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Planning for structural transit in low density environments: the case of Canberra, Australia

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Canberra, the capital of Australia, is a city with two modes of mechanised passenger travel: traditional bus and automobile. Canberra's population of 352,000 is relatively spread out with a low overall average population density. Recently, the local government (the government of the Australian Capital Territory) submitted a bid to the Australian federal government to fund a light-rail system for the city. This paper examines the issues of serving low and medium density communities with light rail, using Canberra as a case study. The paper qualitatively and quantitatively outlines the socioeconomic and demographic profile of Canberra, with a focus on centres of population and economic density; reviews the literature on Light-Rail Transit (LRT) and other 'structural' transit, which includes significant fixed capital investment such as Bus-Rapid Transit (BRT) for low-to-medium density areas; and analyses what an LRT in Canberra would look like if it is to be financially and operationally sustainable.

Keywords: urban mass transit; land use planning; density planning; light rail; bus rapid transport

1. Introduction

What is the critical mass of population size and density, economic activity and financial base beyond which 'structural' transit alternatives (i.e. bus rapid transit (BRT) and light-rail transit (LRT)) become viable for a given service area? Can structural transit attract and carry enough passengers per peak-hour, per direction, to justify its initial investment cost? These are key questions that small and medium-sized city governments often must ask when considering investment in such alternatives.

Canberra, the capital city of Australia, is an example of such a city that is currently considering building an LRT. Opponents of such plans argue that the city is too small in population, not densely populated enough, full of car-loving people and does not have, nor ever will have, the sorts of traffic congestion that would require expansion of transit beyond traditional buses. But proponents argue that there are viable service areas for an LRT and that population and development trends in the city will require structural transit investments. The local Canberra government recently submitted a bid to the Australian federal government to fund a light-rail system for the city, but for the reasons just mentioned, it is a controversial proposal.

This paper examines the issues of serving low and medium density communities with light rail, using Canberra as a case study. This article reviews the literature on LRT for low-to-medium density areas; qualitatively and quantitatively characterises the socioeconomic and demographic profile of Canberra; analyses what an LRT in Canberra could look like if it is to be financially and operationally sustainable; and develops some 'lessons learned'.

2. Canberra: a planned city

Canberra is one of a few cities in the world to be completely planned and created as a national capital. (Brasilia, Brazil, and Washington, DC, are two other prominent examples). Canberra was created after the 1901 Federation as a compromise between potential sites and leading Australian cities Sydney and Melbourne. Situated inland, in the middle of rolling scrub country that Australians colloquially designate as 'the bush', there was little in the way of prior settlement, providing a blank slate for urban design. To contain the city, a new administrative unit called the Australian Capital Territory (ACT) was created, equivalent to an Australian State, although without its full powers and much smaller in geographic size. New South Wales (NSW), the State containing Sydney,

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ceded the necessary land on its southern border (ABS, 2002).

The Australian government sponsored an international competition for design of the new city in 1911. The winner of that competition was an American architect named Walter Burley Griffin, a former collaborator of Frank Lloyd Wright, who came up with a design with streets organised along radial arterials (similar in concept to the Washington, DC, plan), and an artificial lake separating north and south sides of the city (Birrell, 1964).

Griffin did not just devise a static master plan. He also considered how the new city should grow and adopted a modular approach in which small local communities, called 'suburbs', would be the basic building block outward from the core downtown (called 'Civic'). Each suburb was designed to be relatively self-sustaining, with residents supplied by a set of local 'shops' for essentials. These shops would be within walking distance from everyone living in that particular suburb. In this way, Canberra residents would retain a feeling of local community even as the larger urban area grew (Birrell, 1964).

An obvious question, which Griffin did not ignore, was how people were to get around the city, from suburb to suburb, as it grew. The presence of a core set of shops in each suburb that people could walk to limited the need for mechanised trips and had other social benefits, but this design device did not completely eliminate the need for such transport. Thus, Griffin built into his plan a tram system to connect the suburbs. With these two struts of local shops and trams in place, Griffin's vision could be fulfilled without the full surrender to the automobile contemplated and celebrated by other modernist architectural contemporaries such as Le Corbusier (McGregor, 2009).

In fact, there was deviation from these two basic premises of Griffin's vision almost immediately, even with Griffin appointed for a time as planning tsar for the new locale. In particular, Griffin's concept of four radial avenues, Northbourne, Southbourne, Westbourne and Eastbourne, never got past the building of the first of that list. Perhaps more significantly from a transport point of view, the tram, which Griffin had planned for, even to the extent of placement of service yards, and a right-of-way in the middle of Northbourne Avenue, was shelved completely. Although there was an intention to build the system, delays in building the suburbs, followed by the financial scarcities of the Great Depression, caused this element to wither away (McGregor, 2009).

However, Canberra has proceeded to grow along the lines of Griffin's vision of suburbs. The building of local shops has not always been followed through in the construction of more contemporary suburbs and some existing shops have faded away with time. Still, while spread out, Canberra has mostly avoided the suburban sprawl that other communities of its size and density have exhibited (ABS, 2002). Canberra is different from those other communities because its dispersion is guided by certain embedded planning principles. Average overall density is quite low, but there are more dense population centres, with varying degrees of local services contained within those centres and land releases on the fringe are strictly controlled. Because of Griffin's imperatives, there are nodes of dense activity that can be more readily adapted to transit than more typical fringe development.

3. Canberra's spatial and demographic outlines

The overall area of the ACT amounts to 2,358 square kilometres with a 2009 population of 352,000. Canberra is the major population centre in the area, although neighbour Queanbeyan has an estimated population of approximately 40,600. Other significant towns include Bugendore, (2,200), Yass (14,800), and Palerang (14,300) (ABS, 2010). Sydney, the closest large city, is approximately 300 km to the northwest.

Canberra has experienced rapid population growth over the past 50 years, although the rate of growth has slowed significantly over the past ten. From a population of only around 10,000 in 1939, and with a renewed commitment in the mid-1950s by the Commonwealth government to fully develop the ACT and locate of the public service there, the city grew to approximately 50,000 by 1960, to 200,000 by 1976 continuing to add another 70,000 by 1988. The remaining 70,000 residents have been added since then and growth is projected to continue at about 1% per annum through 2030 (ABS, 2002). Figure 1 shows Canberra and its suburbs, and the surrounding region.

Table 1 shows some basic comparative data for Canberra and the other Australian capital cities.

These data indicate that Canberra has a mix of elements both favourable and unfavourable to transit. Comparing Canberra with Sydney, the Australian city with the highest transit mode share, one can see that Canberra has a much smaller total population and a much lower average population density. These characteristics make a high-quality, high-frequency transit service hard to run without significant subsidy. On the other hand there are definite town centres and population/activity clusters that could serve as the basis for economically viable transit stops. Moreover,

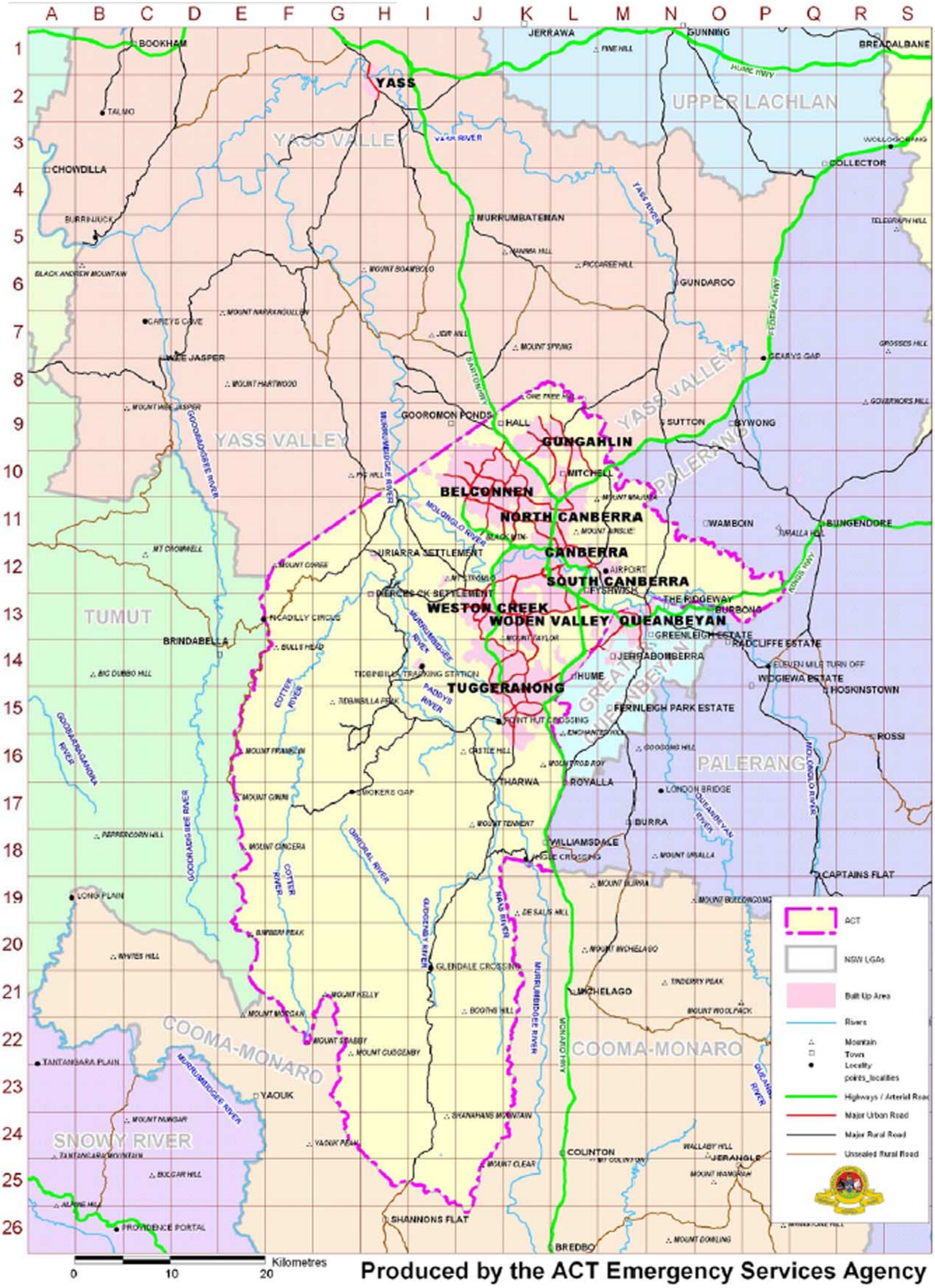

Figure 1. Canberra and surrounding region. http://www.esa.act.gov.au/ESAWebsite/content_esa/bushfires/during_a_bushfire/act_handy_map/act_handy_map.html (source, ACT Emergency Services Agency)

Table 1. Selected population and government data for Australian capital cities.

	Sydney	Melbourne	Brisbane	Adelaide	Perth	Hobart	Darwin	Canberra
1. Population (2006) millions (per cent of total population) (IA MCU, 2010, 9)	4.39 (20.52)	3.89 (18.16)	1.95 (9.08)	1.11 (5.47)	1.60 (7.48)	0.21 (0.98)	0.11 (0.56)	0.35 (1.84)
2. Pop per square kilometre (2006) (IA MCU, 2010 40	2037	1586	918	1374	1213	1027	845	1081
3. Number of LGA's in city (2006) (IA MCA, 2010, 128)	43	31	5	19	30	7	3	NA
4. Transport costs as a percent of household income (2003/4) (Dodson and Sipe, 2007)	14.8	15.2	16.2	15.4	15.3	NA	NA	14.4

Note: IA MCU used different city areas than ABS in calculating population per sq km. Thus figures reported here differ from ones calculated by the ABS and which are used for Canberra in the main text.

Canberra is administratively compact, and does not contain multiple, and sometimes competing local jurisdictions that can hamper transport plans, as can be the case in other Australian capital cities such as Sydney.

Moreover, density figures as generally reported can be misleading since they cover jurisdictional boundaries that usually do not correspond to service areas for transit, areas that might well be much denser than the overall city itself. The key measure here is ridership density rather than population density. This is where the story in Canberra becomes more interesting, for population densities and growth in population vary widely across the suburbs. As such, there might well be corridors that could sustain peak-hour passenger loadings that could justify the capital cost of an LRT.

4. Tipping points for LRT: what the literature says

When is it viable to construct and operate an LRT? There are three basic dimensions to consider in answering this question: cost, density and operating environment.

First, cost: an LRT represents a substantial capital investment for any area considering building one. A meta-review of literature on capital costs of LRT by Zhang (2009), focusing on North American systems, estimated that the average capital cost per route mile was $26.4 million (all figures in 1990 US dollars). The capital costs ranged from $9.4 million to $90.19 million across LRT systems. These average capital costs were more than twice as high as those for bus rapid transit (BRT) but lower than those for traditional heavy-rail metro systems.

Once built, LRT generally had lower operating costs because it offers higher passenger capacity. However, the literature does not seem to find this as a given. Zhang notes that per revenue-mile, LRT actually has higher operating costs as compared to BRT. Other measures, such as cost per rider and cost per mile, often reverse this relationship. The key might be revenue collected per mile: LRT costs more to build than BRT and obviously much more than regular bus service so if it fails to attract enough riders, or if fares are set too low, this would push up the revenue-mile operating costs. Vigrass and Smith (2005) note that in the United Kingdom, where LRT projects must demonstrate in advance that they recover operating and maintenance costs, such unit operating costs are lower than in France where there are no such requirements. In addition, there are cases of specific LRTs that have lower operating and capital costs than some specific BRTs.

Density is the next dimension for LRT viability. In general, the threshold for a viable LRT is seen as around 2223 people per square kilometre assuming four people per dwelling (which is a 'conservative' assumption given that average household size in Australia was approximately 2.6 in 2008 – ABS, 2010). This is as compared to a 988 people per square kilometre threshold for traditional bus service (Zhang, 2009, and author calculations). This metric does not consider economic activity patterns that generate trips; as an extreme example, a very dense population where all leisure and work takes place at home would not generate sufficient trips to support an LRT. In addition, these are population density figures, whereas the key variable may be ridership density. Nonetheless these basic rules-of-thumb suggest a starting point for analysing the numbers needed to support a given transit mode, with LRT being on the higher end of the scale in terms of minimum density.

Finally there is operating environment. This is a catch-all term that includes factors such as fiscal capacity, governance institutions, socioeconomy, physical geography/topography and individual attitudes towards modes. If cost and density can be considered necessary conditions for LRT adoption, these other factors can be seen as the sufficient conditions that tip a community into or out of such adoption. For example many dense cities in developing countries do not have the fiscal capacity to build an LRT even though the fundamental economics might support adoption of such a mode. Similarly, there are physically rugged island communities (e.g. Hawaii) that have dense population pockets separated by impassable ranges. Communities of similar densities with different operating environments might well be able to build a viable system.

5. The past and prospect of LRT in Canberra

Canberra has relied solely on traditional buses for passenger mass transit. Buses are administered by an agency known as ACTION and attract relatively little patronage. In 2006, modes for journeys-to-work broke down as 72.3% car drivers, 8.7% car passengers, 7.9% public transport, walking 4.9%, cycling 2.5%, and ‘other’ 3.6%. Compared with Australian averages, Canberrans drove and cycled more, walked about the same and used public transport less. It should be noted, though, that the overall Australian usage of transit is not especially high, around 10% (ABS, 2010).

This state of affairs has long been seen as static and unchanging. Canberra has been characterised as a ‘car town’ by people no less prominent than the Territory’s Transport Minister. However, in 2008 there was a shift at the political level regarding official attitudes.

This shift had two election cycles behind it. The first was a national election that swept to power a new Labor Party government in November 2007, displacing the more conservative ‘Coalition’ government of Prime Minister John Howard. The new Prime Minister, Kevin Rudd, announced that he was creating a new body called Infrastructure Australia (IA) which would be considering and funding new investments of ‘strategic’ significance.

The second election cycle was within the ACT the following November (2008). The ACT is a long-time Labor Party stronghold and the long-serving ACT Chief Minister, John Stanhope, saw a danger of losing his own re-election because of voter tedium. With his party now in power nationally and with that government calling for infrastructure ideas Stanhope sensed an opportunity. He announced, several months before the election that his government was going to submit a proposal to IA for an LRT in Canberra.

The initial proposal consisted of a LRT costed at $A1 billion, with few details given, and a number of seemingly extraneous elements including road improvements (ACT, 2008d). The ACT government was hoping for full payment of the project by the national government but the policy shift was significant: an LRT was now an official policy objective of the ACT government.

In October 2008, the Stanhope government lost its majority in the Territory Assembly but remained as a minority government supported by the Green party. (The primary opposition party, the Liberals, failed to capitalise on voter fatigue and actually lost one seat.) Although chastened by the electorate, John Stanhope remained as Chief Minister and with the Greens part of his legislative support (they chose not to seek seats in the cabinet, choosing to remain independent but nonetheless explicitly aligning themselves with Labor) the LRT proposal remained as part of the policy agenda.

The proposal then continued to make its way through official processes. IA asked that the ACT government prepare a ‘business case’ and the government contracted with Price Waterhouse Coopers (PWC) to prepare and submit this case which, after a delay, was made public on the internet (ACT, 2008a). In December of 2008, IA announced that a Canberra LRT was on its ‘longlist’ of projects that ‘may’ attract funding; the estimated cost was given as a single line-item of $A2.95 billion (ACT, 2009). IA has not yet made a decision on this proposal, but thus far the project has notionally survived.

Canberra could now be facing the question of what an LRT there should look like. Using the three dimensions above – cost, density and operating environment – does a Canberra LRT actually make any sense?

In terms of population size and density, one could benchmark Canberra against other places that currently have an LRT. Comparisons with other Australian localities would be the first choice of benchmark, but Australian settlements follow a basically bimodal distribution: large cities and their suburbs or ‘country towns’. Because of its planned nature, Canberra’s size is unique in Australia.

An alternative could be a comparison with the US. The US is similar to Australia in that it covers a very large geographic area and has many communities of comparable size. Moreover, some of these communities are relatively isolated, not part of an overall dense network, as is the case in much of Europe. Thus, for rough comparative purposes, the US is used as a benchmark here.

US cities that have LRTs operating for urban populations equal to or less than that of Canberra include Trenton, New Jersey, and Tacoma, Washington. One of these, Trenton, is the state capital of New Jersey, a symbolic parallel to Canberra and the ACT. It is perhaps of some importance to note that most other country capitals around the world have rail transit, although of course most of these cities are far bigger than Canberra (though Washington, DC's population is not especially large in gross terms at 588,292 as of 2007) (APTA, 2008).

Of course most cities with light rail are nonetheless far bigger than Canberra, especially if metropolitan populations are taken into account. Indeed many rail systems serve metro areas rather than just urban cores and Canberra's metro population is not especially large as far as any proposed service area for transit would be concerned. If one looks at overall population density, Canberra's density of 142.1 people per sq km (as of June 2006) is well below that of most other cities with rail transit.

According to detailed ABS estimates for 2006, a majority of Canberra suburbs have population densities greater than 1000 people per square kilometre (the actual count is 58). More than a few, such as Braddon, Turner, Page, Scullin, and Banks, have densities greater than 2000, sometimes well above 2000. Kingston is just short with 1975.3. Palmerston has the highest population density in the ACT at 3038.3 (ABS, 2010).

Densities such as these are comparable to the densities of US cities that have light rail including some big ones. There are 30 urban light rail systems in the US and seven of them have population densities between 1000 and 1600, putting them well within the range of the majority of Canberra suburbs. These include cities such as Houston, Dallas, San Diego and Denver. The large and growing system in Salt Lake City actually covers an urban area with a population density of just 643.3. Canberra has significant pockets of density that approach densities in older and tighter cities such as Cleveland, Pittsburgh, San Jose, CA, St. Louis, Minneapolis and Seattle (APTA, 2008).

It is also interesting to see where population growth is occurring in the ACT. From 1996–2006, there have been clear growth pockets well above the average for the ACT and Australia as a whole in three major areas – the Civic core; Gungahlin and surrounding suburbs to the north of Civic; and Kingston-Manuka to the south. Some well-above-average growth is occurring in pockets of the Woden Valley. These are areas where the ACT government is funnelling a lot of development and all of these areas currently have high population densities, certain to increase with time. There are also some dense suburbs adjacent to these growth pockets that have very high densities. (However, even with high measured density, a particular suburb may still have low travel demand depending upon its land-use and zoning patterns, e.g. where there is a lot of parkland that raises average local density but still yields relatively little activity density.)

From an LRT perspective, many of these suburbs represent centres of activity that could serve as transit stops. These suburbs generally run along a north-south axis with the downtown (Civic) at its centre The ACT IA submission contains a notional LRT network map which is reproduced in Figure 2. The route running from 'Gungahlin' in the north through Civic (the dot just below 'Canberra') and down to 'Woden' is a route that passes through or near most of the population centres noted above and which are generally the consensus for where initial structural transit alternatives should be placed. North of Civic they also happen to be along or near Northbourne Avenue, which is where Griffin placed rights-of-way for his tram system.

More specifically, major population centres are rather conveniently located along a northeast to southwest axis, starting with the newest major centre of Gungahlin then running south through Civic, Woden and Tuggeranong. Lying off of this axis is Belconnen, which lies to the northwest of Civic and the southwest of Gungahlin. If one were to build an LRT along existing roads, the obvious choices would be to run down Flemington Road out of Gungahlin, a street that directly runs into Griffin's original corridor choice of Northbourne Avenue. The route could then continue through Civic and south, across the Lake, along Commonwealth Avenue into Parliamentary Circle and then continuing south around Capital Circle and down Adelaide Avenue and Yarra Glen Road into Woden Town Centre. The service could terminate there or continue down Athllon Drive and Langdon Avenue into Tuggeranong.

The disadvantage of using this particular alignment is that the corridor is currently well served by the existing arterial and high frequency 'Intertown' Bus Service. An alternative routing would keep the Gungahlin/Flemington Road portion and part of the Northbourne Avenue connection but then hook off to the east along Limestone Avenue, off to Anzac Parade and across the Kings Avenue Bridge where the service could potentially make use of existing track and track alignments used by the CountryLink intercity train, which runs through Kingston and Fyshwick. The rail could then spur down along Hindmarsh Drive into Woden. This latter alternative

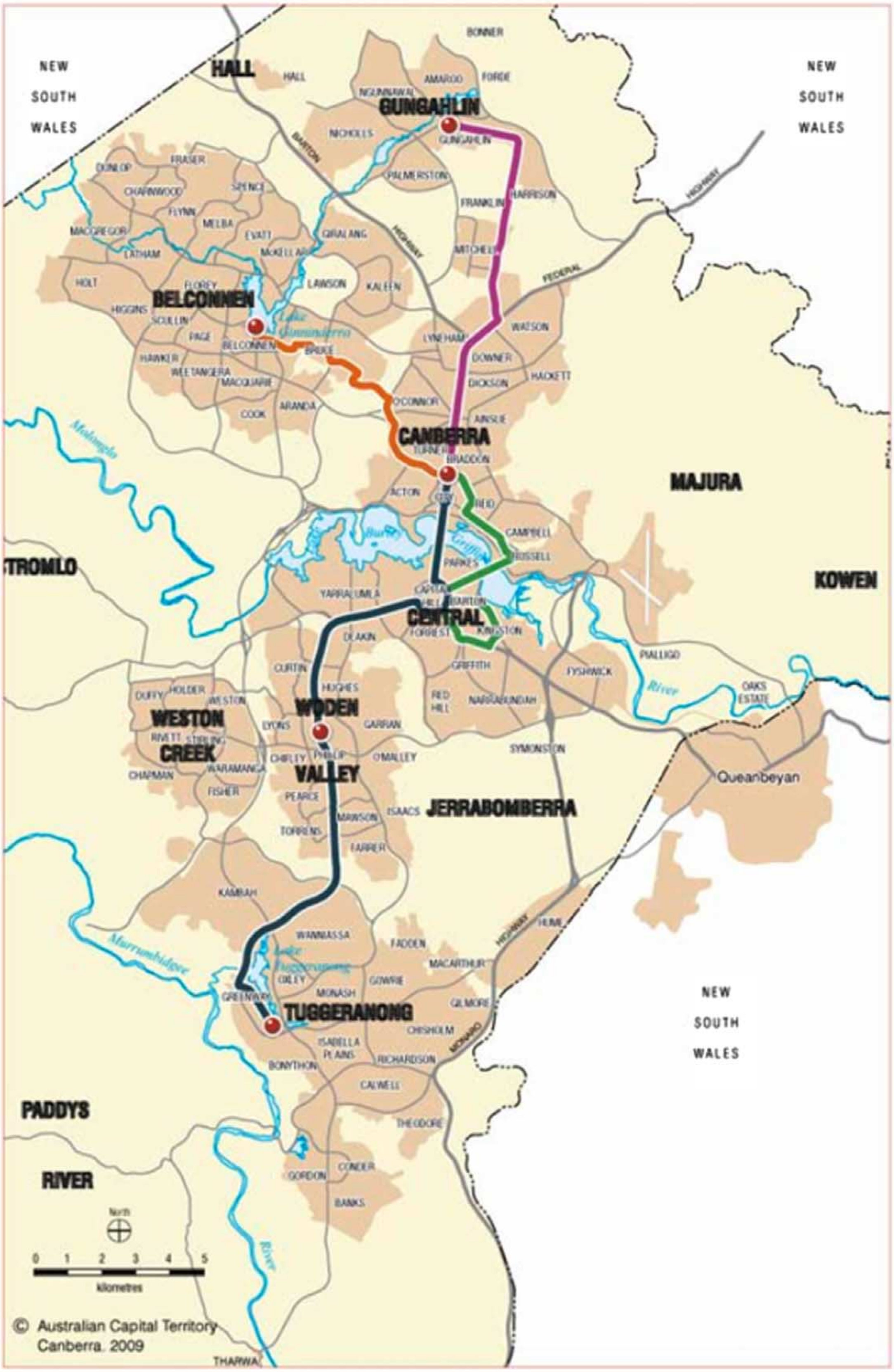

Figure 2. Proposed routes of the light rail system (indicative only).

expands upon rather than duplicates the Intertown service, uses existing rail ROW for a portion of the route and uses another of the corridors – Limestone Avenue – that Griffin anticipated using for a tram. However, the route is somewhat more circuitous and the LRT down the monument-filled ANZAC Parade could present some planning and community challenges.

Belconnen does not fit well into these axial corridor options. The cheapest option for service there would be to feed into the LRT corridor with buses, possibly a suitably redesigned Intertown bus. An expensive alternative would be to build an LRT spur or loop to connect with Belconnen or even a deviation from the Gungahlin-Woden axis to encompass it. The rail options for this community are not included in current plans, and for good reason, since the amount of patronage added would be small relative to the likely cost. An appropriate feeder bus service is likely the best option here.

In a broad sense, the ACT does have enough actual or potential ridership density in adjacency patterns that might support a LRT. One important note, however, is that many of the current densities are below the minimum notional population density thresholds for LRT, although this applies in some of the US cities discussed as well.

This is where cost becomes very important. The ACT IA submission follows very closely a 2004 Kellogg Brown and Root study, commissioned by the ACT Land and Planning Authority (ACTPLA) to examine future transit options (Kellogg Brown & Root, 2004). That report provided a rough costing out of a system of 54.4 km in total with segments mostly similar to the IA submission. That system provided for 108 stations (56 stops) roughly 1 km apart, running along the centre-line. Stations were of a standard design with extended kerbs to form low platforms, and equipped with shelter overhangs, ticketing machines, electronic information boards and other basic passenger facilities. The major structures to be built were three bridges, two rail undercrossings, two ramps, and one underpass, along with a variety of other minor edifices. Approximately ten power substations were also required. Vehicle types were assumed to be ALSTOM Citadis low floor trams with a 40 passenger seatings and a crush load of 197; their assumed cost (as of June 2003) was $A3 million each and the fully implemented system was to have 106 of them and four additional spares (Kellogg Brown & Root, 2004, chapter 11). A completely built out system was estimated to cost approximately $A1.3 billion. Using a 5% discount rate and 20-year useful life, discounted construction costs amounted to $A575 million, with an additional $A190 million in vehicle costs, and $A161 million in operating costs (Kellogg Brown & Root, 2004, chapter 12).

The IA submission appears to closely follow these details, citing the Kellogg report, and updating them for inflation using the Australian Consumer Price Index (CPI) to the base year of 2008. Some broad tweaks are made to the proposed network but it essentially matches the one in the Kellogg report. All land required for right-of-way (ROW) was assumed to be in government ownership. The ticketing system was estimated to cost $A10 million. Similar to the Kellogg report, a 4-year construction period was assumed, with the first section completed within two years and operations commencing immediately after construction is complete. The inflation adjustment led to capital costs of approximately $A2 billion and operating costs of approximately $A1.2 billion (both undiscounted) over the project life period of 30 years.

Are these estimates reasonable given the experience of other systems? To be conservative, if one were to use Zhang's high end estimate for LRT, this would entail an average unit capital cost of $US90 million per mile in 1990 dollars, $US146.8 in 2008 dollars (approximately $US91 million per km in current dollars); converted into Australian dollars, that would entail a capital cost of $A2.75 billion (at exchange rates of 0.66 $A per $US, a low trading range and reflating to 2008 dollars). This figure is well above the initial request that the ACT government submitted to IA. A lower end estimate is the average unit capital cost given by Zhang of $US26.40 million per mile ($US42.91 in 2008 dollars) which would yield a cost of $US16.41 per km ($US26.6 in 2008 dollars) or a total cost of $A808 million in current dollars, an estimate below the official proposal cost. What this broad comparison suggests is that the estimated capital cost is in a feasible range.

Even if this capital amount is fully funded by the Australian Commonwealth Government, the system would need to be operated and this could be a significant ongoing cost. The IA submission estimates a $A1.2 billion operating cost over 30 years (undiscounted), which is an average of $A40 million per annum. Of course, this operating figure would fluctuate as ridership ramped up. The IA submission posits an aggressive 50% increase in public transport share of total work trips over the 30 year project period, from 9% in 2011, to 16% in 2028 (ACT, 2008a, p. 15).

The Buffalo system, a 6.6 mile system serving roughly 20,000 people daily might be a rough cost comparison (although it is not noted for being efficient). Zhang (2009) notes that the 1992 operating on-street costs were $US67 million (roughly $US102 million in 2008 dollars, or approximately $A154 million). Another point of comparison is the more successful Sacramento LRT which, in 2005, incurred total operating expenses of $US82.5 million or $A59.5 million in 2008 dollars (Schumann, 2005, and author calculations). In this case the annual operating cost estimates for Canberra LRT appear to be a bit on the low side.

These operating expenses are substantial. The total expenditure of the ACT government in 2007–2008 was $A3.1 billion (ACT, 2008b). The total budget for ACTION was $A96.5 million, with an ACT government contribution of $A59.7 million. Total boardings for the system were 16 million (in 06/07), and farebox recovery amounted to 19.5% (ACT, 2008c). If an ACT LRT behaved like the Buffalo system in terms of cost and ridership, its operating costs would swamp current bus expenditures and deliver half as many riders (approximately 7.3 million, assuming 20,000 riders 365 days per year). The situation is better if the Sacramento baseline is used, but is still short of the IA estimates. (However this is a cost focus only. If LRT leads to increased economic development, there will be a concomitant increase in tax revenues to help meet the costs.)

Some would still argue that given Canberra's size and density, a purely bus-based system, adequately funded and deployed, is enough to serve the population's needs well into the future. However, Canberra's trip growth is projected to double from current levels by 2026, which in the absence of policy changes implies significantly increased congestion, increases in average travel time, negative environmental impact and travel time unreliability. A doubling of mass transit modal share over the period is estimated to be needed to avoid this outcome. Increased densification through land-use planning and greater restrictions on and increased costs of parking are suggested in current policies but these alone are unlikely to deliver such a large movement towards mass transit in such a short time. Structural transit such as LRT or BRT is the only likely way to achieve such a large modal shift (ACT, 2008e).

It should also be noted that other Australian cities are finding the need to expand structural transit investments, either BRT or LRT. Sydney, for example, is using LRT to fill in gaps in its Heavy Rail network and doing so because it is relatively cost-effective in that context. BRT is perhaps even more of a growth area with one analyst suggesting that BRT in Australasia expanded by 50% between 2006 and 2008, with more expansions on the way, e.g. Brisbane's $1.2 billion busway expansion for 2026 (Currie, 2006). And LRT can serve other functions such as placemaking.

6. Lessons learned about LRT in low-to-medium density communities

What is the 'bottom line' on Canberra LRT and what might its experience imply for other cities its size and density that are considering LRT? Some 'lessons learned' include the following.

Density is not as simple as it seems

Canberra demonstrates that LRT is not necessarily just suited for a big, dense urban area. The oft-cited metric of population density is not equivalent to ridership density. It is possible to have sufficient densities situated closely enough to one another to justify an LRT even if overall population density is low. The broad analysis offered here shows that the viability of LRT cannot be dismissed easily in the case of Canberra. In general, detailed service areas need to be conducted before taking the next step of putting forward specific transit alternative plans.

Putting this another way, there is substantiated general correlation between population density and transit usage, but there are numerous and interesting enough exceptions to the rule that indicate that this is a not a sole determinative factor in the viability of structural transit alternatives such as LRT. To take some broader transit examples for illustration, in the US, Los Angeles actually has slightly higher average population density than New York but of course the former is the quintessential automobile city while the latter is the home of a world-famous subway system. Atlanta is bi-modal in that it has high automobile usage but also relatively high transit usage given its density (Dunphy and Fisher, 1996).

Potential ridership is a complex variable

This leads to a follow-on idea. One may have an airtight analysis of ridership density that indicates viability of structural transit. But this is not enough. Just as there is a fallacy of population density generalisation there is a similar fallacy applying to ridership density. True, it is a more powerful fundamental causal factor in ultimate success but potential riders become actual riders for a variety of reasons. Network extensiveness, along with reliability of service seem to be especially important in bringing riders into a new system, in that these provide the ability to deliver people to most of the key places they want to go when they want to go there. In this way, structural transit contains both cause and effect. For example, one reason that Atlanta is 'bid-modal' in terms of auto and transit is that it has both an extensive road system but also a well-established transit rail (Dunphy and Fisher, 1996).

Demographic characteristics of users are also very important. Some research, for example, suggests that prior history of automobile usage (the converse of transit usage) is strongly associated with current automobile usage, even if that prior usage was in a completely different place (Weinberger and Goetzke, 2009).

Fail to plan, plan to fail

The fact that a combination of factors drives the viability of structural transit suggests that planning must be especially diverse. Well-planned and well-designed systems can work and have worked in places that seemed unsuited to it at first glance but did work in part because planning, both advance and ongoing, was well thought out. Sacramento in particular has seen heavy growth in system usage and its bus ridership in 1987 was similar to current ridership in Canberra in a similarly low-density context, before its LRT was built. Salt Lake City, Utah is perhaps even more relevant to the Canberra case in that, like Canberra, it sits in a broad area and has expanded laterally and with relatively low density. Yet its TRAX LRT system has exhibited strong ridership growth and continues to expand (Thompson and Brown, 2009).

These cities, and others of lower density, have succeeded because the systems designed have been generally responsive to rider characteristics and needs and provide networks that both build off of existing ridership densities while responding, at least for a while, to areas of new growth. Of course the reverse lesson applies – even when factors seem favourable to LRT, poor design and management can make it a failure.

In Australia, current metropolitan growth plans for Melbourne, Brisbane and Southeastern Queensland contain large commitments to transport infrastructure that are very closely tied to development and growth policies to ensure that there is not a mismatch between the population and infrastructure, as is the case in these cities now. However, there are some potential cautionary tales to consider since infrastructure investment should not overwhelm but rather serve local needs. This may not always be occurring in Australia, or elsewhere (Dodson, 2009).

Don't neglect the bus network

Both of the examples just discussed also provide, however, a key cautionary tale: buses matter. After a strong start Sacramento's LRT faltered as it began to neglect the bus network feeding the rail system. Salt Lake City's LRT ridership has remained strong but the performance of its overall transit system is mixed.

The big issue in both places is neglect of the old-fashioned buses that existed before LRT. A key temptation is to cut back buses to focus on the new structural alternative, and the capital and ongoing costs of such alternatives often might seem to require such resource shifts. But structural alternatives tend to require a good bus service as both feeders to and from corridor routes and to increase the density of the network along and close to corridors. Canberra's current plan in fact budgets for cost savings of $A348 million, undiscounted, from fleet reductions in its ACTION service over the project life (ACT, 2008a, Chapter 10, author calculations reflating a $90 million discounted figure at 7% discount rate). Experience elsewhere suggests that such reductions should be looked at carefully and not just assumed or done out of pure fiscal exigency.

Land-use planning is both chicken and egg

Canberra is relatively unique in being completely (if often imperfectly) planned. The periodic planning problems in the ACT – such as the relatively new suburb of Bruce not having much in the way of proper 'shops' despite its density, or the rapid development of Canberra Airport, yet significant neglect of transport links there – do not, however, outweigh a strong planning history and apparatus. The fact that Canberra has population centres located in patterns that could potentially support an LRT corridor or other structural transit spine has arisen in no small part because of planning. Past planning has created current conditions that can support structural transit, and future planning could make the difference between a good viable structural alternative and bus-served sprawl. This is a general lesson for other, similar, communities even if there is not a tradition of master design templates. Indeed many of the places discussed here were not planned in any central way and yet managed to build a LRT that relied, in part, on development policies to help grow and sustain it. This is an oft-made point but one worth repeating.

The lessons for Canberra

Canberra has the planning apparatus, history of planning, wealth, ridership density, and an operating environment that indicate the potential viability of structural transit. From that perspective, federal capital funding of an LRT there might make for a compelling long-term investment (not including other non-financial or operational policy concerns, considered at some length in the IA submission and not the focus of analysis here). Certainly, some structural transit, perhaps BRT, does seem to be suggested for the ACT. More than a few successful LRTs and BRTs have started small and grown to be viable and accepted and efficient carriers of people.

The current proposal does have the basic design elements in place and has suggested seemingly sensible corridors as far as ridership densities. The capital cost estimate seems to be reasonable, as compared to experience elsewhere. But some elements raise questions. The assumption of significant down-scaling in bus service might end up being counter-productive. Integration of LRT with buses and with other policies, such as land-use, must be continually change-managed and are not explicitly addressed. Although federal funding might ease or eliminate the capital cost burden, operating costs will remain as a significant demand on local taxpayers and these appear to be potentially understated. The alternative of a BRT is not fully considered. And perhaps most importantly LRT in Canberra will be a long-term investment with long-term payoffs, where short-term costs will likely not be met with immediate gains.

Oddly, the prospect of system finance through 'placemaking' and joint LRT/BRT development and land-use planning has not been considered by the ACT. Done well, placemaking can lead to significant increases in land values which, in turn, can be tapped through tax-increment financing and increased property tax yields to help finance the transit development itself (Tumlin et al., 2003; Smith and Gihring, 2006). This would seem to be a very viable prospect in Canberra.

Nonetheless a well-designed structural transit system in Canberra could prove to be a worthwhile investment. The conditions do seem to offer the promise of viable structural transit.

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