dwellers. Inner urban dwellers drove the least. As already established, our choice of home location is likely to have a strong influence on subsequent travel. The next section considers neighbourhood attachment as an indicator of links between urban travel and home location choices.

Neighbourhood attachment

The following results are drawn from a series of six statements relating to neighbourhood attachment (see Appendix 1, Section B3). Respondents were asked to rate each statement from strongly agree through strongly disagree from a five point Likert scale. For example, people were asked how much they agreed or disagreed with the statement that they visited their neighbours in their homes. Inner urban dwellers (more transitory overall) most strongly disagreed. The strongest single response was that people neither visited nor did not visit neighbours in their homes. An intriguing result, perhaps indicating people did not want to admit to their relative isolation, or that the statement should have included a time-frame, such as: ' within the last month' .

Survey householders were asked if they wanted to move from their neighbourhood. Nearly everybody disagreed or strongly disagreed with the idea that they wanted to leave their present neighbourhood. Clearly most people are satisfied with their current residential location. People were asked if they felt that their neighbours would help them in an emergency. Nearly everybody thought so. About 80% either agreed or strongly agreed with that statement, with almost all the rest neither agreeing nor disagreeing. Only about 5% strongly believed their neighbours would not help them. This reflects a sense of neighbourhood linkage and help in adversity.

Only about 20% of people disagreed or strongly disagreed with the idea that they regularly stop and talk with people in their neighbourhood. About 25% neither did nor didn't and the remaining 50% strongly agreed or agreed that they regularly stop and talk with neighbours. Responses to the statement of similarity to other people have the general form of the bell curve, centred between ‘ agreed’ and ‘ neither’ . People are ambivalent about their similarity to neighbours, but overall trend slightly toward considering themselves similar to their neighbours.

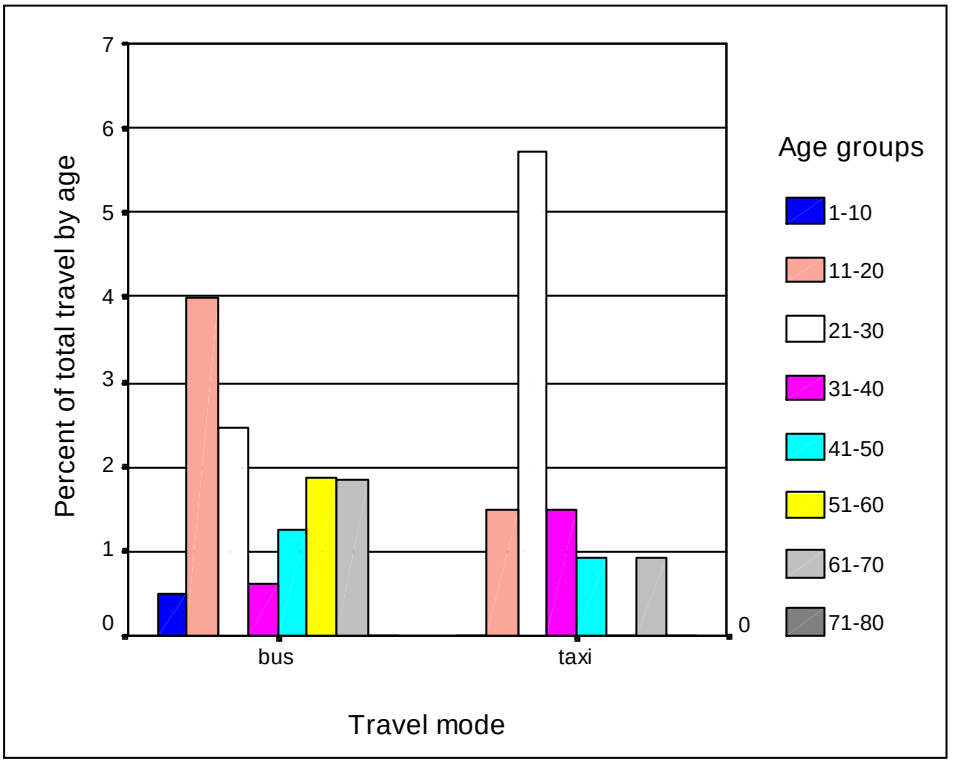
Finally, most people did not agree with the idea that they would like to move from the current neighbourhood because of travel costs. Travel time and costs were not an important consideration for household relocation. There are zonal variations in response to questions of neighbourhood attachment but the overall patterns are relatively similar between zones. Most households were happy living where they have chosen, socially if superficially linked with near neighbours, and not motivated to move for urban travel reasons.

Along with choices of household location, another structural consideration of urban mobility is the availability and use of public transport. An 18-seater bus service (Sunbus) was introduced to Cairns about 18 months before the survey. Some of the responses on the bus service may have reflected some residual 'teething problems', as indicated by respondents who reported the service was 'getting better'.

Buses in Cairns

Only about 35% of respondents answered the section on bus use and perceptions. This reflected the generally low level of bus use in Cairns, about 10% for inner and middle suburbs and at least occasional use by about 20% of outer urban dwellers. People were asked to rate a series of questions on their perceptions of bus use from very poor to very good, considering reliability, connections, frequency, comfort, speed, affordability and passenger information. Most who responded felt that bus convenience (defined as: stops for pickup and drop off are close to your needs) was good to very good. This was particularly true for members of the outer suburbs. Apart from school bus use, Figure 3.4.1 shows that 10 to 20 year olds use buses the most, while 20 to 30 and 50 to 70 year olds are the other main age groups who dominate use of Sunbus in Cairns. A 1998 study commissioned by Queensland Transport (Coory 1998, reported in Chapter 4.6) confirms the general perceptions of buses provided here.

Figure 3.4.1 Percentage of bus and taxi travel by age in Cairns



Bus reliability was mainly seen as neutral to good. Again, the response: 'good' was dominated by outer urban respondents. This was contradicted by written responses, often done by people who had bypassed the block of statements documented here. The quality of bus frequency and comfort were generally seen as good, particularly by outer

urban dwellers. Most people felt bus speeds and ticket prices were neutral to good. However, people were most commonly neutral in their assessment of passenger information, or they felt it was lacking.

People were asked to rank the importance of bus use issues. Cairns residents felt bus reliability and convenience were most important. Frequency was also important. This was reinforced by the attributes of bus travel nominated as the second most important, where reliability again topped responses. The second set of responses also showed that frequency, affordability and to a lesser extent convenience are also important bus issues. The following section opens by considering written responses about the strengths and weaknesses of the Cairns bus service.

Strengths and weakness of urban travel modes

As with all modes of urban travel reported in the following pages, people recorded their views (responding to open-ended questions) on strengths and weaknesses of the Cairns bus service. The service was predominantly seen as unreliable, particularly by outer urban dwellers. Outer urban dwellers also feared poor bus drivers. Middle urban dwellers saw the bus service as convenient and getting better. The second set of perceptions was also led by a perceived lack of reliability.

Again, particularly from the middle suburbs, buses were seen as dangerous. They were, to a lesser extent, seen as inefficient and not catering for cross-town travel. This may become an important issue. The perceived unreliable nature of the bus service in Cairns stands out as the most important aspect of bus use identified in this survey.

Perceptions of car use were extensively detailed in section 3.1. This thesis is focused on changing car use. Figure 3.1.7 shows that cars are seen as providing independence. They are convenient, but come at a high cost. Cars were seen as efficient, although there were parking and congestion problems, and car were seen as polluting and dangerous. While 40% of middle and outer urban dwellers see cars as convenient only about half that percentage from inner suburbs are impressed by the convenience of cars. Compared to about 10% of inner and outer urban dwellers, only about 3% of mid urban dwellers appreciated the freedom provided by automobiles. Middle urban dwellers are

the only group who listed reliability of cars first in their written assessment of the strengths and weaknesses of cars.

Perceptions of cycle use were dominated by the view that cycling is good healthy exercise. Cycling was also seen as cheap and dangerous. Inner urban dwellers particularly feared poor drivers. Middle urban dwellers felt that there was a lack of bike lanes. The second set of perceptions of cycle use, most strongly from the inner suburbs, was a fear of poor drivers. These responses were also dominated by the feeling that cycling was cheap and provided good exercise. This was indicated most strongly from the outer suburbs. People also recorded that cycling reduced or caused no pollution. Rain and heat were seen by some as a deterrent to cycle use, and there was some concern about the lack of cycle paths. The clearest feedback on cycle use was that it provided good exercise, it was healthy, cheap and dangerous. Cycling was seen as most dangerous in general by about 12% of respondents, about 7% feared poor drivers or were unhappy with the lack of bike routes. About 3% were concerned about theft while the bike was parked and about 1% of respondents from the middle suburbs felt there was danger at night or from dogs.

Walking was also seen as providing healthy exercise. This was so for about 30% of respondents, predominantly from the middle and outer suburbs. The next five responses were each less than 10% of total responses. Walking was seen as enjoyable but there was concern, particularly in the outer suburbs, about a lack of walking paths. To a lesser extent walking was seen as dangerous or convenient, with a low-level (about 2%) fear of assault. For the middle and outer suburbs there was a dislike of dogs. The second set of perceptions about walking was of good exercise but dangerous at night, was cheap and enjoyable, provided people contact and conserved energy.

Ride sharing was seen as money saving by about 25% of respondents. Up to 35% of outer urban respondents saw ride sharing as a money-saving option for urban travel. About 10% of respondents supported ride sharing, believing that it was likely to reduce road congestion. About 5% of people believe that ride sharing is energy conserving. The second perception of ride sharing is dominated by the idea that people who ride share become dependent, and that it is cheap. There is people contact, with the belief that ride sharing reduces pollution, but that it may be unreliable.

People mainly saw working from home, if possible, as cost saving, safe or relaxing. To a lesser extent working from home was seen as energy conserving in a nice environment. Cost saving and convenience also dominated the second set of perceptions of working from home, providing independence, people contact and energy conservation.

Like other car reduction strategies, people were encouraged to write three strengths and weaknesses of urban rail use in Cairns. About 18% of people support the idea of urban rail. Urban rail is seen as potentially reducing congestion but there are high costs involved to set up the infrastructure. Others felt that urban rail was not needed, or that it would provide freedom. Although there was a perceived lack of information, urban rail was seen as potentially convenient, possibly cheap and likely to be reliable, while reducing congestion.

Environmental beliefs

This section of the Cairns results documents responses to ten environmental statements. People were asked to rank the statements in Table 3.4.1 on a five point Likert scale, from strongly disagree to strongly agree. A sixth option "don't know" was provided so that people did not feel pressured into responding to all statements (Appendix 10). Table 3.4.1 shows that respondents generally support the precautionary principle, do not support the linear industrial model, nor the unlimited growth scenario (Chapter 1). There is a slight unease about present decision-making processes and the providing powers of technology. Respondents were unsure of the links between ecology and economic growth, the replacement potential of renewable fuels, or the value (or worth) of integrating with natural cycles. There was support for natural indicators of environmental cohesion and for striving for a balance with natural processes.

These results indicate a generally aware and environmentally caring population. Combined with results from the following sections on urban planning and mobility, the above results indicate an informed and environmentally supportive community.

Table 3.4.1 Indication of environmental values in Cairns

Environmental belief statement	mean	Standard deviation	Comments
Putting people and nature at possible risk is acceptable to maximise wealth.	1.6	1.1	Clearly disagree
Humans have the absolute right to dominate, acquire, use and discard natural resources.	1.7	1.1	Clearly disagree
There are no limits to growth.	2.2	1.3	Disagree
Present decision-making structures and institutions are satisfactory.	2.4	1.1	Slightly disagree
Technology will overcome all obstacles to our continued well-being.	2.4	1.1	Slightly disagree
Ecology constrains economic growth.	2.6	1.1	Unsure
With new fuels, we will continue using vehicles as we do at present.	3.3	1.1	Unsure
With technology, we can integrate with natural cycles.	3.4	.9	Unsure
Continued abundant natural fish breeding in near-city mangroves is one useful measure of a sustainable urban environment.	3.6	1.2	Agree
Humans must live in harmony with nature in order to survive.	4.1	1.1	Agree

Note: statements reordered to grade from strongest disagreement to strongest agreement.
Note 2: Likert scale used. 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree, 5 = strongly agree.

Perceptions, views, values and beliefs about current and future travel

This section interprets responses to open-ended questions about current and future urban mobility. The developed analysis frame contains about 80 category codes to represent the many written responses. The first question asked was: *what connection, if any, do you see between the way that suburbs are laid out and the amount of driving you have to do?*

The dominant response was that urban design produced very car dependant residents. That view was expressed fairly evenly across the zones by about 11% of respondents. The second dominant response (particularly from the inner and middle suburbs, but not very much from the outer suburbs) was the belief that there was no connection between urban design and consequent car use. Other respondents felt that the relationship between urban design and car use was acceptable, and about 5% or 6% put forward the idea that urban nodes or urban villages may reduce car dependence.

It was also suggested that there was the need for planning changes, to improve flow or to develop more roads. The call for more roads was most strongly expressed from outer urban dwellers. Other responses, dominated by outer urban dwellers, were that there was too much urban sprawl, with the astute if obvious observation, particularly from inner urban dwellers, that urban planning in Cairns is greatly constrained by topography.

The second recorded influences of urban design on car use were also dominated by urban design producing car dependence for residents. There was acknowledgment of urban sprawl, some would have liked to improve traffic flow and there was an expressed desire for more roads (Appendix 7). The second question on perceptions, views, values and beliefs of current and future travel asked people: *What are your perceptions of urban mobility now? (What you think of the way we travel around at present).*

About 20% of all respondents, up to about 28% of inner urban dwellers, noted that their current urban mobility is very car dependent. However the next most frequent response is that current urban mobility was acceptable or good. Inner urban dwellers suggested ride sharing as a way to improve mobility, and felt most strongly that there should be more public transport, while outer urban dwellers wrote that there should be better public transport. Some respondents felt that there was a peak congestion problem. A few people thought there were too many cars, or that there should be more roads, urban rail or urban villages.

The second set of recorded perceptions about current mobility was dominated by car-based pollution. This view was expressed most clearly by inner urban dwellers, to a lesser extent by outer urban dwellers and not very much by middle urban dwellers. There were opinions focused mostly on the idea that current urban mobility causes congestion, that they do not like their current mobility and that there should be better public transport, although most people noted that their current situation was acceptable or good. Those last issues were all dominant among mid urban dwellers. There were some zone dependent variations in perceptions of current mobility.

The largest single response about beliefs of mobility in the future came from the middle suburbs. They believed there would be more public transport. The second largest response came from inner urban respondents, who believed that there will be technical or fuel changes. The third largest belief was also from inner urban dwellers, who believed that there would be planning changes. Fourth was from the outer suburbs: ‘ we should research and develop alternative fuels’ . Those responses were quite distinct to the particular zones. There were two other responses, without a lot of variation between the three zones. Future urban mobility would remain very car dependent, and urban rail will be used.

The second layer of responses about future urban mobility was dominated by outer urban respondents who believed that urban rail will be part of the future urban fabric. Inner and middle urban respondents felt that there would be better public transport, while all groups equally felt that there would be research and development of alternative fuels.

Easy reductions in the private use of automobiles may well become one of the greatest challenges in the near future. The first set of suggested easy changes was dominated by 'no change'. This reflects a sense that many people expressed: they use their automobiles only for necessary trips already, so it would be very difficult to further reduce their car use. Apart from what could be called cultural inertia, the middle suburbs dominated the next group of responses. Car use could be reduced with better public transport, more public transport or by ride sharing. Only inner urban dwellers (about 4%) suggested increasing car costs would reduce car use.

The second set of suggested changes to easily reduce car use was generally dominated by the outer urban dwellers, who nominated better public transport, ride sharing, solar cars and cheaper public transport. About 3% of mid urban dwellers suggested better bus information or to cycle more. Although legitimate responses were slightly dominated by suggesting more attractive public transport, it is difficult to imagine many people changing from car to bus use without the 'contextual' changes outlined in Chapter 1.

Because the issue of future urban mobility is so important, a third set of responses is given here. Inner urban dwellers most strongly felt that there should be better public transport to help reduce car use, that there should be research and development of alternative fuels, there could be solar electric cars, or small, less powerful cars. We could walk or cycle more. Mid urban dwellers most strongly felt that we should walk more, that there should be electric cars, connecting public transport and that we could ride share more and educate people about alternatives to unconstrained car use. Outer urban dwellers most strongly felt that we may move toward electric cars, urban rail, and more public transport or to better plan trips.

To elicit further ideas on acceptable ways to reduce car use, people were prompted by asking the following. If you knew that petrol was going to sharply increase in price, what would you do, and what sort of changes would you like so that your household needs could continue to be met. The single strongest response was 'no change'. Inner urban dwellers suggested planning trips, use LPG, use motorbikes or scooters, walk or cycling more.

Mid urban dwellers suggested general reductions, use more public transport, to have smaller less powerful cars or to plan trips. Outer urban dwellers suggest reducing the need to travel so much, to ride share, to use LPG, or have smaller less powerful cars. The second response to the prompt of a sharp increase in fuel prices from inner urban dwellers was to suggest more home deliveries or use of LPG. Mid urban dwellers suggested reducing the need to travel, or plan trips, while outer urban dwellers suggested reduction in need, walk or cycle more.

This section on views of current and future urban mobility shows quite distinct zonal variations. The topology of beliefs and values across the urban landscape from the inner to outer suburbs shows clustered sets of values, which is further developed in the secondary analysis following these general results.

People were asked to rate their support for light rail, responding to the statement: I would like to see light rail (perhaps based on sugarcane tram technology) used in Cairns for public transport. About 30% strongly agreed and a further 20% agreed, about 20% were neutral and about 10% disagreed or strongly disagreed with the use of

light rail. The following section provides a background profile of demographic traits of the respondents.

Vehicle details

Only households surveyed from the inner suburbs (about 17%) did not possess a car. In the inner and outer suburbs, 50 to 60% of households had one car, while only about 37% of mid urban households had only one car. About 48% of mid urban households had two cars. A further 10% had three cars, much more than the other two zones. Of all vehicle types, cars clearly dominated all groups.

Roughly equal across the whole metropolitan area, about 15% of households nominated station wagons as their first vehicle, with the highest proportion of four-wheel-drives owned by outer urban dwellers. Cars and station wagons dominated the second nominated vehicle owned, mainly from the middle suburbs, while utilities were nominated by about 10% of households as their second vehicle. Four-wheel-drives were second vehicles for about 10% of outer urban dwellers. Although the percentages are less than 4%, utilities and motorcycles were the most frequently nominated third vehicles where they existed.

Ages of first nominated vehicle tended to be clustered around 5 or 13 years of age; while second nominated vehicles were clustered bimodally around one or about 7 years of age. Four cylinder vehicles were owned by about 55% compared to about 35% of vehicles with six cylinders.

Because the literature suggests that vehicles provided by employer are more likely to be driven for private use than a privately owned vehicle in otherwise similar circumstances (Pucher 1995), people were asked if the vehicle was provided by the employer. This proved to be the case for about 16% of households, most often in the middle suburbs. The final question relating directly to automobile use was to gain an estimate from the householder of their weekly expenditure on transport fuel. Reflecting reported travel distance results, middle and outer urban dwellers dominated the small groups of people who spent $80 or more per week for private vehicle use.

The largest concentration of fuel costs averaged about $25 per week, with about 8% of inner urban dwellers recording that they spent nothing per week on fuel and dominating the group with low weekly fuel expenditure. These results are consistent with other portions of the survey showing frequency of car driving, vehicle ownership and average distances travelled, as calculated from the daily travel record provided by the 515 householders in the Cairns urban mobility survey.

There were no significant differences between average household income across the three zones (Appendix 3). It is noted, however, that the $15- 25,000 per year income bracket had about 25% of inner urban dwellers, whereas the other two zones had less than 10% of households in that annual income group.

Along with questions about attitudes towards cycle use and the detail within the daily travel record of actual cycle use, householders were asked how many pushbikes were owned, and how many were used more than once per week. About 22% of households do not own a pushbike. That was the case for about 30% of middle urban households. Inner urban households dominated ownership of 1 push bike at about 20% compared to 10% for the other two zones, while the number of households with two push bikes was about 30%, relatively equal across the metropolitan area. Three or four pushbikes were owned by about 6% of middle and outer urban households. Not surprisingly, more pushbikes were owned than were regularly used, but most pushbikes were used on a regular basis.

Survey participants also recorded the distance to the nearest convenience store. The inner urban collector districts surveyed tended to have the shortest distance to the local convenience stores and the outer urban respondents tended to have the greatest distance. The distance differences do not appear to be particularly significant (Table 2.6.2 does not include distance to convenience store because there was nearly as much variation between CDs as there was between zones). This may be an artifact of the random selection of the three CDs from each zone than represent any structural dispersion of corner stores at greater separation as one moves from the urban centre.

Cairns composite results

The proceeding has provided a detailed presentation of general Cairns results at the descriptive level. The next section considers composite results (Appendix 8), consolidating multiple responses from such questions as the first: please write why you chose to live at your current address (rather than anywhere else) starting with the main reasons. In this and other results presented in this section, all the written responses to a particular question were combined and generalised.

Grouping the many hundred written responses detailing reasons for home location choice, the overwhelming reasons were, in order: close to city, close to shops, quiet, and because people like the area. 'Close to city' was dominated by inner urban dwellers. 'Close to shops' was reasonably evenly spread across the metropolitan area surveyed. 'Quiet' was least represented by inner urban dwellers as was 'like the area'.

Thirty-three groups of reasons for home location choice were coded from the many hundreds of written responses to this question. After the four already mentioned, the following groups were the most dominant: close to school, even across the metropolitan area, close to beach, represented mainly by the outer urban areas surveyed, and to a small extent by the inner urban areas. Close to most destinations was important, and in decreasing order, people liked the residence, the rent was low or the price was right, their household would be close to friends or family, they liked the quality the suburb or it was close to mountains or the bush.

The second composite results defined people's important travel destinations. Although 'work' was very much the most important travel destination, when first, second and third destinations were grouped together, 'supermarkets' emerged as most important, followed closely by 'work'. This was true in both cases for about 37% of respondents. When all important destinations are grouped together 'friends and social' destinations become the third most important. These results are relatively independent of distance from the CBD.

By grouping all the perceptions of car use together, convenience, independence and high cost emerged as the three main views people had of the automobile. Those views are fairly evenly shared across Cairns. The next three clear perceptions of car use were

that cars provide freedom, that they are speedy, but that there are parking problems. Other emergent views about automobiles, all less than 3%, were that they were polluting, make you lazy, and caused congestion. There were various senses of danger attached to cars and their use, although they were considered reliable, comfortable and cheap. Being weather proof and able to carry loads were also seen as strengths.

When all of the responses to bus use were synthesised, reliability emerged as the main concern, fairly independent of zones. This is also true of the frequency of bus service available, the convenience of bus routes, and affordability of the bus fares. Lesser issues were connections, passenger information, speed and finally, comfort. The written responses to bus use displayed a similar pattern. Reliability was clearly the major issue for bus users and potential bus users in Cairns. Other major written observations about buses were that buses were inconvenient, counterbalanced by an equal percentage of people who felt that buses were convenient. Buses were also seen as dangerous by about 2% of respondents, writing that they feared poor drivers, and about 2.5 % of people felt that bus costs were high.

Synthesising written responses to perceptions of cycle use showed that healthy exercise dominated. Cycling was also seen as cheap and dangerous. People fear poor drivers, although cycling causes no pollution, there is a lack of bike lanes and weather is a problem. About 20% of respondents saw urban walking as healthy exercise. The next responses to perceptions of urban walking were from about 5% of people, who felt that there was a lack of paths, the weather is a problem, but walking is enjoyable and inexpensive.

Ride sharing was seen as money saving by about 16% of respondents, although it leads to dependence and it is inconvenient. Ride sharing conserves energy, provides people contact, reduces congestion and is supported by about 3% of respondents, although it was seen as unreliable or not possible by a similar proportion. Working from home saves money, is not possible, is relaxing and supported, although some people saw working from home as isolating, it was also perceived as energy conserving in a nice environment.

Rail use was supported by about 10% of respondents although it would have high initial costs. Urban rail would be convenient, reliable, speedy, and reduce pollution. About 3% of respondents felt that there were few viable routes to facilitate rail use.

Composite results of broad urban issues

People collectively believe that our urban form has made most of us very car dependent. Aware of urban sprawl, many were satisfied with current urban design, or would like to see more roads, planning changes, increased traffic flow or urban village nodal development. Current urban mobility, although very car dependent, was generally seen as acceptable, with an expressed desire for better public transport. People like their own urban mobility, even though it was largely car dependent.

Future urban mobility may well involve urban rail, more public transport, and alternative fuels, although it will probably remain very car dependent. Planning changes are needed, along with development of better public transport, more efficient engines and greater use of pushbikes. To finish this section of the synthesis of various layers of responses to largely open-ended questions, results are presented on easy changes to reduce car use.

The top response to easy reductions in car use, at about 12%, was a generic ‘ reduce the need’ . More specifically about 8% of people suggested that there should be more public transport or better public transport. Ride sharing was seen as a behavioural way to reduce car use. More cycling and walking was suggested, urban rail was seen as a future alternative to current levels of car use by about 4% of respondents. Smaller cars, solar cars, and use of LPG were also seen as viable alternatives to current car use.

To further clarify these emerging trends from the data, the following section groups like responses together. For instance, in the last section where written responses were coded as better public transport, more public transport, connecting public transport or better public transport, all such responses were grouped together as better public transport. The following section is the final general view of descriptive data.

General aggregate results

Car use was commonly seen as providing independence, appreciated for its convenience, and perceived as expensive. Buses were seen as unreliable, dangerous and expensive. Cycling was seen as dangerous, healthy, not properly catered for and inexpensive. Walking was considered healthy, dangerous and enjoyable, but lacking proper paths. Ride sharing was perceived as saving money and reducing pollution but was inconvenient, making people dependent on others. Working from home would be enjoyable, money saving and was supported. Although not possible for some, it would reduce pollution and congestion.

Urban rail use was supported, although there would be a very high cost attached. Urban rail use would be efficient and there are available routes. It would reduce congestion and have low pollution. Urban planning has produced urban sprawl, which was supported because it gave greater choice of home location. Urban villages were seen as attractive. Urban travel was partly a product of urban sprawl. Current mobility was seen as good, but better public transport is sought. Future urban mobility will include rail, technical and fuel changes. There will be better public transport, people will drive to local pickup points and transit to their destinations. There will be behavioural and planning changes, with a reduced need for urban travel.

Summary

The remaining paragraphs in this section summarise the general descriptive results. The final aggregated information is that the dominant occupation at about 8% were students, about 5% retirees, and about 4% each of professionals, trades persons and then labourers in descending order. About 50% of the full Cairns population was in the labour force (ABS Cdata 1996).

Although work was clearly seen as the most important travel destination, deeper analysis indicates that people are most car dependent for recreation and for supermarket shopping. Indeed, middle urban dwellers self-assessed as being the most car dependent group, perhaps because the inner urban residents are generally close to services, and outer residents in Cairns generally feel reasonably serviced by buses. Few people would choose to leave their current residential location because of urban travel considerations. Most people had some form of social linkage.

Buses in Cairns were used most frequently by outer urban dwellers. Reliability and convenience were identified as core bus use issues. People generally had sophisticated and sensitive environmental values and beliefs. The only incongruous response was a slight overall leaning to believe that ecological considerations do not constrain economic growth.

People generally did not support excesses of consumption, believed that nature and other people should not be put a risk for economic gain, and that there are limits to growth. A majority of people believed that current decision making structures and institutions needed to change. People felt that integrating more with nature, using sensitive technology and renewable fuels would be beneficial.

As noted in Tables 3.1.1, and in many of the above descriptions of peoples' values and beliefs, there were many physical and psychological differences between the three groups of respondents. The following section provides secondary analysis, with particular emphasis on finding relationships within and between respondents from the three urban zones.

Differences between urban zones

3.5 Multivariate analysis

This section seeks to define underlying relationships embedded in the data. Earlier sections of this Chapter provided some secondary analysis. Relationships between age, urban travel distances and zone were explored in Section 3.1, and in Figures such as Figure 3.5.6 and Table 3.4.6. This section does not duplicate that work, but further explores data which appears to be zone related or of planning interest. Statistical processes used in the following analysis include stepwise linear regression, factor analysis, principal components analysis and data base queries.

Neighbourhood attachment

Table 3.5.1 Multivariate analysis of neighbourhood attachment

Component Analysis, component 1 only

Variable	Total Cairns sample	Total	Zone		
			Inner	Middle	Outer
	Mean		1st component only		
Visit neighbours	3.09	.584	.576	.640	.598
Move because do not like neighbourhood	4.10	-.588	-.702	-.603	-.473
Neighbours would help	2.00	.583	.491	.663	.617
Talk to neighbours	2.61	.784	.713	.866	.742
Similar to neighbours	2.70	.675	.756	.388	.870
Move for travel reasons	4.19	-.416	-.284	-.448	-.461

Note: Extraction Method: Principal Component Analysis.
Typically, the 1st component (shown) accounted for about 40% of the variance.
For the mean values given above, 1 = strongly agree, 5= strongly disagree

This analysis shows that the statement: ‘ I regularly stop and talk with people in my neighbourhood’ is the most representative single variable from the neighbourhood statements. ‘ Talking with neighbours’ is thus used as an indicator for further analysis, which includes some consideration of neighbourhood attachment. The above analysis shows talking with neighbours lay about midway on the Likert scale (see mean above), without a lot of variation across zones. It is fairly central in the range of responses, which indicate feelings of linkage with the neighbourhood and neighbours.

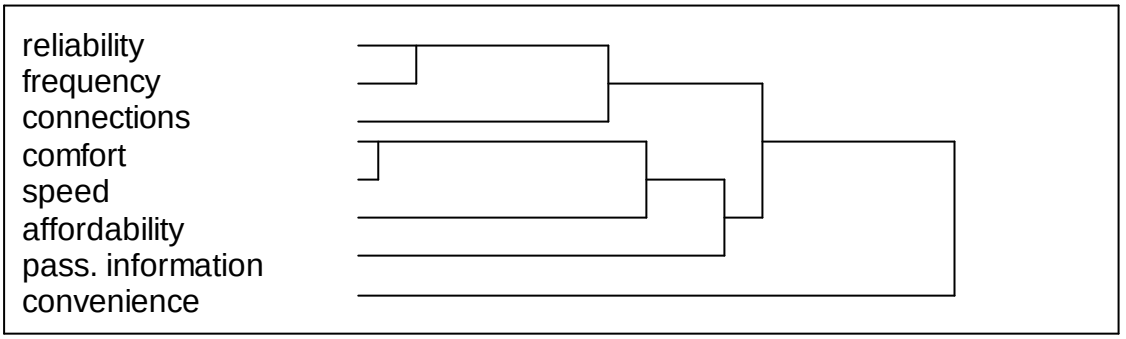
As noted earlier, travel is not a major consideration in home location choice, nor is it a reason to leave the current chosen home. The two statements above related to moving made very little contribution to the overall analysis model, except, to some extent, in the outer zone. The low interest in moving is clearly displayed in the cluster analysis above. The feeling that neighbours would help was strong overall, although slightly lower among the often more mobile inner urban dwellers.

The above results show how different variables directly contribute to overall trends of variance and correlation within each zone (Afifi and Azen 1979). The hierarchical cluster dendrogram shows three distinct groupings to the variables testing for neighbourhood attachment: people do not want to move, people are similar, talk to and visit with each other, and separately, would almost certainly help in an emergency.

Bus services

Table 3.5.2 Principal components and hierarchical analysis of Cairns bus services

Variable	Total Cairns sample	Total	Zone		
			Inner	Middle	Outer
	Mean	1st component only			
Convenience	3.81	.588	.404	.585	.585
Reliability	3.11	.739	.135	.794	.875
Connections	3.10	.820	.924	.750	.834
Frequency	3.31	.819	.918	.774	.816
Comfort	3.33	.565	.796	.569	.544
Speed	2.99	.632	.944	.468	.592
Affordability	3.13	.230	.379	-.293	.454
Passenger information	2.51	.488	.415	.592	.190



The cluster analysis of Figure 3.5.2 shows that connectivity, frequency and reliability were assessed similarly in the rating question on the bus service, while convenience, comfort and speed were clustered as acceptable. Opinions on information and affordability formed a third distinct cluster of responses to defined bus use issues. Convenience was seen as the most representative, and was, on average, seen as the best attribute of the Cairns bus service.

Although about 60% of respondents had never used the bus service in Cairns, and a further 25% had virtually never used the service, about 30% of people responded to the above bus use issues. Thus the data contains conjecture and secondhand impressions, and may not warrant detailed analysis. Convenience and reliability were nominated as the two most important aspects of the service (Appendix 9). Convenience was seen as good, but reliability was assessed as poor in written responses, with some fear of reckless bus drivers. The service had only been operating for about eighteen months at the time of survey.

Reliability was defined as the dominant issue in written responses (Appendix 7), and is used in further analysis. Some of the written responses, indicating range, are given here (Appendix 6): "Lack of regularity, not always a direct service, perhaps a change of bus necessary. Drop kids off in the wrong place. Extremely unreliable. For people who know the bus timetable is an advantage, or otherwise not enough passenger information and buses. My children use it coming home from school. Great for older people or people with no car, and good after hours service."

The above shows a fairly acceptable perception of bus use, although only 10% of inner and mid urban residents use the buses more than once per month, compared to 20% of surveyed residents from the edge suburbs (Appendix 5). Schedules, which allow increased reliability and more sedate bus driving may increase patronage, but bus use must be viewed within the larger context of land use and attractiveness of other modes detailed in the discussion of Chapter 6.

Environmental beliefs

Table 3.5.3 Principal components analysis of environmental beliefs

Variable	Total Cairns sample	Total	Zone		
			Inner	Middle	Outer
	Mean	1st component only			
Consumption/disposal is good	1.68	.565	.629	.603	.542
Ecology constrains economy	2.57	.574	.747	.411	.561
Risk for profit is ok	1.45	.647	.724	.653	.509
No limits to growth	2.18	.739	.762	.691	.780
Decision structures are ok	2.39	.480	.533	.434	.526
Go toward harmony with nature	4.10	-.380	-.621	-.332	-.110
Technology will fix any problems	2.41	.724	.844	.640	.670
New fuels will fully replace fossil fuels	3.28	.495	.425	.522	.658
Aquatic health indicates sustainable urban behaviour	3.64	-.309	-.650	-9.9E-02	2.5E-02
With technology, we can integrate with natural cycles	3.40	3.6E-02	-.126	.234	.101

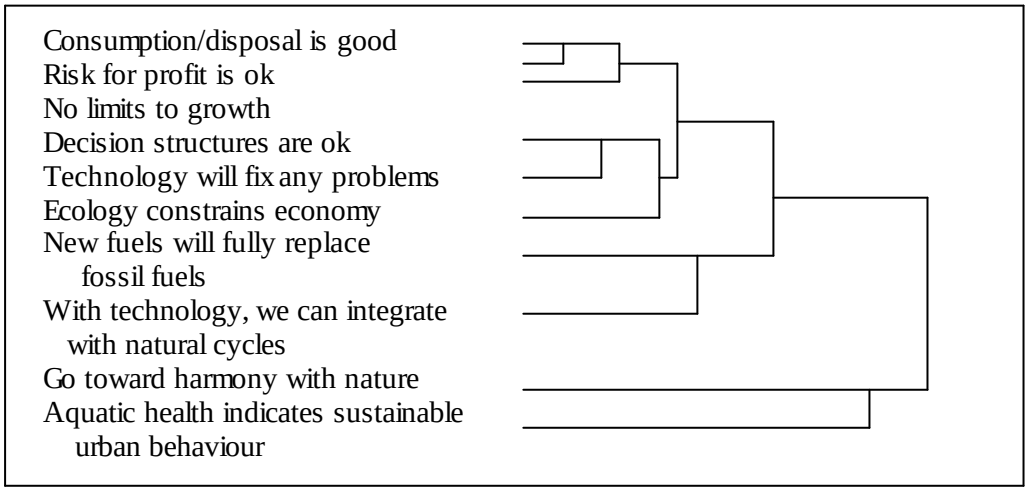
Note 1: Means are derived from the Likert scale where 1 = strongly disagree through to 5 = strongly agree.
Note 2: Only the 1st. component of the principal component analysis is shown.

The mean results in Table 3.5.3 show a collective belief that we need to integrate more with natural cycles, moving away from the linear consumption behaviour of recent decades. Putting people or nature at possible risk was strongly rejected, while there

was ambivalence about limits to growth, the ability of technology to keep supporting our present life-styles and the suitability of decision-making structures (Section 3.3 and Appendix 7).

Results of environmental beliefs using principal components analysis show responses to the assertions that there are no limits to growth or that technology will solve our foreseeable problems best reflect overall polled beliefs. The cluster analysis (Table 3.5.4) shows that the first four variables were closely linked, all leaning toward disagreement to the environmental statements. Beliefs on economic growth being constrained by limits to ecological resilience, decision structures and new fuels are similar, and grouped. Finally, the lower statements in the cluster analysis, harmony with nature, fish breeding viability and technological integration with natural cycles (eg nutrient recycling, urban farming, solar and biofuels) gained general agreement.

Table 3.5.4 Hierarchical Cluster analysis of environmental beliefs



There were three general clusters of beliefs. Future surveys could, on these findings, just ask for responses to three statements to gain environmental value indicators: *there are no limits to growth, existing decision making structures and institutions are satisfactory, and, with technology, we can integrate with natural cycles* because responses to those three statements most closely display respondents' underlying environmental values. Further, a cluster analysis of the environmental statements (Table 3.5.4) indicates that the responses to the statement on decision-making structures are the most representative, used for further comparisons in Chapter 5,

seeking statistical links between the three blocks of questions asked, relating to car dependence, perceptions of buses and environmental beliefs.

Cross tabulations

Some cross tabulations were conducted on the indicator responses developed above. Comparisons of car dependency (to get to the supermarket) and beliefs about decision making structures showed a slight bimodal relationship for inner urban dwellers. People who strongly disagreed with the adequacy of decision structures dominated, and assessed themselves as not greatly car dependent for shopping. The other concentration of correlation for central dwellers, centred on ambivalence for both decision making and car dependency for shopping. Middle urban dwellers most disagreed with the adequacy of decision making and their sense of car dependence. Similar results were found for outer urbanites, with a greater sense of car dependence for shopping.

There were no clear correlations between indicator variables for the three blocks of data analysed above. One exception was from the middle zone, where people who felt decision-making structures were inadequate also thought that bus reliability was poor.

This section has shown that people are generally linked to their neighbourhood in a meaningful way, and do not want to move. The few bus users are basically satisfied with the service, but see reliability as important. Results in this section also demonstrate a well-developed environmental awareness, concern and optimism about the future. These results mesh well with the previously presented results, particularly as they relate to planning. Technology may not have all the answers, but replacement fuels will be commercialised, so we are likely to remain very car oriented.

There was a clear perception that car-based planning caused urban sprawl, but car travel was generally supported, although many respondents encouraged better public transport. Confirming responses on the future use of renewable fuels, many saw future urban mobility using renewable fuels and better public transport. It was generally believed that these changes would help reduce petrol and car use. The following Chapter 4 provides full results from the Townsville survey, then the two studies combine in Chapter 5, leading to the discussion, conclusions and recommendations of Chapter 6.

Chapter 4

Townsville results

This chapter follows a similar format to Chapter three, with some variations to explore outcomes of particular interest such as the rural residential sample. Results at the zonal level of inner, middle and outer areas of Townsville and aggregated Townsville travel and values data follow an initial overview of key results. For the sake of brevity, ' Townsville' refers to the ' twin' cities of Townsville and Thuringowa, as this conurbation represents one coherent population centre, although divided at the local government level.

Townsville, with its population of about 120,000 people in 1996, had extensive and expanding road infrastructure. CBD parking was generally available, costing about $5 per day. In 2001, a CBD task force on people movement will review parking strategies, perhaps along sustainability policy guidelines – parking stations and better facilitation of cycling and pedestrian movement. Townsville does not suffer peak congestion. The main roads are derived from 100m wide cattle and sheep stock routes, so there is ample corridor width. Most ordinary urban streets are generously wide. There are 23X27 seat buses which service the city, along with larger buses reserved for transporting school children from the urban fringes. There is a north-south heavy gauge rail line through the population centre, but no revival of commuter services. The foregoing sets the scene for the following broad review of results.

4.1 Overview of Townsville results

These results show many of the primary similarities and differences within and between the three zones surveyed in Townsville. From 108 forms distributed to randomly selected households within each of central, middle and edge suburbs, 206 completed questionnaires were returned, a 64% return rate (Table 2.4.1).

This section presents demographic information, housing, responses to question blocks, transport and travel details (Appendix 13). Some cognitive issues (how people think about certain things) include a summary of thoughts on planning issues from respondents (Appendix

14 and 15). Following the synthesis of Cairns and Townsville data in Chapter 5, these data lead to discussion and urban planning recommendations which may help reduce overall car use (Chapter 6).

General results

The descriptive data shows sets of grouped traits (Table 4.1.1). Some variables seem independent of geographical distance from the city centre, others graded up or down from the zone near the city centre to the edge of the city. Finally, many variables displayed a unique value in one zone compared to the other two.

Traits independent of zone included average household income of about $35,000, highest education level averaging Year 12, living in Townsville for about 16 years and a 45% likelihood of owning one car. About 1 in 10 households had a car from their employer, and each household averaged two long distance journeys a year.

Traits which decreased from centre to edge included building age, averaging 47, 27 and 12 years respectively. Contrary to expectation, less money was spent on public transport per household from centre to edge, while a sense of independence from cars plummeted as the survey groups were tested at increased distances from the centre of the city. Conversely, absolute car ownership rose steadily from the city centre, as did the number of vehicles per household. Pushbike ownership and use varied across the zones, with most pushbike trips made by residents of the middle suburbs.

Inner urbanites tended to have fewer two-car households (23% compared to 40% for the other two zones), and an average 7 years employment with their current employer, compared to about 10 years for the other two zones. The middle suburb households spent the least on parking and were most interested in buses and pushbike security.

There were features which were clearly zone-related (distance from the old urban centre, the CBD) such as 19% non-ownership of vehicles in the central suburbs, with 6% of surveyed

households in the middle suburbs not owning a car. All edge suburb households in the survey owned at least one vehicle.

Table 4.1.1 Selected data trends across the Townsville zones

	Central	Middle	Edge	Overall mean
Zone independent				
Household income ($,000/year)	34	33	37	35
Age of respondent (years)[1]	43	38	43	41
Education (year)	12	12	12	12
Years lived in Townsville	17	16	16	16
Car engine size (average # of cylinders)	4.8	5	5	4.9
One vehicle owned (%)	49	44	41	45
Vehicle provided by employer (%)	9	9	10	9
Annual journeys from Townsville area	1.8	1.7	1.6	1.7
Decrease across zones from centre to edge				
Age of building (years)	47	27	12	28
Cost of public transport ($/wk)	14	12	7	12
Use public transport (%)	20	17	0	12
Ease of urban mobility without a car. (% who believe relatively easy)	21	10	1	10
Increase across zones from centre to edge				
Percentage of households with vehicles	79	94	100	91
Number of vehicles per household	1.5	1.6	1.8	1.7
Weekly fuel costs ($)	20	27	40	29
Drives more than 10x per week (%)	40	54	69	54
Perceived difficulty without a car (%)	55	63	96	72
Push bikes used/household	.7	1.1	1.5	1.1
Push bikes owned	1.6	2.5	2.9	2.3
Central different from mid and outer				
Born in Townsville (%)	**23**	35	32	27
Two vehicles owned (%)	**23**	40	40	34
Current employment (years)	**7**	10	11	9.5
Middle suburbs different from inner and edge				
Average weekly parking costs ($)	7	**2**	6	5
Female respondents (%)	46	**62**	51	53
Answered questions on buses (%)	29	**37**	21	29
Want more push bike security	17	**28**	9	18
Drives 5 – 10 x per week (%)	14	**6**	15	12
Outer suburbs different from central and middle				
Paying rent (%)	56	56	**24**	45
Use buses – main respondent - (%)	20	17	**0**	12
Home ownership – outright (%)	21	19	**41**	27
- mortgage (%)	21	22	**32**	25
- rent (%)	56	56	**24**	45
Distance to nearest convenience store (Km)	.6	.9	**3.3**	1.5

Note 1: CD M14 (Kirwan), anomalous to the general trend, averaged 31 years respondent age.
Note 2: Features of interest are presented in bold.

The outer suburbs in the sample were distinct because they had a higher absolute home ownership (40% versus 20%) and mortgage ratio (32% versus 21%) when compared with the two more central zones, showing a strong financial commitment to living that far from the city centre. There was a Spearman's rank correlation of .56 between ownership status and age of main respondent, and no significant relationship between age and zone. About 20% of inner and mid urban main adult respondents used buses at least occasionally, compared to one of the 68 outer urban households in the survey. Finally, the average distance to the local shop indicates the car-based nature of the fringe suburbs: 3.3 Km, compared to about .8 Km for the other zones.

4.2 Full results

This section generally follows the questionnaire sequence, providing comparisons between central, middle and edge urban zones (Appendix 17 and 18). Respondents from the inner urban area tended to be between 30 to 40. Mid urban dwellers were mainly spread from 20 through to 50 years of age, and the outer urban dwellers were mainly from 30 to 40, with another cohort from 50 to 60 years of age.

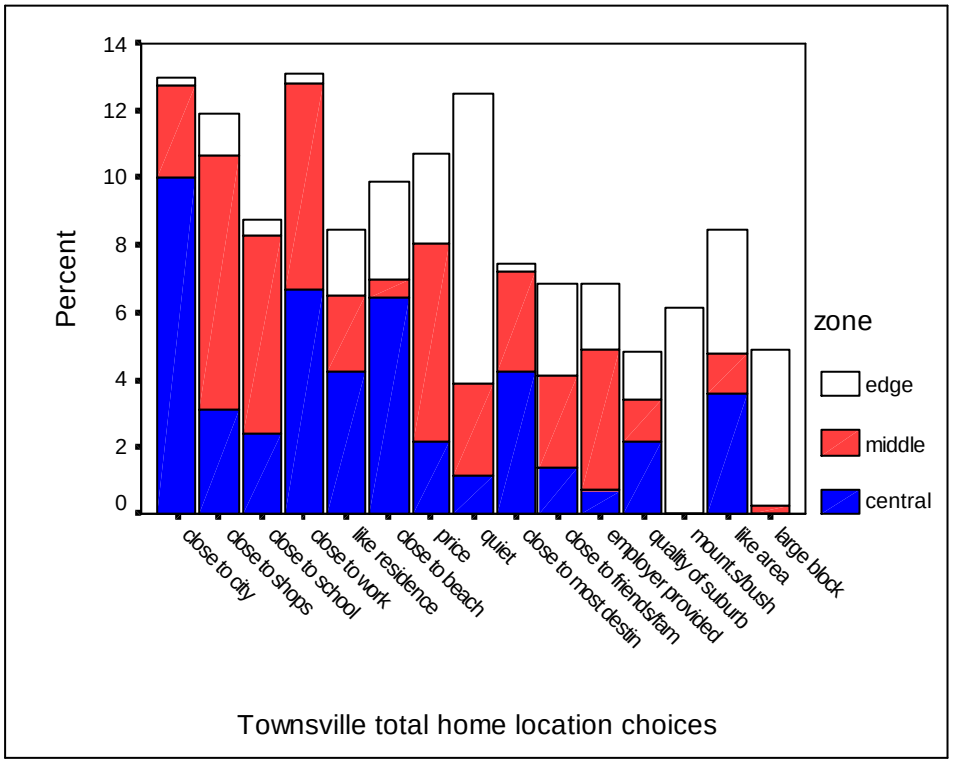
About 40% of dwellings surveyed in the inner suburbs were flats or units, whereas nearly all the survey households in the central and edge suburbs were houses. There is a zone-related difference at the structural level of housing type.

Choice of home location

Because most journeys begin and end at home, choice of home location may be a profound determinant of travel thereafter. Respondents were asked to list their reasons for choosing their current home, beginning with the most important. There was a 92% response to this block of questions about why people chose to: *"live where you do …(rather than anywhere else)"*.

The survey form contained space to write up to five reasons for their choice of residence. Proximity to the city was the main reason for the inner urban dwellers. Secondly, their home was close to work. The main reason for people choosing the middle suburbs was their employer (mainly Armed Forces) provided their home, or because they liked the price. Selecting CDs randomly reinforces the unbiased ' science' of the sample. Proximity to a school was the third most recorded reason for middle urban dwellers home location choice. The dominant reasons for outer urban choice was quiet, in the country or because it had a large block of land. The second round of written reasons for home choice from inner to outer suburbs were: 'close to the city', then 'close to shops' for the middle urban dwellers and 'quiet' for the outer urban dwellers. ' Close to city' dominated inner urban dwellers and ' quietness' or the desire for quietness a high motivation for people on the urban fringe. The third written reasons were similar. Synthesis of home location choices is given in Figure 4.2.1.

Figure 4.2.1 Total reasons for choice of specific residential location



Car ownership correlated to the distance from the central business district (.314 Spearman rank correlation, significant at .01 two-tailed test). Seventy-nine percent of surveyed inner

urban households, 94% of mid and 100% of outer urban dwellers owned cars. Outer urban dwellers were most likely to drive more than ten times per week.

Predictably, inner urban dwellers believed it easier to get to all destinations without a car than members of other zones. The destinations in question were the local shop, shopping mall/supermarket, work, city, school, public transport, friends, recreation and entertainment. There was clear self-assessed car dependence to reach all major destinations, and the dependence was zone related. Townsville residents recorded that getting to the city, entertainment or supermarket without a car is harder from home locations more remote from the city centre (Table 4.2.1).

Table 4.2.1 shows that a rank (negative) correlation (moderate) exists between zone and difficulty of urban travel without a car. The values in the ‘ zone’ column are all negative because the Likert scale ranged from 1 = very difficult to 5 = very easy. As zone value *increased* from central = 1 to edge = 3, perceived travel difficulty *decreased* from 5 = very easy to 1 = very difficult.

Table 4.2.1 Correlation between distance from the city centre and self-assessed car dependence.

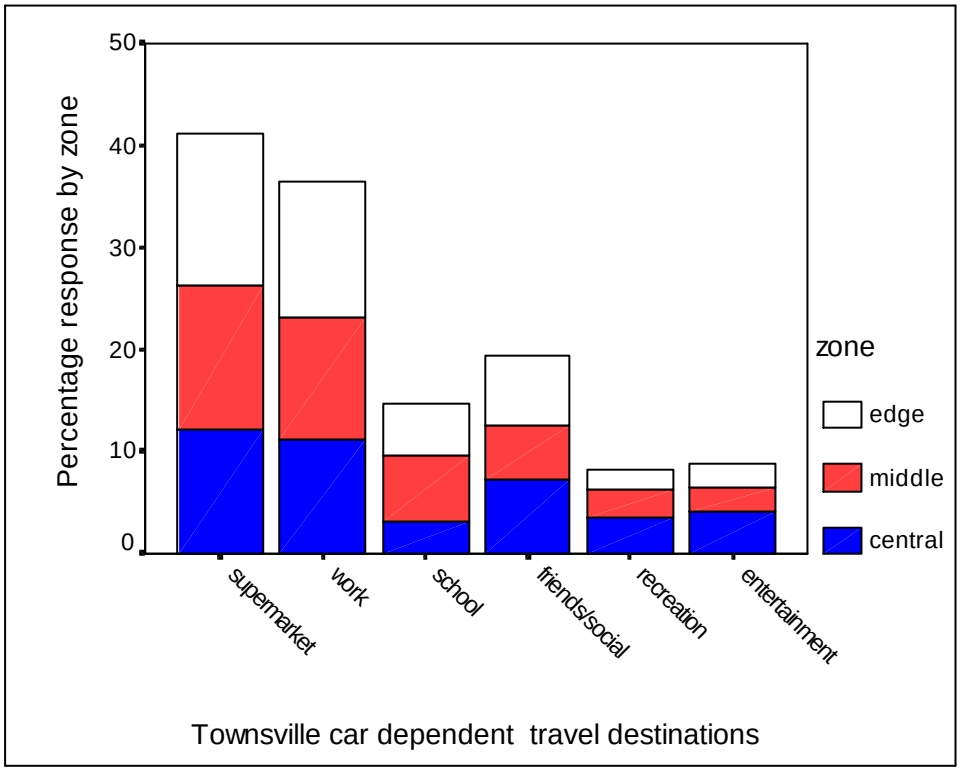
	Difficulty without a car by zone	**Carless, total**
Destination	Spearman's rho	-.459
Local convenience store	-.302	.297
Supermarket/s/mall/ normally used	-.500	.588
Getting to work	-.315	.283
Getting to the city	-.692	.540
Schools	-.087	.072
Public transport	-.162	.200
Friends/ social	-.279	.473
Recreation facilities	-.396	.513
Entertainment	-.542	.604
Carless	-.459	1.000

Note 1: All significant at the .01 level (2-tailed), except the destination ‘ schools’ , which appears decoupled from car dependence among the survey group.
Note 2: The column ‘ Difficulty without a car by zone’ = Spearman’ s (rank) correlation of perceived difficulty getting to each listed destination compared to the zone of respondents, while ‘Carless, total’ gives a comparison with overall respondent perceptions of difficulty of travel without a car.

The destinations nominated as most important were not profoundly zone dependent. The main destinations for about 40% of respondents, irrespective of zone, were getting to work or the supermarket (Figure 4.2.2) followed by social (20%) and schools (15%). Supermarkets now play a large role in our urban mobility.

Urban travel without a car was seen as very difficult by about 90% of outer urban dwellers, compared to about 45% mid-urban, and about 35% of inner residents. A core hypothesis of this research is confirmed: urban mobility and car dependence are strongly related to distance from the CBD.

Figure 4.2.2 Important travel destinations



Neighbourhood attachment

This section reflects the way people from inner, middle and edge suburbs view their connection with their own neighbourhood. Six questions were asked to gain some insight into neighbourhood attachment. Some responses were clearly zone dependent. Nearly 30% of outer urban dwellers strongly agreed with the statement that they visited their neighbours in their homes, compared to about 18% of inner and mid urban dwellers. Outer urban dwellers

surveyed tended to visit neighbours in their homes appreciably more than other Townsville residents.

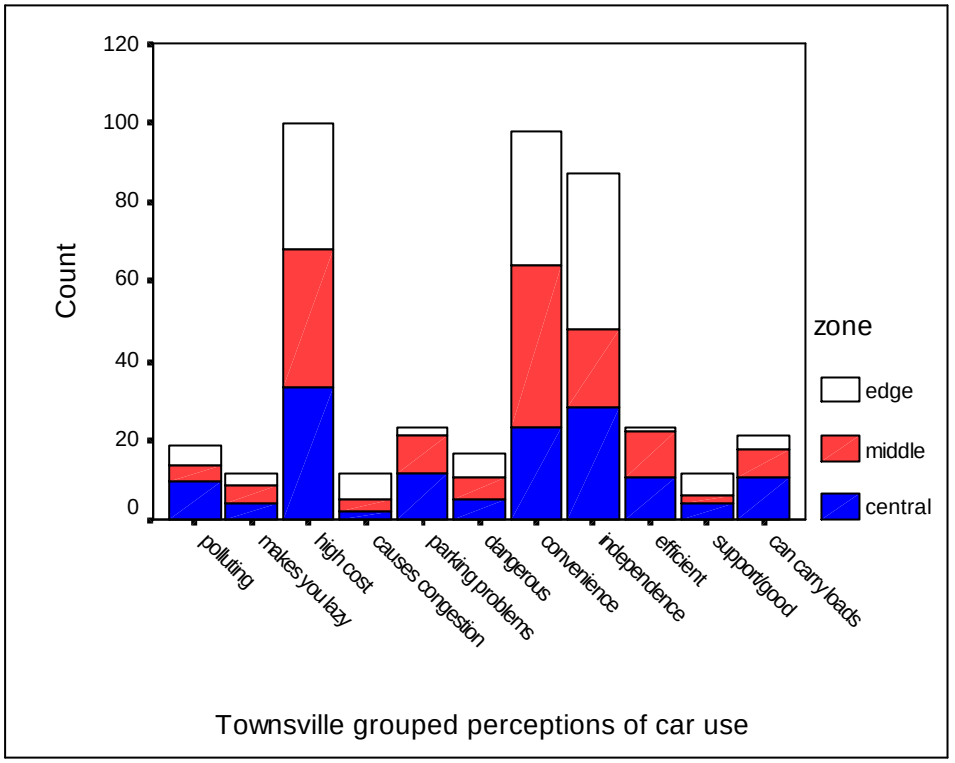
Mid urban dwellers seemed to be least attached, perhaps reflecting the high proportion of armed forces households in the survey sample. Most believed that neighbours would help in an emergency, but this was felt least strongly by mid urban dwellers and most strongly by outer urban dwellers. Neighbourhood cohesion exists, a sense that neighbours would help when it mattered.

Nearly everybody regularly talked with neighbours, except about 20% of mid urban dwellers. Most people saw themselves as at least reasonably similar to their neighbours, again least so among mid urban dwellers. At the zonal level of analysis, few people actively wanted to move from their current location to reduce travel, at most about 20%, producing no clear correlation (Spearman's rank correlation $R_S = .15$) between distance from CBD and desire to move for travel related reasons (Appendix 17). The dominant written reason for wanting to move was to get closer to amenities or usual destinations, strongly related to travel needs.

Perceptions of car use

There are zone-related perceptions of car use. Figure 4.2.3 shows that cars were primarily seen as convenient, with outer urban dwellers particularly seeing cars as providing independence and freedom. The second set of responses to the strengths and weaknesses of cars were not so much the convenience, as their high cost. The perception of high costs was dominated by about 25% of mid urban dwellers, although those same respondents saw cars as highly convenient. The third round of responses was also dominated by high cost, particularly for the outer urban dwellers.

Figure 4.2.3 Townsville perceptions of car use


120
100
80
60
40
20
0
Count
zone
edge
middle
central
polluting
makes you lazy
high cost
causes congestion
parking problems
dangerous
convenience
independence
efficient
support/good
can carry loads
Townsville grouped perceptions of car use

Bus use

More than 50% of the survey group had never used a local bus in Townsville; a further 25% have virtually never used buses. Respondents were actively discouraged from answering sections they were not particularly interested in, so only about 35% of people answered the detailed questions in the bus section. People were asked to rate a series of attributes describing bus use. The rating included categories from very poor to very good.

There were mixed feelings about the convenience of bus use, seen as poor by outer urban respondents and good by mid urban respondents. People seemed ambivalent about the reliability of buses, connections, and frequency. Buses were seen as comfortable and acceptably speedy. Buses were also seen as slightly expensive, although affordability was judged as good by most of the inner urban residents who responded to this section. Passenger information was seen as acceptable.

People were asked to rank the above-described attributes. Convenience, reliability and affordability were seen as the 3 dominant issues in bus use among respondents. Buses were seen as being expensive, unreliable, but getting better. Their perceived lack of reliability has been addressed to some extent since this November 1996 survey (Table 4.6.11), undertaken only a few months after the commencement of the Sunbus service in Townsville. The following subsections describe written responses to other travel modes: cycling, walking, ride sharing, working from home and possible urban rail use. This section finishes with a summary of written comments about special needs groups, such as people in wheelchairs.

Perceptions of cycling and walking

Riding pushbikes was predominantly seen as good healthy exercise. The next clearest perceptions of cycle use were that it was cheap but dangerous. This view was reflected in the second round of written responses, however the third set of written responses was dominated by the perception that cycling was dangerous.

People were asked if they would use their pushbikes more if there was storage security at bus stops. Only about 20% of respondents said yes, so secure storage at bus stops did not appear to be a large issue in encouraging pushbike use at the time of survey. Some respondents viewed pushbike security with deep cynicism.

Walking was also seen as healthy, inexpensive exercise. The second largest additional response from outer urban dwellers was that it was too far to walk anywhere from where they lived. The second round of written responses was dominated by health benefits from the inner suburbs, while the middle suburbs saw walking as inexpensive, were somewhat deterred by the summer heat, and feared assault. Fear of assault was the fourth strongest reaction in the second set of responses. The third set of written responses showed that summer heat was seen as a real deterrent to walking by some Townsville residents, and that the fear of assault was felt particularly by inner urban dwellers.

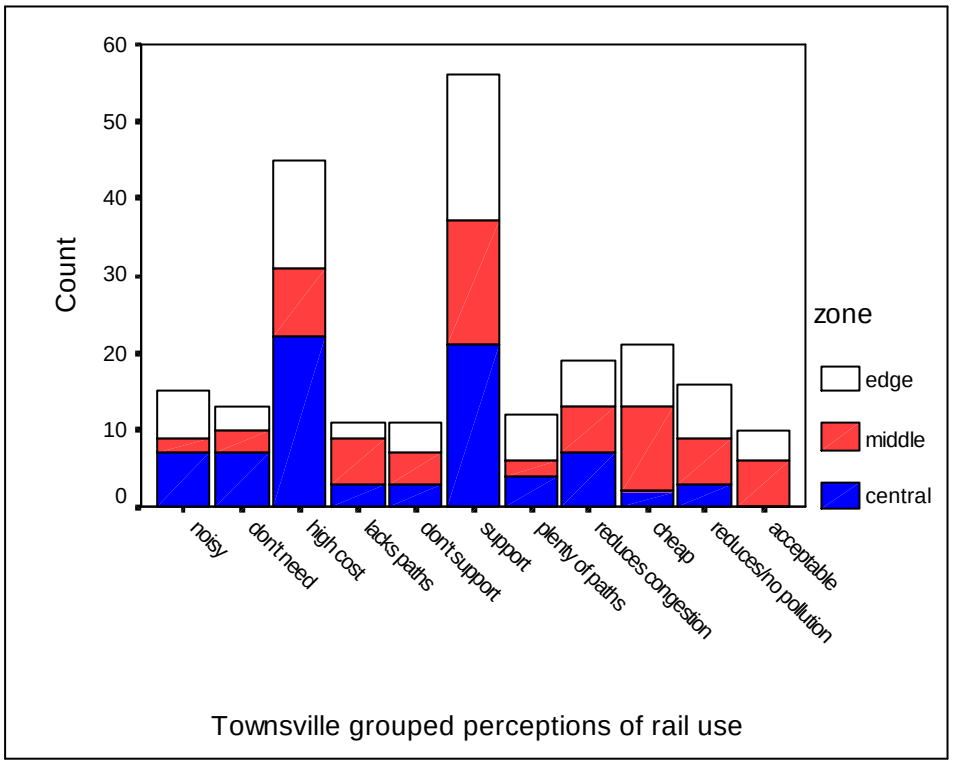
Perceptions of ride sharing, working from home and rail use

Ride sharing was seen as saving money, but with a sense of dependency. The perception of dependence was most clearly felt by outer urban residents. Working from home was seen as money saving, good or not possible. It was seen as most impractical by outer urban dwellers. That pattern was repeated through written responses to perceptions of working from home, although outer urban dwellers acknowledged the convenience of working from home.

People were asked about possible future urban rail use in Townsville. This question produced a great variety of responses. Urban rail seemed like a good idea that would reduce congestion (Figure 4.2.4). There was an understanding that built costs associated with the construction of a viable urban rail system would be high. The second round of written

responses was dominated by mid urban dwellers, who believed rail use in Townsville would be inexpensive and help reduce pollution. The high cost to create the system was seen most sharply by inner urban dwellers.

Figure 4.2.4 Townsville perceptions of future urban rail use



People were asked to comment on special needs groups, producing 60 written responses, ranging from praise through various suggestions to make amenities, shops and ramps off footpaths more accessible, to damning condemnation (eg ' shocking' , Appendix 16). There was a general view that taxis are preferred to buses for vehicular transport for the mobility impaired.

Environmental beliefs

Respondents ranked their level of agreement to 10 statements, reflecting environmental values. On a 5-point Likert scale, people could register how much they agreed or disagreed with each of the statements. A further response category ('don't know') was included to remove confused responses.

Relatively independent of zone, about 60% of people strongly disagreed with the linear industrial model (acquire, use and discard). A further 15% disagreed with that general human behaviour. There was little ideological support for the 'wasteful consumer society'. There was an ambivalent response to the statement that ecology constrains economic growth, but strong disagreement with the idea that impact risks to people or nature are acceptable to maximise wealth.

People believed that there were limits to growth, and, slightly controversially, that existing decision-making structures were not satisfactory. Most people felt that harmony with nature is needed to survive, but there was skepticism that technology will provide for continued well being.

Seeming to contradict the last finding, there was an inclination to believe that new fuels will support unconstrained vehicle use. There was an appreciation that near-city fish breeding indicates a sustainable urban environment, and a belief that we can integrate with natural cycles by using appropriate technology. About 35% of respondents did not answer the question on how long they thought that petroleum would last. Those who did were clustered around the offered projection of 60 years, with about 10% suggesting that it was more like 100 years. There was a general sense of the finite nature of petroleum supply, an implied acceptance of finite reserves.

The next section provides some insights into one CD which did not follow the general pattern of their city at large. The following section considers Rupertswood, where detached dwellings are set on rural residential blocks of land of at least 4000m^2.

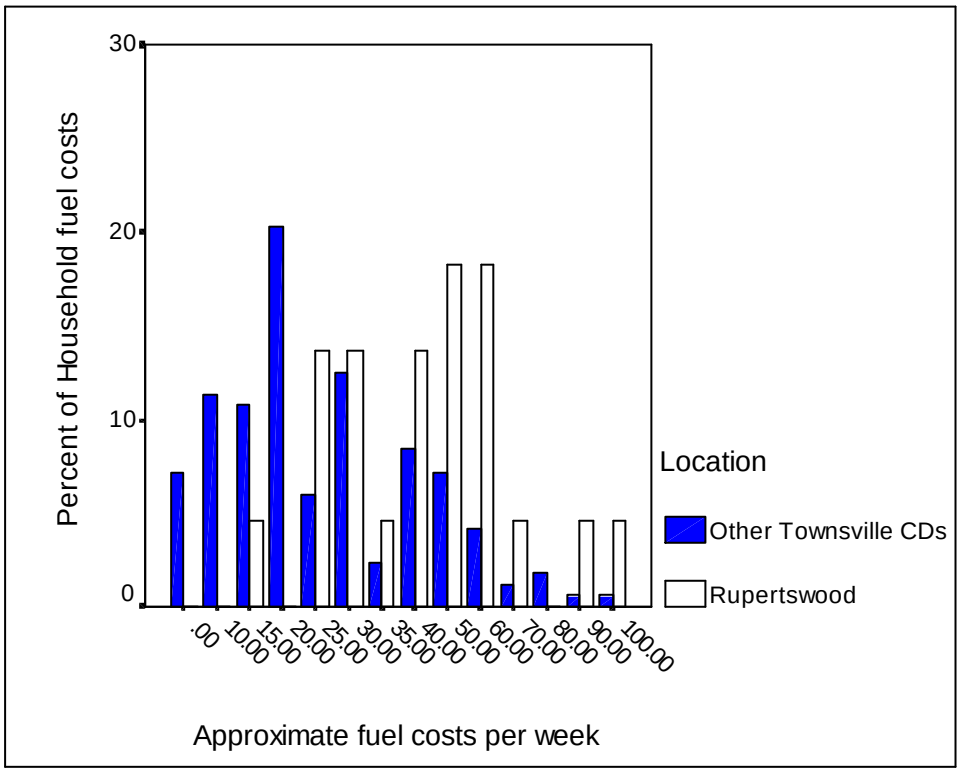
4.3 A case study of one Collector District on acreage - Rupertswood

An outer CD on acreage is analysed as a case study of ' rural/residential' development because such developments are now seen as problematic. They "take up significant areas of land to accommodate a small population capacity. Rural residential areas are often remotely located from serviced urban areas and consequently have relatively poor access to

employment opportunities, social infrastructure services, retail shops and other community facilities" (FNQ Regional Plan 2000, p 222).

Although development of exurbia acreage may not be a major issue in many countries, this case study indicates problems of isolation in developing fringe growth while ignoring the access needs of future residents. Figure 1.4.3 shows the location of Rupertswood. Rupertswood does not fit the general range of CDs within their zones because of 'urban' lot size. The following section provides a detailed analysis of the 22 responding households from Rupertswood.

Figure 4.3.1 Fuel use of Rupertswood compared to 6 other more central Collector Districts



Of the 22 households, 9 were owned outright, 12 were being purchased and one was rented (41, 54 and 5% respectively). Ownership was high compared to the full sample. Inner urban respondents had 24% outright ownership compared to about 35% for the middle and outer zones overall. Seventeen, 23 and 35% of respondents from inner to outer zones respectively

were paying mortgages. Complementary to this, 59, 39 and 28% of inner, middle and outer zone residents respectively were paying rent.

Only one main Rupertswood respondent in this 22 - person sample used public transport, three paid for parking, while each household averaged $47 per week fuel expenses, compared to $23.50 for the 136 more central surveyed Townsville households (Figure 4.3.1). Across the whole sample, people in both centres tend to spend about $25 -$30 per week. Overall, inner urban dwellers spent the least while outer urban dwellers spent the most on fuel.

Home location choice

Figure 4.3.2 Reasons for living in Rupertswood compared to all other Townsville Collector Districts

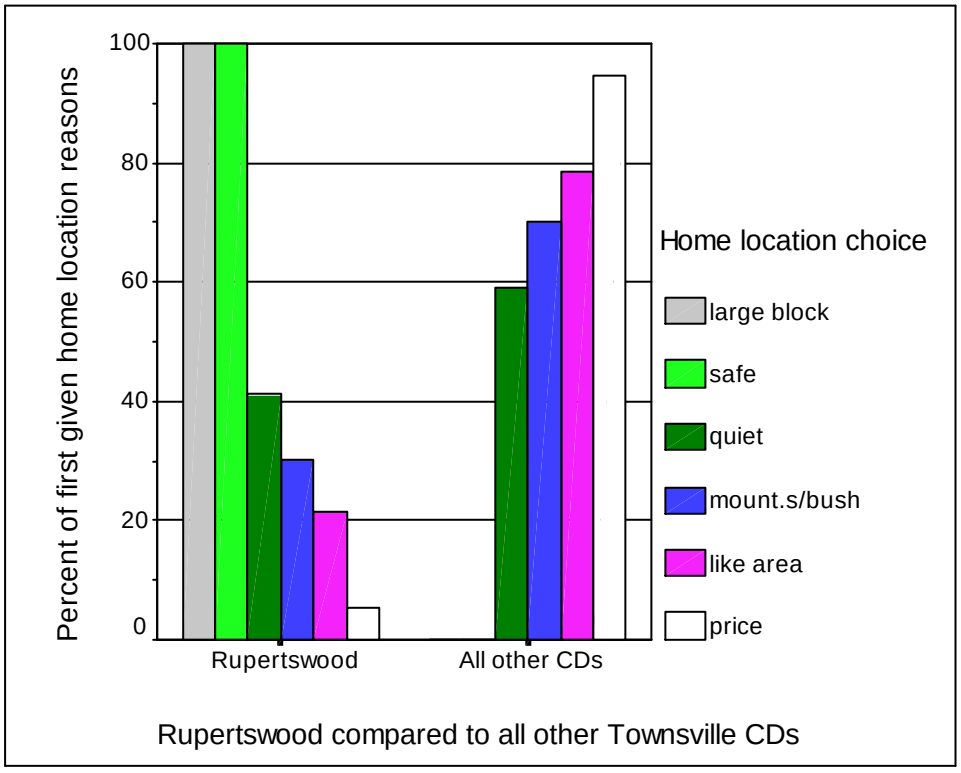


Figure 4.3.2 shows that of the 9 Townsville CD, safety and large blocks were the exclusive first given reasons for home location choice (of 33 coded choices) in Rupertswood. Although Rupertswood represented about 10% of the full Townsville sample, residents there generated

40% of “quiet” as the first reason for choosing a specific location. The natural setting of Rupertswood was also an important attraction.

Figure 4.3.3 Total reasons for choosing to buy in Rupertswood

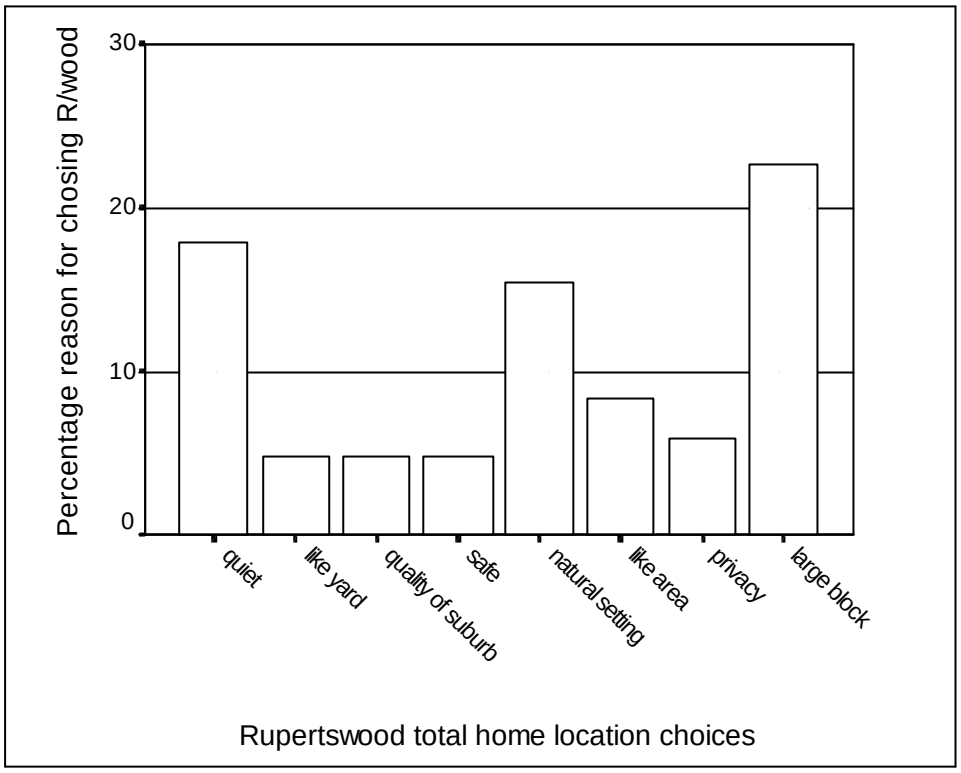
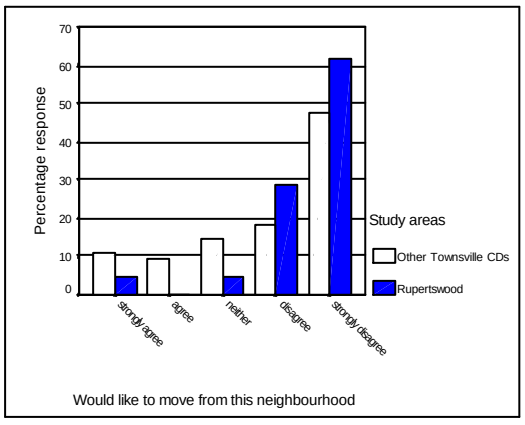
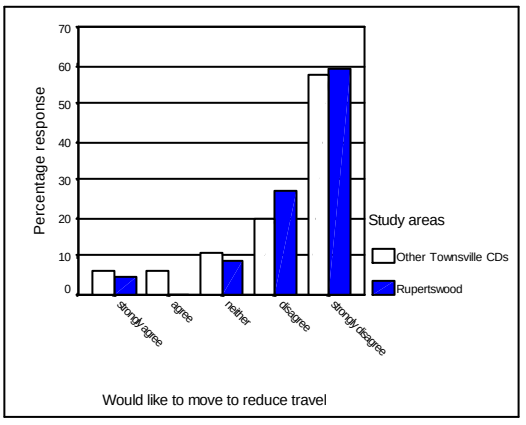


Figure 4.3.3 shows the eight most common written reasons given by Rupertswood residents for choosing to live there. A sense of personal space, of privacy, peace and quite away from the crowded suburbs. The following section shows that the dream of space and privacy has a price attached, not readily admitted.

Neighbourhood attachment

Figure 4.3.4 Likert scale of desire to move from current neighbourhood





Figures 4.3.2 and 3 show that a large block in a quiet bush setting were the main reasons for living in Rupertswood, Figure 4.3.4 indicating a settled group of residents, generally happy to stay where they were. However, further probing challenges this picture in Rupertswood. The following transcriptions from Rupertswood residents show that their sense of isolation from normal destinations is profound. With 22 households in the Rupertswood sample, the main spokesperson for 14 of them (about 60%) wrote in an open-ended section that they wanted to move *to/because*:

"city/big block hard to maintain; Mundingburra/closer; Kirwan/closer; Kirwan/closer to shops and school; Kirwan/near medical; suburb/reduce travel for kids; suburb/reduce travel cost and stress; town/reduce travel costs; inner suburb/closer; city/get married quarters; Kirwan/closer; Townsville/closer; Pallerenda/near beach; suburb/could ride share commute."

Note: household transcripts are separated by ";".

This anomalous result was only pronounced in Rupertswood. Few wanted to move at all from most other surveyed CDs. Methodological and planning implications of the above finding are clear: after the idealism and ' location loyalty' are transcended, a deep locational discontent remains in this rural residential survey.

4.4 Townsville travel details

This section focuses on the quite different travel patterns, particularly peaks, of central, middle and urban edge dwellers. The challenges in data collection and coding were given in the Chapter 2.8. Travel destination and mode are provided for the 1800 trips documented in the three Townsville zones. Table 4.4.1 displays a fundamental zonal difference of urban travel. Trip distances increased from central to peripheral residents, although the number of trips per person remained fairly constant.

Table 4.4.1 Overview of travel details

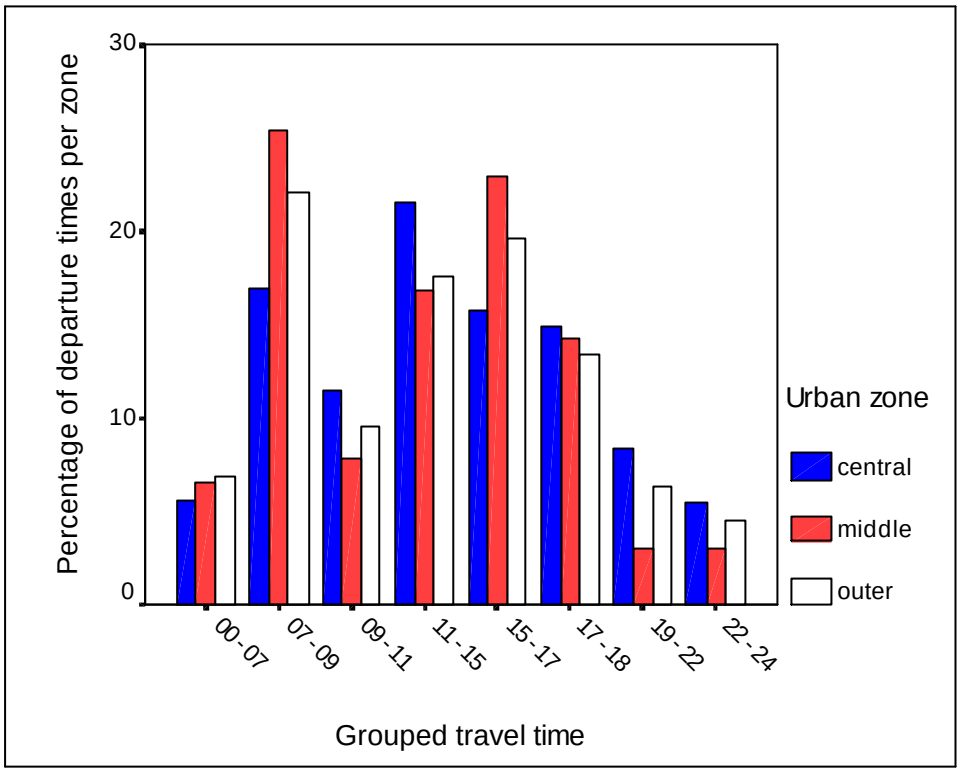
Zone	# of house-holds	# of residents	# of trips	Mean trip distance (Km)	Mean # residents/household	Mean trips/ person
1	70	151	515	3.37	2.16	3.4
2	66	212	688	5.11	3.21	3.2
3	68	197	597	19.00	2.90	3.0
Total	*204*	*560*	*1800*	*9.32*	*2.71*	*3.2*
		With the 42 non travellers removed				*3.5*

Note: young children (< 4 years old) not included, unless travelling to or from day care.

Different departure patterns emerge across the zones, as shown in Figure 4.4.1. Comparison of the three zones show that central residents tended to move around most during the middle of the day. Mid urban residents contributed strongly to a distinct morning and afternoon peak, with a like pattern for the outer urban sample of 597 trips (Appendix 14).

Figure 4.4.2 shows that shorter trips of .1 to 1 Km were dominated by inner urban residents, while 1 – 7 Km trips were dominated by members of the middle suburbs. Outer zone residents covered greater distances, strongly supporting an hypothesis that travel distances are zone dependent. Further analysis shows relationships between the general travel traits of time, distance, mode, destination, age and occupation. Figures 4.4.3 to .5 make clear the dominance of the car, both by frequency of use and total distance travelled. Cars were used to travel about 15,000 Km by 560 people on the day of survey, accounting for about 90% of total distance travelled, while all other modes accounted for about 1,200 Km, about 8% of the total distance.

Figure 4.4.1 Total Townsville travel departure times



Note: Travel departure times coded to the nearest hour, eg recorded 8.30 am departure is in 07 to 09 group.

Figure 4.4.2 Total Townsville travel distances for 1,800 trips

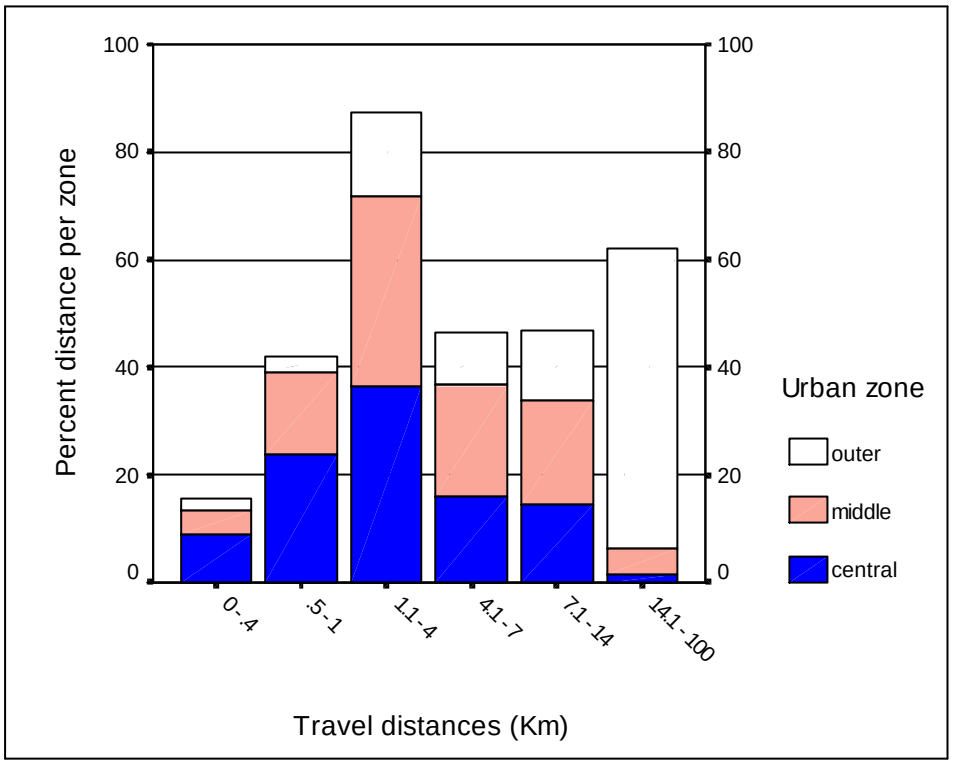


Figure 4.4.3 Percentage trips by travel modes in Townsville

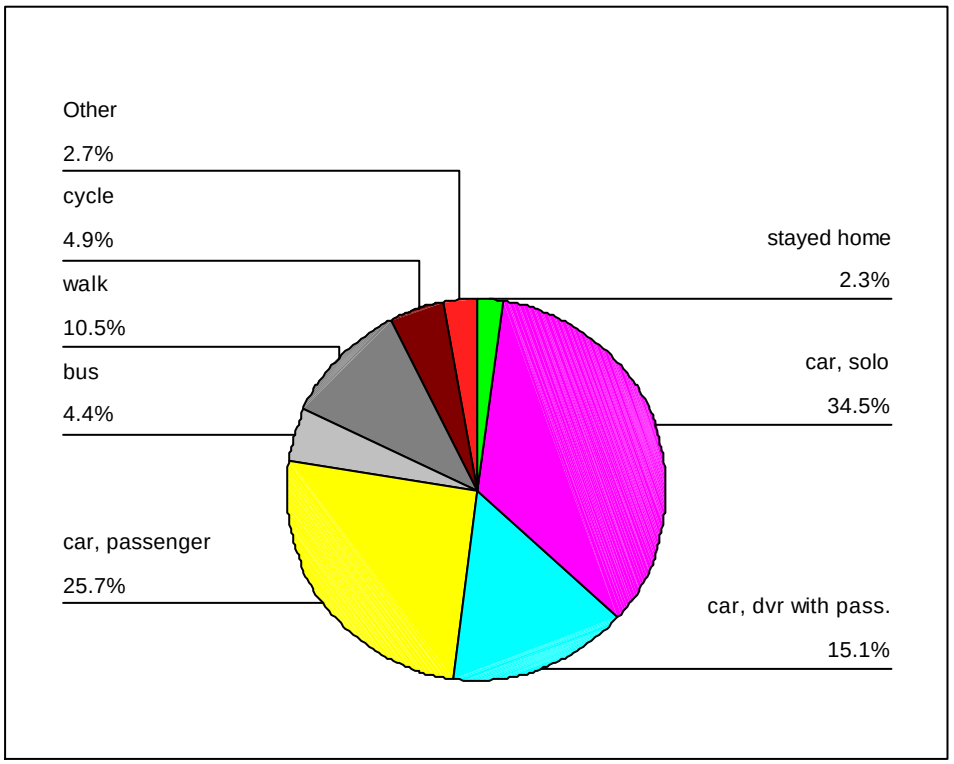


Figure 4.4.4 shows the overwhelming dominance of cars to achieve urban travel in Townsville/Thuringowa. By displaying travel mode as a percentage of total travel, not just trip numbers, cars account for 88% of total distances covered in urban travel. Figure 4.4.5 shows the different modes of transport for Townsville zones, reflected in Table 4.4.2. The percentage of inner urban dwellers driving solo tended to be high compared to drivers from more outer areas. Walking was most frequent in the inner zone, while more people cycled in the mid urban area. General buses were most used by central dwellers, with use diminishing at increased distances from the centre of the city. The converse was true for school buses, used almost exclusively by children from the urban fringe.

Figure 4.4.4 Distances travelled by dominant travel modes in Townsville

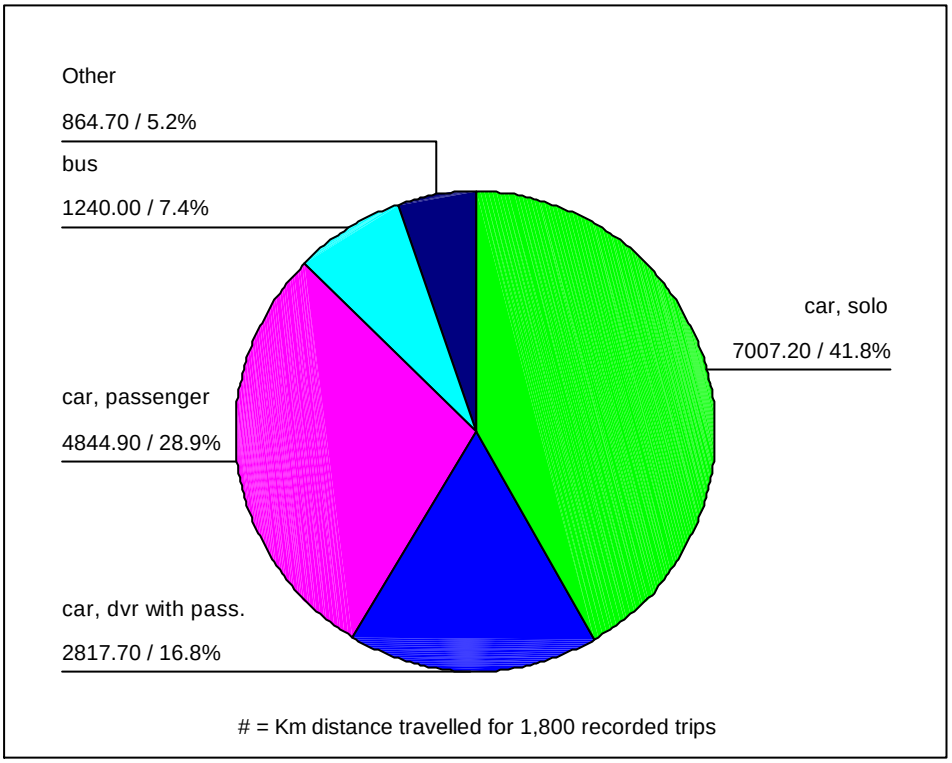


Figure 4.4.5 Percentage use of different travel modes in Townsville

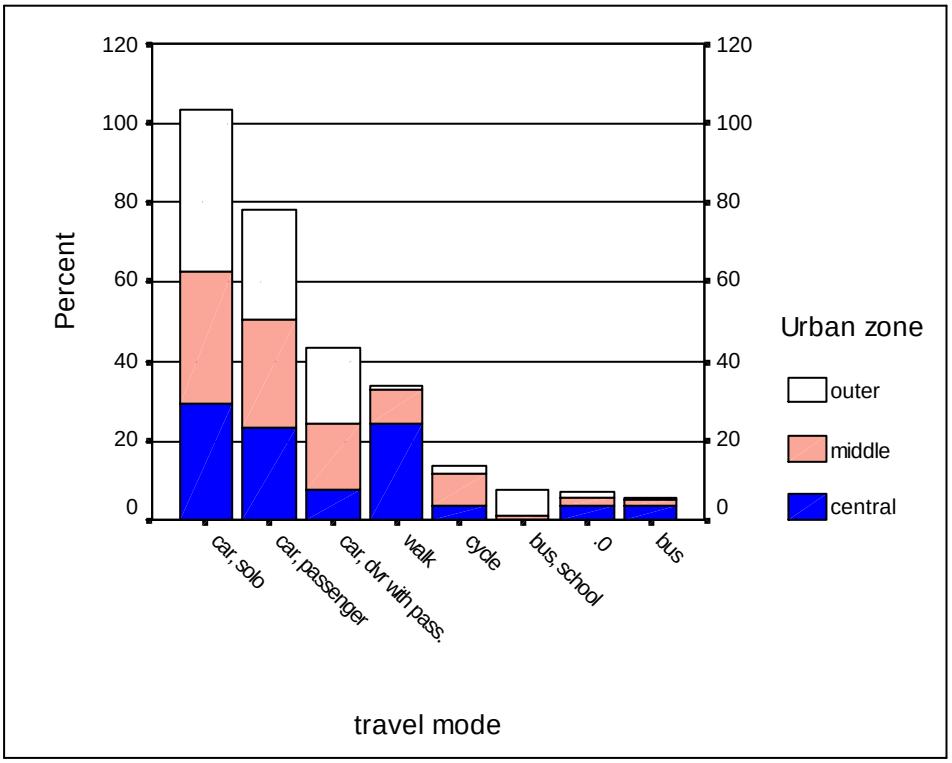


Table 4.4.2 Average and total distance travelled for each mode and zone

Travel mode	Total Km	Average Km travelled			
		Central	Middle	Outer	Total
Car, solo	7,007	5.42	6.08	19.93	11.7
Car, passenger	4,844	3.85	5.79	20.25	10.3
Car, driver with pass.	2,817	4.68	4.88	18.24	10.6
Bus, school	1,009	7.00	3.33	23.38	20.6
Cycle	334	1.99	4.12	5.17	3.8
Walk	252	1.34	1.26	1.93	1.3
Bus	231	7.79	6.57	9.25	7.7
Motor cycle	151	6.00	14.25	20.50	15.1
Taxi	76	2.92	3.15	-	3.0
Ferry	48	8.00	-	-	8.0

A feature of the urban travel survey is the high social mobility of the survey group, especially from the inner zone (Figure 4.4.6). People living in inner Townsville tended to work there the most, and shop more (on Fridays of the survey) than their less central counterparts. There is late night shopping (to 9 pm) in the Townsville CBD on Friday nights and Thursday elsewhere. There appears to be a close association between home and employment, a stated reason for inner urban home location choices. Although the two dispersed Armed Forces locations (Lavarack Barracks and the RAAF base) were coded as separate destinations to emphasise their role as major employment centres, they did not contribute greatly to overall travel in the sample.

Figure 4.4.6 Travel destinations by zone

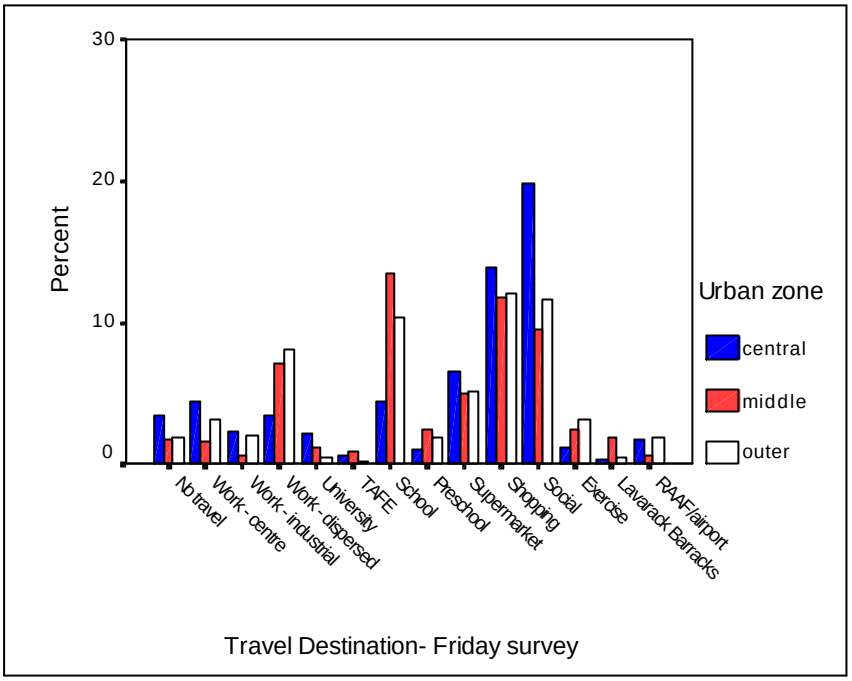


Table 4.4.3 shows that older people tend to stay home or go to the supermarket more than other age groups, with the exception of the middle suburbs, where the average age of those who stayed home on the Friday of survey was 30 years.

Table 4.4.3 Average age of travellers to destinations, by zone

	Average age of travellers (years)			
Destination	**Central**	**Middle**	**Outer**	**Total**
Stayed home	51.50	29.58	51.55	45.1
Exercise	37.50	32.18	25.26	29.8
Home	36.02	28.68	32.49	31.9
Preschool	25.80	20.00	18.73	20.5
School	20.91	19.99	19.48	19.9
Shopping	39.18	35.02	32.11	35.4
Social	31.39	25.09	34.30	30.5
Supermarket	46.26	40.41	46.55	44.3
University	37.36	26.38	52.33	35.4
Work – centre	36.87	34.55	42.79	38.5
Work – dispersed	38.39	35.27	40.21	37.8
Work – industrial	31.08	39.25	39.33	35.8

Note 1: Data analysis derived from Microsoft Access 1998.
Note 2: Averages include such people as drivers who took children to school or preschool.

Younger people tend to walk for exercise. Destination ‘ home’ provides an indication of overall average age, as that destination constituted about 40% of all destinations. In more detail (Appendix 16) walking a total of 41 Km or cycling 36 Km for exercise was undertaken by few

of the 560 people in the Townsville sample. Solo driving or being a passenger absolutely dominates urban travel, particularly for the outer zone. This is most clearly reflected in the "home" destination figures.

All preschoolers in the sample were driven to and from their crèche. School children in the two more central Townsville zones tended to walk about equal distances to school, while mid urban school children covered the greatest distances to school by bike. Almost all shopping and social trips used a car.

Table 4.4.4 Destination, mode and total distances by zone

		Average distances travelled (Km)			
		Zone			
Destination	**Travel mode**	**Central**	**Middle**	**Outer**	**Totals**
Home	Bus, school	7	6	533	546
Home	Car, driver with pass.	69.5	218.5	937.5	1225.5
Home	Car, passenger	163.2	459	1399	2021.2
Home	Car, solo	291.9	570.1	2193.5	3055.5
RAAF/airport	Car, solo	28	10	98	136
School	Bus, school	-	9	449	458
School	Car, driver with pass.	11	68	94	173
School	Car, passenger	15	143	255	413
Shopping	Car, driver with pass.	9	51	160.4	220.4
Shopping	Car, passenger	42	85	357	484
Shopping	Car, solo	58.5	115.1	265	438.6
Social	Car, driver with pass.	47.5	68.5	270.5	386.5
Social	Car, passenger	141.5	289.5	372	803
Social	Car, solo	105.5	106.5	234.5	446.5
Supermarket	Car, passenger	51	32	160	243
Supermarket	Car, solo	75	34	275	384
Work – centre	Car, driver with	-	-	130	130
Work – centre	Car, solo	14.8	46	462	522.8
Work – dispersed	Car, driver with pass.		25	182	207
Work – dispersed	Car, passenger	14	8	306	328
Work – dispersed	Car, solo	89.8	292	838	1219.8
Work – industrial	Car, solo	34	36	283	353

Note: all total values <120 Km have been removed.

As a minor destination from the sample population, trips to University are not shown in Table 4.4.4. On the Friday of survey, one household group of three university students travelled to Magnetic Island by ferry. Most trips to the university were by car, with the greatest total distance travelled to University by inner urban dwellers. Only outer urbanites shared their commuter driving to the city centre with passengers in about 15% of cases. Other results displayed in Table 4.4.4 show detail of urban travel in a highly car dependent society.

Figure 4.4.7 demonstrates how edge dwellers travel much greater distances than their more central counterparts. They also contain a highly mobile group in the 50 - 60 year old age range substantially missing from the other two zones. Figure 4.4.7 depicts the links between age, zone and travel distances. Outer urban dwellers covered the greatest distances, especially females and males over 50 years of age. While few inner urban dwellers ventured further than 8 Km on any leg of a trip, 20 Km was common for outer urban dwellers.

Figure 4.4.7 Zonal traits of age and distance travelled

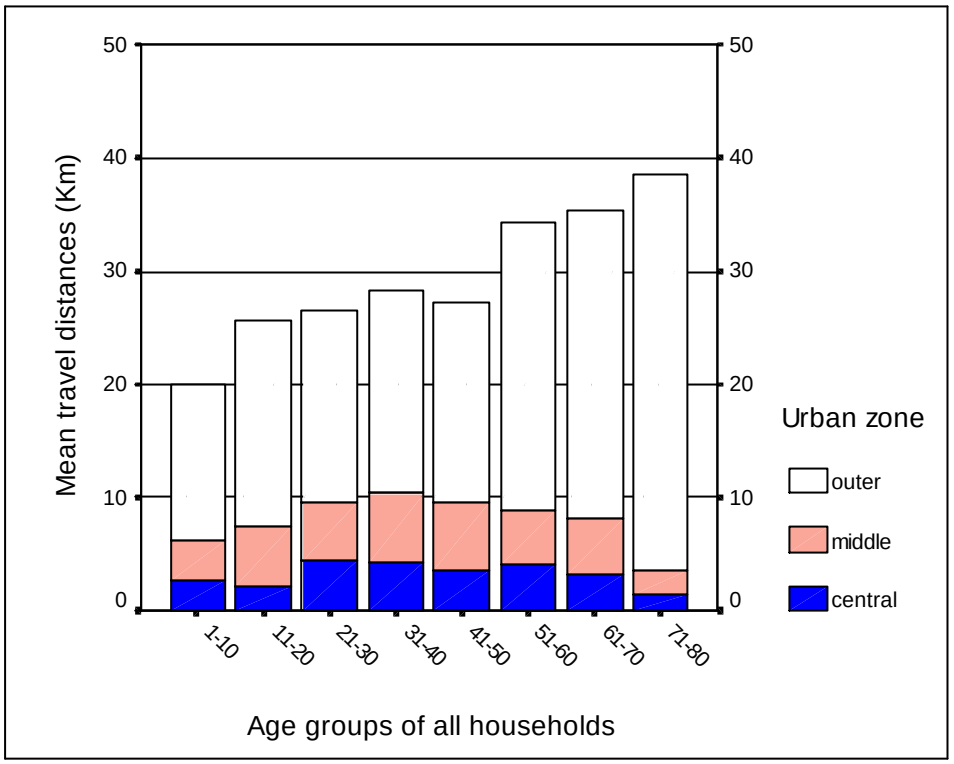


Table 4.4.5 Gender, age of travellers by distance and zone

		Average distances travelled (Km)			
		Zone			
Gender	**Age group**	**Central**	**Middle**	**Outer**	**Totals**
Female	11-20	1.31	5.09	16.64	8.59
Female	21-30	3.89	4.50	15.62	7.52
Female	31-40	3.82	5.54	16.41	8.85
Female	41-50	3.82	3.26	15.90	7.63
Female	51-60	4.78	2.16	22.22	13.28
Female	61-70	3.25	4.33	22.88	8.26
Male	11-20	3.34	5.32	20.13	11.36
Male	21-30	5.03	5.80	20.40	7.90
Male	31-40	4.96	7.09	20.89	11.13
Male	41-50	3.48	7.81	19.38	10.21
Male	51-60	3.73	7.22	28.41	16.50
Male	61-70	3.48	4.94	34.00	8.19

Note 1: Tables 4.4.4 and 5 only include people from 10-70 years of age.

Table 4.4.5 shows that males from 30 to 50 years of age tended to travel greater average distances than females. Both males and females in the 50 to 60 year age group tended to average the greatest trip distance compared to all other age groups, inflated by outer urban

dwellers in that cohort. The travel distances in Tables 4.4.5 and 6 need to be tempered with the knowledge that there are different numbers of people per age group, and per zone. Very clear outcomes probably have meaning, particularly at the ' total' level. These results show absolute rather than per capita travel distances. The results are useful because they reflect the overall make-up and mobility of the population. Total urban travel places demands on urban infrastructure.

Little urban travel was undertaken as exercise *per se*, so that destination has been dropped from Table 4.4.6. The destination ' home' provides an indication of overall travel distances per age group, dominated by the 30 to 40 year old residents. This analysis of destination ' home' reinforces the result that travellers from the outer suburbs have the highest travel distances in every age group, especially 50 to 60 year old residents.

Preschoolers travelled to their crèche less than their 30-40 year old parents because the parents would drop them off, then return later to pick them up. Going shopping was one of the few destinations where inner urban dwellers match their less central equivalents.

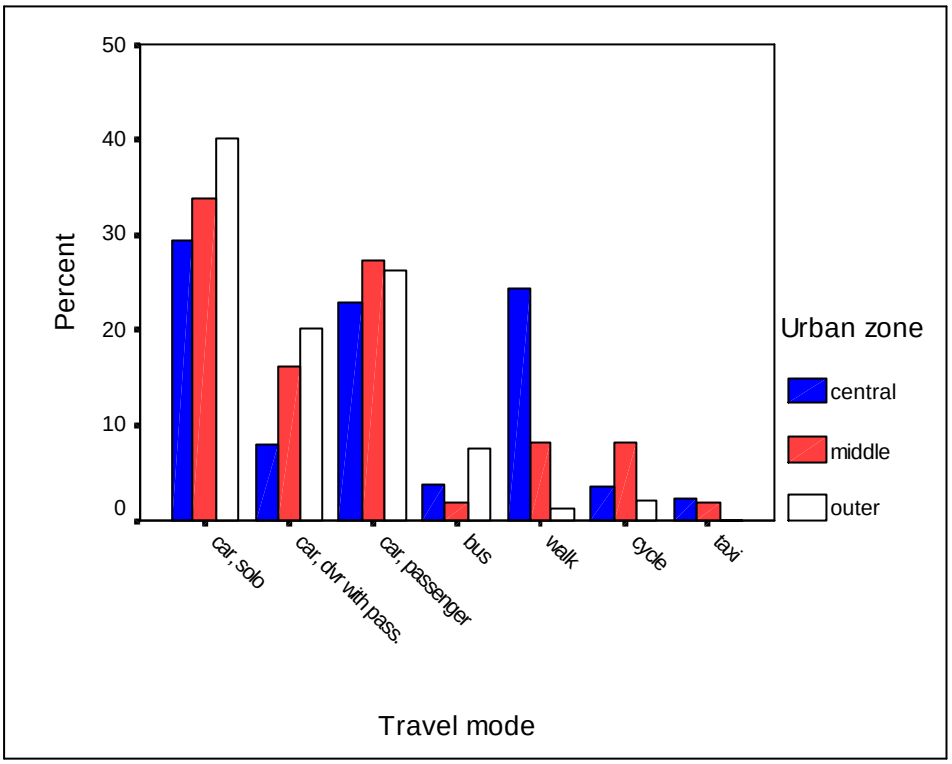
Table 4.4.6 Destination, age of travellers and distance travelled by zone

		Average distances travelled (Km)			
		Zone			
Destination	**Age group**	**Central**	**Middle**	**Outer**	**Totals**
Home	11-20	44.5	247.1	752	1043.6
Home	21-30	149.9	391	730	1270.9
Home	31-40	151.2	326	1230	1707.2
Home	41-50	121.8	249.5	608	979.3
Home	51-60	80.4	67.1	1076.5	1224
Home	61-70	51.7	36	173	260.7
School	11-20	25.4	95.4	518	638.8
Shopping	21-30	31.5	82.2	147	260.7
Shopping	31-40	56.8	55	200	311.8
Shopping	41-50	33.2	27.5	99	159.7
Shopping	51-60	2.1	33.1	116.9	152.1
Social	11-20	5.2	102.5	56	163.7
Social	21-30	110.8	104.5	215	430.3
Social	31-40	208	73	189	470
Social	41-50	34.5	52	149.5	236
Social	51-60	23	16.1	123	162.1
Supermarket	31-40	56	44	68	168
Supermarket	41-50	42	11	81	134
Supermarket	51-60	18	4	148	170
Supermarket	61-70	37.2	12	117	166.2
Work – centre	31-40	10	36	202	248
Work – centre	41-50	6.5	20	196	222.5
Work – centre	51-60	1.3		190	191.3
Work – dispersed	11-20	10.2	14	177	201.2
Work – dispersed	21-30	23	93	153	269
Work – dispersed	31-40	29.8	157	303	489.8
Work – dispersed	41-50	20.6	73	203	296.6
Work – dispersed	51-60	21	30	490	541
Work – industrial	31-40	25	5	145	175

Note 1: categories of less than 120 Km such as work – tourism or TAFE have been removed.
Note 2: Table 4.4.6 only includes people from 10-70 years of age.

Figure 4.4.8 shows the deep reliance placed on cars, and some clear zonal differences. Inner urban dwellers dominated walking, while people from the middle suburbs cycled the most, and had the most solo car use. People living further from the city centre tended to carry passengers the most. About 80% of all trips were by car. Having detailed some of the main urban travel traits for residents in Townsville, the next section provides details of how Townsville residents felt about their urban travel at the time of survey, and in future.

Figure 4.4.8 Percent of travel modes used by zone in Townsville



4.5 Recorded views of urban mobility issues

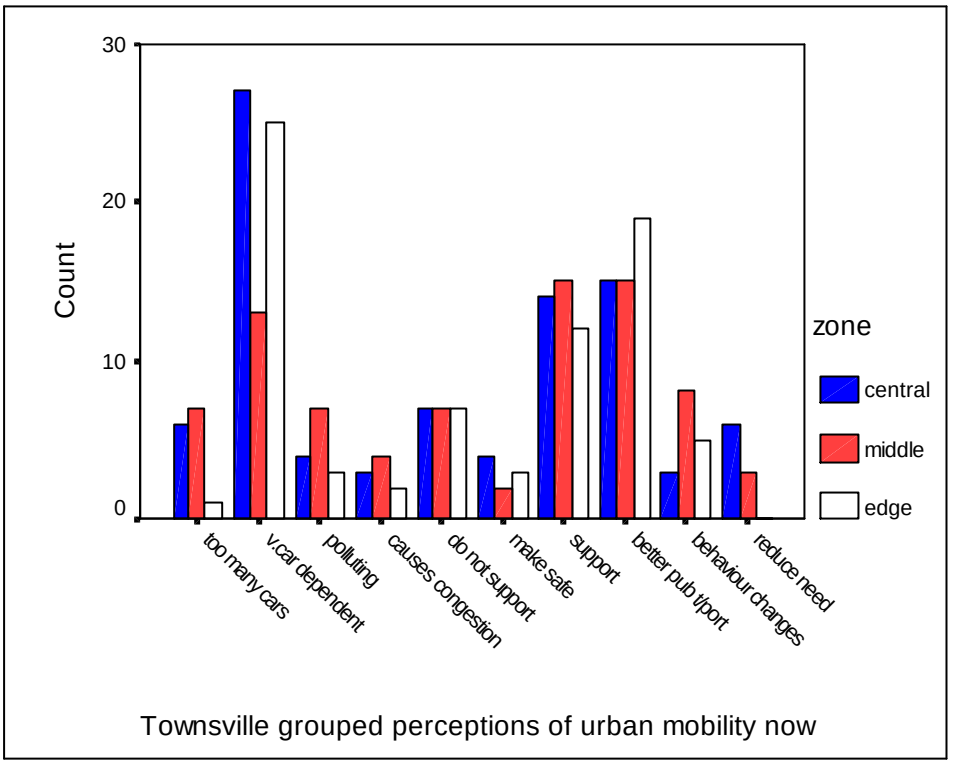
Urban sprawl and car dependence

About 80% of respondents from each zone answered the questions on travel beliefs. In this section people were first asked what connection they saw between urban design and required car travel. Most respondents linked urban sprawl with high car dependence, while some saw no connection between urban design and car travel. The second round of responses was similar: our car dependent behaviour resulted from urban sprawl. The third listed responses were again dominated by the perception of high car dependence.

Mobility now and in the future

Figure 4.5.1 shows that people saw their current urban mobility as very car dependent, especially inner and outer residents. Urban mobility, nonetheless, was to some extent seen as acceptable. People believed that their own urban mobility was generally acceptable or good, although, again, car dependant. A perception of high car dependence also dominated the second round of responses to value placed on their 'own urban travel'.

Figure 4.5.1 Townsville perceptions of current urban travel



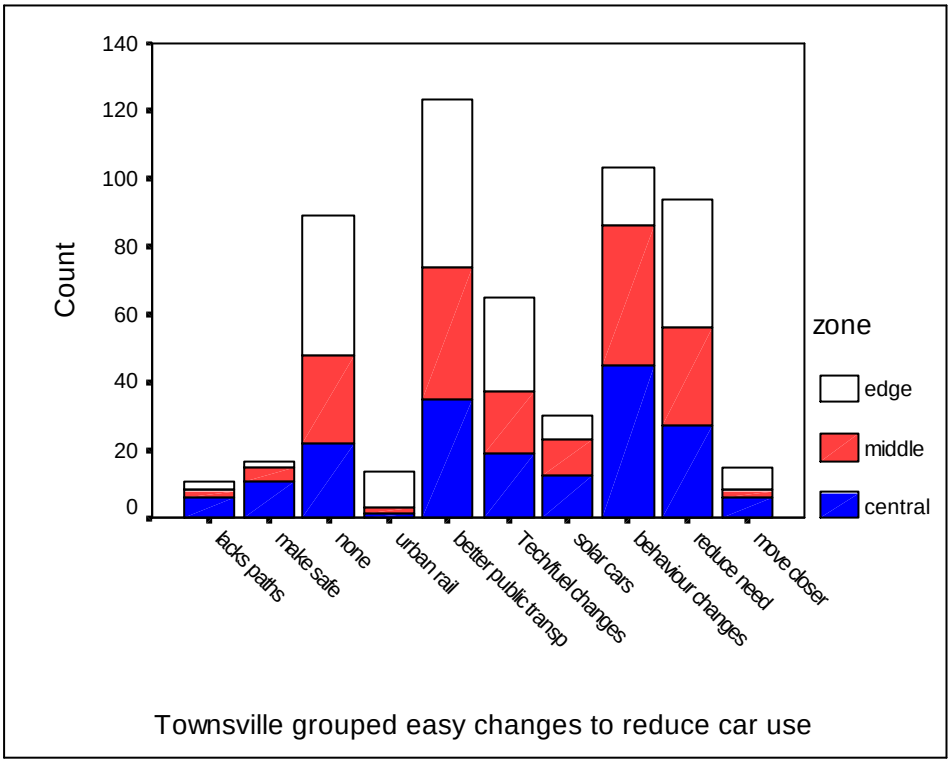
Paraphrasing written responses, future urban mobility will be largely unchanged, with the aid of technical or fuel changes. There will be more public transport, particularly according to residents of the inner and outer suburbs. Public transport will play a large role in the future urban mobility mix. The second set of responses was dominated by inner urban dwellers, believing that there would be little change. The third round of responses was dominated by middle urban dwellers, believing we will remain very car dependent.

Reducing car use

In the second-last section of the survey, people were encouraged (through a series of prompts) to document ways that they or others may easily reduce their car use (Figure 4.5.2). These questions produced a broad array of responses. The first written responses showed a belief that more public transport or better public transport would help reduce car use. The third most frequent response was that nothing would easily reduce car use. The second set of changes had inner urban dwellers suggesting that their car use would be reduced if walking was made safer. Public transport improvements were also supported. The third round of written

responses showed a preference for solar cars in the future, and that people may walk or cycle more.

Figure 4.5.2 Ways to reduce car use



People were asked what changes they might make if there was a sharp increase in petroleum prices. The main response was no change. The second most represented response was improved public transport or to use non-motorised forms of travel. The second round of responses to a sharp increase in petroleum prices was that people would tend to plan trips, walk or cycle more, reduce the need for trips, or make use of improved public transport.

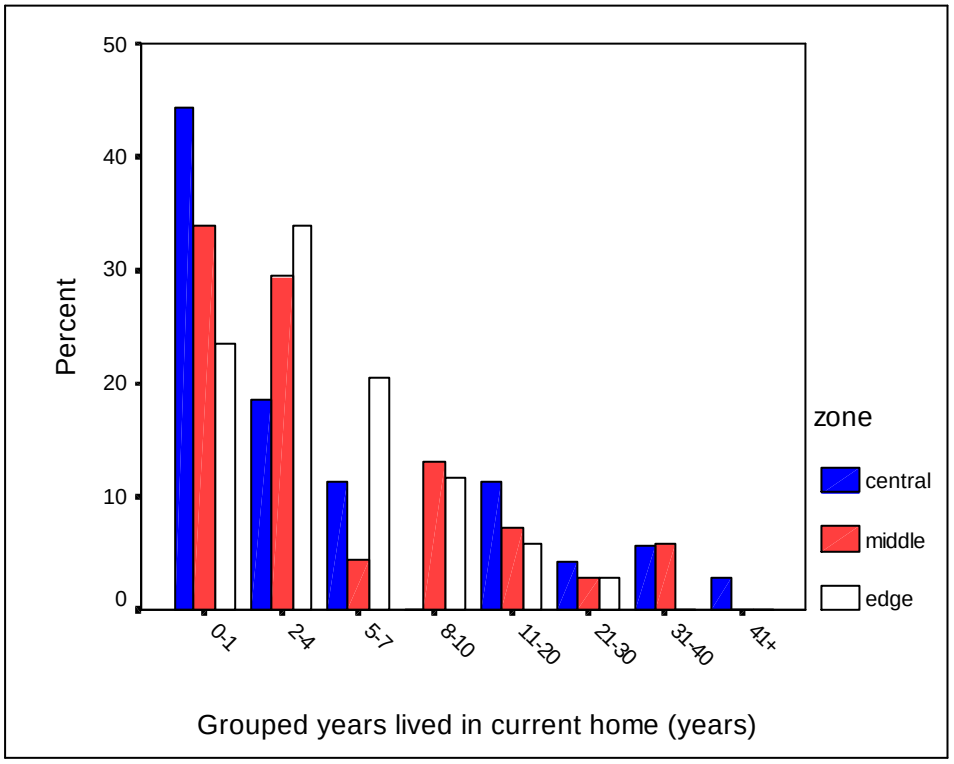
Demography

The following results are given to enable readers to understand the population and the context (Stern *et al.* 1995) of their urban travel decisions. About 30% of the sample were born in the Townsville region, with the highest value of 35% for the middle suburbs and about equal (22%) for the other two zones. Conversely only 6% of middle urban dwellers were born outside Australasia, compared to about 14% for the other two zones. Many internal migrants from

Sydney and Melbourne wrote that their travel from the outer suburbs was much less than what they were used to when they lived "down south".

About 10% of respondents had lived in Townsville for less than a year, equally for two to four years or five to seven years. This transitory sense to the survey group is reflected in the years respondents had lived in their current homes. The largest single group was for less than one year (Figure 4.5.3). About 30% had lived in their homes for less than one year. Older dwellings were closer to the central activity district. Outer urban dwellers dominated outright home ownership at 41%, compared to about 20% for inner and mid urban dwellers. About 55% of the two inner groups were renting their homes. Section 4.3 showed that household ownership in a location they would prefer to leave sometimes binds people.

Figure 4.5.3 Years lived in current home



About 30% of inner urban dwellers had at least one person with a university degree, compared to about 15% of middle and outer households. The length of time with their current employer peaks at about 15 years, particularly for the two outer zones. About 25% of respondents were

with their current employer from naught to four years, further indicating the transient nature of some members of the survey group.

Only about 25% of inner urban households had two vehicles, compared to about 40% of the two outer zones. Automobiles dominated as the first vehicle type, while utilities are the preferred second vehicle for the two outer zones. The majority of first designated vehicles had four-cylinders.

Roughly 10% of households in each zone had a vehicle provided by their employer. The fuel costs per week reflects the earlier presented differences in overall travel distance. The outer zone dominated the high end of money spent on fuel. Inner urban dwellers spent the most on public transport, followed by middle urban dwellers. Outer urban dwellers spent the least, perhaps because it was completely unavailable for some of the survey CDs.

Inner urban dwellers had the highest weekly parking costs. As stated earlier, the overall household income was relatively equal across zones. However, the outer urban area had least low-income households and more in the $45,000 to $65,000 per year bracket.

The rate of pushbike ownership varied across zones in the following way: about 40% of inner and outer households did not own pushbikes compared to only 20% of mid urban households. Slightly less than 30% of inner and mid urban households own one pushbike, compared to about 10% of outer urban households.

Most one-person households were found in the inner areas, while outer urban had the most two person households. The distance from the nearest convenience store correlated with the distance from the city centre (.68 Spearman's correlation co-efficient). Although the overall gender mix of respondents was about 50%, females accounted for about 60% in the mid zone, while males and females responded roughly equally in the inner and outer areas.

This section has shown many zonal traits, from parking costs to push bike ownership. The information is drawn from a rich data set, further explored in Chapter 5, where overall links and

generalisations are made. The following section combines all the responses from survey questions requiring multiple written answers. The results are more general than those just provided.

4.6 Totals for multiple responses

This section provides a synthesis of all variables with multiple responses. The first example, again following the sequence of the questionnaire, is to total all of the written reasons for home location choice. This section is thus the general summary of all multiple written responses, views or perceptions (Appendix 18).

Grouped home choice and travel destinations

Inner urban dwellers chose their home predominantly because of proximity to the city. That reason is followed by closeness to work or closeness to the beach. For middle urban dwellers, the main reasons for home location choice were closeness to shops, closeness to work, closeness to school, price; and that their residence was provided by the employer. This was because one of the three urban CDs was very much an 'Army suburb'. People chose to live in the outer suburbs because it was seen as quiet, they were close to mountains or bush, had a large block of land or liked the area.

Combining the zones, three features of the urban landscape stand out as attractive: close to city, close to work and quietness. Closeness to shops and home price (rent or purchase) were also important. In descending order from there for all zones and all total written responses, the next most attractive features of specific home location choice was closeness to beach, liking the area or being close to most destinations.

Diminished but clear reasons for home location choices included closeness to friends or family, or in this survey, the fact that their residence was provided by their employer. People choosing to live in the outer zones felt linked with nature and attracted to large blocks of land.

Combining all designated important car-dependent travel destinations, supermarkets dominated at just over 40%, fairly closely followed by work. At about 20%, travelling to friends or social

destinations was also important, with school (at about 15%) cited as the fourth most important travel destination.

Grouped perceptions of travel modes

Three features dominated total perceptions of car use across the whole sample group: cars were convenient, provided independence, but were expensive to operate. Although there may have been some parking problems, cars were speedy. Although polluting, they carry loads. Reliability of the bus service was most important for Townsville residents at the time of survey. Frequency and affordability of the service were important, affordability especially for middle urban dwellers. Convenience and useful connecting routes were seen as next most important, with comfort, speed and passenger information the least important. This implies that the 35% of general respondents who answered this section felt these latter features of the bus service were satisfactory.

High cost and a lack of reliability dominated the total perceptions of bus use in Townsville. The inner and middle suburbs contributed most of the perceptions, because some of the outer areas were not serviced at all. The second set of perceptions include the feeling that there was poor access to buses, that they were too slow or inconvenient, or that respondents were not catered for. However, there was a view that the service was improving. To a lesser extent, some people did not support the buses, seeing them as inefficient but comfortable. Some supported the use of buses, seen as cheap and accessible. Clearly there were polarised views in the community about the bus service at the time of survey in late 1996.

At the time of survey, buses were not a popular form of urban travel. Less than 50% of the survey population had ever used the bus service in Townsville, so only about 35% of respondents answered the detail questions on the bus section. Table 4.6.1 shows the relationship between the 1996 survey results and a more recent study conducted directly on behalf of Queensland Transport (Coory 1998).

Phone surveys of respondents over 16 years of age, including bus users, infrequent users and non-users were conducted through 1998. About 380 bus users (more than once per month) were surveyed in Townsville. The 1998 study showed that about 30% of the Townsville population use the bus service at least once a year, about 20% more than once per month,

comparable figures to the 1996 study. The 1998 results place Townsville as the highest population of bus users in regional Queensland.

Table 4.6.1 Perceptions of bus traits in Townsville, 1996 and 1998

Bus trait	N 1996	Mean 1996	Mean 1998[1]
Convenience	48	3.0	3.7/3.8
Reliability	57	2.9	3.5
Connections	57	2.8	3.6
Frequency/accessibility	57	2.8	3.5
Comfort	56	3.6	3.8
Speed	56	3.4	3.6
Cost	58	2.6	3.6
Passenger information	56	2.9	4.0/3.7

Note 1: from Coory 1998
Likert scale values of the means: 1 = very poor, 3 = neutral, 5 = very good.

The perception of the Townsville bus service improved by about 20% from soon after commencement in 1996 to the ACNeilsen study of 1998. This sense of improvement was most acute for passenger information and cost. Comfort and speed, both judged as reasonably good in 1996 were seen as slightly improved, tending from ‘ average’ to ‘ very good, needs little improvement’ . In the 1996 Townsville study there were very mixed feelings about the convenience of bus use among outer urban dwellers, while convenience was seen as good by the mid urban respondents (Figures 4.6.1 and .2). In 1996 the availability of urban bus services in Townsville were uneven. That situation has changed to some extent in the intervening years.

Cycle use was predominantly seen as healthy exercise, an inexpensive but dangerous form of transport. People feared poor drivers and were deterred from cycling by summer heat. There was a perceived lack of paths and the distances involved were too far, particularly for the outer suburbs. Some also wrote that there were plenty of paths, and that cycling reduced or caused no pollution. Bikes were convenient and provided freedom.

Walking in Townsville was healthy exercise, didn't really cost anything, but the heat was seen by some as a real problem. Some people felt that distances involved were too great, that

walking was too slow, there was a fear of assault, or they disliked dogs. Walking was seen as good, not polluting, in a nice environment, an enjoyable, relaxing way to move around the suburbs, but there was some lack of paths.

Ride sharing was seen most strongly as cost saving, but dependent on others. Ride sharing was also seen as reducing pollution and energy conserving, but sometimes not possible, reliable or convenient. There was contact with other people and a reduction in congestion - generally good. A small advantage of ride sharing was reduced parking problems, but some people saw ride sharing as dangerous.

Working from home was also seen as inexpensive but not possible for many. Although generally viewed as a good option, working from home was also seen as isolating. There was a perception that working from home was convenient. It was generally supported: in a nice environment, this energy conserving behaviour was potentially enjoyable, reducing congestion and essentially efficient.

The potential for rail use was seen overall as an attractive option for Townsville, but there would be high construction and general costs. Urban rail was generally supported, and seen as a relatively cheap form of transport. Some felt urban rail would reduce congestion, but some did not support it. There is a perceived lack of viable routes, but urban rail was seen as a way to reduce pollution, and was acceptable in many ways.

Grouped views on urban design

Many people saw that current urban design produced a very car dependent style of urban travel, clearly identifying urban sprawl as a problem. Others felt there was no connection between urban design and car travel. Some people felt the need for planning changes, to develop urban villages, that design was good or acceptable, or that there should be improved traffic flow.

Current urban travel was seen as very car dependent but acceptable. A clear message from respondents was a desire for better public transport or more public transport. Current urban

travel had too many cars, which were polluting and caused congestion. For these reasons some people did not like their current urban mobility. Some suggested we should walk, cycle or ride-share more. Few felt that the road network should be expanded. Urban mobility in the future would remain very car dependent with little change. There may be more roads, better public transport, technological and fuel changes, and more walking. Future travel would be less polluting, cheaper and may include urban rail. There may be no way to reduce car use, although ride sharing, trip rationalisation, making other modes safer may help reduce car use.

Cars in the city

Continuing the general theme of totals for the variables surveyed in the sequence used for the questionnaire, cars made up 64% of the 510 vehicles used by the 208 survey households. About 14% of vehicles were stationwagons, 13% utilities, while motorcycles and four-wheel-drives each represented about 4% of total vehicles in the sample group. About 55% of all vehicles had four-cylinder, about 35% had 6 cylinder engines. Many of the vehicles (36%) used domestically are not standard sedans, implying some specialist use, especially the 13% of utilities.

Household composition

Twenty percent of households had one person, 36% two people, 15% three, 21% four and 8% had five people. As mentioned earlier, one-person households occurred most in inner suburbia. Finally, for this section, the occupation of all household residents was dominated by schoolchildren. The next most represented occupation was retired or on a pension. The third group were tradespersons, associated professionals or clerks.

Composite descriptive results

Results in this section were obtained by combining similar responses to form more general categories. For example, the composite reasons for home location choice included a number of categories concerning proximity to frequent destinations. These frequent destinations were grouped together to produce one large response that the choice of home was mainly motivated by proximity to usual destinations. In fact that group of responses dominated the reasons for

home location choice for the inner and middle suburbs but had very little to do with the choice to live on the urban fringe.

In this section each variable summary is described, then any zonal differences or similarities are noted (Appendix 18). This represents the synthesis of some major internal (thoughts and feelings) and external characteristics and opinions of respondents, perhaps helping explain some of their mobility behaviour. Inner urban dwellers chose to live there because it was near their usual destinations, because of the natural features, and because they liked the suburb. Middle urban dwellers also chose to live where they did because it was near their usual destinations and the price of the dwelling was suitable. To a lesser extent, they liked the suburb. Outer urban dwellers most chose to live there because they liked the location, the natural features and the property size.

Overall, people saw that cars were convenient, provided independence but were expensive. Inner urban dwellers were not as attracted to the convenience of cars as their more remote counterparts, while outer dwellers placed a high value on the independence provided by their cars. The idea of buses was supported, but they were seen to be costly and unreliable. Inner and mid residents supported the idea of buses more than outer residents, but mid-residents saw buses as expensive and unreliable.

Cycling was seen as dangerous although healthy and inexpensive. The danger was felt least by outer residents, but it should be remembered that they tended to cycle the least (Figure 4.4.8). Walking was healthy exercise but some considered the Townsville climate unsuitable for walking. Inner urban residents seemed most at ease with walking, while 20% also saw walking as dangerous.

Ride sharing was considered inexpensive by about 40% of respondents, but it was dependent behaviour, particularly to more remote households. However, it helped reduce air pollution. The data indicates mid-urban dwellers may be most open to greater ride sharing. Particularly inner and outer zone residents saw working from home as worthy of support. It was seen as cost saving, but perhaps not possible, and may be stressful. Rail use had general support but it

may be expensive to set up. Centrally located households most acutely expressed concern over the high costs involved.

Some people saw no connection between urban design and car travel, but many people, particularly from the outer suburbs, saw urban travel as very car dependent, to some extent a product of urban sprawl. Current mobility was seen as very car dependent although most people supported and liked their current urban travel. The car was valued, while people supported the idea of better public transport. Inner dwellers seemed least satisfied with current travel systems.

Easy ways to reduce car use may be achieved by better public transport, behavioural changes or by reducing the overall need to travel. About 40% of respondents felt that there were no easy changes to reduce car use, most pronounced in the outer suburbs, where public transport was strongly seen as the best option to private car use. Outer urban dwellers, the greatest users of transport fuel for urban travel, seem least willing (or able) to reduce their car dependence.

This Chapter has presented results of the urban travel survey conducted in Townsville, detailing choice of home location, neighbourhood attachment, travel details, and environmental values. Perceptions of urban travel, now and in the future have been documented. The following chapter combines the data from Cairns and Townsville, highlighting similarities and differences, providing unique outcomes and outcomes that may be generalised.

Chapter 5
Summary of public and planner input to sustainable urban travel

This chapter synthesises results from the urban travel surveys conducted in Cairns and Townsville. Home location choices, travel traits and values are presented, along with the outcomes of a survey of urban planning practitioners and academics. The planner' s survey comprised 55 urban planning statements derived from the public survey and the urban planning literature.

The public survey data summarise and explore the input of 408 main respondents from the two surveyed North Queensland cities, with travel details from 1,074 individuals making 3,500 trips on the Fridays of survey in late 1996 and early 1997. Discussion in Chapter 4.6 on longitudinal bus studies shows the conservative nature of people' s overall travel behaviour and beliefs from year to year, keeping these outcomes relevant to urban planning during the 21st century transition to the likely post-petroleum era.

The first sections of this chapter provide synthesis of the Cairns and Townsville data sets**,** comparative and secondary analysis, and discussion of the full set of results and analysis, beginning with a demographic profile for both Townsville and Cairns. The section then provides home choice factors, neighbourhood attachment, travel details and perceptions of each transport mode. Summary of environmental values and beliefs sets the scene for views of urban travel, including visions of a future with reduced car use. Secondary analysis in Section 5.5 precedes feedback from a questionnaire sent to 40 planning and energy experts, with 22 responses from the North Queensland region, five Australian capital cities and three other countries.

5.1 General output

For most variables there was little difference between Cairns and Townsville, so results are referred to as Cairns/Townsville, North Queensland (NQ) results, or 'both centres'. Because of these strong similarities, it is reasonable to say that the populations of Townsville and Cairns are part of one larger population living in two geographically

separated cities. There were some differences, particularly the distribution of walking, cycling and bus use at the time of survey. These and other contrasts are tabulated at the beginning of Section 5.2. The following results also consider some of the zonal traits from the combined Townsville and Cairns data (Appendix 16).

North Queensland demographic traits

About 80% of the 408 surveyed householders lived in fully detached houses, with most of the respondents in the 20 to 50 year age group. About 25% had lived in their city for less than four years and about 50% had lived in their current residence for less than four years. There were about equal numbers of both gender responding from each city. The places of birth were very similar in the two cities, except that about 18% of the survey residents in Cairns had been born in Cairns or the Cairns region, and about 26% of Townsville residents had been born in Townsville or the Townsville region.

Housing in Townsville tended to be a little older than in Cairns. In both centres about 30% of homes were owned outright, with mortgage and rental rates roughly equal in the two centres. Ownership status was not evenly distributed across the zones, with inner urban respondents having 24% outright ownership compared to about 35% for the middle and outer zones. Seventeen, 23 and 35% of respondents from inner to outer zones respectively were paying mortgages. Complementary to this, 59, 39 and 28% of zonal residents respectively were paying rent.

The highest education achieved by any household member in both centres was about the same. The largest group was year 12, achieved in 23% of households. In both centres about 18% of households had at least one person with a university degree. Like 'years resident in current household', the dominant group for 'years in current employment' was from zero to four years. There were more basic clerks and labourers in the Cairns sample than Townsville. These demographic and other data were used in multivariate analysis.

The number of people per household was much the same for the two centres, the modal household structure (33%) being two people. Thirty-one percent of inner urban households consisted of one person only, compared to about 12% for the other two zones, while 41% of outer urban households had two people. Inner urban households

had 35% with two people, compared with 26% of mid urban households with two people. Generally, mid urban households had the largest number of people.

Home location choice and method used to generalise written responses

Figure 5.1.1 Detail of first given reasons by zone for choice of home location

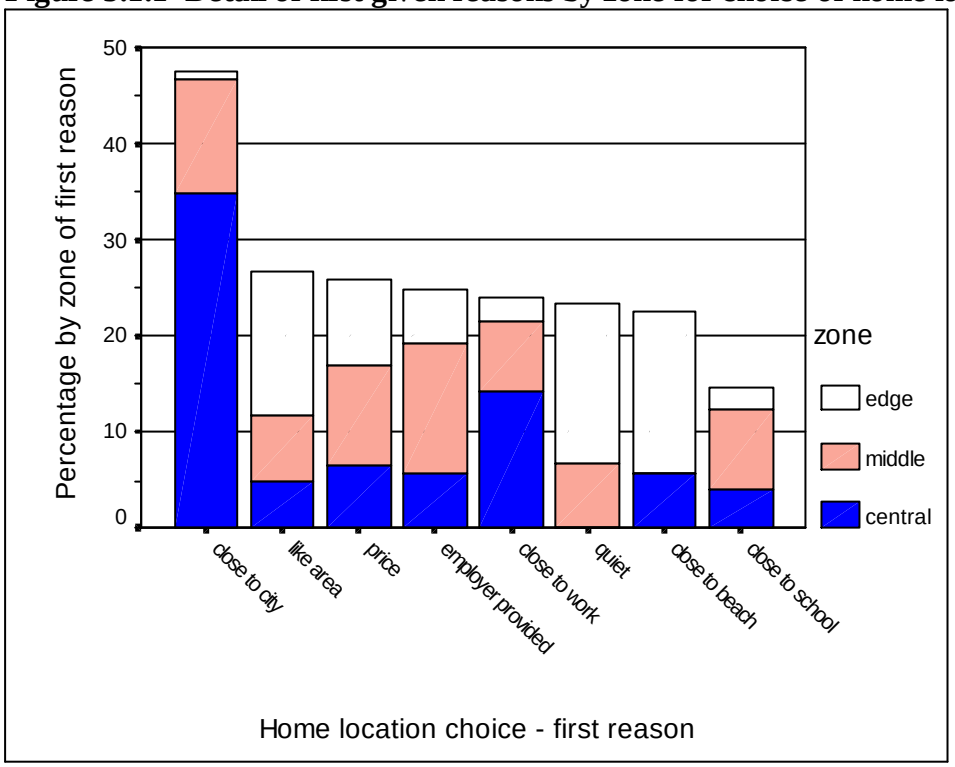


Figure 5.1.1 shows that inner urban residents tended to choose their home for proximity to city and work, mid urban because the residence was provided by employer or was affordable, while outer urban choice was motivated by a desire for quiet, nearness to the beach or an attractive environment.

Responses in the multiple answer sections have been generalised in the coding to give more generic categories than the highly detailed coding originally used to enter individually written responses into the data set. Examples of the general coding are provided in Chapter 3.2 (Appendix 4 for coding details). About 75% of householders in Townsville and 50% in Cairns wrote that they chose to live where they did because they liked the suburb. The second overall reason for home location choice was for 45% of householders in Townsville who felt the price was right, compared to 33% of householders in Cairns. Natural features were attractive to 45% of householders in Townsville compared to 35% in Cairns (Appendix 3, 16 and 18).

Neighbourhood attachment

There were few measured differences in neighbourhood attachment, expressed in the following data (Buckner 1988) between Townsville and Cairns. In Townsville about 40% of people visited their neighbours in their homes, compared to about 30% in Cairns. In both centres about 17% of people disagreed or strongly disagreed with the idea that they would move from their neighbourhood. In both centres about 75% of people felt their neighbours would help in an emergency. About 50% of people regularly talked with their neighbours and about 40% felt that they were similar to their neighbours. About 30% of people felt they were neither similar nor dissimilar to their neighbours and over 50% of people in both centres strongly disagreed with the idea that they would like to move from their current neighbourhood to reduce travel. Chapter four (Section 4.3) shows that deeper questions give a somewhat different response in at least one of the CDs surveyed. Implications of neighbourhood attachment are developed in the discussion and recommendations section of Chapter 6.

5.2 Travel details

Analysis showed that average trip distances by car provided the great contrast between zones. Inner urban dwellers averaged about 4.5 Km, mid urban 6 Km and 16 Km for outer urban dwellers (Table 5.2.1). Outer urban dwellers, about one-third of the survey group, contributed slightly more than half the total kilometres travelled by car. This finding is interesting because middle urban dwellers define themselves as more car dependent than outer urban dwellers.

Table 5.2.1 North Queensland urban zones, travel modes and distance travelled

Zone/ Travel mode	Average distance travelled (Km) Central	Middle	Outer	Total	Total distance travelled (Km)
Car, solo	4.75	6.16	17.29	9.58	11519.5
Car, passenger	3.94	5.98	16.10	8.96	8708.1
Car, driver with passenger	4.86	5.37	13.74	8.66	4641.5
Bus, school	7.00	5.48	18.03	14.16	1374
Cycle	2.06	4.08	3.95	3.24	573.4
Bus	6.68	6.53	15.31	8.64	484
Walk	1.24	1.67	1.73	1.43	398.4
Taxi	2.6	3.5	0	2.9	170
Ferry	8.0	0	0	8	48
Private bus	3	0	0	3	36
Wheelchair	.7			.7	2
Motor cycle	5.00	14.25	16.73	13.74	261
N = 3,500				Total	28,216

A total of 28,216 Km was travelled in the 3,500 recorded trips of this study, an average trip length of 8.1 Km (Appendix 19). Table 5.2.1 shows that car, motor cycle and bus trips, on average, were longer journeys, while cycling trips averaged 3.2 Km and walking averaged 1.4 Km trips. Table 5.2.1 also shows that for car and bus trips, outer urban dwellers average more than twice the trip distance of their more central counterparts.

Table 5.2.2 Some weekly user costs of urban travel by zone

Zone	Statistic	Fuel	Public transport (users only)	Parking (users only)
Inner	Mean **($)**	22.50	16	6
	Std. Deviation	15	13	13
	N	97	23	29
Middle	Mean **($)**	30.50	12	4
	Std. Deviation	20	10	6
	N	131	19	22
Outer	Mean **($)**	39.00	11	7
	Std. Deviation	23	5	6
	N	130	20	17
Total	Mean **($)**	31.40	13	6
	Std. Deviation	21	10	10
	N	358	62	68

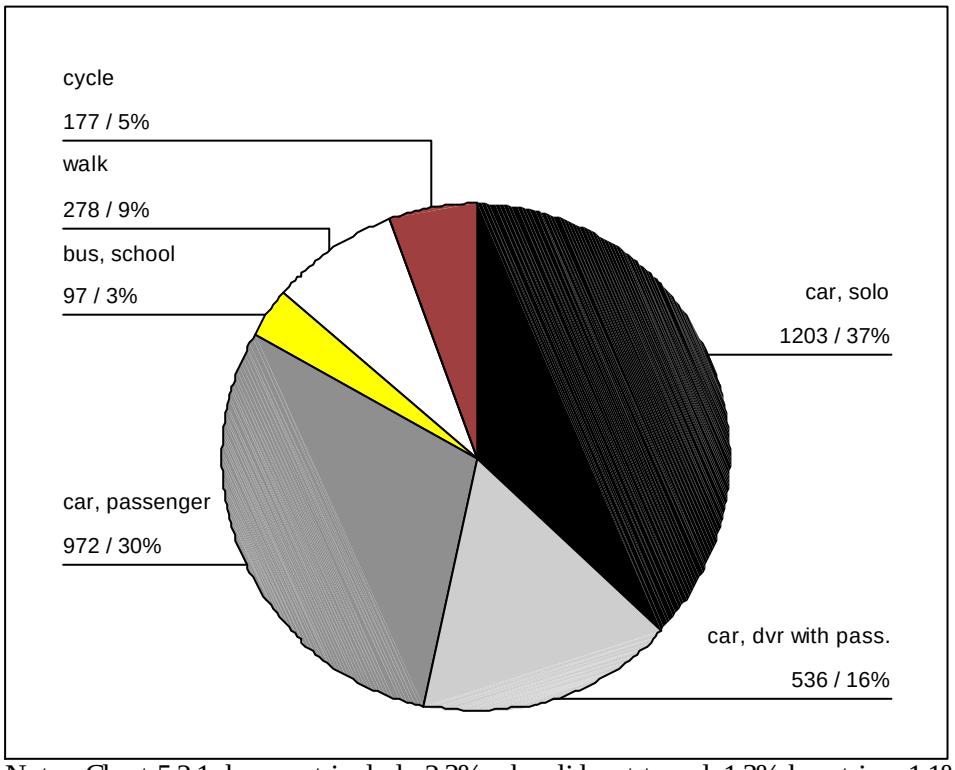
Note: the number of cases N indicates the number of householders who recorded costs for fuel, buses or parking.
Note 2: This summarises use and urban travel costs for 1,074 people from 408 households.

As established in Chapters 3 and 4, about 80% of trips and 90% of urban distance is travelled in cars. Thus only about 6% of people in the two centres paid public transport

or parking costs more than once per week. From this very small sample, public transport users in both centres spent an average of $13 a week (Table 5.1.1). Outer urban dwellers in Cairns and inner Townsville residents tended to use buses most often (Chapters 3 and 4). There was some high household expenditure on weekly bus fares (up to $40 per week in one household), forcing up averages shown in Table 5.2.2.

The average distances to the nearest convenience store are greatest for the outer suburbs of Townsville. These distances may be as great as 5 Km, contrasting with the greatest distance of about 1 Km to the nearest convenience store for the inner suburbs. This provides an indicator of increased auto dependence through urban growth from inner to outer suburbs.

Figure 5.2.1 Overall use of different travel modes



Note: Chart 5.2.1 does not include 2.3% who did not travel, 1.3% bus trips, 1.1% taxi trips and .6% motor cycle use, thus values are slightly higher in Figure 5.2.1 than Table 5.2.3.

Table 5.2.3 Use of urban travel modes on Friday of survey

Mode	Frequency	Percent
Car, solo	1203	34.4
Car, passenger	972	27.8
Car, driver with passenger	536	15.3
Walk	278	7.9
Cycle	177	5.1
Bus, school	97	2.8
No travel on day of survey	83	2.4
Taxi	58	1.7
Bus	56	1.6
Motor cycle	19	.5
Private bus	12	.3
Ferry	6	.2
Wheel chair	3	.1
Total	3,500	100.0
N = 1,074		

Figure 5.2.1 and Table 5.2.2 shows the gross dominance of cars for urban mobility in the study sample. Eighty percent of travel was done by car, 8% walking; cycling catered for 5% of all urban trips, while school buses provided 3% of all trips in the sample of 1,074 people.

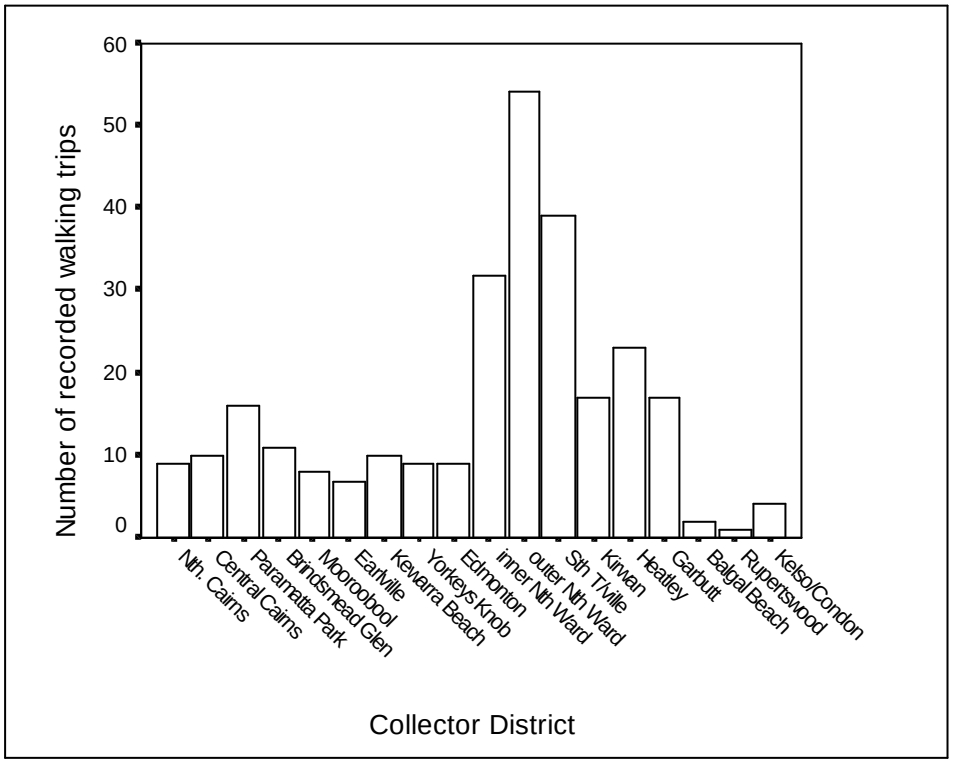
Table 5.2.4 Percentage comparison of main travel modes for the two centres

Mode	Count or % of Total	CITY		Total
		Cairns	Townsville	
Stay at home	Count	42	41	83
	% of Total	1.2%	1.2%	2.4%
Car, solo	Count	581	622	1203
	% of Total	16.6%	17.8%	34.4%
Car, driver with passenger	Count	269	267	536
	% of Total	7.7%	7.6%	15.3%
Car, passenger	Count	502	470	972
	% of Total	14.3%	13.4%	27.8%
Bus	Count	26	30	56
	% of Total	.7%	.9%	1.6%
Bus, school	Count	48	49	97
	% of Total	1.4%	1.4%	2.8%
Walk	Count	89	189	278
	% of Total	2.5%	5.4%	7.9%
Cycle	Count	89	88	177
	% of Total	2.5%	2.5%	5.1%
Totals	**Count**	**1700**	**1800**	**3500**
	% within CITY	100.0%	100.0%	100.0%
	% of Total	48.6%	51.4%	100.0%

Table 5.2.4 shows the strong overall similarity of travel modes used in Cairns and Townsville. Trip distribution was statistically the same for the number of people who stayed at home, used different types of car travel, rode in buses or cycled. The only difference of significance was walking – about twice the recorded number in Townsville than Cairns, with much more walking done in the more central zones of Townsville than Cairns. Also, there were zonal differences in cycling between cities, with most cycling done in central Cairns and middle Townsville.

Figure 5.2.2 shows that inner and mid Townsville residents, as a group, walked the most, explaining the high incidence of walking for Townsville. This more than counteracted the relatively low incidence of walking in Townsville outer suburbs. It is concluded that inner and middle Townsville surveyed areas were more amenable for walking than their Cairns counterparts.

Figure 5.2.2 Distribution of walking trips by Collector District



Note: the first 9 Collector Districts are from Cairns, the second set of 9 is from Townsville.

Table 5.2.5 North Queensland urban travel destinations on Friday of survey

Destination	Frequency	Percent
Home	1347	38.5
Social	438	12.5
Shopping	360	10.3
School	350	10.0
Work – dispersed	231	6.6
Supermarket	183	5.2
Work – centre	145	4.1

Note 1: The full table is provided as Appendix Table A19.
Note 2: Values<100 have been dropped from the above table.

Work of all types attracted 13.2% of all trips (Appendix 19). Shopping and school each attracted about 10% of all urban travel, but when supermarkets are included, shopping was the expressed destination for 15% of all urban trips. Table 5.2.5 shows that on the Fridays of the survey, 'social' was a common destination away from home (12% of all trips).

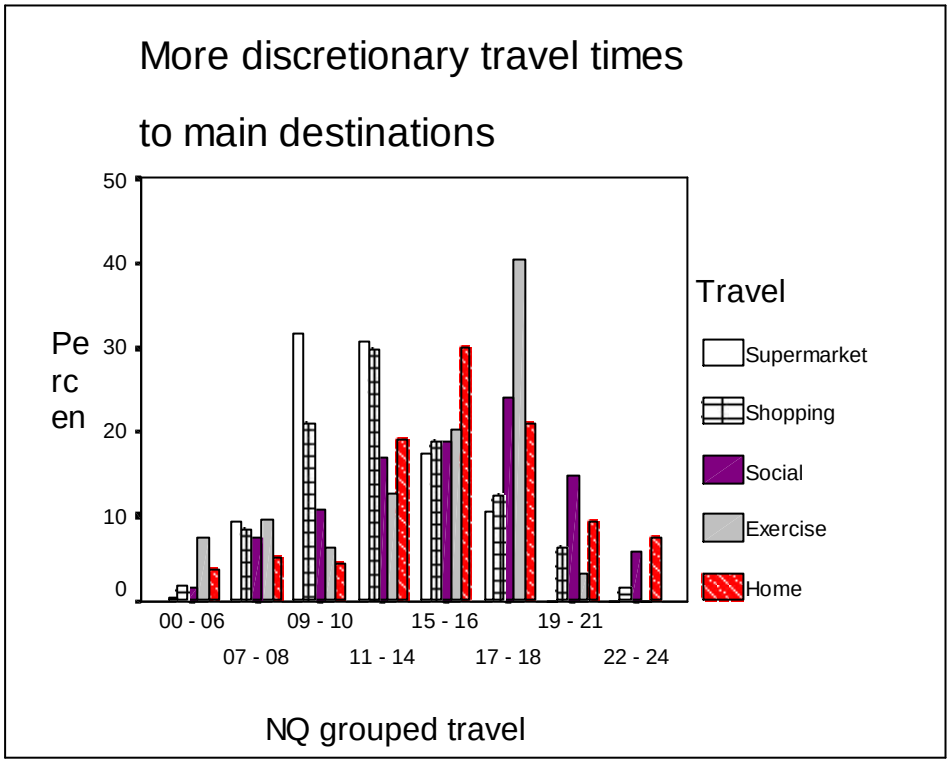
Travel times were generally bimodal, around the normal ' peak' travel times – 7 to 9 am, and 3 to 6 pm in particular. Travel by school and preschool children occurred mainly during those peaks. Fortunately for peak hour congestion, the main travel times for ' housepersons' , the unemployed, retired or people on pensions tended to be during the middle of the day.

As expected, most travel to work occurs before 9 am, although the employed also make trips at lunchtime and later in the day. The peak times for people to travel to the supermarket were mainly from 9 am through to 3 p.m. Shopping more generally peaked around the middle of the day. Exercise mainly occurred from 5-7 pm, and start of travel home peaked from 3 – 5 pm. A lot of social visits built up from early morning to a peak from 5 to 7 p.m. (Figure 5.2.3).

Solo car use was fairly evenly spread from 7 am to 7 p.m., while being a car passenger was bimodal, from 7 to 9 am, and from 5 to 7 p.m. By far the most bus use (30%) occurred around the middle of the day. Walking peaked bimodally before 9 am, and

around 3 – 5 p.m., perhaps boosted by school children walking to and from school. Cycling had a similar pattern, slightly extended to about 7 p.m.

Figure 5.2.3 Time dispersal of some North Queensland discretionary trips



Employed people, as the largest single group, accounted for nearly 80% of solo car use, and nearly 60% of passenger carrying; assisted in this (20%) by people engaged in home duties. School children constituted the largest single group of car passengers, with retired or pensioners and school children using buses the most. The main cycling groups were employed, unemployed or schoolchildren (see Figures 5.2.4 - .6).

Figures 5.2.4 and .5 show the uneven distribution between the sample distribution of selected occupations and the modal split of those occupations. The 22% of employed accounted for about 75% of the solo car driving. The 3% who nominated as "home duties" drove about 25% of the "driver with passenger" trips. The 2% nominated unemployed did 15% of the cycle trips, 10% of the walking and bus trips. School children constituted nearly 40% of car passengers, and about 35% of cycling trips, and 20% of bus (non-school) and walking. Retired people accounted for 20% of bus use.

Figure 5.2.4 Selected North Queensland occupations

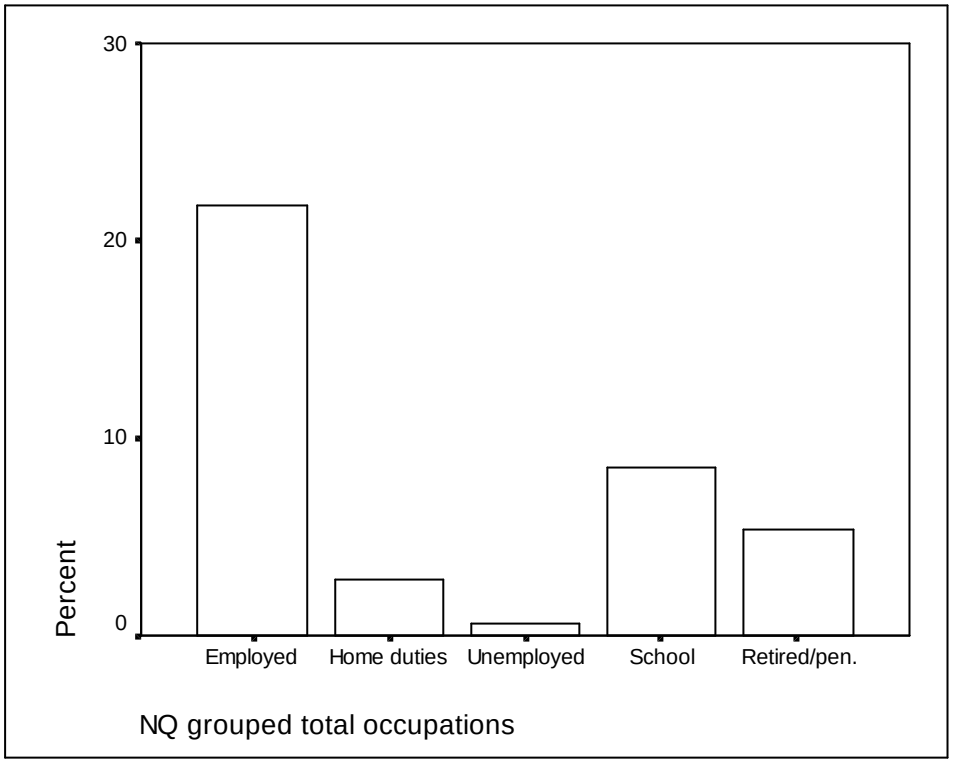
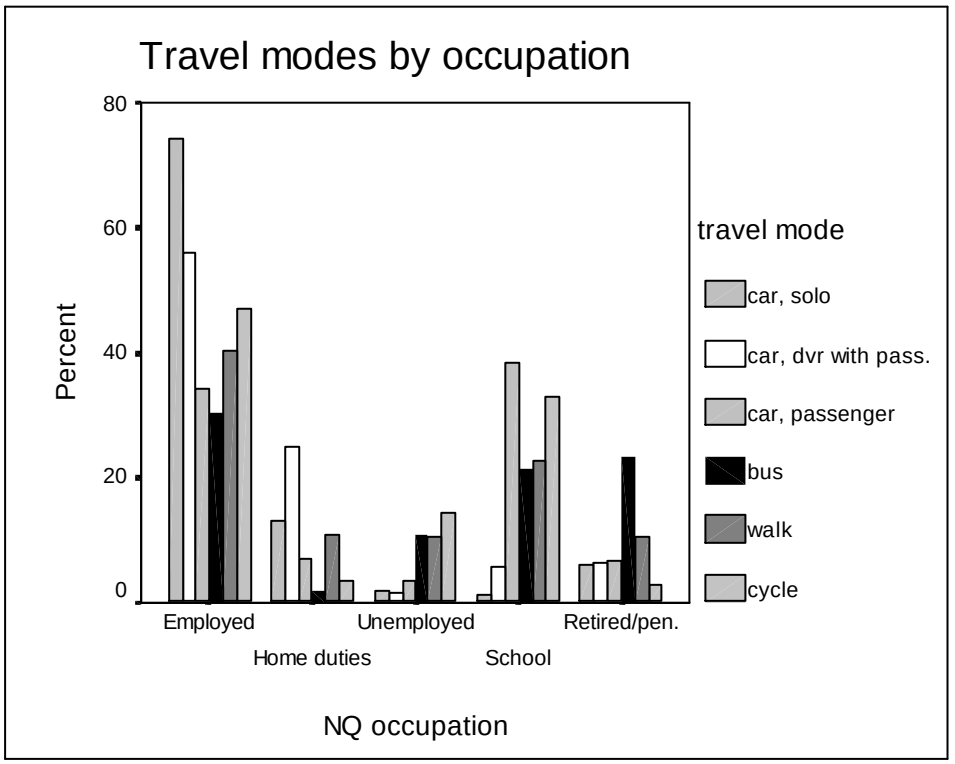


Figure 5.2.5 Travel modes by occupation in North Queensland



Note that school buses have been left out - destination was school or home. Each mode approximately totals 100%, giving relative use across the main occupation groups shown. Occupations: university student and preschooler have been removed, as they do not make a large contribution to the peak road use.

Figure 5.2.6 Townsville travel modes by destination

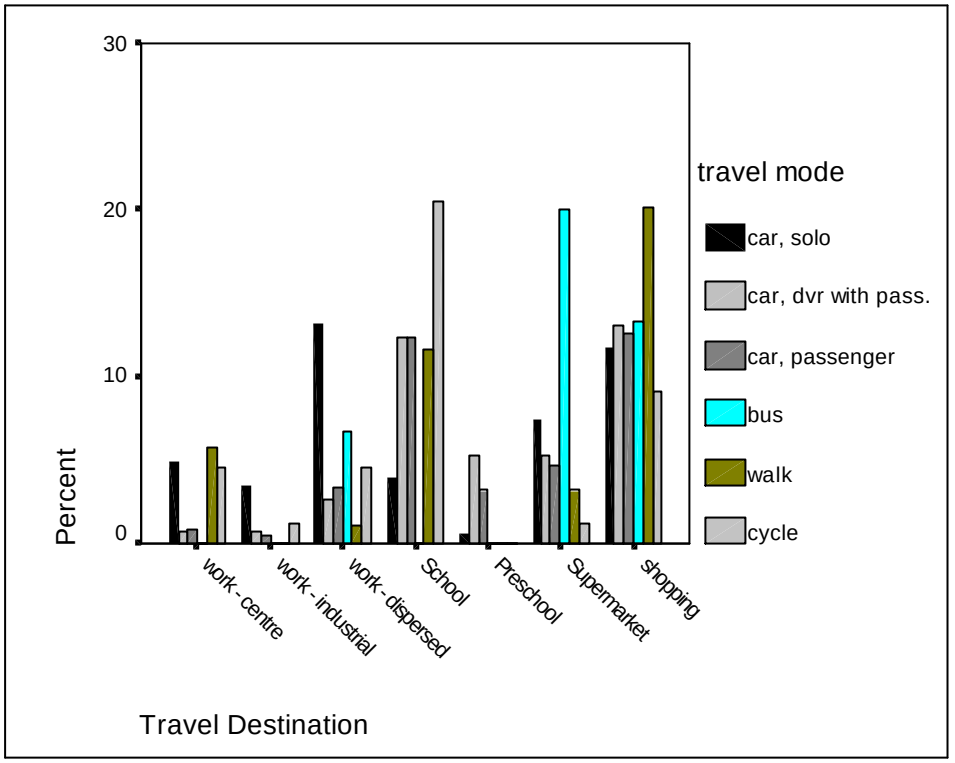
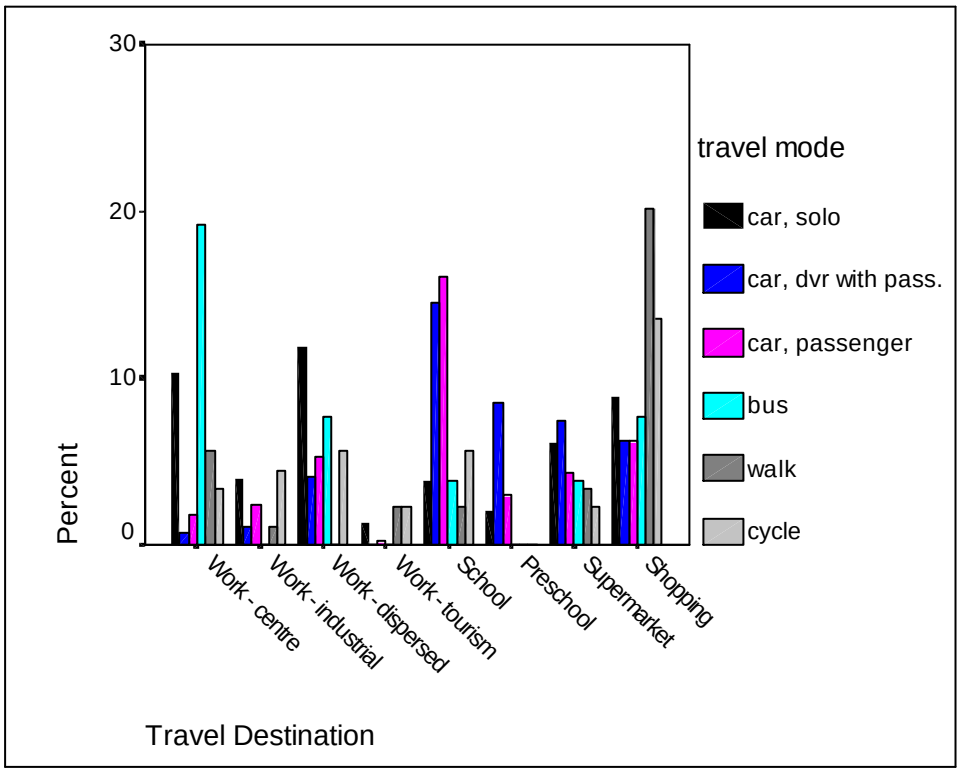


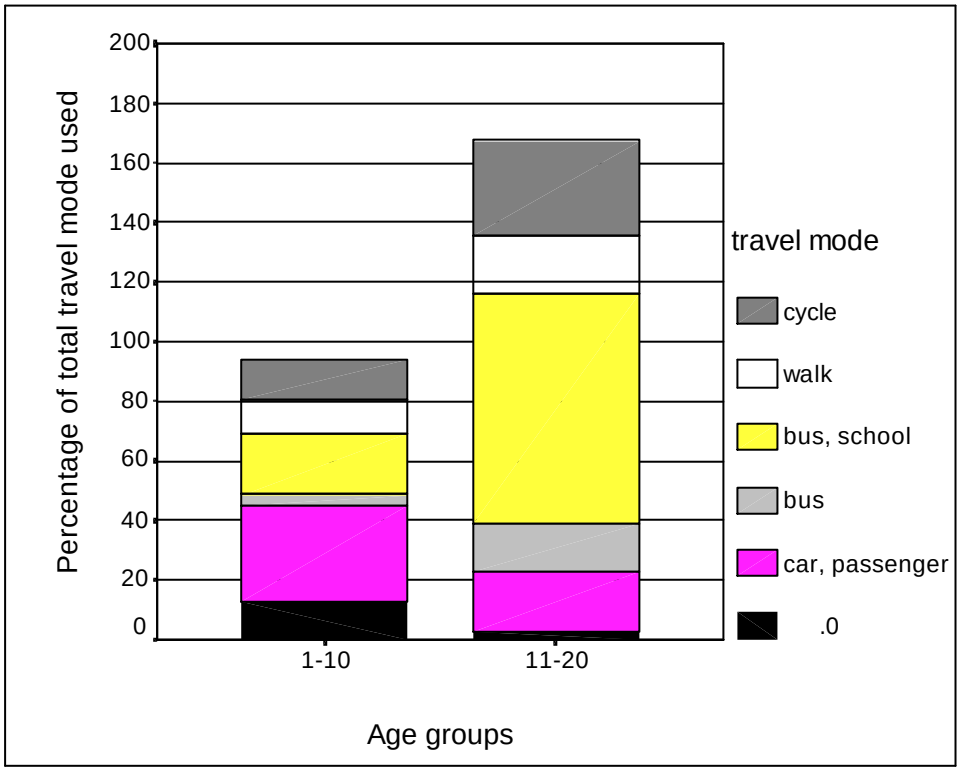
Figure 5.2.7 Cairns travel modes by destination



Excluding home as a destination, Figures 5.2.6 and .7 show that work in the city centre is mostly achieved by solo car driving, or by bus, while dispersed and industrial work rely most heavily on solo car use. Travel to school is fairly evenly spread between being a car passenger (either as a single purpose journey, normally by a parent, or being dropped off while the parent is on their way to work) or cycling. Walking is the third main way for school children to arrive at school. All preschoolers (69 in the survey group) were driven to and from their preschool, while about 10% of all bus trips are used for supermarket shopping. Finally, about 20% of walking was connected with non-supermarket shopping.

Children travelling

Figure 5.2.8 Main travel modes of under 20 year olds



Note: the mode "0" represents the 83 of 1,074 people who did not travel on the day of survey.

Children are active society members. For Townsville, nearly half the total trips of 11-18 year olds are made in school buses, while 5-20 year olds achieved about 45% of all cycle trips and 30% of all walks on the Fridays of survey. Under 20 year olds accounted for slightly more than half the total car passengers of the 3,500 recorded trips (Figure 5.2.8).

Figure 5.2.9 Main non-driving travel modes and destinations

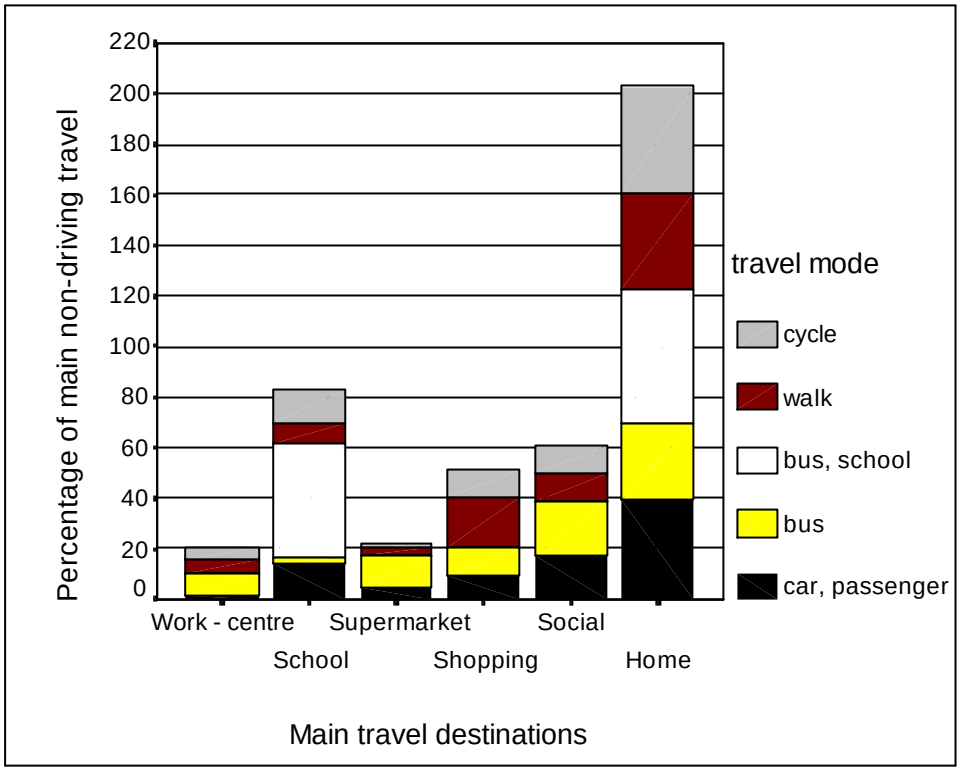


Figure 5.2.9 shows that about 10% of car passenger trips are children driven to school, that about 12% of school children are driven. This partly contributes to the daily traffic peaks; however, a parent on the way to their work does many of the ‘ drop-offs’ . Car traffic around schools is a safety issue, and often a localised congestion issue.

Travel modes

This section introduces results of the various questions on all travel modes, from car to bus, cycling, walking, ride sharing, working from home, or the prospect of renewed urban rail use in either Cairns or Townsville. The following results are drawn from different sections of the questionnaire, with the relevant questions listed in Appendix 1. Modal details are followed by an overview of environmental beliefs, current and future perceptions of our urban land use and travel patterns, finishing with easy ways to reduce car use.

General car use and perceived dependence

About 50% of households own one vehicle; about 35% own and use two cars. This was not evenly spread across the zones, with about 20% of inner urban households owning no car, 50% owning one and 24% of inner urban households owning two cars. Virtually all other households had at least one car, with 42% of middle urban households equally having either one or two cars. Eight percent had three. Fifty-three percent of outer households had one car, 34% had two and 12% had three or more. This zonal variation in car ownership is shown in Figure 5.2.10.

Employers provided vehicles to 14% of the Cairns households surveyed, compared to 9% in Townsville. People in both centres tend to spend equivalent amounts on fuel, averaging $25 -$30 per week when fuel was about 75^{c} per litre in 1996/97. As Figure 5.2.11 shows, inner urban dwellers spent the least on average fuel costs while outer urban dwellers spent the most on fuel.

Figure 5.2.10 North Queensland distribution of car ownership across zones

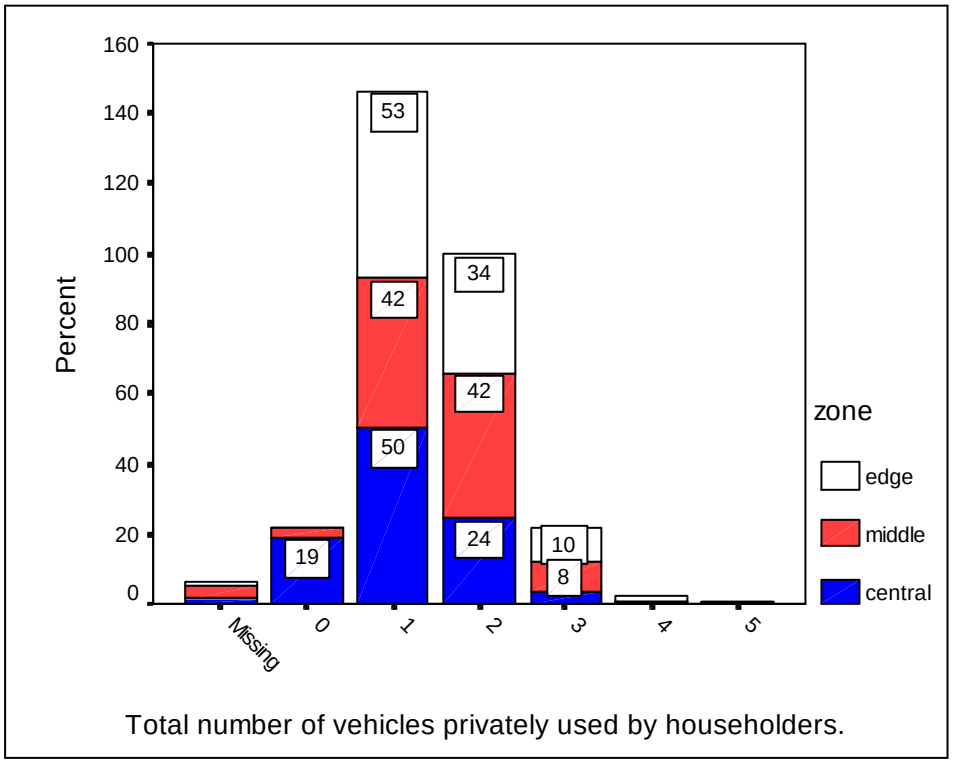
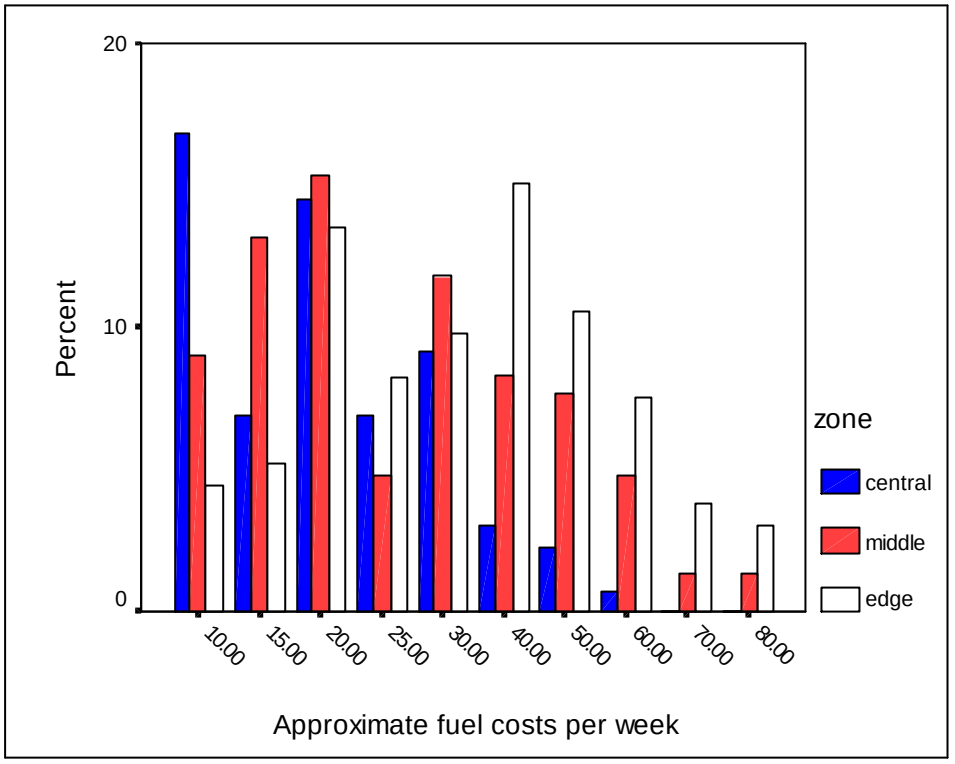


Figure 5.2.11 Fuel expenditure across zones



Approximate household income was equivalent in the two centres at an average of about $35,000 per year, comparing to the full average from the three Local Government Areas (Cairns, Townsville and Thuringowa) of $36,610 (ABS Cdata 1996). There were some disparities of annual household income across the three zones, with about 20% of inner urban households earning $15- 25,000 per year compared to about 13% for the other two zones. There were no other pronounced differences.

An average of two or three daily trips were made by householders in both Townsville and Cairns, with 35% of households making one major annual trip per year . Equally, about 20% of householders made either no or two larger annual trips per year from both cities. About 85% of households owned a car; about 90% of respondents drove a car. Other than 4 of the 68 households (6%) from middle Townsville, all households without cars were located in the inner suburbs. About 50% of respondents drove a car more than ten times per week.

5.3 Perceptions of travel modes, the environment and urban travel

Cars

Although about 50% would find it very easy to get to local shops without a car, about 50% of respondents would find it difficult or very difficult to get to a shopping mall without a car and about the same for getting to work. About 45% of Townsville residents would find it difficult to get to the city without a car compared to only about 30% of people in Cairns. This difference of travel difficulty to get to the city without a car appears to be connected with the relative access to buses in the two centres.

As expected, getting to school without a car was seen as not relevant to about 40% of households, and was only considered difficult or very difficult in about 20% of cases, more in Townsville than Cairns. Being able to reach a bus stop without a car was seen as very difficult, particularly for about 20% of Townsville respondents. The action of visiting friends, getting to recreation or entertainment without a car was seen as difficult or very difficult in 50% of cases.

About 55% of respondents saw getting to work as the most important travel destination, followed by about 18% of households who felt that getting to the supermarket was the most important travel destination. The deeper analyses of those destinations show that the supermarket emerged as the single most important car-dependent destination. About 50% of people (slightly more in Townsville) believed that travel without a car would be very difficult. About 70% felt that it would be difficult or very difficult to achieve urban travel without a car. Only about 10% felt it would be easy or very easy to travel around without a car.

Earlier analysis shows that nearly all people who felt that urban travel would not be difficult without a car live in the inner suburbs. Finally for this section, people generally perceived the car as providing convenience (35%), independence (18%), and freedom (10%). As the first-listed perception, about 7% of people viewed cars as expensive. Cars were clearly seen by about 45% of respondents overall as convenient and costly, while providing independence. These three perceptions dominated the general response from both Townsville and Cairns. Cars were most seen as convenient

by people from the middle suburbs and most providing independence for outer urban dwellers. Perceptions of high costs were fairly evenly spread across the three zones.

Buses

About 60% of respondents never used the bus service and about 27% virtually never did. Nearly 90% of main respondents had virtually nothing or nothing to do with buses in both centres. Although discouraged from answering the bus section without a working knowledge of the buses, about 35% of respondents did respond to the bus questions, more in Cairns than Townsville. Of those respondents, from the block of set questions (see questionnaire, Appendix 1) most felt that buses were quite convenient and reliable. There was neutrality about how well buses connected for links with sequenced journeys, but buses were generally felt to be reasonably frequent and quite comfortable.

Buses were seen as just speedy enough for those who did respond and just affordable enough. Perceptions of passenger information were slightly polarised, seen as either generally very poor or neutral to good. The main issues of bus use identified in this survey were reliability, then convenience and affordability.

The first perception of strengths and weaknesses of bus use was that they were unreliable. This was slightly higher (7%) in Cairns than Townsville (4%). Three other features were about equal in response numbers: buses cost a lot, that they were convenient, and (particularly Townsville) that they were getting better. The next level of responses reflected the idea that some people felt that buses were inconvenient, or (more in Cairns) that they feared poor bus drivers.

About 10% respondents in each centre saw buses as unreliable, although about 10% of Townsville residents and 5% of Cairns residents support the idea of bus use. A similar proportion of respondents felt that bus costs were high. Considering reliability at the zonal level, 9% of residents from the middle suburbs thought buses were unreliable, while 7% of mid urban dwellers felt that costs of buses were high.

Cycling

About 35% of households in both centres had no pushbikes. Approximately 21% of households in both centres had one pushbike; a further 20% had two pushbikes. About 20% of households use at least one pushbike more than once per week; about 15% use at least two pushbikes more than once per week.

Table 5.3.1 Distribution of pushbike use by age

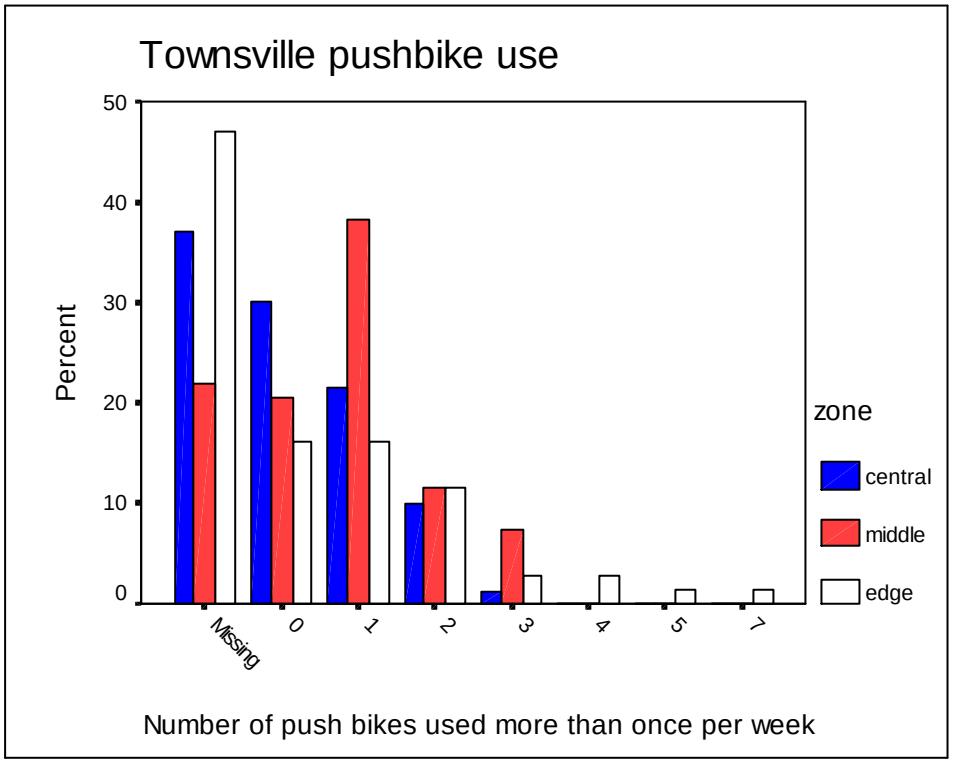
Age group (years)	Statistic	Travel mode				Total
		car, passenger	bus, school	walk	cycle	
1-10	Count	298	27	29	12	420
	% within Age groups	71.0%	6.4%	6.9%	2.9%	
	% within travel mode	30.7%	27.8%	10.4%	6.8%	12.0%
	% of Total	8.5%	.8%	.8%	.3%	12.0%
11-20	Count	191	69	42	61	430
	% within Age groups	44.4%	16.0%	9.8%	14.2%	
	% within travel mode	19.7%	71.1%	15.1%	34.5%	12.3%
	% of Total	5.5%	2.0%	1.2%	1.7%	12.3%
21-30	Count	104		60	28	622
	% within Age groups	16.7%		9.6%	4.5%	
	% within travel mode	10.7%		21.6%	15.8%	17.8%
	% of Total	3.0%		1.7%	.8%	17.8%
31-40	Count	175		72	48	906
	% within Age groups	19.3%		7.9%	5.3%	
	% within travel mode	18.0%		25.9%	27.1%	25.9%
	% of Total	5.0%		2.1%	1.4%	25.9%
41-50	Count	104		38	18	577
	% within Age groups	18.0%		6.6%	3.1%	
	% within travel mode	10.7%		13.7%	10.2%	16.5%
	% of Total	3.0%		1.1%	.5%	16.5%
51-60	Count	20	1	24	7	283
	% within Age groups	7.1%	.4%	8.5%	2.5%	
	% within travel mode	2.1%	1.0%	8.6%	4.0%	8.1%
	% of Total	.6%	.0%	.7%	.2%	8.1%
Of all trips made	Count	972	97	278	177	3500
	% within Age groups	27.8%	2.8%	7.9%	5.1%	
	% of Total	27.8%	2.8%	7.9%	5.1%	

Note 1: Residents over the age of 61 have been left from this table with its focus on cycling
Note 2: Only 4 travel modes are shown, focusing on cycling.

Table 5.3.1 shows the high reliance young children (under 10 years of age) have on car use. Over 70% of their travel was achieved as a car passenger, while only cycling for 3% of their trips. Indeed, about 34% of all cycling was done by residents between the age of 11 and 20, after which car use dominates.

Outer urban householders used pushbikes least. Figure 5.3.1 shows that mid urban households in Townsville used pushbikes the most, contrasting with Cairns where inner urban residents tended to use pushbikes most. This different geographic focus of pushbike use is one of the few clear differences between the two cities. Likely reasons are explored in the discussion section of Chapter 6. In each of the four following Figures, it should be noted that the distribution at the zonal level is not homogenous across the three CDs which make up each zone. In Figures 5.3.2 and 5.3.4, the three inner CDs are listed first for ease of comparison, then the three middle, then the three outer CDs. These results, like many to follow, are developed in Chapter 6.

Figure 5.3.1 Uneven use of pushbikes – Townsville by zone



Note: "Missing" was included in Figure 5.3.1 because it generally means those households did not use pushbikes, along with respondents who wrote in "0".

Figure 5.3.2 Uneven use of pushbikes – Townsville by suburb

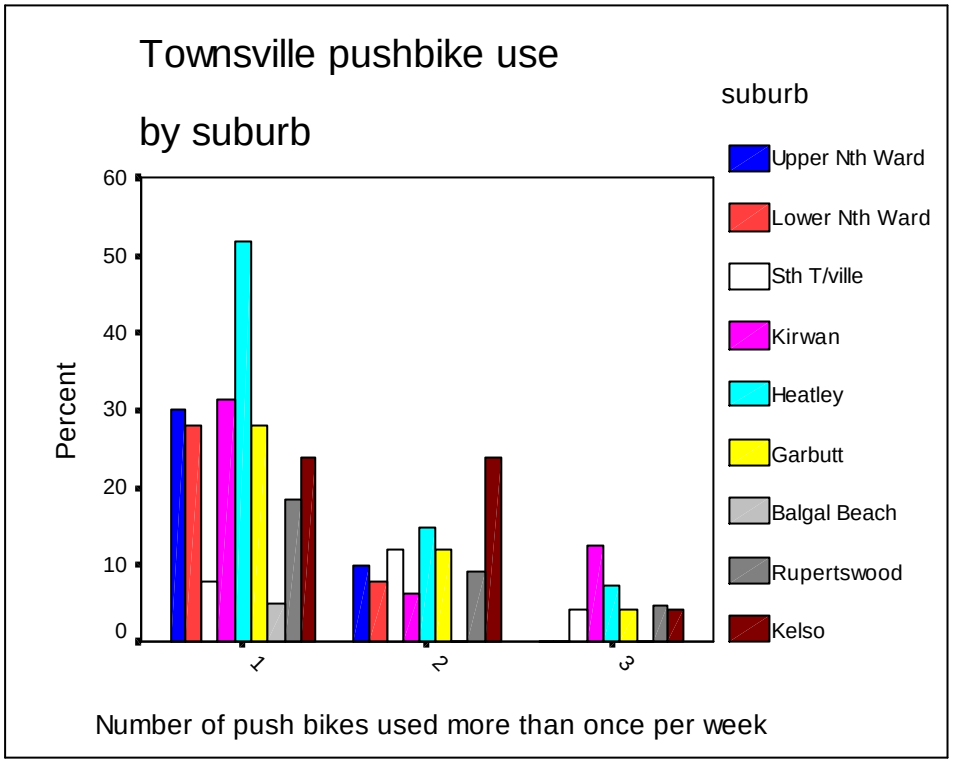


Figure 5.3.3 Uneven use of pushbikes- Cairns by zone

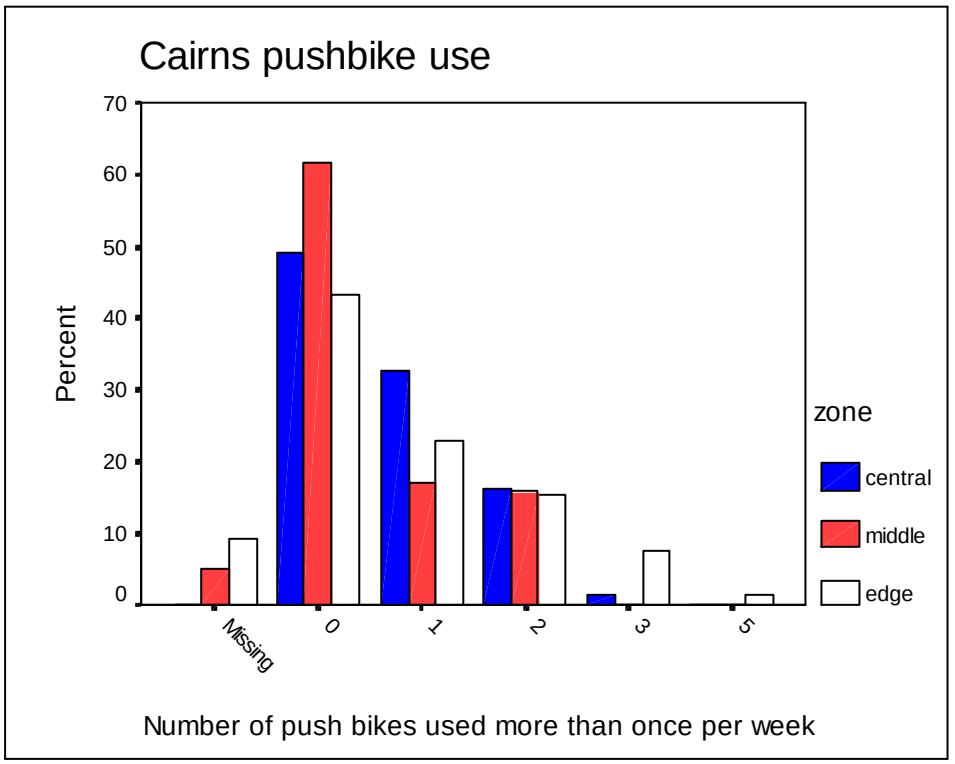


Figure 5.3.4 Uneven use of pushbikes – Cairns by suburb

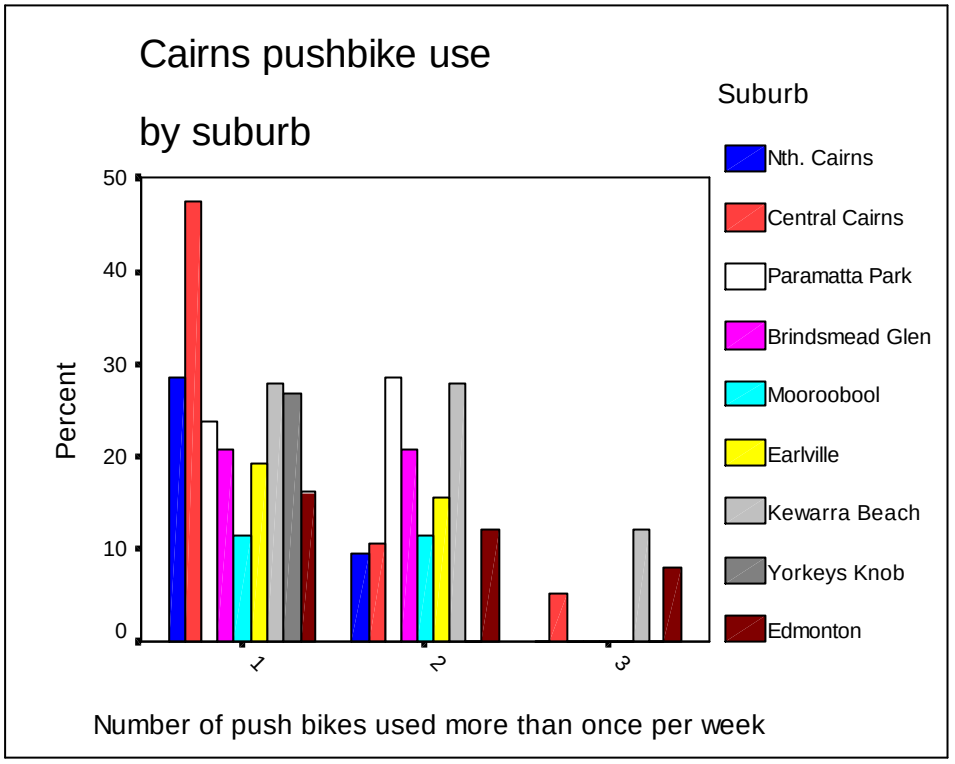


Table 5.3.2 Pushbike use by zone

City	zone	Sum of bikes used >once/week	Average # of bikes used >once/week
Cairns	Central	43	0.70
Cairns	Edge	55	0.93
Cairns	Middle	37	0.51
Townsville	Central	32	0.73
Townsville	Edge	53	1.47
Townsville	middle	56	1.08

Figures 5.3.1 - .4 are included because pushbike use seems to run contrary to generalisations about zones made from nearly all variables based on similarities between CDs. It would seem topography, distance from usual destinations (highly variable, especially for the six outer CDs), and the concentration of employment type in one suburb explain this anomaly. The high number of Army personnel in Heatley explains the very high use of pushbikes from that suburb. According to some Heatley respondents, Army personnel often ride to the barracks to boost their required number of hours of physical exercise.

The lack of homogeneity may be underlined by considering that inner Cairns is very flat, occupied by many young adults. There was high pushbike use in central Cairns compared to other CDs (see Figure 5.3.3). Conversely, One CD from central

Townsville is hilly, one contained a high proportion of infirm (near the Townsville general hospital), and residential surveys from South Townsville produced a recurrent fear of assault or theft. From this, it is reasonable to deduce that predicting local pushbike use is a mix of topography, general age or health, and indices of social dysfunction, or, more simply, fear of assault or theft. Overall, however, cycling was seen by about 20% of respondents as healthy exercise, and, to a lesser extent, that bikes were inexpensive to operate, but seen as dangerous by about 20%. About 10% of people in both centres were deterred from cycling by the weather.

Walking

The first and strongest perception of walking by one third of respondents was that it was good healthy exercise and, like cycling, it was inexpensive. A small group felt there were insufficient or inadequate paths, and that walking was enjoyable. Walking was perceived as healthy exercise by about 40% of households, ahead of a 30% perception of danger, and 20% who were deterred from walking by the weather. About 15% felt that walking was enjoyable.

Ride share, work from home and urban rail

Along with all other travel modes, respondents were asked to describe their perceived strengths and weaknesses of ride sharing (car pooling), working from home or (hypothetical) use of urban rail. About 26% of respondents felt that ride sharing was cost saving, and that participants were dependent (5%), but that ride sharing conserved energy (5%). Ride-sharing would reduce pollution according to 20% of respondents, but also make you dependent according to the same percentage. The first perception of work from home was evenly split, with about 6% seeing it as cost saving, not possible, or that it was a good idea. To about 20% of households, working from home was either money saving, a good idea, or impossible.

About 25% of people felt that urban rail was a good idea, but that it would cost a lot to establish. The first perception of rail use was one of support by about 15% of respondents. About 6% of people from both cities recognise that rail use would reduce congestion, but there would be high costs associated with reintroducing and developing the urban rail system.

To a direct statement: "I would like to see light rail (perhaps cane-tram based) used in the city for public transport", about 30% in both centres strongly agreed, while a further 23% agreed with the statement. Only about 12% in Cairns and 20% in Townsville either disagreed or strongly disagreed with the statement of support for use of light rail as a part of future urban travel.

Environmental beliefs and values

Analysis shows that about 75% of respondents opposed the linear industrial model (Appendix 19). This means that most people opposed the idea of using resources once and then disposing of them in a non-recycling way. The vast majority of people, about 80%, disagreed with the idea that impact risks were acceptable to maximise wealth. In all other environmental statements except ecology constraints, pro-environmental responses were clear-cut (Chapter 1.4, New Environmental Paradigm). Only about 15% of people agreed there were no limits to growth, while more than 50% did not agree that existing decision-making structures are satisfactory.

Nearly 50% of people believe strongly that harmony with nature is necessary for survival, about 70% agreed or strongly agreed with the statement. Fifty percent of respondents disagreed with the statement that technology would provide for our continued well being, while about 20% were neutral.

About 36% of people agreed with the idea that new fuels will support unconstrained vehicle use. This display of optimism for the future does not match (is dissonant with) the prior statement about the prowess of technology to continue providing for our well being. This anomaly is developed and explored in the discussion section. Natural fish breeding in urban waterways was seen as an indicator of environmental well being and people generally agreed (about 43%) with the idea that with technology we can integrate with natural cycles. That closes the section of environmental beliefs, with one related question asking people to indicate how long they thought petroleum would last. It was pointed out in the question that there was a general consensus of about 60 years of reserves remaining. Responses ranged from 30 to 100 years or more. The final portion of the main descriptive results explores responses to urban perceptions, planning issues and ways to easily reduce car use.

Urban planning, travel beliefs and values

In some ways this section is the most important part of the thesis because it summarises views about urban travel and the future. There is probably no better way to convey how people feel about their current and future urban mobility than to use their written responses. The following Figures 5.3.5 - .9 are included in such detail to demonstrate the depth of knowledge and understanding of urban travel issues held within the public domain. They reflect, in detail, the preferred direction of government policy and issue identification and solutions provided through contemporary urban planning literature. This key finding is developed in Chapter 6.

About 30% of Cairns and 45% of Townsville respondents saw some clear link between urban design and resultant car use. Ten and 20% respectively saw no connection. About 10% felt a need for some planning changes, while about 13% noted support for the current urban arrangement. Later responses strengthen and underline this basic satisfaction with current urban travel. The perceived link between urban design and car use is most acutely felt by outer urban dwellers, least by mid urban dwellers. Mid urban dwellers showed the highest level of support for the current arrangement.

When asked to write comments on how they viewed their current urban travel, 45% of Townsville respondents and 30% of Cairns people again stressed how car dependent they were. About 20% gave support to their current arrangements, and, although not prompted, about 22% of respondents wrote that they would like a better public transport system. Some written responses are presented below (Figure 5.3.5) to illustrate some of the points made above, and to stress the fact that many in the population are aware and articulate about sustainability and urban planning issues. A broad range of written responses to the 20 open ended questions are provided in Appendix 6 (Cairns) and 12 (Townsville).

About 20% of respondents believe future urban mobility will include technical or fuel changes and that there would be more attractive public transport. In Townsville 25% and in Cairns 8% of respondents believed that current levels of high car dependence would continue in future. Future behaviour changes reducing car dependence, were anticipated by about 10% of respondents (Figure 5.3.7).

Figure 5.3.5 Written responses to: Your perceptions of urban mobility now (what you think of the way we travel around at present)

House Hold #	Response
101	I acknowledge that too often single occupant trips are made. This creates huge demand on resources including road maintenance, and creates unacceptable levels of pollution levels. Solution? Better public transport, pollution free fuels, more efficient ride sharing.
102	Existing public transport is irregular, slow and expensive. Some main roads could be improved and railway crossings having boom gates or lights instead of stop signs.
415	A sort of insanity which cannot be maintained. Moving a tonne and a half of metal and rubber to transport a 70 Kg person is a massive waste of energy. Most people however have no practical alternative.
104	Cars are too powerful and too expensive to buy and maintain – simpler, slower and cheaper cars would serve us just as well.
107	Still reliant on cheap fossil fuels. Some good mass transit in big cities.
111	Far too reliant on cars/car parking - problem with public perception of "having to catch a bus", safety considerations with public transport and night time use (worry for women and personal safety).
404	Too many cars, trucks and buses. The air in Cairns city is smelly these days, because of vehicle engine fumes.
409	We (Australians) rely far too heavily on personal transport: that is, we tend to use cars too much for too few (usually only the driver).
410	Suburbs should be laid out with low and medium density housing, local shops, church, sport, parks, primary education and kindergartens accessed by closes, sub collector roads, collector roads, sub arterials: "A structured road system".
907	Problems exist for too long before rectification - should be pro-active not re-active.
103	Too many cars.
105	Cairns public transport is limited, run at certain times. That' s why a large percentage of people drive cars.

The final responses reported here describe how people thought they could reduce their car use. The level of response was prompted through five related questions. About 55% of respondents claimed that better public transport would help reduce car use, a further 45% felt there were no ways to reduce car use, or that they could generally diminish their need. Behaviour and technical changes were also prominent responses, as shown in Figures 5.3.7 and .8 below. Responses selected in the these figures are representative of the range of written responses about current and future urban travel, particularly highlighting the depth of thought on urban travel held by ' the public' .

Middle and outer urban dwellers most wanted better public transport and felt their car use was already minimised (Figure 5.3.7). Some written responses (Figure 5.3.8) show real anguish about reducing car use. Many people love their cars, with lifestyles that would be virtually impossible without personal and convenient motorised transport.

Figure 5.3.6 Future urban travel

House Hold #	Response
111	I can' t see it changing until personal safety is assured - I wouldn' t go walking with my family at night.
110	It' s going to be a lot better.
114	Would be improved with better public transport.
407	Electric cars.
408	More public transport will be needed (not buses, perhaps tram/train).
410	For information based professions – technology may allow us to work from home more. Computers, video links, modems etc. will make communications easy. The road network may be used more for delivery and recreation.
412	The bus system has improved 100%. Cars will still be used as the main form of transport.
417	People are unlikely to give up their mobility even if the costs rise (it' s their God-given right). Therefore, as costs rise there will be a demand for and willingness to pay for alternatives.
425	A lot more money and planning needs to be done. We do not use rail enough. E.g., sugar from outer areas should be by rail, and also a lot of heavy transport could be done by rail or ship.
102	More public transport, walkways, and push bike tracks, more rational road planning
107	More mass transit, work from home, fuel efficiency.
404	I think we need to utilize our rail lines, bring back the motor rail, and clean up the air, keep private vehicles out of town, more push bikes.
415	In the short term we must stop building more roads and start making public transport cheaper, more efficient and more convenient for all. Humans wont stop being mobile, so in the longer term we need clean renewable energy sources.
416	With the changes in technology, telecommuting and other interactive services combine with the depletion of resources, mobility will become more leisure activities for those who can afford it. Similar to the turn of the century.
422	More public transport. Why not govt. cars to share – pay more than bus - i.e. commercial type or those with trailers to take the shopping home. Pay for distance travelled on public transport (not a one-fare system).
623	Will be difficult in Cairns if growth is not capped. Geography does not suit further development.
101	We will always want mobility now that we have it. So consciousness has to be raised in the wider community about taking steps to minimise the impact – walk when you can, share ride when you can – live close to facilities, and Govt. and industry have to take bold steps. If alternatives are not found, then attitudes will have to change about our mobility.

Figure 5.3.7 Easy changes to reduce car use

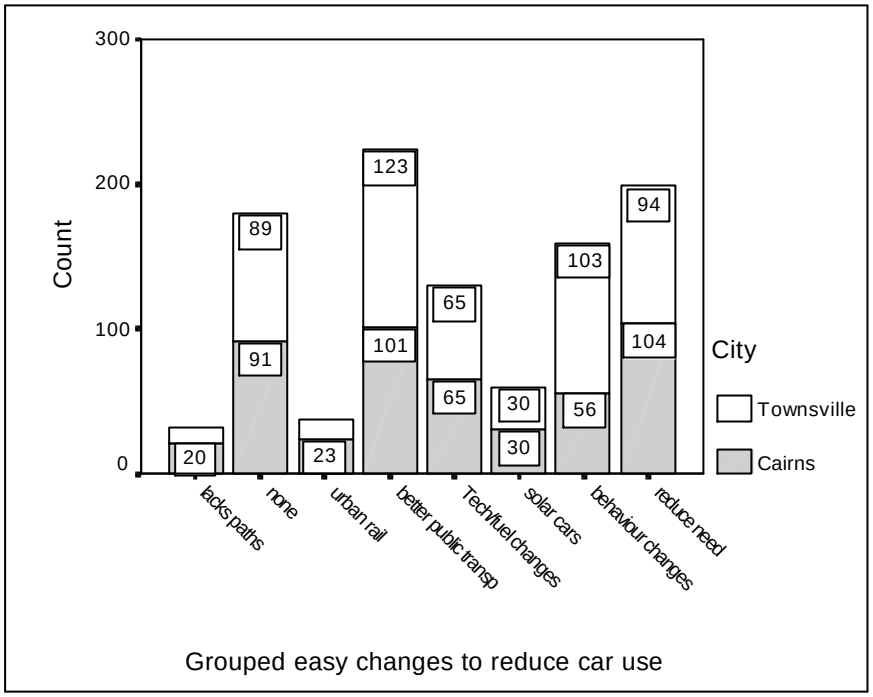


Figure 5.3.8 Easy ways to reduce car use

House hold #	Response
109	We don' t use the car sufficiently to warrant any changes.
401	Don' t know. No easy changes currently available.
106	Greater organisation within the household would cut down on the occasional car use.
107	If my kids biked to school, I wouldn' t have to drive them.
114	Better household delivery.
402	Better school bus service to our area.
403	More public transport.
408	Car-pooling and more information regarding bus services (perhaps letter drop).
426	Other people sharing taking the children to school.
412	No easy changes. I try to avoid car usage so that when I take children to school in the morning I do errands then. I try to use it once going into town.
424	A good bus service.
425	Bike lanes. Rail transport.
414	Change employment.
111	Increase petrol and rego and insurance fees, but please don' t!
202	Increase taxes on [fuels] to reflect the true costs. E.g. pollution, deaths (accidents), stress on pedestrians etc. At 75 cents per litre is <u>much</u> too cheap. Milk (renewable resource) is $1.20 per litre, so is mineral water!
209	Showers at place of work, somewhere to secure bike.
409	Cheaper public transport/more information on timetables/more shelters at stops and a run to work.
421	Direct shuttle, safe and reliable for young school children would remove heaps of morning and afternoon traffic from our roads.
422	More regular bus services. Specific destinations i.e. shops, cinemas, schools, with feeder links to those buses.

Figure 5.3.8 (continued) Easy ways to reduce car use

household #	Response
603	[Need] 8 seat mini-buses in Cairns. It could run frequently inside the suburbs. Air-conditioned in summer. Tickets could be bulk purchased. Costs need to be developed with passengers {paraphrased}.
416	Decentralisation and fast tracking of technologies. Educate commuters as to the efficiencies of car-pooling. Establishing a hybrid urban light rail and monorail (city) transit system.
421	Direct shuttle, safe and reliable for young school children. This would remove heaps of morning and afternoon traffic from our roads.
611	Large cheap/free parking lots on edge of city centre to park there and then have frequent very cheap (all day/weekly/monthly)/ free city travel by public transport.
115	Encourage more push bike use.
420	Go out once and do everything.
122	Make more bike lanes away from the roads. New subdivisions should be made to include separate bike lanes. Many people will not ride bikes with the current road system.
422	Car sharing, more home delivery services from supermarkets (you ring order in, they deliver for a fee).
104	Ride my motor cycle more often.
105	Walk and ride a bike.
114	Increase public transport.
115	Just go to shops once per week.
122	If the prices go up, I would not go out as much.
403	More public transport, otherwise too much financial pressure on families and family outings would have to be curtailed.
412	Because of my sole reliance on the car I would have to cop the increase, but I would try to further reduce use.
415	More planning of trips to reduce mileage.
420	Walk more.
421	Only to make essential journeys – no treats.
424	Get more organised with travel.
101	Probably very few. Perhaps combine more trips. Be more efficient with trip use. Ride a bike.
404	More bike tracks, or USE THE EXISTING RAIL LINES – PLEASE.
417	Even more fuel efficient car, cycle lanes, more buses/trains.
422	Car pool, use public transport, arrange shopping on a roster basis with friends.
416	Increase reliance on public transport and establish a car pool plan, better to reduce the amount of travel required and ideally purchase a vehicle with better fuel economy.

Figure 5.3.9 shows some of the less frequent written ways respondents felt they could reduce car use. Of particular interest are issues of price, as that emerged in the literature as a core issue for behavioural change. With 408 respondents, a count was used in the chart to prevent any obscuring of percentages by the SPSS package. Figure 5.3.9 shows about 3% of respondents, mainly from Cairns, see a direct link between car

operating costs and car use, but only .75% linking parking costs to vehicle use. Much of the parking in the two municipalities is free.

Figure 5.3.9 Less represented easy ways to reduce car use

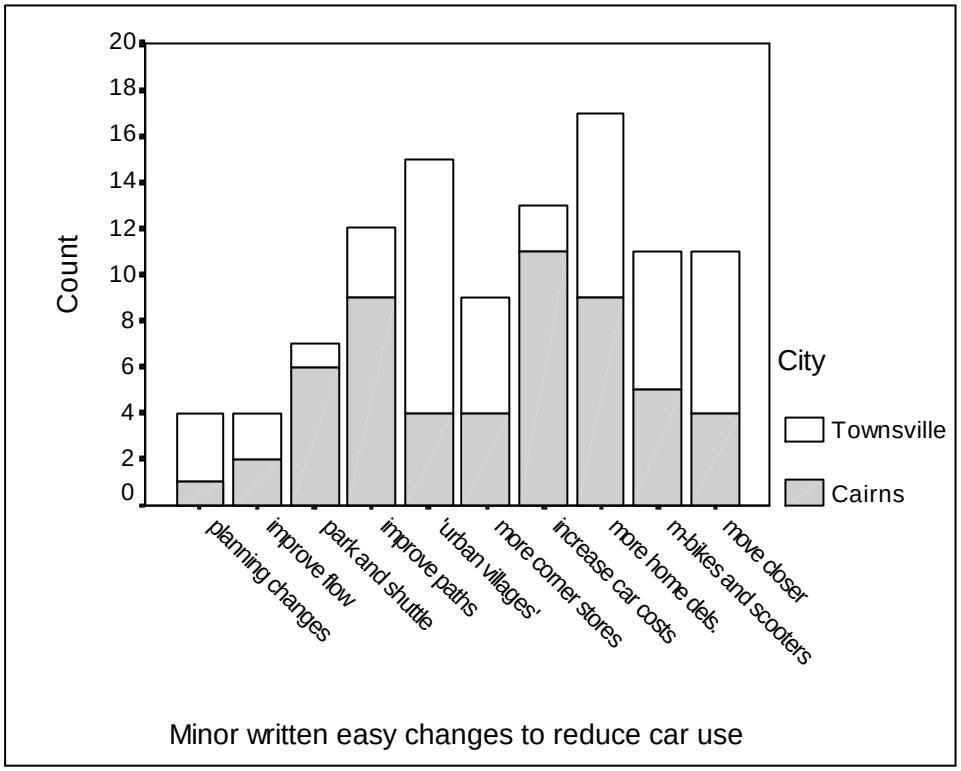
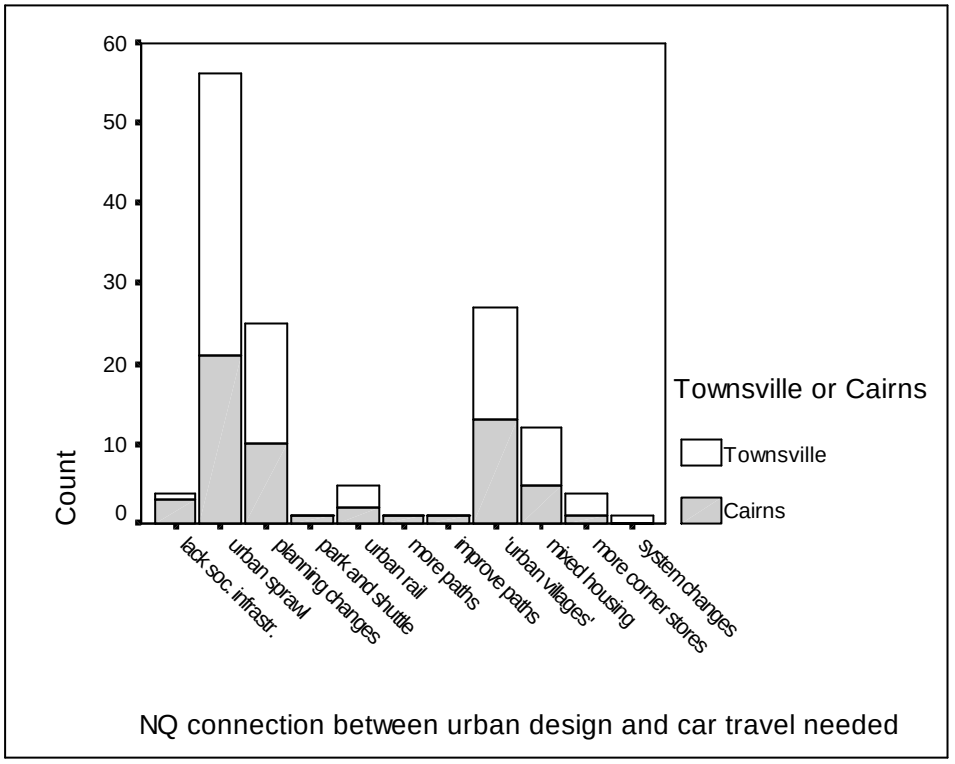


Figure 5.3.10 shows that less frequent links between urban design and travel are of significance, with about 12% of respondents recognising urban sprawl and car use are linked. More interesting to the discussion in Section 6.5 and 6.8 is the suggestion by about 7% of respondents for urban villages or nodes, 6% calling for planning changes and about 3% calling for mixed housing.

Providing final results for this section, the middle suburbs tend to have the most school-aged children, in households with more people than inner or outer suburbs. Outer urban dwellers can see the greatest advantages of improved public transport, and are clearly self-aware about their heavy reliance on car ownership and use.

Figure 5.3.10 Less frequent perception of links between urban form and travel



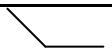
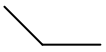
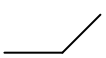
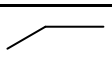
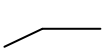
Section 5.4 Direct Townsville – Cairns comparisons

This section shows some relationships between behaviour, beliefs and values connected with urban travel. Table 5.4.1 shows that household income across zones in both centres was statistically similar, as was age of respondent, household education level, car engine size and annual journeys from the region. While years lived in the region, vehicle provided by employer and owning one vehicle were similar across zones in Townsville, they were lower for the first two and higher for the last in the middle suburbs in Cairns. Contrasting this, average weekly parking costs, and respondents who drove 5 –10 times per week were evenly distributed across zones in Cairns, but were less represented in the middle Townsville suburbs.

Analysis of the full data set shows few differences of note in urban travel issues between Townsville and Cairns. In many respects there are zonal differences, with inner urban dwellers spending the least on fuel, and travelling the shortest distances to nearly all significant destinations.

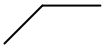
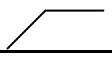
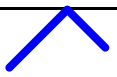
Table 5.4.1 Comparing trends across zones between Townsville and Cairns

The hieroglyphs used to depict differences across inner (left) middle and outer (right) zones depict the data in a compressed way. A horizontal line represents a statistically equal value.

Variable	Townsville	Cairns values	General average value[1]
	I[2] O M	I O M	
Zone independent for Townsville			
Household income ($,000)			36
Age of respondent (years)			43
Education (year)			12
Car engine size (av. # cylinders)			4.9
Annual journeys from region			1.6
Years lived in region			17
Vehicle employer provided (%)			11
Decrease across zones in Townsville			
Age of building (years)			25
Cost of public transport for users ($/wk)			12
Believe relatively easy urban mobility without car (%)			9
Use public transport (%)			12
Increase across zones for Townsville			
Percentage of households with vehicles			93
Weekly fuel costs ($)			30
Number of vehicles per household			1.6
Perceived difficulty without a car (%)			73
Push bikes used/household			.9

Note 1. If two figures are given in the general values column, it means there are differences between the two centres, with the Townsville value given first.
Note 2: I,M,O represent Inner, Middle and Outer zones, the miniature line graphs show the vale for of each variable from Inner to Outer zones.
Note 3: All Townsville outcomes are given with thicker lines. Where Cairns results are significantly different to Townsville their lines are thinner.

Table 5.4.1 (continued)
Direct comparisons of Townsville and Cairns variables

Variable	Townsville	Cairns values	General Average value[1]
Central different from mid and outer for Townsville	**I[2] O M**	**I O M**	
Residents per household			2.8
Born in region (%)			27, 17
Two vehicles owned (%)			35
Current employment (years)			9
Middle suburbs different from inner and edge for Townsville			
Average weekly parking costs for user ($)			5.5
Drives 5 – 10 x per week (%)			12, 25
Female respondents (%)			53
Answered Q on buses (%)			34
Want more push bike security (%)			19
Support light rail (%)			47, 57
Outer suburbs different from central and middle for Townsville			
Distance to nearest convenience store (Km)			1.5, .7
Home ownership Outright (%)			27, 35
Mortgage (%)			25
rent (%)			45, 38
Use buses – main respondent (%)			12

Note 1. If two figures are given in the general values column, it means there are differences between the two centres, with the Townsville value given first.
Note 2: I,M,O represent Inner, Middle and Outer zones, the miniature line graphs show the vale for of each variable from Inner to Outer zones.
Note 3: All Townsville outcomes are given with thicker lines. Where Cairns results are significantly different to Townsville their lines are thinner.

Income, respondent age, highest household education level, average car engine size and average number of annual journeys from the region were statistically identical across the zones and in each centre (independent of location; Table 5.4.1). Years in the region

and a vehicle being provided by an employer was zone independent for Townsville, but was highest in the middle suburbs of Cairns. Age of buildings dropped as the surveyed CDs were located further from the CBD, while money spent on public transport, use of public transport and perceived ease of urban travel without as car dropped steadily from inner to outer suburbs in Townsville. Use of public transport in the Cairns survey group was almost the inverse of the Townsville group, and one of the more interesting contrasts between the two centres.

Household fuel costs rose steadily from the centre of each city to the urban fringe. In Townsville the number of vehicles rose from centre to fringe, as did percentage of high car users, perceived travel difficulties without a car, push bikes owned and used. For these variables, Cairns was slightly different (Table 5.4.1). For many of the 161 variables developed in the survey, many outcomes were essentially the same for both centres. After listing some of the similar variables across demographic, travel data and attitudinal variables, this section explores some more variables that were distinct either at the city or zonal level.

Some similar variables from Townsville and Cairns

The two centres both had about 80% of respondents who lived in detached housing, and represented a similar age range, with approximately 50% of each gender. About 25% had mortgages and 40% rented, mainly in the inner areas. The number of residents and pushbikes per household were almost identical in the two centres.

The first perception of cars as convenient was almost the same (35% and 36%) for Cairns and Townsville, while issues like not visiting neighbours in their home was at 37 and 33% respectively, while 51 and 58% of people regularly talk with their neighbours. In both centres, 76% would not move from their current address for travel related reasons.

Eighty-six and 88% did not use buses, and generally viewed buses, cycling and potential light rail use in a similar way, while environmental values were also largely shared. For example, just under 80% of the 200 respondents for each centre believed that harmony with nature was needed for survival, while just over 50% did not believe that technology will provide for our continued well being.

About 42% of people in both centres saw walking as healthy exercise and had similar responses to all modes, including ride sharing or working from home. Finally, the means of travel in the two centres was extremely similar (Table 5.3.1)

Having expanded the list of near-identical traits shared by the two cities, the next few paragraphs further explores some differences at city or zonal level (Appendix 16 - 19). There were a similar number of one-vehicle households in Cairns and Townsville, but detailed scrutiny showed that 60% of Cairns outer households had one vehicle, while only 40% of Townsville outer households had one (60% had two or three).

Although annual household income was equivalent in the two centres, inner Cairns had about 25% on $15 – 25,000 per year, with Townsville only having about 15% at that relatively low income. Cairns middle suburbs had about 35% earning more than $45,000 per year, while only about 18% of mid urban Townsville dwellers earned that much. There were distinct zonal income differences between the Cairns and Townsville samples.

The general traits for the two centres are quite similar – high car use, low public transport use and greater perceived car dependence from residents further from the CBD. As shown in the Urban Travel section, modes of travel for the 3,500 recorded trips were also very similar. People tended to view the various urban travel options in a similar way. There are pockets of difference shown in Table 5.4.1, considered in the following section.

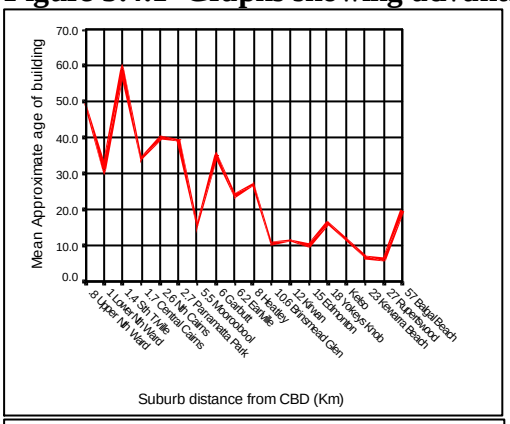
Zones and city differences

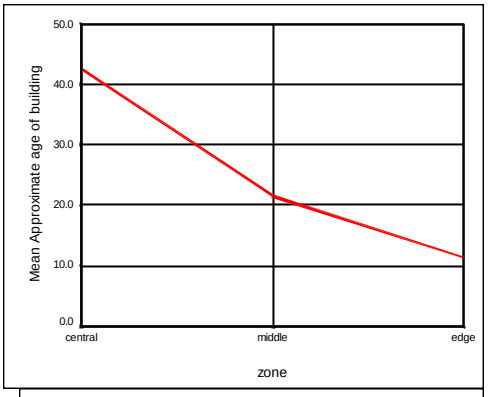
The following Table 5.4.2 and Figure 5.4.1 show that stratification and classification into zones produces an outcome with greater clarity than using an unzoned transect.

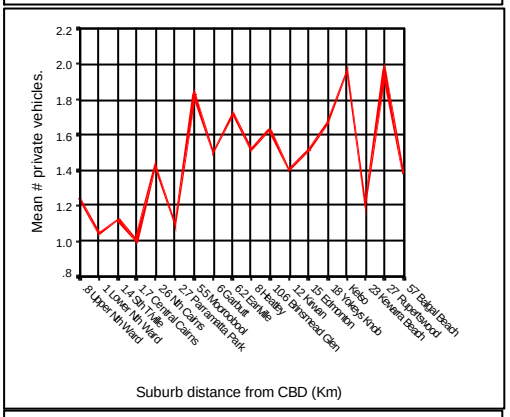
Table 5.4.2 Aligning CDs by distance from CBD via main roads

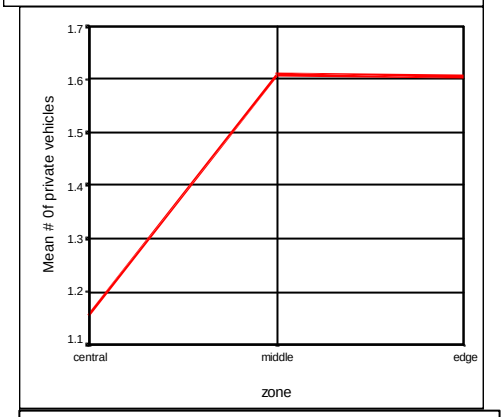
Suburb	Distance from CBD (Km)	Ranked distance from CBD
Nth. Cairns	2.6	5
Upper Nth Ward	.8	1
Central Cairns	1.7	4
Lower Nth Ward	1	2
Paramatta Park	2.7	6
South Townsville	1.4	3
Brinsmead Glen	10.6	11
Kirwan	12	12
Mooroobool	5.5	7
Heatley	8	10
Earlville	6.2	9
Garbutt	6	8
Kewarra Beach	23	16
Balgal Beach	57	18
Yorkeys Knob	18	14
Rupertswood	27	17
Edmonton	15	13
Kelso	19	15

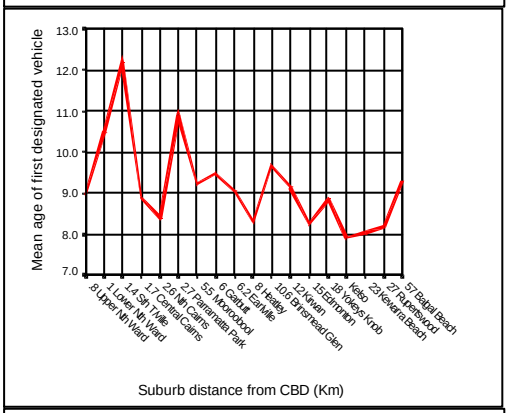
Figure 5.4.1 Graphs showing advantages of zonal analysis

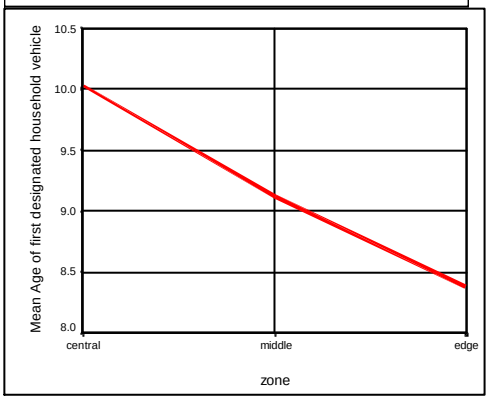


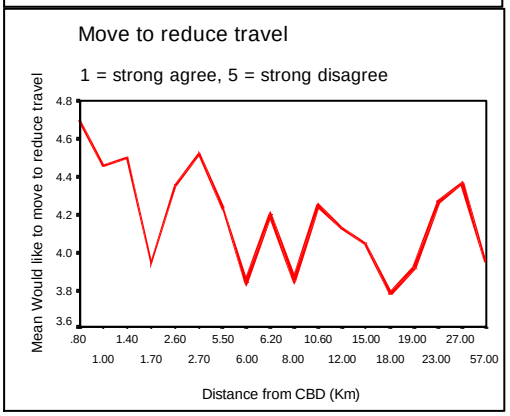












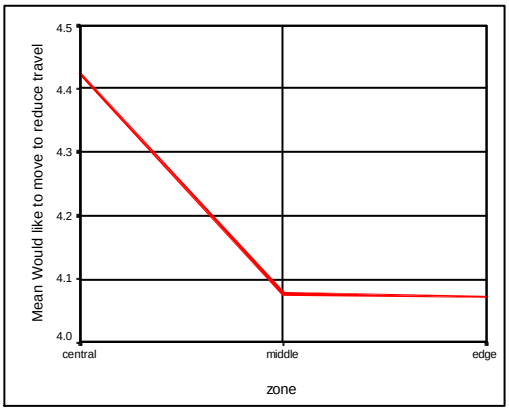


Figure 5.4.2 - Zonal bus use differences, Townsville and Cairns

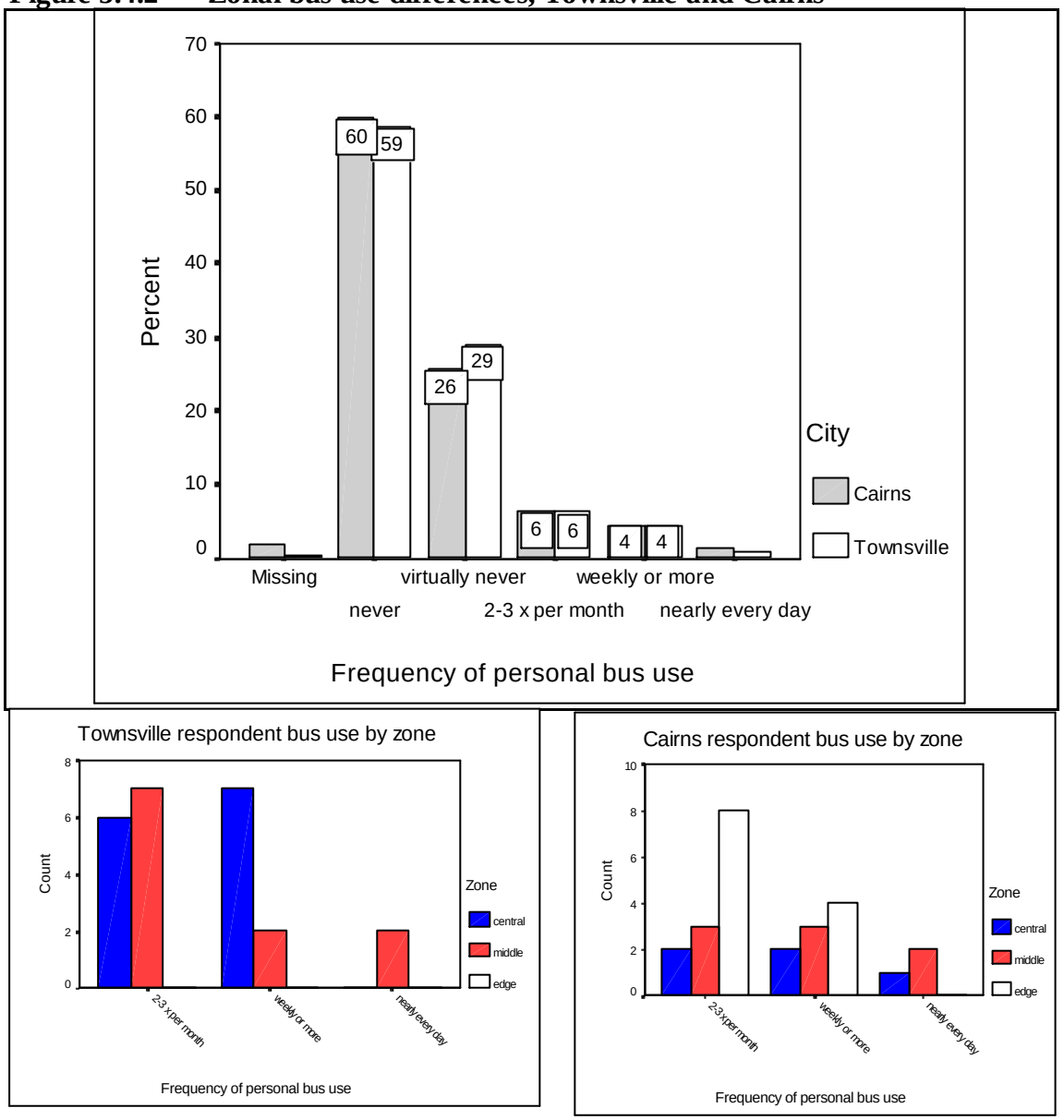


Figure 5.4.2 shows fundamental differences in bus use between the zones in the two cities. None of the outer zone respondents from Townsville reported regularly using the bus, while their Cairns counterparts dominated the casual bus use in that city. The figures underscore the low use of buses in either centre. The overall trend at the time of survey was that Cairns outer and Townsville inner urban residents used buses most.

This section has shown that the two population centres under study are generally similar. The method of sample stratification by zonal distance from the CBD clarifies the zonal dependence of building and vehicle age, desire to move to reduce travel and the number of vehicles per household. Having explored some similarities and differences between zones and cities, Section 5.5 presents some more complex relationships between variables or blocks of questions.

5.5 North Queensland multivariate analysis

Testing between zones and distance in kilometres from the city centre to each of the 18 Collector Districts produced a correlation coefficient of .94, indicating that the zones are a good summary representation of a transect of distances from the centre of the city. Distance from the city centre to edge was associated with an increased perception of difficulty to shop without a car. This generated a correlation of about .34 between zone and perceived reliance on cars.

Used as something of a benchmark, building age correlated with zones at .58. At increased distance from the city centre people tended to own more vehicles, however those vehicles on average tended to be slightly older. There was a correlation of .34 between annual household income and weekly fuel expenditure. A .46 correlation between zones and total travel distances by individuals shows a clear link between distance travelled and distance from the CBD. Further, the distance to the nearest convenience store correlated .58 with distance from the central business district. A similar link of .45 exists between the total distance travelled by individuals and their residential distance from the central business district.

There was a .37 correlation between the number of years the respondent worked and whether or not they owned their current home and a .42 correlation between total vehicles owned and total money spent on fuel (Appendix 20 through 24 for full correlations). These links are discussed in Chapter 6.

Comparison of difficulties of travel without a car showed that differences between zones were most marked for (in order) getting to the city, getting to entertainment,

work, recreation or supermarket. Supermarkets, work, city and entertainment were the most car-dependent destinations. Residents of the middle suburbs found getting to school easier than other residents. This was also true for getting to public transport. Most results were as expected, with difficulty increasing with distance from the central business district (Appendix 21). The only differences between the cities in ease of travel without a car was for getting to public transport or getting to the local shop, in most cases seen as slightly easier in Cairns.

There were few differences across zones in strength of neighbourhood attachment. The only differences were neighbourhood visits, which increase from centre to the edge, and a consideration to move to another location for travel related reasons. This also increased from the centre to the edge. There were no significant differences in any of the neighbourhood attachment questions between the two cities.

A comparison in perceptions of various attributes of bus use showed that a perception of comfort was the only appreciable difference across the zones, falling slightly from the centre to the edge. There were no significant differences in perceptions of buses between Cairns and Townsville. Cairns respondents saw buses as significantly more convenient for drop off and pickups than Townsville, and Cairns residents on average thought that buses were slightly more affordable then did their Townsville counterparts.

An ANOVA performed on the block of statements of environmental values showed that there were no significant differences between zones. An ANOVA was used in this analysis because the data was from a 5-point Likert scale. Although somewhat skewed, there was the general form of a normal curve. Only 3 of 10 statements produced differences between Townsville and Cairns. In each case Cairns showed a stronger agreement to pro-environmental statements, implying that Cairns people are generally more optimistic about our ability to adapt while continuing the kind of urban behaviour we are accustomed to.

Factorial, hierarchical, database and cross-tabulation analysis

This analysis considers previously analysed blocks of questions. Chapters three and four showed great similarity between the outcomes of factorial and hierarchical

analysis, reinforcing and clarifying each other. The results given here follow the general order of the questionnaire. The self-perception of ease of travel to the supermarket, city, to visit friends, recreation and entertainment were all contributing parts to the primary factor involving the need for cars. The secondary factor, less important, included ease of travel to public transport, school and the local shop.

Table 5.5.1 Factor analysis of car dependence

Measure of car dependence	Component 1		
Ease of attaining destination	Cairns	Townsville	Total
Mall/shopping centre	.756	.871	.831
City	.763	.825	.802
Recreation/social	.664	.781	.732
Shops	.582	.681	.653
Work	.622	.570	.580
% explained by 1 component	46	56	52

Table 5.5.2 Hierarchical cluster analysis of car dependence

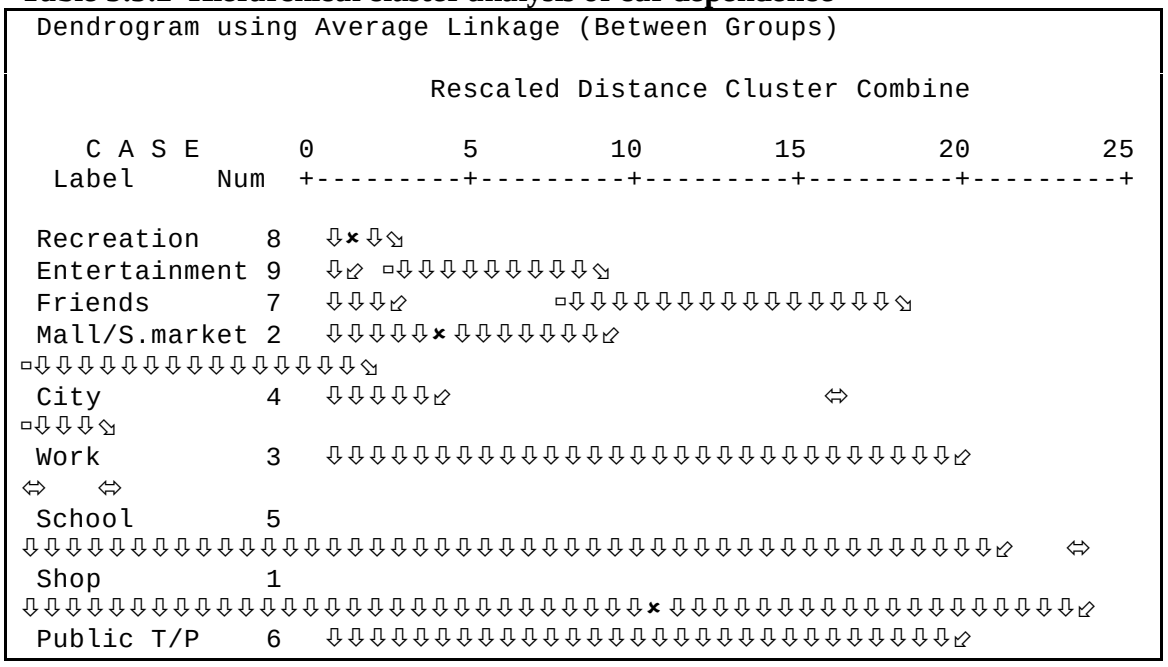


Table 5.5.1 shows the judged difficulty of getting to a shopping mall/supermarket is the clearest single measure of overall car dependence from the block of 9 destinations originally polled. Unless the study population was from a culture that procured food in a structurally different way, this result shows that future urban travel research could

just ask about dependence to get to the supermarket, and perhaps the city and recreation. An hierarchical cluster analysis (Table 5.5.2) confirms this analysis.

Factorial analysis grouped neighbourhood attachment responses into three separate components, mainly involving social travel, desire to move, and judged similarity with neighbours. The final analysis for neighbourhood attachment linked talking with neighbours with a sense of similarity with neighbours. Further analysis has used 'talking with neighbours' as the representative indicator of neighbourhood attachment, as shown in Table 5.5.3.

Table 5.5.3 Elements of neighbourhood linkage

Variable	Component
	1
Visit neighbours	.645
Neighbours would help	.694
Talk to neighbours	.816
Similar to neighbours	.690

Extraction Method: Principal Component Analysis. 1 component extracted
Note 1: Component 1 explains 51% of variance.

Bus assessment showed that reliability and frequency of buses were the most important issues for most respondents to the bus questions and among the more meaningful indicators of people's overall perceptions of buses. An abridged questionnaire, one goal of the research, is provided as Appendix 25, which includes just those two measures of bus perceptions. Environmental values showed an overall alignment with the new environmental paradigm. Results clearly show that there is general optimism that with technology we can integrate with natural cycles. Results also show there is optimism, particularly in Cairns, that new fuels will allow us to travel by car in ways that we are used to.

The factor analysis showed two distinct groups of issues. One factor provides a clear rejection of the dominant social paradigm, rejecting the idea that there are no limits to growth, or that humans have the absolute right to dominate, acquire, use and discard natural resources. The third dominant variable contributing to this first factor is rejection of the belief that technology will overcome all obstacles to our continued well being. The second component gives clear support for the new environmental paradigm.

The sophistication of this response bodes well for the future. The discussion in chapter 6 explores the gap between the quite refined and survival-oriented environmental beliefs and values at the policy and personal level, and actual on-ground behaviour. Figure 5.5.1 clearly shows the strong support for the environmental belief that we can integrate technology with natural cycles.

Figure 5.5.1 Level of support for integrating technology with natural cycles

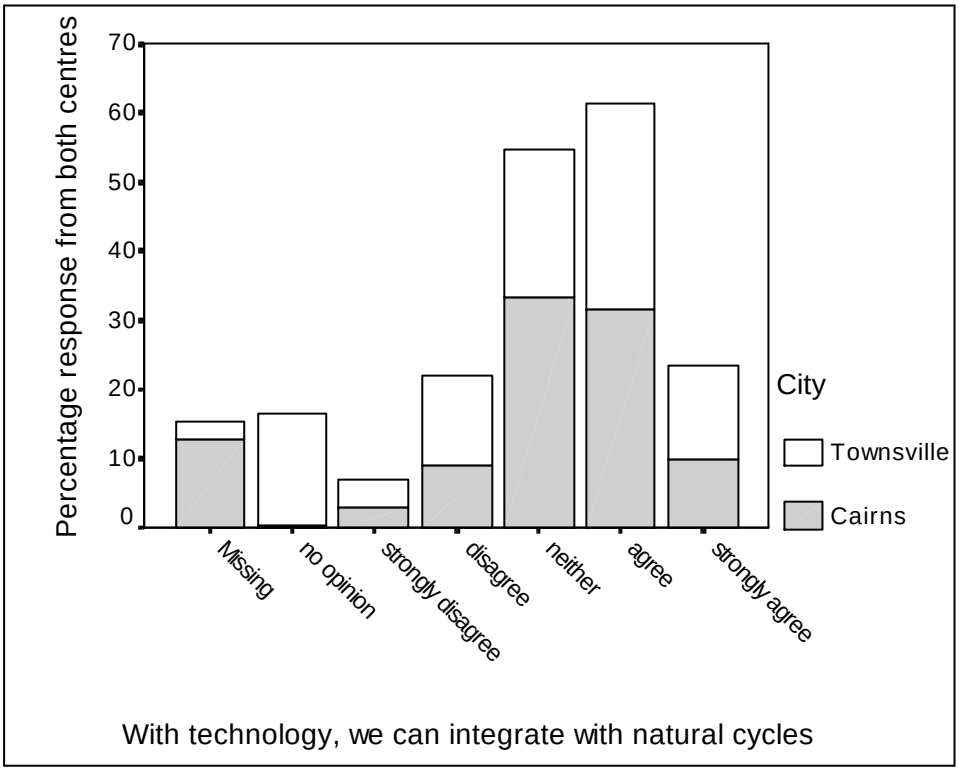
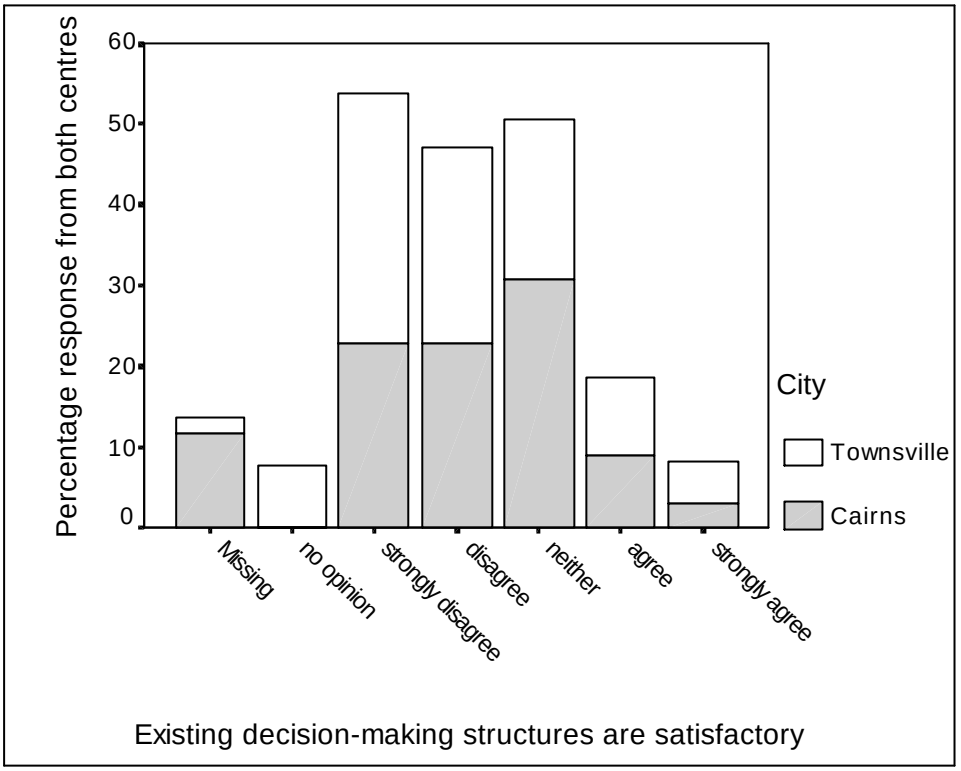


Figure 5.5.2 shows that people tend to question the structural relevance and ability of current decision-making processes to properly guide us toward sustainability, discussed in Chapter 6.

Figure 5.5.2 Faith in current decision-making structures



Database queries

Using query techniques from the Microsoft access database, the following tables are provided to show issues of home location choices, seen as central because that decision dictates much subsequent urban travel. It is therefore important to understand why people have particularly chosen to live in the outer suburbs. It is of further interest to know what binds people to those suburbs. For that reason the indicator of speaking frequently with neighbours has already been established to display strong community linkage.

Thus, responses in Table 5.5.4 show the main reasons why people of different age groups chose to live in the outer suburbs, particularly those who are self-defined as likely to continue to live there. In Table 5.5.4 the dominating reasons were that they liked the suburb and they were attracted to the natural features. Social links were also important. This research indicates that people in the outer suburbs have more social discourse with their neighbours than those from more central suburbs. This generates an argument that there should be more nurture of social interaction between neighbours in the more serviced suburbs. The strengthening of neighbourhood cohesion for inner and middle suburbs may be one antidote to uncontrolled urban fringe growth.

Table 5.5.4 Outer urban home choice aligned by age group, for those with a clear sense of community attachment

Respondent age group	Grouped home choices	Number
30-39	Good price	4
	Like property	7
	Like suburb	12
	Natural features	10
	Social links	9
40-49	Like suburb	7
	Natural features	5
	Social links	5
50-59	Like suburb	4
	Natural features	10
60-69	Natural features	4

Note: Only > 3 responses are included in Table 5.5.2 (see Appendix 23 for full analysis)

The under 40 year-olds from the outer suburbs liked their location, the natural features, social links and their own property. The 40-50 year-olds had similar priorities, while natural features alone dominated the 50 – 60 age group' s reason to live in the outer suburbs.

Further queries shows that people with strong neighbourhood attachment and the strong belief in the value of integrating technology with natural cycles lived in the central zones mainly because (in descending order) it was close to the city, shops and school. For the middle suburbs it was close to work, school and shops.

Outer urban dwellers with a sense of community integration and a clear support for environmental values tended to chose their home because it was close to work, shops or school. This tells us that against the more general reasons for zonal home location choices among the social and environmentally aware were proximity issues, rather than price or natural features which tended to dominate the overall sample from the middle and outer suburbs respectively. This again is used as an example to show how finely the data may be organised to answer questions on almost any of the 161 variables in the database (Appendix 23).

Table 5.5.5 gives a zonal analysis by respondents' perceptions of walking, filtered for age groups, clear neighbourhood attachment and clear car dependence. Walking was

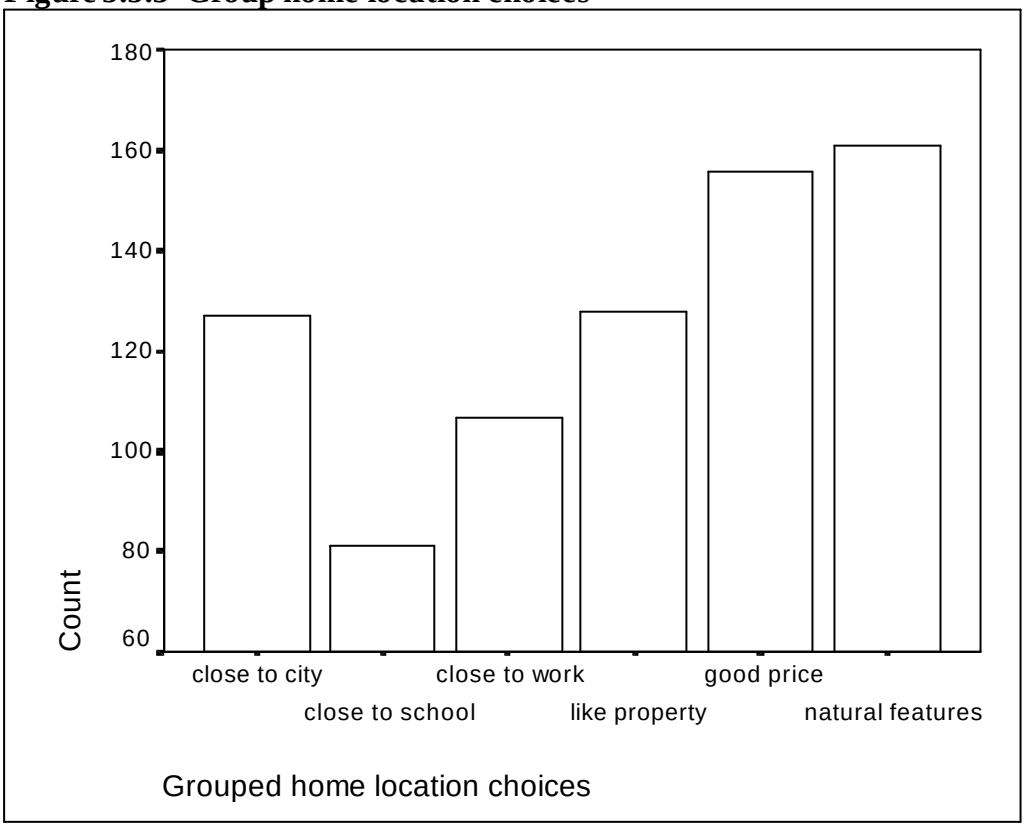
seen as dangerous for mid urban residents over 50 years, concurring with younger respondents from the outer suburbs. Older outer urban residents were less fearful, more focused on the benefits of walking.

Table 5.5.5 Zonal perceptions of walking from respondents who had strong neighbourhood links and were highly car dependent

Zone	Age (years)	Perceptions of walking	Number
Middle	50-59	dangerous	2
Middle	60-69	dangerous	2
Edge	30-39	weather deters	2
Edge	30-39	dangerous	2
Edge	30-39	enjoyable	3
Edge	30-39	exercise/healthy	3
Edge	40-49	exercise/healthy	2
Edge	50-59	exercise/healthy	2

Note: only categories with two or more responses are included.

Figure 5.5.3 Group home location choices



The results indicate that people who are attached to the neighbourhood and are very car dependent tend to view walking as dangerous. This perception will need to change if more urban walking is likely to be taken up by a broad sector of the community.

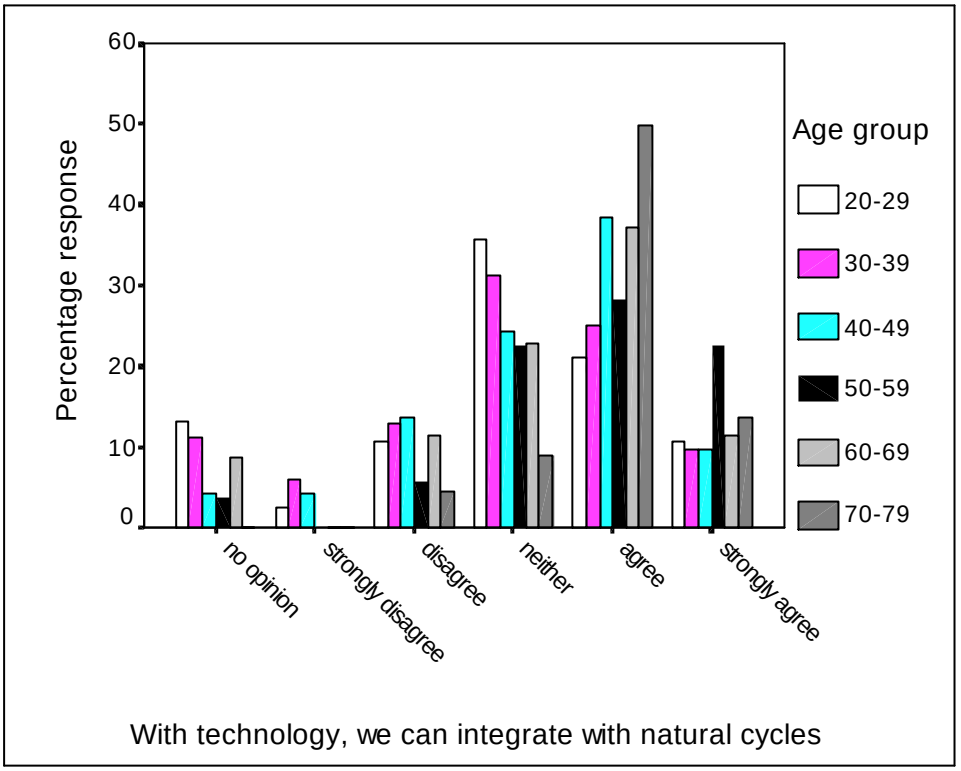
Figure 5.5.3 shows the overall dominant reasons for home location choices. Natural features, good prices, closeness to city and an attraction to the individual property were four overriding reasons for home location choice. People who most value the independence provided by cars were most likely to choose their home because of its proximity to the city. To a lesser extent this was true of people who saw that cars incurred high cost, or were convenient. Closeness to city dominated those three cross correlations to car perceptions, compared to other proximity issues. Choice of home location because of price was most important to people from 20 to 40 years of age.

The main home location choices for 20 to 30 year-olds were property price and closeness to work or the city. Thirty to 40 year-olds were most interested in price, closeness to the city, then an attraction to the property. Forty to 50 year-olds displayed different priorities. Their primary interest was natural features, followed by proximity to city and then prices. Fifty to 60 year-olds were most interested in natural features, an attraction to the property and then closeness to the city. People from age 60 to 70 were interested in closeness to the city or natural features. Other issues were of little importance, although the property needed to be attractive as well.

The final section of this analysis considers relationships of environmental values to parameters of ways of reduce car use, years lived in the same home and general place of birth. Figure 5.5.4 shows the overall distribution of belief that with technology, humans can integrate with natural cycles.

Figures 5.5.1 and .4 show that environmental beliefs are somewhat age dependent, with younger and older respondents (to 60 years of age) most strongly supporting the new environmental paradigm. There appears to be no strong link between environmental beliefs and place of birth.

Figure 5.5.4 Environmental values- integration by age group



This Chapter of public input to urban travel issues and sustainability has shown the overall similarity of urban travel behaviour, values and beliefs between the two subject cities, implying that results may be generalised beyond these two centres. While exploring the differences that existed, the overall outcome is of an aware and caring population in two North Queensland provincial cities, cautiously optimistic that car use will continue to dominate urban mobility, but identifying easy ways to reduce some car use. The final section of this chapter provides a view from planning academics and practitioners.

5.6 Expert survey results

This research set out to poll members of the public on travel behaviour, and views of future urban travel, seeking ways to reduce urban car use. From the information presented to date, public input and views from the urban planning literature were synthesised into a precis of recommendations and 55 planning statements, sent to 40 planning experts (Chapter 2.4, Method 4). Twenty-two experts responded, the group comprising of one North Queensland academic and 9 planning practitioners, 6 Australian capital city planning academics and three practitioners, and one overseas academic each from Thailand, the USA and Scotland (Appendix 26).

The 55 statements and results of the ' experts survey' are presented in Table 5.6.1 and 5.6.2. These Tables respectively show what planning experts felt were the most important travel issues and the easiest, most important changes to reduce car use. The results are given in full below because of the wide level of interest from the 22 responding experts. Also, these Tables in many ways represent the culmination of thesis results. Finally, Table 5.6.3 gives some indication of the level of linkage between expert agreement to each statement and appraisal as easy, effective implementation priories to reduce car use.

Table 5.6.1 shows expert response from a Likert scale where 1 = strongly disagree through to 5 = strongly agree. The precis from which these statements were drawn was also provided to polled experts to clarify any statements deemed ambiguous or unclear (Appendix 26).

Table 5.6.1 Expert level of agreement to urban travel statements

Statement	Mean, where 5 = strongly agree	Rank order
Facilitate walking and pushbike use through greater continuity of paths.	4.77	1
A mix of responses is needed to reduce urban car use.	4.73	2
Ensure conditions which make walking, cycling and public transport use feel safe.	4.67	3
Safety must be addressed for all non-car modes.	4.62	4
Create better walking, cycling and public transport infrastructure to help legitimise those activities.	4.64	5
Provide detailed route and times at each bus stop to help people identify and catch their required bus.	4.55	6
Facilitate walking and pushbike use by asking users or potential users to physically identify problem areas.	4.48	7
Develop interchanges where drive, cycle or walk to a bus or rail terminal is facilitated.	4.41	8
Make city centres and urban nodes more people oriented, at the ‘ human scale’ , with mixed land use and pedestrian zones.	4.41	9
Aggressively move to close the gap between policy and provision of non-car infrastructure.	4.38	10
I support facilitation of walking and cycling.	4.32	11
Facilitate walking and pushbike use through driver awareness campaigns.	4.29	12
Reducing overall urban car use is an environmentally sound goal.	4.27	13
Make urban areas legible, easily ‘ read’ and understood, and permeable to non-motorised travel.	4.25	14
Socially market bus use, walking and cycling as ‘ normal’ .	4.24	15
Facilitate walking and pushbike use (in the tropics) through greater shading and drinking taps.	4.23	16
It will take substantial infrastructure and pricing changes to make a great deal of difference.	4.23	17
Provide a demand sensitive array of bus sizes, times and routes.	4.19	18
Encourage an understanding of environmental and dollar savings by making discretionary journeys outside the peak times.	4.19	19
More assertively implement nodal development linking residential land use with proximate usual destinations.	4.18	20
‘ Soft’ changes should be implemented ahead of demand.	4.16	21
Provide secure parking and showers for cyclists.	4.14	22
Encourage schools to help organise car pooling for staff and students.	4.14	23
Encourage and facilitate the meeting of as many needs as possible in the neighbourhood or a near node.	4.14	24
Much meaningful car reduction is unlikely until significant cost increases for car use.	4.10	25
Develop traffic calming in pedestrian precincts.	4.05	26
Encourage employer-promoted alternative transport plans, such as ride sharing, bus or cycle use.	4.00	27
Support social suburban nodes and networks.	4.00	28
In any implementation of light rail, special attention needs to be given to noise.	4.00	29
Develop 30KPH traffic calming in the city centres, helping make the pubic transport speed competitive, and walking and cycling safer.	3.91	30
Increase parking charges for commuters.	3.91	31
Encourage a legal protection for people who wish to ride share.	3.86	32

Table 5.6.1 (continued) Expert level of agreement to urban travel statements

Statement	Mean, where 5 = strongly agree	Rank order
Encourage schools to help organise group bike riding to and from school (bike trains).	3.86	33
Develop a process where residents may indicate preferred bus times, routes and destinations to produce a map of bus demand.	3.86	34
Use social marketing to help link environmental concern with car use reductions, especially during peak hour.	3.84	35
Encourage public figures within the political process to lead by example, a move towards more trips that are shared with others, rationalised, or made by walking and cycling.	3.82	36
Encourage working from home one or more days a week where possible.	3.82	37
Minimise further facilitation of car use.	3.81	39
Encourage ride sharing through community service announcements.	3.80	38
Encourage and facilitate legally sanctioned ride sharing.	3.80	40
Encourage major employers and schools to consider staggered start and stop times to disperse the extremes of the morning and evening peaks.	3.77	41
Pay proportionate registration through fuel price, financially rewarding low car use.	3.77	42
Looming fuel scarcity is likely to cause major fuel price increases within 10 years.	3.73	43
Start the process of piloting urban rail along the existing southern route into Cairns.	3.71	44
Encourage delaying discretionary trips through community service announcements.	3.65	45
Encourage planned multi-purpose trips through community service announcements.	3.63	46
Provide sub-offices at nodes for some central-place services.	3.62	47
Allocate light rail routes connecting the main nodes designated in the regions' strategic plans.	3.55	48
Ride sharing needs to be seen as part of a strengthened social local or work network.	3.50	49
Constrict fringe growth by charging full service provision and infrastructure upgrade costs to fringe developers.	3.43	50
Support informal surveillance.	3.38	51
The Internet can act as a clearinghouse to link people at the local level with demographically similar people, home locations, destinations and travel times.	3.41	52
Pay employees not to park in company-provided parking.	3.14	53
Encourage use of a compressed working week, working four 10 hour days, spreading the peak	3.14	54
Facilitate neighbourhood socialising through neighbourhood houses.	2.95	55

Table 5.6.1 shows that more continuous paths are likely to encourage reductions in car use as part of a mix of responses, including better non-car infrastructure to legitimise other travel options. Non-car travel must both feel safe and be safe. This issue of 'feeling safe' becomes central to the greater uptake of non-motorised travel. The legitimisation of walking and cycling through a greater on-ground designation of

routes, coupled with social marketing of these preferred behaviour needs to be coupled with a sense of safety to attract people from the perceived relative safety of their cars.

Detail of bus movements must be available at bus stops, while non-car routes should be improved with public input to problem areas. Full travel mode interchanges should be developed along with urban nodes at the ' human scale' , all the above helping close the gap between policy and implementation to achieve environmental and social goals.

It is perhaps as interesting to consider the least agreed to statements, particularly the use of community service announcements and strengthened local social networks. Urban planning is not yet strongly seen as a social science by many planning experts. Travel is still part of expressed individualism, more than a derived demand, although social and more co-operative planned trips (to the supermarket, to work or school) may need to be enhanced to reduce solo or ' chauffeur' driving.

Table 5.6.2 shows expert response to what they considered were the "top ten contenders (10 rates highest – the most important, in your view) to commence immediate implementation) … to rank some of the above statements in your perceived order of effective, easy ways to reduce car use. Place numbers 1 – 10 (10 scores highest) in the left-hand column, ranking your top ten contenders to commence implementation." The resultant score is simply the tally of points given to each statement.

As with the public, Table 5.6.2 shows that experts perceive that a sense of safety is a very high priority to encouraging non-car urban travel. Experts believe that improved non-car infrastructure will legitimise walking, cycling and the use of public transport. Assertive development of nodes, at the ' human scale' linked to residential land use is important to reducing car use, along with clear bus information at bus stops and more continuous walking and cycle paths, with problem areas identified by users or potential users. Linking registration fees directly to car use through fuel pricing is seen as likely to discourage some car use, as are price signals in general. These were seen as some of the more important, easy and effective immediate implementation strategies to help the public reduce our car reliance.

Table 5.6.2 Summary scoring of planners for implementation of effective, easy ways to reduce car use

Statement	Number of respondents	Score
Ensure conditions which make walking, cycling and public transport use feel safe.	9	57
Create better walking, cycling and public transport infrastructure to help legitimise those activities.	10	55
A mix of responses is needed to reduce urban car use.	6	49
More assertively implement nodal development linking residential land use with proximate usual destinations.	7	46
Aggressively move to close the gap between policy and provision of non-car infrastructure.	5	45
Provide detailed route and times at each bus stop to help people identify and catch their required bus.	5	37
Facilitate walking and pushbike use through greater continuity of paths.	6	36
Pay proportionate registration through fuel price, financially rewarding low car use.	6	32
Encourage an understanding of environmental and dollar savings by making discretionary journeys outside the peak times.	5	30
Make city centres and urban nodes more people oriented, at the ‘ human scale’ , with mixed land use and pedestrian zones.	6	26
It will take substantial infrastructure and pricing changes to make a great deal of difference.	5	24
Facilitate walking and pushbike use by asking users or potential users to physically identify problem areas.	4	24
Encourage public figures within the political process to lead by example, a move towards more trips that are shared with others, rationalised, or made by walking and cycling.	4	24
Constrict fringe growth by charging full service provision and infrastructure upgrade costs to fringe developers.	4	23
Encourage working from home one or more days a week where possible.	3	23
Safety must be addressed for all non-car modes.	3	22
Encourage and facilitate the meeting of as many needs as possible in the neighbourhood or a near node.	4	22
Develop interchanges where drive, cycle or walk to a bus or rail terminal is facilitated.	4	22
Use social marketing to help link environmental concern with car use reductions, especially during peak hour.	3	21
Encourage major employers and schools to consider staggered start and stop times to disperse the extremes of the morning and evening peaks.	3	21
Much meaningful car reduction is unlikely until significant cost increases for car use.	5	20
Socially market bus use, walking and cycling as ‘ normal’ .	4	19
Make urban areas legible, easily ‘ read’ and understood, and permeable to non-motorised travel.	3	19
Increase parking charges for commuters.	6	19
‘ Soft’ changes should be implemented ahead of demand.	3	16
Minimise further facilitation of car use.	2	16
The Internet can act as a clearinghouse to link people at the local level with demographically similar people, home locations, destinations and travel times.	2	16
Encourage schools to help organise car pooling for staff and students.	2	16
Encourage employer-promoted alternative transport plans, such as ride sharing, bus or cycle use.	2	15

Table 5.6.2 (continued) Summary scoring of planners for implementation of effective, easy ways to reduce car use

Statement	Number of respondents	Score
Develop 30KPH traffic calming in the city centres, helping make the pubic transport speed competitive, and walking and cycling safer.	2	13
Encourage a legal protection for people who wish to ride share.	2	13
Develop traffic calming in pedestrian precincts.	2	12
Start the process of piloting urban rail along the existing southern route into Cairns.	3	11
Encourage schools to help organise group bike riding to and from school (bike trains).	1	10
Allocate light rail routes connecting the main nodes designated in the regions' strategic plans.	2	8
Provide a demand sensitive array of bus sizes, times and routes.	2	7
Facilitate walking and pushbike use (in the tropics) through greater shading and drinking taps.	2	7
Ride sharing needs to be seen as part of a strengthened social local or work network.	1	7
Looming fuel scarcity is likely to cause major fuel price increases within 10 years.	1	6
Encourage and facilitate legally sanctioned ride sharing.	2	6
Reducing overall urban car use is an environmentally sound goal.	1	5
Pay employees not to park in company-provided parking.	1	5
Develop a process where residents may indicate preferred bus times, routes and destinations to produce a map of bus demand.	1	3
Support social suburban nodes and networks.	1	2
Provide sub-offices at nodes for some central-place services.	1	1
I support facilitation of walking and cycling.	0	
Provide secure parking and showers for cyclists.	0	
In any implementation of light rail, special attention needs to be given to noise.	0	
Facilitate neighbourhood socialising through neighbourhood houses.	0	
Encourage planned multi-purpose trips through community service announcements.	0	
Encourage ride sharing through community service announcements.	0	
Encourage delaying discretionary trips through community service announcements.	0	
Support informal surveillance.	0	
Facilitate walking and pushbike use through driver awareness campaigns.	0	
Encourage use of a compressed working week, working four 10 hour days, spreading the peak	0	

Combining the above two sets of data, Table 5.6.3 was derived by listing the top ten easy, effective implementation strategies to reduce car use, and the equivalent level of agreement. Table 5.6.3 also lists the top ten statements according to their level of expert agreement, cross-referencing the two sets of results. By this method, for example, aggressive nodal development is 4th on the scale for immediate implementation, but only ranks 20th in how much the 22 responding experts agreed with that strategy.

Table 5.6.3 Comparison of expert agreement and priorities for effective car reduction strategies

Ranked most important to reduce car use	Statement	Rank agreement with statement
1	Ensure conditions which make walking, cycling and public transport use feel safe.	4
2	Create better walking, cycling and public transport infrastructure to help legitimise those activities.	3
3	A mix of responses is needed to reduce urban car use.	2
4	More assertively implement nodal development linking residential land use with proximate usual destinations.	20
5	Aggressively move to close the gap between policy and provision of non-car infrastructure.	10
6	Provide detailed route and times at each bus stop to help people identify and catch their required bus.	6
7	Facilitate walking and pushbike use through greater continuity of paths.	1
8	Pay proportionate registration through fuel price, financially rewarding low car use.	42
9	Encourage an understanding of environmental and dollar savings by making discretionary journeys outside the peak times.	19
10	Make city centres and urban nodes more people oriented, at the ‘ human scale’ , with mixed land use and pedestrian zones.	9
12	Safety must be addressed for all non-car modes.	5
16	Facilitate walking and pushbike use by asking users or potential users to physically identify problem areas.	7
18	Develop interchanges where drive, cycle or walk to a bus or rail terminal is facilitated.	8

Table 5.6.3 shows that, according to polled experts, a mix of implementation responses from existing policy should be aggressively pursued to reduce car use by providing a greater sense of safety and, with user input, continuity of paths. There should be clear signage at bus stops, price signals and links between price and environmental impacts. Nodal development should be assertively pursued, pitched at the ‘ human scale’ while including full interchanges between travel modes. The tables in Section 5.6 provide a condensed depiction of expert opinion late in the year 2000, a clear consensus on the ways and means of reducing car use, further discussed in Chapter 6.8.

Chapter 5 shows similarities between the two provincial cities under study and a convergence of views from the public and planning experts in the need for, and ways to reduce car dependence. Chapter 6 provides a discussion of the results, with comparisons between the North Queensland outcomes and similar survey work reported in the literature.

Chapter 6
Moving toward more sustainable urban travel

This thesis would be a largely theoretical and hypothetical document, except for overwhelming evidence that the peak global production of petroleum will occur within ten years. The period leading up to and beyond this peak of petroleum availability is likely to render overwhelming change to mobility and food provision. With about 85% of Australians living in an urban setting, this will manifest as a largely urban issue.

This research set out to understand current urban travel, detailing travel, values and beliefs about the future in a way not done before. The composite picture is of householders generally fully car dependent, self aware and accepting of that dependence, but with a clear environmental concern. The key issue for 2001 and beyond is closing the gap between policy and individual behaviour, with this research helping to show an implementation sequence preferred by the public and planners. Broad sustainability policy is now firmly in place. The next and crucial step is to develop urban structures and link individual behaviour to overall preferences of policy for less car dependence, using results from this survey of acceptable and preferred change.

The prior five Chapters have set the context and provided the data for this final Chapter, discussing urban travel issues and exploring the implications of this work. The main outcome is that policy, the public and planners all see the need for car reductions. This work shows that planners see a strong need for accelerated implementation of current government policy.

A model linking internal and external space (values and infrastructure) to price signals has been constructed, forming the anchoring point of this thesis. This model provides a framework of theoretical meaning and explanation for the research results, as well as a practical guide to the preferred direction in urban planning, travel structures and behaviour. After describing the outcomes of hypothesis testing (Chapter 2.1), this Chapter provides discussion of Cairns, then Townsville results, before discussing their

synthesis, and synthesis with the literature. The discussion uses relevant literature to allow for generalisation of the results, reinforcing and extending our understanding of acceptable ways to reduce car use. Most of the authors cited in this chapter have arrived at socially sanctioned strategies to reduce car dependence. Their findings are discussed and used to reinforce many of the outcomes from the North Queensland study.

Fuel prices will eventually cause conflict between transport convenience and affordability. This will place alternative urban travel, widely canvassed in the literature, at a relative advantage. Respondents in the North Queensland survey supported the idea of alternatives to car use in future urban travel, generally imagining a less car dependent future. The overwhelming outcome from the literature and the survey is a stark gap between the environmentally preferred behaviour and our actual behaviour.

It is now acknowledged that more sustainable urban travel will be achieved by a combination of engineers, urban geographers, planners, politicians, central government policies (Troy 1990) and public involvement. More sustainable urban travel will be achieved by acknowledging physical constraints of fuel supply, finite urban boundaries and clear visions of what may or may not work to meet a fundamental human urge to move around our landscape. More sustainable urban travel will be achieved by listening to the actual public input contained in documents such as the following discussion.

Neither average income, age nor education played an active part in generalisations made at the zonal level of analysis. Others (Troy 1982, Curtis 1996; 58) have also found that urban mobility appears to be independent of education or income (Rouwendal 1996; 9), apart from the very poor (Turton and Knowles 1992; 84), who are considered to be among the 'transport disadvantaged' (Town 1980).

Analysis of results clearly shows that there are statistical differences between zones. Although not yet prevalent in the literature, authors like Turton (1992), Sheppard (1993; 93) and DBIRD (1995a) refer to zonal qualities of cities as a basis for research

and analysis. It is hoped that results from this urban geography methodology will prove attractive to future urban travel researchers. Statistical tests also indicate that the samples from the three zones are representative of the full population of the nine collector districts included in the survey. Using Collector Districts as the primary unit of sampling has proven to be an effective sampling methodology, allowing comparisons with Australian Bureau of Statistics data.

The main publicly perceived strength of cars is convenience, leaving other modes less attractive in all but 10% of urban travel distances from the 3,500 recorded trips surveyed in North Queensland. A study of 42,000 households in the USA showed that 86% of their trips were conducted in private vehicles (Cervero 1996), comparable to the results from the current study of 80%. The US study also found a strong link between mixed land use and reduced car dependence, discussed under the heading of urban planning in this chapter. This chapter considers all urban travel modes, comparing theory, the literature and North Queensland responses, finishing on a projection into the future, including recommendations, conclusions and significance of this work.

A large part of this research explored how people thought and felt about issues relating to urban travel, including ways to easily reduce car use. Few (4%) of respondents suggested a rise in car costs. The impacts of increased fuel price on consequent use may appear contentious. This chapter identifies price signals as a core issue in urban sustainability, drawing on planning and economic literature to argue that substantial behaviour change away from solo car use will only occur after substantial increases in fuel price. This is despite high expressed environmental values. Increased fuel prices may bring further social problems for the mobility disadvantaged, or may foster better, cheaper public transport, which can also be used by the previously disadvantaged.

6.1 Hypotheses and the results

Hypotheses

1	People will report that significant increases in the price of petroleum would cause them to reduce their car use.
2	Outer urban residents will drive the most – distance from the Central Business district will largely determine fuel consumption.
3	Outer urban dwellers will be employment disadvantaged.
4	Price, convenience (closeness, frequency), comfort and safety are major issues of public transport patronage.
5	Shaded, safe cycle paths and walkways, suitable public transport, and encouraging car-pooling will be reported as ways to reduce private car use.
6	Vehicle use will be clustered by household location and composition.
7	Travel records will show that telecommuters drive less than commuters.
8	Respondents will report that deliveries of items and providing sub-offices of some central-place services will reduce car use.
9	Householders with a high environmental awareness (knowledge of resource depletion, personal impact on the environment) will use cars less than people who believe current travel patterns can continue indefinitely.
10	The largest single predictor of urban car use is the stage in the household life cycle (from young and single, young family, teenaged children, retirees).
11	Residents will generally report that home use of information technology along with small changes in service provision, knowledge and values are each likely to reduce private automobile use.
12	Respondents will tend to support the New Environmental Paradigm.

Hypothesis 1. Surveyed residents in North Queensland reported that rationalising trips, reducing unnecessary trips and better public transport would result from anticipated petroleum scarcity. People generally reported that significant increases in the price of petroleum would cause them to reduce their car use, although 45% indicated that they thought they would or could not reduce car use at all.

Hypothesis 2. The research found residents made an average of 3.5 trips per person on the day of survey, irrespective of distance from the CBD. However, the average trip length of solo car use was 5, 6 and 17 Km for central, middle and outer suburbs respectively, giving a moderate correlation of distance travelled to distance from CBD (R_S = .46, sig. = .0). On average, outer residents drove the most by a factor of three.

Hypothesis 3. It was hypothesised that outer urban dwellers would be employment disadvantaged. Results were inconclusive. The sample of outer residents included many who were retired (about 33% of total retirees in the sample) or in the building trades (40%), associate professionals (eg nurses, teachers aides, 42%) or production

and transport (42%). The only transport disadvantages experienced by outer residents was the greater travelling distances, with the obvious fuel costs per household ranging from $22 through $30 to $39 from inner to outer, with modes of $10, $20 and $40 respectively. With poor outer urban bus services in Townsville, teenagers from those areas are clearly transport disadvantaged.

Hypothesis 4. Although it was hypothesised that price, convenience (closeness, frequency), comfort and safety would be major issues of public transport patronage, in fact reliability was the most common concern for about 30% of respondents to bus questions. Price, a sense of danger (especially in Cairns), and perceived inefficiency were issues of concern.

Hypothesis 5. The survey results show that the public believe that shaded, safe cycle paths and walkways, suitable public transport and encouragement of car-pooling may all help reduce private car use. Results also indicate that high prices for car use are the only likely impetus for widespread reductions of car use. Within that context, it was found that safety is the primary concern for cycling, followed by the positive of exercise and the deterrent of the weather. These outcomes were similar for walking. Inducements for walking and cycling, according to surveyed planners, include continuity of paths, and legitimisation of the behaviour by improved infrastructure. In the model for change presented in this chapter, perceived safety is important for sustainable urban travel. These issues are developed in the discussion of travel modes in Section 6.5. Safety stands out as a major incentive to continue using a car.

Hypothesis 6. The hypothesis that household location and composition (age and type) would largely explain levels of vehicle use only proved true for location (distance from the CBD). About 20% of inner urban households did not own a car, whereas few of the middle (3%) and none of the surveyed outer urban households were without a car.
Hypothesis 7. From the sample surveyed it is not possible to generalise if telecommuters drive less than commuters. Only 2% of respondents suggested working from home as a way to reduce car use, and only 8% supported the idea when directly prompted. Hypothesis 8. Home delivery of items was suggested by only 4% of

respondents, while providing sub-offices of some central-place services was virtually unidentified as a way to reduce car use.

Hypotheses 9 – 12. Despite exhaustive statistical tests, householders with a high environmental awareness (knowledge of resource depletion, personal impact on the environment) did not seem to use cars less than people who believe we can continue current travel patterns indefinitely (see also Goudie 1995). Most people used cars for most journeys. Hypothesis 11 was not supported by the research. Respondents did not reflect a strong latent desire to drive less if small changes made it easier to stay home more often. As shown by earlier research, people generally displayed the beliefs and values of the New Environmental Paradigm (Hypothesis 12).

An assumption tested in the questionnaire design was that household location choices would differ according to the three distinct distances from the CBD. This was found to be true, with inner urban more focused on proximity issues, middle on proximity and price, while outer seemed most interested in block size and being in a more natural setting. A study reported by Curtis (1996) on household location choices near Oxford, England, found accessibility to the workplace was the strongest criteria of residents considering a change in household location (p60).

Hypotheses and the literature

The majority of respondents reported that significant increases in the price of petrol would cause them to reduce their car use (hypothesis 1). Among Westernised nations, where the real price of petrol differs by a factor of four, Schipper *et al*., (1993) report a clear correlation between petroleum costs and per capita distances driven. Fuel price as a central determinant of travel behaviour is developed in Section 6.6.

The Cairns/Townsville urban travel research rightly hypothesised that total car travel would correlate with the distance from the Central Activity Area (Davidson 1995, Pucher 1995), so that, on average, outer urban residents drove more than demographically similar, inner urban residents (Ryan and Mc Nally 1995). This (normally unstated) assumption of greater distances travelled also underscores much current urban policy and theory in planning, urban renewal and medium density housing (AMCORD 1995, AURDR 1995a).

Current urban planning theory includes the belief that outer urban residents are employment and ‘transportation disadvantaged’ (Newman and Kenworthy 1989, p6), often making it harder to escape the poverty cycle, as travelling to work is sometimes impossible without use of a car (DBIRD 1995b). The Cairns/Townsville urban travel research did not find a zone-based poverty connected with restricted access to employment. Indeed, self-defined unemployment dropped from 7 through 5 to 3% from the central to the outer zones. The larger group of unemployed had the highest proximate access to employment and service opportunities. This is probably because older, low cost rental accommodation is most available in both inner cities.

Most of the hypotheses were confirmed, displaying car dependence linked to distance from the CBD. Most results conform to findings from other research, with the exception of employment disadvantage, which, in the subject cities, did not increase with increased distance from the city centre.

The next section provides a theoretical discussion and framework for this research, advancing our understanding of the links between context and behaviour. This helps to understand urban travel choices and preferred developments. As established in Chapter 1, we are not entirely rational, and our behaviour is influenced by many factors. The following section provides a framework

6.2 Theory and model development

Development of this thesis lead inductively to the model (Figure 6.2.1), attempting to explain the link between values, beliefs, infrastructure and the ‘context’ of Stern *et al.* (1995). Financial considerations are among the three main determinants of home location choice and costs are placed in the top three perceived weaknesses of car use. Thus the model places human urban travel behaviour at the intersection of internal and external space and price signals. This research has shown that home choice profoundly affects consequent urban travel, with outer urban dwellers averaging two to three times the trip length of their more central counterparts. Questioned on ways to reduce future car use, 4% of respondents suggested raising the costs of operating a vehicle, then often added variations of “but please don’t.”

The literature shows a non-linear link between fuel price and car use (higher prices cause less use), but substantial fuel price rises alone will not produce substantial change. Infrastructure changes are also needed, along with restrictions on car use to draw people from cars to alternatives. Surveyed experts in late 2000 placed the need for a mix of responses in the top three of 55 statements relating to more sustainable urban travel. A conclusion of this study is that only fully pricing automotive fuel incorporating all external costs, thus greatly increasing the motorists' costs, will profoundly alter urban travel behaviour (and land use). With the peak of petroleum production likely within 10 years (Campbell and Laherrere 1998, Williams and Collins 1997), the primary economic dynamics of supply and demand (Tientenberg 1992) will boost fuel prices, apart from any consideration of wider environmental or social cost.

The following model is placed within this context: increased fuel cost is a given. Behaviour is unlikely to greatly change until fuel prices induce change, but planning for that change has long lead times, a good theoretical rationale and the research knowledge base provided in this thesis. Much of the discussion in this chapter uses the model as the framework, providing a unifying structure and setting the scene for conclusions and recommendations.

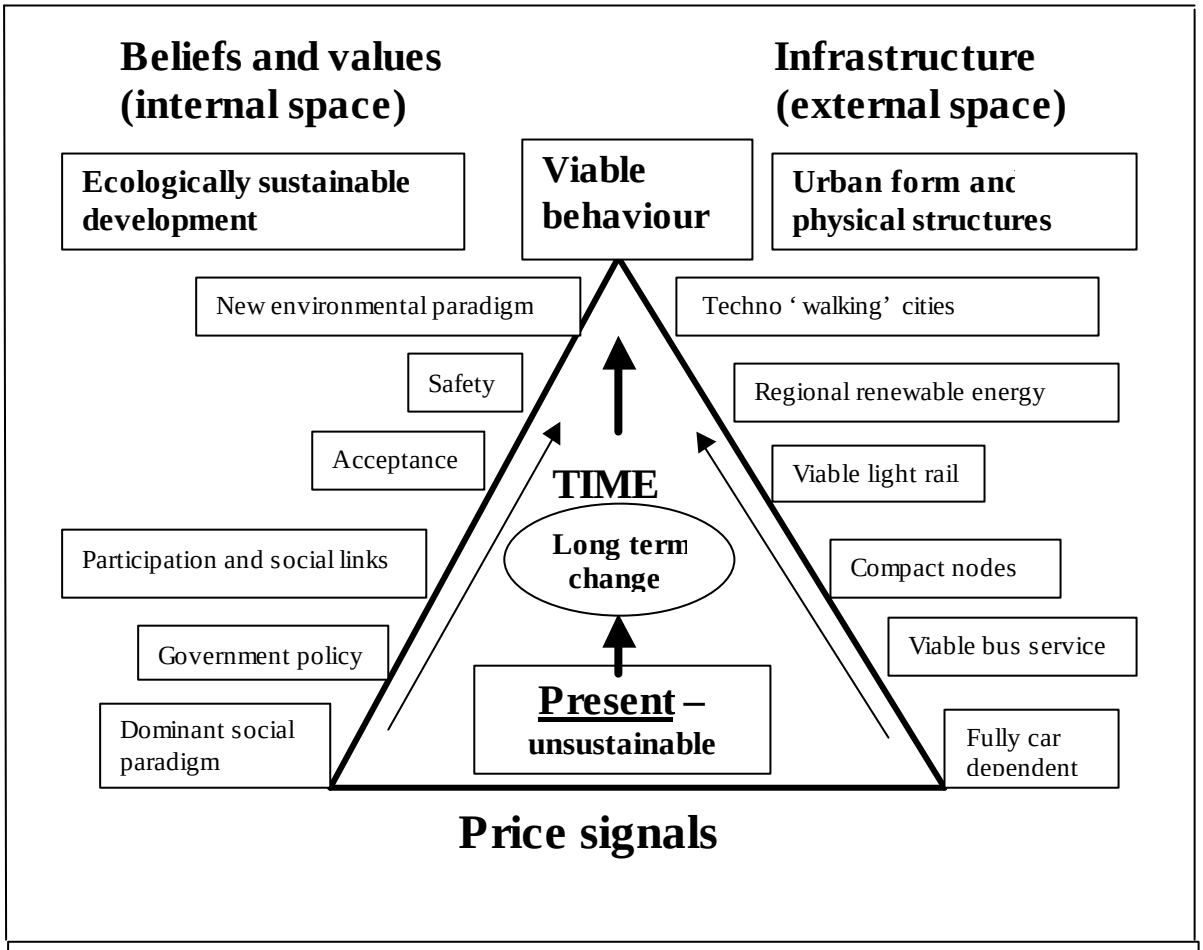
Model theoretical context

Theory of humanity's position in nature has long intrigued geographers. In 1921 de la Blache wrote of humans as a factor in the environment, part of the terrestrial unity (de la Blache 1921 in Agnew *et al.* 1996). Use of critical science techniques, rather than positivism (Johnston 1997) helped develop the methodology leading to this *a posteriori* model, supporting the use of a somewhat open-minded, heuristic or inductive approach to human behavioural research. Humans are not the normative automatons of the positivists, but the responding organisms within the context described by Stern *et al.* (1995) or Kitchin (1996).

The model of Figure 6.2.1 sets out to reposition humans into a refined urban landscape within the context of reduced petroleum use, underscored by environmental concerns over greenhouse gases. Respondents to the survey section on environmental values showed a deep appreciation of the need to operate sustainably within natural systems,

also expressed in the policies of greenhouse gas reduction (eg Alderson 2000). Use of the model will help reduce the 12% of Australia's total greenhouse gases released by private vehicles.

Figure 6.2.1 Developing more sustainable urban travel – closing the gap between policy and practice



Outcome of sustainability price signals: reduced car dependence with local meeting of most needs, especially energy and dense multinodal development linked by rapid rail.

The model

The following sections methodically consider a summary of theory and research, providing substance for the model for changes in urban travel (Figure 6.2.1). This discussion first considers each of the steps (in boxes) of internal space (beliefs and values), then, working from the perspective of infrastructure or external space, moves through the steps from near-full car dependent infrastructure to a more sustainable mix of safe, attractive alternatives. The discussion is informed by relevant North

Queensland results, making this section the pivot of the theoretical content of this thesis. This discussion then considers the convergence of policy, theory and public input about more sustainable infrastructure – the physical facilitation to meet community needs and how they may influence urban travel behaviour.

The model of Figure 6.2.1 outlines the stages needed to close the gap between policy and wasteful aspects of current behavior. Although much more complex models could be built (Aspinall 1992), changing urban travel requires the three-way advance from the dominant to the new environmental paradigm (see Chapter 1.4). The model must also incorporate all external costs (infrastructure, health, pollution and future value of depleted resource) in car use, and develop an infrastructure catering for other modes while dissuading greater car use. The accepted value system of sustainability requires moving from the present unsustainable structures and behaviour through long term change to more viable behaviour. The encouraging result from the Cairns/Townsville urban travel research is that most people seem to have the environmental mind-set of the new environmental paradigm. Studies in Toronto have found similarly high environmental concern and awareness (Haywood 1994).

Issues of public participation are developed in Section 6.9. Public participation in decision-making may be seen as part of a wider community strength of strong interpersonal relationships through social contacts (Schwirian *et al.* 1995). These stronger social contacts with neighbours were most displayed by outer urban dwellers in the Cairns/Townsville study, although they were the group with the most householders who wanted to move " closer" for travel related reasons. Consultation (public participation in decision-making) is seen as so important by sustainability theoreticians, it is now a necessary part of any ESD planning process, and thus placed in the model. As part of the ESD process itself, this thesis is presented in part as a document of public input, with financial support from Queensland Transport at the early write-up phase to produce detailed reports of findings for both study centres.

Acceptance of the limited fuel supply seems to be the final hurdle to reducing car use. As explained earlier, about half the sample felt car use would not become financially prohibitive in future. Concurrently, most planners, especially road builders, seem reluctant to slow the pace of road construction (see Davidson 1995). There are clear

energy conservation arguments to develop freeways to replace stop-start high volume routes, as has happened in Melbourne from the airport to the city precinct. Development of the infrastructure from car to walking, telecommuting, rapid transit routes linking high density and high activity nodes is a process now underway in some Australian locations.

Internal space – values and beliefs

As already stated, the move in Figure 6.2.1 from the dominant social paradigm to the new environmental paradigm has largely occurred. Section 6.7 outlined the policy shift to sustainability, while the planning literature is adamant about the need to reduce car use. The Cairns/Townsville results reflect the theoretical shift, where 75% of respondents rejected the concept of a high consumption, high waste society, with only 15% believing there were no limits to growth. Like the literature of other environmental awareness surveys (eg Stern *et al.* 1995), the current study shows that the intellectual paradigm shift has largely occurred in the subject sample. The Cairns/Townsville study shows environmental awareness and concern is essentially unlinked to behaviour, displaying internal dissonance or ' contradictions' of Jensen (1999), adding to the chorus of studies showing little if any link between attitudes and behaviour.

Like the gap between planning policy and practice, there is little evidence of behavioural change. Government policy is another subject of internal space. Policy for sustainability is deeply in place. Queensland, for instance, proclaimed the Integrated Planning Act in 1998 (IPA 1997), prefaced by detailed ESD criteria (excluding the precautionary principle). All major planning documents in Australia have been prefaced by support for ESD principles since the mid 1990s. ESD practice remains largely elusive, hence the model is subtitled: ' closing the gap' .

Kitchin points out that not everyone behaves in a spatially rational manner (p59), an assertion heavily supported by the Cairns/Townsville results. Some people seem to drive with little planning or concern for repetitious trips that rudimentary planning would reduce. There is a moral element to environmental and resource depletion,

encapsulated in ESD as the rights of nature (protecting biodiversity) and the rights of other people (including non-car users – intra and inter generational equity).

The behaviour-environment model developed by Kitchin includes human cognition (internal space which processes raw signal perceptions through the senses from the external world), combining 5 theories of cognitive maps to develop a schemata of spatial thought and behaviour. Figure 6.2.1 draws on Kitchin' s work of synthesis to explain our present urban travel situation and point the way, through internal and external change, to achieve more sustainable urban travel. Public information is not in the model, because awareness of most of the issues already exists in the community. Information itself has little direct impact on attitudes and behaviour (Walmsley and Lewis 1993).

Acceptance

Part of the suite of issues needing acceptance is the full cost of various urban travel modes, where life cycle analysis (IEA 1993) shows that some higher initial costs will reap long term economic and environmental benefits. The British government has accepted the basic need for transport change, aiming, for instance, to quadruple bicycle use in urban areas (Hamer 1994). Acceptance of change, which may involve less convenience, seems difficult, but the need rests on acceptance of pending fuel shortages or substantial price increases.

At the time of survey, the notion of limited fuel resources was presented as a 60 year time frame for depletion of recoverable reserves. The presentation of peak, then diminishing petroleum production has only been disseminated widely since 1998 (Campbell and Laherrere 1998). Even so, the most common response to the question of petroleum reserves was that it would be depleted within 60 years. There is a general acceptance of the finite nature of petroleum. The time frame is outside most respondents' life spans, and there is the widespread belief that replacement fuel will fully substitute for petroleum.

Many in the Cairns/Townsville study were aware of the impact of their car-based urban travel: "I acknowledge that too often single occupant trips are made. This creates huge

demand on resources including road maintenance, and creates unacceptable levels of pollution levels" (Householder 101), or "At the moment we travel for our own convenience. I hate driving, and try to drive as little as possible. Most travel is not for pleasure, but for general running of household and business" (Householder 106), many respondents in turn see ways to reduce their own car use: "Walk and ride a bike" (Household 105), or "More planning of trips to reduce mileage" (Householder 415).

There is little evidence of self-induced behavioural change to more benign urban travel. A study of recycling behaviour shows some indicators of pro-environmental behaviour acceptance and change, prefaced by behavioural intent to change (Taylor and Todd 1995). There was little evidence of that intent for behavioural change among the 408 main north Queensland respondents. Their behaviour raises a deeper issue that may be moderating urban travel choices: subjective norms.

Changing subjective norms

Although the major recorded perceptions of walking and cycling in Cairns/Townsville were of healthy exercise, but dangerous, there may be a perception that these behaviour are not socially sanctioned. This may be partly true of bus use. These behaviour may be outside the current social normative values, mainly undertaken by school children, pensioners and the unemployed. Cairns householder 422 wrote: "Tourists, school children and lower income families tend to use public transport. Middle class families tend to have two cars (his 'n' hers)".

More benign urban travel may have an image problem, such as arriving hot and sweaty from a cycle ride to work. An integrated approach to sustainable urban travel will develop shower facilities at main destination points. Another form of urban travel, ride sharing, was seen as losing independence, but there may be procedural obstacles in using buses or ride sharing. Kearney and De Young (1995) suggest that a lack of 'how to' knowledge (as with recycling) may be holding people back from ridesharing. This form of procedural knowledge is developed further in Section 6.5, dealing with travel modes. Regular ride sharing requires a close conjunction of route, destination and travel times and a sense of dependence and inconvenience absent from solo car use. A normative shift to ride sharing for work and school children is intellectually supported by many respondents, but is not often matched by behaviour.

Having made choices about their home location for proximity, lifestyle or cost (Section 6.12) people then choose their travel mode or modes among those available or possible for them. The central outcome of thesis research is that people place convenience and cost above environmental concern. Rendering the shifts in travel modes asked of by theory and policy is unlikely to happen without a suite of price signal changes and changed urban form (Witherby 1996). As things are, "the more spread out, the more driving." (Householder 107).

The final step in the model for internal space change to enact the New Environmental Paradigm is to address the issue of safety. Many people are generally unlikely to walk or ride bikes while perceptions of those modes rank safety as the second main issue, after acknowledging those non-motorised modes are healthy and good exercise. One quarter of surveyed South East Queensland cyclists reported having at least one crash on their bicycles (MCR 1998). Safety and its perception need to be fully addressed. "I can't see it changing until personal safety is assured - I wouldn't go walking with my family at night" (Householder 111). The next section considers the external space, and the intimate effects on travel choices. Because car use has allowed unprecedented urban travel, it is difficult to imagine a satisfactory urban form with low auto-reliance.

External space – infrastructure

Infrastructure falls within theoretical concepts of structuration (our organisation of the physical environment) developed by Gidden in the 1970s and 80s, and by Walmsley and Lewis (1993; 136). This, along with price signals is the context within which our travel decisions are made. As described earlier, about one third of Cairns/Townsville respondents felt strong links between urban design and necessary car use. Householder 409 commented on those links: "A great deal. We all move into the suburbs before public transport is provided. Only when the population increases is public transport provided. Unfortunately by then the car has been entrenched as the prime form of transport - thus we drive nearly twice as much as necessary. However, Canberra is an exception, as much thought and care is given to this in the ACT."

Current car dependence

Ninety percent of the 38,000 Km recorded in the travel diaries of over 1,000 participants in the Cairns/Townsville record of 3,500 trips were made by car. Cars are the overwhelming transport mode of choice, or necessity, given other contextual issues, like home location choices. If we are undergoing a paradigm shift which translates into changed behaviour, such fundamental conflicts as those expressed by Householder 106 must be resolved: "I live in Nth. Cairns/city, but travel out to the suburbs because of lack of parking in the city".

Car-based infrastructure is not just the roads. The car industry, globally, employs the largest number of people, has the highest advertising expenditure, highest accidental death rate and the greatest single contribution to global warming (Newman 1999). Newman and Kenworthy are among many, including most North Queenslanders, who recognise the unsustainable nature of our deep reliance on the automobile. Newman and Kenworthy (1989, 1999) strongly advocate use of light rail to help engender permanent, viable nodes.

Viable bus service

The basic conflict between the use of buses, light rail or trains is unresolved, but there is an increased theme through the literature that planning is necessary to provide for future use of either mode. There are authors who advocate buses as being more flexible and cost effective (see Section 6.5). People of Cairns/Townsville tended to see buses as unreliable, not very attractive, although about 10% supported the idea of buses. Buses were available, used and appreciated by outer urbanites in Cairns, but not Townsville. Only about 8% of respondents used buses more than once per week. Ninety percent never or virtually never used them.

Within the model context, the bus service is barely viable because the ubiquitous car is more convenient, reliable and conforms to the norm. However, 56% of respondents cited better public transport as a way to help reduce car use. Buses are seen as more efficient but generally unattractive. There is public concern over environmental damage, there is awareness that car use is likely to decrease in future, and there is acknowledgement that greater public transport use will reduce car use. According to

interviewees, developing an attractive public transport system is a necessary infrastructure step toward sustainable urban travel.

Nodalism, modular settlement or Activity Centres

Issues of urban density and ‘ Nodalism’ (here defined as development of designated growth and urban consolidation nodes, with high density housing, meaningful employment, recreation and education access focuses on well-defined, concentrated centres. Ideally, nodal centres are linked by attractive rapid transit), contrasting with the ‘ donut effect’ of aging and abandoned car-based city centres have all received much attention in planning and policy literature (eg Troy 1995, Curtis 1996, TTSP 2000). Considering the nodal meeting of needs, it is interesting that nearly all the 13% of respondents who did not own a car live in the inner city. This strongly supports the Newman and Kenworthy hypothesis that density and proximity to usual destinations largely remove the personal need for a car.

For most residents, however: “You have to own a car to live in Cairns [or Townsville] comfortably.” (Householder 102). A viable bus service has been placed next on the sustainable urban travel infrastructure hierarchy of the Model because buses are more flexible and cheaper to set up than rail. There is scope in either case for park and ride: “Large cheap/free parking lots on edge of city centre to park there and then have frequent very cheap (all day/ weekly/ monthly)/ free city travel by public transport.” (Householder 611).

The arguments for compact nodes are well developed in the planning and policy literature reviewed in this thesis. The basis for future growth in the Townsville region in the strategic plan is explicitly node-based, with the old CBD retaining central-place functions, but with three further designated nodes, and 12 designated subnodes. This may still seem theoretical to many residents, as it was rarely mentioned in written responses. This lack of public understanding may encourage some public explanation as to the larger benefits of nodal development, expanded and explored in Section 6.10.

Regional renewable energy sources

Because this thesis is largely focused on behavioural issues, the inclusion of local renewable energy sources as a necessary part of long term sustainability requirements is to provide a comprehensive planning picture. Ensuring that low impact energy is captured and stored as near to the point of use as possible (solar farms or dispersed solar collection from roofs, wind generators, energy storage) is to reduce transmission or transportation losses. Also, it will help psychologically to understand that unlimited amounts of energy do not just come from 'somewhere' (Goudie 1992). For a transport system to be sustainable, the energy sources, definitively, will need to be renewable.

Viable light rail

After a high initial cost, energy efficient light rail is highly effective for the bulk movement of people (Newman and Kenworthy 1999), and has a strong influencing role on preferred nodalism. With the relative permanence of light rail stops, business catering for people travelling from the stop to or from home can develop with some sense of certainty. North Queenslanders generally supported the idea of light rail. Because it would be introduced into an urban setting unused to it, special attention would need to be given to the noise factor: "The [Cairns] northern beaches and southern development (Centenary park etc) is a linear development and may be a good idea. The established [sugar cane] tram system will have to be upgraded to suit smaller, faster trams - more noise, safety, tram crossing/road frequency. Turn the old tram track routes into walk/bike path recreation paths." (Householder 410)[1].

Just over 50% of respondents supported or strongly supported the idea of light urban rail in Townsville and Cairns, with a few respondents noting that a north-south heavy rail track exists through both cities, once used for commuters. The choice for bus or rail infrastructure is difficult and the literature debate quite fierce. As Edwards and Mackett (1996) point out, it is often irrational and political. Their analysis tends to support bus use in most cases.

[1] This written response alone shows the advantages of open-ended responses to 'tick the box' type questionnaires. Such questionnaires cannot derive a range of responses not already known to the researcher.

Techno-walking cities

The term ' techno-walking city' is coined to underscore a developed nodal city which includes the use of the internet to link some work functions to homes (telecommuting) or nodal computer centres, and to link people with ride-sharing or flexible bus pick-ups. The idea of techno-walking cities is more than a nostalgia for the pre-car compact city. The techno-walking city embraces nodalism, rapid and frequent cheap transit between nodes, telecommuting, feeder systems from the fringes to the nodes, and a lot more cooperative ride sharing, reduced need to travel and more rationalised trips, as the delayed travel need builds into planned urban travel action. These themes are developed in Sections 6.12 and 6.13. The one single greatest response to increased fuel prices imagined by Cairns/Townsville respondents was greater use of an improved public transport system. Along with more attractive public transport, respondents saw the need for more (and safer) walking and cycling paths, something that is relatively inexpensive and environmentally benign. Although there is a Cairns cycling strategy, it is under-funded, with plans for improved and contiguous tracks projected many years from implementation. Householder 122 wrote: "Make more bike lanes away from the roads. New subdivisions should be made to include separate bike lanes. Many people will not ride bikes with the current road system."

Mixed land use, some quite elegant (DBIRD 1995b) is seen as a necessary part of urban sustainability in the planning literature. This was recognised by some Cairns/Townsville respondents as a need for planning change, such as Householder 905: "I can see suburb design getting better for people who are not driving. I think a lot more could be done. Eg: designing suburbs around shopping areas, schools, sporting areas and bus transport terminals with access to the city (like a spider' s web)".

The final section of 5.3 shows that about 7% of the Cairns/Townsville respondents called for urban villages or nodes, 6% for planning changes and about 3% suggested mixed housing, showing that some were intuitively or actually aware of current planning trends. Integrating residential and employment land use is supported right through the literature (eg Gilbert *et al.* 1996, Ryan and Mc Nally 1995), a distant concept to the zones of dormitory suburbs and remote industrial areas of recent planning.

This section has shown a strong alignment of policy, paradigm shift and perceptions of urban infrastructure within a model for change derived inductively from the research; suffused with influence of price signals. A gap has been identified in the public perception about looming scarcity of transport fuels, and indeed that ' denial' is evident by its absence, except within technical reports (eg Williams and Collins 1997). Until that acceptance enters the public domain, and looming or actual price rises are blatant, it is unlikely there will be any major shift of behaviour through the hierarchy of internal and external change, although most of the internal changes are in place. The next three sections discuss the results, first from Cairns, then Townsville, and then the combined outcomes.

6.3 Discussion of Cairns results

This discussion explores outcomes from the Cairns research, finding a strong match between public opinion, as indicated by this research, government policy and theories of sustainable urban development. About 17% of inner urban households, mainly young adults, did not own a car. All mid and outer urban households did own at least one car. This reflects the inner urban land use patterns, which were established before widespread automobile use. It must also be noted that there were more transient people located in the inner suburbs, with about 25% of households on $15 - 25,000 income per year (Appendix 7), some householders may not have been able to afford a car.

Bates (1981) noted that household size is a large determinant of overall car ownership, and the inner zone contained numerous one person households. The number of residents per household averaged 2.4 in the inner suburbs and was about 2.9 in the other two zones. This increased number of household occupants should be remembered when considering results at the household level.

The Cairns research displays a tension between urban density and consequent travel which has been clearly noted over an extended period in the literature (eg Bates *et al.* 1981). Although closeness to shops appears to have a profound effect on choice of commuter mode (Cervero 1996), that reason for home location in Cairns was nominated 6th. Outer urban dwellers use public transport the most in Cairns, paid for

inner urban parking most and owned the highest number of pushbikes per household, although inner urban dwellers used pushbikes the most. Outer urban dwellers, on average, travelled the greatest distances. With a survey-wide average of about eight kilometres for a solo car journey, outer urban dwellers averaged about 13 Km for solo car journeys.

Important travel destinations and car dependence

The 500 householders recorded 1,700 trips for the day of survey. They travelled about 11,400 Km. 10,200 Km (about 90%) was car travel. The destination categories were chosen from the literature (eg Pickup 1981), and all modes were included, a deficit of some earlier urban transport surveys, which excluded walking. On a superficial level, work was nominated by nearly two-thirds of respondents as their most important travel destination. Thus one might expect that their commuter trips would rate as their most car dependent destination, given that 89% of total distance travelled was by car. This was not so, except perhaps, for outer urban residents.

Principal components analysis indicated that people were the most car dependent for their weekly supermarket trip, and to socialise. The life-style changes facilitated by widespread car use (Davidson 1995) are reflected in the survey results. The pattern of low-density fringe growth and the resultant automobile dependence is well documented in the literature, certainly from the early 1980s onward (eg. Manning 1984, Kenworthy and Newman 1999).

Cairns travel details

The average trips per person across the three zones did not differ significantly. However the mean distances travelled rose markedly from inner through to outer urban dwellers, from 3.4 through 5.8 to 10.6 Km per trip. There is a fundamentally distinct temporal pattern of travel between the three zones. The reason most inner urban journeys occurred between 11 a.m. and 2 p.m. requires further study. If the 61 households surveyed from central Cairns are representative of that zone, inner urban dwellers do not contribute markedly to the morning and evening traffic peak.

Finding that the main travel time for inner urban dwellers spanned the middle of the day may prove to be one of the most interesting results of the whole study. As evening

electricity consumption rates dictate the number of billion dollar power stations required to meet demand (Goudie 1995), so the peak use of our road network drives the demand for further costly road infrastructure upgrades. The average travel distances for the outer suburbs were about twice that of the middle suburbs, about three times as much as the average journey for inner urban dwellers. Further, outer urban residents contributed most to the morning and evening peak and drove slightly more than half the total kilometres travelled by car. If these two features are combined, it indicates that outer urban dwellers contribute most to peak congestion. This finding is interesting because middle urban dwellers define themselves as more car dependent than outer urban dwellers.

All 318 Km travelled to convey children to or from preschool were done by car. This implies that there is a relatively full disconnection of home from choice of preschool centre. The convenience of cars is underlined when considering the transport of toddlers by any other mode. Of 44 scrutinised trips to Cairns preschools, 25 respondents returned straight home, 9 travelled on to work and 8 trip-chained via the supermarket to home from the preschool centre. This displays the way some people will plan trips to incorporate multiple destinations in the one journey. Further, children travelling to or from school were driven about 2.5 times the total distance as their counterparts who travelled to school by bus. This again underscores the convenience of cars and may indicate a progressive downgrading of the school bus system from all but the outer suburbs. Because of a relative disconnection between household location and school, private and public schools can draw students from throughout an extended urban catchment, from a mix of socio-economic enclaves unrelated to school locations.

Shopping generated about 40 Km of bus travel and 260 Km of car travel, substantiating the self reported perception that shopping was a very car dependent behaviour. Similar ratios were found for supermarket shopping, which totalled about 420 passenger Km. Socialising was almost exclusively achieved by car, often as a passenger. This also concurs with perceived car dependence. Solo car drivers, who travelled about 1,200 Km, dominated travelling to work by car. Such drivers make a major contribution to the morning and evening peak, and are thus an obvious target for any efforts to reduce those peaks.

Findings from this study that the 40 - 50 year-old males and females from the outer zone average the greatest trip distances may stimulate further analysis of the 1997 data or trigger a focused follow-up survey. This finding should be tempered by results which shows that the total kilometres travelled by 40 – 50 year olds on their return home was about 500 Km. As an indicator of overall travel, travel to home was also high (800 Km) for 30 to 40 year-olds from the outer zone.

Young adults from the middle suburbs tended to travel more than their more central or peripheral counterparts for social gratification. This may imply that catering for social and entertainment activities in the middle suburbs may diminish the need for those residents to travel so far for social purposes.

The next section considers bus use in detail, the first of the non-automobile travel modes discussed. At the time of survey, Cairns had a very low rate of bus use. Reliability was identified as a key issue in bus use in Cairns responses, although reliability was judged to be adequate in the block of bus use statements rated by respondents. This was perhaps one of only two anomalies (internal dissonance, see Lutzenhiser 1992) displayed in response to the long and complex questionnaire.

Queensland transport commissioned a report on 8 Queensland bus services during 1998 (Coory 1998), generating a phone survey of respondents over 16 years of age, including bus users, infrequent users and non-users. About 330 people were surveyed in Cairns. Discussion with the Consultant' s contact (*pers. comm*. S. Huf 22.10.99) showed the Likert scale used in the QT commissioned report was similar to the 5 point Likert scale used in the early 1997 Cairns study by Goudie, reported in prior pages (Appendix 7). Responses to most bus questions lay between neutral/average and very good/excellent.

Table 6.3.1 Perceptions of bus traits in Cairns, 1996 and 1998

Bus trait	N 1998	Mean 1996	Mean 1998[1]
Convenience	67	3.81	3.27/3.57
Reliability	74	3.11	3.26/3.14
Connections	70	3.10	3.36
Frequency/accessibility	75	3.31	3.47/3.44
Comfort	70	3.33	3.6/3.46
Speed	71	2.99	Approx. 3.48
Cost	72	3.13	3.39
Passenger information	71	2.51	3.38/3.33

[1] Coory 1998

In nearly all cases, Table 6.3.1 shows a slight improvement from 1996 to 1998, particularly speed (compared to ' overall length of trip time') from 3 to 3.5, and passenger information, jumping from 2.5 to 3.4. As indicated earlier in the text, the service was only running for a few months at the time of the first survey, and there was still some confusion among fledgling users, and some drivers. It was noted that safety was a recurrent theme in the 1996 survey, and it is interesting that safety was rated at 3.5 in the 1998 study, about midway between ' average' and ' very good, needs little improvement' . However, Cairns was nominally seen as least safe of the 8 surveyed services (Coory 1998, p13).

Current and future mobility

Cairns residents are quite aware of, and accepting of their car dependence. The freedom and convenience are very attractive. Many may not feel very comfortable with the urban sprawl made possible by cars, but the expanded choices of home location are well appreciated. Some respondents spoke of urban nodes, a concept supported in the literature throughout the 20th century (Stone 1971). Nodes are an attractive concept, and are now pursued in strategic planning in north Queensland (FNQ2010 1998 and TTSP 1998, 2000).

"Suburbs should be laid out with low and medium density housing, local shops, church, sport, parks, primary education and kindergartens accessed by closes, sub

collector roads, collector roads, sub arterials: ‘ A structured road system’ .”
(Respondent 410).

Even with rapid transit to new nodes around Stockholm, it has been found that people still travel chaotically between home and often distant employment (Cervero 1996). The designated nodes will further develop in relation to central Cairns (FNQ regional plan 2000), but home locations still seem largely disconnected from individual school and work sites. Few respondents considered access to public transport when choosing a home.

Canberra, discussed in Chapter 1.2, is based on the nodal template. The decentralised services reduce some travel, but there appears little linkage between home and work locations (King, pers. Comm. 2000). The rapid transit linking nodes provides most Canberra residents with a viable alternative to their car for commute trips, allowing them to separate home from work (seen by some respondents as desirable). Many other regular destinations are provided within the nearest node to home.

Cairns is clearly seen as an attractive place to live, although, as observed by some residents, expansion is constrained by topography. Problems with great congestion were noted and there was a clear support for better public transport, convergent with government policy and urban planning literature. People may say better public transport will help reduce their own car use, but that implied intent may not be reliable, without a package of incentives for alternatives to solo car use, and deterrents for solo car use (Hamer 1994).

Urban rail was generally supported in Cairns, particularly by members of the outer suburbs. There was recurrent written and verbal support for the idea of a monorail linking the northern beach suburbs, close to the coast, that would connect with the city centre. In future, more people may drive, cycle or walk to a bus or rail terminal, then mass transit to main nodes. This idea could be explored for the southern route into Cairns, where a rail line already exists. There was clear support for urban rail in Cairns. Initially avoiding infrastructure costs is possible by recommissioning the southern line to commuter use. Rail use is slowly reasserting in Perth, Melbourne (where, unlike most cities, the tram system was not decommissioned), Sydney, and, most recently, in Brisbane

with the linking of the airport to the city centre. Grounding the argument for rail use in Cairns, Respondent 417 wrote: "If Cairns can't make justifiable use of buses (which it can't), a rail network has virtually no hope."

Cycling in Cairns

A survey of cycle issues in Greater Nottingham (McClintock and Cleary 1996) detailed deterrents to resident's bike use. Top at 21% was danger, then congestion at 11%, fearing poor drivers at 7.5%, pollution at 5.5%, and the unchangeable: weather, at 18%. Although Nottingham is a compact city with a strong cycling tradition (socially normative), most issues raised in Cairns were similar. The equivalent weighted Cairns results were: 12% dangerous, congestion was not mentioned, poor drivers 7%, pollution not mentioned, weather deters 3%. Fifteen percent of Cairns respondents saw cycling as healthy exercise, and 11% as inexpensive. It is interesting that both studies found danger was the main deterrent to greater cycle use. Of further interest to Cairns cycling facilitators is that large roundabouts have been identified as 'cycle –hostile' (McClintock and Cleary 1996; 73). Respondent 502 thought that cycling was: "Great exercise. Theft of parts or whole of bike if left all day. Some cycle paths are potentially dangerous for school children, specifically: winding area along the De Jarlis Rd., which joins Toogood from Earlville."

To enhance cycling, money is needed to improve safety through improved routes and facilities (McClintock and Cleary 1996) and ongoing driver education. The final point on cycling is that there may be cultural deterrents (Turner *et al*. 1996) – it may be associated with childhood, or seen as something done by poor people. Establishing a full time bicycle and pedestrian manager (Dornfeld 1996), or a fully representative regional cycle committee (as has recently happened) may help facilitate and enhance the status of cyclists and their rights.

As this survey shows, safety is a major issue for walking and cycling (Wadhwa 1995). Poor paths and 'choke points' to cycling, along with fear of dogs are clear deterrents to cycling. If the urban planner's new strategy is to localise nodal development, linked by paths and public transport (TTSP 1998, 2000), the paths in the tropics may need shade where possible. About 5% of Cairns respondents avoided cycling or walking because

they were deterred by heat. The Cairns study has found that bike security at public transport stops was not a major issue. Cairns launched an integrated bikeway plan (Loder *et al.*, 1996), responding to an identified need during the process of developing the area strategic plan (FNQ2010 1995, 1998). Respondents in the urban travel study noted that paths were dangerous or non-existent in some important places.

People were asked about their perception of catering for the mobility of special needs groups. Respondent 707 wrote: "Lack of footpaths create difficulty for wheel chair user (wheel chair user)". Many who responded felt that taxis did a good job, but there were not enough ramps into buildings, or path crossovers. A group representing the disabled was approached in 1996 with copies of the survey form, but perhaps due to that group' s restructuring, no formal response was provided. Taxis seem to be the preferred option for vehicular mobility for disabled. Getting wheelchair users off and on buses was seen as too slow to allow buses to stay on schedule. Other written responses include:
"Very hard to use buses. Taxis can cater for specialised needs." (Respondent 412), and "I have noticed just with a stroller in the Nth Cairns area the lack of firm paths to walk along, and difficulty in crossing Sheridan St. On foot. (Respondent 106).

Ride sharing can only work for commuters who have similar home and destination locations or routes and similar arrival and departure needs. Car-pooling is supported in Cairns. Summarising some written responses: ' It will save money and reduce congestion, but people become interdependent. You have to rely on the punctuality of others, and there is some loss of free movement.'

Reducing travel need was given written support by 14% of respondents, planning trips was nominated by 6% as the first easy way to reduce car use. Planning or rationalising trips emerges as the least demanding and most acceptable behavioural change to reduce overall car movement. Discretionary trips, especially from the outer suburbs, appear to make a clear contribution to the peak commuter and school drop-off traffic. This could be addressed by subtle public education. Respondent 106 wrote: "Greater organisation within the household would cut down on the occasional car use."

This section has served as a summary introduction to the public survey results and discussion. Issues raised from the Townsville research are discussed next, followed by a synthesis of features raised from results analysis.

6.4 Discussion of Townsville results

Neighbourhood attachment, including one suburb on acreage, and travel details from the whole Townsville survey sample are compared with findings from other research. The great dependence on car use is reinforced and discussed on a zone and region basis. Discussion includes people' s reasons for choosing to live where they did and the implications for more sustainable planning embedded in those results (Katsof 1995, Mowbray 1995, Rose 1993, Schmidt 1995). Knowing people's main travel destinations is also discussed in the following section, along with people's perceptions of all modes of urban travel.

There were no real pockets of poverty in the nine collector districts studied. At the zonal level household incomes averaged about $35,000, with little difference in the average level of education, or the period living in Townsville. In these regards the representative CDs per zone produced reasonably homogeneous results.

Like most cities, much of the Townsville home building over the decades has radiated from the central area, generally proceeding toward the current urban fringe. There is some pressure and active debate about urban infill (Troy 1995), now occurring on vacant land close to the city centre. People choosing to live at particular distances from the city centre produced the following behaviour and reported views of their situation. Inner urban dwellers tended to use public transport more than outer urban dwellers, contrary to normal patterns and expectations. Fewer inner urban dwellers owned cars, and although many of their destinations were within walking distance of their homes, they still had a derived demand (Fox 1995) which, for public transport use, was mainly met by 22 seater buses which largely service Townsville.

Members of the outer urban areas under survey owned their own houses outright in 40% of cases compared with 20% for the more central areas. This may reflect the fact that retirees tend to gather in the quieter outer suburbs, and are at that point in their life

cycle where they could afford to purchase their property outright. One adult in 70 from Townsville's outer zone sample used public transport. At the time of survey such public transport was largely unavailable. At the time of writing that situation has changed slightly. For instance in Rupertswood in late 2000, there is a reliable but infrequent bus service.

The relationship of car ownership and distance from the CBD is stark, where car dependence generally increases with greater distance from the central activity area. Some have argued that the rights of car users has caused 'the rights of the non-car users to be largely ignored' (Blowers 1995; 115). About 20% of households in the more central areas had some bus use. Many argue (eg Curtis 1996) that urban form, household location and public transport provision are intimately linked. The findings of this research support that argument. The self-assessment of car dependence displays accurate self-awareness, where 21% of inner urban dwellers, 10% of mid and 1% of edge dwellers believed that urban mobility without a car would be relatively easy.

Neighbourhood attachment

The Rupertswood case study shows ' transport disadvantage' felt by people who chose to leave suburban living to live in the peace and quiet of the country on large park residential blocks (Section 4.3 and Map as Figure 2.4.3). Rupertswood households, out past the contiguous urban fringe, spent about $50 a week on fuel, while Heatley households, in the middle zone spent about $25. Many householders in Rupertswood wanted to leave because they felt isolated from some of the main travel destinations.

The case study of Rupertswood reflects some of the concerns of locational disadvantage, explored by such authors as Maher *et al.* (1992). Land use patterns and car dependence are intimately linked (eg. Black 1996) and the Rupertswood findings support the belief that acreage blocks remote from activity centres produce petroleum-dependent lifestyles.

These results are interesting from a survey methods perspective, because the written responses deeply contradict stated neighbourhood attachment via Likert scale statements. Likert scale tests showed little inclination of respondents to leave their suburbs. About 90 % of Rupertswood respondents disagreed or strongly disagreed that

"I would like to move from this neighbourhood" and 85% either disagreed or strongly disagreed that "*Considering travel time and costs, I/we would like to move from this neighbourhood"*. However more than 50% of householders in Rupertswood wrote, on further prompting, that they wanted to leave their suburb. For Rupertswood residents the overwhelming reason was one of mobility and access (Chapter 4.3). These results beg the question: is a Likert scale an accurate reflection of people's internal space, or do they just give a superficial response of what interviewees believe to be the 'right' answer, in this case displaying a loyalty to their suburb?

Since Dunlap and Van Liere (1978) developed indicators of neighbourhood attachment there has been some question about how fully people are in touch with their own thoughts and feelings (eg Fien 1993, White 1988). This study of neighbourhood attachment responses in Rupertswood shows internal conflict within individual respondents. There is an unexplained disparity between the responses on a Likert scale and the actual written responses concerning desire to leave their particular household location. The working hypothesis is that there is loyalty to their current location (and the initial decision to move there) as reflected in their responses to neighbourhood attachment questions.

The example of Rupertswood has shown the profound costs of urban travel associated with living on the urban fringe, and also the underlying discontent felt by the majority of respondents in that survey to their current location, articulating a sense of isolation and resented travel needs. Much of the urban stress research previously conducted (eg Schwirian *et al.* 1995) has considered the stress associated with high-density populations. This current study has shown that the opposite form of stress can also apply.

There are general trends in Townsville neighbourhood attachments that are zone dependent. For instance nearly 30% of outer urban dwellers strongly agreed that they visited their neighbours in their homes, about twice that of the two inner zones. The sense of community, and community discourse is clearly stronger in the outer suburbs. The filtering system which determines who lives where indicates that outer urban residents are more inclined to neighbourhood interactions than mid or inner urban residents. A further hypothesis is that there are greater interactions on the urban fringe

because of necessity, sharing gardening resources, providing a sense of security in these areas of relative isolation. The questions on neighbourhood attachment did show an overall neighbourhood cohesion. Most people talked to their neighbours.

Townsville travel details.

There were 1800 journeys recorded by 560 people, averaging about three daily trips per person, without much variation between the three zones. The average trip distance provided the great contrast between zones. It was about three Km for inner urban dwellers, five Km for mid urban dwellers and 19 Km for outer urban dwellers. Clearly it is not the number of journeys that is significant, it is the average distances of the journeys which is of importance for resource depletion and, indeed, infrastructure and vehicle maintenance costs.

If outer urban residents represent about 10% of the population, the weighted average trip length in Townsville was about 5.5 Km. There was an average of 3.2 trips per person in the sample. Generalising the results for the 120,000 people above 4 years of age, people of Townsville/Thuringowa travel about 2 million kilometres each working day. This is comparable with the 47 million vehicle kilometres driven each working day by 2 million residents of the Brisbane area (Queensland Government 1996; 8). With about 16 times the population, average Brisbane travel distances were about twice those of Townsville, where an average household made about 8 trips per day (3.2 trips per day by 2.6 persons per household = 8.4 daily trips per household), compared to about 10 per day in Brisbane (Queensland Government 1996).

Another point of interest from the Townsville travel details is that the middle urban dwellers had the most pronounced peak hour travel patterns, from 7 - 9 a.m. and 3 - 5 p.m. Analysis has shown that many of these trips were discretionary and that further expansions to road infrastructure could be delayed or deferred indefinitely by an active program to discourage discretionary use of the roads during peak hour (Ampt *et al.* 1985). It should be noted that there was a concentration of children of school age in the middle suburbs and their movements do explain the peak from 3 - 4 p.m.

Analysis by zone shows that buses were used least by members of the outer suburbs, cycling was done most often by members of the middle suburbs, while school buses were used almost exclusively by children from the outer suburbs. Bicycle use will be discussed in some detail while considering people's perceptions of each of the travel modes. Cycling accounted for about 5% of travel journeys but only 350 Kilometres of the total 16,000 Km travelled, about 2% of total distance. Motorcycles, suggested as a part solution to car dependence, only accounted for about 150 Kilometres of the 16,000 Kilometres of urban travel recorded by the 560 respondents. Taxi use was half that. Walking accounted for about 250 Kilometres. Cars dominated.

The reasons for urban travel varied across the zones. The largest single destination for the inner suburbs was social. This survey asked for Friday travel details, the time of the week when social activities are traditionally high. The dominance of inner urban social mobility may reflect the stated attraction of some of the respondents to live in the inner urban region because of the many public social destinations within a short distance of their homes. Shopping and supermarket shopping were also high on the destination list. More of the employed from the middle and outer suburbs travelled to dispersed employment than to work in the old CBD. Despite its historic role, central Townsville is no longer the primary focus of employment.

Analysis of age and destinations show the rather surprising result that both males and females in the 50 to 60 age group had the greatest average travel distances. Further analysis (Appendix 14) shows this age group in the outer suburbs tend to work as associate professionals, trades persons (dispersed work destinations), as advanced clerks, with home duties, or be retired. Their major destinations include shopping, supermarket or social.

There was some age stratification within the survey zones. There tended to be fewer children in the inner suburbs and a cohort of 50 to 60 year-olds dominating the outer suburbs. Car ownership had a significant correlation with distance from the CBD, showing that car dependence was related to distance from most usual household destinations. Car ownership was fully linked to respondent’ s perceptions of his or her own car dependence. The most car dependent destinations, fairly independent of zones, were the supermarket, getting to work and getting to friends or social locations.

The importance of the supermarket in our lives cannot be overstated. From as early as 1981 (Pickup), research has shown that households, especially housewives, have become increasingly disadvantaged with the closure of local small businesses because of the ubiquitous spread of supermarket and mall shopping.

At the time of survey, buses were not a popular form of urban travel. Less than 50% of the survey population had ever used the bus service in Townsville, so only about 35% of respondents answered the detailed questions on the bus section. Table 4.6.1 shows the relationship between the 1996 survey results and a more recent study conducted directly on behalf of Queensland Transport (Coory 1998).

Phone surveys of respondents over 16 years of age, including bus users, infrequent users and non-users were conducted through 1998 by ACNeilson (Coory 1998). About 380 bus users (more than once per month) were surveyed in Townsville during 1998. The 1998 study showed that about 30% of the Townsville population use the bus service at least once a year, about 20% more than once per month, comparable figures to the 1996 study.

Table 6.4.1 Perceptions of bus traits in Townsville, 1996 and 1998

Bus trait	**N 1996**	**Mean 1996**	**Mean 1998[1]**
Convenience	48	3.0	3.7/3.8
Reliability	57	2.9	3.5
Connections	57	2.8	3.6
Frequency/accessibility	57	2.8	3.5
Comfort	56	3.6	3.8
Speed	56	3.4	3.6
Cost	58	2.6	3.6
Passenger information	56	2.9	4.0/3.7

Note 1: from Coory 1998
Values: 1 = very poor, 3 = neutral, 5 = very good.

The perception of the Townsville bus service, as assessed by this research, improved by about 20% from soon after commencement in 1996 to the ACNeilsen study of 1998

(Table 6.4.1). This sense of improvement was most acute for passenger information and cost. Comfort and speed, both judged as reasonably good in 1996 were seen as slightly improved, tending from ‘ average’ to ‘ very good, needs little improvement’ .

In the 1996 Townsville study there were very mixed feelings about the convenience of bus use among outer urban dwellers, while convenience was seen as good by the mid urban respondents. In late 1996 the availability of urban bus services in Townsville was fairly uneven. That situation has changed to some extent in the intervening years. Combined results (Appendix 18) show that reliability, affordability and frequency were the three dominant bus issues according to survey respondents, requiring ongoing work by the bus service providers, Sunbus, and the supervising government agencies.

The human activity approach views urban travel as a derived demand (Fox 1995). Travel required is within the physical realities of the environment, especially travel distances. Distance excludes nearly all outer urban school children from riding to school, while outer urban dwellers in Townsville saw walking as irrelevant to their urban travel needs, because all destinations were beyond walking distance.

Townsville had more pushbikes per household than Brisbane (current study compared to Transport research centre 1994), although about 11% of Townsville school children cycled to school, compared to about 16% in Brisbane (MCR 1998). There is potential to increase cycling in Townsville to a greater extent than Brisbane, because of the generally dry climate, flat terrain and wide roads. Townsville is seen as a potentially high cycling city in a more sustainable urban travel mix. Heat and humidity are cited as deterrents.

This section has discussed results derived from the Townsville study, showing different spatial cycle and bus use than Cairns, and addressing some problems associated with urban enclaves. The following sections concentrate on the combined data, generalising, where possible, the two studies to traits which are largely shared, implying more universal relevance.

6.5 Travel modes

This section provides a brief overview of people' s assessment and feelings on the various possible modes of urban travel, linked to the literature. Cars, buses, rail, walking, bikes, working from home, including telecommuting, ride sharing and staying at home or trip planning and deferment are all considered. Cycling, walking or ride sharing with three or more people are the most energy efficient modes of travel. Rail, then buses are generally more efficient than solo car use, the most inefficient and preferred. Before travel modes are considered in detail, the reason for travel, the destinations, need to be clear as part of the theoretical ' activity base' approach to travel research which considers travel as a derived demand (Fox 1995, Pendyala *et al.* 1997).

Trip purpose

A 1996 study (Queensland Government 1996; 8) found the destination mix in Brisbane was: shopping 31%, work 30% recreation 10% and education 8%. Recording different destination categories to the Government study, the current study found shopping was the goal of 15% of all trips. Work of all types attracted 13% of all trips and school 10%. On the Fridays of survey, 'social' was a common destination away from home (12% of all trips). Home was the destination for nearly 40% of trips recorded in Cairns/Townsville, a destination largely missing from other studies. If the 40% ' home' is removed, shopping accounts for 26%, work 25%, all education 22% and social 21%. Recreation and social are seen as fairly interchangeable in the literature, as there is no one rigidly defined set of destinations. For example, nominating "supermarkets" as a distinct destination (about 8% of all destinations if "Home" is excluded) in this research has produced a clear new category for future use.

These destination ratios are clearly different from the Brisbane sample, showing that local surveys are needed to establish destination priorities for the specific target population. A British analysis of census data from the 403 local authority districts in England and Wales found a modal split of car 51%, walking 34%, bus 8% and cycling 2% (Banister and Banister 1996). The Cairns/Townsville study found the percentage of each travel modes used (except walking) were almost identical when comparing Cairns and Townsville (providing an informal but convincing Chronbach' s alpha of internal statistical consistency).

The Cairns/Townsville study showed that 78% of the 3,500 recorded trips were made in a car, 8% walking, 5% cycling and 4% by bus. In Brisbane in 1992, about 22% of recorded trips were walking, 4% by bike (Richardson and Ampt 1994). All trips were included in both surveys. The difference is partly explained in that, like the 20% walking from the Bureau of Transport and Communications (BTCE 1996), trip chaining in larger centres often involves a drive, then walk to public transport, then walk to work. Most north Queenslanders drove to work, described as one trip only.

Kitamura *et al.* (1999) develops an elegant theory about social optimum to explain the high incidence of car use, given its benefits to individual travellers. Like the tragedy of the commons where more people subsume more public space for their own private gain, a new car driver reduces the free flow of public transport, encouraging more people to drive if the road network is expanded to adsorb the extra traffic, reducing public transport patronage, so less is provided. Also, with more congestion, unit operating costs of public transport increase, maintaining the superiority of the car. Kitamura *et al.* recommend reassignment of road space to light rail. There was reasonable support (50%) for light rail in Cairns/Townsville, and general satisfaction with cars, at least while operating costs are low.

Jensen (1999; 21) in Denmark, like the Cairns/Townsville urban travel research, found by in-depth interviews that there were contradictions between attitudes and behaviour, theory and practice in urban travel choices. Their work graded car users and cyclists/public transport users according to how passionate they felt about their chosen mode, finding the more passionate non-car users tend to live close to their work, and their modal choice was not based on income – they could afford a car. This was not as clear in the Cairns/Townsville study. Here there were respondents clearly and deeply linked to their cars, but very few true cycling or bus enthusiasts. Cars were generally preferred.

Cars

Even the rail lobby acknowledges the benefits of cars: "The private car is one of the most dramatic development of the [20th] century. There are currently 600 million in use. Cars are instantly available." (Isaac 1996). There are about 11 million vehicles in Australia, travelling about 180 billion Km each year (BTCE 1996). In Cairns and Townsville, virtually all middle and outer households owned at least one car, about 35% have at least two. Most North Queensland households (and elsewhere) which can access them prefer to use cars where possible or at all practicable. In Cairns/Townsville cars are seen as convenient, expensive and reliable. They provide relative safety and can carry loads, used for 80% of all trips. A large Australian survey of all capital cities found cars constituted 75% of all trips (Brewer 1998).

An issue of debate (Schipper *et al.* 1996) is the impact of private use of company cars. In the UK, over 50% of new cars were company cars, where the user did not incur costs, perhaps leading to more cavalier car use. There were 14% of households with an employer-provided car in Cairns (18% for residents of the middle suburbs) and 9% in Townsville. Householders using employers' cars averaged 9 Km trip lengths, those without averaged 8 Km, an inconclusive connection between use of a company car and greater overall car use.

Not owning a car is the exception in most parts of Westernised society. To not own a car is to make an ideological decision, be young, old or poor (eg Kramer-Badoni 1994). In Cairns/Townsville, non-owners tended to be young, poor and inner urban. This result is similar to a study showing car ownership was diminished in the inner urban areas of larger cities, especially in western Germany, where almost half the inner urban households do not own a car (Reuter and Reuter 1996).

In 1998, the largest single reason to drive rather than use public transport (44%) was because there was none where they lived (MCR 1998), true in all outer urban cases studied in Townsville in 1996. The desire to use public transport is only possibly fulfilled if it is physically available, facilitating a convergence of behaviour with external choices.

The ‘ ’ persuadables’ is a term coined to describe car users who may be induced from their commuting cars to public transport, one third of a 456 sample in Liverpool (Curtis and Headicar 1997). The study reported by Curtis found many of the persuadables already used public transport for other purposes. One reason people do not use public transport is because the experience seems daunting. In a culture where only 5% use buses (Cairns/Townsville), the clear majority of the population (60%) have no experience in bus use, although it is reported as the most likely fallback when there are major fuel cost increases. Curtis found people in their are 30s most susceptible to change. This is noted as one target group more likely to change commuting behaviour to public transport.

Ride sharing

Despite efforts to develop a clearinghouse to facilitate ridesharing (Trayford and Marshall 1995), without such a device only small scale informal ride sharing occurs. The model of Figure 6.2.1 positions ride sharing as a subset of strengthened local social networks, whether neighbourhood, school or work. There is support for the idea of ride sharing in Cairns/Townsville, (as with all alternative modes), but it is viewed to some extent as dependent behaviour. There was informal ride provision within families, linked to the number of people and cars per household (Golob *et al.* 1996).

According to 27% of respondents, ride sharing was a cost saving strategy, energy conserving but dependent (5%). Ride-share with three or more people is more energy efficient than mass transit (Gordon 1991). Like Banister and Banister (1995), Gordon (1991) makes clear that ride sharing is usually more efficient than mass transit. Car-pooling is proving successful in the USA and is the second most important form of commuting, used by one fifth of all commuters (Turton 1992; 74). It can only work for commuters who have similar home and destination locations and similar arrival and departure needs. A comprehensive report on car pooling (Trayford and Marshall 1995) found a clear perception of environmental gain associated with car pooling, often the case in the Cairns/Townsville study. The 1995 study showed that reliability to be the most important consideration among potential car-poolers, implying the sense of dependence shown in the Cairns/Townsville study.

Fifteen percent of Cairns/Townsville respondents suggested ride sharing as a way to reduce car use. People are pre-disposed to ride sharing, making this an easy target to reduce travel costs. In a question specifically on ride-sharing, 34% noted it would cut costs, 20% recognised that it would reduce pollution or make you more dependent. Car pooling is proving successful in the USA (Turton 1992; 74). The research found little evidence of car pooling in Cairns/Townsville, outside dropping children at school on the way to work, or giving family members lifts to a great diversity of locations. Ride sharing was practiced at a low level for social outings, such as to the movies.

Bus and rail

In Europe about 15% of all trips were public transport, in the US about 5% (Schipper *et al.* 1993), in the present study it was 4.4%, which included 2.8% school bus use. There is room for increased use. To reinforce a central theme of this thesis, Schipper *et al.* found that public transport use tended to rise and fall slightly with real petrol prices, higher in countries with higher fuel prices. They concluded: "while fuel prices are only one factor in boosting transit ridership, they cannot be ignored" (p14).

There was intellectual support for public transport use in Cairns/Townsville, but not much use of public transport. Safety was something of an issue for bus users, particularly in Cairns. Some respondents felt the bus drivers drove recklessly. It was not a major deterrent. Along with a preference for trams over buses because of the capacity, speed and comfort provided by trams, a study by FitzRoy and Smith (1998) explained why public transport use in Frieburg, Germany, has doubled in a decade to 18% of the modal share. Given a compact city centre, the strategy included very cheap fares, traffic exclusion or calming and increased parking costs. The traffic calming to 30 KPH made the public transport speed competitive, and walking and cycling became safer.

Although increased use of public transport and inducements to greater local walking and pushbike use are advocated by most developed countries, worldwide trends are toward greater car use (Newman and Kenworthy 1989, Pucher 1995). Research by such authors as Kirchhoff (1995), Pucher (1995) and Delle Site and Filippi (1995) has shown that price, convenience (closeness of pick-up and set down points to own travel destinations, and frequency of service), comfort and safety are major issues of public

transport patronage. The Cairns/Townsville study emphasised reliability as important, and expressed a preference for sedate bus drivers. But at core, buses are in competition with cars: "There appears to be a good bus service in Cairns, but we prefer to use our car." (Respondent 109).

On demand and semi-on demand public transport services are being trialled in various centres to help cater for cross-town and non-work urban travel. This concept relies on modern GIS technology, mapping caller location and intended destination, then a central dispatcher sends an appropriately sized bus to best fit the destinations of callers in a given city sector. 'Dial-a-bus' services have recently been piloted in Germany, and considered for Australia, with trials for 'personal public transport' in Perth (AURDR 1995b; 104). Seeking public input to acceptable methods of increasing public transport use, walking and cycling are clearly part of urban policy and theory (eg. AMCORD 1995).

The use of Geographical Information Systems (GIS) in urban planning and transport management is increasing (Bishop *et al.* 1993, Budic 1994, Crane 1993, Edralin 1991, Harland 1994, Hensher 1974, Huxhold 1991, Huxhold and Levinsohn 1995, Luckman *et al.* 1990, Mc Allen *et al.* 1995, Mc Dougall *et al.* 1992, Meaille and Wald 1990, Middleton and Pyke 1992, Peterson 1993, Pequet and Duan 1995, Popovic 1995, Price 1989, Robson 1993, Sargent, 1992, Sheffi 1985, Sheppard 1986, Taylor 1988, Vrana 1989, Williams 1993, Young 1993 and Young and Gu 1993).

An undeniable advance in bus routing will occur with the use of GIS to help determine optimal bus routes (O' Sullivan *et al.* 2000), as outlined in Section 2.4 and as respondent 410 felt: "The route is too indirect - it takes too long to get to work, and I can't rely on it to be at work on time because of the number of pick-ups." There does appear to be room to refine routes in both centres to facilitate the most direct routes for the greatest number of people. The main bus company, Sunbus has its manager based in England. It seems difficult to influence the provider with useful input (Townsville Councillor Gleeson, Townsville Bulletin 31.5.2000; p 1).

Time is part of the travel budget. Respondents were fairly neutral about local bus trip times. Earlier studies suggest that trip speed has a very strong effect on usage (Kirwan 1992), however speed was ranked 8th. in importance for the survey group. The gap-

closing model developed in Section 6.2 suggests that a viable bus service should precede a viable rail service. This is because of the flexibility of buses, and some possible drawbacks to rail use, including establishment price, speed and impacts on urban form (Rubin *et al*. 1999). Newman and Kenworthy (1999) tend to hold the opposite view.

North Queensland respondents tended to support either public transport mode, and saw public transport improvements as the largest single issue to reducing car use. The bus/rail debate is unresolved and 'rational' analysis appears built on personal preferences (Edwards and Mackett 1996), and should certainly be case specific. Cairns residents tended to see the noise of trains or trams as a potential problem. Support for light rail in Townsville and Cairns was clear, although many respondents also appreciated that infrastructure costs would be high. There was an overall sense that light rail would be reliable, safe, and would reduce congestion.

It is not difficult to envisage light rail subsuming some major arterial lanes in future, and there seems to be agreement that for fixed bulk peak passenger carrying, light and heavy rail are more energy efficient that buses. Perhaps in future, fewer people will need to travel to work every day, working compressed weeks or telecommuting one or more days per week, further reducing commuter loads and congestion. Finally, a 1998 SE Queensland survey of 330 respondents found that 60% would use public transport more if it was more frequent. Slightly less would use it if they didn't have access to a car, or if the pick-up was closer to their home or faster, cheaper or there were government charges for road use.

Bicycles and walking

Safety in walking and cycling was a strong issue for North Queenslanders, in agreement with Tolley (1996) who asserts that concerns over the perceived danger are real. This is an important internal issue, and is underlined in the recommendations of Section 6.13. Walking accounted for 8% of all trips, cycling for 5%. Safety and perceived safety are inseparable in their power to deterrent non-motorised travel. Safety is a concern for bicycles themselves. Nearly 20% of respondents stated they would be more likely to ride to a bus stop if there was secure storage. This idea of 'secure' drew some derision.

The main Cairns/Townsville assessments of cycling and walking are that they are healthy (34% and 42%) and dangerous (42% and 30%) respectively, and the weather may be a deterrent (23%). The Queensland government now encourages 8% cycling. A 1992 household travel survey of SE Queensland, showed only 2% of all trips were cycle trips (QT 1998). The danger in cycling is well recognised (eg South Sydney Council 1995). In walking there is some fear of assault, but the main fear for cycling is of poor drivers. There are good arguments for fully segregated paths (Wardman *et al.* 1997), but there may then be a loss of casual surveillance which helps repress assault. Wardman *et al.* conclude infrastructure changes alone are unlikely to meet the UK target to quadruple the cycle share, lending support to the internal/external tandem model.

Flexible work arrangements

Cairns/Townsville respondents support working from home, viewing it as cost saving but often not possible because of the nature of their work. There is great potential for people based at computer workstations to work from home and, according to Brewer (1998), evidence that employers are slowly embracing compressed working weeks (15%) and flexible working arrangements such as telecommuting (6%) in England.

To reduce peak load and defer expensive road infrastructure upgrades, an easy adjustment would be employer-promoted alternative transport plans and flexible work times (Rye 1999). To help reduce peak solo car use, Employer Transport Plans (ETP) are being developed in Europe. They are generally not initiated for environmental reasons, but because of intended expansion in already congested areas. The more successful ETPs have executives who are personally committed to the plans. Some ETPs have failed in the US, because, despite efforts of individuals, no great overall improvements were noted (Rye 1999).

ETPs work in Holland because of the culture of cycling. Rye's work found the same dissonance between values and likely behaviour: 60% of employers felt they had some responsibility to reduce employees' impacts from their travel to work, but only 20% felt it should cost the employer anything. The study found a reflection of the different normative values to urban travel between the UK and the Netherlands, again

underlining how much our internal space, our cognitive processes (Kitchin 1996) impact on our range of likely behaviour, and the ongoing relevance of price signals.

6.6 Context of urban travel, theory and choices – fuel price

Scarcity of fuel is likely to begin by 2007 (Campbell and Laherrere 1998, Williams and Collins 1997, Figure 1.1.1). The most recent oil production figures at time of writing are from 1998: production up by 1.4%, with oil prices, after deep and prolonged falls, at $13.11 a barrel, the lowest in real terms since before the oil crisis of 1973 (Aylott 2000; 25), although media reports have prices of $34 per barrel in August 2000. Figure 1.1.1 shows the consensus view of possible world oil production. To clearly understand the implications of these predictions, the model (Figure 6.2.1) distinguishes internal and external structures. Internal space or structure consist of beliefs, values, feelings, including a sense of safety. External structures are the infrastructure of roads, paths, parking, public transport and security measures. The theoretical contribution of the model is to intimately link internal and external structures with price signals.

The North Queensland research shows the population has highly evolved environmental values. The central outcome of this thesis is the gap between those values and personal day to day behaviour. That gap is best explained by the context (Stern *et al.* 1995, and Kitchin 1996) of price. Kitchin develops an integrative conceptual schema, synthesising prior models of the environment-behaviour interaction to explain the "mental processes that are used in the environment-behaviour interaction. This provides a theory which is framed in cognition *and* human agency, and which is reactive to environmental, societal and cultural contexts." (Kitchin 1996; 56).

A 1991 Australian simulation found that a 20% cost increase in commuting may result in a decrease in the distance of journey to work of up to 10% (Horridge 1991; 61). Costs of urban travel change now and in the future in terms of catastrophic global change may or may not prove to be expensive. This dilemma is an issue of ethics (Troy 1990; 20), activating the ESD philosophy of dealing cautiously with uncertainty. ESD demands that we act in a precautionary way to this and other environmental unknowns.

If the dominant context is price/time signals, then the internal dissonance between environmental values as evidenced in this research, and actual behaviour derives from the convenience of cars, but more fundamentally from the relatively low cost attached to that convenience. The average weekly fuel cost per household was $27. For that $27 most households purchased about 50 single trips by car per week. Excluding indirect personal vehicle costs (maintenance, registration and insurance costs), each car trip costs fifty cents on average to go where you want, when you want, carrying other people or goods if you wish, staying cool and dry, feeling safer than using any other mode.

Perhaps the final irony of low-cost car use is all the direct but ' hidden' costs to individual motorists. Newman *et al.* (1995; 57) calculate that cost to be about $0.40 per passenger Km, compared to about $0.25 for bus or rail. This transferred cost from the environment, resource use and infrastructure from the underpaying car user to society (the social optimum of Kitamura *et al.* 1999) and nature (Nash 1996, Fien 1993, Stern 1992) at large is the external cost often referred to in this thesis and the environmental and planning literature at large.

After convenience, costs were nominated as the second most important issue involving car use in Cairns/Townsville. Fuel price increases need (according to nearly all commentators) to be coupled with changed land use and public transport provision (the planning and pricing of the British strategy; see Mitchell *et al.* 1996). The ' cocktail of solutions' (many changes each synergistically supporting each other) also include price of parking, road use charges and public transport inducements (eg IEA 1993, Annon. 1996).

Developing complex modelling, Pendyala *et al.* (1997; 187) found that congestion pricing (transponder-triggered charge for using freeways during peak hours) would have a strong deterrent to peak travel, and parking charges would be likely to produce a commuter mode change for about 30% of 655 survey in Washington DC. In a money/time economy, the low direct effort and high convenience car is the mode of choice four out of 5 times, despite often high environmental awareness and concern.

Wooton (1999), like others, sees the uptake of cars, the car culture, beginning properly after World War II, generating a particularly car dependent urban form and infrastructure. His analysis suggests that if we could restore public transport to 1955 levels, it would still only meet 8% of travel now made by car. Car use has generated urban travel unachievable by other means. This is the challenge of developing a sustainable urban travel system and allied behaviour.

There were 1,074 North Queenslanders who recorded that 78% of 3,500 urban travel trips were made in a car. A recurrent response to reduced car use is opitimised by: "No easy changes. I try to avoid car usage so that when I take children to school in the morning I do errands then. I try to use it once going into town" or "If the price of fuel went up I would worry more, but I have few enough hours in the day as it is without buses etc." Becoming less car dependent will be an enormous challenge. People are clear about current travel, reflected in this articulate summary of current urban mobility: "A sort of insanity which cannot be maintained. Moving [half a tonne] of metal and rubber to transport a 70 Kg person is a massive waste of energy. Most people however have no practical alternative" (Respondent 415).

The key question is one of acceptable change. Fuel price rises are essentially guaranteed given basic economic forces of supply and demand (Tientenberg 1992) and looming scarcity. A key issue, besides preparedness of infrastructure and behaviour, is the amount of price rise needed to curb fuel use. Some respondents were adamant there would be no change to their car use if there is a substantial price increase: "I don' t care what price, I still have to get around". Others were slightly more flexible: "Because of my sole reliance on the car I would have to cop the increase, but I would try to further reduce use." If fuel scarcity is looming, and expert opinion is unanimous, reductions will necessarily have to curb away from the steady 2% per annum growth of consumption each year for the past 80 years (Banister and Banister 1995, Weirauch 1995) to consumption commensurate to the possible maximum supply after about 2007.

There is a clear relationship between fuel price and per capita automobile use (eg Farrington 1992; 65, Schipper *et al.,* 1995). The issues of environmental and social external costs should not be ignored (Serageldin 1996). Nor should the effects of driving style, a behavioural change to reduce fuel use (Rouwendal 1996). Rouwendal modelled

driving behaviour and found fuel use doubles from a vehicle speed of 50 Km per hour to 120 Km per hour. Acceleration rate also has a major effect on fuel consumption. Like this research, Rouwendal found that in a study involving 3,000 observations, income did not have an effect on fuel use. However, drawing on the broader North Queensland data, it was found that the unemployed and pensioners tended to use bicycles and buses more than the employed.

Authors such as Delle Site and Filippi (1995), while underlining the narrow elasticities of reduced fuel use in response to increased prices, believe from mathematical modelling that a 20% increase in auto costs, coupled with slightly lower bus fares, would lower car use by about 10%. Increasing car costs, outside increased crude oil on the global market would be politically unpalatable, be they pollution or congestion charges (Neale 1995). Urban car dependence is now one of many cases where economics and environmentalism meet (such as land clearing, irrigation and salination), in this case considering the long term economic changes likely to occur through CO_2 emissions. Azar (1994), based on intergenerational equity, develops a strong case for cuts in CO_2 emissions from the perspective of long term economic wellbeing.

A key paper by Kirwan (1992) uses Newman and Kenworthy's work (1989) to plot density of world cities against average household petrol consumption, then shows that a loglinear relationship exists where the price of petrol, car ownership and outer area population density accounts for 97% of variance in private vehicle use, with 92% of that explained by variations in fuel price. Kirwan projects that a 50% increase in fuel price would render the same car use reduction as a near doubling of urban density. The analysis by Kirwan (p16) indicates that a 25% increase in fuel price in Australia would result in a 25% decrease in fuel consumption, 10% of that from changing urban density, 8% from by increased vehicle efficiency and 7% from reduced use. The Rupertwood case (Chapter 4.3) indicates that fringe dwellers often experienced a desire to ‘ move closer’ because of transport disadvantage. Within the model of Figure 6.2.1, increased fuel price translates as a greater pressure for attractive public transport or greater urban density.

An analysis by Boyd and Uri (1994) shows impacts of increased fuel excise, but failed to factor in any projections based on greater impacts of price charged by suppliers of dwindling reserves and growing demand. Fuel price increases would need to be coupled

with other increases in car costs like parking or low occupancy charges. Pucher (1998) documents how a combination of increased car costs and improved alternatives has decreased car use in some cities. The detail is provided in Section 6.10.

The price-related multidimensional approach finds support from Johnstone and Karousakis (1999), arguing to internalise external costs of fuel by a ' vehicle characteristics tax' as well as a fuel tax, aimed at reducing pollution. This would get some support in Cairns, where there are "too many cars, trucks and buses. The air in Cairns city is smelly these days, because of vehicle engine fumes" (respondent 404). Detailed analysis by Johnstone and Karousakis found it hard to identify clear vehicle characteristics linked to increased pollutants, although for their sample of 2850 observations, vehicle age was a general indicator correlating with higher emissions.

Within the primary emergent context of price signals, the following sections consider policy, technical changes, and environmental and social influences from the literature and the research results. Some commentators or researchers believe that "travel demand management strategies involving financial disincentives are essential if total automobile use is to be contained to sustainable levels" (Hensher 1998; 197). The era of frequent solo use of heavy private vehicles is passing. Manipulating parking charges or paying people not to park in San Francisco has produced "strong mode shifts away from driving alone." (Lewis 1998, p 148). Cairns City Council in late 2000 is profoundly remodelling their parking policy in a pro-ESD manner. Townsville appears entrapped by a need to avoid repelling would-be shoppers from the underused city centre.

One of the necessary steps toward sustainable urban travel provided in the Model for Change is the internal concept of acceptance. Acceptance in part refers to the looming reality of expensive fuel, and the evidence that driving behaviour is clearly modified by price signals. Because it is well understood in planning theory that pricing and regulation policies profoundly influence urban form and transport choices (Banister and Banister 1995), the next section deals with policy.

6.7 Policy

In part this survey tested links between policy and public perceptions of urban travel planning. From the United Nations down to local government level (Chapter 1.2), the overwhelming urban policy is to reduce car use, for environmental, health and infrastructure cost reasons. Coupled with the price imperative established in Section 6.6, there is overwhelming reason for rapid and profound change.

This section highlights some government policies, noting efforts at policy implementation. Thirty five percent of the Cairns/Townsville residents surveyed linked prolific car use with urban sprawl, with about the same percentage acknowledging that their urban travel was very car dependent. Urban sprawl is the consequence of local government seeking to attract new settlers by offering cheap land to expand their rates base. At the same time there were strong pro-environmental views among respondents, irrespective of distance from the CBD, and over half of the sample wrote of easy ways to reduce their car use. Further, only about 15% saw the future as being very car dependent, implying an overall perception and acceptance that future urban travel is likely to be less car dependent.

As a clear policy direction, the United Nations encourages energy efficiency in transportation (UN DPI 1994). Increased urban travel is directly linked to loss of open space, so at a policy level urban infill along nodal transport routes is encouraged (Kuiper 1993). Agenda 21 was developed to create policy direction within an ecologically sustainable framework for local governments from most countries, endorsed by 150 nations, the intent including energy efficient transportation (Gilbert *et al.* 1996).

Curitiba, Brazil, is cited as a success story, increasing public transport use by 50% over two decades (Gilbert *et al.* 1996; 39). Integrating compact land use and transport is a key initiative. There are aggressive strategies in many European countries, notably England and Germany, to reduce car use (see Chapter 1 and Section 6.10). Even the ‘ forerunner’ cities of Germany have great trouble just repressing growth of car use (Bratzel 1999). India is trying to curb the projected 12% per year growth of passenger traffic, with its consequent increase in energy use and pollution (Ramanathan and

Parikh 1999). Much of Australia's urban planning is now guided by AMCORD (1995), requiring an ESD approach, including a 'movement without cars' strategy (AMCORD 1995 PNP7; 7), because of environmental impacts of cars (AMCORD 1995 PNP3; 1).

South Sydney has a strategy to discourage single occupancy vehicle use, through developing a land use proximity of residential to main destinations (South Sydney Council 1995). South East Queensland, through the Integrated Regional Transport Plan, aims for a long term move toward a quality urban experience on a walking scale (Queensland Government 1996). This strategy aims to make walking more attractive, part of the 'techno-walking city' concept explained in Section 6.2.

Finally, both the Cairns and Townsville regions have regional strategic plans, aiming, in part, to develop alternatives to car use to "encourage changes to community travel habits" (FNQ2010 1998; 74). This section has shown there is conscious government policy, from global to local, to reduce car use, and integrate urban travel and land use. The next section deals with a seeming solution to resource depletion and urban pollution: technological improvements, including use of renewable fuels.

6.8 Technical developments

When asked about future urban travel in North Queensland, almost 50% of respondents envisioned technical or fuel changes. In developing a profile of environmental awareness and concern, respondents were asked if they thought that new fuel would allow for unconstrained vehicle use. About 40% thought that was likely. This is an optimistic view of transport fuel, given that only about 15% of respondents felt that technology would provide for our continued well-being.

Environmental and other values and beliefs are detailed in Section 6.11**.** The literature on technological change and alternative fuels throws into doubt that replacement fuel will be as cheap or as easily available as petrol within the long time-frames required by sustainability. Without consideration of pricing, environmental or social policies, the following is indicative of technological developments.

Electric vehicles show some promise. Future electricity will come from renewable and fossil sources. Improved efficiency in the use of fossil fuel is occurring in electricity generation plants by using pulverised fuel. The long life of coal generating plant means that as current stations run through their 20 year life-cycle, more efficient upgrades can be made (Schmidheiny 1993). Gas fired generating plant have become more efficient, using a ' combined cycle' system where waste heat is reused through a boiler (Gardner and Shaw 1993). Road transport has also increased fuel efficiency and use of renewable energy in recent years, with more improvements expected with ethanol (Energy Focus 1993). New applications and implementation of alternative fuel sources is occurring in Australia (eg AEN 2000; 42).

Renewable energy sources are now being harnessed with greater sophistication (Schuck 1993) and the future outlook for cheaper solar electric panels is promising (Green 1994). As the implications of scarce fossil fuels translate into their full long term value at the institutional and political level, financial rewards for successful renewable energy researchers and product developers will be high. There have been major gains in wind energy (Davidson 1993), solar-electric energy (Corkish and Aberle 1993), solar thermal energy (Luzzi 1993) and mini hydro systems (Stephens 1993).

Most proponents of renewable energy do not see one source providing all our energy needs, rather, a sophisticated 'cocktail' of sources and storage systems is considered to be the most likely solution for most regions. It is clear from the above that we can reduce our reliance on fossil fuel for the supply of energy. Hydrogen fuel cells, in hybrid (mixed fuel source) vehicles are likely (Black 1996).

Ammonia (NH_3), as a biologically generated methane ' waste gas' has a lot of potential from sewage and methane digesters as an urban fuel, potentially for use in high efficiency fuel cells (Sinor 1996). Sinor also details methanol, ethanol and other biofuels. Certainly there is potential in North Queensland to harvest electricity from the efficient burning of sugar waste, bagasse, and using sugar to produce some ethanol.

At time of writing, except in the most remote areas, fossil fuels are cheaper than renewable energy, unless those renewables are essentially direct waste from a process such as milling or old land fill. Price signals are instrumental in peoples' transport

choices, and in choice of fuel. This short section on technical changes is included because there is an underlying belief by many people that we will be able to keep using cars the way we are used to. Investigation of alternative fuels and efficiencies does not currently support that belief. Thus a key component of the model for change is within the ' internal space' of the way people think and feel. It is important to understand what values and beliefs drive social evolution, what social, environmental and resource depletion paradigm we hold. This internal world has a rich body of psychological, human geography and sociological literature (Agnew *et al.* 1996, Kitchin 1996, Jensen 1999, Johnston 1997, Kilmartin and Thorns 1978, Stern 1992), trying, as the model in section 6.2 undertook, to explain why we do the things we do. Further, from a planning point of view, there is a need to understand how we may change behaviour from our current deep reliance on cars. The next section links the research with the ESD requirement of public participation.

6.9 Public participation

Public participation is a defining element of the ESD planning process. This research has enabled input from the public. Indeed, results from the Cairns research have been used in planning changes to the Kuranda Range Road, the main link between Cairns and its rich hinterland. A striking feature of all written survey responses was an almost total lack or request or demand for greater say in the planning process. The depth of understanding and concern expressed in the written responses shows that many people care profoundly about planning issues, but are perhaps caught in a kind of fatalistic apathy, feeling disempowered by the political processes. Over 50% of respondents did not feel that existing decision making processes were satisfactory.

Public participation is required during at least two phases of all major planning processes in Australia (AMCORD 1995), seen by theoreticians as a key concept of ESD (eg Mc Namara *et al.* 1993). Consultation is seen as necessary, used, for instance, in developing the rapid transit review in Western Australia (James *et al.* 1995). It is also seen as a necessary planning phase overseas, especially in Europe (Barlow 1995).

People in Townsville (including the author) have been involved in public consultation processes for years. There have been ' Vision' developments and inner urban redevelopment brainstorming. There was a location dispute triggered by threatened

local residents over a gas-fired power generation plant and major access route options to the port. Consultation occurred over major drainage issues, a major land parcel designation for heavy industrial growth and the relocation of the Townsville railway station. The opening of the main Townsville water storage (Ross Dam) for recreational use has also been the subject of public consultation.

It is difficult to tell how much is genuine public guidance of decision making and how much is going through the required motions to a decision predetermined by larger and more powerful forces. The majority of feedback according to the main regional daily newspaper (The Townsville Bulletin) for the railway station relocation was to leave it where it was, but that was not an option on the proforma ' consultation' surveys. A very impressive $28M redevelopment of the main erosion-prone beach of Townsville was done without consultation, as was the siting of the world' s largest zinc refinery (opened in May 2000 by the Australian Prime Minister) near the Townsville coast.

Full and responsive consultation requires public interest. Listening to and incorporating the public will is perhaps one of the more difficult behavioural shifts for professional planners to make, as they are most immersed in the subtle forces which may define a predetermined outcome. There are legal requirements to give planning notice, and many efforts by Councils to gain public input, although sometimes deemed inadequate. Also, there are many levels of public participation, but people must feel they are effective for ongoing involvement to have meaning, rather than disappointment or frustration. Public participation was not actively on the agenda of any of the 408 Cairns/Townsville respondents, but the travel survey process itself is providing some input to planning in their region. The following section explores urban planning in some depth.

6.10 Urban planning and expert opinion

There is a core, often unstated tension in the literature between those who believe that density is the measure of all things to do with less car dependent urban travel and those who support nodal development connected by rapid transit. It appears more pragmatic to build on what exists already. The embodied energy (amount of energy to create our current structures) is unrepeatable.

The Townsville Thuringowa strategic plan (TTSP 2000) does just that, acknowledging there is nodal growth around the three major non-CBD shopping complexes. They are designated as regional subcentres, with smaller centers designated as sub nodes. Higher level activities (eg State and Federal Government) are supported at the central place CBD, creating a nodal network in time. Density without nodal intensity and links will fully utilise existing infrastructure and facilitate more public transport use, but nodal development will allow for open space and maintenance of most existing low-density housing. Nodes and transport networks are in their infancy in the two north Queensland ' proto-cities' , each of about 130,000 people.

Chapter 1 established that the ongoing tension between market forces and planning has produced sprawling suburbs since WWII (Gleeson and Low 2000), and that there is now a trend toward more compact nodes (AMCORD 1995). When people choose a place to live, there is a real confluence of internal and external space, time and price considerations. Much travel stems from the home location choice. Market forces, developers and property users, play a large role in urban planning. A desire for near-urban acreage has produced such subdivisions, now discouraged in the Cairns region. Current market forces are producing gentrification of inner city areas and medium density housing. This seems a rare and fortuitous confluence of market forces, planning theory and policy. Many Cairns/Townsville respondents had well developed views on urban planning. Respondent 412 wrote: "Many suburbs are spread out and you have to drive when going out socially and recreationally", with 37% noting some connection between urban sprawl and car use.

Needing to reduce car use (eg Gilbert *et al.* 1996) is fully established in the literature and policy. Most theorists and published researchers advocate urban consolidation or ' infill' (Banister 1996), making use of existing infrastructure, and through increased density, making public transport more viable. Like the Cairns/Townsville study, Banister reports on evidence that as distance from the CBD increases from 4 to 12 Km in Oslo, transport energy use increases 41%. In the Cairns/Townsville study, inner and mid urban in Townsville averaged about $25 per week fuel costs while the outer zone, for about the same trips per household, averaged $40, with Cairns only slightly less pronounced. The outer three Townsville CDs averaged 34 Km from the CBD and their

transport energy consumption was about 1.6 times (60%) greater than their more central counterparts.

Low density urban growth clearly carries a high ongoing transport energy cost. A cost-based way to reduce sprawl (eg ESD *Working Group* 1991c) has been developed at the state level in Australia by ESD based, post AMCORD95 legislation such as the Integrated Planning Act in Queensland (IPA 1997). This Act obliges the developer to meet most of the cost of new or upgraded headworks, reducing public subsidies to peripheral development. The sustainable policy shift is now finding expression in law.

Dwelling size, household demography (decreasing people per household) are all now changing, with some convergence between market forces (Gleeson and Low 2000) and planning theory and practice, with more inner city units being constructed in the two North Queensland centres. The node-based regional plan for the Townsville area (TTSP 2000) will provide further convergence.

Nodal centres

Supported by such Australian planning luminaries as Troy (1995), forming intense activity nodes is supported in the literature since at least the early 70s (Stone 1971). There is increasing market force to provide upper income inner city living (Brotchie *et al.* 1995). Seeking suburban self-containment is not possible, but aiming to meet as many needs as possible as much as possible, as outlined at the end of Chapter 1, appears to be desirable from theory and policy (eg Banister and Banister 1995, AMCORD 1995), and is in keeping with the views of some surveyed North Queenslanders. Householder 2816[2] wrote: "Very poor planning by government bodies in the placing of services such as (eg) Transport Department in the centre of industrial area of Garbutt – the only mode of transport to this place is by car", 2701: "There is no option but to own a vehicle. Stop the number of small centres (business and shopping) from increasing. Provide public transport for future sub divisions to existing centres."

[2] Household codes: The Cairns household codes used 3 digits, where the first digit represents the CD, while the 2nd and 3rd digits show household identification number within each specific CD. Townsville coding used 4 digits, where the 1st digit (2) identifies Townsville, the 2nd digit identifies the CD, then the 3rd and 4th digits identify the household within specified CD (see end of Appendix 4).

There are positive comments as well, such as "Fuel price/availability will become a problem, but while its available I will use it. People will need to re-evaluate transport/distances travelled, and constraints in the future may see a return to localised living/working/shopping/socialising." (42 year old student, Householder 2906). Householder 2907 again displays the sophistication of many of the written responses (Appendix 6 and 12): "Perhaps interlinked tram-like vehicles in urban areas – connecting with buses from outer areas with incentives (like not expensive) so people who can travel this way will leave their cars at home and just use them for family and weekends etc". Overall, 4% of North Queenslanders supported the idea of ' Urban villages' . The understanding of nodal development seemed poorly formed in the public mind in 1996/97 in the study area.

Changes in urban form are seen as necessary to reduce resource depletion and wastage. Producing more convivial local networks to share rides, to meet social needs more locally and support informal surveillance to improve a sense of safety for walking or cycling are all clear motives for change, but a main motivator for change is environmental. Greenhouse gases may render unacceptable climate change, and we have universal agreement on the importance of this issue. The Cairns/Townsville urban travel research set out to measure environmental awareness and concern, discussed in the following section.

Developing urban nodes or villages received support from some respondents, and is aligned with policy and theory (eg. Heywood 1994). Cervero (1996) produces convincing analysis from US census data to show that people who live within 300 metres of a local store are much less likely to drive than commute in buses or trains. There is a link between near-neighbourhood shopping, easy for pedestrians, and the overall likelihood of driving. Given that the NQ study showed the dominant position of using the supermarket as car dependent, developing medium density housing around such ' Activity centres' or nodes (as encouraged in TTSP 2000) may decrease overall car use. Mixed land use is acknowledged as a part of the solution to increased car use. Some respondents in the Cairns study envisioned urban villages.

Expert input

The results in section 5. 6 show a clear set of trends. Not only is there support both among planners and theoreticians to close the gap between theory and practice, to do so ' Aggressively" ranked among the top five of 55 statements to do with a less car-dependent urban future. As both the Townsville/Thuringowa strategic plan (2000) and FNQ Regional Plan (2000) stress, the policy and planning only set the context for implementation. The Queensland Premier and relevant Planning Minister stressed the need for implementation at the August 2000 launch of the TTSP in Townsville, as did the Mayors.

The political will, blue print and public understanding and tacit acceptance are all in place. As with the public survey, the expert' s survey showed the importance of safety in urban planning, from the structural design to encourage informal surveillance to the improved non-car infrastructure to legitimise those travel modes, and in that way develop the critical mass of walking and cycling to provide for safety in numbers.

The development of nodes, so encouraged in the planning literature, is strenuously supported in the survey response of experts. This idea of conscious concentration of structures and urban behaviour into a designated hierarchy of nodes or activity centres is provided as the framework for urban change in the strategic plans of the subject North Queensland cities. This is more than a happy coincidence calling for assertive implementation by experts, rated by experts within the top five of easy and effective strategy implementations. It appears that the convergence on nodal development is near universal among policy-makers, planning academics and practitioners. Safety, continuity of paths, aggressive policy implementation and nodal development are matched by simple changes like clear signage at bus stops to help reduce car use.

The expert survey shows the strength of the shared vision, the depth of the paradigm shift toward more sustainable urban travel. The public survey detailed in this thesis indicates how much people care about the environment and accept the need for reduced car use. At time of writing (November 2000) there is widespread concern about petrol retailing around $1 per litre. This may or may not be the inexorable climb of fuel prices linked to the projections of Figure 1.1.1, but the pressing implications of our dependence on petroleum has developed as an issue of high public concern. The

increased taxes now derived from high at-bowser prices can be used, old paradigm, to improve roads, or develop strong nodal connections to immediately reduce car reliance. The theory, will, expert opinion and public acceptance are in place; implementation of more sustainable urban travel should now follow.

Expert survey leads to the conclusion that there needs to be a cocktail of responses, that there is no one or easy solution to reducing car use, yet, if Figure 1.1.1 is right, there has to be car reductions. For these reasons a combination of many small infrastructure and behaviour changes is needed to address the problem. This was the original thesis, developed in 1995, supported late in the year 2000 by a consensus of experts.

Experts scored "Encourage an understanding of environmental and dollar savings by making discretionary journeys outside the peak times" as the ninth of 55 statements to assist in the mix of responses needed to reduce car use. The next section shows that there already exists a strong environmental awareness and concern, not yet linked strongly to our urban behaviour.

6.11 Environmental values

Testing environmental awareness has a rich history since the late 1970s. There are many levels of theoretical 'internal space', from the technocentrism and ecocentrism of Fein (1993) and earlier authors to the land ethic of a balance with nature and egoism of Stern (1992) and others. The main method of quantifying environmental values was carried out and published by Dunlap and Van Liere in 1978, discussed later in this section. Research commissioned by Queensland Transport in 1998 found that environmental friendliness was the second last of 7 features when buying a motor vehicle in SE Queensland, but fuel efficiency was the second most important, after cost (MCR 1998; 85).

Nearly everybody responded to the questions on environmental beliefs. Most responses were not related to zones. People generally did not support the linear industrial model and were unsure about whether ecology constrains economic growth. There was strong disagreement with the idea that impact risks were acceptable to maximise wealth. Results from this survey show that people generally have a

sophisticated set of environmental values, embedded (perhaps unwittingly) in the theoretical frame of the new environmental paradigm (Stern 1992, Fien 1993).

Stern *et al.* (1995) assert that the link between environmental values and an awareness of consequences as interchangeable. Research in North Queensland (Goudie 1995) indicates a high environmental awareness among North Queenslanders, but little connection with the consequences of their own energy consumption. The prevailing local ' culture' may explain that disparity. A study by Taylor and Todd (1995) showed that there were no differences of attitude between householders who recycled (an environmentally positive behaviour) and those who did not. These researchers found there was a clear difference in ' procedural knowledge' (p653). It is not just how you feel that determines behaviour, but the detail of what you know, especially ' how to' knowledge.

The majority of people did not believe that existing decision-making structures are satisfactory. This profoundly questions the current decision-making processes, increasingly requiring public participation. In November 1999 a major public discussion was underway about a core long-term issue of urban mobility: location of the railway station and surrounding interchange infrastructure in Townsville. The current decision-makers clearly preferred to relocate the functions of the Townsville railway station, but many letters to the editor of the local newspaper (the Townsville Bulletin) express the belief that the functions of the railway station would be much better left at the current historic location. A clear message from one of ten statements on environmental values is that the majority of the public do not feel that present decision making processes are adequate. If the tiers of government want public participation, as AMCORD policy and Queensland (IPA 1997) and other States require, there needs to be incentive for that participation, and, most certainly, a feeling that the participation has real influence on the outcome. This is also an environmental issue because public participation may need to extend beyond the consultation phase to changed behaviour. Landcare is a good example of group agreement on strategy, then active involvement in implementation.

Most people believed that harmony with the rest of nature is needed for survival. These feelings expressed through this survey work strike a clear resonance with the

main goals and aspirations of the ESD process required by government. There was a belief that technology will not provide for our continued well being, implying that behavioural changes are needed. Publicly perceived need for behavioural change lends hope to a more sustainable urban future.

Although technology does not hold all the answers (according to most of the respondents), new fuels will, in balance, be reasonably likely to support unconstrained vehicle use in future. There is a sense of this in the literature as well, but the theoretical element missing from the sample response is the need to include ' external costs' (Barrett 1995). Including the currently external costs of fossil fuel use is the one step needed to push greater uptake of renewables, and constrain the use of non-renewables (Diesendorf 1992, Business Council 1991, Greene 1992). Finally, people saw a need for technology to integrate with natural cycles. This means more judicious collection, use and recycling of water, nutrients and energy.

One of the many ' isms' which seem to have merit for planning purposes is ' ecologism' where "environmental care requires a change in our relationship with the environment, which, in turn, necessitates a change in our social and political lives." (Cutter 1994, p 220). These values, this philosophy and stated need for behavioural change (Dwyer and Leeming 1993) is an expression of the ESD embraced by most national governments in the early 1990s, and underscores much consequent policy and theory. Research at that time in Vancouver found, after a year of public involvement, that concern for environmental quality was "the most important priority of the overall community, ... influencing the strategic planners' increased emphasis on environmentally friendly public transport." Heywood 1994, p 69). Fien (1993; 24) reported on clusters of environmental beliefs, some tested in the Cairns/Townsville urban travel research. There were no significant differences between centres, again showing the homogenous nature of the overall sample from the two cities in travel behaviour and beliefs.

Comparing some identical or equivalent statements with the original survey of 800 Washington State residents in 1976 (Dunlap and Van Liers 1978), the earlier study found 56% and 39% strongly or agreed with the statement: "Humans must live in harmony with nature in order to survive". Forty six and 27% of North Queenslanders felt the same –

slightly lower. The earlier survey did not have a neutral category, accounting for 10% of the Cairns/Townsville sample. Comparison of responses to: " There are no limits to growth " show 73% of the US sample agreed, while 63% of the Cairns/Townsville sample agreed, with 13% neutral.

In general terms, both studies show an overall rejection of the dominant social paradigm. Stern (1992) suggests that beliefs about the environment can change with new information, but values that in turn may generate action are less mutable. This is an important insight into linking knowledge to behaviour change, developed more in the following sections, especially as it relates to personal choice. A good example of the ' internal space' linking to behaviour change may be that once there is a widespread belief that fuel prices will rise, people will place more value on homes which are closer to their usual destinations, producing, with relocation, a very different set of travel behaviour.

Urban travel beliefs

About 80% of respondents answered questions on travel beliefs, displaying high interest levels. Many written responses were lengthy and detailed. Like the indications of environmental beliefs just discussed, the written responses to travel beliefs show that most people had a sophisticated and accurate view of the relationship between urban mobility, urban design and car dependence. Some written examples are given in Chapter 5 and Appendix 16.

The link between urban form and car dependence was recurrently underlined by respondents, as in much of the literature. Such authors as Newman *et al.* (1995) point out that changed urban form will not provide all the answers, but a multi-nodal (medium density housing, linked by rapid transit) physical structure will definitely help reduce car dependence. Although urban mobility is seen as very car dependent, it was also seen as acceptable or good. Urban mobility may change in future according to respondents, or it may become cheaper, less polluting and people may walk more.

Car use may be reduced by more or better public transport, or it may not be reduced at all. Inner urban dwellers most saw the benefits of walking, reinforcing the earlier discussion point that many inner urban dwellers chose their home location specifically

because of proximity to usual destinations. As discussed earlier, this was not the case for outer urban dwellers. Solar car use in future would produce less urban pollution (according to some respondents), running on renewable energy.

People in the middle suburbs stated that if there was a sharp rise in petroleum prices they could use their pushbikes more, plan trips or walk more. Outer urban dwellers saw that they may be able to reduce their need through planning. There was a slight support overall for urban light rail. People were generally optimistic about future urban planning, seeing the need for a less car dependent future, in accord with current urban travel literature and policy.

To pursue more sustainable urban travel, travel demands will probably need to be reduced, using the mechanism of some payment for some external costs (Neale 1995). This raises social justice issues: intragenerational equity, in the parlance of ESD. However, there are many ‘solutions’ offered by policy, literature and respondents that should provide improved urban amenity, noise and air quality, all flowing on from reduced car use.

6.12 Personal choice and social equity

This section deals with apparent choice, choice of home location, choice of how when and where to travel, considering the geographic issues of place, time, distance and money. There is a long and rich literature on most of these issues (eg Manning 1984, Agnew *et al.* 1996, Levinston 1999) with the link between urban form and travel behaviour well established. For instance Pickup (1981) established that change in food retailing to major shopping complexes produced social disadvantage to the majority of British women who had previously walked to obtain food.

This behaviour is now confined to some inner city dwellers, or, with surrounding low density housing, the relative few who live within a comfortable walk of a shopping complex. The issue of choice was elaborated by Town (1980) who particularly found the young and elderly, or those without cars to be generally transport disadvantaged. The Cairns/Townsville study makes it clear that many who do not have a car lived in the inner city areas and would perhaps like a car. This study also found that a

disproportionate number of the unemployed and school children tended to dominate use of push bikes.

Gender issues of mobility were explored by Mensah (1995) who found poor urban women tended to prefer part time work and travelled less distance to that work than their male counterparts. The current study found no such patterns, but did find that Cairns women aged 50 – 60 living on the urban fringe were among the highest group for total distances travelled. Again it emerges that it is difficult to generalise outside the actual study time or area.

Although there is a common assertion in the literature that outer urban dwellers are socially disadvantaged (eg Maher *et al.* 1992) this may be true only for adolescents in the study area, as all surveyed outer urban households had at least one car. On the other hand, the in-depth analysis of the outer Collector District, Rupertswood, found that half the respondents would like to move closer to their usual destinations, perhaps as the idealised lifestyle manifest as inconvenient from a mobility perspective. At the time of survey there were few travel mode choices for outer urban dwellers in Townsville, and a good bus service for their counterparts in Cairns. Choosing where to live is discussed next.

Home choice

Choice of home location matters in urban travel research because most journeys begin and end at home each day (Marble 1967). Ultimately, home location choice is embedded within the ongoing debate on urban sprawl and consolidation (Troy 1995). The debate has been joined by Prime Ministers (Keating 1991), the popular press (see ‘ bus and rail’ section of Chapter 6.5) and the public.

The link between outward or 'centrifugal' growth (Maher *et al.* 1992) and increasing total travel to facilities and services is the subject of ongoing research. Maher, like others, speaks of locational disadvantage, found concentrated in the outer suburbs. Although this was generally found across capital cities in Australia, the authors also noted that there was a tendency for some socially disadvantaged groups to concentrate near the centre of those cities. This was found to be superficially true in the Cairns/Townsville study.

Efforts to understand the links between integrated land use and transport are ongoing (Young and Gu 1993). The Cairns/Townsville research supports the findings of others (Town 1980) because home location choice appears now to be largely a life-style choice. Town points out that people living in "suburban areas inevitably experience longer journeys than those who live near the town centre, where the majority of facilities, and the nodes of bus networks, are located" (p14). The Cairns/Townsville study certainly confirms that observation.

Most of the reasons for particular home location choices are to be expected. Inner urban dwellers generally chose to live there because they wanted to be close to the city, close to work or close to most destinations. Mid urban dwellers often made a life-style choice about their home location based on perceived closeness to the city, or because they liked the area. Price was also a consideration. Three of the six outer urban areas were close to the beach. Thus home location choice results from these randomly chosen CDs cannot be legitimately generalised to any outer urban area on the fringe of any growing city. That they liked the area and the price was attractive may be generic to most outer urban home choice.

Although not cited in the survey as the main reason for relocating to the urban fringe, there is an assertion in the literature that the main reason was price. An Australian study in 1992 found that 26% of internal migration in 1992 was caused by employment considerations, but that an increasing reason for internal migration was the quality of life-style (Wright 1992). It is thus reasonable to conclude that most of the outer urban dwellers have made a life-style choice, based on a pleasant environment rather than any travel considerations.

Home location choice needs to be viewed within the larger context of land use in general. DBIRD (1995b) presented a powerful argument to support a policy encouraging fully mixed land use, with the proviso that higher impact uses are buffered from residential areas by other land uses such as warehouses and consumer services. The disassociation of housing from employment and education is generally a product of the 20th century (Newman and Kenworthy 1989). Although it is acknowledged that choices of residential location are complex (Sheppard 1993; 208), the Cairns research

indicates a strong correlation between distance from the city centre and the total distance travelled in private cars.

AMCORD 1995 requires that locational choice should be regulated for efficient use of land, providing, among other things, affordable housing for the poor. The Cairns/Townsville study found that mid urban dwellers were the most price driven in their housing choice. These households often had children and two cars, also choosing their location for reasons of proximity to usual destinations. Market forces and the changing makeup of many households support the AMCORD requirement for greater housing choice.

One third of inner urban dwellers in the survey lived alone. Authors like Sheppard (1986) point out that such people who wish to live alone may have few choices about which zone to live in, as small units may only be available in the inner city area. Available housing types is certainly a determinant of housing choice, part of the external structures which in turn are likely to affect urban travel patterns. Choosing to live on the urban fringe for space and a sense of nature usually means greater travel to usual destinations. Although there are indications that the duration of trips is linked to how long a traveller stays at that destination (Levinson 1999), outer urban dwellers in Cairns/Townsville had similar trip destinations to others, with no indications they, for instance, shopped longer because the trip to the supermarket took longer. Whatever the subtext of travel duration, outer urban dwellers travelled the greatest distances, using the most fuel.

Another major and changing locational issue is the location of the workplace (DBIRD 1995b). Although Townsville tends to have three main work nodes: CBD, University and the Army Barracks, that influence did not greatly effect overall recorded travel or beliefs, found to be statistically identical to Cairns in nearly all respects. There are other, smaller work nodes in Townsville such as the airport and the industrial estate of Garbutt. A survey starting with those nodal destinations would probably be needed to properly assess their influence on urban travel. That influence appears small from the residential-based survey spread across the whole metropolitan area. The potential to telecommute and work at more suburbanised nodes in discussed in following paragraphs. Often outer urban workers were dispersed tradesmen, who needed to travel

long distances to their ever-changing work sites. This result conforms to similar findings by Naess and Sandberg (1996).

Recent work by Lewis (1998) has found that financial incentives to avoid commuter car use in San Francisco creates incentives for people to seek a home in a location near public transport. Only 1% of 400 respondents cited ‘close to public transport’ as a reason for their home location choice in Cairns/Townsville, while ‘Good transport network’ was a consideration to about 4%. Proximity to public transport was not an important issue when deciding on a home in North Queensland. Perhaps with the pressured removal of inner urban parking (as with San Francisco), that could change slightly.

Choosing a home is a great commitment, as the act of moving requires great effort and dislocation. People in the two study centres generally had the luxury to chose because of proximity considerations (centre), price (middle) or environment (outer). Choosing a mode of travel thereafter is far narrower, with 80% of trips made for convenience or necessity by car. The next section provides recommendations sanctioned in the literature, by most surveyed experts, and. tacitly, by the surveyed public.

6.13 Recommendations to reduce car use

For most of us, cars are a necessary part of our lives, our life-style. We are habituated to them. There are publications from the 1970s onward with coherent and useful lists of ways to reduce car use. Policy has embraced the need since the mid 1990s in Australia, although in countries like Holland and Germany (Pucher 1999), constrained car use policies have been in place for decades. Appealing to people on environmental grounds seems to have little impact, so facilitation and price signals seem appropriate, although politically very difficult. Increasing the sense that walking and cycling are ‘normal’, healthy pursuits may help remove the view that only poorer people walk to normal destinations under 1 Km, that only kids, the fitness conscious and the unemployed cycle for more than recreation.

There are ‘soft’ measures (Rye 1999), soft behavioural targets like ride share, planning and deferring trips, developing cycle projects to enhance that experience, and making

urban pedestrian routes, already used by ‘ pioneers’ along less car-used streets. Car pooling to bus stops can be encouraged, once the status of bus use is enhanced. There are many soft ways to encourage, facilitate and reward reduced car use, but it will take substantial infrastructure and pricing changes to make a great deal of difference. Secure parking and showers for cyclists, having realistic and safe alternatives to car use are all parts of a required multifaceted approach.

The mind set or internal space of the community has an influence on outcomes. Many employers in Britain were not entirely happy with the idea of Employer Transport Plans, whereas more in the Netherlands did support them (Rye 1999). There are cultural values embedded and reflected in decisions, although there is policy consensus that reductions in car use are desirable and needed.

Convivial open spaces, shade and seats with informal surveillance will help encourage people to move around without their cars. Much of the human scale (rather than car scale) infrastructure can be developed before there are any fuel price calamities. That requires local government to make investments ahead of the public demand.

Within the frame of the Figure 6.2.1 there are various attitude or value changes which will help reduce car use. Travelling in buses in the study centres was not seen as a particularly attractive behaviour. Buses may become more attractive if the services are perceived to be reliable. People increasingly like the convenience, flexibility, speed and security, offered by cars, with a declining interest in using public transport in Australia (Mathers 2000). With most respondents already possessing refined environmental values, it is clear that more than environmental concern is needed to draw many from their cars. Acceptance of impending and irreversible fuel price increases seems unlikely, although most of the Cairns/Townsville respondents could nominate strategies to reduce their car use once they feel they have to.

People act within their own values and context. A major factor in urban travel is the urban form and the choices and needs they have about moving through that urban form. Community integration, nodal development, attractive and relevant public transport (Cervero and Radisch 1996) is as necessary as safe non-motorised routes. Urban areas should be legible, easily ‘ read’ and understood, and permeable to non-motorised travel.

This may mean having short connecting lanes from courts to adjoining streets, footbridges over some waterways or major roads.

Newman and Kenworthy (1999; 144) see traffic calming in pedestrian precincts as necessary, along with quality in non car travel modes, urban villages, growth management and proper costing or taxing of car use. They write of reurbanisation, with many of their core views endorsed by Gleeson and Low (2000) and some of the more aware Cairns/Townsville respondents, eg respondent 416: "The establishing of villages within a metropolitan area separated by natural and rehabilitated corridors would reduce the desire to get away from the built environment, and basic services and entertainment would be readily accessible."

The best strategic planning methods now require input for the public and experts. An outcome of this thesis is feedback from experts to a summary (Appendix 26) sent to 40 experts (electronic copy is at back of this document) to develop an expert perspective indicating easy and effective ways to reduce car use.

Developing models and drawing on expert opinion does not guarantee identical outcomes, but it does help narrow the range of choice which planners and political decision-makers may wish to consider. Still *et al.* (1999) used three techniques for strategic planning – a Delphi panel of local experts, a static and a feed-back loop model to connect changing land use and transport. The results of their research indicate that modelling is far from finalised. Expert feedback on the Cairns/Townsville study most supported nodal development and legitimising safe, continuous paths. These results indicate that a simple survey of experts is a meaningful method to help focus and sequence planning issues.

There are many specific planning issues provided by residents (Appendix 6 and 12). The body of this thesis has only produced general recommendations, accepting that the detail of changes to reduce car use must fit the specific needs of the locality in question, once there is firm political and public commitment to reducing car use.

Being able to choose a home which is central to normal destinations, has a good natural environment and sense of safety are all important, as most travel flows to and from

home. Nodal urban form is almost certainly the preferred development direction, with medium density housing, attractive open space at the human scale, and a normative value which eschews car use for short or solo trips. Alternative fuels will become cost-competitive as petroleum prices rise, so that the role of cars as a major pollution source will slowly curtail. Government regulation and taxing may drive that development, but it will happen past the peak of petroleum production anyway.

Paying employees not to use their company car parks (Lewis 1998) may help a little, as may road costing to motorists. Cycling is highly efficient and uses little space per user. A small percentage of the Cairns/Townsville sample saw that cycling and walking would help reduce car use. Cycling has a lot of support in the literature, but a sense of being safe, and condoned by the community are important.

A final indication from this research is that we will probably conduct less urban travel in future. In the extreme, three car trips to the local shop in one morning is likely to become a thing of the past. Economic realities will prevail where environmental concern has not. The most energy efficient form of urban travel is to delay or cancel the need to travel. There are powerful arguments that cars have met an unfulfilled travel desire that will not be replaced (Wooton 1999). The model refers to the key component of urban sustainability: acceptance of reduced car use.

There are examples where a high regional goal of increased public transport use has been attained (FitzRoy and Smith 1998, Pucher 1998), but the kind of concerted thrust, built on examples where that has been a prime land use and infrastructure goal for decades has only recently developed relevance in Australia, where the car, despite current policy, is still facilitated.

Behaviour and value shifts by employers are seen as part of the solution to our overarching car dependence. By facilitating flexible hours, compressed working weeks (Hung 1996), ride sharing and telecommuting, along with facilitating flexible hours may ameliorate peak traffic enough to remove the need for road expansions. The consensus from the literature is that a cocktail of as many of the above programs at once will produce the greatest behavioural shift. Using techniques of social marketing

may help target the preferred behavioural shifts among the population groups most likely to undergo the preferred change.

Seeing urban travel as a derived demand of people moving about to meet their needs allows planners to reconfigure ‘ the problem’ into ways to reduce those needs, defer those needs, or have them met in a less transport-intense way. Australian urban theorists like Troy can develop a broad-scale approach to urban sustainability, by nurturing local social networks through such things as neighbourhood markets, allowing for local food production, with as many needs as possible met at the neighbourhood level, with higher needs available at larger nodes.

The following recommendations are drawn directly from the grouped expert’ s responses, an overview of urban change that is reinforced as acceptable to the public and planners. The recommendations are all likely to incur no net cost within the larger framework of time, resource and external costs developed throughout this thesis.

Recommendations

1 Ensure conditions which make walking, cycling and public transport use feel safe.

2 Create better walking, cycling and public transport infrastructure to help legitimise those activities.

3 A mix of responses is needed to reduce urban car use.

4 More assertively implement nodal development linking residential land use with proximate usual destinations.

5 Aggressively move to close the gap between policy and provision of non-car infrastructure.

6 Provide detailed route and times at each bus stop to help people identify and catch their required bus.

7 Facilitate walking and pushbike use through greater continuity of paths.

8 Pay proportionate registration through fuel price, financially rewarding low car use.

9 Encourage an understanding of environmental and dollar savings by making discretionary journeys outside the peak times.

10 Make city centres and urban nodes more people oriented, at the ' human scale' , with mixed land use and pedestrian zones.

11 Safety must be addressed for all non-car modes.

12 Facilitate walking and pushbike use by asking users or potential users to physically identify problem areas.

13 Develop interchanges where drive, cycle or walk to a bus or rail terminal is facilitated.

Reducing car use requires changed infrastructure, price signals and a normative shift. The infrastructure changes promoted by policy and theory have been elucidated, trending toward the walking techno-city. The abandonment of old urban travel behaviour for new is not so clear cut. Exhortations to drive less, walk and cycle more are true but trite. Reducing random spontaneous trips by deferred and carefully planned trips is a soft, easily achieved behaviour shift, once there is acceptance of the desirability of change. Ride sharing exists at the informal household scale. Encouraging institutions and employers to facilitate ridesharing through Employer Transport Plans and transparent database facilitation is a legitimate planning goal to link people, times and places will reduce parallel solo trips. On demand bus pick-ups, facilitated by GIS to provide ' real time' vehicle and potential passenger locations, is likely to become part of the Australian cocktail of car reduction strategies. The Cairns/Townsville urban travel research has shown that people are essentially aware of

a future need for change away from full, often solo car reliance. People are reluctant to sacrifice the convenience of their car use until something as good or better comes along, or they are forced to alternatives because of increased car costs.

6.14 Conclusions

Methodology

The methodology of the Cairns/Townsville urban travel research appears to have been substantiated, highlighting previously unknown behavioural and choice differences between inner, middle and outer urban dwellers. The methodology used two small north Queensland cities as a sample and bounded example of a portion of larger, more complex urban forms. By asking and analysing about urban travel as an activity of linked trips from home and back, along with various values and beliefs on home location, neighbourhood attachment and the environment, this research is embedded in the area of human geography which overlaps with psychology, sociology, environmental science and planning. The findings are relevant to all fields, although the outcome is intended to be a practical guide for planners to better understand the communities they are planning with and for.

Theory

Like many studies, the Cairns/Townsville work found a high and sophisticated environmental concern and awareness, essentially divorced from day to day travel behaviour. There was little linkage of our world view (Cutter 1994) to behaviour; not surprisingly, as "this link, to date, remains elusive." (Walmsley 1988; 109).

The explanatory model shows little link between internal and external space in this regard. Stern *et al.* (1995) allows that the connection between detailed personal behaviour and environmental issues of monumental concern is hard to make. More profoundly, Kitamura *et al.* (1999) suggest that there are issues where seemingly great personal effort or inconvenience would be felt to make virtually no difference overall. We have a behavioural dilemma where a perceived personal sacrifice would go unrewarded.

Appeals to change for the sake of the environment are unlikely to work. This is clear from the Cairns/Townsville urban travel research. People already care about the environment, generally understand the negative impacts of car use, but persist because of the convenience and independence. An extensive survey by Rye (1999) found that the majority of larger employers in Holland and Britain would or do support Employer Transport plans (to help employees reduce car use), but rarely for environmental reasons. Congestion was the main reason.

Overall results and inferences for change

The study has found that although Cairns and Townsville are 400 Km apart, their use of different travel modes and attitudes toward home location, neighbourhood attachment, the environment and travel issues were nearly identical. It is likely that the results could be generally extrapolated to non-metropolitan Australian cities. The sample is a group of people who care about the environment but do not particularly connect it with their daily use of the car. Most see that petroleum will be depleted within 40 years, but are only likely to change their car use as fuel prices rise. If 'soft' targets are promoted and facilitated, there is an incipient groundswell of people who would like to walk or cycle more if there were better, safer paths. People would like to work from home or ride share. There is an easy potential for schools to facilitate ride sharing and pushbike 'trains' from home to school and back.

Employers would find many who would like to travel outside the peak hour, if it were facilitated. In the year 2000 there is an understanding that car use will decline in the long term, but few external Government signals that there will be anything but continuation of the status quo. Development will continue on the urban fringe as a life-style choice, underwritten by the erroneous and unstated belief that fuel will remain cheap and freely available.

ESD requires public participation, so the research reported in the prior pages records people's current urban travel in Townsville and Cairns (North Queensland), and their attitude toward current and future urban travel. This research provides evidence of community support for ESD principles relating to sustainable urban travel, but also shows that the car, its freedom, convenience, security and speed is very much appreciated by most residents. There is a convergence of opinion among urban

planning theorists, government policy and the public about the need to reduce car use, but it will be difficult for most to reduce the amount of private car use currently enjoyed.

6.15 Significance of this research

The research has methodological significance. By stratifying the survey sample by zone, this research has found that travel patterns and household location choices are zone dependent, meaning that inner, middle and outer zone residents have different motives and needs. Because outer urban dwellers travel by car, on average, two to three times the distance of their more central counterparts, they present as the most transport disadvantaged in the coming years of increased fuel prices, suggesting preparations for that time are needed.

Open ended questions, rather than ' pick and tick' , although much harder to code, have a depth and range of response which make it the preferred questionnaire approach for all but the simplest of possible responses. Also, the questions on ways to reduce car use had multiple prompts, eliciting more responses from interviewees, so multiple prompting is recommended for core future survey questions.

This research has confirmed the earlier findings of the author and many other researchers who seek a link between environmental attitudes and behaviour- the links are tenuous at best. The research has found that the context of urban travel, what is available and deemed necessary in time, space, distance, travel modes and finances are likely to dictate travel behaviour, not environmental attitudes, beliefs or values. Thus, to change behaviour, the context needs to change.

Developing a questionnaire which itself represented part of an ESD process is an original contribution to Human Geography research, while further reinforcing the theoretical approach that urban travel is a derived demand, best studied as activity-based behaviour to fulfil needs which may be otherwise met without frequent solo car trips. The survey approach was informed by the view that urban travel is a derived demand, fully documenting trip chains.

This research set out specifically to test for the first time if choice of home location had a direct impact on consequent urban travel. Results show that distance of the chosen home from usual destinations is also a choice about how far, rather than how often, household members are likely to travel to achieve their derived travel demands.

The human activity approach has proved useful in understanding how people move around, and, through their designated destinations, why they move around. The methodology, through meaningful results and model building, has been substantiated. Future urban travel researchers may use detail of the survey development like including the destination "Supermarket", judged the most car dependant destination.

The Cairns/Townsville urban travel research, like others, shows how space, time and activity are linked. People set out to satisfy a need, or a set of needs, within certain constraints, often including a time budget. Because of their convenience and relative speed, time in urban travel seems central to people' s expressed support for cars.

Seeking the value-laden outcome of easy, preferred ways to reduce car use, this research sits uniquely at the confluence of science, Government policy, planning theory and public participation in planning. The method of polling experts proved relatively inexpensive and effective. The strongly supported need to accelerate implementation of planning policy is one clear outcome of that survey methodology.

The Cairns/Townsville urban travel research has added to the recently escalating interest in global to local implications of the embracing philosophy of sustainability, concentrating on energy supply, use and values, focused on urban travel. It has shown there is a high level of environmental awareness in North Queensland. Because Australians are often exposed to the same information from the national media, it is reasonable to generalise the Cairns/Townsville display of environmental awareness and concern to the national level. People know and care about human impacts on environmental integrity, but rarely link it to our own behaviour or impacts.

Further, the research shows that urban North Queenslanders are aware of the impacts of car use, are aware of alternatives, but those alternatives are not properly catered for, are ' for losers' (outside normative behaviour) or are perceived by a significant minority as

dangerous. This research indicates that price signals will force the normative shift in travel behaviour advocated by theory, policy and more aware residents. Only with substantially increased fuel prices is there likely to be any major behaviour shift away from often single occupancy vehicles.

Development of a theoretical model for change represents an original outcome of this research, showing how behaviour and preferred urban travel rests deeply on the combination of price signals, how people think and feel, and on the landuse patterns and urban structures connected with urban mobility.

This research has significance for Government, because it shows that the Australian public concurs with government policy to reduce car use. This research thus challenges public servants charged with policy implementation to inform, facilitate and encourage the public to consider travel as an integral and major issue in choice of household location. Responsible government is challenged to improve the continuity, surfaces and safety of walking and cycling paths, and curb greater facilitation of cars in favour of other urban travel modes. There was cautious public support to investigate use of urban rail in the two centres. Government agencies, as considerable employers obliged to subscribe to current government policies to reduce car use, are encouraged to develop Employer Traffic Plans.

This research has significance to schools and larger employers, because they can help reduce cars used for commuting during the peak hour by facilitating Employer (or school children) Travel Plans. Finally, the research has significance to residents of the two centres, and Australian residents more broadly. Residents care about the environment but often do not factor in detailed travel implications of their housing choice. They need to be informed of inevitable fuel price increases so they can plan and lobby accordingly. The implication for the survey participants, hopefully, is that their public input to the planning process has and will make a difference to the long term quality of the urban experience.

Study results imply that the research methodology is sound and further studies relating to urban mobility may be achieved using this methodology, although the need for such detailed survey data would be reduced in any future applied survey work. Factor

analysis has shown that many of the questions could be collapsed together. For instance, neighbourhood attachment would be accurately indicated by two questions, not six asked in the 1996/97 survey. Similarly the group of questions on environmental values could be greatly reduced, just using the identified indicators. Other questions could be selected on the target purpose of the proposed survey, and results incorporated into the analysis frame developed through this research, but requiring a far shorter questionnaire (Appendix 25) and relatively easy analysis.

The recommendations to help reduce car reliance are to make non-car travel modes more attractive, minimise further facilitation of car use, encourage planned multi-purpose trips, ride sharing and delaying discretionary trips.

Timing discretionary trips outside the peak travel times will postpone the need for costly expansions to the road infrastructure. Working from home one day per week reduces commuting by 20%. Linking personal car use to wider issues of resource depletion and pollution, and having respected community members ' model' preferred behaviour are all likely to reduce car use.

There is convergence between theory, policy and public perception about a more sustainable future urban travel. There is a need for structural and behavioural changes to reduce our car dependence, and the most powerful single tool to achieve that is economic. When the full external costs of our daily car dependence are incorporated ' at the bowser' , and other modes are made to seem safe, cheap and attractive, the evolution of cities into a fully multi-nodal settlements with appealing non-car travel linkages should help reduce car dependence.

As the peak of petroleum production approaches in the near future, the crude prices of petroleum are likely to trigger many of the recommendations developed though this research. The only real issue for political structures and planners is how prepared we will be to meet the quantum shift away from frivolous and solo car use.