

**INCREMENTAL INTENSIFICATION:
Transit-Oriented Re-Development of Small-Lot Corridors
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ABSTRACT

The imperative to redesign car-dependent cities for a low-carbon future requires that we engage with the challenge of increasing densities along existing road-based transit corridors and within the constraints of existing morphologies. Such corridors are often lined with small lots that are valued for their functional mix and urban character. This paper explores the degree to which small and narrow lots constrain urban intensification through a study of a series of tram corridors in Melbourne. We examine the impact of site area, shape and access conditions as mediators of development densities. Except in the extreme, small and narrow lots have not prevented intensification that is substantial in its accumulated effect and is less damaging to urban character than large lot development. Lots with a single street frontage are being intensified, but in a manner that is likely to entrench car-dependency and prevent functional mix. The paper discusses the intersections between issues of density, mix and access as well as tensions between car-dependency, intensification and urban character.

INTRODUCTION

Intensified urban development with walkable access to mass transit is now well recognized as a key challenge for urban development in an era of climate change and the imperative for a low-carbon city. The problem for highly car-dependent cities is partly one of adapting the existing morphology for intensification around existing transit lines and nodes. Such existing neighbourhoods are often small-lot subdivisions that are highly valued by local residents for their diversity, low density and urban character - there is often substantial resistance to transformational change. This paper engages with the question of the degree to which small-lot subdivisions constrain or enable urban intensification. While the focus is on one city, the lessons are likely to apply in different degrees to any transit corridor characterized by low-density small-lot morphologies.

While incremental intensification is a practice as old as cities there is remarkably little research literature investigating the ways in which morphology and lot size constrain or enable it. The idea of small-grain development was integral to the seminal work of Jacobs (1961) where it was part of a set of synergies between old and new buildings with a mix of rental value, a mix of functions and a mix of building types.

Myers and Baird (1978) put the case for incremental intensification or 'infill' as it was then known and their work in Vancouver suggested that small lot sizes presented a significant constraint, a view that has been echoed since (Tabuchi 1996; Mejias and Deakin 2005; Gao and Asami 2007), including for Australian cities (Glackin and Trubka 2013). Based on work in the San Francisco Bay Area, Mejias and Deakin (2005) found that smaller lots are redeveloped but require a higher level of design creativity. In the Australian context Glackin and Trubka (2013: 2) found that smaller lots constrained any "transformation of the urban typology". In the Japanese context, surely the global champions at small-grain development, a minimum financially viable lot-size was found to be about 100 square metres (Assami 2007). The extent of street frontage emerges as a key variable in several of these studies (Gao and Assami 2007; Colwell and Scheu 1989; Glackin and Trubka 2013) and is often connected to the issue of car access and parking, particularly in North America. Tumlin and Millard Ball (2003: 3) argue that in the North American context "TOD and parking are inextricably entwined" and that while local councils were likely to waive parking requirements for small projects, developers often saw reduced parking as a risk.

MELBOURNE

Melbourne is a key test-site for such issues: regularly listed as a 'most livable' city yet with low densities and entrenched car-dependency. The urban policy framework has long called for consolidation within existing activity centres and along transit corridors but change has been difficult in the face of community resistance to what is seen as a threat to the valued character of suburban life (Dovey & Woodcock 2011). Melbourne has an extensive tram network, mostly built in the period between 1885-1940 and beyond the central city its routes are lined with small-lot subdivisions and with buildings rarely exceeding three storeys. Many of these tram routes are appropriate for corridor intensification. While during peak times some tram routes operate at capacity, there is spare capacity on many others (PTV 2014), there are significant corridor segments of mixed land use (and in some cases, vacancies are high), and many of the streetscapes are vibrant and walkable with good access

to a residential catchment. These conditions suggest there is much potential to improve the amenity of many tram corridors.

Compact city policies apply at both state and local governance levels, yet corridor intensification is frequently a site of resistance and tension. Resident groups have bitterly opposed developments that they see as too large and out of character with the context. At the same time, developers have argued for larger lot-sizes and greater height limits as a way to improve the viability of corridor intensification. Heritage and other development overlays often restrict the capacity for site amalgamation and intensification generally in the interests of protecting valued urban character. Indeed, the heritage urban character may be one of the attractors to development in this area. Local councils are elected by residents and are often reluctant to support site amalgamation or increased height limits. Car parking is another contentious issue for corridor intensification. With increasing densities, existing residents are frequently concerned about the congestion of on-street parking and increased local area traffic. Despite the location of tram corridors, residents often resist efforts by developers to reduce the amount of car parking included in developments, and apartments without a car park are reportedly more difficult to finance and sell. In this study area at least one on-site car park must be provided per dwelling although exemptions are sometimes approved.

In the study entitled 'Transforming Australian Cities' Adams (2009) proposed that intensification of road-based mass transit corridors represents the major opportunity to absorb substantial new development in Melbourne while also protecting the character of existing suburbs. Adams proposed intensification only for the sites with frontages to the transit routes, while leaving existing development in the walkable residential catchments beyond largely untouched (2009). Furthermore, in Adams' study, in addition to excluding sites covered by heritage overlays, sites with less than 6 metres frontage, or lacking rear lane access were further excluded from consideration on the basis that they did not offer potential for intensification. In a related study of Melbourne's capacity for intensified development within the existing morphology, Woodcock et al (2010), focused on the capacity of land parcels within larger activity centres, and adjacent to tram corridors, railway stations and one orbital bus route, and found that modest intensification at 4–5 storeys could accommodate very significant proportions of projected population growth. A later study, focused on modeling tram corridor intensification, found that resident opposition to intensified redevelopment increases sharply above about four storeys (Woodcock et al 2012).

THE STUDY

The tram network in metropolitan Melbourne comprises a total of 242 km of tram routes - essentially a network in the central city becoming a radial system in the inner and middle suburbs. Our sample is drawn from a 6 x 6 km frame located in the middle-ring suburbs where significant potential for intensified development can be found (Figure 1). It extends from about 4- 10 kilometres from the city centre, largely outside the heritage areas of the inner city yet well within metropolitan boundaries. This 36 square kilometre frame contains a series of six tram corridors totaling 29 km that were analysed for this study. The study incorporated a morphological analysis of all lots located directly adjacent to the tram routes using GIS. These lots were mapped according to size, shape and level of access. In total 3867 individual lots covering an area of 192 hectares were mapped along the six tram corridors.

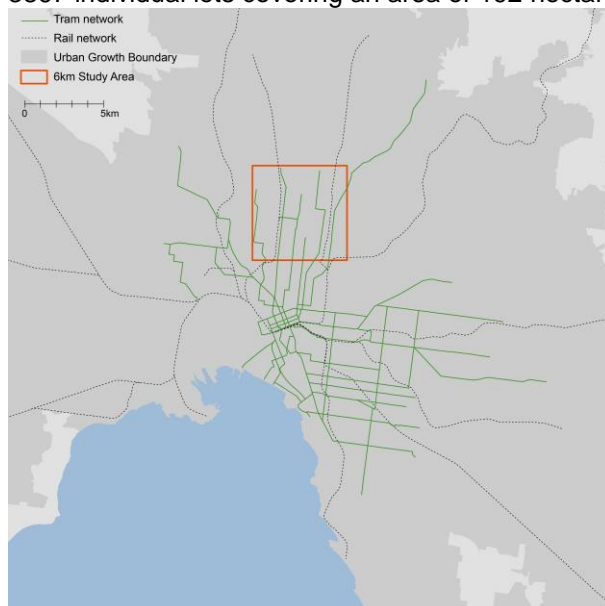


Figure 1: Metropolitan Melbourne: Location of Study Area

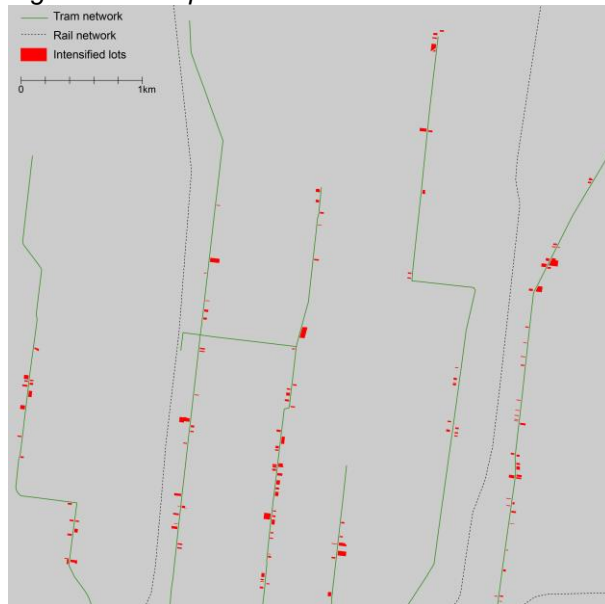


Figure 2: Intensified lots in the study area

The range of existing morphologies is illustrated in figure 3 with some examples of intensified projects in figure 4. The existing corridors range from suburban (figure 3A) to industrial (3C, 3D) and retail (3B, 3E) with retail strips having the smallest grain and an active public interface. While some strips have development constraints due to heritage (3B), many corridors are somewhat derelict (2E) and/or have very significant potential for redevelopment (3C, 3D, 3E). Figure 4 shows examples of some of the most substantial redevelopments that have taken space during our study period. They range from about 4 storeys (4C) to 9 storeys (4A) often depending on local codes and on site-by-site decisions of planning tribunals. They are at times juxtaposed against single storey suburban or retail buildings (4A, 4B, 4D) or even open lots (4E). Some streetscapes have been largely transformed from 1-2 storeys to 3-6 storeys (4C). Projects that occur within retail strips are generally required to maintain an active retail frontage (4A, 4C) or to create one on former industrial sites (4B) but car-based frontages are not uncommon (4D).

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Figure 3: Existing morphologies before redevelopment



Figure 4: Recent redevelopments (2000-2014)

The three factors anticipated to be most likely to affect intensification were lot-size, lot-shape and street access. The lots ranged in size from less than 250 square metres to over half a hectare and were classified into five categories along this continuum: Extra Small (less than 250sq. metres), Small (250-750sq. metres), Medium (750-2000sq. metres), Large (2000-5000sq. metres) and Extra Large (greater than 5000 sq. metres). These categories are relative to the particular sample rather than the suburban hinterland. Lots were also classified into three shape categories based on the ratio of width to depth: Extra Narrow (width: depth greater than 1:5) Narrow (1:5 to 1:2) and roughly square (less than 1:2). This final category also incorporated irregular lot shapes as well as shallow lots with wide street frontages. Street access was classified according to Single access (single street frontage),

Dual access (street plus backlane) and Corner access (two street frontages). These three factors of size, shape and access were chosen due to being perceived constraints on development. Lots that are too small or narrow are frequently cited as lacking capacity to produce sufficient density or a viable project size (Tabuchi 1996; Mejias and Deakin 2005; Gao and Asami 2007; Glackin and Trubka 2013). Access is an issue because of the general requirement for off-street parking (Gao and Assami 2007; Colwell and Scheu 1989; Glackin and Trubka 2013). Single access lots require under current provisions car access from the main street frontage which can undermine strategies for a pedestrian friendly public realm.

A second layer of analysis was to identify all new buildings constructed from 2000-2012 that could be considered intensification (including residential use at a rate greater than one dwelling/lot). For this sample of 156 intensified properties, additional characteristics were documented including height, interface conditions at front and rear, number of dwelling units and ground floor functional mix. The two measures of intensification were building height and dwellings per hectare. The classification of height here is relative to the suburban context. These tram corridors have traditionally been lined with 1-2 storey development - rarely over 3 storeys. More recent developments only rarely exceed 6 storeys. In this context we classified buildings of up to 3 storeys as Low, 4-5 storeys as Medium, and 6 storeys or more as High. The collection of data on the number of dwelling units allowed for net densities of dwellings per hectare to be calculated. These measures of actual intensification are then compared to the morphological data in order to better understand how the site size, shape and access conditions enable or constrain intensification. This is an exercise in trying to understand capacities for urban change; while we have enumerated characteristics of the urban morphology, capacity for development depends on a much larger socio-spatial assemblage of actors and interests incorporating design, governance, residents and the development industry. While this study will relate to the particular local context, the method was developed to allow a detailed study of the potential for any small grain corridor intensification.

Figure 5 shows a sample of the mix of access types, lot shapes and sizes along a 300 metre segment of tram corridor. In this stretch located closer to the city, all lot sizes, shapes and access types are represented and this morphological mix is loosely observed throughout the tram corridors. Other stretches in the study area and located further from the city were not mixed: they were largely suburban in their morphology.

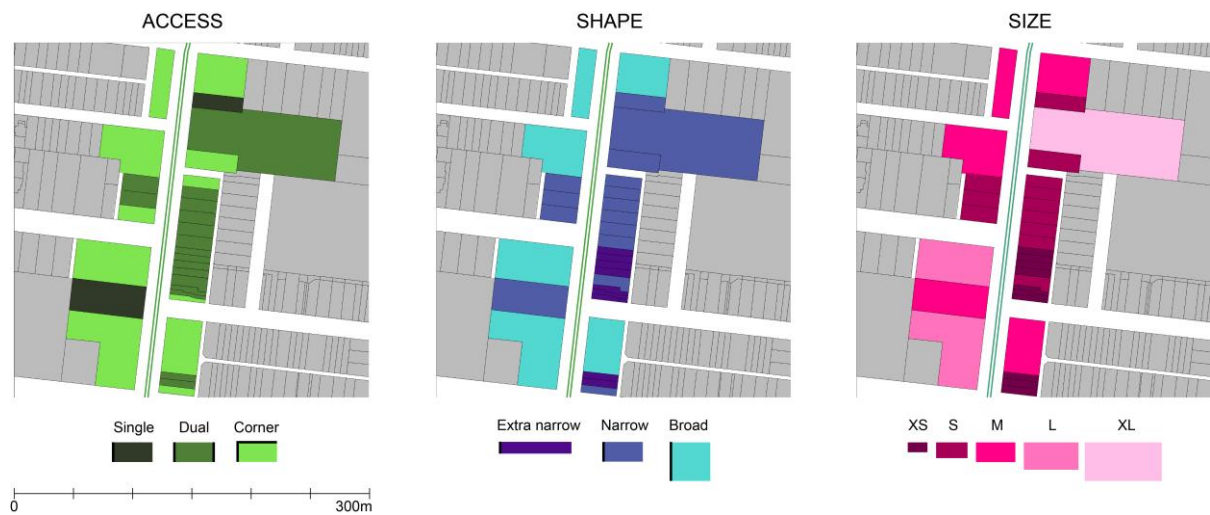


Figure 5: Sample mix of Access, Shape and Size

PREVALENCE AND PREFERENCE OF LOT TYPES

Figure 6 is a graphic representation of the entire database developed for this study including both the existing morphology (prevalence) and the intensified parts of it (preference). Our method of analysis generates a total of 45 categories of site types - 3 shapes x 3 forms of access x 5 lot-sizes. The upper diagram shows a 3 x 3 grid where the three shape variables (broad, narrow, extra-narrow) are mapped against the three access variables (single, dual, corner). In each of these boxes we have represented the percentage of the total land area that falls into that category, differentiated by site size. Thus all of the existing land in the study area is represented in a single image.

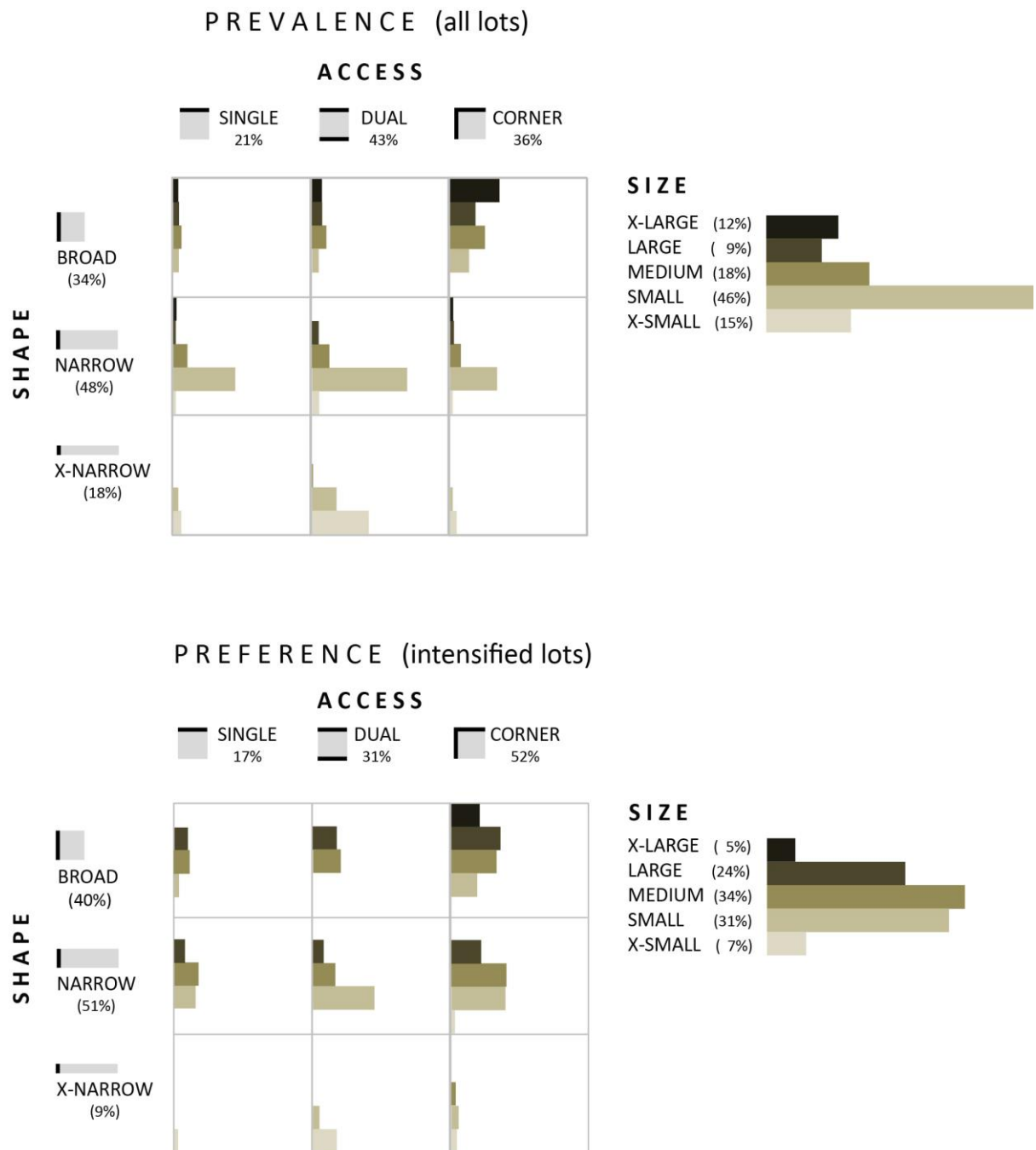


Figure 6: Prevalence and Preference by Access, Shape and Size

While all size categories are well represented, over 60% of the total area of sites along the corridors are classified as small and extra small (less than 750 square metres) with 22% in the two large categories (larger than 2,000 square metres). Almost half the land is on sites categorized as narrow (48%), followed by broad (34%) and extra-narrow (18%). Corner access (36%) and dual access (43%) are more common than single access (21%). As is evident in Figure 6 the most prominent sub-categories are the small narrow sites with any access (35%) and broad corner sites of any size except extra small (23%). As lot size increases the lot shape generally becomes more broad. Small and extra-small sites are predominantly dual access, while medium and above are predominantly corner sites.

The lower part of figure 6 repeats the graphic framework but represents the morphological characteristics of those sites that have been intensified over the study period (2000-2014). Within this study area, approximately 6% of the total study area has been intensified (11 out of 292 hectares).

In summary development is distributed primarily across the three middle lot-sizes and particularly the medium and large lots; there is a slight preference for corner access and either narrow or square lot-shape. However, there are no high concentrations on any lot-types. Lots with single access are often

considered undesirable for intensification, yet single access sites accounted for 17% of the intensified site area. There is a general aversion by developers to very-narrow and extra-small lots; as sites became larger, the impact of shape is reduced and intensification becomes very substantial on narrow, but large sites.

We now want to ask the general question of how the desire or preference for different site types relates to the prevalence of those sites - the preference/prevalence ratio. A ratio of 1:1 would indicate that the site type is being developed in the same proportion as its prevalence, ratios greater and lesser than this would indicate preference and aversion respectively. Figure 7 combines the data from figure 4 into a single image where the preference/prevalence ratio is superimposed onto the prevalence data and shown as a level of intensity (lot-size remains indicated by location). This image can then be read as an indicator of demand as applied to the relative availability of site types. It shows that intensification of medium and large sites is occurring at well in excess of their prevalence along the corridors and suggests that lot size has a significant influence on market uptake. It also shows that small site size is neutral while extra-large and extra-small lots can constrain intensification.

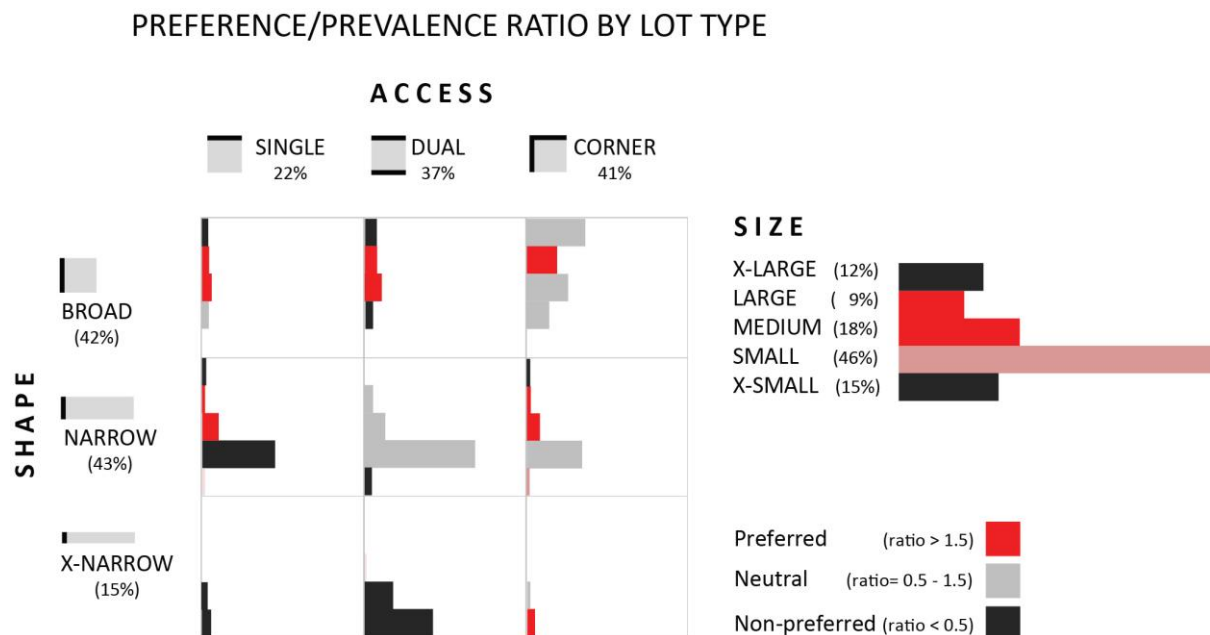


Figure 7: Preference/Prevalence Ratios by Lot Type

In making this distinction between 'prevalence' and 'preference' we also need to note that our study area extends from between 4 to 10 kilometres from the central city and that demand and land costs increase with proximity. We cannot presume that preferences are simply driven by morphologies. The paucity of development on extra-large sites may be accounted for by the fact that such sites are more common further from the city where demand for large-scale apartment developments is lower (a condition that may change over time). As might be expected Figure 7 suggests a greater preference for broader sites and an aversion to extra-narrow (except on corners). There is no clear preference for corner lots and little aversion to single access unless they are small and narrow. Figure 7 again suggests an aversion to extra-small and extra-large sites and a preference for small sites only where they are square or have corner access. If lots are single access then larger sizes are preferred. It is important to note that the impact of these preferences is in proportion to the size of the colour block and those with small areas can be discounted. In this regard we note that the large amounts of land in the categories of extra-narrow with dual access and small narrow with single access represent clear constraints on intensification.

DENSITY

We now want to turn to the density of development that has been occurring along these transit lines and how it is related to the morphology. The net density in terms of dwellings/hectare was calculated for all intensified sites and also analysed for its relationship to lot size, shape and type of access. This measure of density was limited by the available data and we acknowledge that it does not account for average size of dwellings nor for the mix of retail space at ground level (Pafka 2013). The few new developments that were not primarily residential were not included in the analysis. The relationship between density and height was also explored. Figure 8 shows this data in graphic form.

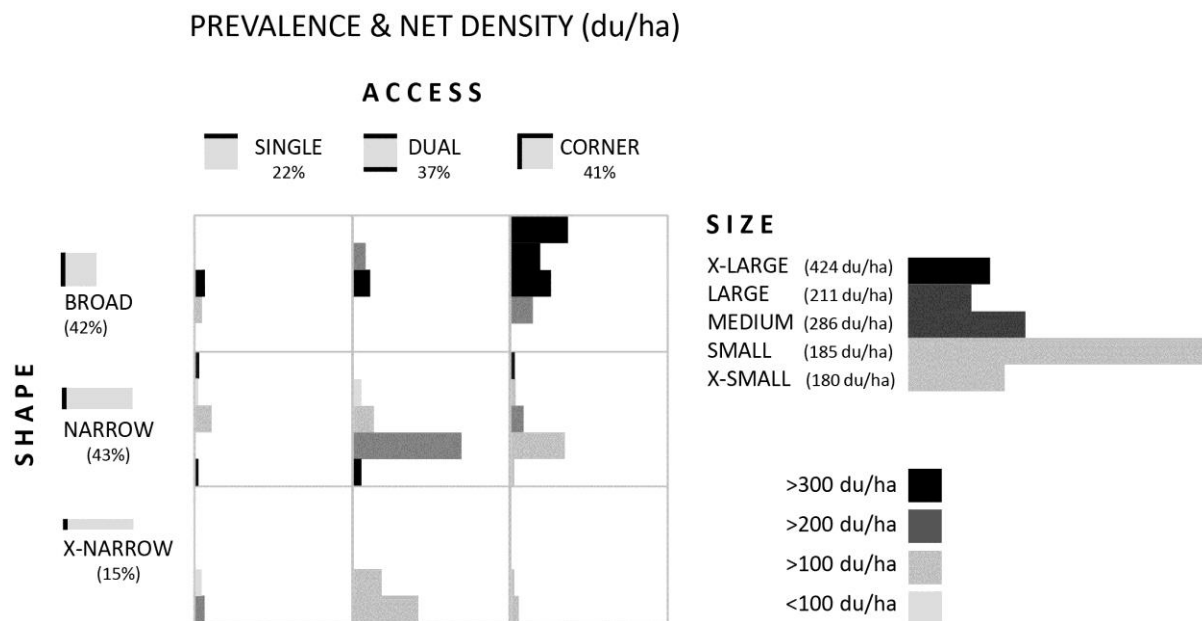


Figure 8: Density Yields by Access, Shape and Size.

The graph on size (Figure 8 - top right) shows that average densities in each lot size range from 180 to 424 dwellings/hectare and peak in the extra-large range. When specific site types are considered, the maximum density for any site type was 467 du/ha which occurred on medium sized broad shaped lots with dual access, and the minimum was 50 du/ha, which occurred on large broad sites with single access. While extra-small sites have limited capacity the vast bulk of intensification occurred in the >300 du/ha range regardless of lot type or size. Shape also had a significant relationship to density. The average density of broad blocks was more than double the average density of very narrow blocks, and notably higher than narrow blocks. This is consistent with the market preference for broad blocks, despite the limited occurrence of these along tram corridors. In terms of access the graph indicates that corner and dual access blocks yield notably higher levels of net density. Sites with single access produced an average of 135 dwellings/ha, while corner and dual access sites produced 222 and 245 dwellings/ha respectively. It is also the case that within the limited sample of developments, there was some evidence that more recent developments on small and narrow lots were achieving much higher densities due to changes in the market. During the last 15 years in Melbourne, apartments have become much smaller overall, with a greater number of 1-bedroom units and designs that utilize borrowed light.

Using these average net densities, we are able to project some broad estimates regarding the overall potential for intensification that exists along these corridors. If all lots were intensified, what might be the number of dwellings that could be accommodated? This projected capacity is calculated by multiplying the average density for each site type to all existing sites. If all sites were intensified along these 6 tram corridors within the 6 x 6 km frame, we found that between 42000 and 45000 dwelling units could potentially be produced. In other words, while about 2500 dwellings have been added along these corridors during the study period, this could be increased more than 16 fold before saturation is reached - based on current market practices.

DISCUSSION

The key findings of this study involve the ways in which the size, shape and access conditions of small-lot morphologies can enable and constrain the intensification of transit corridors. Most of the intensification in this case is occurring on middle-sized lots with both extra-large and extra-small lots seeming to constrain development for different reasons. Smaller lots have a lower yield and therefore lower profits often as a result of difficulties of access and narrowness of block shape. The aversion to extra-large blocks is more complex to explain. A large-scale development requires a more substantial demand than currently exists in some of these locations. There is a risk of lengthy delays in planning approval as planning amendments may be required. Large projects are more likely to meet resident resistance and a risk of rejection by planning authorities. A limited number of developers will be able to fund large projects and there are higher levels of investment risk. It is also likely that underlying high

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land values inhibit site amalgamation, however land values were not analysed in this study. The increased planning complexity increases the holding times and costs for site development.

Very narrow sites with minimal street frontage were also identified as a significant constraint for intensification, producing the lowest average density of any site type. Broad sites were clearly attractive for intensification, allowing for greater flexibility in design, and yielded substantially higher densities. This is consistent with much of the existing literature (Gao and Asami 2007; Tabuchi 1996; Mejias and Deakin 2005; Glackin and Trubka 2013). In our study, narrowness of blocks became less of an issue as sites became larger, confirming the significance of lot frontage rather than the ratio. This also validates the exclusion of very narrow sites from the Adams (2009) analysis of intensification for Melbourne; and from Baird and Myers study in Vancouver (1978).

Corner access sites are clearly attractive for intensification – they possess better streetviews and natural light, and they often accrue symbolic capital due to enhanced visibility. Corner blocks have a more extensive public/private interface and enable better car access. The better car access generally allows for greater yields, increasing a development's profitability. Despite the preference for corner blocks, there was no clear preference for dual over single access lots..

There are some significant issues concerning car access. Car access often produces a loss of yield and compromised design outcomes on very narrow sites. Parking requirements are in a state of transition and the market for apartments without parking is now well-proven. The Commons development in Brunswick, Victoria demonstrated the success of apartments with no car parks (Lucas, 2015). As this trend continues the preference for narrow and single access sites will increase as will the yield on those sites. Single access sites developed with off-street parking have a tendency to produce a car-dominated street frontage (Figure 4D). The most common form of single access development involves a transformation from a single house to a multi-unit development with car access dominating the street. This is a form of intensification that cuts across any prospect for a walkable mixed-use urban frontage at ground level. While local planning controls include guidelines for "an attractive safe and accessible footpath environment..." (City of Darebin 2013) and designs that minimize car access from the street are encouraged, in practice car access often dominates. The walkability and functional mix of the street interface, while not our focus here, is clearly a significant issue for any intensification strategy. The best forms of intensification will include retail, commercial, community and production functions at ground level with a high quality pedestrian interface. This has implications for car access and there is a strong case to eliminate off-street parking on many small-lot development sites unless rear or side access is available. Car-dependency remains an assumed premise of almost all new development and neighbours are generally concerned about on-street parking congestion. It sometimes appears forgotten that reduced car-dependency is a central goal of an intensification strategy. A transit corridor needs density, mix and access to work in synergy with a priority for walkable access. The small lot subdivision inherently constructs a functional mix that works in synergy with a permeable, active and walkable interface and public transport.

There are limits to the densities that these corridors can sustain. These are established in part by the street section and the tram capacity. Although tram network frequency and capacity may be improved, there are also limits to the degree to which suburban neighbours will tolerate the bulk, height, overlooking and potentially the loss of sunshine that comes with corridor intensification. Rear interfaces in this case study are often mediated with setbacks to reduce over shadowing, however there is little activation of rear lane interfaces and these can be considered an unrealized opportunity. Rear lanes could be better utilized for car access if required, as well as provide an alternative for pedestrian access.

Most research to date has looked at the relationship between morphology and land values, or broad constraints to intensification, however there has been little attention paid to the relationship between intensification itself and morphology. The method presented here is transferable, and provides a straight forward means of evaluating the patterns of intensification that occur in any given urban area. Our review of just 12% of Melbourne's tram corridors shows substantial unrealised potential for incremental intensification. Although it is unrealistic to expect that every lot be redeveloped, the capacity that exists here suggests that incremental intensification presents a significant opportunity for absorbing growth and reducing car-dependency. The outcomes primarily emerge from a complex intersection of the forces of demand and resident resistance, as mediated by the small-lot morphology and governance frameworks. While there is not scope here, there is a good deal more to be explored and written about the ways in which these different forces play out along transit corridors. A key question must focus on the concept of 'capacity' which is clearly not simply established by lot size, shape or access, but also depends upon demand and resistance.

REFERENCES

- Adams, R. (2009) 'Transforming Australian Cities for a More Financially Viable and Sustainable Future', *The Australian Economic Review*, 42 (2), p. 209–16.
- Colwell, P. and Scheu, T., (1989)'Optimal Lot Size and Configuration', *Journal of Urban Economics*, Vol 26, p. 90-109
- City of Darebin (2013), St Georges Rd Corridor: Urban Design Framework 2013- Exhibition Edition. City of Darebin, Preston, Victoria.
- State of Victoria (2002) 'Melbourne 2030: Planning for Sustainable Growth' Department of Infrastructure, State of Victoria, Melbourne
- Gao X. & Asami, Y. (2007). 'Influence of lot size and shape on redevelopment projects' *Land Use Policy*, Vol 24, Issue 1, Jan 2007, p. 212-222
- Glackin and Trubka(2013) 'Creating a Spatial Decision Support System for Housing Redevelopment in Australian Greyfields' 7th Australasian Housing Researchers' Conference Proceedings, 6th – 8th February 2013, Fremantle Australia
- Hatta and Akai (1995) 'Analysis on the Land and House Lease Law— with a fixed cost being considered'. *Housing Problem Studies* 12 (1), p. 2–8 (*in Japanese*).
- Jacobs (1961) The Death and Life of Great American Cities', Random House, New York.
- Lucas, Clay(2015) 'Architects and investors hope to revolutionise apartment living in Melbourne' The Age, January 15, 2015. Accessed online 10 November, 2015: <http://www.theage.com.au/victoria/architects-and-investors-hope-to-revolutionise-apartment-living-in-melbourne-20150114-12o699.html#ixzz3r9IVKvR>
- Mejias, L. Deakin, E (2005) 'Redevelopment and Revitalization Along Urban Arterials: Case Study of San Pablo Avenue, California, from the Developers' Perspective' Journal of the Transportation Research Board, Volume 1902, Transportation Research Board of National Academies, Washington D.C. p. 26-34
- Myers B. and Baird, G. (1978), 'Vacant Lottery, Design Quarterly No. 108', Walker Art Centre, Minneapolis, USA.
- Newton, P and Glackin, S. (2014) 'Understanding Infill: Towards New Policy and Practice for Urban Regeneration in the Established Suburbs of Australia's Cities' Urban Policy and Research, Volume 32, Issue 2, p. 121-143
- Newton, P., Murray, S., Wakefield, R., Murphy, C., Kohr, L. -A. & Morgan, T. (2011) 'Towards a New Development Model for Housing Regeneration in Greyfield Residential Precincts' Final Report No. 171, Australian Housing and Urban Research Institute, Melbourne. Available at www.ahuri.edu.au/publications/projects/p50593.
- Pafka, E (2013) 'Northing Gained by only Counting Dwellings per Hectare: A hundred years of confusing urban densities'Ed. Kristian Ruming, Bill Randolph and Nicole Gurran State of Australian Cities Conference Proceedings. 26-29 November, 2013, Sydney
- PTV 2014, Yarra Trams Load Standards Survey Report, May 2014, Melbourne, Public Transport Victoria, online publication, accessed 28 April 2015: http://ptv.vic.gov.au/assets/PTV/PTV%20docs/Loads/PTV_MACA-Yarra-Trams-Load-Survey-Report-May-2014-Public.PDF
- Tabuchi, T., 1996. 'Quantity premia in real property markets' *Land Economics* Vol 72 (2), p. 206–217.
- Tumlin & Millard Ball (2003) 'How to Make Transit-Oriented Development Work' *American Planning Association Magazine* , May 2003.
- Woodcock, I. Dovey, K., Wollan, S. & Beyerle, A. (2010) 'Modelling the compact city: Capacities and visions for Melbourne', *Australian Planner*, 47 (2), p. 94–104.
- Woodcock, I., Dovey, K. & Davison, G. (2012) 'Envisioning the Compact City' *Australian Planner*, 49 (1), p. 65-78.