Strategic Forecasting and Planning that City Planners can do Themselves: Examples of Simple but Powerful Visual Techniques for Specifying Urban Outcomes in Growing Metropolitan Regions

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1 ABSTRACT

Where urban regions are growing and changing quite rapidly, effective metropolitan strategies should be supported with quite detailed projections and descriptions of the region's future subregions, districts, centres and neighbourhoods.

These descriptions should include, for instance, detailed and explicit forecasts, targets and specifications of future population densities and distributions, of future patterns of land use, and of the future social characteristics of neighbourhoods and districts. This detail is not a 'blueprint' or masterplan: it provides a meaningful picture of one possible set of outcomes of the present metropolitan strategy. These kinds of pictures are essential if stakeholders are to engage in a meaningful dialogue with the planners and decision makers. Perhaps even more importantly, these pictures can be continuously refashioned and updated as policies change and as the real city evolves. Without such a detailed picture of the future urban region, metropolitan strategies are not only vague and 'broad brush', but also inaccessible, weak, unconvincing and unable to influence the powerful actors who shape the future region through their day-to-day investment decisions.

This paper presents three concrete examples of visual techniques for exploring and anticipating the future spatial characteristics of the urban region, techniques which are quite powerful but simple enough for the planners to use themselves, thus avoiding forecasts, population projections and scenarios which are driven by the practices and demands of other disciplines.

2 MOTHER OF INVENTION

2.1 Challenges and opportunities

The modest ambition of this paper is to present three examples of the visualisation of metropolitan development to support the formulation of strategic metropolitan policy.

Each example begins with standard demographic and spatial data. Through simple manipulations, the data is transformed into 'operational graphs', 'operational charts' or 'operational maps'. In this form, standard metropolitan data is used to present policy issues in a visual form. More importantly, these 'operational' formats can become live tools for shaping and testing policy.

The experiments that led to these tools were prompted by specific problems. Metropolitan planners in Perth, Western Australia, work within a longstanding tradition of strong regional planning. They have comprehensive statutory powers, bipartisan commitment from governments and a high level of community support. (A description and explanation for this happy situation can be found in Dawkins (2009), written when the author was executive chairman of the Western Australian Planning Commission.) Nevertheless, in the mid-2000s the planners had no effective responses to a number of important policy opportunities.

A centre-left state government – effectively the metropolitan government of Perth, almost solely responsible for urban development, hard and soft infrastructure and urban services, and equipped with an integrated land, transport and urban planning portfolio led by a smart and energetic minister – had won the public argument for a 'sustainable' Perth: impeding sprawl, densifying existing built areas, privileging public transport, expanding the well-equipped and well-run urban rail and bus systems, developing new 'activity centres' and 'activity corridors', and adopting stronger measures to protect water resources and biodiversity (WAPC 2004).

This was a historic opportunity to foster new forms of urban development, and to reverse long-term patterns of low-density car-based suburbs, dispersed employment, poorly located centres of intense activity such as university campuses and hospitals, and a demand-led approach to the provision of land, roads, water, power, etc. Given the role of the state government as the funder, regulator or provider of all these things, and given the high level of legitimacy enjoyed by the state's planning agency, the Western Australian Planning

Commission, there were few institutional or political impediments to major changes in policy and performance. Furthermore, the growth of the metropolitan region, propelled by China's appetite for the energy and mineral resources that Western Australia has in abundance, meant that new policies were not only urgently needed but would have a rapid impact. (A reasonable way to characterise the situation was to say that Perth was halfway through a century of growth, and would grow from 1.5 million to 2.5 or even 3 million by about 2050.)

2.2 Opportunities not taken

If they were to lead this transformation of planning in Perth, the planners would need to do a number of things.

- Firstly, the planners would need to propose how the distribution of the population in the Perth region would change with growth. If the inner and middle areas were to resume the growth that slowed and stopped a few decades ago, how soon, at what rate, and to what degree would 'urban consolidation' impact on their current character? If the outer areas were to slow down and stop growing, how soon and at what rate would this happen? The planners would need a plausible method for arriving at population 'targets', and a method for depicting patterns of growth over time.

- Secondly, the planners/policy makers would need to propose concretely how the existing patterns of urban and suburban development would change, and what the new urban living environments would be like. They would then need to find a way to communicate this to all the stakeholders.

- Thirdly, the planners would need to conceptualise the intended structure of the metropolitan region over time, and find a way to depict it and communicate it.

Over a period of years the Western Australian Planning Commission pressed the Department of Planning and Infrastructure, which provided the Commission with planning services, to undertake the above tasks. No progress was achieved. There appeared to be several reasons for this failure to act. The transference of power from heads of technical departments to ministers, a transference which occurred in most countries with 'representative government' systems during the latter third of the last century, weakened the public sector and led to a serious loss of capacity in departments such as the Department of Planning and Infrastructure. In the period examined in this paper, 2004-2008, the very competence and confidence of the minister only made matters worse. Metropolitan and regional strategic planning is a fairly fragile art with few expert practitioners, so the loss of capacity in this area was nearly total. There was no-one to challenge the demographers and other specialists, who operated their black boxes to produce population projections that were largely impervious to policy objectives.

The projects briefly described and illustrated in this paper were my response to this unfortunate circumstance. The projects – part demographics, part new policy, part persuasion, part graphic communication – were undertaken to demonstrate by example the possibilities of new policies and new ways of communicating them through simple visualisation techniques. They are not offered as more than this, and certainly not as a comprehensive set of regional planning tools.

3   DISTRIBUTING FUTURE POPULATION

3.1 First, meaningful pictures of the past

We worked with readily available statistics on population and households: those for each of the local government areas in the metropolitan region. We could have used statistics of a much finer grain based on census collector districts of roughly 400 households each, but such high-resolution data was not necessary or appropriate. We could have created a different geography, for instance a grid of urban cells. As it happened, the number of local government areas in the region, thirty-two, were sufficient to provide a reasonable mid-resolution picture of the region, and in any event were the obvious areas to work with since the politicians and communities of each of the local governments had to be persuaded that our 'targets' were plausible, probable and acceptable.

We worked with census data from 1961 onwards, because that was within a decade of when post-war growth really took off, and was when the national census settled down into a regular pattern of five-yearly censuses. In each presentation we depicted data for the census year until 1996, and then used both census data and

806

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annual intercensal estimates for the years 1997 to 2007. (Due to local government boundary changes, each graph needed two small boxes to explain sudden changes in trajectories: the boxes said, 'From 1991 the population of "Perth area" splits into Perth, Cambridge, Victoria Park and Vincent' and 'From 1998 Wanneroo splits into Wanneroo and Joondalup. Their respective populations are shown from 1991' respectively.)

For those with a deeper interest in how Perth had developed into its present form, we drew the graph for population change over the previous period, showing the actual number of people by which the local government area increased or decreased in each interval (figure 1). The graph shows significant and unexpected volatility (as different areas were developed and the market changed) and presents a visual impression of when local government areas took off – reflecting Perth's planned frontal expansion – or when they started losing population.

We translated the data into growth rates for each of the intervals (figure 2). While the older suburbs were losing population, there is a clear picture of the new suburbs, in turn, experiencing initial high rates of growth, then decaying gradually until a generalised growth spurt in the late eighties, a time of resource-based economic expansion. The graph demonstrates that growth rates can be highly misleading (rates are a ratio related to the base population, and are correspondingly larger in small local government areas) and at the same time revealing: a small council with a modest population increment is still faced with major challenges if the rate is high.

We depicted the extent to which the different local government areas shared in metropolitan growth (figure 3). Again, there are surprising variations and volatilities, at odds with expectations and conventional wisdom, with local government areas swapping places from census to census. Overall, the graph dramatised how, at any one time, the share of metropolitan growth was dominated by a few outer urban areas.

Finally, we showed the total number of people, at each interval, in each local government area (figure 4). Overall, this is a picture of exponential growth, although local government areas started to grow at different times in the past 45 years. The growth curve of individual local government areas rises and then flattens out: this can be seen in the graph. A number of interesting cases stand out: for instance, three fully developed middle-ring local government areas remain largely stable in the twenty-thousands for four decades, yet the distinct upward movement of one of them in recent years can be taken to foreshadow future demand for inner-city living in all three.

This fourth graph depicted the familiar measure of the total number of people in each of the 32 local government areas, that is, population as commonly understood. This became the benchmark for the next phase of the project, exploring desirable distributions of the regional population in the future.
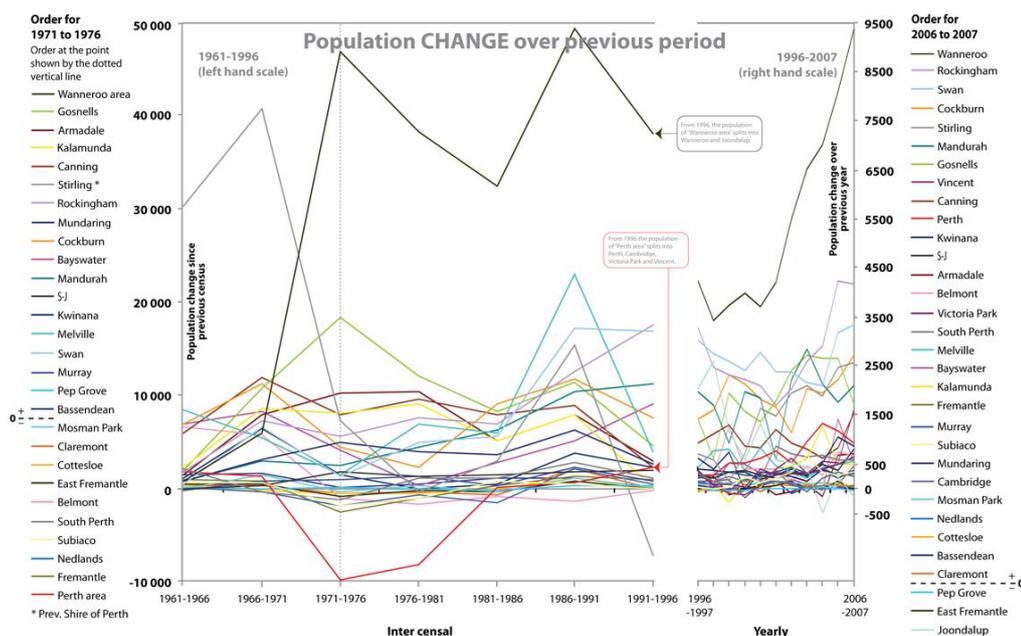

Fig. 1: Population change in local government areas in the Perth metropolitan and Peel regions from 1961 to 2007 (Dawkins and Matan 2008a, p. 7)
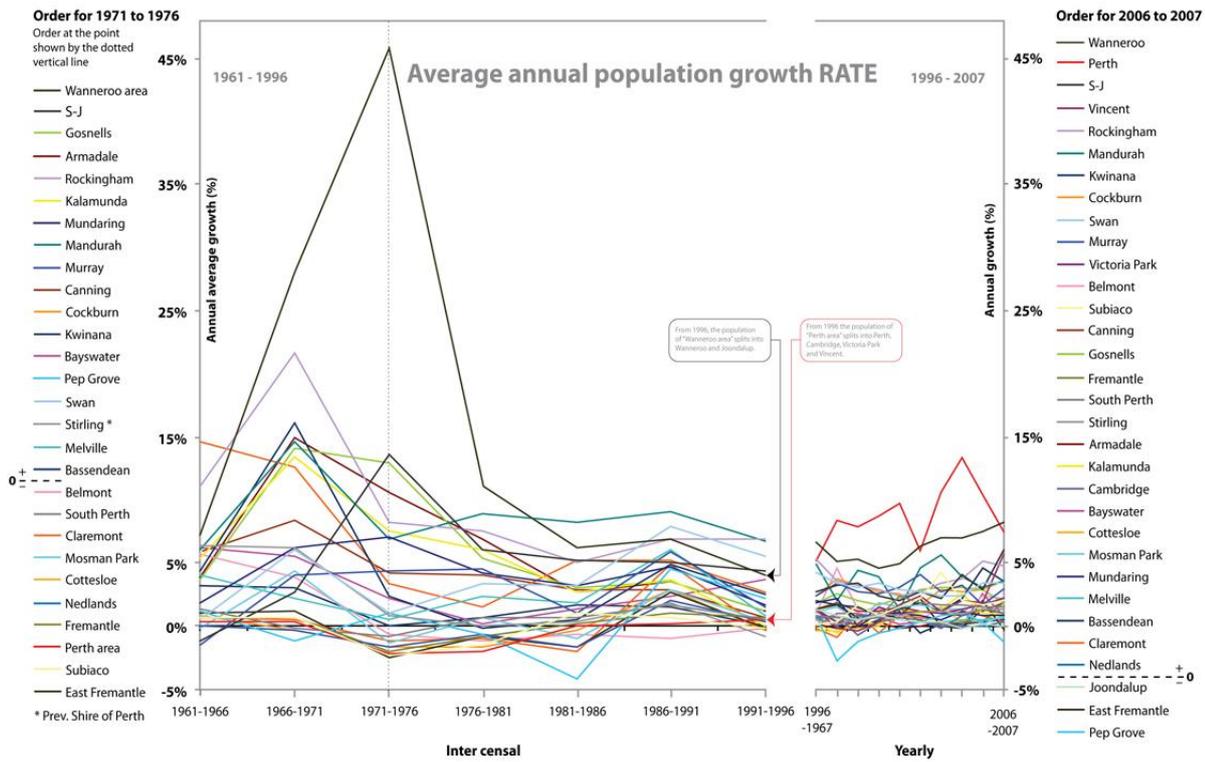
Fig. 2: Average annual population growth rate by local government areas in the Perth metropolitan and Peel regions, 1961 to 2007 (Dawkins and Matan 2008a, p. 9)
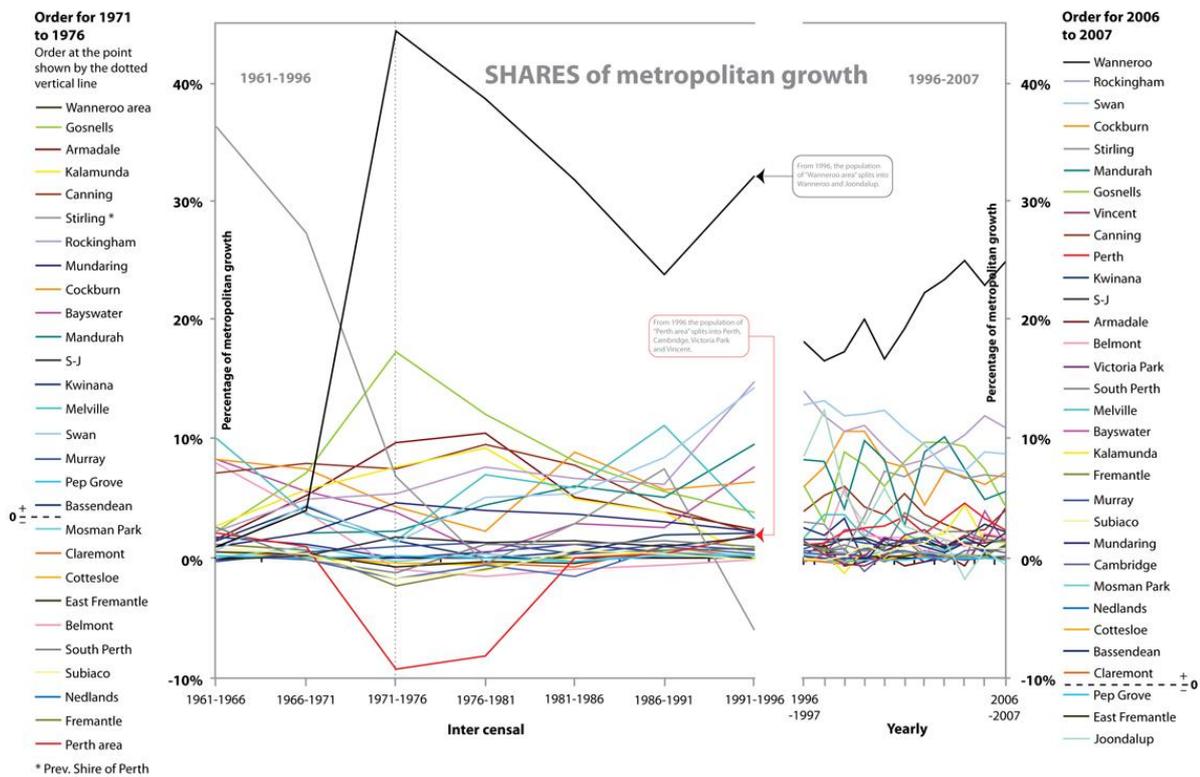

Fig. 3: Shares of population growth in local government areas in the Perth metropolitan and Peel regions from 1961 to 2007 (Dawkins and Matan 2008a, p. 11)
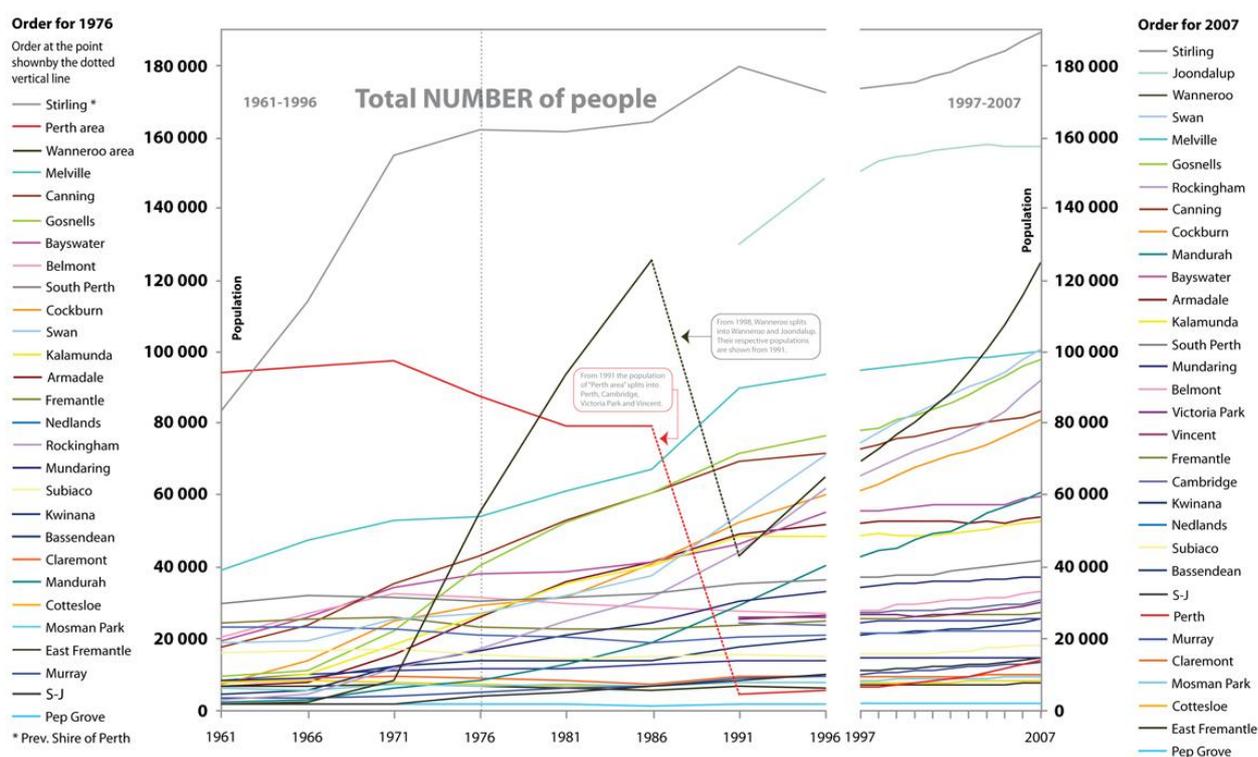
Fig. 4: Population in local government areas in the Perth metropolitan and Peel regions 1961 to 2007 (Dawkins and Matan 2008a, p.13)

3.2 Then, a policy for the future

The demographers in the Department of Planning and Infrastructure used sophisticated methods for allocating the population projections of the Australian Bureau of Statistics to smaller areas, and specifically to Perth's local government areas. They carefully analysed past development and density patterns, and calculated potential capacities based on local zoning and development standards (figure 5). This generated accurate projections only if all these assumptions were correct, and no transformations in policy and performance took place. In other words, the official projections showed us what we did not want Perth to become. Despite this, the demographers regarded any other form of projection as unscientific: they seemed to have no tools with which to assist the planners to project the outcomes of alternative policies, except through mechanical measures such as future zoning changes. Perhaps under this influence, the planners separately attempted to derive various small-area population projections based on simple mathematical formulae, for instance adjusting growth rates down for outer areas and up for inner areas, or applying factors based on, for instance, the number of train stations in a local government area. They were uncomfortable with the idea of subjectively applying a combination of local knowledge and known policy objectives: any projections (no matter how much at odds with commonsense) had to be arrived at by the application of 'objective', numerical methods. The result was a set of projections which, for instance, treated all inner and all outer areas the same, despite fundamental differences in policy terms, and which contemplated sudden step changes in growth rates as a result of the application of notional growth factors.

A novel approach was called for. This could be called a 'planning' approach: subjectively combining a detailed knowledge of the region and its component parts with a clear view of policy objectives. How to apply this approach? The method chosen was a form of reverse engineering, by directly shaping the population curves of each local government area to reflect policy objectives. Specifically, the curves are generated by a table of populations for five-year intervals to 2050 for each of the 32 local government areas. The value of each cell is manually adjusted, with the only hard constraint being no change in the total population for the region in any year: the curves are literally shaped to produce the most appropriate picture of population change across the region. The resulting set of curves in figure 6 has the following characteristics.

- Interval by interval, a plausible change is proposed based on explicit policy objectives (slow outer growth, densify inner areas, intensify future major centres including those on the fringe, recognise

growth moving from north to south, strengthen activity corridors, etc) and on a feel for momentum and inertia resulting in development lagging behind policy changes.

- At each of these intervals, for each local government area, the population estimates are based on explicit quantifications of greenfield suburban development, exurban development, intensification of centres, urban infill, and wholesale redevelopment, depending on the nature of the local government area.

- At all times, the total population of the region remains the same as that in the official projections (these are zero-sum redistributions of the population between local government areas).

- Unlike the step projections calculated by other methods, these curves can generate smooth year-to-year, or even month-to-month, population projections (targets).

- The curves are alive: anyone can fine-tune the curves (by adjusting the values in the cells of the table) to propose alternative outcomes, or test scenarios, or to illustrate alternative assumptions and alternative policies.

- At the same time a strict discipline is imposed on the testing of such alternatives: local governments cannot aspire to higher populations (in the case of the booming outer areas) or resist densification (in the case of inner areas) without showing all the gains and losses amongst the other local government areas.

As an aside, it may seem to some readers that the difference between figure 5 and figure 6 is inconsequential. Coming to that conclusion would be to misread the graphs (perhaps because the graphs, admittedly, remain hard to read) or to underestimate the challenges of overcoming momentum, inertia and path dependency in order to reverse current trends in metropolitan growth. The targets depicted in figure 6 are actually bold, even heroic, leading to an ever-widening gap between the intended structure of the region and the business-as-usual region.

For want of a name, figure 6 is an example of an 'operational graph'. Manipulations are carried out by modifying the cells in the associated table of populations, generating a visual and (with a bit of effort) readily understood picture of the regional population over time, and at the same time allowing the population of each local government area for any given year to be read from the table.

This is just an illustration. The same manual-visual technique can be used for larger and smaller areas, for traffic, for housing types, for urban hierarchies, for commercial centres, for the distribution of jobs, etc.
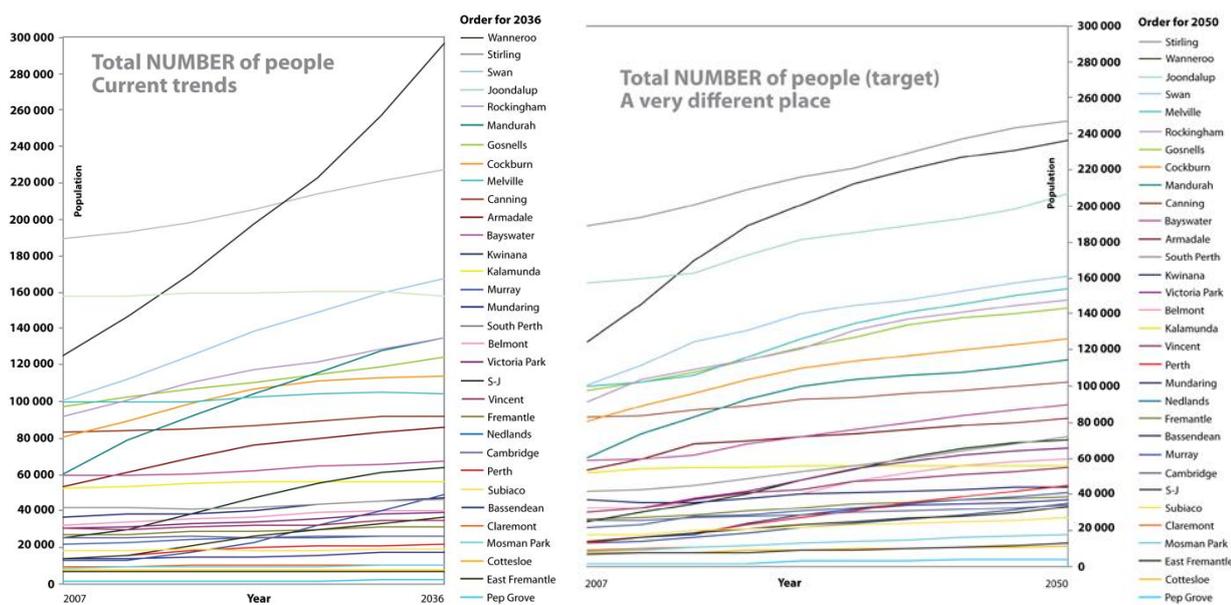

Fig. 5: Official population projections (based on continuation of current trends and policies) (Dawkins and Matan 2008a, p. 14). Fig. 6: Population targets for Perth's local government areas to 2050, (extract from 1961-2050 graph) (Dawkins and Matan 2008a, p. 17)

810

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4 PROFILING URBAN PLACES

4.1 First, x-raying the urban area

In the mid-2000s Perth had an opportunity to begin a significant reconfiguration of the metropolitan region, fundamentally changing the outcomes of the rapid growth that would characterise the next several decades. To better understand the past and present anatomy of the region, and to more concretely describe the forms of urban area that might be possible, it was essential to go beyond averages, norms and generalised patterns. Tradition and habit made this almost impossible: the practice was to write planning rules without feeling any need to first understand the complexity of existing urban areas and processes, to prescribe the future without closely investigating past and present growth trajectories, and to work with coarse tools, such as 'residential', 'commercial centre', '15 dwellings per hectare', etc. (Worse, when measuring or prescribing dwelling density, as in '15 dwellings per hectare', there was no recognition that values can vary by orders of magnitude depending on what kind of 'hectare' forms the denominator of the ratio: site, neighbourhood, local government area, etc.) These practices, which made it nearly impossible to understand the starting point of any development strategy, or to work with the dynamic forces shaping the new built environment, simply meant that regional policies and strategies were not going to change what would happen in any event.

Novel tools were needed to expose the rich complexity of the urban area behind the bland, broad-brush descriptions and proposals. The necessary inputs were readily available.

- Census data was available from the Australian Bureau of Statistics giving household characteristics for each of 3000 collection districts in the region (200-300 households per collection district). For regional analysis this resolution was ideal: both sufficiently fine and sufficiently manageable to reveal the 'DNA' of the region.
- Simple land use data was also available: the state government's Valuer General regularly valued every land parcel in the state, and from field surveys assigned a land use code to every land parcel in their geographic information system.

Accessing the digital and spatially-referenced raw data, we were able to construct tables of broad land use, dwelling density and household size (more strictly, persons per dwelling) for every collection district. To test the methodology, we chose thirteen diverse 'places', each of 53 collection districts. These sample areas constituted an interrupted transect from the northern fringes of the metropolitan region through new suburbs, post-war suburbs and older suburbs to the mixed inner areas and the dense core, the City of Perth.

This analysis was able to provide remarkable insight into the richness of what might have seemed to be a fairly uniform built environment, and to reveal patterns that were otherwise hidden by cruder characterisations of the region. These insights and patterns are presented and discussed in detail in Dawkins and Matan (2008b). There is space here only to provide a glimpse of how the data was presented in a visual form, using data for two of the thirteen places, Subiaco, an attractive, diverse inner area with rich urban, social and environmental resources, and North Joondalup, a newer, more distant area with uniform, low-density residential areas and a planned commercial centre on its way to becoming a subregional CBD (figure 7).

- Land use – the proportion of each collection district used for residential sites, roads and 'other', that is, everything else – was shown in charts for the thirteen places. Each chart became a kind of profile showing similarities and differences between the individual collection districts; the bars at either end gave the resulting land use proportions for the whole 'place'. The charts were assembled on one page so that the similarities and differences in the land use 'profiles' of the thirteen places could be explored and explained.
- Dwelling density was shown in two graphs across the 53 collection districts of each place, one plotting dwellings per residential-site hectare (often inexactly referred to as net density) and the other plotting dwellings per collection district hectare, in other words dwellings divided by the area of the collection district in hectares (equally inexactly referred to as gross density). The graphs also showed, as lines, the averages of these measures, that is, dwellings divided by the total area of residential sites in the place, and dwellings divided by the total area of the place.

- The sizes of households were estimated by showing, for each collection district, the number of dwellings (light blue bars in the lower charts of figure 7) and the number of people (dark blue bars), then resolving this into a graph of persons per dwelling across the collection districts, and persons per dwelling for the whole place.
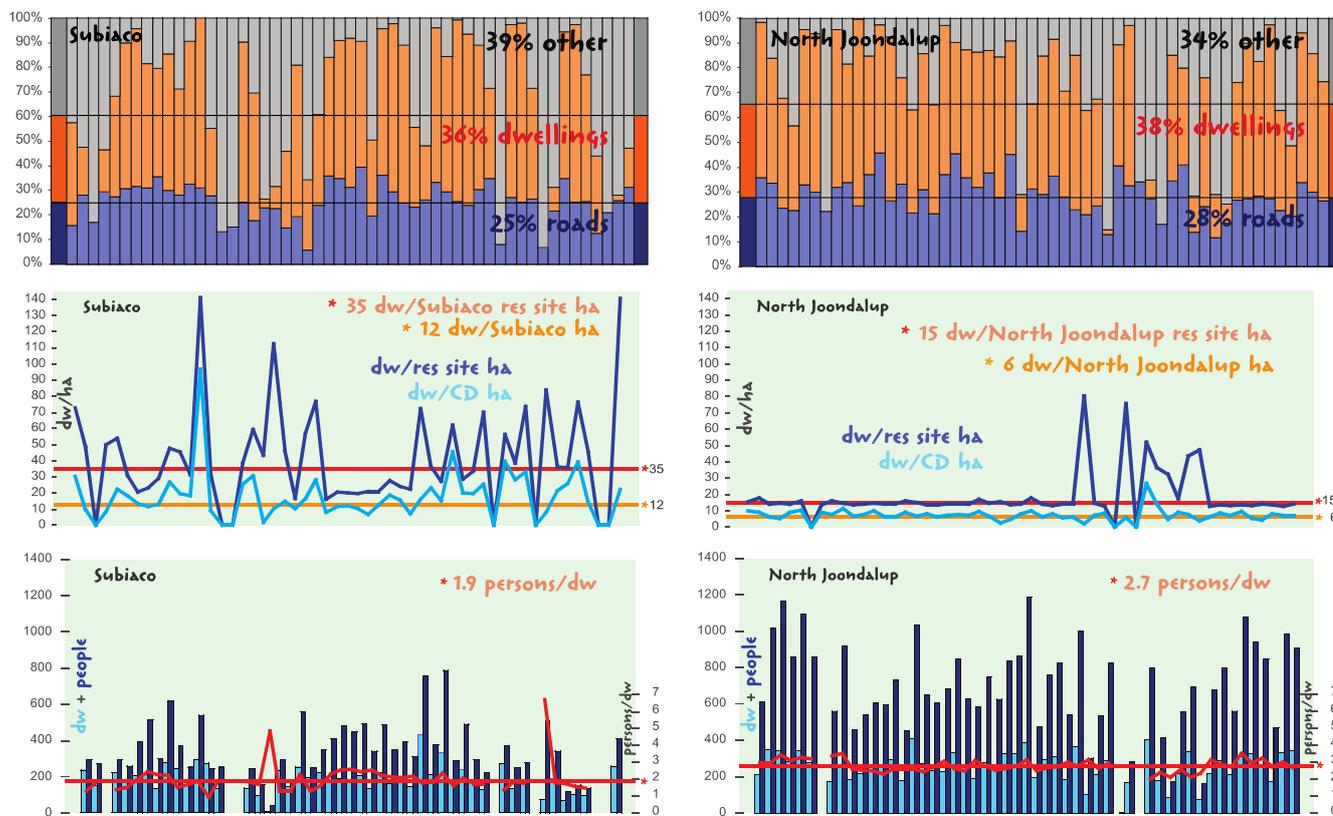

Fig. 7: Land use, density and household profiles for two sample places in the Perth region (Dawkins and Matan 2008b, pp. 13,15, 19)

The three pictures, or profiles, of each place can be read vertically: the collection districts are arranged in the numerical order assigned by the census bureau, so the land use, density and household characteristics of any one collection district correspond vertically. The pictures can be read horizontally, in the sense that the land use, density and/or household profiles of Subiaco can be compared with those of North Joondalup. Assembled on one page, as in figure 8, the pictures present the possibilities of the region, inviting comparisons and the identification of typologies.

Particularly in the case of the density profiles, there is a remarkable convergence between plotting the data and visualising the actual place it refers to. Subiaco is a diverse, mixed inner-city area with areas of high and low density residential use, and diverse areas of non-residential use. The density profile almost allows the cityscape to be imagined. In North Joondalup, much of the place is single-storey, single-family housing, producing the flat lines of most of the area, but it also has the emerging CBD, which is represented by a cluster of collection districts with dense residential development. This convergence is of course most noticeable in the City of Perth, where residential development is confined to high-density enclaves, and produces a pattern that resembles the CBD skyline. The City of Perth also illustrates the potentially large gap between dwellings per site hectare (101 dwellings/site ha) and dwellings divided by the area of the whole place (only 6 dwellings/City of Perth ha) (figure 8).

4.2 Then, designing new urban forms

The findings of this exercise in profiling urban areas included the following.

Even this relatively simple data can provide a typology of places as guides to new and revitalised places. Should East Wanneroo be more like Subiaco, or Vincent, or Joondalup? East Wanneroo should be a new urban form, but how do these places provide models to identify the differences intended for East Wanneroo? What is the broad land use pattern likely to be? What is the diversity of neighbourhoods in terms of land use

mix, dwelling types and densities, and household types and sizes? Plans that do not attempt to answer these questions, even tentatively, are hardly plans at all.
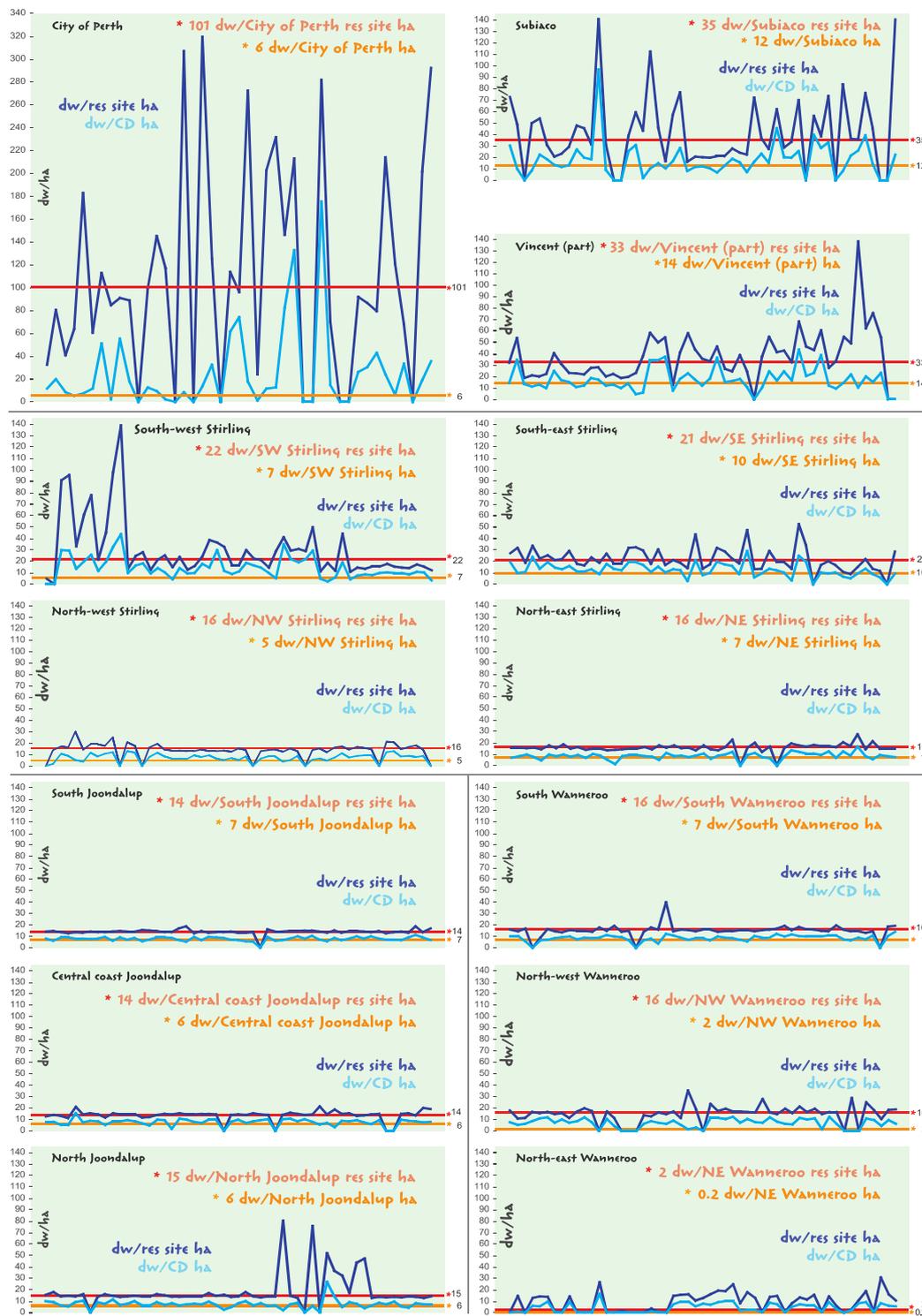

Fig. 8: Density profiles for thirteen sample places in the Perth region (Dawkins and Matan 2008b, pp.15)

What other places in the region can develop some of the characteristics of the City of Perth? Can we reproduce, in other activity corridors and urban areas, some of the land use mix, the dwelling diversity and density and the household patterns of Subiaco? Is Vincent a reasonable model for new and revitalised urban areas? Is it appropriate to see the profile of SE Stirling as a baseline from which to plan new urban areas? Should the precincts being developed around new rail stations have aspects of the profiles of Subiaco, or Vincent, or SE Stirling? How will their profiles differ? Likewise, what should be the profiles for Stirling Highway, Canning Highway, Guildford Road? Which of these profiles are appropriate for the centre and inner areas of Mandurah and for the corridor between Mandurah and Pinjarra? How will the profiles for the Cockburn Coast, Alkimos, Keralup, Wungong, the hills, etc, reflect or differ from the thirteen places in the transect? (Dawkins and Matan 2008b, p. 24)

All of these questions invite planners to not only use the profiles as typologies or partial typologies, but to test new alternatives and manipulate the profiles into new forms. In short, these charts and graphs are 'operational', like the population graphs discussed earlier. If planners are anticipating, or designing areas for, specific mixes of land uses, residential forms and households, all this can be depicted – visualised – in this manner. The proposed pattern of uses, densities and households can be created as notional collection districts, then plotted and graphed so that comparisons with existing, profiled places can be made, and further iterations of the notional places can be carried out.

As with the earlier example, this exercise in picturing the characteristics of urban places is just an illustration of technique and potential. The project report said that the 'search for a typology needs to be comprehensive and therefore include more types of places…and the profiles need to include the age, qualifications, occupation and purchasing power of the people in each collection district. These are relatively minor extensions of the matters explored in this paper' (Dawkins and Matan 2008b, p. 25).

5 DEPICTING THE STRUCTURE OF THE METROPOLITAN REGION

The map in figure 9 illustrates a novel way to visualise the characteristics of the metropolitan region. Typically, a regional map which attempts to show policy or strategy uses simplifications such as symbols to represent different centres in the centres hierarchy, uniform corridors, growth paths in the form of arrows or something similar. These kinds of strategy map cannot even hint at the richness and complexity of the real world. Their idealised simplifications, often not even based on an attempt to characterise how the city is presently structured or how it is presently evolving, provide little guidance for action and intervention. Strategies presented in this way are inaccessible to stakeholders, unconvincing and unable to influence the powerful actors who shape the future region through their day-to-day investment decisions.

In contrast, the map in figure 9 attempts, despite its own simplifications, to capture the fuzziness of the urban area, it transitions, its range and spread of denser and more intense areas, none of which have discrete locations and hard edges, and most of which do not conform to idealised notions of the metropolitan structure.

The map is also 'operational'. It lends itself to the building and testing (in a qualitative manner) of alternative scenarios – for instance, more growth north than south, greater or lesser degrees of expansion, this corridor rather than that… Given access to the graphics file, planners can change the parameters, modify the growth patterns, and produce different metropolitan regions. Each is a picture, and can support discussion and debate through semi-realistic images of the future region.

6 CONCLUSION

Planners often lack simple techniques for presenting to the public a meaningful picture of what their locality or district or subregion will be like. To the extent that forecasts and depictions of the future urban region are provided at all, they are generated by demographic and other experts in ways over which the planners have little control, and which often claim to be exact and precise, with little responsiveness to changes in policy and preferences. If the planners had simple visual methods for depicting the future region to the politicians and the public – and if they can show both how those depictions were created and how they can be continuously adjusted and adapted as preferences, priorities and politics change – discussion of the strategy would take on greater reality, and politicians would be less concerned about being trapped in specific promises.

This paper has merely sought to illustrate three such techniques. The salient feature of all three is that they are policy oriented, attempting to translate into visual forms the subtle, possibly abstract, and sometimes complex issues of metropolitan strategy. All three are 'operational', in that they invite live modification, to test alternatives and explore options.
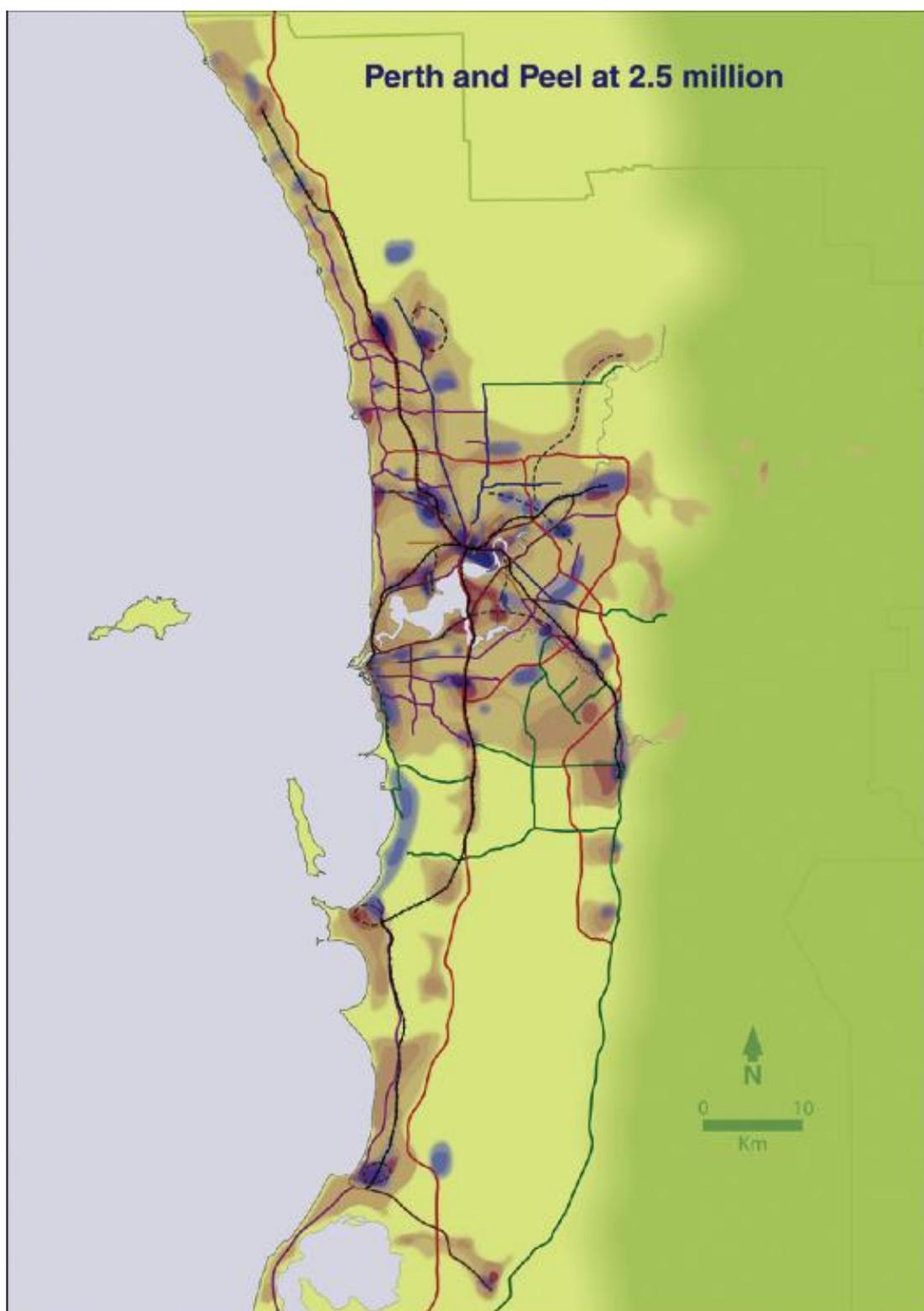
Fig. 9: A visualisation of urban densities, and the intensities of activity centres and corridors, in Perth in 2050 (Dawkins and Matan 2008a, p. 21)

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