

Working with 'Housing Variance' to Model Urban Growth Futures within Inner Metropolitan Melbourne

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Abstract: Continued population growth in Melbourne over the past decade has led to the development of a range of strategies and policies by State and Local levels of government to set an agenda for a more sustainable form of urban development. As the Victorian State government moves towards the development of 'Plan Melbourne', a new metropolitan planning strategy currently being prepared to take Melbourne forward to 2050, the following paper addresses the issue of how new residential built form will impact on and be accommodated in existing Inner Melbourne activity centres. Working with the prospect of establishing a more compact city in order to meet an inner city target of 90,000 new dwellings (Inner Metropolitan Action Plan - IMAP Strategy 5), the paper presents a 'Housing Variance Model' based on household structure and dwelling type. As capacity is progressively altered through a range of built form permutations, the research attempts to assess the impact on the urban morphology of a case study of four Major Activity Centres in the municipality of Port Phillip.

Keywords: population growth, Port Phillip, residential built form, activity centres

1. Introduction

Working with the prospect of establishing a more compact city within the inner Melbourne region, the following paper focuses on key suburbs within the Port Phillip area and will attempt to understand some of the impacts of population change at a local level through the intensification of residential built form. A methodology based on six indicators: population profile with respect to household structure, location, typology, size, arrangement, and density, was developed to assess the shift in housing required to meet the Port Phillip target of 16,300 new dwellings by the year 2030 (City of Port Phillip, 2007). Using the six indicators as variables within a 'Housing Variance Model' based on household structure and dwelling type, the paper attempts to explore the impact on the urban morphology of the four Major Activity Centres through a range of built form permutations that begin to address the simulation of alternative household size profiles. Housing choice is becoming a significant issue with respect to Melbourne's inner metropolitan area. Through the development of a number of built form permutations, this paper raises questions with regards to existing methods of demographic forecasting by presenting a range of 'what if' scenarios based on a more diverse set of housing occupancy profiles. The generation of permutations is facilitated by utilising the theoretical framework established in the 1960s by Leslie Martin and Lionel March, referred to as 'the grid as generator'. Heavily influenced by Raymond Unwin and his essay 'Nothing is gained by overcrowding', Martin and March developed the framework for the future accommodation of new growth within existing urban areas through models that explored a range of densities and distribution patterns.

The paper is structured to present the methodology and discussion included as part of a doctoral thesis undertaken by the principal author. In order to establish the context, the physical and policy setting is discussed first, followed by in-depth presentation of the development of the 'Housing Variance Model'. The generation of housing growth permutations is then presented, with the visualisation of two key examples of projected growth according to the Port Phillip – West housing occupancy profile. A discussion about some of the impacts of these growth patterns on the City of Port Phillip is then followed by some concluding remarks about the study and its future development.

2. The City of Port Phillip - Activity Centres and Morphology

The City of Port Phillip consists of eleven suburbs, four of which contain Major activity centres identified under the Melbourne 2030 strategy as centres which will contain a substantial proportion of new housing in the next 20 years. For the purposes of this paper, the suburbs will be grouped into two subsets, Port Phillip West and Port Phillip St Kilda, correlating with the Statistical Local Areas (SLAs) as defined by the Australian Bureau of Statistics census data structure. The Port Phillip - West region comprises the four suburbs of South Melbourne, Port Melbourne, Albert Park and Middle Park. The two former identified as Major Activity Centres in the Melbourne 2030 strategy. Whilst the Port Phillip – St Kilda region comprises the suburbs of Elwood, St Kilda West, Ripponlea, St Kilda East, Balaclava and St Kilda, the latter two of which were also identified as Major Activity Centres in the Melbourne 2030 strategy.

The City of Port Phillip exhibits a range of different grids stemming from the morphological development of its structure of streets and blocks. A specific shift in morphology exists between the western half of the municipality and the eastern half, heavily directed by the street structure established by the location of the main arterial of St Kilda Road/Brighton Road. Figure 2 analyses the urban structure through an analysis of existing grids across the municipality. The grids for South Melbourne and Port Melbourne are identical in size, but differ in orientation by 90 degrees and are the most rigid in form, with city blocks measuring 100m by 200m. St Kilda's grid is the most irregular of the eight identified grids. It is important to note that topography and land contours play an important part in determining the regularity of the grid. This distinction arises in St Kilda, with the suburb effectively being located what is commonly referred to as the 'St Kilda Hill'. This topography combined with the orientation of the adjacent Brighton Road has led to a collision of grids across St Kilda and Balaclava. In turn, this has created a number of irregular sized and shaped urban blocks, many of which are triangular. As a result of this, the perceived urban 'blocks' in St Kilda East and Ripponlea are larger in size than those found in the remainder of the municipality. These two areas therefore rely on a network of smaller internal streets that connect main roads.

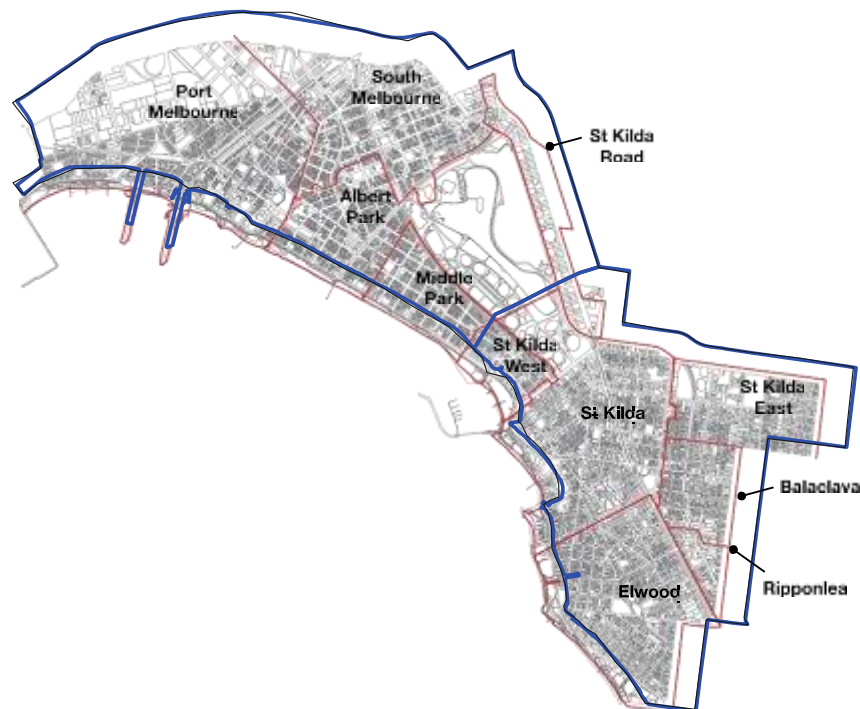


Figure 1. The City of Port Phillip, showing suburbs

3. Household and Dwelling Data

The City of Port Phillip released their Housing Strategy in 2007 – a critical piece of work that formed the culmination of an intense period of strategic thinking and planning involving the future vision of all activity centres across the municipality. In it, the municipality's direction on the future location of housing was published, establishing specific geographic locations for new housing. It could be argued that the locations chosen by the municipality were politically driven, with new housing being prescribed largely where higher density housing currently exists and thus not affecting areas covered

by heritage overlays or subject to local character assessment. Housing locations reflected the pattern of growth that had already occurred in the preceding five years before its publication with a significant proportion of new housing (68.4%) to be located along the St Kilda Road/Kingsway axis of the municipality, and to a lesser degree on Bay Street, Port Melbourne and in specific sites in St Kilda. Figure 2 outlines the physical location of preferred new housing according to the City of Port Phillip in their Housing Strategy of 2007.

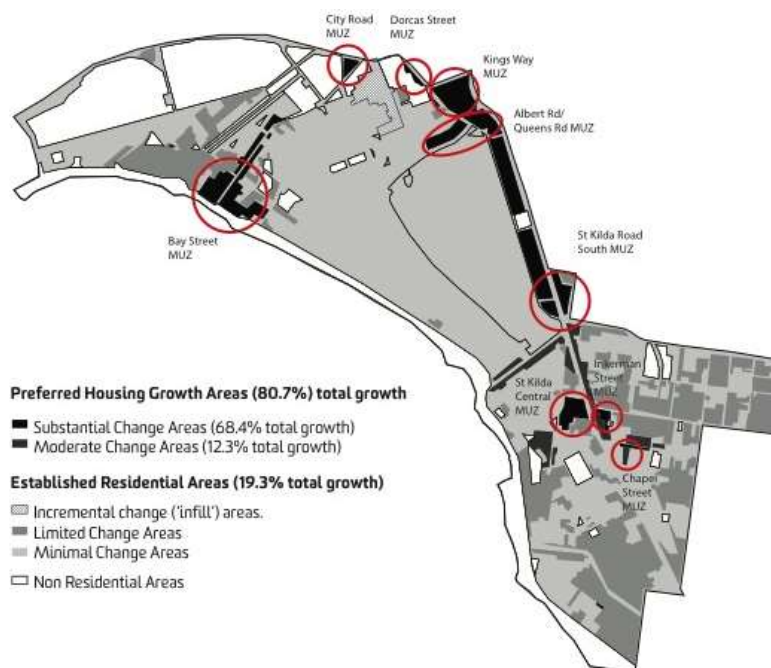


Figure 2. Preferred Housing Growth Areas, 2007 Port Phillip Housing Strategy. (City of Port Phillip, 2007)

The Urban Development Program (the State Government's program for managing the completion status of multi-residential housing developments) presents, for the period between 2002 and 2010, a growth in constructed dwellings of just over 4,700 across the Port Phillip municipality. The majority of larger housing development projects have occurred in Port Melbourne and along the St Kilda Road precinct where the provision of larger development parcels has attracted significant development opportunities. Whilst there has been a significant shift in housing typology in Port Melbourne due to the availability of large sites formerly used for industrial purposes, a substantial proportion of new housing across the municipality has thus far been constructed in buildings with 50 or less dwellings.

A closer examination of the figures for multi-residential developments across Port Phillip reveals that just over 30% of the target proposed new housing growth to 2030 had occurred by 2010, in the first eight years after the publication of the Melbourne 2030 policy. Figure 3 outlines the multi-unit housing development figures as they stood in 2010 for each of the Major Activity Centres and for 'out-of-centre' locations.

	Completed	Under Construction	Construction 0-2 years	Construction 3-5 years	Possible construction 6-10 years	Activity Centre Total
Port Melbourne	2,529	210	406	96	0	3,241
South Melbourne	443	32	368	0	0	843
St Kilda	1,100	31	126	346	120	1,723
Balaclava	94	13	14	0	0	121
<i>Sub total</i>	<i>4166</i>	<i>286</i>	<i>914</i>	<i>442</i>	<i>120</i>	<i>5,928</i>
Out-of-centre#	1,723	98	255	97	11	2,184
Total	5,889	384	1,169	539	131	8,112

Figure 3. Multi-unit housing developments in Port Phillip, 2000-2020. (Source: Urban Development Program, 2010)

Out-of-centre development refers to new housing that is located outside the 400m walking catchment of Activity Centres. From this data, it can be assumed that housing growth across the municipality is occurring in a similar way prescribed in the Housing Strategy. “Out-of-centre” development includes a greater proportion of new housing occurring along the northern edge of the municipality. This is namely the growth assigned to the Kingsway and St Kilda Road precincts in accordance with the Housing Strategy. The out-of-centre category also includes the smaller developments seen in neighbourhood centres like Elwood and St Kilda East where, whilst not within walking distance of a Major Activity Centre, large areas of existing residential land has undergone some physical change since 2000.

4. Housing Growth & Variance – Household Size Translated into Dwelling Size.

In order to establish a basis for the Housing Variance Model, an analysis of the demographic and housing data was conducted through the establishment of a data framework. ABS census data for the period between 1996 and 2006 was included in this analysis, focusing specifically on selected population and housing datasets for target localities across the inner metropolitan region of Melbourne.

The data framework consists three main categories; Household Occupancy, Household Type, and Dwelling Typology, covering a range of datasets included in the Census data, but more importantly presenting opportunities for the analysis of the demographics (how people live) and housing data (where people live). By data-mining the Census, it was possible to formulate some assumptions about trends in housing occupancy and how the population’s housing choice options may have changed over time. Figure 4 outlines the data framework, identifying the links between data and its corresponding geographic references.

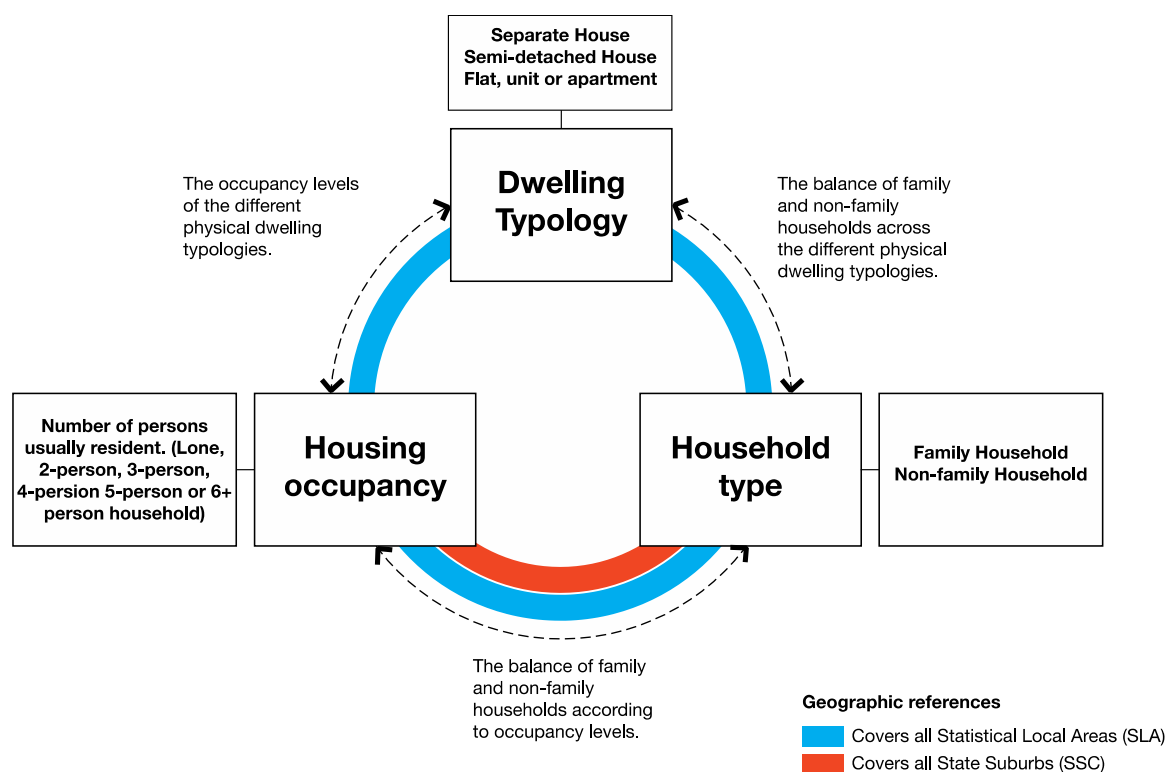


Figure 4. Demographic data framework. (Source: Author)

The City of Port Phillip’s ‘supply’ figure of 16,300 dwellings has been utilised as the benchmark figure for future growth. A total of 8,188 dwellings was used as the figure for future projected housing growth, as it reflects the remainder of housing to be developed according to the combined Housing Strategy and UDP data. The resultant proportional growth distribution was applied to the two Port Phillip Statistical Local Areas (SLAs) with the remainder being allocated to ‘out-of-centre’ growth.

4.1 Developing the permutations

The Housing Variance Model (HVM) carries with it a method of application utilising adapted growth profiles according to two different housing distribution models, three core development size footprints and three nominated development heights. Figure 5 outlines the Housing Variance Model.

The purpose of the permutations is to test the projected growth figures by applying different dwelling size profiles to them and locating them within the network of centres across the Port Phillip municipality. This operation occurred in four stages:

1. Application of a housing growth distribution model.
2. Simulation of growth according to building development footprint size.
3. Simulation of growth according to building height.
4. Mapping of built form permutations onto the Port Phillip municipality utilizing a distribution order based on the identification of grids utilizing the morphological characteristics of the subject area and a dispersion distance between occurrences of buildings.

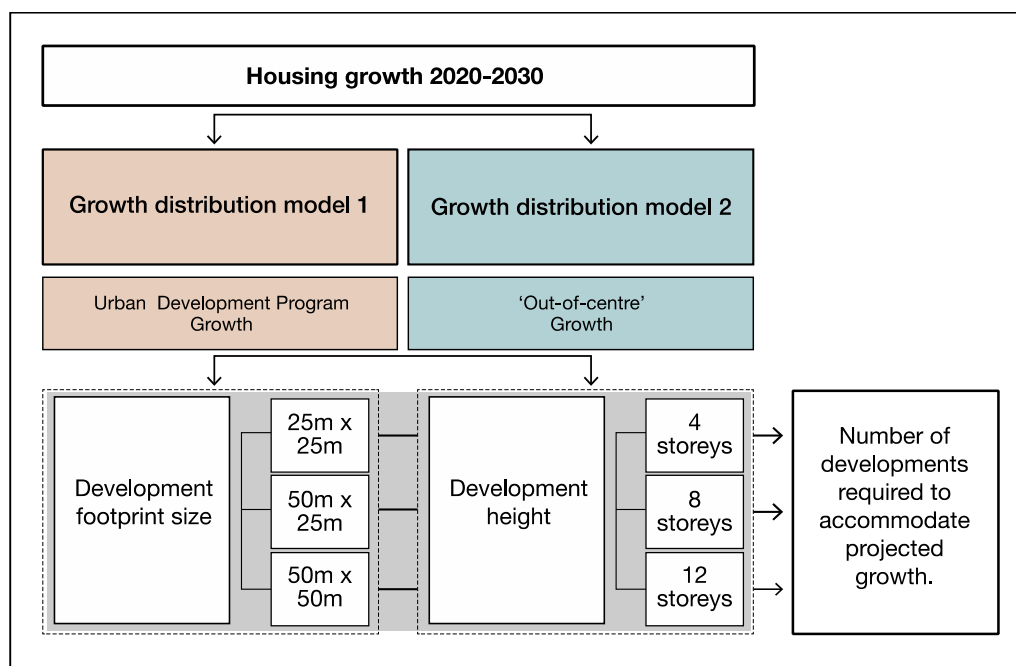


Figure 5. Housing Variance Model (HVM).

4.2 Application of Housing Growth distribution models

Two models were developed in order to establish how new housing growth might be distributed across the municipality (See Figures 6 & 7). Utilising the framework of the two statistical local areas in the Port Phillip municipality, the models employ a system of allotted proportion in order to determine where new growth could be located, with the express aim of analysing impacts through a series of indicators. Each model contains three categories of location for the distribution of growth; 'Port Phillip – West', 'Port Phillip – St Kilda', and 'Out-of-centre'.

4.2.1 Growth according to the Urban Development Program model.

This model simulates future housing growth according to the distribution balance outlined in the Urban Development Program (see section 3). As the formal growth management program, the UDP sets a relatively balanced growth distribution for the period between 2010 and 2020. Utilising the detailed data outlined in the UDP, a number of assumptions were made with regard to the allocation of the three categories. Growth in the UDP was outlined according to whether new housing is to be developed in existing Major Activity Centres, or in 'Out-of-centre' locations. Because growth in the UDP is allocated to individual Major Activity Centres, an agglomeration was undertaken in order to be

able to apply the growth proportions according to areas reflecting the Port Phillip SLAs. The growth prescribed in the Urban Development Program for South Melbourne and Port Melbourne were combined to form the growth assumed for the 'Port Phillip West', constituting 50% of the total growth. Likewise, the growth outlined for the 'St Kilda and Balaclava centres was assumed to form the growth for the 'Port Phillip St Kilda', constituting 23% of the total growth.

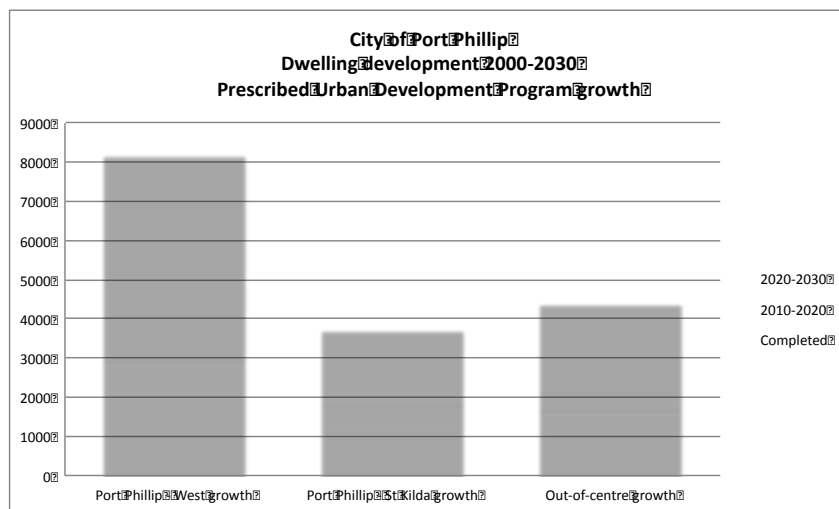


Figure 6. City of Port Phillip, dwelling development 2000-2030 as prescribed by the Urban Development Program growth. (Data source: Urban Development Program, Land Victoria, 2010)

4.2.2 Out-of-centre bias growth model.

This direction of growth distribution in the 'out-of-centre' model presents a key alternative to the current practice of directing the majority of growth to Major Activity Centres. In this model, 75% of all growth is directed to the municipality's eight neighbourhood centres whilst the remaining 25% is directed towards the Port Phillip – West area. Port Phillip – St Kilda receives no growth due to the identification (through the analysis of ABS census data for housing type) that the Major Activity Centres in the immediate St Kilda area may no longer have room to accommodate further growth in their current configuration. This model therefore sets out to simulate the impacts of smaller centres becoming larger and possibly competing (in terms of size) with existing Major Activity Centres.

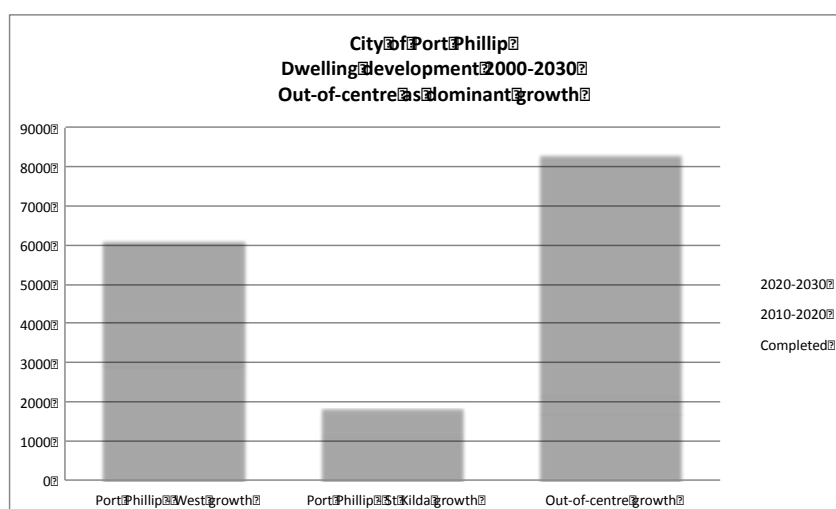


Figure 7. City of Port Phillip, dwelling development 2000-2030. Out of Centre as the dominant growth. (Data source: Urban Development Program, Land Victoria, 2010)

In order to establish a comprehensive and contextual range of housing size profiles, a more extensive analysis of metropolitan Melbourne SLAs was conducted with a specific view to analysing and observing dwelling size changes between 2001 and 2006. During this time period, most of inner Melbourne experienced significant demographic change and a number of different growth corridors were established in which shifts in dwelling diversity can be identified.

Six SLAs (Port Phillip – West, Port Phillip – St Kilda, Melbourne – Inner, Yarra – Richmond, Hobsons Bay – Williamstown and Bayside – Brighton), two alternatives of the Western Australian ‘Residential Design Code’ model (chosen as a key example of policy that recommends specific housing size requirements), and a profile based on the population projection model presented by *i.d forecast* were used as the basis for the generation of permutations.

The selected SLAs were chosen due to the range of dwelling size profiles they contribute, from compact (Melbourne – Inner) to disperse (Bayside – Brighton). The Western Australian (W.A.) design code models were established after observing a key piece of policy on the design of dwellings. Many residential design codes fall short of prescribing the manner in which dwellings should be distributed across an urban or suburban location. The W.A. Residential Design Codes, prepared by the Western Australian Planning Commission as part of the Planning and Development Act 2005. The code prescribes specific rules about the manner in which dwelling sizes should be distributed across developments of more than twelve dwellings. For the purposes of this paper, two models were derived from the limits set within the W.A. model. They are referred to as the ‘low end’ and ‘high end’ models due to their resultant profiles reflecting the balance of dwelling sizes established by the rules. Clause 7.4.3 in the code refers to “Dwelling size”, stating:

“Developments that contains more than 12 dwellings are to provide diversity in unit types and sites as follows”: ([Western Australian Planning Commission, 2010](#))

- Minimum 20% 1-bedroom dwellings, up to a maximum of 50% of the development; &
- Minimum of 40% 2-bedroom dwellings.”

From these key rules, the two profiles assumed two positions – one (the “low end” profile) would be predominantly aimed at single or couple living with most of the dwellings ranging from one to two bedrooms, and, two would be a profile that exhibits a much more balanced outlook on dwelling size, with a predominance in the two and three-bedroom sizes. The final of the nine profiles focuses on the population projections developed by demographic forecasters *i.d forecast*.

Figure 8 illustrates the final suite of profiles in order of prevalence of 1-bedroom dwellings. It can be assumed that the first three profiles in the diagram (W.A. design code profile, *i.d forecast* projection profile and Melbourne – Inner SLA) may be classified as achieving a more compact city ideal due to the proliferation of smaller dwellings. This data supports the direction of creating more compact urban areas with the notion that it will provide a more “sustainable” future. These profiles, whilst representing strict net floor areas, presents a valuable range of dwelling mixes to inform the overall profile of housing in the City of Port Phillip.

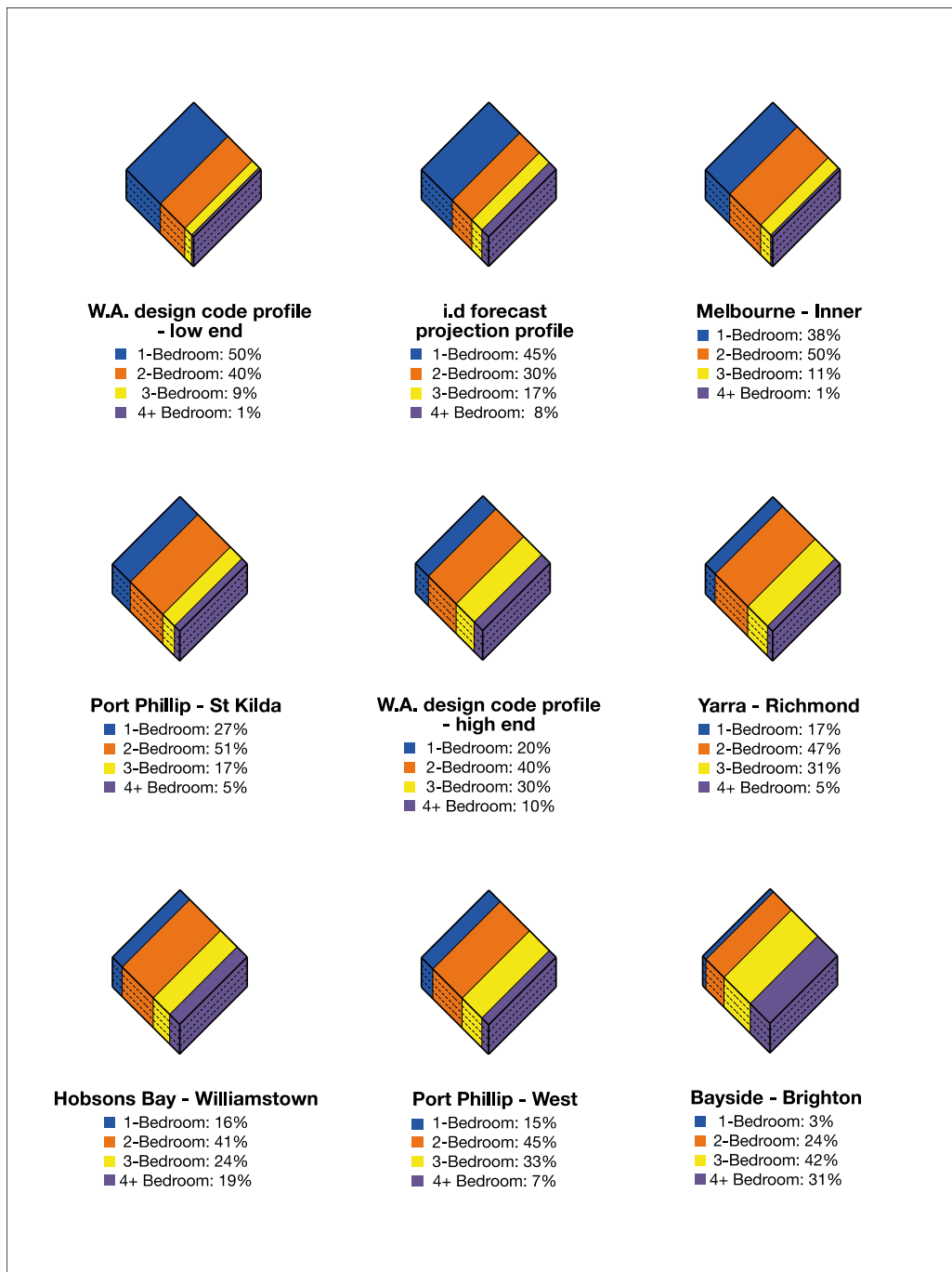


Figure 8. Growth dwelling size profiles for the six metropolitan Melbourne SLAs, two W.A. design code profiles and the i.d forecast projections profile.

4.3 Determining a range of generic dwelling sizes.

Base floor plate sizes were established from a study of existing trends in housing development, as well as suggested recommendations for future housing sizes by the City of Port Phillip in their Housing Strategy capacity studies. Whilst the physical size of apartment dwellings in inner Melbourne range significantly, a study of real estate data revealed some commonalities across several suburbs that allowed for a base assumption about the size of typical rooms inside dwellings, such as bedrooms and living spaces. From this data, four main dwelling sizes were established for the purposes of generating the housing permutations (See Figure 9); (a) 60m² for a 1-bedroom dwelling, (b) 75m² for a 2-bedroom dwelling, (c) 100m² for a 3-bedroom dwelling and (d) 150m² for a 4 or more bedroom dwelling.

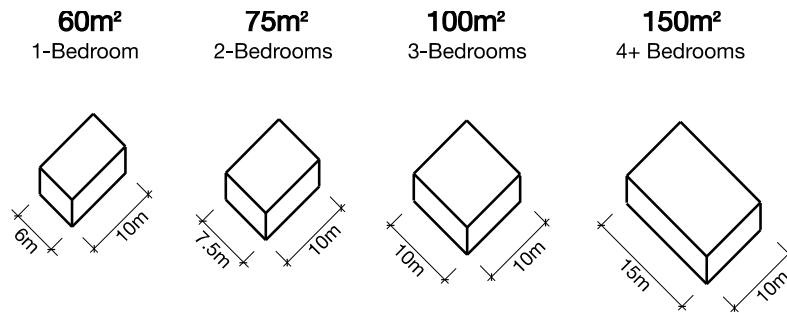


Figure 9. Generic housing sizes.

4.4 Simulation of growth according to development footprint size.

The housing typology study was central in informing the development of the footprint sizes used in the permutations. A number of footprint sizes were used to assist the generation of built form permutations. These sizes were predominantly based on observations of multi-unit residential development trends across the inner Melbourne region. The nominated sizes are to function purely as indicative net floor space for the provision of housing growth, reflecting a similar built form result to existing precedents. The simulated permutations serve as a vehicle for wider discourse about how and in what form new housing may be implemented across the City of Port Phillip. The following range of footprint sizes were selected for this study:

1. 25m x 25m or 625m² footprint,
2. 50m x 25m or 1,250m² footprint, and
3. 50m x 50m or 2,500m² footprint.

Whilst the permutations outlined in this paper aim to reflect a degree of relative built form impacts a sustained population growth may have on the context, it is important to note that the footprint sizes utilized indicate “net” floor area. That is, spaces such as open space, circulation space (external to individual dwellings), service space, retail/commercial spaces are not included in the Housing Variance Model (HVM).

As different typological forms of housing would result in requiring varying degrees of auxiliary spaces, it was decided to not include an allowance for this in the permutations. Instead, the results should be viewed and studied with this in mind.

4.5 Simulation of growth according to building height.

Built form height is a critical factor in the discourse surrounding the potential impacts of housing growth in inner Melbourne. For the purposes of the built form permutations, three main building heights were chosen that potentially present a range of density outcomes: (a) 4 storeys, (b) 8 storeys, and (c) 12 storeys.

Presenting a range of building heights was important, as it allowed for the simulation of alternative built form outcomes across an area. This depends almost entirely on the characteristics of the context in which the permutation is being located. It also allows for experimentation across the range of building heights to examine different models of built form density. Figure 10 presents the matrix of building heights versus footprint sizes utilized in the permutation generation process.

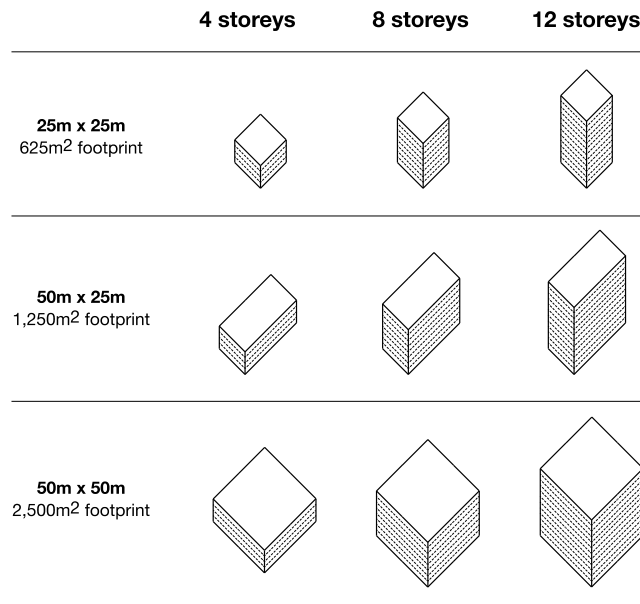


Figure 10. Generic housing development sizes used in the Housing Variance Model to facilitate the generation of permutations.

4.6 Mapping of built form permutations.

With the development footprint sizes and heights established, the total projected housing growth was divided according to each dwelling size profile to reach a growth impact figure (in dwellings) for each of the four categories of housing size. The development footprint area was initially divided by the applied dwelling size profile to reach a figure for dwellings per story. This figure was in turn multiplied by the applied building height, as per the development height options, to arrive at the total dwellings per development. This total then went on to inform the establishment of a matrix outlining the number of housing developments required to accommodate the total growth across the municipality by dividing the total projected growth by the number of dwellings per development. Once the matrix was complete and the permutations established, a range of mappings were performed, facilitated by the plotting of morphological grids over the municipality. Further to this, the application of a dispersion distance variable facilitated the location setting for the generic housing developments – one of the most critical of steps in the contextualization of the permutations.

The application of a dispersion distance was key in establishing the permutation mappings. Whilst a range of distances could be explored with varying built form implications across the physical context, it was decided that a distance of 200-metres between developments would adequately demonstrate a reasonable dispersion level across the municipality, whilst retaining a geographical base point around identified activity centres. Implications of built form density may arise when considering the dispersion level of new housing developments. Access to activity centres and the public transport network are foremost indicators under metropolitan strategies such as Melbourne 2030. The generic nature of the built form presented in the permutations allows for a more objective assessment of the relative impacts that may potentially be experienced through a significant physical change over time.

Martin and March (1972) established in 1968 a methodology for exploring built form options through the use of a morphological grid armature. Building on the work of Raymond Unwin, they set out to investigate how built form densities might be arranged to form more efficient outcomes across urban environments, particularly in direct relationship with open space. The central principle in their methodology involves the use of Fresnel's diagram, in which "each successive annular ring in the diagram diminishes in width but has exactly the same area as its predecessor". (Martin, March 1972) Figure 11. outlines the generic mapping process, reflecting a similar process of grid application. The process commences with the establishment of the grid structure and its dimensions and culminates in the locating of built form across the municipality.

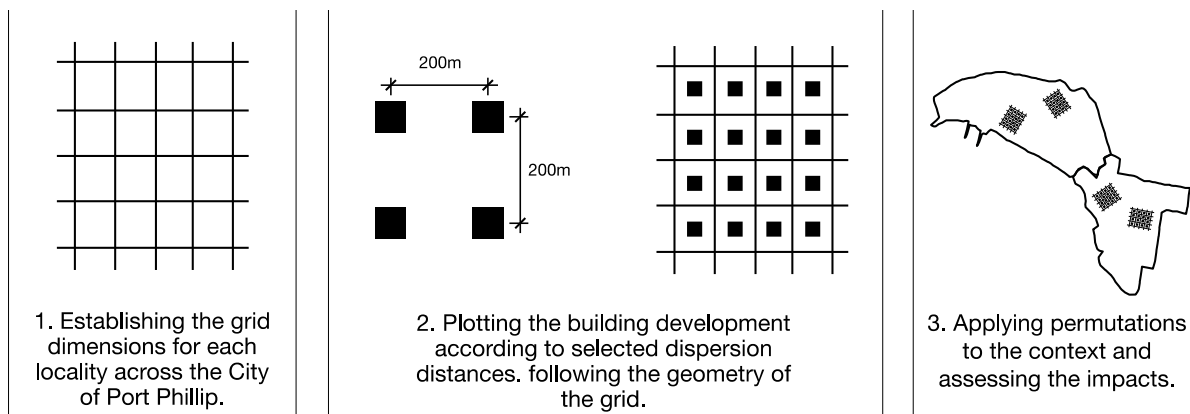


Figure 11. Mapping the permutations, from grid to assessing impacts.

5 Housing Growth Permutations Based on Changing Variance.

Whilst a total of 162 permutations were generated in the greater study, for the purposes of this paper, a core sample will be presented to demonstrate the output visualisations. Data is presented here (See Figure 12) to illustrate the number of new built form developments required for each of the geographic locations utilising the two growth distribution models – the urban development program growth model and the out-of-centre growth model. Total building developments for the selected permutation of 50-metre by 50-metre footprint size at four storeys building height are listed in numerical order below:

Profile	Number of building developments in permutations.
W.A. “design code” profile – “low” end	57
Melbourne – Inner (SLA)	60
i.d forecast population projection profile	61
Port Phillip – St Kilda (SLA)	63
W.A. “design code” profile – “high” end	68
Port Phillip – West (SLA)	69
Hobsons Bay – Williamstown (SLA)	77
Yarra – Richmond (SLA)	115
Bayside – Brighton (SLA)	134

Figure 12. Total number of developments needed at 50-metres by 50-metres footprint size and 4 storeys building height, to accommodate Port Phillip growth between 2020 and 2030.

When the permutations are mapped onto the context of the Port Phillip municipality, the most immediate physical impact characteristics of the new growth are uncovered. The following maps outline the growth according to the Port Phillip – West dwelling size profiles. New housing is located either in an existing Major Activity Centre (i.e. South Melbourne and Port Melbourne for the Port Phillip – West region, or St Kilda and Balaclava for the Port Phillip – St Kilda region) or an out-of-centre location. The out-of-centre location is denoted throughout the permutations as consisting (where possible) an equal spread of new housing to be located across the eight neighbourhood activity centres. Out-of-centre growth is denoted by the blue coloured markings, whilst “in-centre” growth is denoted by the orange markings.

The Urban Development Program growth model (Figure 13) exhibits the equalised growth balance across the municipality, with the majority of new growth being located within existing Major Activity Centres. While the mapped permutations denote a 50-metre by 50-metre built form footprint size and

a building height of four storeys, the immediate visual impact of the number of developments required for the accommodation of new growth in this model is striking, particularly around the Major Activity Centres in Port Melbourne and South Melbourne. The degree to which Port Phillip – West is to grow becomes significant, particularly in consideration of established local character profiles across parts of Port Melbourne and in particular Albert Park and Middle Park, where minimal physical change has occurred over the past 10-15 years.

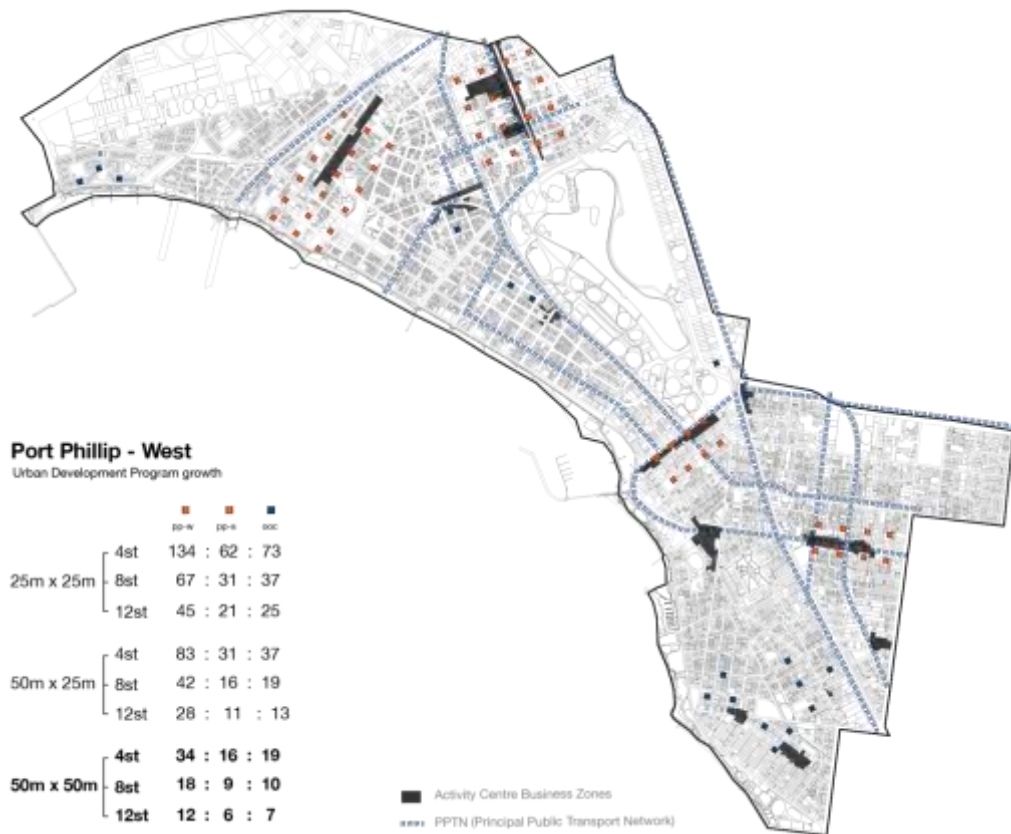


Figure 13. Permutation demonstrating growth according to the Urban Development Program – Port Phillip – West dwelling size profile.

The second mapping utilising the Port Phillip – West profile demonstrates the out-of-centre distribution model (Figure 14). Of particular note is the locational relationship between the three neighbourhood activity centres in Elwood to the south end of the municipality. Here, the collection of three centres, all within an approximate distance of 1 kilometre of each other, present an interesting mapping outcome. The dispersion distance of 200 metres, utilised across all mapped permutations, results in new growth in Elwood spreading evenly across the suburb and into the neighbouring suburb of Ripponlea.

When the total data for projected building developments is analysed according to building footprint size, some interesting observations arise. As the development footprint becomes smaller, the balance between housing size profiles shifts slightly towards a more even difference across the nine profiles. The 50-metre by 50-metre footprint size exhibits a different range, with two profiles at the high end of the occurrence scale standing out significantly from the other profiles. Yarra – Richmond (115) and Bayside – Brighton (134) tower above their closest profile by almost 40 developments. This highlights the disparity between household sizes across the selected SLA regions.

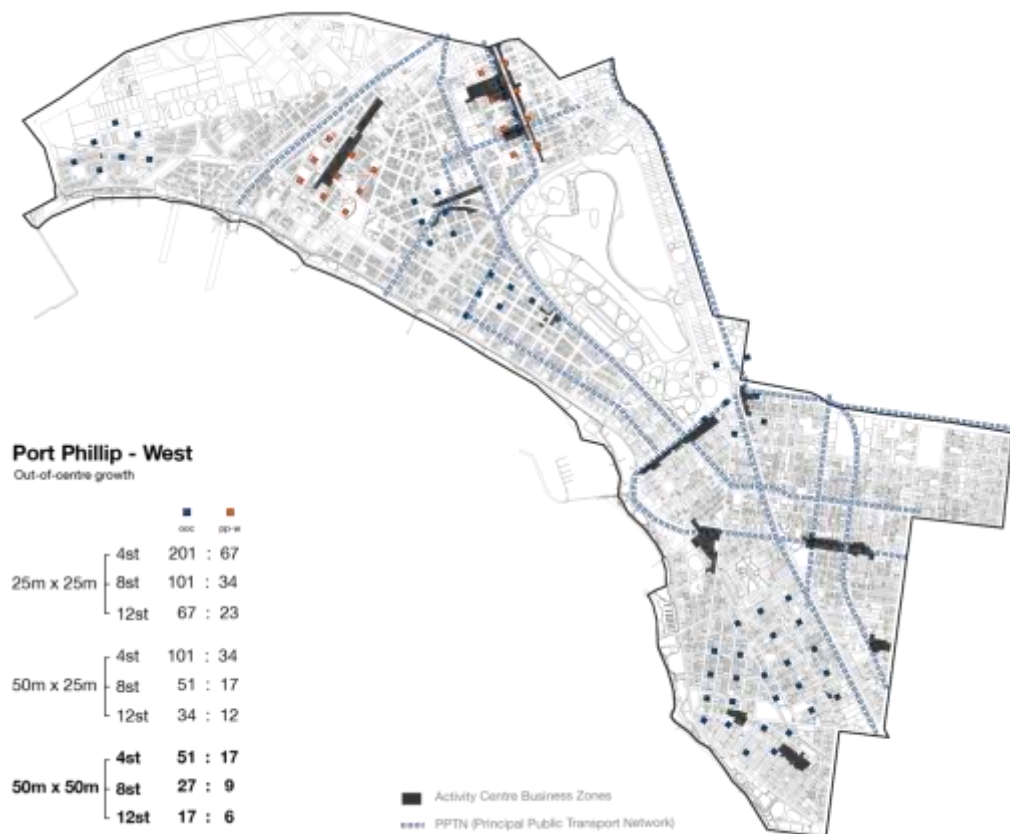


Figure 14. Permutation demonstrating growth according to the Out-of-centre growth bias – Port Phillip – West dwelling size profile.

6. Built form impacts of the permutations.

A number of key built form impacts were uncovered through the process of generating and applying the permutations to the Port Phillip context. Impacts on public open space, movement, housing and housing location are discussed here.

6.1 Impacts on public open space.

The choice of housing typology and thus the size of development stands as the major determinant on the provision of public open space. As the demand for development area continues to rise in the municipality, the pressure on existing public open areas also grows significantly. The provision of public open space across the City of Port Phillip is currently regarded as sufficient for the needs of the existing community. Whilst the built form permutations does not specifically include a provision for open space, it can be assumed that a certain degree of growth in public open space will be required with any degree of sustained population growth. It has been evident, through the process of gentrification across the City of Port Phillip and other inner Melbourne municipalities, that as profiles have shifted from a base of family households to a mix more dominated by single living and couples, the need for public open space has also shifted.

6.2 Impacts on movement.

Concerns regarding the relative impacts of a sustained population growth on the existing public transport network have been at the forefront of the critical assessments of the Melbourne 2030 strategy. (Editorial, 2004; Austin, 2005) Introduced built form has the potential to impact movement in a significant manner across the City of Port Phillip. Kellett highlights that the “morphology of Australian cities appears to be at a crucial point in its history. Trends suggest that it has passed its extreme low-density phase and that increasing concentration in centres and along main public transport corridors is likely.” (Kellett, 2011, 266) Population congestion, particularly around public transport use and localized retail activities, is at the forefront of issues relating to population growth

across the Inner Melbourne region. This is especially accurate for retail activities associated with convenience shopping and every day services that are located within these centres.

ABS Census data for 'Method of travel to work' for the City of Port Phillip confirms that a total of 48% of all workers travel by car, either as a driver or passenger. (ABS (2007) Census 2006, Basic Community Profile, Port Phillip (C) LGA) The projected household profiles of any new housing development and the subsequent travel patterns of residents will therefore have a significant impact on existing congestion levels. This has been identified as a major issue across all inner areas of Melbourne, as rail services have reached their capacity, and stands as one of the main challenges for policy-makers in the coming years.

6.3 Housing Impacts.

The permutations mappings presented in the previous section – Housing Growth Permutations Based on Changing Variance, utilize a relatively modest built form height of four storeys across the municipality. Reflecting on the other permutation figures, particularly those using the 12-storey development height, the immediate visual impact within an existing context may potentially be significant, depending on the location and distribution of new housing developments.

The development of the permutations raised a core question about the provision of housing mix and how this may impact policy-making processes. The housing development market - based on an economic model of maximising returns, determines private housing mix at present. This often results in the same or similar housing typologies being applied as in other areas of similar demographic profile. Whilst this most certainly functions well for economic sustainability both in the short and long term (provided the housing market is buoyant), demographically and perhaps even culturally, it fixes in a specific profile for the long term thus establishing a particular character that may not have the ability to accommodate diversity. For instance, if a policy decision takes place to accommodate the majority of single and two-person households within the St Kilda neighbourhood, the existing profile of a predominance of one and two-bedroom dwellings in the Port Phillip – St Kilda SLA (78% balance of all dwellings) may render the future housing size profile mono-cultural.

6.4 Housing location.

The location of new housing plays a significant part in determining the overall impacts of new housing development. This paper has presented two main alternatives for housing location; 'in-centre' and 'out-of-centre'. While the Melbourne 2030 strategy specified that 89% of all new housing in the Port Phillip municipality should be located within existing Activity Centres (with a priority towards Major Activity Centres), it has become apparent through the process of conducting the studies in this paper that this could not be achieved without a significant amount of physical change. This physical change would affect most notably the existing local character – the very aspect municipalities are trying to safeguard from over-development.

Through undertaking the permutation exercises, it has become apparent that the decision-making process about where to locate new housing is key in determining the built form impacts of a sustained population growth. The City of Port Phillip's Housing Strategy outlines a number of strategic areas that are closely located to areas of established retail areas or areas in which higher densities of housing already exist. The principal challenge in managing the location of growth in this manner may lie in the establishment of a suitable mix of housing, particularly in areas that carry a restricted physical dimension where only high-rise developments can take place due to the existing context (i.e. the St Kilda Road precinct). Likewise, locating the majority of new housing within the four Major Activity Centres across the municipality would likely cause issues associated with a doubling or tripling (depending on the profile of households) of the immediate population in each location and hence impact significantly transport and pedestrian circulation requirements, along with the need to maintain local amenity and the requirements for open passive/active recreational space needs.

Locating new growth within existing neighbourhood centres presents some challenges in regards to the immediate built form impacts of the change. The geographic location of some neighbourhood centres, in particular those to the south-east of the municipality (Elwood and Ripponlea), results in a possible congestion issue as four centres are located quite closely to each other. The result of this is evident in the mapped permutations, with some of the profiles (Bayside – Brighton and Yarra – Richmond) exhibiting substantial projected footprint impact on these suburbs. Whereas the profiles that resemble a more compact form (Melbourne – Inner, W.A. design code (Low End) and i.d forecast) exhibit a much lower impact at the smaller development footprint sizes. It is important to note the development size and its relative physical impacts when they are plotted. Whilst only one

footprint size has been mapped onto the Port Phillip context in this study, observations about the contextual impact of the mapped permutations can inform a degree of comparative judgment as to the impact the other development footprint sizes may have.

7. Conclusion

This paper has presented a methodology for the exploration of projected housing growth permutations in the City of Port Phillip in Melbourne. The balance of dwelling size profile across metropolitan Melbourne has raised several issues pertaining to how categories of size should be interpreted. The theoretical concept of the variance model suggests a dynamic method of permutation generation, affording the visualization of a number of formal options that have been assessed against a number of contextualized impacts. While some limitations exist, the Housing Variance Model can be applied to test certain housing profiles according to the projected demographic profile, rendering it a valuable model for possible application during the early stages of strategic direction and policymaking at state or local government level.

Various issues have arisen that are directly related to the policy and governance relationships between the various levels of government (namely State and Local) and the housing development industry. Challenges arising from the critical nature of the relationships between government and the development industry will continue to shape the way in which the physical dimension of our urban areas are procured.

While this type of model may be viewed as purely conceptual, it raises some key questions about the generation of possible degrees of housing mix – one of the central issues in the urban consolidation discourse occurring in Melbourne. At present, the concept of housing mix is provided through a range of typological and size-based alternatives generated by the housing development sector. It is anticipated that this study is the commencement of the further set of studies into how housing choice may be improved through the development of more refined typologies.

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