

Greening the Greyfields: Unlocking the Redevelopment Potential of the Middle Suburbs in Australian Cities

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Abstract—Pressures for urban redevelopment are intensifying in all large cities. A new logic for urban development is required – green urbanism – that provides a spatial framework for directing population and investment inwards to brownfields and greyfields precincts, rather than outwards to the greenfields. This represents both a major opportunity and a major challenge for city planners in pluralist liberal democracies. However, plans for more compact forms of urban redevelopment are stalling in the face of community resistance. A new paradigm and spatial planning platform is required that will support timely multi-level and multi-actor stakeholder engagement, resulting in the emergence of consensus plans for precinct-level urban regeneration capable of more rapid implementation. Using Melbourne, Australia as a case study, this paper addresses two of the urban intervention challenges – *where* and *how* – via the application of a 21st century planning tool *ENVISION* created for this purpose.

Keywords—Green urbanism, greyfields, planning tools, urban regeneration.

I. INTRODUCTION

SUSTAINABLE urban development constitutes a principal challenge for the 21st century. By 2050 it is estimated that 75% of the global population will be urban. In Australia, one of the most urbanized nations, population is projected to reach more than 35 million by mid-century, and over 70% of this growth will be in the capital cities [1]. Providing an adequate supply of affordable housing to meet the demands of fast-growing cities is now a critical issue for governments at state and national levels [2]. Within Australia's big cities, where should this population growth go?

Despite the more recent injection of 'smart growth principles' into urban planning processes, low density greenfield development remains the dominant model for much city building in Australia within both government (e.g., Victoria's Growth Area Authority) and the private sector property development industry [3]. The effect is to perpetuate much of the city-building processes of the past 60 years which are proving to be unsustainable in terms of a range of key

metrics associated with resource consumption and environmental degradation [4, 5, and 6].

In the absence of government regulations that would require higher levels of environmental performance, e.g., integrated urban water systems [7], building energy performance that meets international best practice [8], distributed renewable energy generation [9] and local waste utilization via eco-industrial clusters [10], opportunities are being lost in current greenfield developments to wind back the unsustainable ecological footprints of Australia's cities. Melbourne's footprint is 6.4 ha/person, approximately three times the global average [11].

Attempting to avoid the negative externalities associated with suburban sprawl is the principal driver behind compact city strategies. The case for redirecting more population and residential investment inwards – to the established middle suburbs – marks a radical departure from past practice. However, it is based on clear sustainability principles. It makes economic sense. Trubka, Newman and Bilsborough [12] calculate that each new greenfield fringe block incurs an extra \$85,000 in infrastructure costs compared to urban redevelopment, and \$250,000 extra in transport costs over 50 years. Cunningham [13] sees urban regeneration and redevelopment as the basis for a new restoration economy capable of significant wealth generation and job creation. The core areas of the large cities in the USA are also proving to be more resilient economically following the global financial crisis [14]. Price premiums of between 40% and 200% on a \$/square foot basis for residential property are emerging for walkable urban places as opposed to nearby 'driveable' suburban places [15].

It makes environmental sense. More compact cities require up to 40% less transport energy to operate and can save similar amounts of carbon dioxide emissions from urban transport [16]. Medium density housing is typically 25% more energy efficient than detached [17]. There are a range of other environmental benefits that relate to reduced water and material use and waste generation [18] as well as preservation of farmland and green space at the edges of the city [19]. It also makes sense from a social perspective. The vulnerability of residents in car-dependent outer suburbs to rising petrol prices linked to peak oil [20] represents an additional layer of socio-economic disadvantage to that already identified in outer suburbs of cities such as Melbourne and Sydney [21, 22]. Cities that fail to recognize this bifurcation, which will be further accentuated by emerging new energy realities, will suffer in respect of their resilience, competitiveness and

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liveability. Redevelopment of ageing detached housing as medium density will not just deliver more housing, but more housing choice throughout the middle suburbs of our cities, capable of better meeting the needs of a nation whose demographic profile is now markedly different to that of the period when those suburbs were constructed.

It is critical that cities seek to reinvent themselves, to undergo regeneration on a continuing basis as part of their process of evolution. This should be based on a clear idea of what the city needs and what is capable of being translated into development projects.

II. CURRENT METROPOLITAN PLANNING STRATEGIES

The most recent strategic plans for Australia's major cities (Table I) clearly reveal an attempt to move away from *greenfield* development as the principal means of delivering new housing for metropolitan residents: with targets of the order of 50%-plus of new development to be built within established residential areas, principally the inner and middle ring suburbs. Results suggest that the challenge of meeting these '*infill*' targets, especially in the middle ring suburbs – and under current industry, government and community processes – may be insurmountable unless there is a major transformation in the process by which, and the scale at which, the existing built environment can be regenerated.

TABLE I
INFILL TARGETS FOR MAJOR AUSTRALIAN CITIES [2]

City	Strategic planning document	Timeframe	Target dwellings (number)	Percentage from infill (%)
Sydney	City of Cities: A Plan for Sydney's Future	2005-31	640,000	60 to 70
Melbourne	Melbourne 2030: A Planning Update – Melbourne @ 5 Million	2009-30	600,000	53
South-east Queensland	South-East Queensland (SEQ) Regional Plan	2009-31	754,000	50
Perth	Directions 2031 Spatial Framework for Perth and Peel	2009-31	328,000	47
Adelaide	30-Year Plan for Greater Adelaide	2010-40	258,000	Moving from 50 to 70

Reviews of these strategic plans [e.g., 23, 24] suggest that 'on the ground' implementation could be problematic – what Bramley [25] called 'an implementation gap'. Warning signs exist, for example, insufficient progress in redirecting residential growth from the fringe to established areas of the metropolis, lack of significant residential or mixed-use development around principal and major activity centres, and lack of progress by local governments in developing housing strategies and estimates of housing capacity for their municipalities.

Politically, redevelopment is fraught, given the paradigm that currently operates in Australia's cities:

'One of the dirty secrets of the population debate is that Sydney and Melbourne can carry many more residents within their existing postcodes. The problem is that no government, federal or state, wants to put their name to a strategy that sees every spare piece of inner-city land converted to high-rise apartments. Better to send lower income families to some new housing estate than keep them close to the services that the rest of the nation takes for granted ... The metropolitan fringes of Sydney, Melbourne and southeast Queensland are the problem, not the solution to the nation's population challenge. The first federal or state government that can refocus and redirect growth will deserve the compliment of nation-builder' [26].

From a population, housing and employment perspective, the *middle suburbs* of large Australian cities such as Melbourne are clearly under-utilized. These suburbs are where the residential building stock is failing (physically, technologically and environmentally), constituting an under-utilized asset awaiting redevelopment. Their energy, water and communications infrastructure is also ageing and in need of regeneration.

III. THE MIDDLE SUBURBS: CHALLENGES AND OPPORTUNITIES FOR REDEVELOPMENT

Historically, Melbourne (together with all other Australian cities) has accommodated population growth primarily via a model of low density greenfield housing development. Until the 1950s this pattern was strongly influenced by the fixed-rail networks of trains and trams. The next 50 years were characterized by automobile-dependent suburbanization. The planning and design of most post-1950s urban growth was undertaken in an era when practitioners and populations alike foresaw little or no resource or environmental constraints on urban development [4]. This approach has now been shown to be unsustainable [6].

Laid out originally as residential dormitories, the middle suburbs now constitute a contiguous built-up region between 10 and 30 km from the CBD (see Fig. 1). They stand in

contrast to the inner suburbs where significant urban regeneration is already well underway, dating back to the beginnings of residential gentrification in the 1970s and where manufacturing precincts have been progressively abandoned since the 1980s [27] to be replaced by mixed use residential development. Brownfield developments and commercial-to-residential conversions of CBD high-rise buildings in the 1990s all reflect efforts towards urban regeneration that are largely lacking in the middle suburbs. Unlike the inner

suburbs, they have tended to retain much of their original status, albeit with many buildings and infrastructures likely to be showing signs of physical and technological obsolescence. Their urban character and demography varies substantially with disparities in housing affordability and diversity. This belt of suburbia is service, transport and amenity rich in comparison to the outer suburbs. However, its contribution as a destination for new housing and population at higher densities is lagging, as the following metrics illustrate.

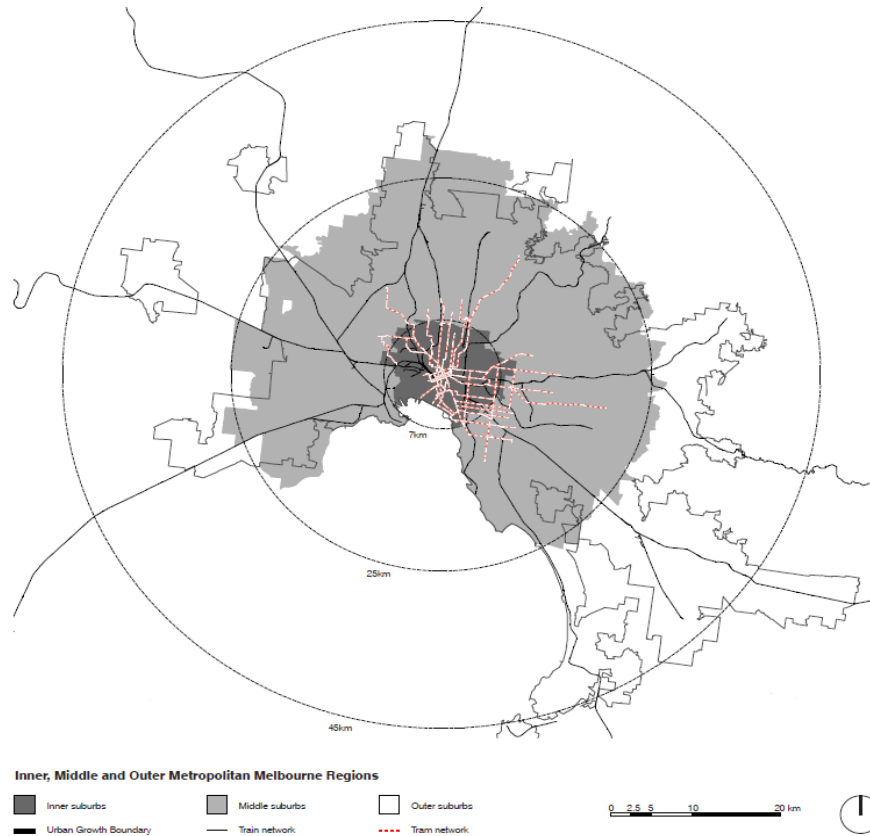


Fig. 1 Melbourne's inner, middle and outer suburbs [28]

A. Public Transport

Public transport access tends to be good for many of the middle suburbs, but declines dramatically in the outer and fringe suburbs (Fig. 2). Increasing residential density in precincts with good public transport access should avoid

automatic loading of the local road network which is already congested at peak times, but would remain one of the issues to examine for precincts less well served by public transport.

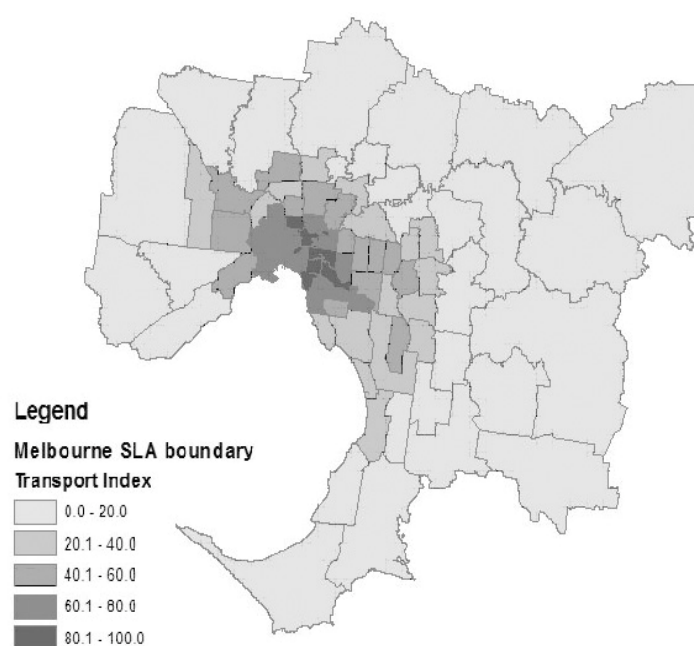


Fig. 2 Public transport richness index, Melbourne, 2008

Note: Map depicts percentage of Statistical Local Area that is within 400 metres of any form of public transport (train, tram, bus)

B. Housing

The volume of housing stock (number of dwellings) in the middle ring suburbs relative to inner and outer is somewhat smaller, revealing a potential for increasing capacity (Fig. 3).

Compared to the inner city, there is relatively little variety in the types of dwelling on offer.

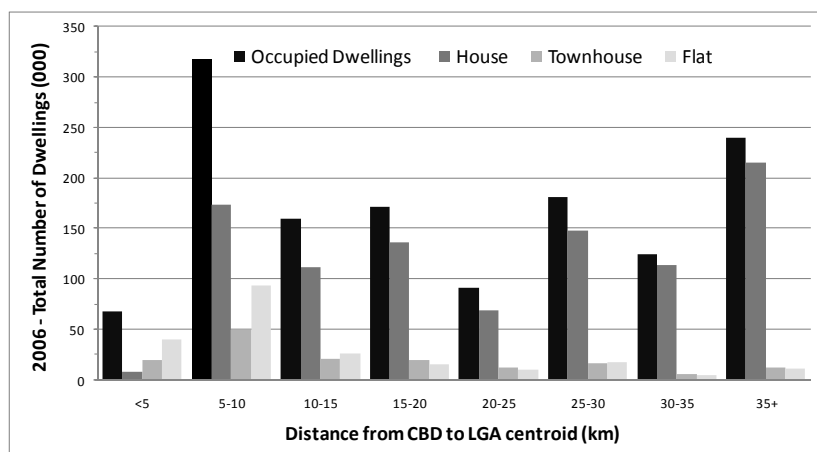


Fig. 3 Distribution of dwellings, Melbourne, 2006, by distance from CBD [29]

New dwelling construction in the 5 to 15 km ring beyond the inner city has remained modest over a 20 year period,

albeit from a period in the early 1980s where there was actual net loss of housing stock (Fig. 4).

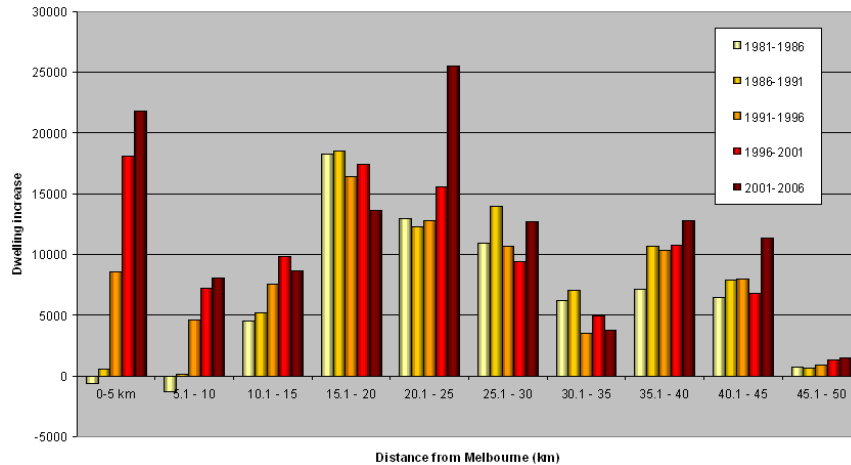


Fig. 4 New dwelling construction by distance from CBD, Melbourne [29]

C. Population

The number of people living in the middle suburbs is significantly less than in the inner and outer suburbs, with a net population density in the 20 to 30 persons per hectare

range. Despite this, they had the lowest levels of population growth in 2001-06 (Fig. 5), with the outer greenfield suburbs being the main demographic absorbers.

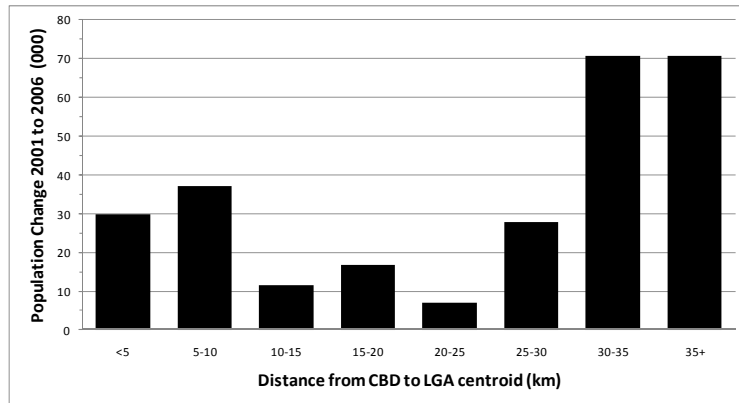


Fig. 5 Change in population, Melbourne, 2001-06, by distance from CBD [30]

D. Employment

The central city and inner suburbs have the highest concentration of jobs (Fig. 15). Middle ring suburbs are well

placed geographically to access jobs located in both inner and outer rings.

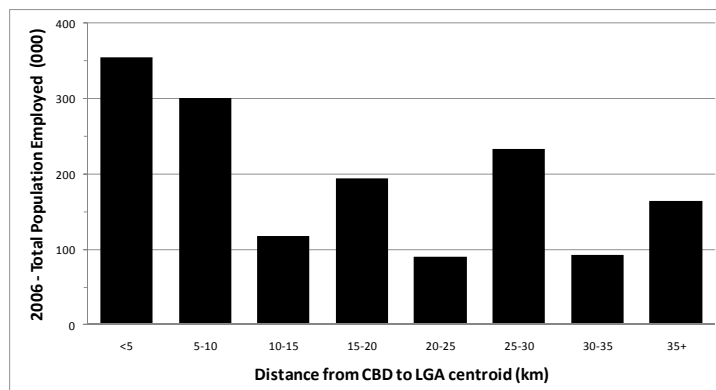


Fig. 6 Distribution of jobs, Melbourne, 2006, by distance from CBD [30]

E. Residential Amenity

Using house prices as a hedonic guide to the locality's value, residential amenity is highest in the inner suburbs and

diminishes with distance from the CBD. The disparity between inner, middle and outer prices has exploded over the past 15 years (Fig. 7).

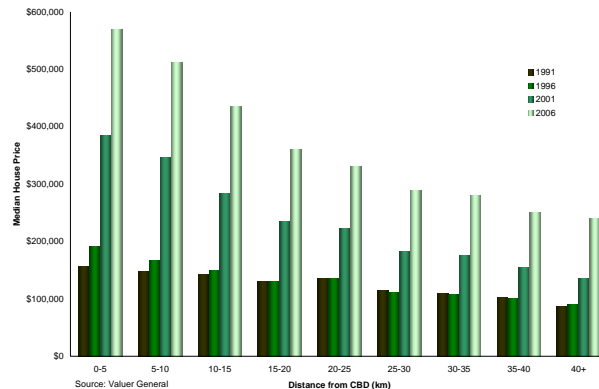


Fig. 7 House prices, Melbourne, 1991-2006, by distance from CBD [31]

IV. ARENAS OF URBAN HOUSING REDEVELOPMENT IN THE MIDDLE SUBURBS

The terms 'urban regeneration', 'redevelopment' and 'retrofit' have been used somewhat interchangeably to refer to the processes associated with revitalization of the built environment. With specific reference to housing and precincts, it is possible to distinguish three scales of operation and transformation:

- Retrofit implies a *modification* to a structure already in use, employing materials or technologies developed after the period of original manufacture or construction;
- Redevelopment implies a *reproduction* of something, e.g., new housing for obsolescent housing (albeit using contemporary designs and materials);
- Regeneration should be seen as a higher order process. It implies a *complete re-creation* to a better form or condition than the past, extending beyond the individual dwelling to neighbouring properties and infrastructure [32, 33, 34]. Urban regeneration is advanced here in the context of *precinct regeneration* as a critical component of

sustainable urban development as well as a new engine for the economy, given the global challenge of delivering more sustainable cities and creating new classes of industry and employment [13].

Table II is illustrative of this spectrum. Housing retrofits (1) occur principally to update those parts of a dwelling that are performing poorly – physically, technologically and socially – and usually target kitchens, bathrooms and entertainment areas where there is a dramatic contrast between mid-20th and early 21st century dwelling designs, fittings and fixtures. Retrofits tend to occur in well located and sought-after neighbourhoods. Housing redevelopment (2) in the middle suburbs is mostly fragmented or piecemeal infill activity, with a small net addition to housing stock but no change to land use mix or neighbourhood design. Housing regeneration (3) is a term that can be assigned to larger-scale housing projects that occur at a precinct level in established areas, often designated in metro strategies (e.g., activity centres, transport corridors, brownfield areas) as areas for more rapid change.

TABLE II
TYPES OF HOUSING REDEVELOPMENT IN THE MIDDLE SUBURBS [35]

Arena	Net addition to housing stock	Planning framework
1. Alternations, extensions, refurbishments to existing residential properties; 1 for 1 replacement	Nil	'No go'; limited change zone – specific characteristics recognized for protection, providing limited opportunity for increased housing
2. Piecemeal infill (typically demolition and replacement on a single or double adjacent parcel of property)	Typically ranges from 2 for 1 to approximately 4 for 1 (for a single parcel)	'Slow go'; incremental change zone – respects existing neighbourhood character while providing for an increase in housing diversity with moderate increase in new dwellings
3. Precinct regeneration: activity centres/TODs, transport corridors	Significant addition to housing stock	'Go go'; substantial change zone – designed to promote a significant increase in new dwellings, greater housing diversity and new built form and character

In respect of opportunities for housing intensification and precinct regeneration in the middle suburbs, we identify two prospective arenas for strategic urban planning and development: the *brownfields* and the *greyfields*.

B. Brownfield Precincts

Brownfield redevelopment has emerged as a process for re-imagining and transitioning those parts of our cities which have 'outlived' their original industrial-era functions. Principal among these are the abandoned or under-utilized docklands which now occupy prime waterfront sites in all coastal cities, as well as the thousands of industrial sites [36] that are to be found in all large metropolitan areas: the factories, scrap yards, railroad corridors and vacant petrol stations which catalogue the nation's industrial past.

They are typically: owned by a single party, usually government or industry; of a scale which is closer to that provided by greenfield sites for development; contaminated to some degree, depending upon the nature of prior use; and unoccupied, obviating the need for community engagement at the level required of greyfields.

As such, brownfields have become attractive to the property development and finance industry who have been able to create a model to undertake major projects such as Docklands and Federation Square in Melbourne, Darling Harbour and Barangaroo in Sydney, Newport Quays in Port Adelaide and Southbank in Brisbane. They represent an important contribution to the revitalization of abandoned urban land and to the net addition of housing stock in growing cities, but are far from sufficient to meet aggregate metropolitan demand for new infill housing.

B. Greyfield Precincts

Unlike brownfields, greyfields usually have no need for site remediation. They predominantly lie between the more vibrant CBD and inner city housing market and the more recently developed greenfield suburbs, providing greater access to employment, public transport and services. Greyfields in the Australian context have been defined as ageing but occupied tracts of inner and middle ring suburbia that are physically, technologically and environmentally failing and which represent under-capitalized real estate assets [37]. In pockets, greyfield housing has also become a major location of social disadvantage [38].

The term 'greyfield regeneration' is used here to denote a new and critical focus for strategic metropolitan planning, requiring articulation of a new process (framework, model) for a more effective triple bottom line transformation of large tracts of our cities. This necessitates a focus on *precinct*-scale rather than piecemeal infill; on *new housing typologies* such as low-rise high density development; on *new partnerships* that involve community participation; on *new modes of constructing* the built environment of the future; and on the establishment of new, nimble '*regen*' organizations capable of catalysing regeneration. It will encompass the existing public sector interventions relating to housing in deprived neighbourhoods [39] that mostly involve government housing and welfare tenants – less than 5% in any Australian city – but will aspire to the much more substantial rejuvenation of under-performing, privately owned housing in inner and middle

suburbs. Greyfields regeneration represents a process for a more intentional transformation of neighbourhoods, rather than waiting for degeneration to reach such a tipping point that major public intervention is required.

Greyfields have become a key target for more intensive redevelopment by state government planning agencies in their capital city development strategies (viz. 50% + targets for 'infill'). But outside of activity centres, there is currently no established development model for encouraging precinct-scale redevelopment or regeneration. In addition to activity centres, transport corridors and greyfield residential precincts need to be 'in scope' for a regeneration of the middle suburbs.

C. Activity Centres and Transit-Oriented Development

Activity centres have been a focus for intensification of greyfield sites predating Melbourne's 2030 Strategic Plan. They now constitute a renewed focus, coupled with transit-oriented development (TOD) projects, not only for Melbourne but also for Adelaide, Brisbane, Perth and Sydney. The principles of TOD are well established: a stimulus for urban renewal and enhancement of centre image that clusters a greater mixture of land uses and housing, at higher densities, around high quality transport services configured as the heart of the enlarged community [40]. They also benefit from having a number of development models that are effectively being applied to TOD projects: government-led (e.g., Gold Coast University hospital precinct), private-sector-led (e.g., Albion Mill precinct in Brisbane [41]) and public/private partnerships (e.g., Green Square Town Centre in Sydney).

Their rate of progress has been much slower than anticipated, due to local reaction directed principally against the scale of high-rise development proposed and change to neighbourhood character. In response, the previous Victorian Labor state government proposed the establishment of Development Assessment Councils to control planning permit decisions in activity centres which are currently made by local councils [42]; the current Liberal-National conservative government has appointed its own Ministerial Advisory Committee to oversee a new Melbourne Metro Strategy.

D. Public Transport Corridors

A recent proposal for urban redevelopment is one which identifies linear transport corridors as an additional focus for medium-rise high density development. Requiring approximately 9% of Melbourne's existing urban area, the developable sites along major corridors (estimated to be 12,400 along tram lines and 22,000 along priority bus routes) are proposed to collectively accommodate about 500,000 new dwellings. The requirements for this to work are set out by Adams *et al.* [43] and include prescriptive controls over key aspects, including up-front 'as of right' development to levels of four to eight storeys. Key drivers, in addition to providing a pathway for delivering a significant volume of net new housing in greyfield areas (as a result of enabling land value for redevelopment to be more easily determined), include the removal of development pressure off the existing interstitial suburbs which enables them to act as the 'green lungs' (enhanced water, energy, food production etc.) of our cities, at their existing levels of low density.

Both activity centres and transport corridors featured explicitly and prominently in Victoria's 2010 State Planning Policy Framework: Clause 12 (VC67). As with all greyfield redevelopment initiatives, a key challenge is achieving public acceptance. The principles outlined for the corridor strategy will assist in this regard, as they are intended to assure the community that corridors are fixed and will not spill over into suburban areas in between. Following a change of state government in 2011, however, the status of corridor precinct development is less clear.

E. Greyfield Residential Precincts

As Newton [37] has argued elsewhere, current brownfield and greyfield approaches to urban redevelopment are necessary but not sufficient for a sustainability transition of our cities, as they consign the remaining 90% of greyfield residences to piecemeal infill redevelopment. This represents a sub-optimal solution for regenerating housing, energy, water and waste systems and local amenity via enhanced mixed-use development and active transport (e.g., walking, cycling and public transit access) options, all best done at a precinct level [44, 45, 46]. The advantages of precinct-scale regeneration have been identified as:

- Housing: delivers a mix of dwelling types, styles and costs, at higher densities, with some mixed use, while time having the capacity to deliver a more aesthetically pleasing and higher-amenity redesigned neighbourhood [28];
- Energy: achieves carbon neutrality or zero carbon status with the introduction of distributed (renewable) energy and micro-generation technologies as new elements of hybrid buildings or precincts, capable of generating energy for local use as well as for the national grid [17];
- Water: integrated urban water systems involving water-sensitive urban design are best implemented at precinct scale, enabling appropriate mix of technologies for local water capture, storage, treatment and end-use to be

introduced in an eco-efficient manner, implementing 'city as catchment' [7, 47];

- Waste: precinct-scale redevelopment can optimize reuse of demolished stock and minimize the waste stream from new construction, as well as automate waste disposal and maximize recycling from occupied dwellings [48];
- Walkability: opportunity to reduce land assigned to car transport, reconfiguring it to encourage more active transport modes such as walking and cycling [49];
- Construction: linking off-site manufacture and on-site modular assembly to reduce many negative impacts of a traditional construction site, e.g., time to 'construct' and cost of delivery, while increasing quality to more closely align with a manufactured product [50];
- Sense of place: opportunity to create an attractive physical neighbourhood and social community setting, with a distinctive look and feel [51].

V. ASSESSING CURRENT PERFORMANCE AGAINST METRO TARGETS

Melbourne @ 5 Million established a government target of 600,000 additional dwellings to be built over the next 20 years. The spatial target was further simplified to 316,000 (53%) being in established areas, equating to 15,800 per annum, and 284,000 (47%) being in growth areas [52]. In this section we report on how Melbourne is tracking in relation to these strategic urban development targets, using parcel level property data assembled for the period 2004-09 that identifies new dwelling construction activity.

The bulk of dwelling construction projects continue to occur in the outer suburbs (Table III), areas with significantly less access to public transport, employment and services than middle and inner suburbs. The middle suburbs constitute the principal focus for extensions and alterations.

TABLE III
VALUE OF NEW DWELLING CONSTRUCTION VERSUS UPGRADE (EXTENSIONS, ALTERATIONS) PROJECTS, MELBOURNE, 2009 [53]

Region	New construction		Extensions and alterations	
	Value (\$M)	% of total	Value (\$M)	% of total
Inner suburbs	466	7.7%	439	29.7%
Middle suburbs	1,775	29.5%	783	52.9%
Outer suburbs	3,781	62.8%	257	17.4%
Total	6,022	100.0%	1,479	100.0%

Table IV indicates that infill is contributing approximately 48% of new housing stock for that period, below the

designated target for 2030. 53% of infill development is concentrated in the greyfields.

TABLE IV
GREENFIELD RESIDENTIAL DEVELOPMENT AND INFILL REDEVELOPMENT, 2004-09

Greenfield		Infill		Total construction		Infill as % of total new dwellings	
Constructed dwellings	Net increase in dwellings	Constructed dwellings	Net increase in dwellings	Total constructed dwellings	Total increase net	% constructed dwellings	% net increase
69,413	69,216	83,169 30,199 brownfield + 52,970 greyfield	63,885 29,690 brownfield (47%) +34,195 greyfield (53%)	152,582	133,101	54.51%	48.00%

Are activity centres attracting infill? They represent a major geographic focus for concentration and intensification of future development in Melbourne (Fig. 8). They have multiple objectives relating to employment, transport and housing.

From a housing perspective, activity centres attracted 28% of net new dwelling additions between 2004 and 2009 (Table V). The Central Activity Districts (CADs) contributed half of this, and here the relative contributions of each of the six CADs varied significantly, with the CBD being the principal magnet for new dwelling units.

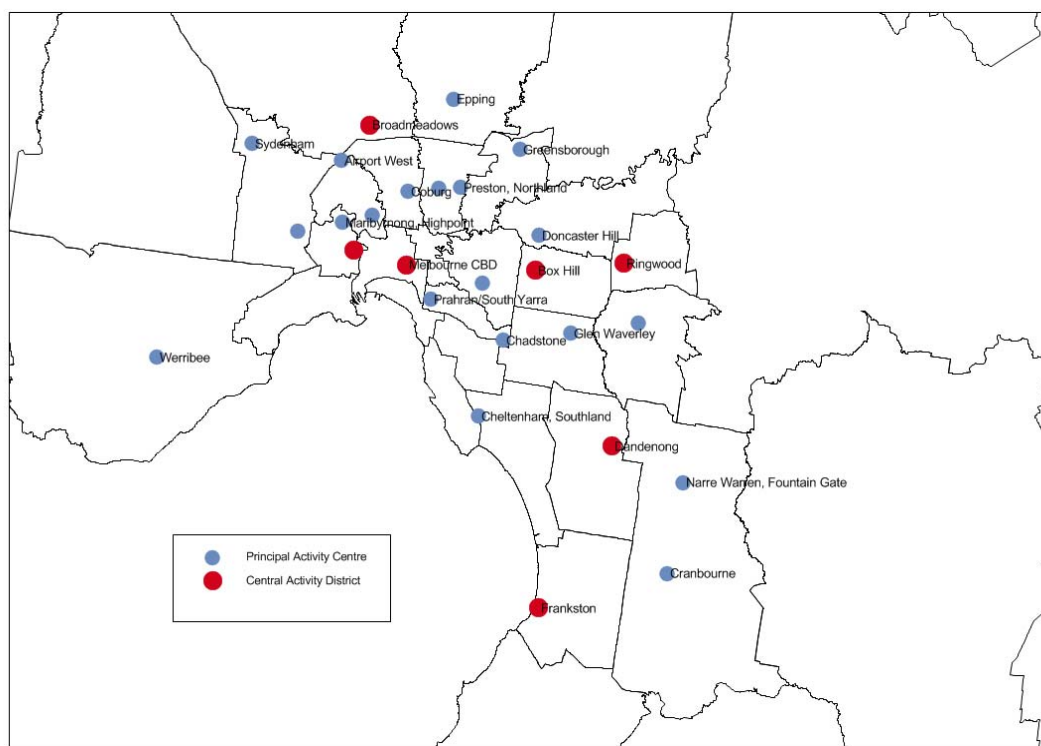


Fig. 8 Central Activity Districts and Principal Activity Centres in Melbourne

TABLE V
THE EFFECT OF ACTIVITY CENTRES AS ATTRACTORS FOR RESIDENTIAL INFILL, 2004-09

Category of activity centre	Total		Greyfield as % of activity centre infill		Activity centre infill as % of total infill	
	New dwellings	Net increase	New dwellings	Net increase	New dwellings	Net increase
CAD						
CBD	7,138	7,130	0.03%	0.00%	8.58%	11.16%
<i>Frankston</i>	112	84	100.00%	100.00%	0.13%	0.13%
<i>Dandenong</i>	538	443	72.30%	68.40%	0.65%	0.69%
<i>Broadmeadows</i>	72	52	100.00%	100.00%	0.09%	0.08%
<i>Footscray</i>	634	594	29.65%	25.93%	0.76%	0.93%
<i>Ringwood</i>	181	151	99.45%	100.00%	0.22%	0.24%
<i>Box Hill</i>	494	420	92.71%	92.14%	0.59%	0.66%
Total CAD	9,169	8,874	15.28%	12.75%	11.02%	13.89%
Principal	4,247	3,345	53.43%	42.27%	5.11%	5.24%
Major	5,445	4,662	45.84%	37.54%	6.55%	7.30%
Specialized	1,248	1,235	12.74%	11.98%	1.50%	1.93%
Totals	20,109	18,116	31.45%	24.53%	24.18%	28.36%

Note: All activity centre boundaries were assigned a 400 metre buffer to allow for the capture of any 'knock-on' effect.

Is public transport access attracting infill? A transport corridor model has been advanced as an additional focus for urban redevelopment [43] but does not feature formally in current government metro planning frameworks. To examine the extent to which road transport corridors are attracting new residential development, a public transport access level (PTAL) metric-based analysis (0-10) was calculated at the mesh block level which is indicative of level of public transport access and connectivity servicing precinct populations (see Table VI). Roads with high access (PTAL 7-

10) were associated with the highest level (proportionate to existing stock in the zones) of net new dwelling construction between 2004-09, but only in the (predominantly inner city) brownfields. Perhaps a more striking finding was the absence of any difference in the proportionate rate of housing redevelopment between PTAL zones with medium public transport access and those with little or none. When focus is on total infill, percentage of net dwelling increase is more evenly spread across PTAL zones (33%, 35%, 32%). In other words, much new infill housing remains car-dependent.

TABLE VI
PUBLIC TRANSPORT ACCESS LEVEL (PTAL) AND REDEVELOPMENT

	Metro Melbourne	Brownfield		Greyfield		Total infill	
	Total residential properties	Net increase	Net increase as % of total dwellings in PTAL zone	Net increase	Net increase as % of total dwellings in PTAL zone	Net increase	Net increase as % of total infill
High (7-10)	219,613	16,040	7.3%	4,939	2.2%	20,979	32.8%
Medium (3-6)	573,340	8,410	1.5%	14,199	2.5%	22,609	35.4%
Low (0-2)	778,903	5,240	0.7%	15,057	1.9%	20,297	31.8%
Total	1,571,856	29,690	1.9%	34,195	2.2%	63,885	100.0%

What are the dwelling yields in brownfield versus greyfield areas? The story here is telling (see Table VII). Greyfields redevelopment is dominated by the piecemeal, sub-optimal infill represented by 1:1 replacement (detached) dwellings and the 1:2-4 redevelopment of residential properties where 80% or more of the property value is vested in the land rather than the built asset. There is a well-established operational model for this class of development. Higher density apartment development (20+ units in complex) is confined mostly to

brownfield sites, larger and normally more centrally located. There is an operational property development model for this class of project also. A major gap in the residential property development market is for projects capable of yielding dwellings in the range of 6 to 20 units as a low-rise medium to high density product. There is currently no workable development model for this class of project – *greyfield residential precinct regeneration*.

TABLE VII
NEW HOUSING YIELD FROM REDEVELOPMENT IN GREYFIELDS AND BROWNFIELDS, MELBOURNE, 2004-09

Region	1:1	1:2-4	1:5-9	1:10-19	1:20+	Total
Greyfield	16,889	30,064	5,952	1,953	5,088	59,946
	28.2%	50.2%	9.9%	3.3%	8.5%	100.0%
Brownfield	1,339	525	664	2,701	26,422	31,651
	4.2%	1.7%	2.1%	8.5%	83.5%	100.0%

VI. REQUIRED: A NEW LOGIC FOR URBAN DEVELOPMENT

Clearly, a new logic for urban development is required. As David Harvey [54] has argued: 'the prospects for making and re-making the city in a different image and according to a different logic is omnipresent. We need to seize these prospects in order to transform the city.' Green urbanism is this new logic (see Fig. 9). In the 21st century, urbanism is the dominant representation of the principal built, social and economic systems on earth: the human settlements and living

spaces that will be home to over 70% of the world's population by 2050 [55], and the location of its economic engines, control centres and workforces [56]. Green urbanism has emerged as a necessary condition IF urbanism is to remain a resilient and sustainable life-form [57, 58, 59, 60]. It represents a transformation of the built environment and the manner in which it is operated. From an urban planning and design perspective, green urbanism involves a new policy focus that has greyfields regeneration as a principal objective.

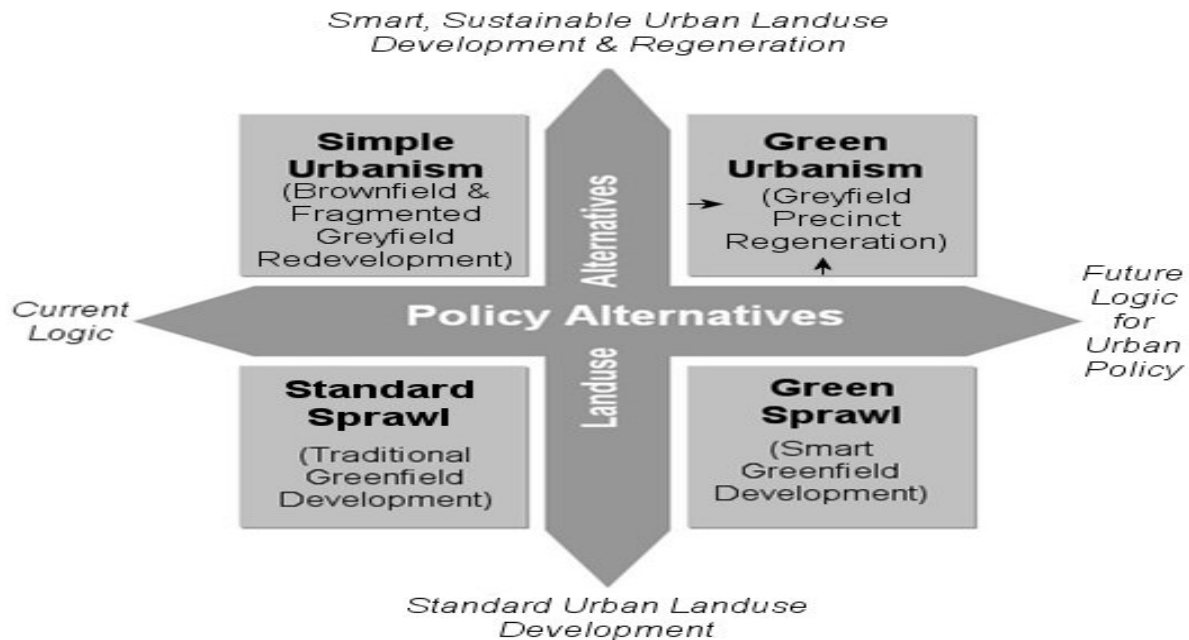


Fig. 9 Green urbanism: Green urbanism: a framework for eco-city development [61]

Achieving a greater level of residential intensification and broader-based urban regeneration in the greyfields, particularly at precinct scale, will require innovation in several arenas identified by Newton *et al.* [35], including:

- Urban policy capable of articulating a long-term strategy for regeneration in the middle suburbs. Notwithstanding targets for infill development, the preference by successive governments has been to release greenfield land on the fringe of the major cities as a pathway of least resistance to accommodating a growing population;
- Establishing a greyfields regeneration organization equivalent in power to those that exist to develop the

greenfields (Growth Area Authority) and brownfields (Places Victoria) in Melbourne;

- A 21st century spatial information and planning platform with associated tools capable of identifying most prospective precincts for regeneration, and providing capacity for stakeholder engagement in visualizing development options and their contribution to more sustainable urban development;
- New urban designs for low-rise (4 to 6 storeys) medium density precincts, including high environmental performance (energy, water, waste) and high residential and social amenity;

- Innovative *construction* processes and changes to the labour force capable of providing more attractive and affordable solutions to medium density housing developments. Industrialized processes that include combinations of prefabricated panels, service systems and interiors can provide fast turnaround options for replacing existing low density housing. These may make medium density options more affordable to residents in existing greyfields; Current *planning* is structured to manage impacts, rather than to deliver visionary outcomes. A map of the geography of proposed property projects taken to the Victorian Civil and Administrative Appeals Tribunal by councils or residents in opposition to developer requests for a planning permit reveals a concentration in the inner and middle ring suburbs where opportunities for urban regeneration are greatest but opposition is strong. This opposition is reinforced by virtue of redevelopment pressure being centred for the most part in higher income suburbs (see Fig. 10); in addition, the two outer municipalities with higher levels of planning appeal are favoured tree-change and sea-change residential areas.

For the most part, planning law focuses on historical precedent and has little scope to address shifts in modes of living or new housing approaches or typologies, or the urban challenges of the 21st century which depart significantly from those of the 20th when our planning regimes were instituted. The limitations of current planning prevent the uptake of greyfield precinct redevelopment and, unless otherwise convinced, developers will continue to pursue well-tested 'safe' approaches. Therefore, there is a need for a new robust planning instrument or code for the redevelopment of greyfield residential precincts;

- Greyfield precinct regeneration offers opportunities to engage citizens as 'partners' in development, from both planning/design and finance perspectives. This will require a new mode of *engagement* that departs radically from the established 'placatory' or 'adversarial' models that often come into play with populations targeted for redevelopment.

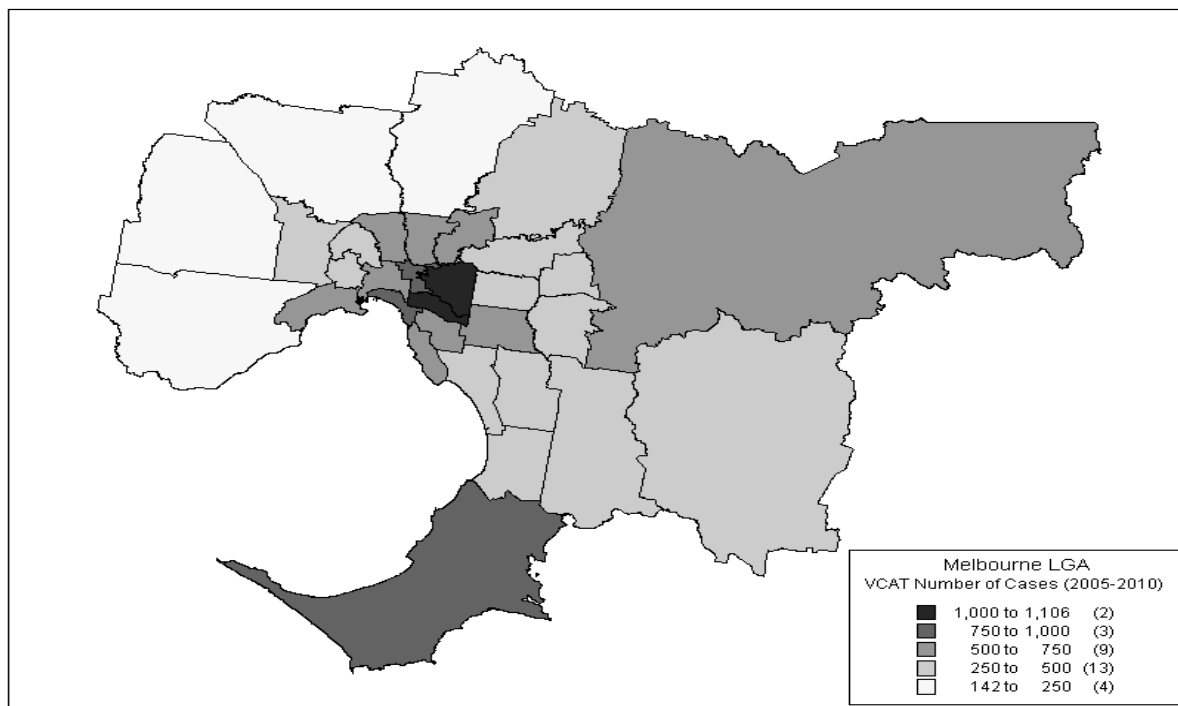


Fig. 10 Planning appeals related to contested property development permit applications, 2005-10 [62]

VII. REQUIRED: A 21ST CENTURY SPATIAL INFORMATION PLATFORM AND PLANNING TOOL

Cities represent the most complex systems on earth, and as home for a projected 75% of the world's population by 2050 (currently over 75% of Australia's population live in cities) they are required to be efficient and productive, environmentally sustainable, liveable, equitable and socially inclusive [63]. Their complexity derives from many sources, but two dimensions of relevance to this paper are the multitude of 'objects' involved (human and physical) that combines to make up the urban system, and the range of 'stakeholders' that need to have a voice in city development in pluralist liberal democratic societies. Regarding the former, Mitchell's [64] 'city of bits' metaphor can be appropriated to positive effect as a basis for representing each element of a city as an object in an urban information model.

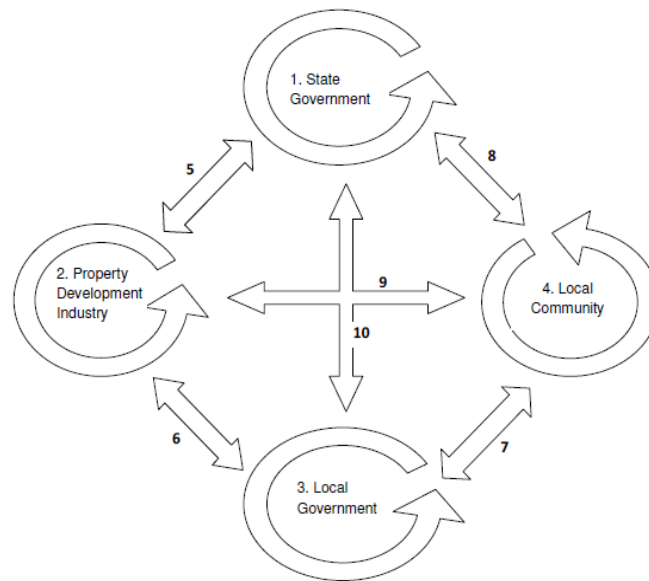
Table VIII shows the key elements of such an urban information system, organized in terms of the principal domains that need to be part of a spatial platform capable of being used by different stakeholder groups to envision and plan future urban (re)development.

The key stakeholder groups that characterize cities (see Fig. 11) tend to operate mostly as reactive 'silos', given the urban planning paradigm that has dominated to date: *top down urban development strategy (elites/regime) → devise plan → impose plan → community backlash (slow or no progress)*.

These features of planning processes have been deemed to stifle change [65, 66]. Stakeholder groups also lack a common set of information and tools capable of supporting the types of stakeholder engagement indicated in Fig. 11.

TABLE VIII
DATA DOMAINS FOR SHARED URBAN SPATIAL INFORMATION PLATFORM

Regulatory Factors (R)	Market Factors (M)	Situational Factors (S)
R1: Planning Zoning	M1: Housing Unimproved Land Value	S1: Physical Infrastructure Water
Overlays	Capital Improved Value	Condition and Capacity
R2: Heritage	Property Sale Volume	Gas
Register	Age of Property	Electricity
Overlays	Strata Titled Property	Transport
R3: Aboriginal Cultural Heritage	Strata Titled Property	Proximity Metric(Transit)
R4: Activity Centres	Redevelopment Potential	Walkability
Proximity	Demolitions	S2: Social Infrastructure
Zoning Effect	M2: Demographic	Education
R5: Biodiversity	Age	Social Services Position
	Specific Age Groups	Community Services
	Various Cohorts	S3: Parks and Public Spaces
	Age Projections	S4: Publically Owned Land
	Various Cohorts	
	Generations	
	Gender	
	Household Type	
	Various Cohorts	
	Generations	
	Cultural background	
	Household Income	
	Housing Tenure	
	Tenant	
	Purchaser	
	Owner	

**Engagement Arenas:**

1. State government (planning department, related departments and appeals tribunals etc)
2. Property development industry (for profit; not-for-profit etc)
3. Local government (council officers; elected councillors etc)
4. Local community (entire municipality; specific neighbourhoods etc)
5. Envisioning future development – major projects; planning appeals
6. Envisioning future development – individual projects (pre-planning permit discussions)
7. Community engagement: long term development strategy for municipality
8. Community engagement: long term development planning for municipality
9. Brokering precinct regeneration projects
10. Envisioning and agreeing future development strategies for municipalities and urban sub-regions

Fig. 11 Types of stakeholder engagement in cities

A. Data Platform

Due to the necessity of utilizing a wide variety of data sources, the technology driving the access and integration of spatial information will be a distributed geographical information system incorporating data from multiple state government and local government sources. The objective is not to take ownership of proprietary datasets, but to remotely access and combine existing data sources to generate a spatial platform for envisioning future redevelopment landscapes. Such platforms are being implemented at AURIN, <www.aurin.org.au>, and the CRC for Spatial Information's Virtual Australia, <www.crcsi.com.au>, with which both senior authors of this paper are affiliated. In total, 50 urban indicators feature in the shared urban spatial information platform.

B. Spatial Tools

A new urban planning paradigm is required that will support timely stakeholder engagement that is multi-actor in nature, encouraging consensus around area redevelopment or precinct regeneration opportunities that are capable of more rapid realization and implementation than is presently the

case. A computer-based tool with the functionality to support the range of spatial queries likely to arise in the various stakeholder arenas has been developed as open source GIS software (*ENVISION*). The power of this planning decision support system is due to the fact that it combines DATA with *Spatial Queries* and *Analysis* plus *Tacit Knowledge* (that resides with each of the stakeholder represented and is triggered in powerful ways via the visualization of data and subsequent dialog). *ENVISION* is also designed in a way that is capable of being end-user driven and not reliant on an external consultant.

In a series of stakeholder workshops held to gain feedback on the utility of the tool, the following types of question were explored with the City of Manningham (one of Melbourne's 30 municipalities, located in the middle ring of suburbs):

- Where has housing redevelopment been taking place recently (planned development zones versus outside of zones)? Fig. 12 illustrates the extent to which urban planning is *not* directing development to the extent currently sought by local government.

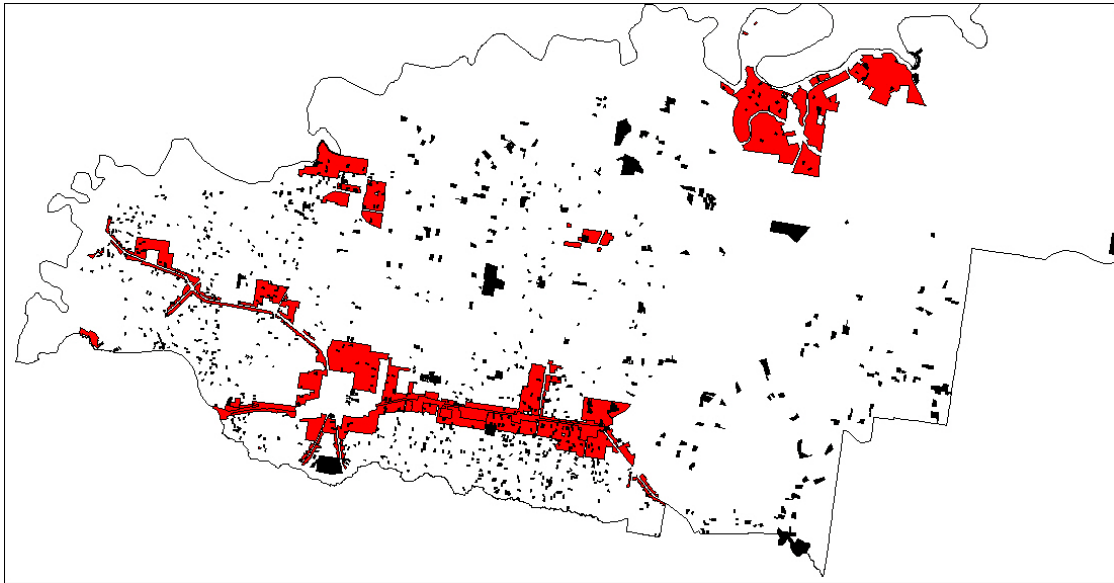


Fig. 12 Housing redevelopment in the City of Manningham 2004-09, with designated development zones highlighted

- How to use *ENVISION*'s multi-criteria evaluation(MCE) capability to locate 'substantial change zones' (refer again to Table II) in the municipality, based on criteria that feature prominently in a planner's 'tool kit': distance to activity centre, train station, tram or bus stop, neighbourhood centre etc., including the weighting to be assigned to each factor (see Fig. 13). Fig. 14 illustrates

an MCE outcome for City of Manningham which confirms some of the local planner's thinking in relation to intensification of development along the main arterial transport corridor, but is also indicative of some 'offshoot' locations that might be further considered for intensified development.

GreeningTheGreyfields

Introduction | **Planning / MCE tool** | Market / Redevelopment Tool | Zoning / Capacity Tool | Housing Typology / Design Tool

Property Attributes

RPI <input type="checkbox"/>	<input type="range"/>	10	Zoning <input type="checkbox"/>	<input type="range"/>	10
Age of dwelling <input type="checkbox"/>	<input type="range"/>	10	Strata titled <input type="checkbox"/>	<input type="range"/>	10
Area <input type="checkbox"/>	<input type="range"/>	10	Vacant land <input type="checkbox"/>	<input type="range"/>	10
Frontage <input type="checkbox"/>	<input type="range"/>	10	LGA owned <input type="checkbox"/>	<input type="range"/>	10
Development efficiency <input type="checkbox"/>	<input type="range"/>	10	Extra land <input type="checkbox"/>	<input type="range"/>	10
Lot squareness <input type="checkbox"/>	<input type="range"/>	10	Sensitive area <input type="checkbox"/>	<input type="range"/>	10

Demographics

Age 20 - 29 quartile <input type="checkbox"/>	<input type="range"/>	10	SEIFA quartile <input type="checkbox"/>	<input type="range"/>	10
Age 30 - 54 quartile <input type="checkbox"/>	<input type="range"/>	10			
Age 55 - 74 quartile <input type="checkbox"/>	<input type="range"/>	10			
Age 75+ quartile <input type="checkbox"/>	<input type="range"/>	10			

Location

Dist to major/principle centre <input checked="" type="checkbox"/>	<input type="range"/>	17	Dist to primary school <input type="checkbox"/>	<input type="range"/>	10
Dist to neighbourhood centre <input checked="" type="checkbox"/>	<input type="range"/>	13	Dist to secondary school <input type="checkbox"/>	<input type="range"/>	10
Dist to local centre <input checked="" type="checkbox"/>	<input type="range"/>	10	Dist to tertiary school <input type="checkbox"/>	<input type="range"/>	10
Dist to train station <input checked="" type="checkbox"/>	<input type="range"/>	13	Recent nearby demolitions <input type="checkbox"/>	<input type="range"/>	10
Dist to bus stop <input checked="" type="checkbox"/>	<input type="range"/>	16	Relative density <input type="checkbox"/>	<input type="range"/>	10
Dist to main road <input checked="" type="checkbox"/>	<input type="range"/>	15	Net increase <input type="checkbox"/>	<input type="range"/>	10
Dist to park <input type="checkbox"/>	<input type="range"/>	10	PTAL <input type="checkbox"/>	<input type="range"/>	10

Variables selected: 6 Total Points allocated: 84

Title for analysis layer:

Fig. 13 *ENVISION*'s MCE user interface



Fig. 14 Possible strategic redevelopment areas, City of Manningham

- Using *ENVISION*'s capability for a more 'market-led' filtering of data, it is possible for stakeholders (e.g., local government plus property development practitioners) to nominate those variables that they believe are linked most closely to residential redevelopment potential (e.g., ratio of land value to total property value, age of dwelling,

condition, size of land, frontage, whether there have been recent demolitions in the neighbourhood) as well as those that would inhibit redevelopment (e.g., heritage overlay, strata title) with a view to identifying possible greyfield precincts comprising contiguous land parcels. Fig. 15 and Fig. 16 illustrate typical outputs against such queries.

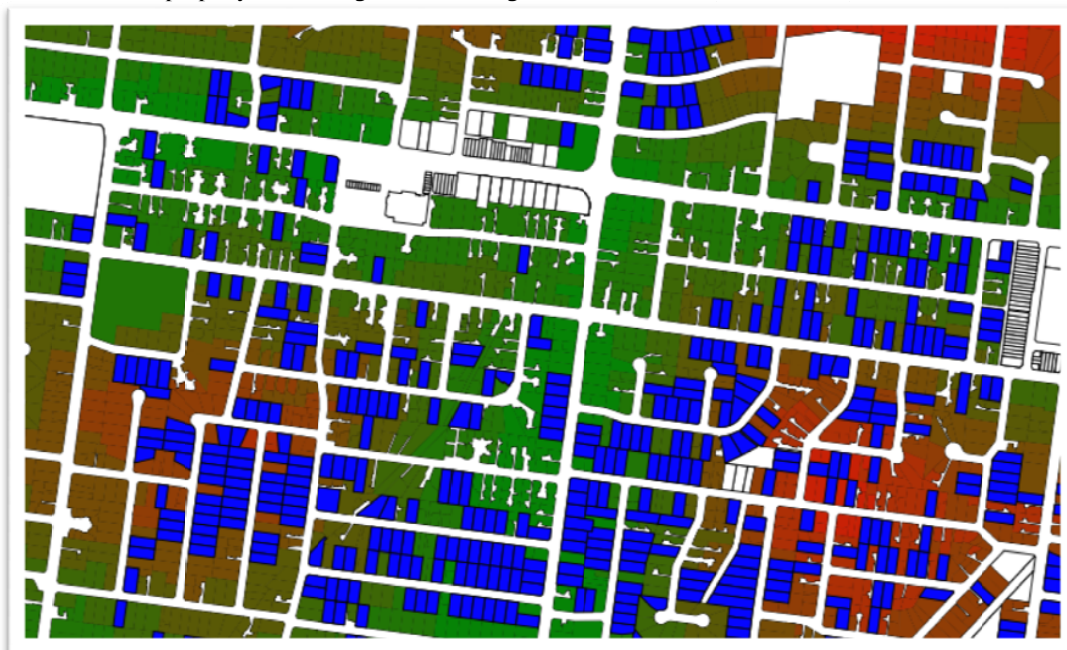


Fig. 15 Results of *ENVISION*'s search for prospective properties for residential redevelopment



Fig. 16 Zeroing in on prospective greyfield residential redevelopment precinct

Fig. 17 illustrates the introduction of a Google earth layer that provides the basis for a more 'concrete' level of discussion and a better 'feel' for the type of neighbourhood identified for possible regeneration.

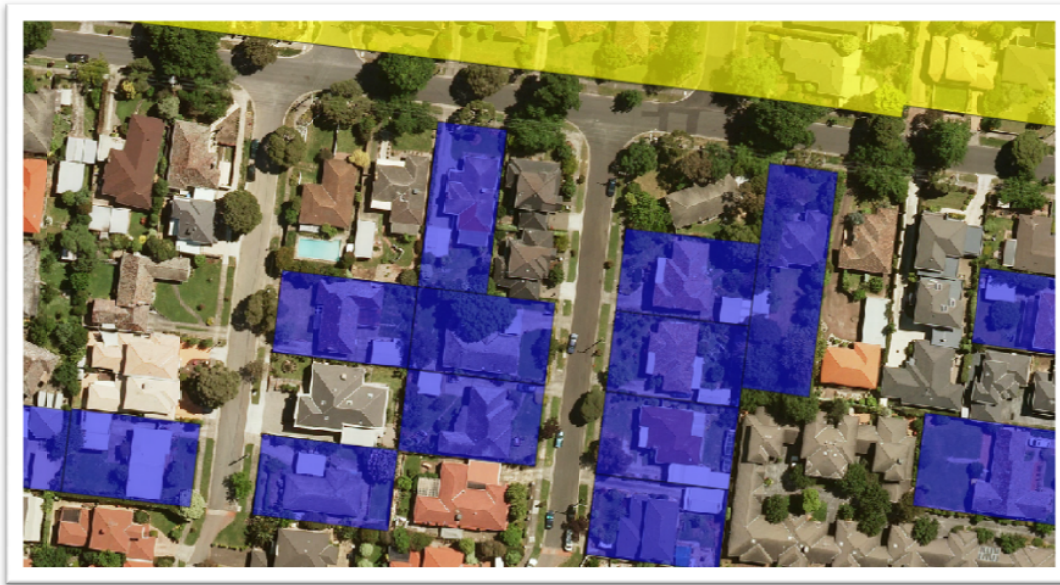
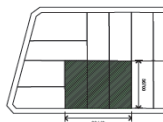


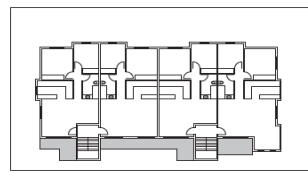
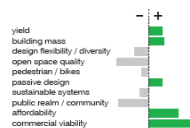
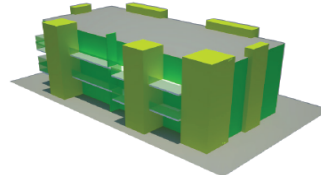
Fig. 17 Overlay of photo imagery on properties identified as most prospective for redevelopment

Further questions could then be raised about the housing typologies (Fig. 18) most suited to the precinct (issues of neighbourhood character as well as customer housing preference) and the associated dwelling yield (Fig. 19). The larger the precinct, the greater is the variety of potential redevelopment and housing options.

Triple Lot 'Walk-up' (3 storeys)



Business as Usual

8 x 2BR apartments
Garages at ground level (under apartments)

Design Alternative

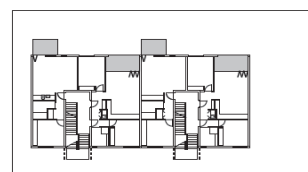
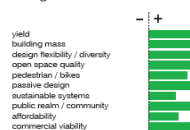
2 x 1BR, 8 x 2BR apartments; 2 x 3BR apartments
Common parking area at grade

Fig. 18 Part of a suite of housing typologies for precincts of varying size and configuration suited to low-rise medium to high density solutions [67]

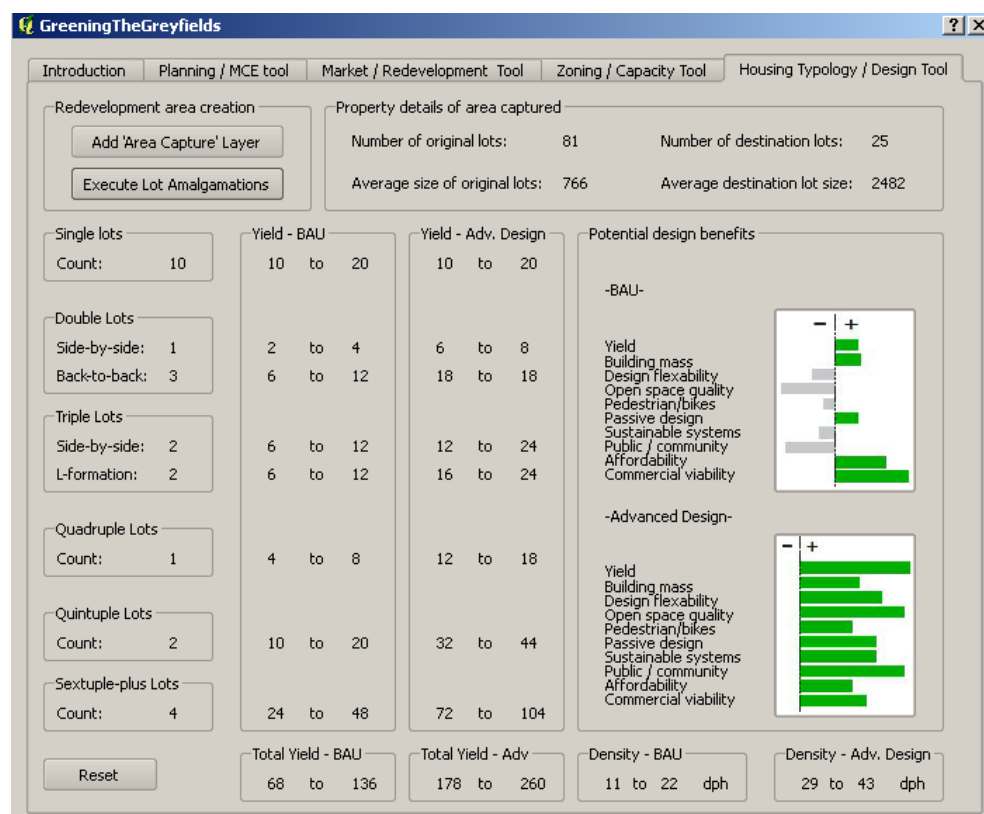


Fig. 19 Possible housing yields and sustainability performance associated with different redevelopment typologies

As end-user requirements dictate, additional functionality for ENVISION could include:

- 3D visualization of the precinct, its individual buildings and landscape, and the surrounding neighbourhood context;
- Attachment to 3D printers capable of outputting a physical model of the precinct or its objects;
- Eco-efficiency assessment of the proposed precinct that incorporates a range of environmental performance metrics (e.g., energy/carbon, water, waste, e-mobility) as well as a cost calculator.

VIII. CONCLUSION

Regeneration of residential greyfield precincts is advanced as a necessary addition to a suite of metro planning strategies – transit oriented intensification around designated activity centres, transport arterials and brownfield areas – all of which aim to reduce the pressure on fringe development and urban sprawl by re-directing population and investment inwards. There are clear economic, environmental and social benefits from pursuing this class of redevelopment, but it is challenging. It requires innovation in several arenas briefly outlined in this paper and discussed in more detail by Newton *et al.* [62].

The objective of this paper has been to outline the importance of recognizing the greyfields as a significant part of contemporary cities, perhaps more so than their more recognizable counterparts: the greenfields and brownfields. All have a role to play in delivering more sustainable urban development in the 21st century, under a new paradigm of green urbanism, but to date there has been a reluctance to engage, in other than sub-optimal ways, in a search for a more robust and effective set of planning strategies and (re)development processes for the middle suburbs of our cities.

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