

The Capacity of Government to Deliver Sustainable and Integrated Transport: The Case of Transit Oriented Development in Perth, Australia

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Abstract—There is a renewed interest in land use transport integration as a means of achieving sustainable accessibility. Such accessibility requires designing more than simply the transport network; it also requires attention to place (built form). Transit-oriented development would appear to capture many of the criteria deemed important in land use transport integration. In Perth, Australia, there have been planning policies for the past 20 years requiring transit-oriented development around railway stations throughout the metropolitan area. While the policy intent, particularly at the State level, is clear the implementation of policy has been fairly ineffective.

The first part of this paper provides an examination of state and local government planning and transport policies, evaluating them using a set of land use transport integration criteria considered all encompassing. This provides some insight into the extent of state and local government capacity to deliver land use transport integration. The second part of this paper examines the extent of implementation by examining existing and proposed land use around station precincts throughout metropolitan Perth.

The findings of this research suggest that the capacity of state and local government to deliver land use transport integration is reasonable in a planning policy sense. Implementation, despite long policy lead times, has been lacking. It appears to be more effective where local planning controls have been suspended with new redevelopment authorities given powers to develop land around railway stations.

Keywords—Transit-oriented development; sustainable transport; transport policy

I. INTRODUCTION

LAND use transport integration (LUTI) is seen as one means to the achievement of sustainable accessibility. It captures an approach that goes beyond simply designing a more effective public transport network by giving attention also to the way the built form can support that network, and vice versa. Transit-oriented development would appear to capture many of the criteria deemed important in land use transport integration. In Perth, Australia, there have been planning policies for the past 20 years requiring transit-

oriented development around railway stations throughout the metropolitan area.

The LUTI message is reinforced in Australia by the National Charter on Integrated Land Use and Transport Planning [10] and in Western Australia metropolitan local governments signed an agreement in 2001 to work cooperatively with the state in accordance with an 'Integrated Transport Planning Partnering Agreement' [16]. However the capacity of local and regional government to implement policy and invest in transport decisions has emerged as an important issue for transport policy in urban areas [11]. In many western European countries and the USA the trend has been to devolve decision making and resources to the local level, this is also the case in Australia. Given this direction it is important to examine the degree to which integrated land use and transport planning policy is being adopted by local and state institutions, the influence of any such policy on decision making and the difficulties encountered in implementation [2].

Reitveld and Stough [15] argue that one of the primary barriers to the delivery of sustainable transport is the institutional barrier. Such barriers can either reduce the potential of delivery, or make it impossible to achieve [1]. This requires an understanding of two components – the rules and rule structures that guide action [14] and the organisations as agents of those rules and the way in which they act (culture). An analysis of the institutional barriers can provide for an exploration of the interactions between different levels of public sector policy, including an examination of the benefits to be achieved from policies which reallocate authority. By examining how organisations operate it is possible to evaluate the impact on delivery of sustainable transport outcomes.

One type of institutional barrier arises where there is an inability of one jurisdiction of government to effect the actions of another [17] and it is this area of research which is the subject of further investigation in Western Australia: the ability of state agencies to effect the delivery of sustainable transport through other agencies including local government; and the ability for agencies at the local level to influence each other for more holistic and integrated outcomes. This gives rise to the following research questions:

1. What is the current capacity of state and local public agencies to deliver infrastructure/services for collective and active modes of transport (using statutory and non-statutory powers)?

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2. What is the current capacity of state and local public agencies to manage car-based travel?

3. What are the institutional constraints (rules, finance, structures, cultures etc) to delivery?

4. How can the capacity be improved?

This paper focuses on these key questions to report on the first stage of the research. This has involved an examination of state and local government planning and transport policies in one Australian city: Perth, Western Australia. The policies have been evaluated using a set of LUTI criteria considered all encompassing. The aim is to provide some insight into the extent of state and local government capacity to deliver land use transport integration in relation to the built form. It was envisaged that four potential conditions could occur, or a degree of concordance, where:

1) There is complete concordance between the LUTI principles and policy documents;

2) There is a gap in the capacity to deliver the principles;

3) There is complete discordance between principles and documents;

4) There are new principles in the documents suggesting an enhanced capacity to deliver sustainable transport.

The first part of the paper reports on the findings of that work. The second part of the paper, drills down to the detail by taking a case study of one key aspect of LUTI – transit oriented development. The extent of implementation is assessed by examining existing and proposed land use around the 69 station precincts throughout metropolitan Perth.

II. RESEARCH APPROACH

The research approach involved document mapping and narrative analysis to evaluate of the range of policies and plans

of state and local agencies. The capacity of state and local government to deliver LUTI was assessed by conducting a content analysis of their planning and transport policies using pre-established framework derived from earlier research (see [8] for a detailed discussion). This framework is shown in Table I. It sets out the physical planning principles that define LUTI required for the delivery of the built form. These were developed with reference to the literature, international policy documents and a survey of experts.

The LUTI criteria are grouped into three key components: access, land use, and 'people places'. 'Access' principles involve creating a transport network connected to centres, capable of meeting local and regional travel needs. The assumption is that many of the daily activities should be served locally. The network must provide for transport choice enabling local trips to be undertaken by walking and cycling and inter-suburban trips by public transport, with the less frequent trips outside centres and further afield by car. 'Land Use' principles focus on locating higher density/intensity uses close to transit and clustering complementary uses in walking proximity. 'People places' focuses on design at the human scale assuming pedestrian and bicycle priority.

This paper draws on an analysis of the statutory planning policies of Perth local governments (32) found in Town Planning Schemes. Theoretically the policy content of Town Planning Schemes must be in accordance with State planning policy. Furthermore as a statutory policy, Town Planning Schemes have significant weight in the decision making process, they direct the approach to development, defining such things as the location of given land uses, the intensity of activity, the orientation and design of buildings and so on.

TABLE I
LAND USE TRANSPORT INTEGRATION – PHYSICAL PLANNING PRINCIPLES

Access	
The Network	• high degree of interconnectedness to urban system (adjacent centres, residential catchments, transit interchanges) • balance of access between through-travel and travel to the place; local and regional access requirements • choice of transport options in close proximity to many homes and facilities - the possibility of substituting the right mode for the specific trip
Activity function (rather than transport function)	• highly connected street network focussed on access to centres and transit stops, permeable for people • well designed walkable catchments, high quality pedestrian experience - safe, well lit, trees, shelter • arterial roads have safe pedestrian facilities, on-road cycle lanes
Traffic Management	• lower traffic speeds, moderate traffic volumes, narrower streets (but not at the expense of conditions for cyclists) • effective traffic management • pedestrian priority
Service	• integrated transport - easily accessible by all modes and interchange between these modes to destinations reached on foot; seamless and safe connections, ease of movement • in operational terms – timetabling; easy to navigate system, high frequency, reliable, efficient public transport service to many destinations– no need for consulting timetables • safe, secure, convenient and comfortable stations, stops and interchanges • accessible by people with disabilities, seniors, children, mothers with prams etc. • cycle friendly; secure cycle storage; connective networks of adequate capacity • good business servicing opportunities
Land Use	
Land use configuration	• land use integrated with integrated transport

	• a robust urban form – can adjust to changes in demand for transport and land use • greater diversity, vibrant mix of land uses (within precincts and within buildings) • high pedestrian trip generating uses at ground floor, housing above in close proximity of transit stop • buildings oriented to station/streets/paths • active ground floor uses for surveillance • frontage development - human scale
Density/Intensity	• highest residential density in close proximity to activities (but ensure includes family housing types) • medium to high residential densities
Proximity	• compact cluster of related (compatible) activities (highly visited) in close proximity (walking distance), clustered around rail station/high frequency bus stop • more intensive/ high-medium density office, retail and other commercial uses (measured by high worker densities) within walking distance of transport facilities
Parking	• car parking areas managed so pedestrian access, amenity and safety not compromised • parking provided in shared structures rather than on individual sites • car parking behind buildings not fronting street • street parking • short term parking but limited commuter parking • car-based retailing (drive-thru) and light industry located on periphery of town with good car access
'People Places'	
Scale and Design	• human scale – less demand for 70kph scale advertising, more public art opportunities, sense that cars are not the priority mode • integration of character and scale of development within precinct • respecting existing development (through retention or sympathetic re-development) • diversity of architectural styles • legible design - is easily understood for residents and visitors
Amenity	• high amenity precincts – a place you want to go to – a destination in its own right • community/neighbourly feel – mixed ages – family friendly • good 'people places' – public open space, public seating, public art • more social encounters due to more walking, cycling, use of public transport • busy places

The LUTI criteria in Table I were categorized to create a set of planning considerations. Town planning schemes were then examined for the presence of these as a means of assessing the capacity to deliver LUTI. As well as assessing the extent to which these LUTI criteria featured in the schemes, a rating system was used, based on a 7 point scale, which measured the extent to which that criterion could be delivered, or actioned given the way it was communicated. The rating scale was:

+3 Strongly satisfies LUTI criterion and works to deliver it

+2 Satisfies LUTI criterion and works to deliver it

+1 Weakly satisfies LUTI criterion

0 Ambiguous

-1 Weakly works against LUTI criterion

-2 Works against LUTI criterion

-3 Strongly works against LUTI criterion

The following examples give an impression of the way in which this was applied. So for the 'Access' LUTI criteria 'Service - cycle friendly; secure cycle storage; connective networks of adequate capacity', an example of a policy statement which scored '3+',

"... end of trip bicycle facilities are to be provided in accordance with the standards for respective uses detail in Austroads standards *Guide to traffic engineering practice part 14 – Bicycles* as set out in schedule 11B." [4].

Whereas an example of one which scored '1+',

"..in considering an application for planning approval shall have due regard whether adequate provision has been made for access for pedestrians and cyclists" [5].

In example one, the policy gives clear guidance that bicycle facilities are to be provided, and also refers to precise design standards. In example 2, the words 'due regard' suggest a level of flexibility dependant on the decision maker (there is nothing to say, for example, that due regard will be given but the result be no provision), also 'adequate provision' is not defined. The first example gives a clear idea of action required for effective implementation.

In another example from the "Land Use' suite of considerations, for 'medium to high residential densities', an example of a rating '-2' clearly works against the LUTI intent, "The predominant use shall be low density residential development to a maximum of two stories"[6].

Compared to an example of a rating '+3',

"The Council may permit a site to be developed at a density exceeding R80 to a maximum of R100 where any 4 or more of the following 8 Performance Criteria are met.." [7].

Here an explicit indication is given of the desired density required.

III. CAPACITY FOR LUTI: LOCAL GOVERNMENT TOWN PLANNING SCHEMES

Tables II, III and IV show the extent of coverage in local government town planning schemes for the 'Access', 'Land Use' and 'People Places' suites of LUTI criteria. For each criterion the bars show the number of local governments who positively address this criterion in their town planning scheme, there are 32 local governments. Overall it can be seen that

there is greater capacity for the delivery of the 'Land Use' and 'People Places' considerations. Less than half of all local governments (LG) have any 'Access' considerations in their statutory town planning schemes.

In the 'Access' suite, five considerations are not covered at all - four of these concern public transport operations and one street design. While the public transport considerations may not be perceived as land use matters by those preparing town planning schemes, it would be reasonable to expect a focus on creating narrower streets as part of any new sub-division, this is not for example dependent on the operations of an outside agency. It is particularly odd given that of all the 'Access' considerations, 'effective traffic management' is considered by the majority of LG schemes.

In the 'Land Use' suite, parking considerations are the most well covered set of considerations. Management of parking access to favour the pedestrian scores most strongly, as does a concern to focus on shared parking schemes rather than provide separate structures serving individual buildings. These are positive findings in the pursuit of LUTI. However, LUTI is not fully delivered because considerations for the location of parking either on-street or at the rear of buildings (rather than in large frontage car parks which create an unfriendly pedestrian environment) are only considered by about a quarter of all LG's. This approach is amplified by the low number of LGs considering building orientation to the street and frontage development - all considerations strongly advocated by the new urbanism movement as part of a philosophy of creating places that favour non-car modes. Density of residential development is reasonably well considered by many LGs, but mix of development and the intensity of commercial development in close proximity to transit are only considerations addressed by about one quarter of all LGs; this despite a much larger number of LGs supporting the LUTI consideration "greater diversity and mix".

The 'People Places' suite were the most well covered by LG town planning schemes. There was a strong focus on creating precincts of high amenity and for development which respected the scale and character of the existing area, although there lacked a focus on design around non-car modes more specifically.

In addition to the examination of the extent of coverage of LUTI criteria, policies were rated according to how well, or otherwise, they satisfied the individual criterion. Overall, where criterion were included, the majority were rated positive, but of concern is that the average score was around 1 to 1.5 out of a possible 3 which indicates that policies are not strongly worded, directive and obvious to action. On a positive note, there were very few negative ratings, that is those instances where policies worked against the LUTI criterion. Here there were only 11 of the LUTI criterion (including items such as cycle provision and car parking). The impact of this was quite limited since it was only one or two LGs that had such policies.

IV. DELIVERING LAND USE TRANSPORT INTEGRATION: A CASE STUDY OF TRANSIT-ORIENTED DEVELOPMENT

As indicated above, a transit-oriented development would appear to capture the type of built form deemed important in land use transport integration. In Perth, Australia, there have been State planning policies for the past 20 years requiring transit-oriented development around railway stations throughout the metropolitan area.

A. State Planning Policy

1989 marks the start of a period where the State Planning agency began to explicitly direct land use decisions around railway station precincts. The Western Australian Planning Commission (WAPC) policy *Development Control Policy 1.6 eResidential Development near Metropolitan Railway Stations* [18] promoted the need to achieve a higher intensity of development around Perth's metropolitan railway stations. In 1999 the policy was revised and renamed *Planning to Enhance Public Transport Use* [19] so further reinforcing the policy approach. A third revision was made in 2005, now renamed *Planning to Support Transit Use and Transit Oriented Development* [21]. The re-write was designed to reinforce the strong messages outlined in two key higher order State policies focussed on a sustainable future: the *State Sustainability Strategy* produced by the Premier and Cabinet's Department and endorsed by government in September 2003; and *Network City*, the new metropolitan planning strategy for the Perth and Peel regions (endorsed in 2004). The development control policy provides a means to articulate these higher order strategies into action through control of development. Furthermore the policy is strengthened by reference to the statutory policy - *Statement of Planning Policy 3 Urban Growth and Settlements (SPP3)*, which for example includes policy measures such as,

"Supporting higher residential densities...around high frequency public transport nodes and interchanges"... and"Clustering retail, employment, recreational and other activities which attract large numbers of people in activity centres around major public transport nodes..."

The 2005 development control policy sets out expectations that are even more explicit than in earlier versions, particularly in identifying specific density goals,

"In reviewing town planning schemes and proposed scheme amendments that include transit precincts as defined by this policy, the WAPC will expect local governments to identify and promote opportunities for residential development at a minimum density of 25 dwellings per hectare, and will expect the application of densities substantially higher than 25 dwellings per hectare where sites have the advantage of close proximity to a rail station, major bus interchange or bus route that provides service frequencies equivalent to rail..." [21].

Guidance on the need to locate high trip generating development close to transit facilities was made explicit, particularly the type of uses, although a potential problem is that no guidance was provided to define 'significant generators',

TABLE II LUTI 'ACCESS' CONSIDERATIONS – NO. OF LOCAL GOVERNMENTS WITH A POSITIVE CITING OF EACH CONSIDERATION

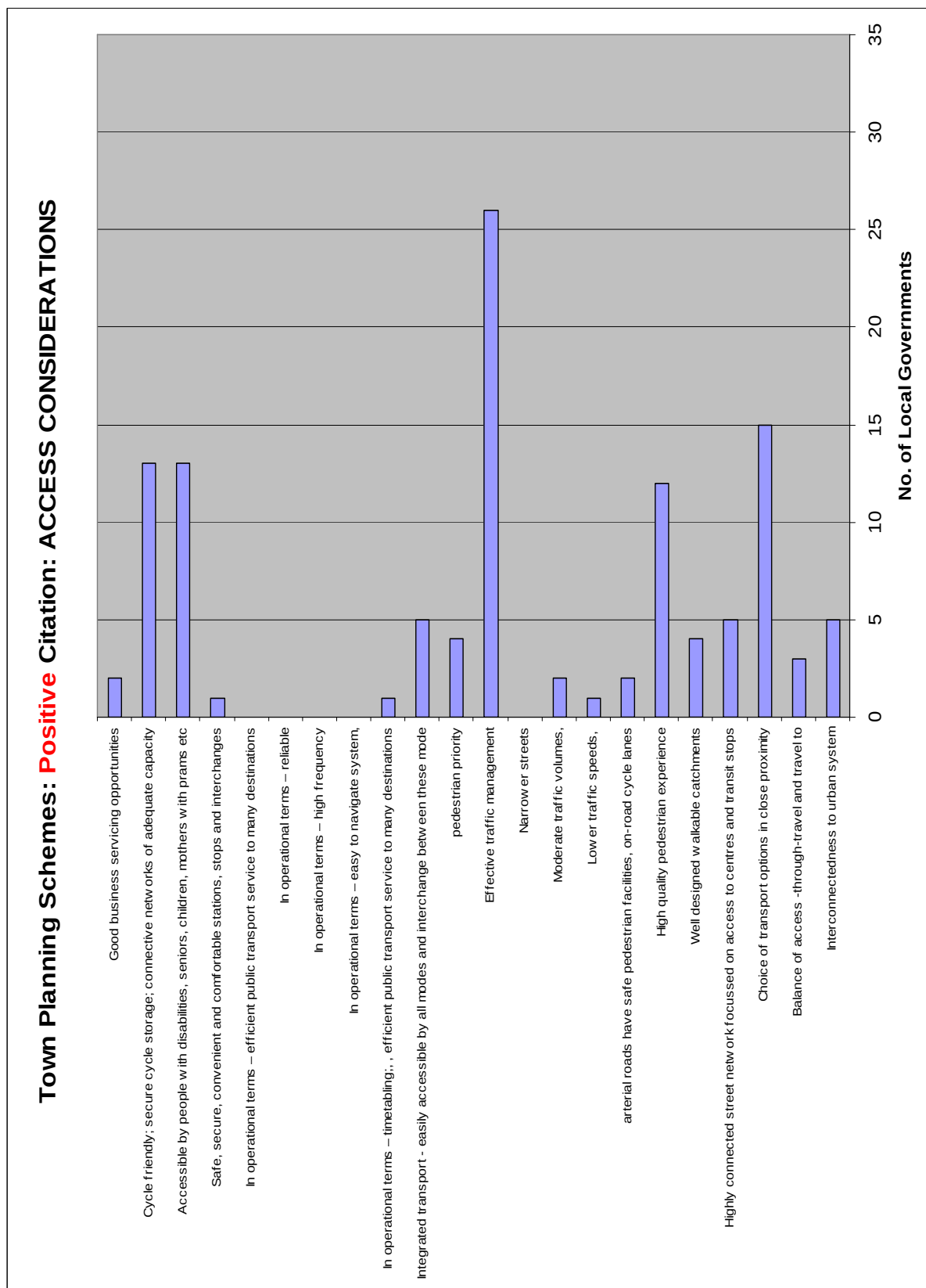


TABLE. III LUTI 'LAND USE' CONSIDERATIONS – NO. OF LOCAL GOVERNMENTS WITH A POSITIVE CITING OF EACH CONSIDERATION

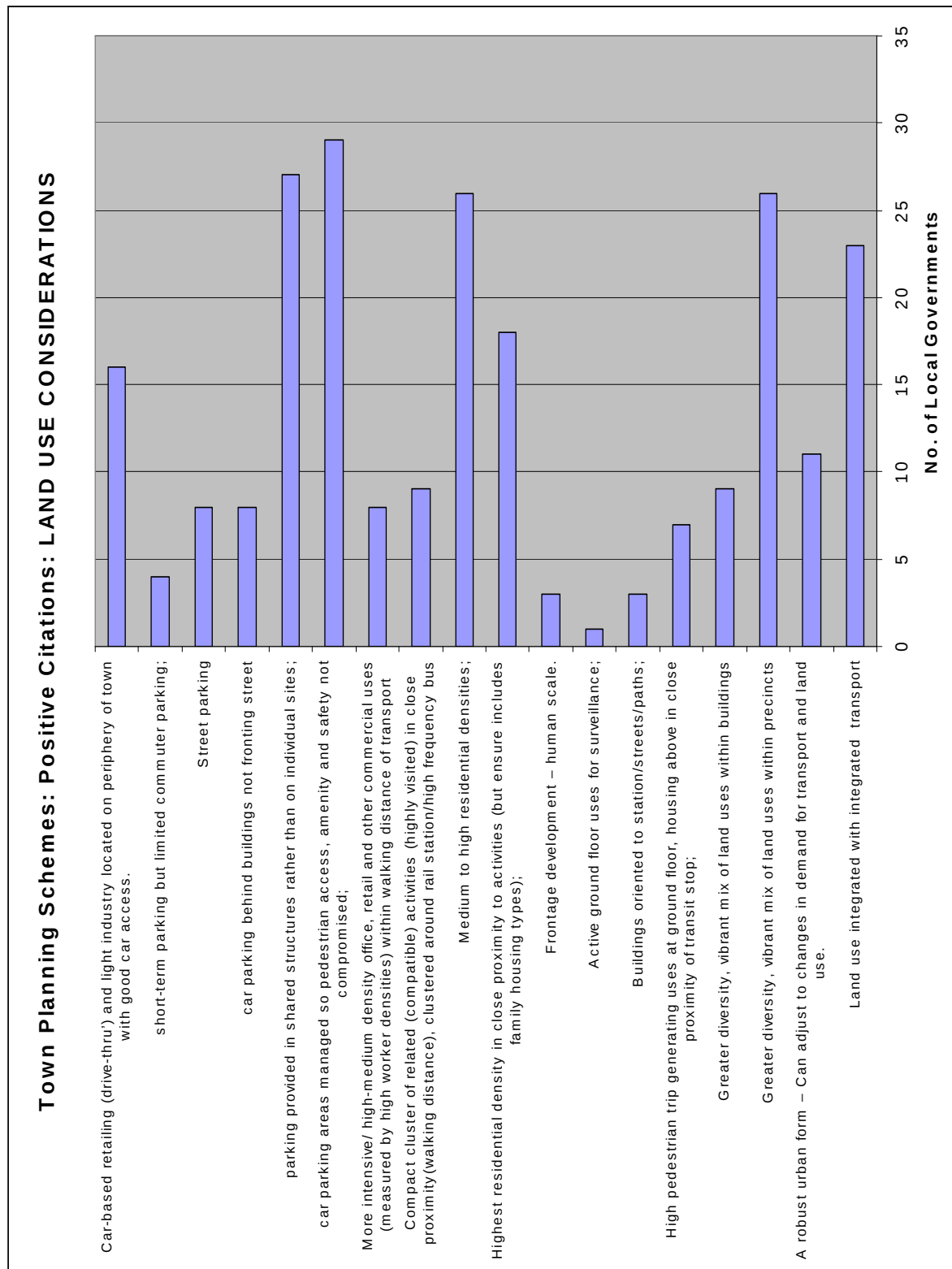
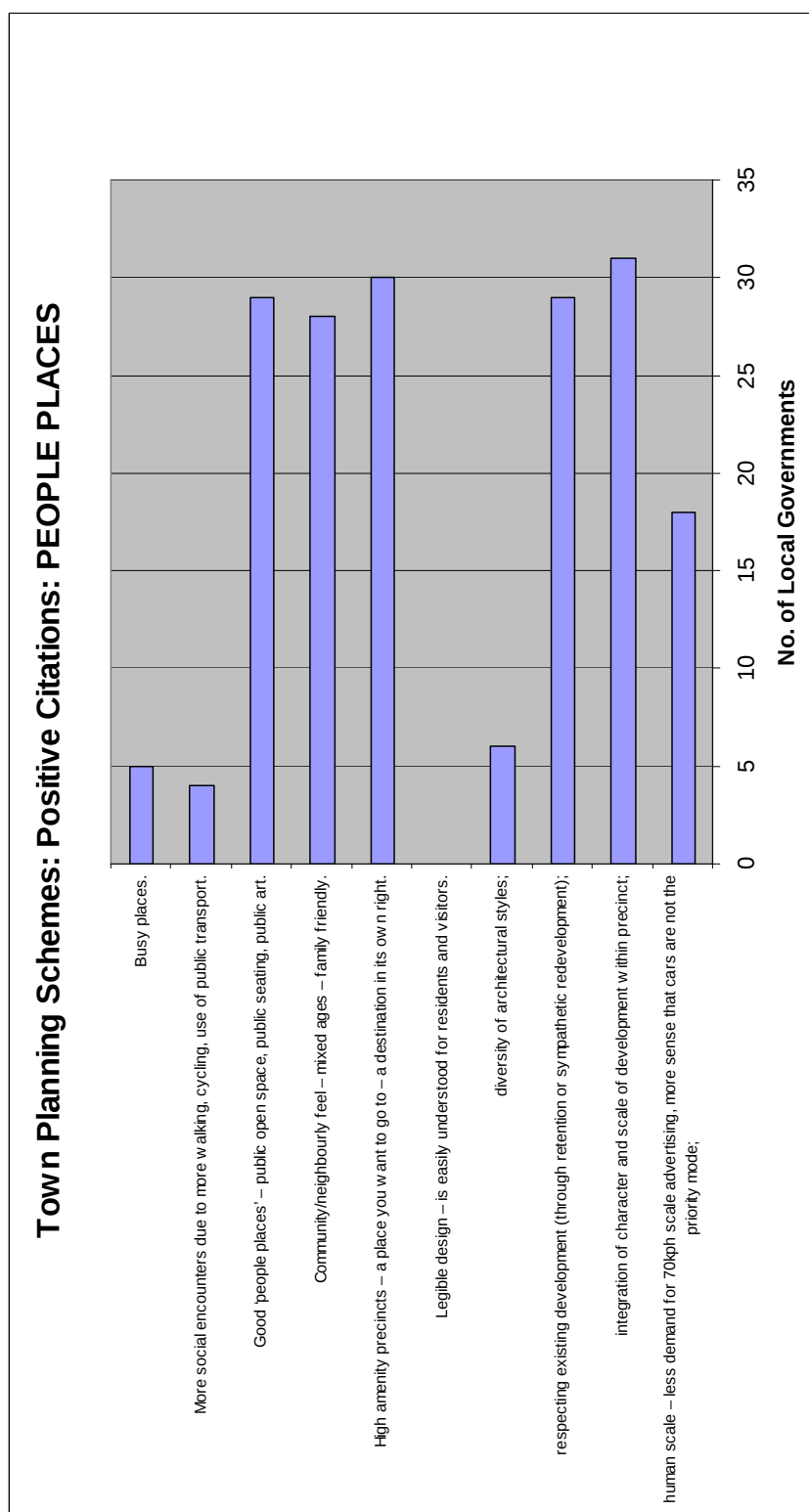


TABLE. IV LUTI 'PEOPLE PLACES' CONSIDERATIONS – NO. OF LOCAL GOVERNMENTS WITH A POSITIVE CITING OF EACH CONSIDERATION



“Other uses that are likely to be significant generators of transit trips should also be located close to transit facilities wherever possible. Relevant uses include office and other ‘high-density’ employment- generating activities, intensive leisure facilities and retailing. Similar considerations apply to such uses as aged persons development, schools and tertiary education uses, hospitals, community facilities and social services” [21].

Transit oriented precincts were not only defined in text, but also mapped,

“Defining ‘transit oriented precincts’... there is a common ‘threshold’ for walking to those facilities. This equates to:

- about 10-15 minutes walking time, or 800 m distance, for rail stations, transit interchanges or major bus transfer stations or terminals and,
- about 5-7 minutes walking time, or 400 m, for bus stops located on bus routes with multiple bus services that are high frequency of 15 minutes or less during peak periods (see map attached)” [21]

So by the mid 2000’s there was a strong raft of policy emanating from the State government demonstrating clear intent in the need for development around the metropolitan railway stations. Not only found in a wide range of documents within the State planning agency, but also from other state agencies. As well as these higher order policy statements (often more generalised) the long standing development control policy outlined above was designed to operationalise the broader policy aspirations of the strategy type documents.

The mechanisms of delivery of this state planning policy are of two types. Planning legislation requires each LG to produce a statutory Town Planning Scheme (TPS) for its entire area. The content of the TPS is dictated by a State planning agency guide, the Model Scheme Text (see Figure 1). TPS include a set of policies that will be used to determine applications for planning permission and building approval. In addition a land use zoning map and accompanying zoning table set out the type of land use, and its residential density, in specified locations. The TPS is required to conform to state planning policy, and is checked for compliance and consistency by this state agency and finally signed off by the State Minister for Planning. A further mechanism for delivery is provided through the decision process for sub-division of land. In this case it is the State planning agency that assesses sub-division applications which are then determined by the WAPC and Minister. This structure not only provides strong vertical linkages for policy articulation, but strong powers for decision makers.

Local Planning Policy: Town Planning Scheme intentions

The sub-set of LUTI considerations which would deliver transit-oriented development around rail precincts includes those concerning density and intensity of use. As indicated in the earlier section of this paper, residential density was well covered in these schemes, but to a lesser extent was mix and intensity of commercial development. In addition to the analysis of the written policies in the TPS, mapping and

analysis of zoning maps has been conducted for land use in the 69 station precincts (using the state definition of transit precinct above). The 69 station precincts fall under the jurisdiction of 25 different local governments.

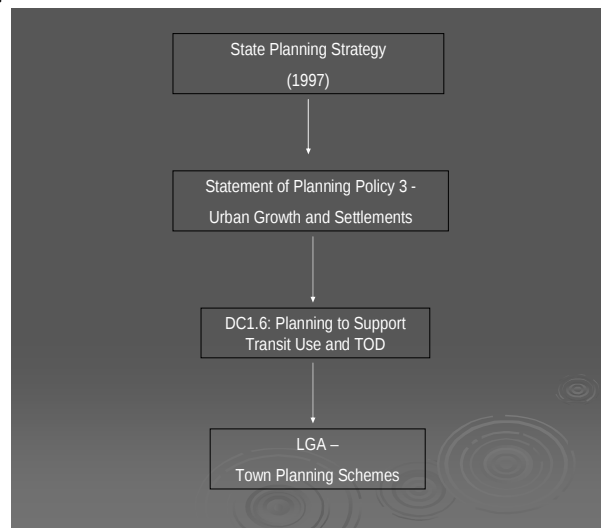


Fig. 1 State planning policy is articulated into local Town Planning Schemes

The data enables the mapping of the proportion of land within each transit precinct zoned for residential, employment and ‘other’ uses. In addition, residential land zoning includes an ‘R Code’ to give an indicative residential density for that land parcel. For example a one hectare parcel of land zoned R20 would theoretically be permitted to develop up to 20 dwellings. In practice, due to other planning controls concerning dwelling set backs, provision of private open space and so on, only about 75% of the given density will be delivered. So in this example R20 would more likely deliver a maximum of 15 dwellings on the one hectare parcel. One other issue is that the developer is at liberty to develop residential land at densities lower than the given R Code, and this in itself is one issue for the implementation of LUTI. For our purposes we have assumed that zoned land will be developed at the maximum density (further research is required to test how often land is developed at lower densities), so erring in favour of the most optimistic outcome. In some cases the zoning map permits a ‘dual R Code’, here we have assumed that higher density will be delivered.

There is no density equivalent for land zoned for employment purposes, thus limiting the possibility of analysis of any intent to intensify the number of employees on any given zoning parcel. Clearly this also has implications for the ability of local government to deliver high intensity employment in station precincts.

Fig. 2 shows the net residential density intent of all current Perth metropolitan Town Planning Schemes. A dramatic 97% of all station precincts provide the possibility for residential development to be built at a net density of 15 du/ha. For ease of analysis three categories of net density have been created: in the Perth context, low density includes those sites with a net density lower than 10 du/ha; medium density those between 10

and 15 du/ha; and higher density, those greater than 15 du/ha. Over the last year the state government have settled on 15 du/ha as a benchmark for net residential density in support of transit.

	Net density <10 du/ha	Net density 10 - 15 du/ha	Net density >15 du/ha
Inner Suburb	0	0	26
Middle Suburb	0	0	13
Outer Suburb	2	0	24
Total	2 (3.1%)	0	63 (96.9%)

Fig. 2 Town Planning Scheme Intent: Net Residential Density of Station Precincts by Location (no. of precincts)

NB. 4 precincts have no data available for residential zoning.

While TPS intent for net residential density looks promising, to gain a more accurate picture of the extent to which residential intensity may be being maximised through the TPS it is necessary to consider both the footprint of these high net densities in proportion to the whole station precinct and the gross residential density – both measures give a clearer indication of the extent of planned policy implementation. Of the 63 precincts planning net residential densities of 15 du/ha or more, in only ten precincts this residential development covers more than three quarters of the precinct and a further 18 precincts have this taking half the precinct.

The gross residential density intent of town planning schemes shows a less optimistic picture (Figure 3), 63% of station precincts still plan to develop at very low gross residential densities. At the lowest gross densities there are as many inner city precincts as outer suburban precincts. A further analysis is required to establish if these inner city precincts are strong employment centres instead, otherwise the outcome would be poor. For those 27% of precincts planning higher gross residential densities, middle suburban and outer suburban precincts show the higher proportion of precincts. NB. 4 precincts have no data available for residential zoning.

The current suite of TPS's were written over a long time period ranging from 1983 to 2007 (Figure 4). Ten of the station precincts are governed by TPS written before the 1988 state development control policy for development around railway stations, it may be reasonable to expect these schemes to not to show a high residential density intent. 55 precincts are governed by schemes written after DC1.6 – one would expect these schemes to show higher density intent if they are to implement state policy and this is confirmed (Figure 5). Gross residential density shows a different picture (Figure 6) with only 22 precincts out of 55 (40%) showing higher residential densities.

V. EVIDENCE OF IMPLEMENTATION

Given this long standing policy in favour of delivering TOD, over two decades, it would seem reasonable to expect some evidence of development change on the ground. What

follows is an analysis of the 69 metropolitan railway stations in Perth using data from the Valuer General's Office for land use within precincts¹ at 2001 and census data for population and employment from the Australian Bureau for Statistics 2001.

Intensity of Use at 2001

The gross residential density ranged between 0 and 18 dwellings per hectare, with three quarters of all precincts having a gross density of 8 du/ha or less. Net densities ranged from 0 to 21 dwellings per hectare, although again three quarters of all precincts had a net density of 12 du/ha or less. These densities fall considerably short of the state's benchmarks of 15 du/ha for net density and 25 du/ha.

Set in an international context, both the State benchmark and the actual densities fall well below other benchmarks. Calthorpe recommends a benchmark of a gross density of 40 du/ha (this figure in addition to commercial uses within the precinct) required to support public transport [3]. Others have used a level of service specification for public transport to determine minimum residential densities required to support a particular service frequency (Table 5). Perth's station precincts fall considerably short of all of these benchmarks.

¹ Using the same definition of a 'transit oriented precinct' in D.C 1.6 – land within 800m distance of the railway station (10-15 minutes walk) – or 201 ha.

	Gross density <10 du/ha	Gross density 10 - 15 du/ha	Gross density >15 du/ha	Total (row %)
Inner Suburb	8 (35.7%)	13 (46.4%)	5 (17.9%)	26 (40%)
Middle Suburb	3 (23.1%)	3 (23.1%)	7 (53.8%)	13 (20%)
Outer Suburb	9 (39.3%)	5 (17.9%)	12 (42.9%)	26 (40%)
Total	20 (30.8%)	21 (32.3%)	24 (36.9%)	65 (100%)

Fig. 3: Town Planning Scheme Intent: Gross Residential Density of Station Precincts by Location (no. of precincts)

	Pre 1988 State policy DC1.6	1988 – 1998 Policy DC1.6 original version	1999 – 2005 Policy DC1.6 version 2	2006 or newer Policy DC1.6 version 3
Inner Suburb	1	11	14	2
Middle Suburb	5	3	5	0
Outer Suburb	4	3	21	0
Total	10 (14.5%)	17 (24.6%)	40 (58%)	2 (2.9%)

Fig. 4: Age of Town Planning Scheme by suburban location

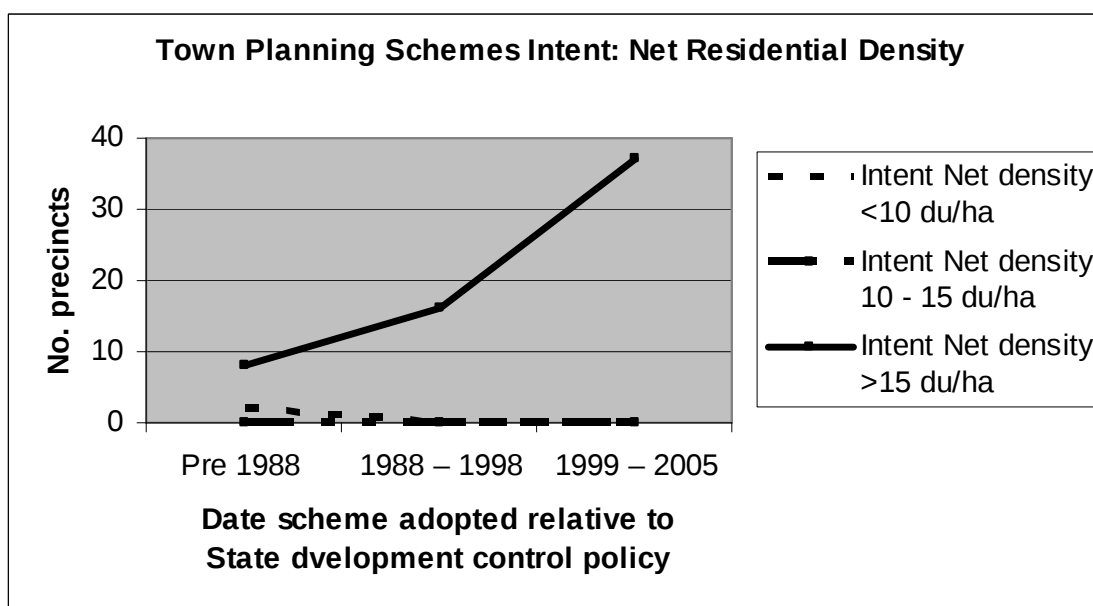


Fig. 5: Age of scheme by Town Planning Scheme Intent - Net Residential Density (no. of precincts)

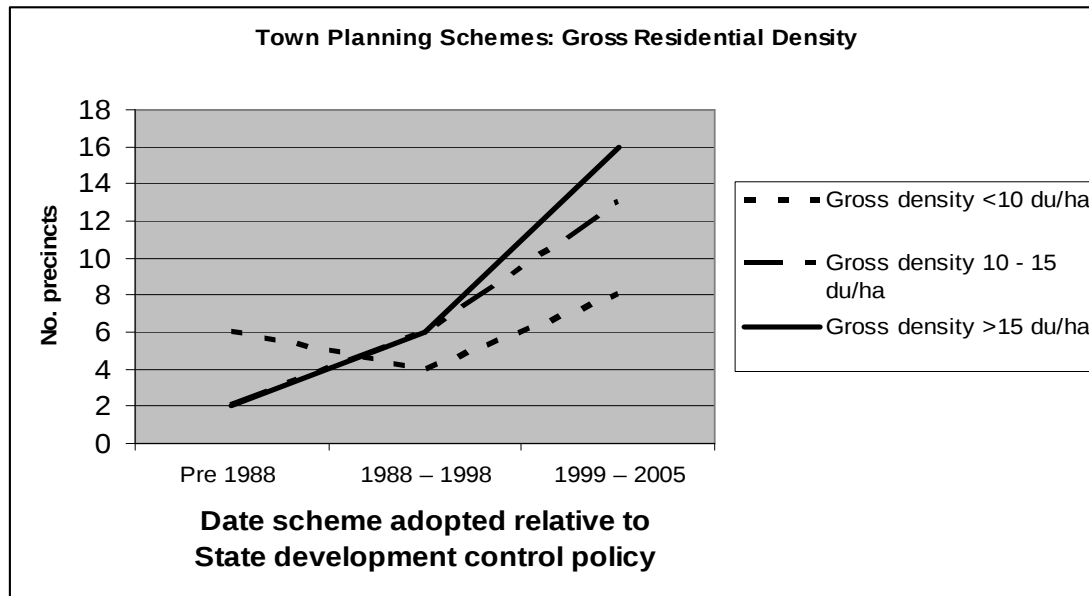


Fig. 6: Age of scheme by Town Planning Scheme Intent - Gross Residential Density (no. of precincts)

TABLE V THE RELATIONSHIP BETWEEN DENSITY AND SERVICE FREQUENCY

Service Frequency	Min. Residential Density Required (Units)		
	Puskarev & Zupan, 1977 ¹	Messenger & Ewing, 1994 ²	Dittmar & Ohland, 2004 ³
Bus - 1 hour service	10/ha (4/acre) adjacent to corridor	N/A	N/A
Bus - 1/2 hour service	17/ha (7/acre) adjacent to corridor	19/ha (8/acre)	>12/acre (suburban neighbourhood)
Bus - frequent service (<15 mins)	37/ha (15/acre) adjacent to corridor	>26/ha (>11/acre)	48/ha (20/acre) (urban neighbourhood)
Rapid Transit 5 minute headway in peak hour	30/ha (12/acre) over extensive area with high density close to station	N/A	>144/ha (>60/acre) (hub of radial transport system – urban downtown)

Source: ¹Ministry of Transportation and Ministry of Municipal Affairs, 1995 citing Pushkarv B S and Zupan JM (1977) Public Transportation and Land Use Policy; ²Messenger and Ewing, 1994 cited in Dittmar and Ohland, 2004; ³Dittmar and Ohland, 2004.

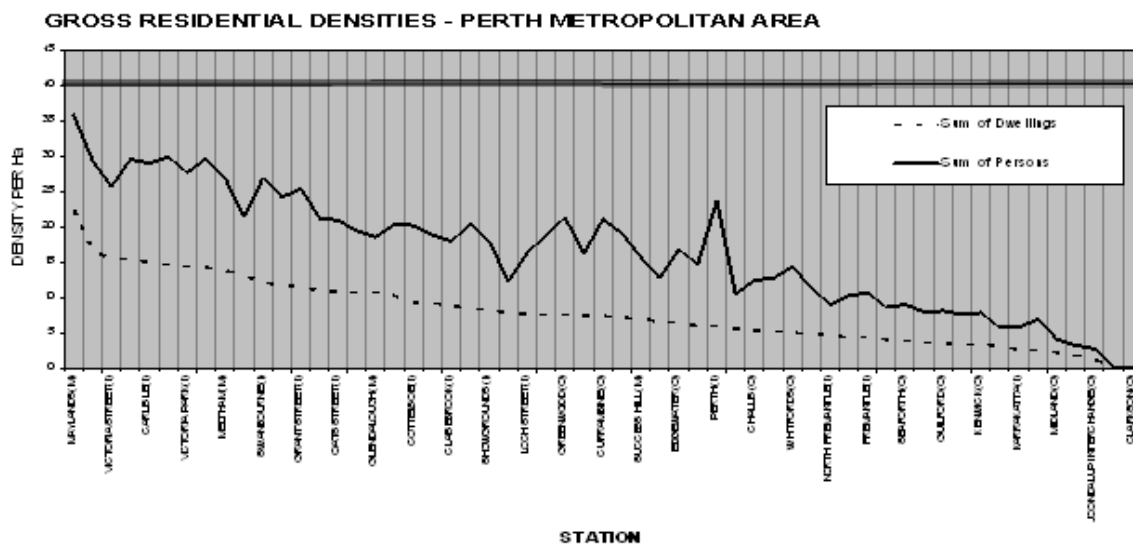


Fig. 7: Residential Density – Perth Stations

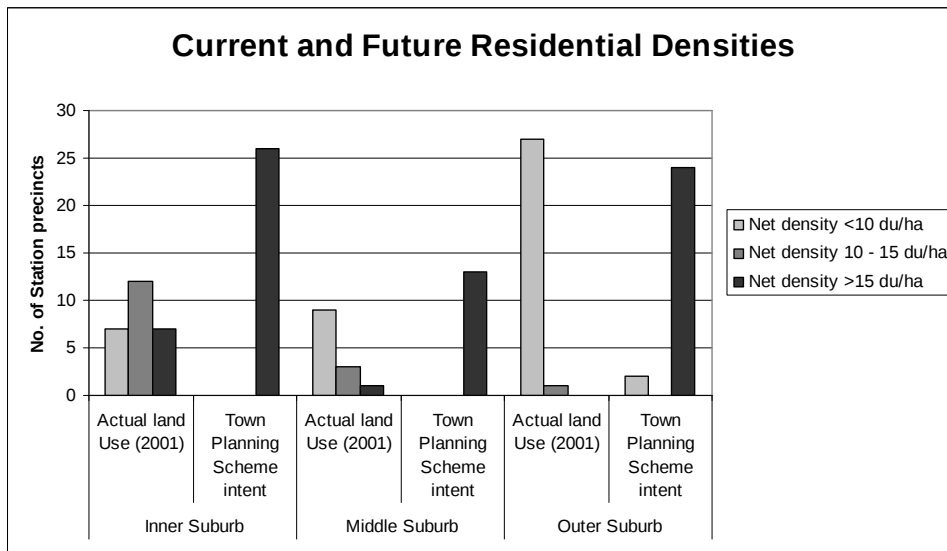


Fig. 8: Perth station precincts: Current and Future Residential densities

In comparison with the actual net residential densities in 2001, it is evident that local government intentions show a clear intent to implement State planning policy (Figure 8). While in 2001 only 8 station precincts had a net density of 15 du/ha, if Town Planning Schemes are implemented this would rise to 63 precincts. The most dramatic change would be in outer suburban station precincts. In addition to the density consideration above, Newman contends that for a station precinct to maximise on its accessibility of public transport and offer best efficiency for supporting public transport, a threshold of 10,000 employees and/or residents should be based in the station precinct. None of Perth's stations reach this figure for residents alone; only 5 stations meet this benchmark on employees alone. The maximum number of dwellings in any one precinct was 3645, the minimum 35 and the mean 1237. Number of residents living in station precincts ranged between 18 and 5995. The number of employees based within each precinct ranged between 0 and 59,012 with the mean at 4118. Three quarters of all stations had less than 2335 employees. The combination of residents and employees puts only 8 of the 69 stations within this benchmark; all are based within the inner suburbs.

Figures 9a and 9b show the land use mix for each station precinct at 2001. The pie diagrams show the proportion of land allocated to residential use, employment use and other uses, as well as indicating the intensity of use (net residential density or employment intensity expressed as a worker floorspace density). Two thirds of the precincts had more than 50% of the precinct area allocated to housing. Yet only

8 stations (12%) had a net residential density of more than 15 dwellings per hectare - the density stipulated in the latest version of DC1.6), almost all are within the inner suburbs of Perth. There is a clear density gradient - highest densities are close to the centre, towards low density in outer suburbs. 62% of precincts have very low net residential densities of less than 10 dwellings per hectare.

The picture for gross residential density was worse: 84% of station precincts had a gross residential density of less than 10 dwellings per hectare (compared to the policy stipulation of 25 dwellings per hectare); only 1 station achieved a gross residential density greater than 15 du/ha (Maylands an inner suburb precinct at 18 du/ha).

Outside the central area very few precincts have any employment land (18 precincts), and even fewer (2 precincts) have high employment densities (>1 employee per 150 sq. metres). Within the central area of Perth 11 of the 13 precincts contain employment land; all but one has a high employment density.

Where station precincts are governed by a Town Planning scheme adopted after the 1988 state development control policy one would expect the 2001 actual densities to be higher. Figure 12 shows that this is clearly not the case with a higher proportion of precincts in each category having the lowest net density, and the same for actual gross density. There would, however, appear to be some evidence that local government zoning schemes written in the ten year period after the first version of DC1.6 have translated to the delivery of some higher density precincts (30% of precincts are medium density compared to only 13% post 1998).

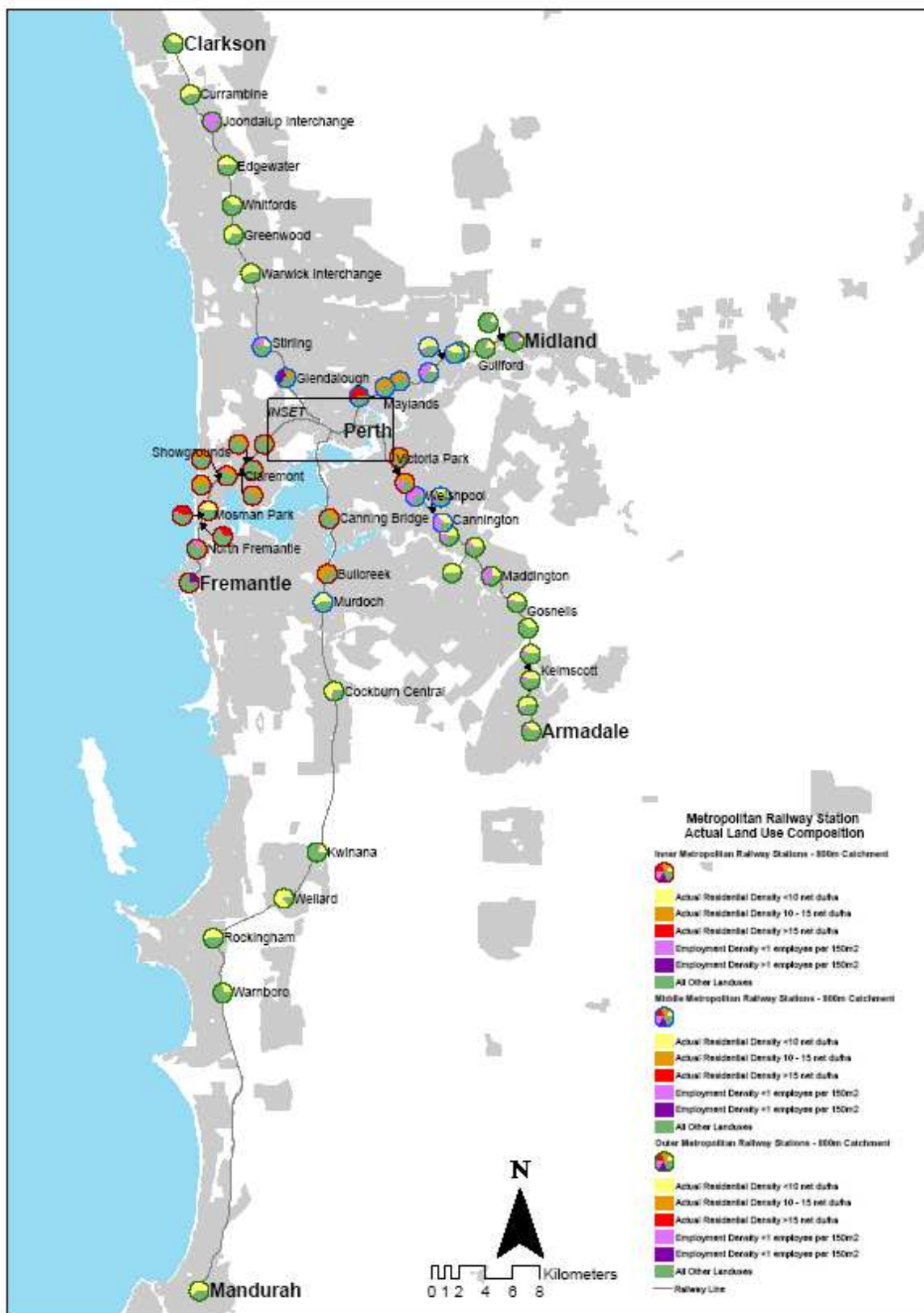


Fig. 9a: Perth metropolitan railway precincts: Land Use 2001

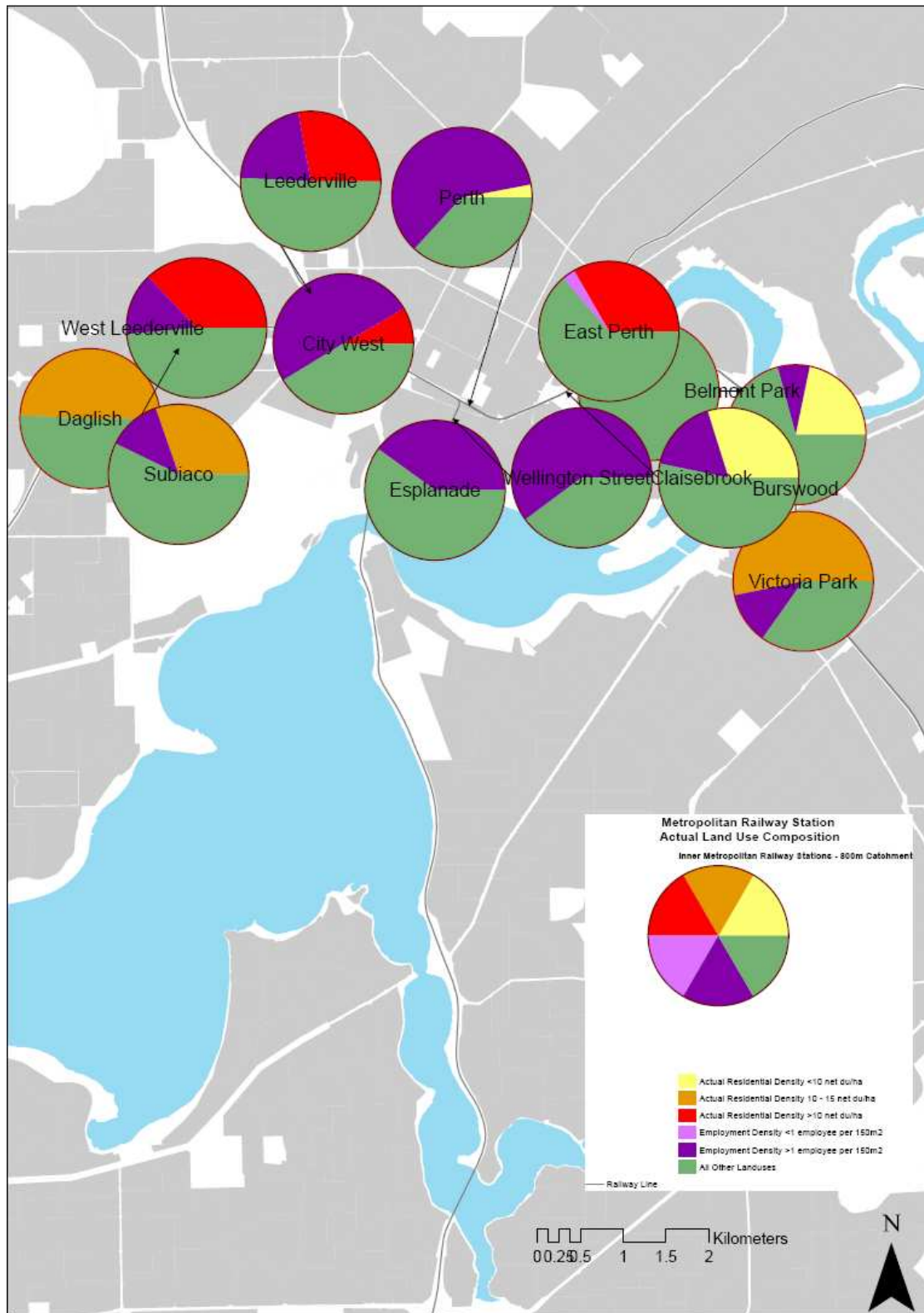


Fig. 9b: Perth central area railway precincts: Land Use 2001

	Net density <10 du/ha	Net density 10 - 15 du/ha	Net density >15 du/ha
Inner Suburb	7	14	7
Middle Suburb	9	3	1
Outer Suburb	27	1	0
Total	43 (62.3%)	18 (26.1%)	8 (11.6%)

Fig. 10: 2001 Net Residential Density of Station Precincts by Location (no. of precincts)

	Gross density <10 du/ha	Gross density 10 - 15 du/ha	Gross density >15 du/ha
Inner Suburb	20	8	0
Middle Suburb	11	1	1
Outer Suburb	27	1	0
Total	58 (84.1%)	10 (14.5%)	1(1.4%)

Fig. 11: 2001 Gross Residential Density of Station Precincts by Location (no. of precincts)

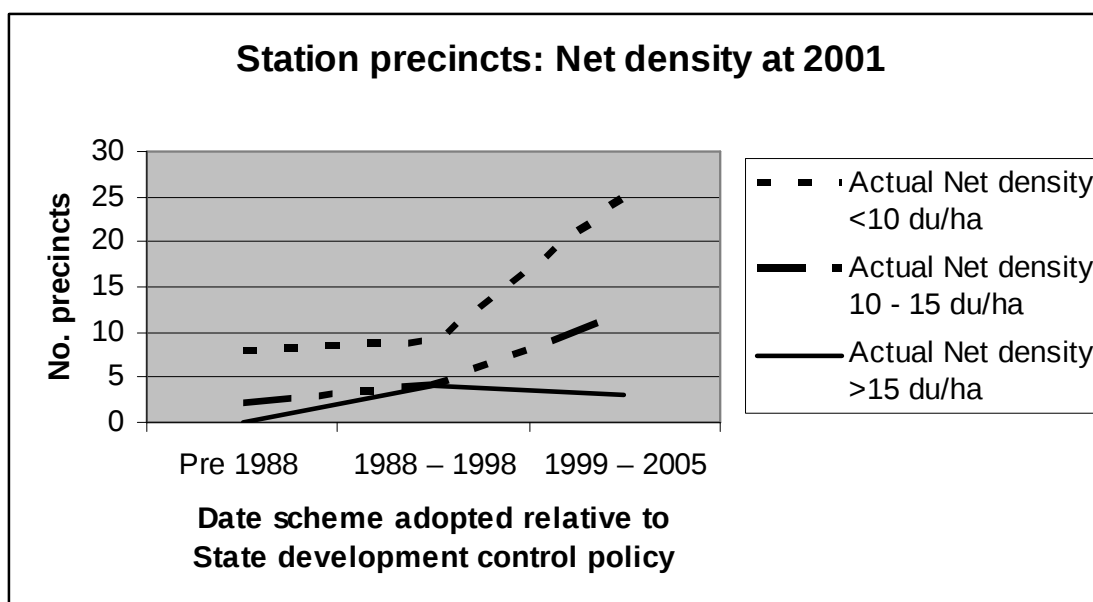


Fig. 12: Age of scheme by Actual Net Residential Density (no. of precincts)

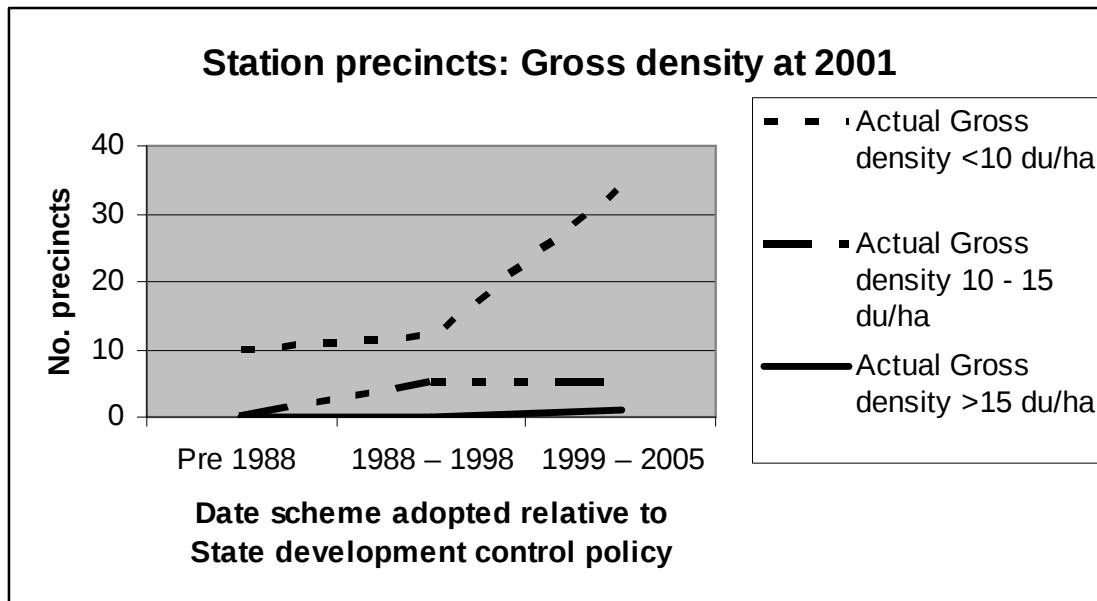


Fig. 13: Age of scheme by Actual Gross Residential Density (no. of precincts)

VI. DISCUSSION

This research is concerned with the question of the capacity of government to deliver sustainable and integrated transport. There is clear national, state and local agreement with the broad principle of focus on action around LUTI. If LUTI principles are to be implemented at a physical planning level then implementation must be achieved through the development of strong, directive policy which gives clear direction for action. Therefore an analysis of policy intent will enable the question of 'capacity to deliver' to be assessed, at least in the policy dimension.

The analysis of state and local government policy coverage confirms that there is a capacity to deliver LUTI principles. There is evidence of vertical linkage – the direction and translation of LUTI policy principles from state government to local government. There is also some evidence of horizontal linkage between different state agencies.

A closer analysis of local government policy as set out in the core statutory planning policy – the Town Planning Scheme – finds a much more mixed capacity outcome. The full suite of LUTI considerations are not all covered by local government, this is particularly so of those concerned with the public transport service. Where LUTI considerations are found in the policy documents – not all councils include them, and in some cases less than half of the metropolitan councils demonstrated such capacity. Further analysis is needed on the detail of this in order to understand whether the differences are a result of differences in types of local government (by location, by size of council and so on) or by age of TPS, or by relationship with other policy documents (perhaps these give greater coverage). This analysis will be the subject of a future paper.

Even where LUTI considerations are included they are not always well supported by the full set of complimentary LUTI considerations – the example of this is shown above with reference to car parking and to street design and traffic management. A further factor which impacts on the ability to implement policy is the strength of the policy statements. The rating system used to measure the ability of any policy to be operationalised showed that many policy statements were fairly general, loosely defined and open to interpretation. In such cases implementation will depend on the whim or ability of the planner or decision maker. Again this aspect will be examined in detail in the next stage of the research.

Finally, in the context of the case study on transit-oriented development, it is evident that despite clear policy intent to deliver a more transit-oriented development – expressed in this case by the requirement for development in station precincts to be built at higher residential densities, high intensity of commercial use and in a more mixed use form – it has not translated in many instances into actual development on the ground. By 2001, despite a 20 year policy 'lead time' only one station precinct out of 69 had a 'high' gross residential density (18 du/ha). Even this precinct did not measure up either to state or international benchmarks for the appropriate density. The picture for net residential density was slightly more promising; here 8 precincts did contain residential development built at a net density greater than 15 du/ha. All but one of these is located in the inner city, the other on the edge of this area. In some of these locations implementation has been achieved by the proactive actions of development authorities rather than through the normal town planning process. The inner city location would suggest the influence of high land values is likely a catalyst for development, facilitated by town planning schemes – but likely in 'reactive' mode rather than 'proactive'.

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