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Understanding variations in travel time to access key activities for accessibility planning

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Abstract

Accessibility is a key element of transport and a goal of transport planning. The process of accessibility planning uses accessibility indicators as a basis for transport planning to improve accessibility to key activities. Setting accessibility indicators and thresholds for different trip purposes is typically based on current actual travel behaviour from travel surveys such as median travel times. To help develop indicators for accessibility planning and understand community perceptions of acceptable access times to key life opportunities, the paper analyses existing travel time behaviour in Sydney to access important daily activities. Analysis focuses on variation in travel time for the trip purposes of primary education, tertiary education, commute to work, medical and dental, shopping, recreation and entertainment activities by location, mode and demographic characteristics using 13 years of Household Travel Survey data from Sydney. Implications for accessibility planning of variations in actual travel time, including much longer travel time by public transport than by car, are discussed.

1. Introduction

Governments take a triple bottom line approach in framing high level objectives for the transport system. Objectives include providing access to opportunities to support economic activity (both for industry and for workers), providing access to opportunities for social and equity objectives, and providing access to encourage environmental sustainability. When considering the role of public transport as part of the transport system, it is more unusual to find objectives for the public transport system framed so generally. In NSW, as with many other jurisdictions, accessing opportunities such as work, education, health care and other activities using public transport is usually defined by reference to access to public transport itself, with the implicit assumption that public transport permits accessibility to opportunities. This is evident in the Service Planning Guidelines for bus services in Sydney (NSW Ministry of Transport 2006) where the target for public transport is expressed in terms of the percentage of households within a 400 m or 800 m distance of a public transport service.

There are often more specific targets for public transport. In NSW, for example, the State Plan (NSW Government 2010) contains two public transport related targets. There is a set of mode share targets for the journey to work by public transport to selected centres. There is a second target to increase the population with access within 30 minutes by public transport to a centre which is large enough to provide a range of activities and services. The rationale is that accessing a certain size centre provides multiple opportunities (services, education, access to the public transport network) so the time target may be considered an efficient way of stating an “accessibility to multiple opportunity” target. These targets were set by the former Labor Government and may not necessarily be retained by the new Liberal/National Government elected in March 2011.

The underlying motivation for this paper is the link between public transport accessibility and accessibility to opportunities to fulfil social objectives, specifically to support social inclusion (and minimise social exclusion). Social exclusion is a complex, multi-dimensional concept and individuals at risk of social exclusion may exhibit more than one element of vulnerability. A very general definition is to recognise that an individual can be socially excluded if they are unable to access activities, available to the majority of people in society, which give rise to an acceptable quality of life. Transport disadvantage is more specific and relates to the social exclusion of an individual through lack of transport access to opportunities whether this results from income or absence of transport opportunities for some other reason such as no public transport service or no car access.

In meeting social objectives, particularly to promote social inclusion, public transport has a critical role as many potentially excluded individuals do not have access to opportunities by private transport. This is why accessibility is a key element of public transport and a goal of public transport planning. Within transport planning, accessibility refers to the 'ease' of reaching destinations. It can be measured in time, distance or 'generalised cost' which is a combination of time and money. Improved accessibility in this context relates to improved 'ease' of access or improved spatial access.

Accessibility planning is the process of using accessibility indicators as a basis for transport planning. The structured approach of accessibility planning assesses actual accessibility to opportunities such as work, education and health care at different spatial levels against indicators to identify accessibility inequities as the basis for developing and implementing plans to improve accessibility. Strategically, accessibility planning can form the basis of evidence-based decision making in the allocation of resources to improve accessibility and improve social inclusion.

Daniels and Mulley (2010) discussed the research and policy issues of introducing accessibility planning in Australia, based on the UK approach. An input to setting targets in accessibility planning is understanding current travel time to access key activities, and any variations in travel time by mode, location and demographic characteristics.

This paper analyses existing travel time, based on actual trips made by people, to access key opportunities of work, education, health care, retail and recreational opportunities in Sydney. Understanding current travel is a pre-requisite to developing an accessibility planning framework where existing travel patterns can be used to examine whether the allocation of existing resources provides equity in access to opportunities. The analysis of existing patterns of travel times to reach key activities is an important benchmark with which to link an understanding of community perceptions of acceptable access times to key life opportunities. It provides a benchmark by which to examine equality of access by different socio and spatial factors and provides an evidence base to consider changes in public transport resourcing to enhance access to particular key opportunities by types of individual and or spatial location.

The paper is structured as follows: section 2 provides background on travel time research, section 3 describes the data used to analyse travel times in Sydney, section 4 presents the results by different trip purposes, section 5 discusses implications for accessibility planning, and section 6 makes conclusions.

2. Travel time to activities

The existing literature has focused on total daily travel time, and time to access various activities. These are considered in turn in the next two sections.

2.1 Total daily travel time

Much research on travel time has focused on total daily travel time, and establishing whether there is a constant daily travel time or not, known as a "travel time budget". The Marchetti

principle (Marchetti 1994) states that people do not travel more than an hour a day on average. However, the interpretation depends on the level of aggregation and averaging of data. The literature has suggested that total daily travel time shows remarkable consistency over time (Goodwin 2005).

In Sydney, Milthorpe (2007) found there has been an increase in the average daily travel times in the period 1981 to 2005, a result consistent with findings from North America and some European countries but in contrast to the findings in Great Britain. The paper highlights issues of aggregation and averaging, where the analysis and reporting of mean travel time masks the considerable variation between individuals. In particular, the paper reports variation in the daily travel times between genders and age groups, and between residents of different geographic regions. It concluded that the evidence from the Sydney Household Travel Survey does not support the concept of constant travel time as a fundamental principle of travel behaviour in Sydney."

Research may have focused on daily travel times as much data comes from one-day travel diaries. Data over longer time periods is desirable to understand travel time variations, and multi-day data collection based on respondents carrying GPS devices is a step in this direction (Stopher et al. 2010).

2.2 Access times to different activities: understanding thresholds

The literature on daily travel budgets suggests that individuals may be trading between their ideal opportunity and an opportunity that can be accessed within an acceptable time. This section examines how access times to different activities vary by and within different jurisdictions. The evidence here is more limited since few countries have adopted the UK approach to accessibility planning which makes this information more easily available.

UK

The accessibility indicators for the UK are summarised in Table 1. For each core indicator it is possible to compare accessibility for a journey purpose for the entire relevant population and for those deemed to be an appropriate proxy for people at risk of social exclusion.

Table 1 UK Core accessibility indicators

Purpose	Indicator
Education – primary and secondary	% of a) pupils of compulsory school age; b) pupils of compulsory school age in receipt of free school meals within 15 and 30 minutes of a primary school and 20 and 40 minutes of a secondary school by public transport
Education – tertiary	% of 16-19 year olds within 30 and 60 minutes of a further education establishment by public transport
Work	% of a) people of working age (16-74); b) people in receipt of Jobseekers' allowance within 20 and 40 minutes of work by public transport
Health – Hospital	% of a) households; b) households without access to a car within 30 and 60 minutes of a hospital by public transport
Health – GP	% of a) households; b) households without access to a car within 15 and 30 minutes of a GP by public transport
Major Centre	% of a) households; b) households without access to a car within 15 and 30 minutes of a major centre by public transport

Source: UK DfT (2005)

All the indicators relate to total travel time by 'public transport', where public transport includes: registered bus services; flexibly routed services which are available to the general public, and which have a defined area of operation (though comprehensive data on these may not be available for the 2004 indicators); and walk and, where appropriate (secondary school, further education, work, major centres), cycle modes.

The travel time benchmarks used in these indicators were based on actual travel behaviour from the UK National Travel Survey on median travel times for different trip purposes where the lower threshold is usually approximately the median time (that is the time boundary that includes half of the trips), with the upper threshold set at twice the lower one (UK Department for Transport 2005).

Halden (2011) noted for the UK that lower income groups spend more time than higher income groups travelling for shopping and personal business (the largely market based services), but spend less time travelling for work and education. Low income groups spend less time travelling for sport and leisure activities.

Europe

Raux et al. (2011) focused on time budgets for travel and out-of-home activities in eight European cities and the determinants of an individual's daily travel time budget and trip duration to various activities. They found males have a longer travel time budget compared with females, younger people (under 15 years) have a shorter travel time budget when compared with adults over 65 years, while those between 15 and 65 years have a longer travel time budget, and the presence of children under 12 years or living as a couple induces a shorter travel time budget. In terms of trip duration, Raux et al. (2011, p. 406) found that controlling for mode, the higher the density, the longer trip duration, interpreted as "the result of two opposite effects, the one exerted by spatial proximity to amenities, the other by congestion following from density, the second one being stronger". In terms of age, Raux et al. (2011, p. 408) found "youngsters under 15 have shorter trip durations (and shorter travel time budgets). Youngsters between 15 and 25 have shorter trip durations for school and shopping/personal business purposes but a longer travel time budget: they may compensate by more trips overall. Older people (over 55 years) have longer trip durations whatever the trip purpose but a shorter travel time budget: they may compensate by fewer trips overall."

Australia

In Australia, Dodson et al. (2010) investigated the travel behaviour patterns of socially disadvantaged groups using household travel survey data from the Gold Coast, Queensland, in the context of understanding transport disadvantage and the transport dimensions of environmental justice. However, they focused on trip rates, travel mode, and number of km travelled by modes. They did not investigate travel time or trip duration.

In Sydney, Transport Data Centre (2010) reports Household Travel Survey data on average trip times for different purposes in Sydney, and that average trip duration by purpose has not changed significantly over time. Transport Data Centre (2006) indicates how travel behaviour such as total travel time per person per day, total vehicle time and mode use varies across the ten Metropolitan Strategy subregions in Sydney. However it is reported at a highly aggregate level, and does not indicate variations in travel time by trip purpose.

3. Description of data for Sydney

Household Travel Survey data for Sydney is analysed to explore and understand current travel time thresholds for different trip purposes in different locations and for different demographic groups.

3.1 Source of data

The Household Travel Survey (HTS) is the largest and most comprehensive source of personal travel data for the Sydney Greater Metropolitan Area and is a benchmark for best practice in travel surveys in Australia and around the world. It is a continuous survey, running every day since 1997/98. For the 13 years, there are approximately 35,000 trip records per year and over 400,000 trip records in total. It is a face-to-face interview survey collecting data on the travel of every member of the survey household for one day, as well as socio-demographic data on the household. The HTS provides detailed data on travel

behaviour in Sydney, the Illawarra and the Hunter regions for various trip purposes such as commuting, education, childcare, personal business, retail, and social/recreational. Similar household travel surveys are also conducted in other Australian cities, such as VISTA in Melbourne, although surveys are less frequent than in Sydney.

3.2 Data issues

Trip purposes and trips from home

Due to the purpose of understanding travel time for accessibility planning, analysis focuses on trips from home for the following trip purposes:

- Education – primary: trips from home to primary education, undertaken by children on weekdays.
- Education – tertiary: trips from home to tertiary education including universities and TAFEs.
- Work: trips from home to full-time work. Part-time work was excluded due to the lower proportion of part-time work trips originating from home.
- Medical/dental trips: trips from home for the purpose of medical or dental purposes. It includes GPs and specialists and hospitals. It does not include visiting people in hospital. It is a subset of personal business trips.
- Shopping: trips from home to shopping, where shopping represents purchases of goods, which may range from food to clothes and other household items.
- Recreation: trips from home for recreation purposes. Recreation trips are generally considered to be for, but not excluded to, the purpose of leisure and exercise activities, usually involving a level of physical activity. Trips tend to be to outside destinations involving the natural environment.
- Entertainment: trips from home to attend entertainment. Entertainment trips are generally considered to be for, but not excluded to, the purpose of cultural, social activity and personal learning activities, not usually involving physical activity. Trips tend to be to inside destinations involving the built environment.

Not all trip purposes have detailed sub-categories available.

Table 2 shows the proportion of trips for each trip purpose which are made from home. Most of the education and work trips start from home. About half of all shopping trips are made from home, as shopping trips are more likely to be associated with other purposes such as shopping trips undertaken from work during the lunch hour.

Table 2 Trips from home as a proportion of all trips by trip destination, Sydney

Purpose	No. of trips from home	Total trips	% of trips which are from home
Education - primary	4,104	4,847	85%
Education - tertiary	1,256	1,752	72%
Full-time work	12,127	14,905	81%
Medical/dental	1,756	2,634	67%
Shopping	18,250	39,228	47%
Recreation	7,541	12,073	62%
Entertainment	9,663	20,613	47%

Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

Sample size

To ensure sufficient sample size, all 13 waves of HTS data from 1997/98 to 2009/10 were combined as preliminary analysis indicated there was no change in average trip duration over the waves. But due to sample size, some analysis by demographic and trip

characteristics is limited. The analysis uses unweighted data based on the number of trips in the sample. It is not expanded up to represent the total population in Sydney.

Demographic and trip characteristics

Trip travel time is reported by demographic characteristics including sex (male and female), age, household car ownership (yes, no), and household income (in quartiles based on the whole sample), and trip characteristics such as priority mode (car, public transport and walk only), day of week of trip (weekday, weekend) and home location (ABS Statistical Subdivisions in Sydney, see Figure A1 in Appendix).

Trip travel time is calculated from the respondent identifying what time they left home and what time they arrived at their destination. There is a tendency for respondents to round to 5 minutes. Thus median trip durations are often in multiples of 5 minutes. For public transport trips, the travel time includes the access and egress trips to public transport, while walk mode represents walk only trips.

4. Analysis of travel time variations in Sydney

Table 3 summarises the median travel time for the seven trip purposes of education–primary, education–tertiary, full-time work, medical/dental, shopping, recreation and entertainment, by the key demographic and trip variables. There is more variation in mean travel time than median travel time, but the median is reported as it indicates that 50% of people achieve their purpose in this time. The 75th percentile, reported in the subsequent Figures, indicates that 75% of people achieve their purpose within this time (and that correspondingly 25% of trips are longer than this time).

The following sections focus on analysis of variation in travel time for each trip purpose by demographic and trip variables including median travel time, and the interquartile range (25th – 75th percentile). Analysis varies according to the trip purpose, based on the nature of the trip purpose and the sample size available for each trip purpose. Key findings across all purposes and implications for accessibility planning are discussed in section 5.

Table 3 Median travel time (minutes) for trip purpose by selected demographic and trip variables

		Education-primary		Education-tertiary		Full-time work		Medical/dental		Shopping		Recreation		Entertainment	
		N	Median	N	Median	N	Median	N	Median	N	Median	N	Median	N	Median
Total	Total	4,104	10	1,256	40	12,127	30	1,756	15	18,250	10	7,541	15	9,663	15
Day	Weekday	4,081	10	1,209	40	11,295	30	1,587	15	10,979	10	4,648	15	4,620	15
	Weekend	23	12	47	40	832	20	169	14	7,271	10	2,893	15	5,043	15
Sex	Male	2,116	10	633	40	7,249	30	744	15	8,179	10	3,589	15	4,582	15
	Female	1,988	10	623	40	4,878	30	1,012	15	10,071	10	3,952	15	5,081	15
Age (years)	0-4	49	10					104	15	74	15	508	13	367	15
	5-14	4,055	10					94	15	673	10	871	10	1,149	15
	15-19			366	50	323	25	67	10	787	10	340	15	658	15
	20-24			497	40	1,329	35	56	14	1,092	10	361	15	668	15
	25-34			234	30	3,302	33	163	15	2,900	10	971	15	1,299	15
	35-44			82	30	2,920	30	252	15	3,587	10	1,122	15	1,511	15
	45-54			51	25	2,788	30	258	15	3,418	10	1,171	15	1,383	15
	55-64			24	33	1,334	30	265	15	2,548	10	1,065	18	1,178	15
	65 and over			2	43	131	25	497	15	3,171	10	1,132	15	1,450	15
Household income	1st quartile (lowest)	1,121	10	465	35	910	30	654	15	5,477	10	1,899	15	2,526	15
	2nd quartile	1,140	10	288	40	3,037	30	414	15	4,481	10	1,690	15	2,278	15
	3rd quartile	890	10	264	43	4,078	30	315	15	4,030	10	1,748	15	2,350	15
	4th quartile (highest)	953	10	239	45	4,102	33	373	15	4,262	10	2,204	15	2,509	15
Household car ownership	No	194	10	217	35	650	43	185	30	1,770	15	577	20	833	17
	Yes	3,910	10	1,039	40	11,477	30	1,571	15	16,480	10	6,964	15	8,830	15
Priority mode	Car	2,680	10	486	30	8,240	25	1,390	15	13,255	10	3,351	15	7,487	15
	Public Transport	474	30	620	60	3,338	55	191	48	1,252	39	325	65	882	52
	Walk	950	10	150	15	549	15	175	15	3,743	10	3,865	15	1,294	10
H'hold location (Statistical Subdivision)	Inner Sydney	164	10	166	30	1,117	30	90	20	1,560	10	761	15	890	15
	Eastern Suburbs	227	10	137	22	860	30	103	15	1,279	10	812	15	910	15
	St George-Sutherland	288	9	80	55	1,051	30	156	15	1,546	10	621	15	896	15
	Canterbury-Bankstown	327	10	66	51	841	30	142	11	1,420	10	480	16	682	20
	Fairfield-Liverpool	366	10	106	45	889	30	145	15	1,376	10	326	15	571	15
	Outer Sth Western Sydney	329	10	49	30	693	40	116	15	1,035	10	201	16	398	15
	Inner Western Sydney	250	10	103	47	840	30	119	18	1,216	10	498	15	692	15
	Central Western Sydney	332	10	98	45	927	30	137	15	1,299	10	443	15	592	15
	Outer Western Sydney	387	10	60	30	739	30	110	15	1,107	10	308	15	572	15
	Blacktown	204	10	41	50	522	30	65	15	685	10	167	15	375	15
	Lower Northern Sydney	189	10	124	33	1,050	30	135	15	1,317	10	729	15	784	15
	Central Northern Sydney	481	10	143	50	1,253	38	200	15	1,957	10	841	15	1,045	15
	Northern Beaches	241	10	51	55	751	33	106	15	1,206	10	765	15	568	15
	Gosford-Wyong	319	10	32	63	594	30	132	15	1,247	10	589	15	688	13

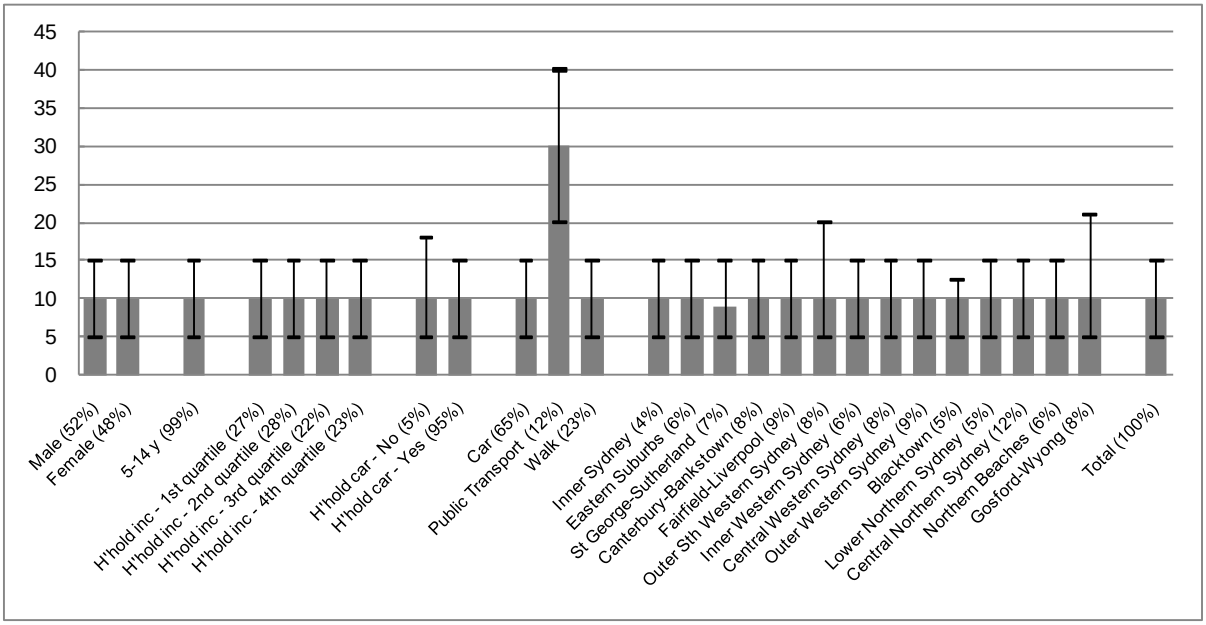
Source: Bureau of Transport Statistics Request No.11/150, Household Travel Survey 1997/98 to 2009/10, Sydney Statistical Division. Figure A1 shows Statistical Subdivisions.

4.1 Access to education – primary

Unlike many other trip purposes, education–primary trips are made by one age group (5-14 years), and on weekdays only. The HTS does not record whether the school is a government school or private school. This is relevant to travel time since a private school is likely to be further away from home than the local government school. Approximately 70% of primary students attended government schools and 30% attended non-government schools in NSW in 2010 (Australian Bureau of Statistics 2011).

The median travel time for education–primary trips is 10 minutes. Figure 1 shows primary education travel time does not vary much with respect to any of the categories, with the exception of mode. Trips by public transport trips are three times longer in median duration than car or walk trips. In Sydney, education-primary trips are longer in Outer South Western Sydney and Gosford-Wyong, and shorter in Blacktown as shown by the 75th percentile.

Figure 1 Education-primary trips: variation in travel time in minutes (median, 25th and 75th percentiles)



Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

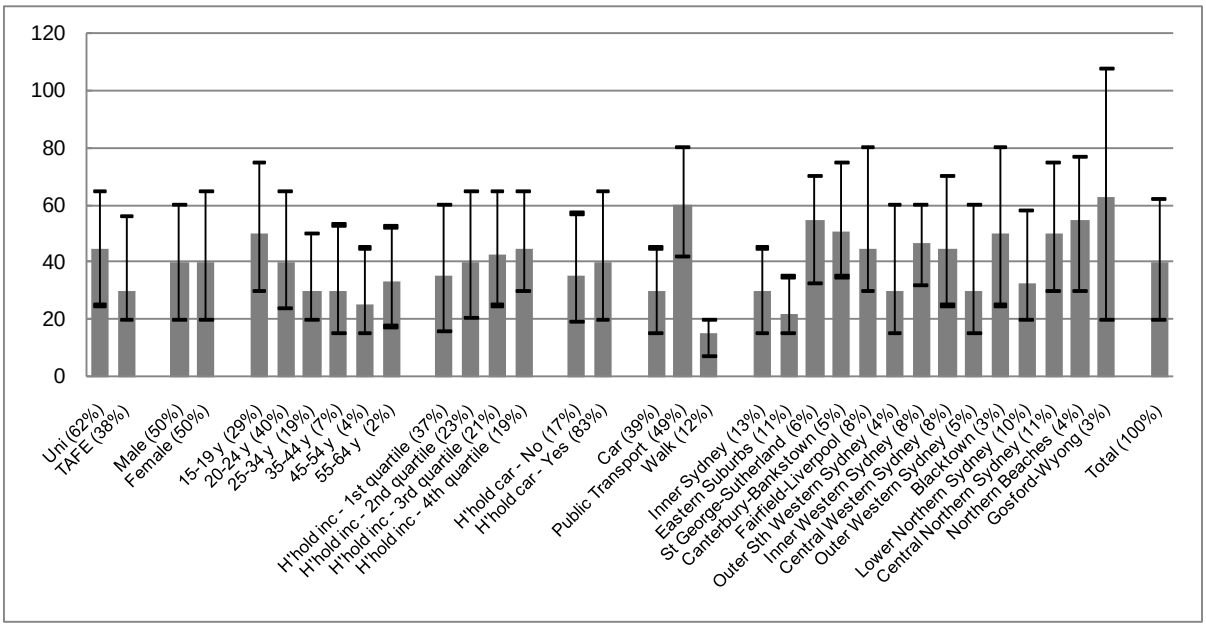
4.2 Access to education – tertiary

Over 70% of education–tertiary trips are made from home. As these trips are trips from home, they most likely are full-time students and exclude part-time students who attend after work. Like education–primary trips, education to university and TAFE trips are mostly made on weekdays and by younger age groups although not as restricted in age as education–primary trips. An element of choice is involved as different institutions offer different courses, but students may have to travel longer to reach the course of their choice. There are more TAFEs than universities, but a higher proportion of education–tertiary trips from home are to universities (62%) than to TAFEs (38%).

The median duration for education–tertiary trips is 40 minutes, the longest of any trip purpose. Trips to universities are longer than trips to TAFEs. Figure 2 shows variations by characteristics. As with other trip purposes, there is a large difference by mode, with the median duration for public transport trips about twice as long as car trips. In contrast to other trip purposes, trips from no car households are shorter in time than those from households with cars. By location, there is much variation in trip duration by region in Sydney, but there are small samples in some areas as shown in Table 3. Education–tertiary purpose shows the most variation in travel time by location of any trip purpose. Trips in Gosford-Wyong are

very long, as shown by the median and 75th percentile but there are only 32 trips in the sample. Trips from the Eastern Suburbs and Inner Sydney are noticeably shorter, reflecting student home location relative to the University of Sydney, University of NSW and University of Technology, Sydney.

Figure 2 Education-tertiary trips: variation in travel time in minutes (median, 25th and 75th percentiles)

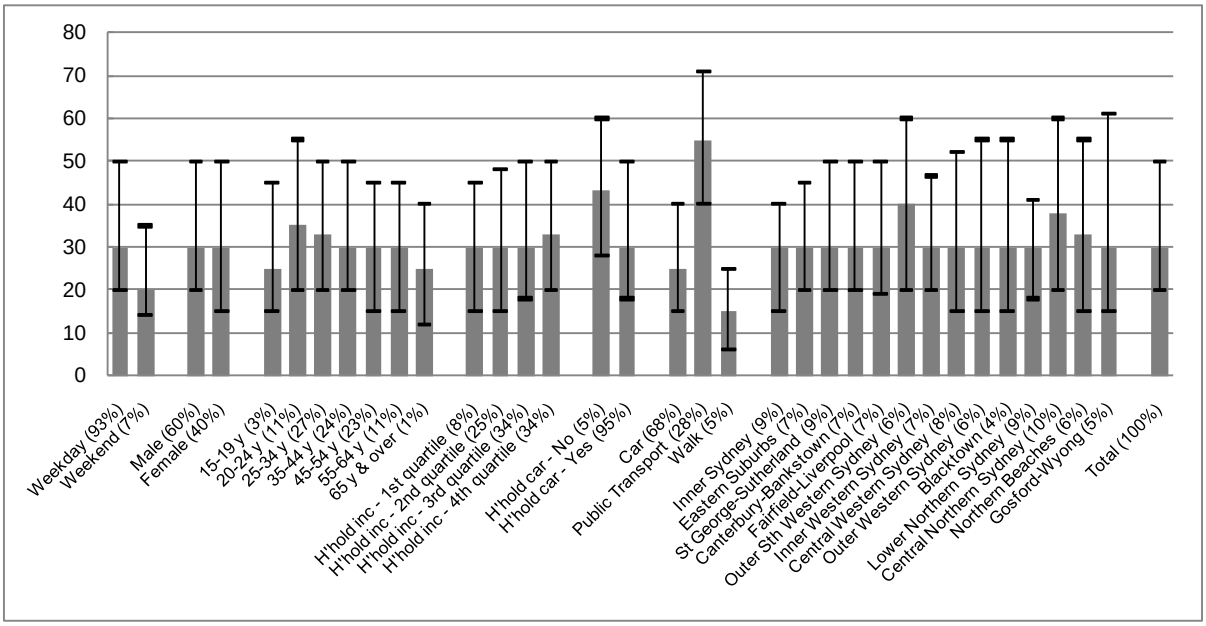


Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

4.3 Access to work

Over 80% of trips to full-time work are made from home. The median duration for full-time work trips is 30 minutes. Figure 3 shows variations by characteristics. Trips on the weekend are shorter than on weekdays, possibly reflecting the nature of weekend jobs in retail and hospitality which are more locally based and more evenly distributed close to homes. As for education–tertiary trips, public transport trips are twice the median duration of car trips. As expected, trips by no car households are longer in time than those from households with cars. The effect of age on travel time is striking: median travel time (and 75th percentile) decreases with age. Travel time at the 75th percentile increases with household income. By location, Outer South Western Sydney has the longest median travel time, while that area, Central Northern Sydney and Gosford-Wyong also have long travel time at the 75th percentile of 60 minutes, meaning 25% of trips are longer than 60 minutes.

Figure 3 Work (full-time) trips: variation in travel time in minutes (median, 25th and 75th percentiles)

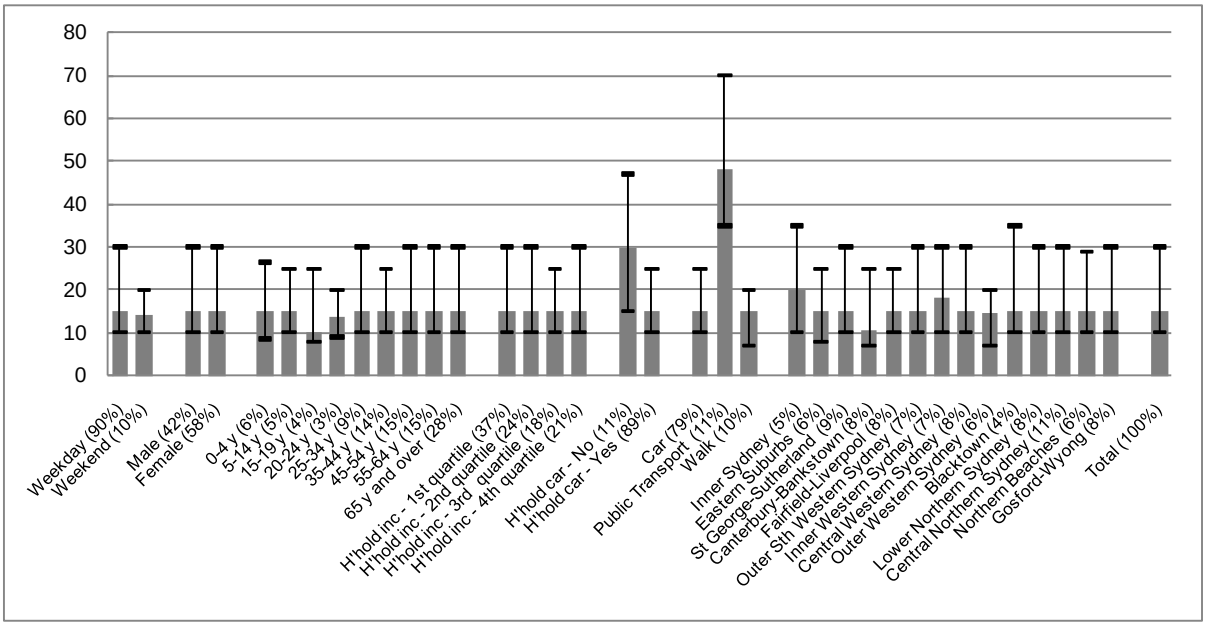


Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

4.4 Medical and dental

Medical and dental trips include trips to local GPs as well as to specialist medical appointments in medical centres or hospitals. The purpose does not include visiting people in hospital. People over 65 years make over a quarter of medical/dental trips from home, which is disproportionately high compared to other trip purposes. The median duration for medical/dental trips is 15 minutes. Figure 4 shows variations by characteristics. There is difference in travel time by mode and by household car ownership: for public transport trips, the median travel time of 48 minutes is more than three times longer than the median of 15 minutes for car trips. By location, Inner Sydney has the longest median travel time at 20 minutes while Inner Sydney and Blacktown have long travel times at the 75th percentile. This variation by location could have multiple inter-related causes including the location of specialists and hospitals, use of public transport, and health status in different locations with a different mix of GP vs specialists as destinations. Medical and dental is the only trip purpose where Inner Sydney has longer travel times than outer areas.

Figure 4 Medical and dental trips: variation in travel time in minutes (median, 25th and 75th percentiles)



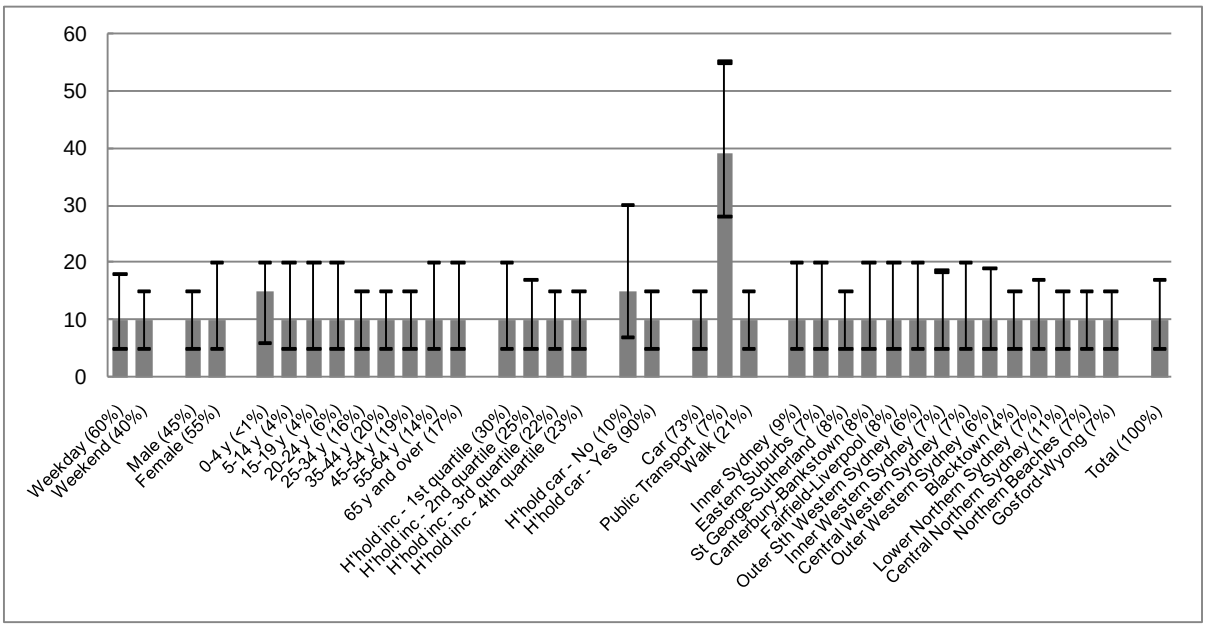
Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

4.5 Access to shopping

Of the purposes selected for this paper, shopping purpose represents the largest number of trips from home, although shopping trips have the lowest proportion of trips which are made from home (46% of all shopping trips). Shopping includes food and other goods. Food shopping is of most interest for use in accessibility planning, but no further breakdown of type of shopping is available from the data.

The median travel time for shopping trips is 10 minutes, the shortest of all purposes reflecting the local base for shopping. Figure 5 shows variations by characteristics. Once again, there is a large difference in median travel time by mode, with median travel time for shopping trips by public transport four times longer than by car, the greatest difference of any trip purpose. Travel time at the 75th percentile decreases as household income increases. The 25th percentile of 5 minutes and median travel time of 10 minutes is consistent across all locations.

Figure 5 Shopping trips: variation in travel time in minutes (median, 25th and 75th percentiles)



Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

4.6 Access to recreation and entertainment

Access to recreation and entertainment is important for social inclusion. A diverse range of activities and destinations is captured in these trip purposes. The median travel time is 15 minutes for recreation trips and 15 minutes for entertainment trips. Figure 6 and Figure 7 show variations by characteristics. Once again, public transport trips for recreation are longer than car trips, about four times as long as car trips, although there are very few trips by public transport for recreation. A high proportion of recreation and entertainment trips occur on weekends. Weekend trips are longer than weekday trips for recreation, but travel time does not vary for entertainment trips.

By location, Outer Western Sydney, Blacktown and Gosford-Wyong have shorter recreation trips at the 75th percentile than other areas, possibly reflecting closer location by walking to recreational opportunities in the natural environment. For entertainment trips, St George-Sutherland, Northern Beaches and Gosford-Wyong have shorter trips at the 75th percentile, possibly reflecting a focus on more local destinations.

The mix of activities covered in recreation and entertainment may explain the little observed differences by characteristics (other than mode). If the aim is to recognise the importance of social interactions in a social inclusion policy, these travel purposes may need to be more disaggregated.

Figure 6 Recreation trips: variation in travel time in minutes (median, 25th and 75th percentiles)

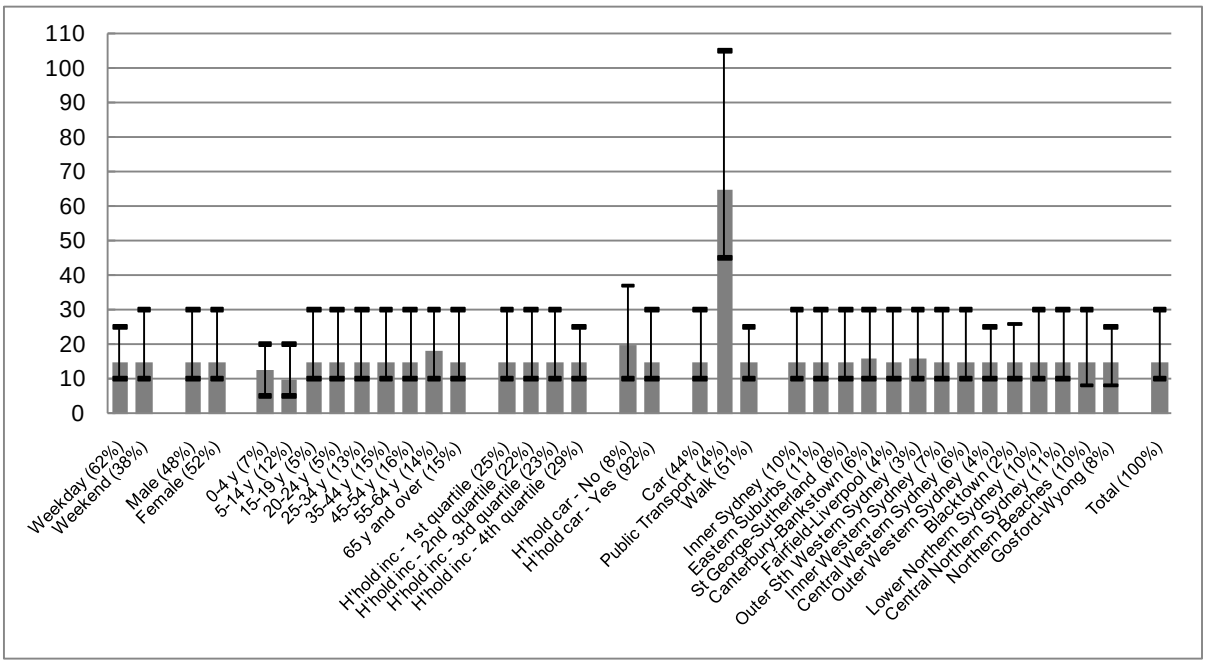
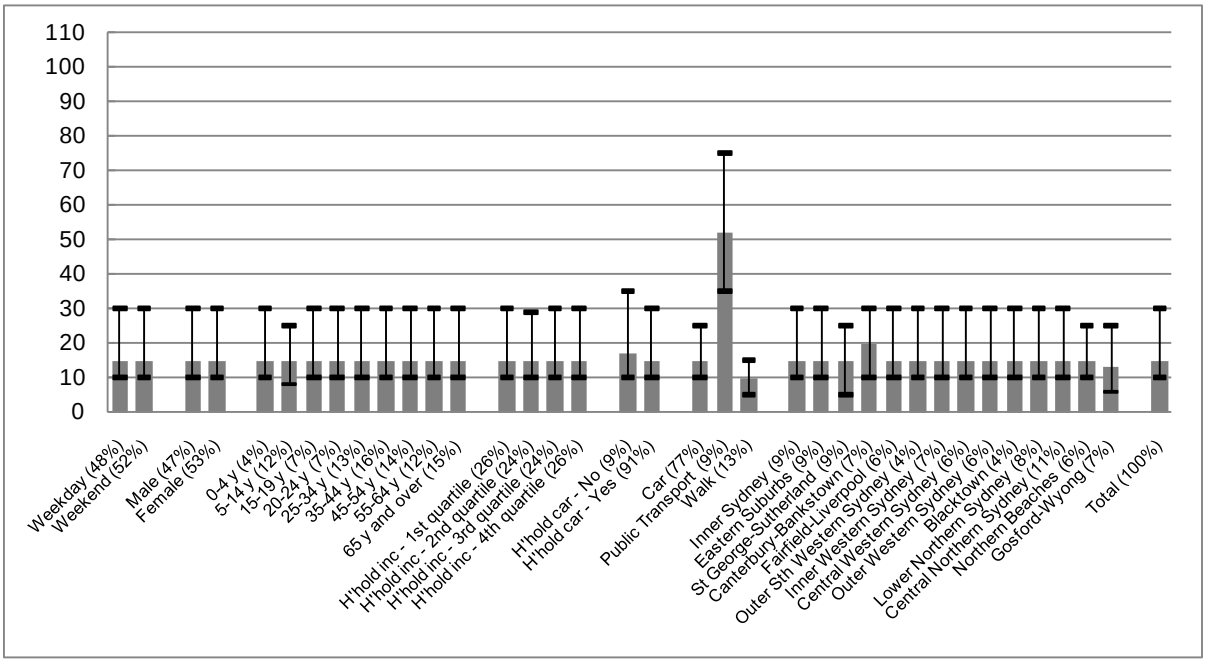


Figure 7 Entertainment trips: variation in travel time in minutes (median, 25th and 75th percentiles)



Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

5. Discussion

The analysis of travel time and variations in travel time highlights several interesting issues including the role of mode in travel time, implications for accessibility planning, and responding to disadvantage through allocation of transport and land use resources.

5.1 Understanding variations in travel time

The most striking variation in travel time for each purpose is by mode, with public transport trips much longer than car or walk trips. For six of the seven trip purposes, the 25th percentile

time for public transport is higher than the 75th percentile time for car trips. For the other trip purpose of education-tertiary, the 25th and 75th percentiles are similar. Table 4 shows the ratio of public transport trip travel time to car trip travel time (for both the median and mean). For work and education trips which are mostly undertaken in the peak, the public transport median travel time is only two times longer than median car travel time. But for shopping and recreation trips, which are often off-peak trips, public transport trips are four times longer in median than car trips. Off-peak public transport services have lower frequency which increases travel time if transfers are required and there are fewer express and limited stop services which also increases travel time in the off-peak.

Table 4 Ratio of public transport travel time to car travel time

		Median travel time (minutes)			Mean travel time (minutes)		
Purpose	% of trips by public transport	Car	Public transport	Ratio of PT: car	Car	Public transport	Ratio of PT: car
Education - primary	12%	10	30	3.0	10	32	3.0
Education - tertiary	49%	30	60	2.0	31	65	2.1
Full-time work	28%	25	55	2.2	29	59	2.0
Medical/dental	11%	15	48	3.2	18	58	3.2
Shopping	7%	10	39	3.9	13	46	3.5
Recreation	4%	15	65	4.3	23	92	4.0
Entertainment	9%	15	52	3.5	20	64	3.1

Source: Bureau of Transport Statistics Request No.11/150, HTS 1997/98 to 2009/10, Sydney Statistical Division

After mode, the most striking variation is by location. But the impact of location varies by trip purpose. It is not always the same areas with the shortest or longest travel times for each purpose. Locational variation reflects the location of facilities such as education and health institutions, with implications for land use planning.

In terms of demographic characteristics, there was variation in travel time by household car ownership, which is closely related to travel mode. There was no variation in travel time by sex, little variation by age, and some variation by household income.

Further work on understanding variations in travel time includes using current travel behaviour data and combining it with other data on the location of facilities such as schools, universities, doctors and hospitals.

5.2 Implications for accessibility planning

Data issues

In using information on current travel behaviour in accessibility planning, data limitations must be recognised. One-day travel diaries do not record the frequency of travel. This makes it difficult to determine to what extent people may travel further, but less often for some activities. This is a common issue with other data sources, but the large sample size of the Household Travel Survey over 13 years makes this less of a limitation. Travel diary data does not identify barriers or attitudes to travel which may limit how far people travel. Non-time barriers to accessibility include cost of travel, information, and perceptions of safety and security which can influence choice of destinations and choice of mode. People may prefer to travel shorter times but facilities are not available closer, or people may prefer to travel further to better facilities but they cannot. There is no measure of the quality of the activity, or people's satisfaction with the destination they have travelled to. In addition, travel time to activities reflects the location and distribution of land uses.

Using travel time

To understand the relationship between travel time in Sydney and the UK, Table 5 summarises median travel times and the equivalent UK national indicators (from Table 1). It is important to recognise that different trip purposes will have different levels of importance to individuals. Thus the different trip purposes discussed in this paper should not be directly compared. Table 5 shows that actual travel times by public transport in Sydney (measured by median time) are much longer than in the UK. Public transport use is lower in Sydney than in the UK. The UK national accessibility indicators refer to the median and twice the median to identify areas of relative disadvantage, and disadvantaged groups. They are not targets in the sense that it is the aim for all trips to be less than the thresholds. In addition to the core national accessibility indicators, local authorities may identify relevant local accessibility indicators.

In setting indicators of disadvantage or inequity, means, medians, 75th percentiles or 90th percentiles could be selected. Each would have different implications for identifying areas of disadvantage. A key issue in setting targets or thresholds for access to key activities is to what extent accessibility indicators can and/or should recognise and reflect choice. Travel times longer than the 75th percentile probably represent an element of choice.

Table 5 Using travel time variation to set accessibility indicators

Purpose	Mode	Travel time (minutes)		
		Sydney Median	Sydney 75th percentile	UK (Median and 2 x median)
Education-primary	Total	10	15	
	Public Transport	30	40	15 mins, 30 mins by public transport
Education-tertiary	Total	40	62	
	Public Transport	60	80	30 mins, 60 mins by public transport
Work (full-time)	Total	30	50	
	Public Transport	55	71	20 mins, 40 mins by public transport
Medical/dental	Total	15	30	15 mins, 30 mins (GP) by pt
	Public Transport	48	70	20 mins, 60 mins (hospital) by pt
Shopping*	Total	10	17	
	Public Transport	39	55	15 mins, 30 mins major centre by pt
Recreation	Total	15	30	NA
	Public Transport	65	105	
Entertainment	Total	15	30	NA
	Public Transport	52	75	

Note: *Purpose not directly comparable between Sydney and UK.

5.3 Responding to disadvantage: allocating transport resources (and land use)

Analysis of travel time has implications for allocating transport and land use resources. Preliminary analysis of travel time highlights the much longer time for trips to access activities by public transport. Access to shopping to public transport could be improved by improving off-peak public transport.

In some cases, addressing travel times requires changes to land use, rather than transport. The travel time analysis suggests the need to improve access to tertiary education in Gosford-Wyong and to medical/dental opportunities in Inner Sydney and in Blacktown.

6. Conclusions

There are many issues in implementing accessibility planning, identified in Daniels and Mulley (2010). One of these is understanding current travel and developing indicators which can be used to identify areas of relative disadvantage. Household travel survey data can be analysed to understand current travel behaviour in travel time to access key activities of education, work, health care and retail. Analysis of median and percentiles shows how trip

travel time varies most markedly by mode, with public transport trips at least twice as long, and up to four times as long as car trips by purpose.

The analysis provides a basis for firstly developing indicators, and secondly establishing targets and benchmarks in an accessibility planning framework. Household travel survey data can be supplemented by other data to more fully understand reasons for differences in travel times, and the most appropriate solutions to improve equity – whether transport and/or land use.

There are opportunities to include accessibility indicators and targets in the current national urban policy process. Infrastructure Australia (2010) acknowledged accessibility as a measure of the liveability and social inclusion of major cities. The federal government released national urban policy discussion papers in early 2011 and its National Urban Policy, *Our Cities Our Future*, in May 2011 (Department of Infrastructure and Transport 2011). The policy has a strong focus on public transport including the need to improve accessibility, reduce people's dependency on the car, and develop high quality public transport and infrastructure systems to ease congestion and improve quality of life.

Future research to support accessibility planning includes understanding community perceptions of standards for accessibility, as identified in Daniels and Mulley (2010). It is important to identify what is in the "basket of accessibility" – what services and activities should people have access to, and access within what time frames by what modes is considered an appropriate community standard. This understanding of current access times can be used in community surveys to investigate community standards for accessibility.

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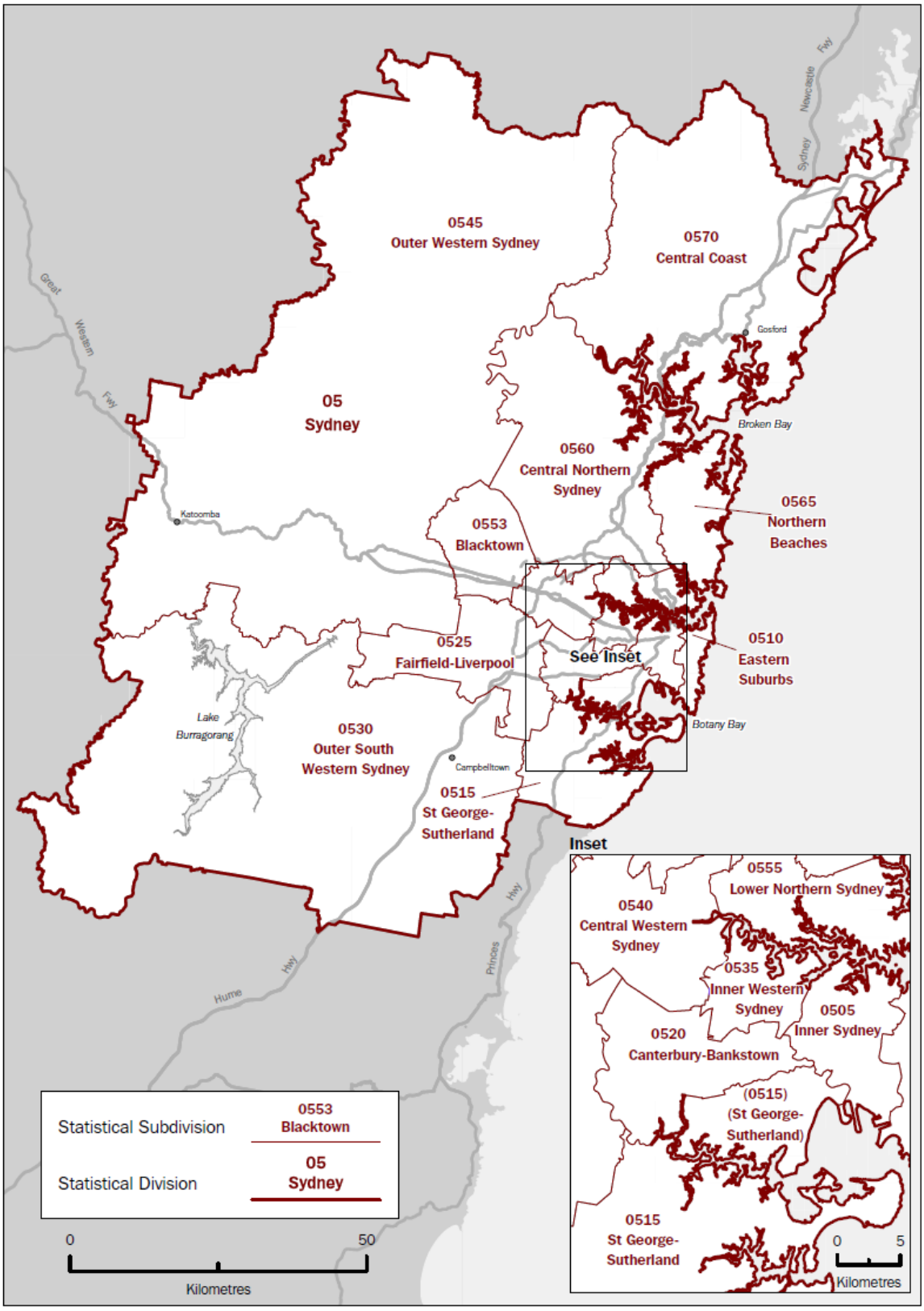
Appendix: Figure A1 Location of Statistical Subdivisions in Sydney



Source: Australian Bureau of Statistics (2009) *Australian Standard Geographical Classification (ASGC), Australia maps, July 2010*. ABS Catalogue No. 1216.0. http://www.abs.gov.au/ausstats/abs@.nsf/mf/1216.0