

## PUBLISHED VERSION

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## Exploring infrastructure provision issues in greenfield and urban infill residential developments

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**Abstract:** Australia is a highly urbanised country. Planning policy in most Australian cities is trying to divert development that would naturally have occurred on the urban fringe into inner established areas. A large part of the argument for this policy is that State and Local governments are challenged to provide appropriate standards of infrastructure and services in greenfield locations. This paper explores the extent of infrastructure provision issues and tries to identify the actual costs of provision in different situations. Three case studies in metropolitan Adelaide were chosen to explore the cost factors for developers and government. One case study is in the greenfield development within the Playford Alive project on the northern urban fringe; the second is within the renewal area of Playford Alive; and the third is the transit oriented development in Bowden, adjacent the Adelaide Park Lands. While some costs are able to be determined from a review of budget documents and annual reports of State and Local government agencies, the study has found it somewhat difficult to arrive at any firm conclusions about relative costs of infrastructure provision. The estimated costs for infrastructure for the infill development at Bowden are approximately one third that of both greenfield and renewal areas of the Playford Alive project. In established areas, the increased density of development implies a policy review of the capacity of existing infrastructure. In addition, there is concern about standards for streetscapes and transport infrastructure required to meet multiple objectives such as high quality urban design and active/healthy living.

### Introduction

Almost 80% of Australia's 23.6 million people currently live in its major cities (Department of Infrastructure and Regional Development 2015). It has previously been predicted that, by 2050, more than 90% of Australia's population will reside in these urban areas (Infrastructure Australia 2010). As home owner occupation rates in Australia have consistently been around 70% over the last four decades (Kupke and Rossini 2011), and the costs of transferring home ownership (such as stamp duty) are factors which may prevent people from moving, the location chosen is an important decision for home owners. The proximity to infrastructure and services can influence this decision not only as it affects a house's value when sold (Reed 2007) but also the costs for accessing services through normal day to day living (Badcock 1982; Dodson & Sipe 2008; Whitzman 2011; Kellett et al. 2012). Water, wastewater, drainage, energy, transport and telecommunications services have been a mandatory developer funded requirement for new development estates for some decades (Neutze 1995). The privatisation of utilities and the funding model which has moved from taxes for funding infrastructure toward a user pays system has resulted in developers continuing to provide water, wastewater, roads and stormwater infrastructure in greenfield areas with costs supposedly passed onto house (or land) purchasers (see Neutze 1995; Gurrán et al. 2009). The need to provide infrastructure into communities, however, is acknowledged to extend beyond the traditional networks to also include community facilities and other social or soft infrastructure (see Malecki 2002; Casey 2005; Kerkin 2013). Developers have expressed concern about the increasingly complex and diversified nature of infrastructure provision and that government may be expecting them to provide a broader range of infrastructure or contribute toward funding infrastructure deficits (UDIA 2013).

Many Australian cities are now pursuing urban consolidation through the use of planning policies such as urban growth boundaries and planning strategies that establish targets limiting growth in greenfield areas. Some studies conclude that increasing the number of new dwellings in inner suburban locations reduces the cost of providing services and infrastructure in these locations compared to greenfield locations, particularly when the transport costs of providing services are included (Litman 2013; Trubka et al. 2010). Other literature concludes that increasing the density of population within established areas potentially leads to modifications or additions to infrastructure and services which are not always included in costs of development (Searle 2004).

Three questions are considered in this paper:

1. Are there real differences in infrastructure cost factors in greenfield (non-serviced) and infill (serviced) residential developments?
2. Can the costs be identified for these cost factors?
3. What are the implications for planning new development?

The paper commences with a short review of relevant literature identifying the infrastructure costs for infill and greenfield development for developers and government that have been previously reported in published studies and reports. It then presents the analysis of the infrastructure cost factors for the three case studies, highlighting differences and whether developers or government bears the cost. The paper discusses the potential impact of these costs and concludes by commenting on the findings in light of current policy directions for directing dwelling construction toward inner city suburbs and transport corridors.

### **Reviewing the literature**

Adams (1994) explains property development in terms of a sequence of events as well as actions of specific agents (actors and institutions). Similarly, Coiacetto (2012) explains the costs of the development process in terms of the types of activities involved in the stages of development. These stages may include studies and reports; the preparation of applications; acquiring and holding land; design of development, buildings and infrastructure; earthworks and preparatory work; infrastructure provision and construction; building construction; landscaping; and various fees including statutory charges and for professional services. Generally, the key actors in the housing development process in Australia are: the developer who prepares the land and arranges for the building of housing; the house purchaser who chooses dwellings for occupation or for investment; and government (both State and Local) which regulates land zoning, subdivision, the character of development, assesses development against standards and guidelines, and ensures the provision of essential infrastructure and services. Hence, both developers and government may provide infrastructure for new housing development. Each may pass costs onto households, either directly within a new development or indirectly, to the broader community. In the following sections, the literature relating to developer cost factors and government cost factors is summarized. Generally the term developer is used to describe a private sector company that makes a direct financial profit from the process of development, operating as a trader or investor (Wilkinson and Reed 2008, p. 12). Developers may be public or private, and range from an individual person to a multi-national company. The scale of development is a key aspect which determines the type of developer. Small or medium scale housing development is rarely undertaken by large developers but would be more likely undertaken by small to medium size developers (Ruming 2010).

### ***Developer Cost Factors***

Based on previous studies (ACIL Tasman 2006; Coiacetto 2012; Urbis 2011; Gurrans et al. 2009) developer cost factors include: land holding and subdivision; professional and legal fees which may include feasibility studies, engineering, soil tests, design of infrastructure and housing, and associated approvals; the construction of infrastructure and housing; and marketing. ACIL Tasman (2006) noted that external and indirect authority requirements, such as the extension of roads and major road intersection work, sewer/stormwater outfalls and external electricity supply, were generally a small percentage of the total cost of developing land. Government taxes and charges, which included 'direct' charges such as stamp duty on purchase of land, levies, public open space (POS) contributions and land tax, were also considered to be small components but were noted to have increased as a percentage of the developer cost over the decade (ACIL Tasman 2006). The larger costs relate to land purchase, professional and legal fees, local infrastructure and the construction of housing itself.

Few studies have compared the differences in developer costs for new housing in greenfield and infill areas. One study (see Urbis 2011) compared developer costs to developers of new housing in infill and greenfield developments across five mainland cities, Brisbane, Sydney, Melbourne, Perth and Adelaide. For Adelaide, infill development costs were based on 50 apartment dwellings at Hindmarsh 5 kilometres (km) west of the central business district (CBD), while greenfield development costs were based on 100 detached dwellings at Salisbury, approximately 20 km north of the CBD (Urbis 2011). The infrastructure costs for developers in the Adelaide examples (Urbis 2011) have been summarized in Table 1. While infrastructure costs were stated to be very low for the infill site compared to greenfield development, due

to the former having no subdivision construction costs, the Urbis study found that infill development failed to deliver a return to developers compared to greenfield development at Parafield Gardens, in the City of Salisbury, located 20 kilometres north of Adelaide's CBD.

**Table 1. Developer costs for infrastructure per dwelling in 2010 \$ in infill versus fringe development in Adelaide (Source: Urbis 2011)**

Category	Inner	Outer
Infrastructure charges	\$6,000	\$4,000
Subdivision construction (inc. GST)	0	\$47,574
<b>Total</b>	<b>\$6,000</b>	<b>\$51,574</b>

The South Australian Government recently released a consultant's study (InfraPlan 2014) which sought to estimate costs (in 2013 \$) for infrastructure for greenfield and infill development in metropolitan Adelaide. The InfraPlan study applied two approaches to estimating infrastructure costs for greenfield development: one used unpublished data from current greenfield developments on the periphery of Adelaide; while the second approach used infrastructure costs from other Australian cities. InfraPlan (2014) concluded that the average cost of infrastructure for greenfield development for the northern fringe of Adelaide was \$80,500 per lot (range \$72,000 to \$89,300), while cost of infrastructure for Mt Barker in the Adelaide Hills was \$61,900 per lot. Estimating the cost for infrastructure in infill locations was stated to be much more difficult and was estimated from the policy of full cost recovery applying in Sydney (\$15,300 per lot) and from data from Moreland City, Victoria (\$18,300 per lot excluding trunk infrastructure). The InfraPlan (2014) study estimated infrastructure costs for infill development in Adelaide to be \$20,000 per net dwelling (range of \$15,000 to \$25,000). Their report stated that this figure excluded local government sponsored projects within infill development sites and the open space contribution. These costs are summarized in Table 2.

**Table 2. Estimates of infrastructure costs in 2013 \$ for infill (inner) development versus greenfield (northern fringe) development in Adelaide (Source: InfraPlan 2014)**

Category	Inner	Outer
<b>Infrastructure</b>	\$20,000	\$80,500
<b>Range</b>	<b>\$15,000-\$25,000</b>	<b>\$72,000- \$89,300</b>

Some qualifications to the estimates of developer infrastructure costs are made by InfraPlan (2014). Firstly, infrastructure components will differ depending on the level and degree of excess capacity which, for both greenfield and infill sites, will determine the need for augmentation of existing infrastructure. Second, they assume that for greenfield projects, major economic and social infrastructure is normally located off-site. Third, local reticulation infrastructure for connecting each allotment is included as it is located within the development site. Finally, Infracplan (2014, p.22) states that government has traditionally provided headworks infrastructure for roads, water, sewer, energy and communications, as well as town centres, health care facilities, schools, emergency services, police, public transportation and recreation services. Based on these qualifications, the estimates arrived at by InfraPlan (2014) capture only the costs of infrastructure to developers.

In other relevant research, Murray (2011) noted that the affordability of infill development in metropolitan Melbourne was affected by costs such as undergrounding carparking to maximise amenity of open space. He also stated that consolidating land parcels into a single contiguous assembly of allotments is considered to be desirable for construction efficiencies, however is difficult in reality (Murray 2011). Dalton et al. (2011) found that the housing industry and developers generally prefer greenfield sites as they allow simpler and faster site preparation and construction.

### **Government cost factors**

Research on government cost factors has mainly focused on infrastructure and servicing (Newman & Kenworthy 1999; Trubka et al. 2010). Newman and Kenworthy (1999, pp. 374-384) developed an

economic impact assessment methodology which costed development infrastructure, capturing capital expenditure and servicing costs per household. Their study found that infrastructure and servicing costs for fringe development in metropolitan Perth, Western Australia (WA) totalled \$73,100 per dwelling. For inner suburban development at Fremantle, the costs were calculated to be \$20,000 per dwelling. Newman and Kenworthy also calculated transportation costs for fringe development (\$176,400 per dwelling in 1999 \$) compared to inner suburban development (\$89,400 per dwelling). Table 3 summarises the costs for these factors. Included in operational costs of transportation, however, were the costs for residents and hence this cost was not solely indicative of costs to government.

**Table 3. Costs for infrastructure and servicing per dwelling in 1999 \$\* in inner suburban (redevelopment) versus fringe development in Perth (Source: Newman & Kenworthy 1999)**

Category	Inner	Outer
Infrastructure and servicing	\$20,000	\$73,100
Transportation	\$89,400	\$176,400
<b>Total</b>	<b>\$109,400</b>	<b>\$249,500</b>

(\* in 1999 \$ calculated over 15 years discounted at 10%)

More recently, Trubka et al. (2010) estimated the capital costs for infrastructure for new dwellings in both fringe development and inner suburban development in Perth, Western Australia, drawing on data commissioned by the Western Australian Planning Commission in 2001 (ERM cited in Trubka et al. 2010). The initial capital costs found in Trubka et al. (2010) are summarised in Table 4. From this study, the cost of infrastructure for fringe development (approximately \$136,000 per dwelling) is significantly higher than that for inner suburban development (\$50,503 per dwelling). Of note are the costs of infrastructure for education and roads which are ten times and six times higher, respectively, for fringe development. Trubka et al.'s study assumes that infrastructure for gas, emergency services (fire and ambulance) and police is not required in inner suburban locations. As local government provides community infrastructure and services, in addition to maintaining local roads and footpaths, it is difficult to directly compare the costs for infrastructure and services determined by Newman and Kenworthy (1999) with the study of Trubka et al. (2010) as the latter did not include data on the costs of providing municipal services for each development. InfraPlan (2014, p.32) stated that the costs of infrastructure determined in the Trubka et al. studies (2012; 2010) were high and unreliable given the age of the original data (p.66).

**Table 4. Initial capital costs for infrastructure for 1000 dwellings in inner suburban (redevelopment) versus fringe development in Perth (Source: Trubka et al. 2010)**

Infrastructure Category	Inner	Outer
Roads	\$5,086,562	\$30,378,881
Water and Sewerage	\$14,747,616	\$22,377,459
Telecommunications	\$2,576,106	\$3,711,851
Electricity	\$4,082,117	\$9,696,505
Gas	\$0	\$3,690,843
Fire and Ambulance	\$0	\$302,509
Police	\$0	\$388,416
Municipal Services	Not reported	Not reported
Education	\$3,895,458	\$33,147,274
Health	\$20,114,867	\$32,347,327
<b>Total</b>	<b>\$50,502,726</b>	<b>\$136,041,065</b>
<b>Cost per dwelling</b>	<b>\$50,503</b>	<b>\$136,041</b>

From this review, it is clear that few studies have been undertaken and findings are mixed. The following sections describe three case studies of recent residential development in metropolitan Adelaide and proceed to summarise the infrastructure costs for developers and government that could be ascertained from reports and discussions with staff of Renewal SA.

### **Case studies - Playford Alive and Bowden Urban Village**

The Playford Alive project provides an infill (urban renewal) case and a greenfield case while the Bowden Urban Village project provides a second infill development case.

The Playford Alive project in the City of Playford, 30 km north of the Adelaide CBD commenced in 2008 with an aim to develop 1,000 hectares (ha) of land with over 500 ha of new residential development. The existing population of approximately 13,000 is expected to expand to almost 40,000 by 2023. Innovative small lot housing has been developed to fill a stated gap in the market for affordable medium density housing (Renewal SA 2014).

- **Case 1 Playford Alive Greenfield**

The greenfield component aims to deliver 4,000 new dwellings in Munno Para through a staged release. In addition to providing the traditional civil works (internal roads and footpaths, water, wastewater and stormwater pipes) in the greenfield area of Munno Para, a recycled water scheme to service up to 19,000 dwellings is also being developed as a partnership between the City of Playford, SA Water and Renewal SA (Renewal SA 2012). Housing in the greenfield area is required to be connected to the recycled water system (Renewal SA 2012).

- **Case 2 Playford Alive Urban Renewal**

The urban renewal component, which is project managed by Renewal SA, will demolish or upgrade 1,100 publicly owned houses in Davoren Park and Smithfield Plains and through new construction will achieve 1,800 dwellings.

- **Case 3 Bowden Urban Village Infill**

When completed in 2026, Bowden Urban Village will be the first transit oriented development (TOD) in Adelaide. The 16.1 ha site will provide a minimum of 2,400 high quality apartments (5 to 6 star Green Star) and terrace dwellings, accommodating a minimum of 3,500 people. Eighty (80) apartments will be for city workers in rental and purchaser markets (rent then buy) with 32 apartments offered to key city workers such as nurses, police officers and teachers (Renewal SA 2014). In addition to housing, the Bowden project is expected to incorporate up to 20,000 sqm of commercial space and around 12,000 sqm of retail space, generating over 1,200 new jobs (Renewal SA 2014). The site is located on the boundary of the City of Charles Sturt and directly adjacent to the Adelaide Park Lands. The land required remediation prior to development due to contamination from its previous industrial uses.

#### **Developer costs**

Information about developer costs for each of the infill and greenfield areas of Playford Alive was obtained from Renewal SA *Annual Reports* (Renewal SA 2012; Renewal SA 2013) and from a discussion with the Project Director (pers. comm., J Blaess 2014). Information about developer costs for the Bowden Urban Village project were provided by the Project Director (pers comm., C Menz 2014) and from reports (Renewal SA 2014). An open space contribution is required of all new development in South Australia and may be in the form of land set aside within the development (greenfield sites) or a monetary contribution in lieu of land (renewal). The known developer costs are summarised in Table 6.

**Table 6. Developer infrastructure costs per dwelling – 3 cases**

<b>Infrastructure Category</b>	<b>Case 1 Greenfield</b>	<b>Case 2 Urban Renewal</b>	<b>Case 3 Infill TOD</b>
Infrastructure Design and Approvals	\$2,580	\$2,775	\$749
Roads	\$45,500	\$28,400	\$10,433
Water and Sewerage	\$1,650	\$7,750	\$2,887
Telecommunications			\$105
Electricity	\$3,850	\$4,000	\$8,188
Gas		\$250	\$963
Open Space	(land)	\$6,488	\$3,330
<b>Total per dwelling</b>	<b>\$53,580</b>	<b>\$49,663</b>	<b>\$26,655</b>

### Government costs

Estimates of local government infrastructure costs and services being provided for each of the case study areas were obtained from budget documents and asset management plans of the City of Playford and City of Charles Sturt and from project update reports (City of Playford 2012/2013). State government costs were obtained from a review of Renewal SA Annual Reports. The known government capital costs for infrastructure (ie. not including ongoing operating or servicing costs) are summarized in Table 7. Infrastructure costs are mainly borne by State and Local government, while some contributions from Federal government were noted.

**Table 7. Summary of government capital costs for infrastructure in the case study areas**

Infrastructure Category	Case 1 Greenfield	Case 2 Urban Renewal	Case 3 Infill TOD
Roads	\$4,975,000	\$10,600,000	n.a.
Public transport system upgrade	\$13,000,000		
Fire and Ambulance	n.a.	n.a.	n.a.
Police		Police and Community Working Together Program	
Open Space	\$5,000,000	\$2,250,000	\$4,900,000
Municipal Services	\$17,301,000	\$8,170,000	\$403,000
Education	\$68,400,000 to \$88,400,000	\$44,800,000	\$579,674
Health	\$7,500,000	OPAL program	
<b>Total</b>	<b>\$116,176,000 to \$136,176,000</b>	<b>\$65,820,000</b>	<b>\$5,882,674</b>
<b>Cost per dwelling</b>	<b>\$29,044 to \$34,044</b> (4000 dwellings)	<b>\$36,566</b> (1800 dwellings)	<b>\$2,451</b> (2400 dwellings)

(n.a. = not available)

Both of the projects considered in this study have budgets approved by the Parliament of South Australia. The total approved Renewal SA investment in the Playford Alive project is \$315 million (URA 2013). If 5,800 new or upgraded dwellings are constructed in Playford Alive area (combined greenfield and renewal), the average cost per dwelling is \$54,310. For the Playford Alive project, Renewal SA (for the State government) and the Playford Council have established a joint employment and skills development program. In addition, a new retail centre, a GP Superclinic and community centre have also been provided on the boundary between the urban renewal and greenfield areas of the Playford Alive project. The Local and State government cost sharing arrangements for improvements to local infrastructure within the urban renewal (infill) area had not been resolved at the time of the study (pers.comm. G Pattinson 2014). Other costs in addition to infrastructure provision are also being borne by State government. As Renewal SA is both the developer and an agency of the South Australian government, its net costs are also a cost to state government.

The total approved Renewal SA investment in the Bowden Alive project is \$264.7 million (Renewal SA 2014). If the 2,400 dwellings are constructed, the average cost is more than \$110,000 per dwelling. In addition, Stamp Duty concessions up to \$21,330 per dwelling are being given to off-the-plan purchasers of apartments in Bowden with a value up to \$500,000 (Renewal SA 2012). Although indirect, these concessions are real costs to government. For the Bowden Urban Village project, the costs for local government are mainly borne by the City of Charles Sturt. While in its 2012 *Annual Report*, the City of Charles Sturt indicated that extra rates revenue from new dwellings in the Bowden Urban Village would match the extra cost to service the area, budget documents indicate that in the Bowden/Brompton area, extra infrastructure or services are proposed. The Bowden Urban Village project is not the only major residential development being undertaken in the City of Charles Sturt's area of responsibility. The City of Charles Sturt states that from 2011 to 2031, population growth of 13,404 (medium level) is likely, which places additional strain on existing open space assets, and increases requests for new

assets (City of Charles Sturt 2013). Urban development that increases density of dwellings has a number of implications noted by the City of Charles Sturt (2013). These include: increased demand for a higher standard and diverse type of reserve and ancillary facilities; additional maintenance costs in small development areas; smaller streets which could impact on service delivery with limited space for field staff trucks & equipment, and a need to review engineering, open space and recreation guidelines. In addition to the developer obligations to address open space within the Bowden Urban Village development itself, the project also includes a \$4.9m allocation to redevelop 5 ha of the Adelaide Park Lands opposite the Bowden site (Adelaide Park Lands Authority 2014). The Park Lands upgrade design has been endorsed by Adelaide City Council (ACC) and is targeted for completion in 2015 (City of Charles Sturt 2014). The Landscape Master Plan lists 14 projects including: formal and informal recreational facilities, social/cultural facilities and upgrades to access to the Park Lands and North Adelaide Railway Station for both the Bowden residents and North Adelaide residents as well as upgraded lighting. It is stated that the State government currently makes a total annual contribution of \$1.3 million to the maintenance of the Park Lands (Adelaide Park Lands Authority 2014). The preliminary estimate for annual maintenance costs for the upgraded Park Lands area opposite Bowden is approximately \$150,000 (Adelaide Park Lands Authority 2014). There is an expectation from ACC that the State government will increase its annual contribution to cover the increased cost of maintenance. Hence the new infill development at Bowden has resulted in new or upgraded community infrastructure with associated increased costs to local government for servicing.

### Combined infrastructure costs

The combined cost of infrastructure for developers and government for these cases is presented in Table 8. There is surprisingly very little difference in total infrastructure cost between the greenfield and renewal areas of Playford Alive, while the total cost of infrastructure for infill at Bowden Urban Village is only one third of that for the Playford Alive project.

**Table 8. Combined developer and government infrastructure costs per dwelling**

Infrastructure Category	Case 1 Greenfield	Case 2 Urban Renewal	Case 3 Infill TOD
<b>Developer</b>	\$53,580	\$49,663	\$26,655
<b>Government</b>	\$29,044 to \$34,044	\$36,566	\$2,451
<b>Total</b>	<b>\$82,624 to \$87,624</b>	<b>\$86,229</b>	<b>\$29,106</b>

### Discussion

From the costs that have been obtained in the current study, a number of points emerge. Firstly, the cost to the developer in providing infrastructure at the Bowden infill site, estimated to be \$26,655 per dwelling, aligns with the Infracplan (2014) estimate of an average of \$20,000 per dwelling. However it is just over half the cost estimated to service the urban renewal area of Playford Alive (\$49,663 per dwelling) and approximately half of the estimated cost to provide infrastructure to the Playford Alive greenfield site (\$53,580 per dwelling). The infrastructure fees of \$6,000 per dwelling for infill development included in the Urbis (2011) study appear to significantly underestimate the infrastructure costs to developers. The magnitude of the developer costs for the renewal area of the Playford Alive project are nearer to the cost (\$50,503 per dwelling) estimated by Trubka et al. (2010) for infill development although the latter also included government infrastructure costs.

Second, for the Playford Alive project, the government infrastructure costs are similar for both greenfield and renewal areas but are approximately fifteen times that for the Bowden infill site. For the infill development at Bowden, infrastructure costs are approximately one third that of both greenfield and renewal areas of the Playford Alive project. The combined developer and government infrastructure cost for infill development at Bowden (\$29,106 per dwelling) is only a third that of the Playford Alive project and is similar to the cost for infill development estimated by InfracPlan (2014) and the earlier study of Newman and Kenworthy (1999). The combined infrastructure costs for both greenfield and renewal areas of the Playford Alive project are similar to the costs estimated by the InfracPlan (2014) report for greenfield areas which is an interesting finding as the renewal area is already serviced. However, the



combined cost for the Playford Alive greenfield area (\$82,624 per dwelling) is significantly less than the \$136,041 per dwelling estimated by Trubka et al. (2010) for fringe development.

Third, the lack of spare capacity in the existing infrastructure to cope with growth from new housing development may have been a factor which has increased costs in the renewal area of the Playford Alive project. It is clear that a new school in this area has added to the government infrastructure costs for this area. As previously noted, the infrastructure required in delivering new residential development is site specific and depends to an extent on the type of housing being delivered which in itself is catering for particular demographics of household type, age, income and employment. Based on the target market of professional couples and single city workers in the Bowden Urban Village, there is not an anticipated need for a new school in the Bowden area. Further research to monitor the household types taking up residence in Bowden Urban Village should be undertaken to ensure that the capacity of current school infrastructure can cope with the actual growth taking place. In established areas, the increased density of development implies a policy review of the capacity of existing infrastructure.

While some absolute costs were able to be determined from the review of budget documents and annual reports of State and Local government agencies, the study has found it somewhat difficult to arrive at any firm conclusions about relative costs of infrastructure provision. In part this is due to difficulty in obtaining information about government infrastructure costs for specific projects, as the budget estimates and annual reports to Parliament as well as costs for Local government infrastructure projects are often included in an aggregate of costs for broader programs. In addition, the costs for some aspects of infrastructure provision for Playford Alive, which has both renewal and greenfield projects, were provided as a total for the entire project. Negotiations taking place at the time between state and local government for cost-sharing for open space and street infrastructure upgrades, meant that some data could not be provided or apportioned to either Local government or State government so was aggregated and presented as government cost.

The response of State government to the recommendations of the Expert Panel on Planning Reform states that:

*The Government agrees with the Expert Panel that there is a pressing need for a single statutory framework that brings together planning, prioritisation, coordination, funding and delivery of infrastructure under one umbrella that is integrated with zoning and assessment decisions (Government of South Australia 2015).*

The lack of infrastructure planning prior to the Mount Barker rezoning was one of the triggers for the planning system review which has recently taken place in South Australia (see UrbanAnalyst 2011). Hence the lack of coordination of infrastructure information and planning across State government has been previously recognized.

Both developers and government need to pass on costs of infrastructure and services. This paper has not analysed how these costs are being passed on, however it was noted that for the Bowden Urban Village development, the City of Charles Sturt expects all additional costs they incur for infrastructure and services to be covered by rates for the new dwellings. The delivery of high quality public realm in some areas (see the *Urban Design Guidelines* for the Bowden Urban Village (Renewal SA 2014)), and additional maintenance adds a cost to Local government in the new area and potentially increases expectations in surrounding areas. The capacity of Local and State government to deliver higher standards of maintenance in the public realm has been raised in respect of the Adelaide Park Lands upgrade adjacent to the Bowden site and which comprises the majority of the government infrastructure cost per dwelling. The findings of this study appear to support previous statements made by Searle (2004) in respect of assessing the capacity of infrastructure and services to support infill development. There is concern about standards for streetscapes and transport infrastructure required to meet multiple objectives such as high quality urban design and active/healthy living. The broader capacity of government to increase standards of infrastructure and maintenance was beyond the scope of this study but should be assessed further. This aspect is of particular importance as the State government wants infrastructure planning to be integrated with urban planning and to be funded through a standardized framework that spreads the cost burden. Mechanisms such as long-term value capture or improvement levies and tax increment financing have been listed as options to manage affordability (Government of South Australia 2015).

## Conclusion

This paper has examined three cases of residential development in metropolitan Adelaide, attempting to identify infrastructure cost factors borne by developers and government and has estimated costs per dwelling for these cost factors. It is clear from the analysis undertaken that the costs for infrastructure for the infill development at Bowden are approximately one third that of the Playford Alive project. The infrastructure cost factors for both the greenfield and renewal areas of the Playford Alive project are surprisingly similar which may reflect a lack of capacity in some infrastructure or the need to upgrade standards of infrastructure in the renewal area. In general the evidence suggests that it is less costly in infrastructure terms for government to develop on infill sites rather than greenfield sites. Furthermore this may not always be the case for developers. More research is needed and better quality comparable data required to clarify much of this debate. Policy needs to recognise the variety of circumstances that exist, especially in respect of the capacity of existing infrastructure and land ownership patterns that can impact on development costs for both government and the private sector. The findings of this study align well with previous studies that have assessed the costs of providing infrastructure for infill and greenfield development. In addition, this study confirms the importance of understanding the capacity of the existing infrastructure to cope with growth and the extent to which infill development renews established areas. As governments plan for increased density of dwellings and population in established areas, they should ensure they understand and direct development toward areas where there is spare capacity in existing infrastructure. In addition, government should develop mechanisms to fund infrastructure shortfalls that may limit infill development.

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