Study Report SR405 [2018]

International literature review on medium-density housing issues

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ISSN: 1179-6197

Acknowledgements

Thanks to Toni Kennerley for reviewing this document and providing valuable insights.

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Reference

Allen, N. and Bryson, K. (2018). *International literature review on medium-density housing issues*. BRANZ Study Report SR405. Judgeford, New Zealand: BRANZ Ltd.

Abstract

This report identifies what medium-density housing (MDH) means in an international context. It complements a previous BRANZ report on defining MDH (Bryson & Allen, 2017), which reviewed New Zealand literature on MDH. Understanding the international context of MDH research will enable BRANZ researchers to identify and understand how learnings from international experiences about MDH can inform the development of further MDH research in New Zealand. This international literature review provides insights on the range of international research available and includes a comparison of MDH definitions and identification of emerging themes. It reviews technical research alongside strategy and policy documents regarding MDH to understand current knowledge gaps and implications for successful MDH delivery in New Zealand.

Keywords

Medium-density housing, MDH, medium-rise housing, mid-rise housing, attached housing, multi-unit housing, higher-density housing, missing middle, intensification

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Executive summary

This report is to inform the BRANZ medium-density housing (MDH) research programme entitled 'Medium-density housing that meets the needs of New Zealanders'. Its aims are to:

- review international definitions of MDH and compare them with the definition in use by BRANZ
- review international research relating to MDH and identify key research themes
- review international technical research relating to MDH
- review international strategy and policy documents relating to MDH
- identify knowledge gaps relating to MDH and compare them with the knowledge gaps in New Zealand.

Definitions of MDH in international literature

- There is no standard definition of MDH in use internationally. However, there is general agreement that attached low-rise dwellings, albeit of varying heights, are the principal type of buildings that can be considered to be of medium rather than low or high density.
- Although no standard definitions exist, there is considerable common ground among the definitions. Predominantly, the definitions were in line with BRANZ's identification of MDH as any form of attached housing up to 6 storeys.
- The international context is very similar to the New Zealand context, where definitions are usually divided either according to the typologies included or according to a measure of neighbourhood density. Neighbourhood density is predominantly measured by dwellings per hectare or less commonly by people per hectare.
- 'Medium-density' as a term is more prevalent in Australia and Canada, whereas 'missing middle' is a more prevalent term in the United States literature. In the United Kingdom, 'higher-density is predominantly used, and often medium-density solutions are included in broader higher-density strategies where the focus is mostly on high-density and high-rise typologies.
- Other words used in the literature include mid-rise, medium rise, moderate density, multi-unit housing, multi-family dwellings, multi-family residential development and infill development.

Observations by region

All regions are looking to increase the variety of MDH available to residents.

Australia

Australia is more policy focused, both in terms of the amount of policy available that specifically addresses MDH delivery and in terms of the literature available that specifically discusses MDH issues. Australian research was also the most directly comparable with New Zealand. Research on MDH in Australia could be categorised into six key categories. Studies either focused on the socio-spatial issues and opportunities for intensification typologies (including MDH), the demographic issues aligned to promoting MDH or on questioning or promoting liveability outcomes from MDH. In turn, a body of literature in Australia focuses on the affordability issues currently being experienced in housing markets and the role MDH can play in addressing these issues. MDH was also researched through subjective surveys and interviews that look at

perceptions of MDH. Another, popular research field in Australia was the discussion of policy issues and the review of MDH-related policy and strategy.

Canada

MDH research and policy has been widespread in Canada since the 1960s. As a result, a nuanced understanding of neighbourhood satisfaction also comes through in MDH research in Canada. While research on neighbourhood satisfaction in the United States tends to focus more on place making, satisfaction research in Canada tends to focus on policy improvements. Canada also has a variety of research work that has looked at issues of an ageing population, and this work is directly comparable with the New Zealand context.

United States

In America, research about the reimagining of the American dream and the affinity of residents with traditional stand-alone typologies is directly comparable to the New Zealand context. So too is the identified mismatch between existing housing stock and changing demographic patterns. There is a particular perception that MDH is a large part of the solution to meeting the housing needs of an increasingly diverse population. Missing middle research is widespread in America (the concept was founded in America) and is focused on emphasising the need to provide more diverse housing typologies for 'consumers' across all demographics but in particular to provide a more diverse range of affordable options to recognise the broad demographics for whom both home ownership and renting can be unaffordable.

Notably, terraced houses, manor houses (multiple dwellings in a building that appears to be one house), duplexes and triplexes are all heavily mentioned in missing middle texts.

United Kingdom

The UK has a long-established history of MDH, and therefore much research includes some MDH but is often more focused on high-density as well (above 6 storeys). The relationship between social life and physical forms (i.e. the neighbourhood environment) is a more established research field in the United Kingdom than in New Zealand. However, New Zealand has been making great progress in this field of late.

Key themes in the research literature

A number of key themes were identified, six of the most prevalent being as follows:

The impact of intensification policies on housing densities

Within the context of urban growth management research and discussions of urban form, a number of studies focus on the impact of intensification policies on housing densities. MDH is often, but not always, included in this discussion, either directly or by implication.

Supply and affordability

Housing supply issues and medium-density solutions are addressed in both academic and market research alike. Issues of supply are now most often associated with issues of affordability, given the current context, whereby increased land prices and construction costs have been affecting all of the countries and cities considered in this review.

Housing supply chain and skills gaps (affordability)

As a follow-on from the affordability debate, housing supply chain and skills gaps research has also been growing in prevalence. This research area – and the notable gaps within it – is particularly relevant to the New Zealand context, where skills shortages are proving to be an issue of increasing importance.

Tenure models

Tenure models, along with research about the management and maintenance associated with MDH, is a research area that is gaining traction. In particular, this issue can be identified as a response to the affordability – or unaffordability – context.

Housing needs and preferences

As urban lifestyles have increased in prevalence, so too has research about housing needs and preferences. Understanding the subjectivity of housing choices has also become a significant research theme as cities have seen more mobile populations as well as more diverse demographics. This trend has been noticed in the international literature as well as the New Zealand literature.

Perceptions of density

Related to housing needs and preferences research, the number of studies that consider resident perceptions of density and intensification have also been increasing. Traditionally, this research has been prominently in the field of social science. However, more recently, there has been a trend towards design and policy research that also focuses on understanding the complexity of subjective resident perceptions.

Key themes in the technical literature

Technical research can predominantly be divided into two categories:

- Research that looks at sustainability issues (particularly environmental sustainability in the case of the technical literature). Environmental research considers issues from energy consumption and efficiency, passive or zero-energy solutions, reducing emissions and life cycle assessment.
- Research that looks at construction technology opportunities and concerns for MDH typologies. Construction technology research considers issues such as water use and timber technology opportunities.

Key themes in international strategy and policy documents

The concept of MDH was encouraged and positively perceived in all the international strategies and policies where it was mentioned.

The main focus of policy and strategy documents in terms of MDH was the potential to contribute to more affordable and sustainable residential development outcomes in the market and for residents.

Literature review methodology

This literature review contributes to an understanding of what MDH means in an international context. It identifies the key themes and research gaps in the international literature that will aid BRANZ in further shaping its MDH programme. It includes a review of:

- relevant books
- journal articles
- conference papers
- reports and consultation documents
- government policy and strategy documents.

The search engines used included SAGE Journals, Taylor & Francis Online, Informit, SpringerLink, JSTOR and Google Scholar. The search terms used included:

- medium-density housing
- medium-density neighbourhood
- higher-density housing
- higher-density intensification
- urban intensification
- town centre development
- mid-rise housing
- medium-rise housing
- multi-unit housing
- multi-family dwelling(s)
- multi-family residential development
- infill development
- missing middle

Search restrictions were placed to limit the scope, including publication dates from 2005 to 2017. Figure 1 shows the three search terms that yielded the most relevant articles for use in this review from the three most useful search engines.

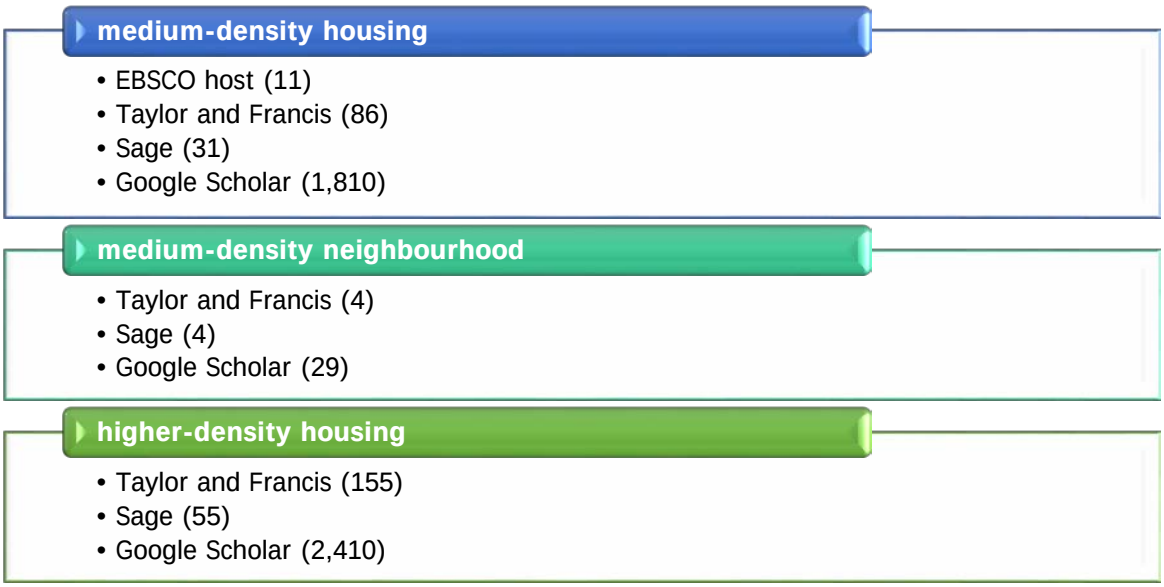


Figure 1. Search terms yielding the most relevant MDH articles.

1. Introduction

MDH supply and diversity is becoming an increasingly important research field. MDH strategies are being pursued in cities that are facing growth management challenges and are looking to intensify their existing suburbs while maintaining or enhancing quality of life outcomes for their residents.

This report is focused on identifying what MDH means in an international context. It complements a previous BRANZ report on defining MDH (Bryson & Allen, 2017), which reviewed New Zealand literature on MDH.

This research will enable us to identify and understand the learnings from the international literature focused on MDH. The international literature review will provide insights on the range of international research and the successes and failures associated with MDH projects overseas. These learnings can then be applied to the New Zealand MDH context where appropriate. As a result, the following five research aims were developed to be addressed in this report:

- Review international definitions of MDH and compare them with the definition in use by BRANZ.
- Review international research relating to MDH and identify key research themes.
- Review international technical research relating to MDH.
- Review international strategy and policy documents relating to MDH.
- Identify knowledge gaps relating to MDH and compare them with the knowledge gaps in New Zealand.

In order to consider each of these aims, the report is subsequently divided into five sections:

- Section 2 looks at international definitions of MDH and provides an overarching summary of how the term ‘medium-density housing’ and other aligned terms are defined and considered in international literature.
- Section 3 presents the key research as divided by the international regions that proved most relatable to the New Zealand context – Australia, North America (Canada and the United States) and the United Kingdom. Where relevant, comparison to New Zealand literature has also been included in the discussion.
- Section 4 identifies and discusses the key research themes that emerged from the literature.
- Section 5 summarises the technical research literature focused on medium-density typologies.
- Section 6 summarises a selection of policy and strategy documents that address MDH typologies and MDH neighbourhoods within current growth management and intensification contexts.

Throughout each section, the knowledge gaps arising are also discussed, and where relevant, comparisons are made to the New Zealand context. These are summarised in section 7.

2. How is MDH defined in international literature?

In order to develop this report, the first issue to be considered was how the term 'medium-density housing' was defined and used in the international literature. A lengthy process had been undertaken to develop a BRANZ definition for medium-density housing and the result – multi-unit dwellings (up to 6 storeys) – encompassed all the typologies of building that were commonly included in medium-density definitions across New Zealand. This definition was also found to be applicable and in line with the international literature.

As in New Zealand, no standardised international definitions of MDH exist. Neither does an international standard defining MDH typologies or densities. A list of the definitions identified in the literature is provided in Appendix A.

In general, Australian literature was most aligned to New Zealand literature in terms of the issues identified and the use of the terminology. Commenting on the Victoria State Government in Australia, Buxton and Tieman (2005) identify that, in policy, the term MDH has been replaced in favour of 'higher-density housing', whereas this is not always the case in academic research, which often uses both terms simultaneously. They go on to comment that their preferred definition "identifies medium density housing as any form of attached housing, including residential buildings above three storeys, and any additional detached dwelling on a single block" (2005, p. 142).

While literature from North America and the United Kingdom did use the term 'medium-density housing', it was found that alternative terms were also often used to describe typologies and neighbourhoods that fit within the multi-unit dwellings (up to 6 storeys) definition. 'Mid-rise' housing and 'medium-rise' housing were commonly used in Canada. However, at a government level, Canada's authority on housing, the Canada Mortgage and Housing Corporation (CMHC), uses the term 'medium-density housing' in its research publications. This has likely encouraged the use of the term in academic research and associated funding applications in recent years. 'Multi-family' housing was a term that also featured in some Canadian research, although to a lesser extent than 'medium-density housing'.

In American literature, 'the missing middle', 'town centre development' or 'mixed-use development' were often cited where MDH may have been the term used in New Zealand. In the literature from the United Kingdom, 'higher-density housing' and 'urban intensification' featured more frequently than 'medium-density housing'.

Many studies from all of the primary regions considered also focused on specific typologies rather than considering MDH generally. However, the typologies referred to included what would be considered medium density under the BRANZ definition, such as terraced houses and duplexes. Some studies addressed both low-rise and high-rise apartments (i.e. both medium and high densities), which meant that not all the results were relevant to MDH issues specifically. In both cases, the relevant sections of the typology-focused studies were able to be included in this review, albeit not in this definition section.

As with the New Zealand literature, differences of scale underpin two common approaches to defining MDH: typology-based definitions and neighbourhood-based definitions (Bryson & Allen, 2017).

Typology-based definitions

Typology-based definitions identify whether an individual building can be classed as medium density. For example, Alves (2004, 2006), a prominent Australian researcher of MDH, defined the term in one publication as “any form of attached housing” (2004, p. 2) and in another observed that “a basic definition of medium density housing is any attached housing not requiring lifts” (2006, p. 1). Randolph and Freestone (2012, p. 2567) similarly define MDH as semi-detached houses, blocks of flats and townhouses.

Searle and Filion (2011, p. 1420) refer to MDH as attached dwellings in buildings up to 3 storeys (see also Kupke, Rossini & McGreal, 2012). CMHC (2016b, p. 3) comments that buildings of 5–6 storeys are often referred to as mid-rise construction. Newton et al. (2011, p. 51) expand the definition up to 7 storeys, and Collins-Williams and Burda (2015) expand it to 11 storeys. The medium-density design guide in New South Wales (Department of Planning & Environment, 2016a, p. 4) refers to low-rise medium-density residential development as development that contains more than one dwelling and has a height of less than 10 metres. The existing policy context and the density history of an area appear to be the most significant aspects that affect how MDH is considered.

To explain its medium-density residential zone code standards, a local council planning agency in Eugene, Oregon, identifies the typologies shown in Figure 2 as all being MDH (Envision Eugene, 2017).

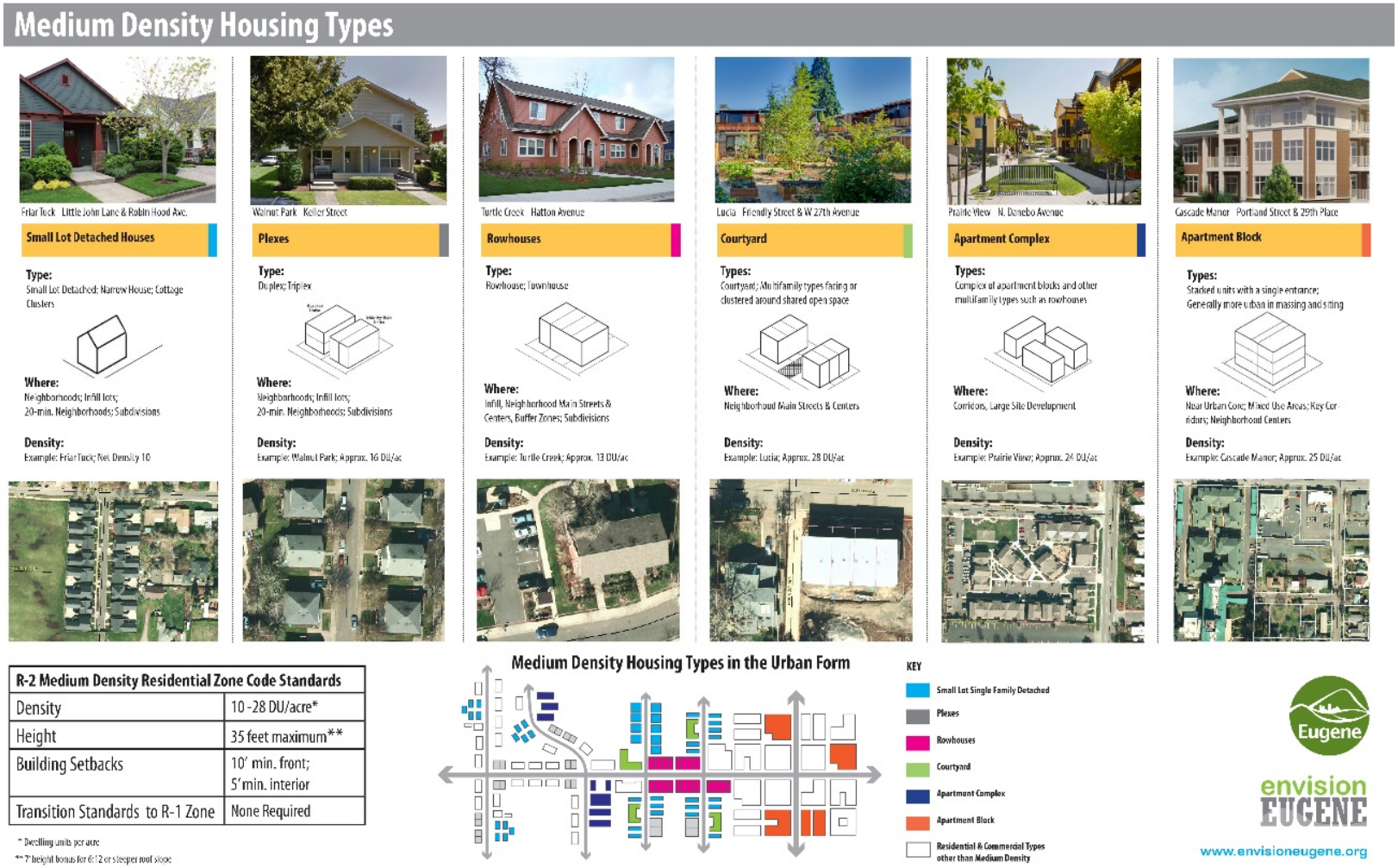


Figure 2. MDH typology examples from Eugene, Oregon.

Used by permission of City of Eugene

Similarly, in the Portland guide to integrating infill development in existing neighbourhoods (City of Portland Bureau of Planning, 2008b) a number of typology examples are given as well as a visual explanation of what can be built in each zone. These are shown in Figure 3, Figure 4 and Figure 5.

Figure 3. MDH typology examples from Portland, Oregon.

Figure 4. MDH typology examples from Portland, Oregon

Medium-Density Zones: What Can Be Built?

The medium-density multi-dwelling zones—R3, R2 and R1—allow a wide-range of residential building types. Below is a summary of some of the basic regulatory parameters governing the intensity and scale of development allowed in the medium-density multi-dwelling zones. The images are examples of projects built in each zone—the upper images highlighting development at the upper limit of allowed building scale and the lower images showing projects at the lower end of intended development intensity.

R3		R2		R1	
Allowed Density*		**Allowed Density***		**Allowed Density***	
Max:	1 unit per 3,000 SF of site area	Max:	1 unit per 2,000 SF of site area	Max:	1 unit per 1,000 SF of site area
Min:	1 unit per 3,750 SF of site area	Min:	1 unit per 2,500 SF of site area	Min:	1 unit per 1,450 SF of site area
(3 units on a 10,000 SF site)		(4–5 units on a 10,000 SF site)		(7–10 units on a 10,000 SF site)	
Building Height		**Building Height**		**Building Height**	
Maximum 35 feet		Maximum 40 feet		Maximum 45 feet	
Minimum Building Setbacks		**Minimum Building Setbacks**		**Minimum Building Setbacks**	
Front:	10 feet	Front:	10 feet	Front:	3 feet
Side/ rear:	5–14 feet (depending on size of building wall)	Side/ rear:	5–14 feet (depending on size of building wall)	Side/ rear:	5–14 feet (depending on size of building wall)
Building Coverage		**Building Coverage**		**Building Coverage**	
Maximum 45% of site area		Maximum 50% of site area		Maximum 60% of site area	
Landscaping		**Landscaping**		**Landscaping**	
Minimum 35% of site area		Minimum 30% of site area		Minimum 20% of site area	

**Note: Accessory dwelling units (ADUs) can exceed the maximum allowed density. Also, minimum required densities for sites smaller than 10,000 SF are less than those shown here.*

Figure 5. MDH zones from Portland, Oregon.

Neighbourhood-based definitions

Neighbourhood-based definitions refer to the average density of the area. This can include a mix of many typologies. The number of dwellings per hectare is the most common form of neighbourhood-based MDH definition, although the parameters vary considerably. For example, the definition developed in the Planning Strategy for Metropolitan Adelaide 2006 and adopted by Sivam, Karuppannan and Davis (2012) considers MDH to be 35–70 dwelling units per hectare. Udell, Daley, Johnson and

Tolley (2014) argue that MDH "is generally considered to be 25 to 60 dwellings per hectare" (p. 10). Timlett and Williams (2009, p. 500) concur, and Levitt (2012, p. 1) offers a definition of 30–60 dwellings per hectare. In a comparison of policy documents across Australia, Fitzpatrick and Wadley (2013, p. 344) observe that medium density varies across regions from 20–40 dwellings per hectare to 34–67 dwellings per hectare.

In contrast, in both The London Plan (Greater London Authority, 2016) and the London Housing Design Guide (Greater London Authority, 2010), MDH is not specifically mentioned. However, density is divided into three categories: suburban, urban, and central (Table 1).

Table 1. Density definitions in London (Greater London Authority, 2016).

Setting	Public transport accessibility level (PTAL)		
	0 to 1	2 to 3	4 to 6
Suburban	150–200 hr/ha	150–250 hr/ha	200–350 hr/ha
3.8–4.6 hr/unit	35–55 u/ha	35–65 u/ha	45–90 u/ha
3.1–3.7 hr/unit	40–65 u/ha	40–80 u/ha	55–115 u/ha
2.7–3.0 hr/unit	50–75 u/ha	50–95 u/ha	70–130 u/ha
Urban	150–250 hr/ha	200–450 hr/ha	200–700 hr/ha
3.8–4.6 hr/unit	35–65 u/ha	45–120 u/ha	45–185 u/ha
3.1–3.7 hr/unit	40–80 u/ha	55–145 u/ha	55–225 u/ha
2.7–3.0 hr/unit	50–95 u/ha	70–170 u/ha	70–260 u/ha
Central	150–300 hr/ha	300–650 hr/ha	650–1100 hr/ha
3.8–4.6 hr/unit	35–80 u/ha	65–170 u/ha	140–290 u/ha
3.1–3.7 hr/unit	40–100 u/ha	80–210 u/ha	175–355 u/ha

- Central – areas with very dense development, a mix of different uses, large building footprints and typically buildings of 4–6storeys, located within 800 metres walking distance of an international, metropolitan or major town centre.
- Urban – areas with predominantly dense development such as, for example, terraced houses, mansion blocks, a mix of different uses, medium building footprints and typically buildings of 2–4 storeys, located within 800 metres walking distance of a district centre or along main arterial routes.
- Suburban – areas with predominantly lower-density development such as, for example, detached and semi-detached houses, predominantly residential, small building footprints and typically buildings of 2–3 storeys.
- hr/ha = habitable rooms per hectare, hr/unit = habitable rooms per unit, u/ha = units per hectare

Neighbourhood-based MDH definitions can also refer to the number of people in a given area. For example, Committee for Sydney (2016, p. 7) defines it as 365 people per hectare and adds the provision for 55% open space.

2.1 Summary

The following summations can be made following a review of the literature:

- There is no standard definition of MDH in use internationally. However, there is general agreement that attached low-rise dwellings, albeit of varying heights, are the principal type of buildings that can be considered to be of medium rather than low or high density.
- Although no standard definitions exist, there is considerable common ground among the definitions. Predominantly, the definitions were in line with BRANZ's identification of MDH as any form of attached housing up to 6 storeys.
- The international context is very similar to the New Zealand context, where definitions are usually divided according to the typologies included or according to

a measure of neighbourhood density. Neighbourhood density is predominantly measured by dwellings per hectare or less commonly by people per hectare.

- ‘Medium density’ as a term is more prevalent in Australia and Canada, whereas ‘missing middle’ is a more prevalent term in the United States literature. In the United Kingdom, ‘higher-density housing’ is predominantly used, and often medium-density solutions are included in broader higher-density strategies where the focus is mostly on high-density and high-rise typologies.
- Other words used in the literature include mid-rise, medium rise, moderate density, multi-unit housing, multi-family dwellings, multi-family residential development and infill development.

3. Regional observations

This section presents the key research as divided by the international regions that proved most relatable to the New Zealand context; Australia, North America (Canada and the United States) and the United Kingdom. Where relevant, comparison to New Zealand literature has also been included in the discussion.

Australian research was the most directly comparable to New Zealand because Australia has experienced a similar evolution towards intensification since its post-war years. Similarly, North America has comparable elements because, like New Zealand, it is dealing with growth management issues in how to address the intensification of its suburbs. Issues such as the need to increase the variety of MDH typologies, the environmental impact of MDH neighbourhoods and identifying new methodologies and strategies to approach issues of density are all comparable to research being undertaken in New Zealand.

Unlike in Australia, the term 'medium-density housing' is not as prevalent in North America, here terms such as 'missing middle', 'transit-oriented development' and 'Leadership in Energy in Environmental Design' (LEED) (as spearheaded by the United States Green Building Council and Canada Green Building Council) are more widely used than MDH specifically. Other concepts such as 'new urbanism' and 'smart growth' are also popular in North America. While research focused on these concepts does not usually directly reference MDH, the need for MDH typologies and medium-density neighbourhoods is implied by their suggestions of intensification. Another area of research that is closely related to MDH is mixed-use development. In the interests of narrowing the scope of this review, however, mixed-use specific literature, as well as growth management and density studies that don't directly reference MDH, have been excluded from this review.

The United Kingdom has an established urbanism that already includes many MDH typologies. Because cities in the United Kingdom and also Europe have experienced and accepted density for a long time, examples of MDH research are often contextualised differently from those in Australia and New Zealand. In many cases, 'higher density' is the term used to discuss intensification in the United Kingdom, and while this can mean MDH is some contexts, it also often means high-rise high-density development. 'Medium rise' and 'mid-rise' are also terms that are popular in UK literature on housing intensification. The scope of density research in the UK is extensive. Therefore, in this literature review, only articles where the terms 'medium density', 'medium rise' or 'mid-rise' are used have been included. For these reasons, there were not as many directly comparable sources to the New Zealand context as there were Australian and North American examples.

While they are now out of date and were focused on issues surrounding urban growth management and intensification rather than specifically MDH, two studies in New Zealand have previously compared international research to the New Zealand context. These are the Regional Growth Forum document International Trends and Lessons in Growth Management (Knox & Smith, 2007) and the Ministry for the Environment report Curbing the Sprawl: Urban Growth Management in the United States – Lessons for New Zealand' (Gow, 2000). Knox and Smith (2007) discuss four Australian cities, (Melbourne, Sydney, Perth and Brisbane), one American city (Portland) and one Canadian city (Vancouver). Gow (2000) focuses on the United States planning system at local, metro, and state wide levels. In these reports, the reasons given for the

comparability of the New Zealand context to these areas were that each has comparable priorities around key issues such as liveability and sustainability. These reasons stand true for this report also.

Initial literature searches were also conducted to look at MDH-related research in Asia, Africa, the Middle East and South America. However, due to the significant differences in aspects such as the spatial evolution of cities, the socio-cultural understanding of growth and density, climatic conditions and political structures, a review of the MDH literature in these areas was not deemed necessary to achieve the research objectives.

3.1 Australia

Australian MDH research is multifarious. Overall, it is more policy focused than that of other countries. It is generally the most directly comparable to New Zealand because Australian cities have undergone a similar post-war evolution from prioritising sprawl to prioritising compact city outcomes. However, Australia has been intensifying, particularly in its main centres through both medium and high density since the 1970s. As Australian cities generally have much higher populations than New Zealand cities, the quantity of MDH that has been built is much greater than in New Zealand.

The 2000s saw a push towards prioritising the delivery of compact city strategies and, in turn, an increasing supply of MDH across Australia. A conference was held in 2005 entitled Post-Suburban Sydney: The City in Transformation. While no papers directly discussed MDH, the emphasis on intensification generally implied that MDH outcomes were required. At this conference, Anderson (2005) referenced the impact of the American concept of sprawl on the Australian context and discussed the slow transition away from the suburban ideal of stand-alone housing towards more varied typologies. This is similar to the way that New Zealand researchers have discussed the affinity of Kiwis with stand-alone housing, dubbed the ‘pavlova paradise’ (Buckenberger, 2009; Haarhoff et al., 2012; Read, 2015).

A useful introduction to the Australian context of MDH research is provided by Randolph (2006), who considers the trend towards compact city development and the increase of MDH typologies in Australia. His findings identify two key observations (see also Anderson, 2005; Searle, 2007; Searle & Bunker, 2010; Searle & Filion, 2011; Woodcock, Dovey, Wollan & Beyerle, 2010):

- The considerable trend towards increasing numbers of MDH typologies being integrated into traditional low-density suburbs in Australia.
- The changing demographics of higher-density residents whereby MDH preferences were becoming more widespread, irrespective of age, education and economic status or life stage.

In addition, Newton (2013) identifies eight issues facing Australian cities from the context of city regeneration – climate change, resource constraints, population change, urbanisation and the intensification of urban development, ageing infrastructure, socio-demographic change, the green economy and financial uncertainty (p. 576). These findings are comparable with the New Zealand context, particularly in main centres such as Auckland.

Fitzpatrick and Wadley (2013) also track the evolution of how the term ‘MDH’ has been used in Australia. They note its significance in 1980s planning legislation and then its relative disappearance in the 1990s before it resurfaced in the 2000s (p. 347). Bunker, Holloway and Randolph (2005) add that, in their view, “attached dwellings in medium-

and high-density configurations, have become the predominant form of new residential development since the early 1990s in Australia".

Australian research on MDH issues was coded into six categories in this review. It was found that studies tended to focus on intensification typologies, changing demographics, liveability issues and preferences or affordability issues or through subjective surveys and interviews looking at resident perceptions and experiences of MDH. Another popular research field in Australia was policy issues and the policy review of MDH-related policy and strategy.

Woodcock et al. (2010) outline principles that affect compact city development in Melbourne, in particular, the transit-oriented planning principles and urban design criteria that are shaping higher-density outcomes. They profile suburban streetscapes of 4–6 storeys and consider height controls and issues around as-of-right development. Other research by Dovey, Woodcock and Wood (2009) considers inner-city intensification and the design quality of outcomes, which are often MDH typologies.

Bunker, Gleeson, Holloway and Randolph (2002) discuss the local impacts of urban intensification (using the term 'urban consolidation') in Sydney's suburbs. In looking at three local council policies, Bunker et al. (2002) highlight that one of the strongest arguments for intensification is that it can be a process for increasing the range of housing choices available for an increasingly diverse population. This ties strongly to the New Zealand context where increasing the diversity of MDH typologies available continues to be seen as a way of addressing housing supply issues and providing affordable options for a wider demographic (Boon, 2010; Dixon & Dupuis, 2003; Dunbar & McDermott, 2011; Witten, Abrahamse & Stuart, 2011).

Additionally, Kupke, Rossini and McGreal (2011) conducted research about MDH intensification and neighbourhood change within the suburban neighbourhoods of three Australian cities (Adelaide, Sydney and Melbourne). They were seeking to identify whether MDH development has influenced housing market performance. They concluded that MDH development was consistent across all three cities. They also found that, while additional intensification will see changes to the physical structure of existing neighbourhoods, increasing the prevalence of MDH typologies seemed to have a minimal impact on the social structure of neighbourhoods.

Other studies that sit at the cross-over of intensification and housing research include Buxton and Scheurer (2007), Shaw (2013), Newton (2010) and Randolph and Freestone (2012). Density is generally discussed in these intensification studies, but MDH is not mentioned. In a similar vein, Searle (2007) has conducted intensification research as part of the Griffith University Cities Research Institute. He looked at design quality associated with higher-density housing and the policy issues associated with delivering intensification. 'Medium-density housing' as a term is not used. Searle's work is another example where MDH is implied rather than explicitly discussed. It is only in the last 2–3 years that the term 'medium density' has become more likely to be mentioned specifically.

Eight studies were found that focus on the relationship between changing demographics and MDH typologies. The most relevant is a study conducted by Fincher and Gooder (2007). They discuss the contested political ground of MDH in Melbourne (p. 169) and consider the relationship between MDH and views of 'home'. By interviewing 30 planners, architects and developers of MDH, they concluded that "medium-density housing in inner Melbourne calls forth a particular imagining of 'home', usually signalling 'belonging', from developers, architects and planners as they

use their narratives to make sense of this form of housing" (p. 181). They go on to comment that "more than for single family housing or high-rise apartment housing, medium-density housing means home outside the domestic space of family privacy for these practitioners; it means a lived experience of belonging to an immediate community, often (though not always in the same terms) of diversity" (p. 181).

Dowling and Mee (2007) also explain the importance of considering the concept of home and homemaking in housing developments. They explain that both social and cultural factors related to a neighbourhood context can affect the feelings of users about their house. Although their paper does not specifically mention the term MDH, the paper investigates "the ways in which the physical space of the dwelling is experienced though the transmission of smells and sounds". As they continue, it is evident that they are discussing MDH typologies, cautioning that, in some cases, "the physical proximity of neighbours leads some tenants to feel they are being monitored and others to manage their behaviour so as not to disturb neighbours" (p. 163).

Nematollahi, Tiwari and Hedgecock (2016) conducted a survey in three designated transit-oriented development areas in Perth to find the desirable density from residents' viewpoints. The result shows that, in all three case study areas, MDH was more desirable than higher-density apartment and low-density detached houses in terms of both social and physical characteristics. They concluded that "residents consider medium-density housing a safer development option in the context of any future social problems" (p. 148). Research in New Zealand is split as to whether MDH is as or more desirable than traditional low-density (Bryson, 2017; Haarhoff et al., 2012, 2013; Yeoman & Akehurst, 2015).

Randolph and Tice (2013) consider who the owners and tenants are that live in higher-density housing (apartments) in Sydney and Melbourne as a way to consider changing housing demand and the spatial nature of housing markets (p. 2663). Similarly, Bunker, Holloway and Randolph (2005) connect housing needs (demographic factors) to the metropolitan plan for Sydney. Both identify similar trends towards diversifying demographics, smaller household sizes and the ageing population. Bunker, Holloway and Randolph (2005) also look at the tenure characteristics of MDH typologies and consider how dwelling tenure has shifted away from ownership – a shift that has also occurred and is continuing in New Zealand.

A further study to look at demographics and housing was conducted in Sydney and Melbourne by Kelly, Weidmann and Walsh (2011), which spurred a replica piece of research in Auckland (Yeoman & Akehurst, 2015). Kelly et al. (2011) consider MDH supply and demand as part of their larger examination of low to high-density models. In total, 700 residents were questioned about their housing choices and preferences. The study elucidated trends and trade-offs in the housing choices process including the following observations:

- The majority of housing was built over 20 years ago, when costs, prices and the structure of the city were all very different.
- People stay in the same house for a long time. A quarter of Australians have lived in the same house for over 15 years, even though household needs may well have changed over time.
- Relatively few houses are available at any one time. Combined with time constraints and search costs, this lack of choice can lead movers to choose a second-best option.

- Lack of local choice (along with the infrequency of property vacancy) means that some households can't live in the type of house they want in their preferred location. (Kelly et al., 2011, p. 13)

In many instances, housing needs research converged with liveability and quality of life research. Nine articles were found about liveability studies conducted in Australia (Alves, 2004; Bunker, Holloway & Randolph, 2005; Buys & Miller, 2012; Kennedy & Buys, 2010; McCrea & Walters, 2012; Mee, 2010; Queensland University of Technology, 2009). Many of these are outlined in section 4. Shyy, Stimson, Chhetri and Western (2007), for example, conducted a survey about quality of life experiences in South East Queensland. As is indicative of studies pre-2010, the results showed that "most respondents (82.4 percent) either disagreed or strongly disagreed that more medium-density housing built in their neighbourhood has merit" (p. 20).

Fifteen articles were reviewed in the policy review category. Issues raised ranged from social media use in the face of NIMBYism (Williamson & Ruming, 2017) to the role of practitioners as 'city shapers' (Raynor, Matthews & Mayere, 2016) and planning theory (March, 2010) in supporting consolidation. Leading on from studies that focused on intensification and yet closely connected to policy review, affordability was an issue closely aligned to the intensification context (Beer, Kearins & Pieters, 2007; Higgins & Moore, 2015; Sharam, Bryant & Alves, 2015). Sharam et al. (2015) conclude with the comment:

> The failure of public policy to deliver affordable medium density infill housing has variously been laid at the door of the planning system, at taxation policy and at construction costs. We have shown that planning on its own cannot deliver affordable housing as an outcome; there needs to be a structure of housing provision capable of responding to the housing objectives of the planning scheme. (Sharam et al., 2015, p. 216)

Perhaps the most significant issue at the nexus of the relationship between policy and outcomes is the need for evidence-based policy that takes into account the subjective perceptions of residents (Fincher, 2007; Randolph & Freestone, 2012; Sajan, 2015; Sivam, Karuppannan & Davis, 2012). An example of a perception-based study was undertaken by Mee (2010), who conducted mailbox drop surveys with 504 residents in seven suburbs in the inner areas of Newcastle, Australia. Questions focused on finding the effect of neighbourhood form on adults' perceptions about whether their neighbourhood was suitable for children. They concluded that:

> Housing type is clearly a key factor in whether a neighbourhood is seen to be a good place for children ... Adults were concerned that medium density living did not provide enough space for children and also that medium density dwellings were unsafe for children. Despite this, it was clear that many tenants thought that a well-resourced medium density neighbourhood could be a very good place to raise children (p. 208)

This type of survey provides valuable primary data about how residents use and value their neighbourhoods and the amenities they access. Having up-to-date primary data is important, given the changeable context of how well urban lifestyles are being embraced by residents.

Finally, Douglas and Leshinsky (2017) consider the ethical concerns associated with bodies corporate in medium-density townhouses. They surveyed 34 body corporate managers about internal dispute experiences and issues with the governance of

higher-density developments. They conclude that best-practice examples and a stronger network of community amongst body corporate managers was required to improve governance models. More research to build on this work would be required before stronger conclusions could be drawn.

3.2 North America

3.2.1 United States

MDH in the United States has a long history (Marcus & Sarkissian, 1988). The way in which the 'American dream' developed to include the ownership of a single family stand-alone home in turn influenced post-war housing patterns in both Australia and New Zealand. The United States is now experiencing both growth in a number of towns and cities and challenges of regeneration. It is facing similar challenges to New Zealand in terms of how it manages intensification, regeneration and the legacy of the American dream (Lincoln Institute of Land Policy, 2017). Other ways in which the United States has a comparable MDH context to New Zealand includes the identified mismatch between current housing stock in the United States and the shifting demographics alongside changing lifestyle preferences and the growing demand for walkable urban living environments (Parolek, 2010, 2016).

This context led to a significant shift in thinking about housing in the United States – that there was a considerable need for diversity of typologies to suit the diverse needs of residents. This is the basis of a significant concept that has emerged out of United States research in 2010: the missing middle. This term was developed by Daniel Parolek of Opticos, an urban design and architecture consulting firm based in California.

Described as a "new movement for housing choice" (www.opticosdesign.com), the missing middle has become synonymous with diverse housing choices at affordable prices and a stronger connection between sustainable and walkable places. Howard and Joslin (2016) define missing middle housing types as "accessory dwelling units, bungalow courts, duplexes, four-plexes, and small apartment buildings which allow a greater number of people to share land cost in structures that are compatible with the neighborhood character in existing residential neighborhoods" (p. 2). They also comment on the way in which the missing middle concept and diverse housing typologies have become a major topic of discussion in land development codes "due to their promise to increase options for affordable housing" (p. 2).

At a city scale across America, the missing middle concept has become embodied in policy making and neighbourhood development processes. For example, in Austin, Texas, a project was undertaken to consider the development ability to increase density through the insertion of missing middle housing typologies in existing neighbourhoods (Howard & Joslin, 2016). Another example in Chattanooga, Tennessee, is a medium-density housing toolkit developed to consider how the city can encourage an increasing number of missing middle typologies (Incremental Development Alliance for the Lyndhurst Foundation & Chattanooga Neighborhood Enterprise, 2016).

A number of groups in the United States have developed research or commentary on MDH where missing middle typologies are often also discussed. These include the Urban Land Institute, the National Multi Housing Council and the Department of Housing and Urban Development (HUD) (Haughey, 2005; Howard & Joslin, 2016; Urban Land Institute, 2016). University research collaborations also consider MDH.

These include the Urban Land Institute at Virginia Tech (Danielsen & Lang, 1998), Stanford University (Krueger, 2007) and the Joint Center for Housing Studies at Harvard University.

However, largely, academic literature in the United States tends to use the term 'higher-density housing' rather than MDH. Multi-family housing is also a popular term in both academic literature and market research (Knaap, Meck, Moore & Parker, 2007; Myers & Gearin, 2001). The term 'consumers' is used more frequently in market research, in contrast with the term 'residents' in academic publications (Myers & Gearin, 2001, p. 633).

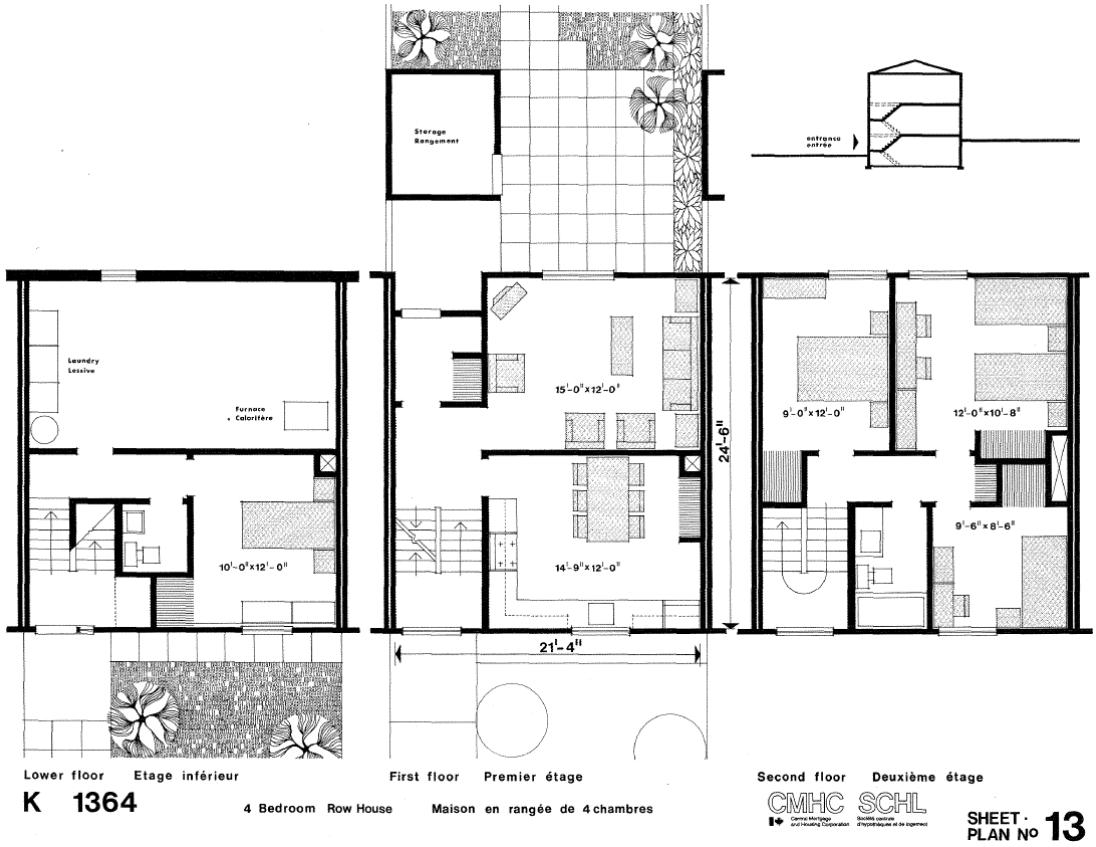
The missing middle is also a discussion point on the popular online resource for city planners, Planetizen (www.planetizen.com). Articles discuss issues from affordability to community resistance to MDH to supply and demand issues to the role of missing middle housing in growth management. In general, affordability as a term is mentioned less in the United States literature than it is in other regions. However, the missing middle has been used as a way to discuss affordability issues in some cases without directly discussing affordability (Kolson Hurley, 2016). Other research areas common in the United States include the trend towards renting (Next City, 2016) as well as resident perceptions and the relationships between intensification and liveability experiences (Myers & Gearin, 2001; Smith & Billig, 2012).

The MDH context has also captured the imagination of New Zealand researchers. In both 2013 (Collins, 2014) and 2015 (Hermans, 2015) Beacon Pathway[1] led study tours to North America, specifically to Vancouver, Victoria BC, Seattle and Portland. Parallels between housing markets were drawn, where market models in both the United States and Canada have successfully delivered the middle and top end of the MDH market but, as in Auckland, there are issues in delivering affordable housing (Collins, 2014). Similarly, it was identified that these cities are facing ongoing housing challenges as a result of the ageing population and, conversely, the trend whereby young families and first-home buyers are struggling to enter the housing market. Other trends identified on the study tour included the need for considering long-term rental and alternative tenure models, the imperative to consider transport infrastructure and housing together and the necessity to balance density with accessible shared open space (Hermans, 2015). Lastly, MDH models in the United States are increasingly following a 'mix it up' motto, whereby mixed use, mixed income, mixed ownership neighbourhoods are being prioritised. Both Collins (2014) and (Hermans, 2015) contend that North America has been actively developing MDH solutions for over 30 years and has much to offer New Zealand in terms of viable MDH solutions.

3.2.2 Canada

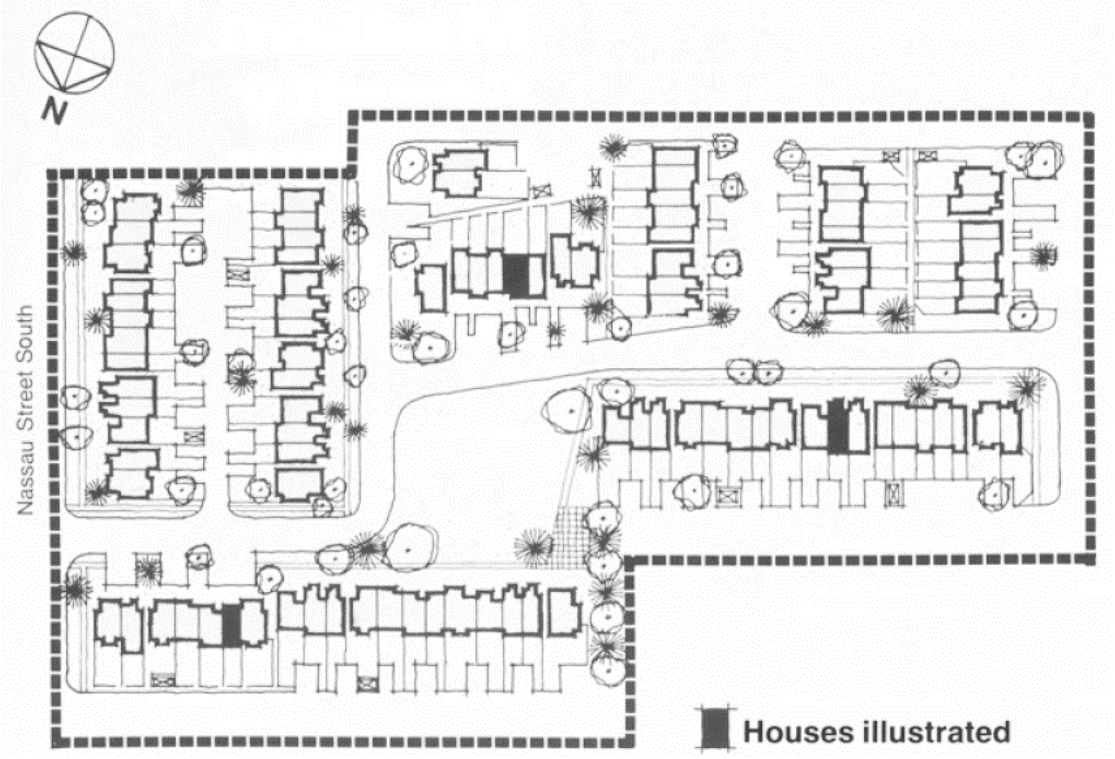
Canada has a long history of MDH research and, as a result, is advanced in its thinking about the issues and opportunities posed by the integration of MDH typologies into existing neighbourhoods. In the 1970s, the Canada Mortgage and Housing Corporation (CMHC) of the Canadian Government developed an information pamphlet on medium-density housing (CMHC, 1979). It provided both exemplar masterplans of medium-density subdivisions as well as exemplar floor plans for individual units (see Figure 6 and Figure 7). These were based on projects completed across Canada from British Colombia to Toronto to Newfoundland.

[1] Beacon Pathway is an incorporated society with the objective of making New Zealand's homes and neighbourhoods high performing, adaptable, resilient and affordable.



Source: Canada Mortgage and Housing Corporation (CMHC), reprinted with permission.

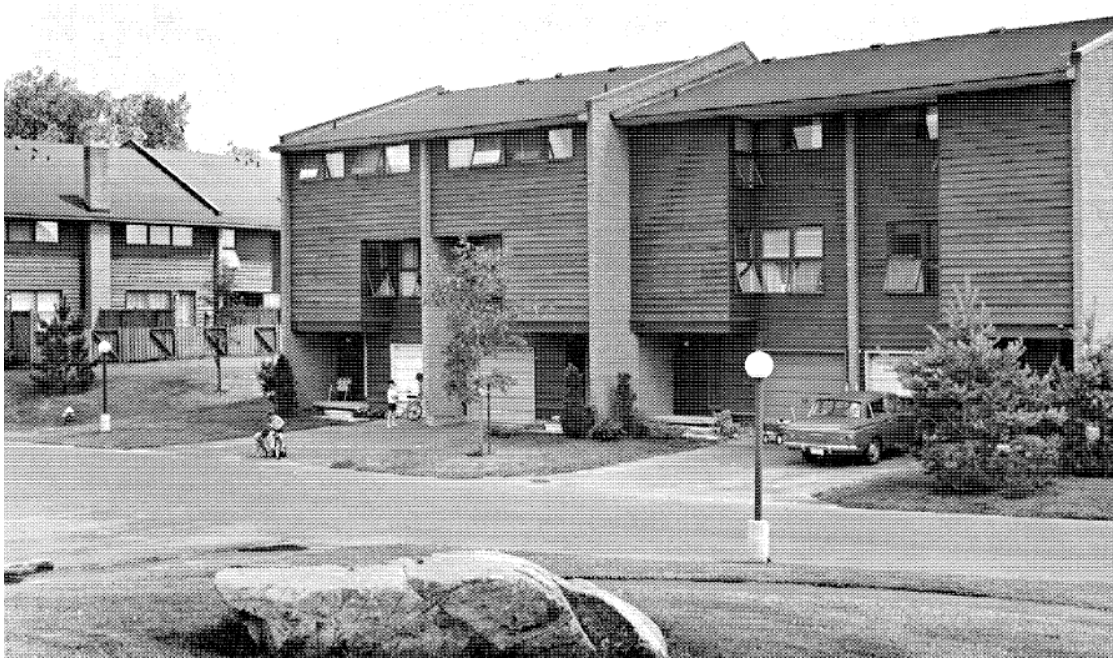
Figure 6. Exemplar MDH floor plan (CMHC, 1979, p. 22).



Source: Canada Mortgage and Housing Corporation (CMHC), reprinted with permission.

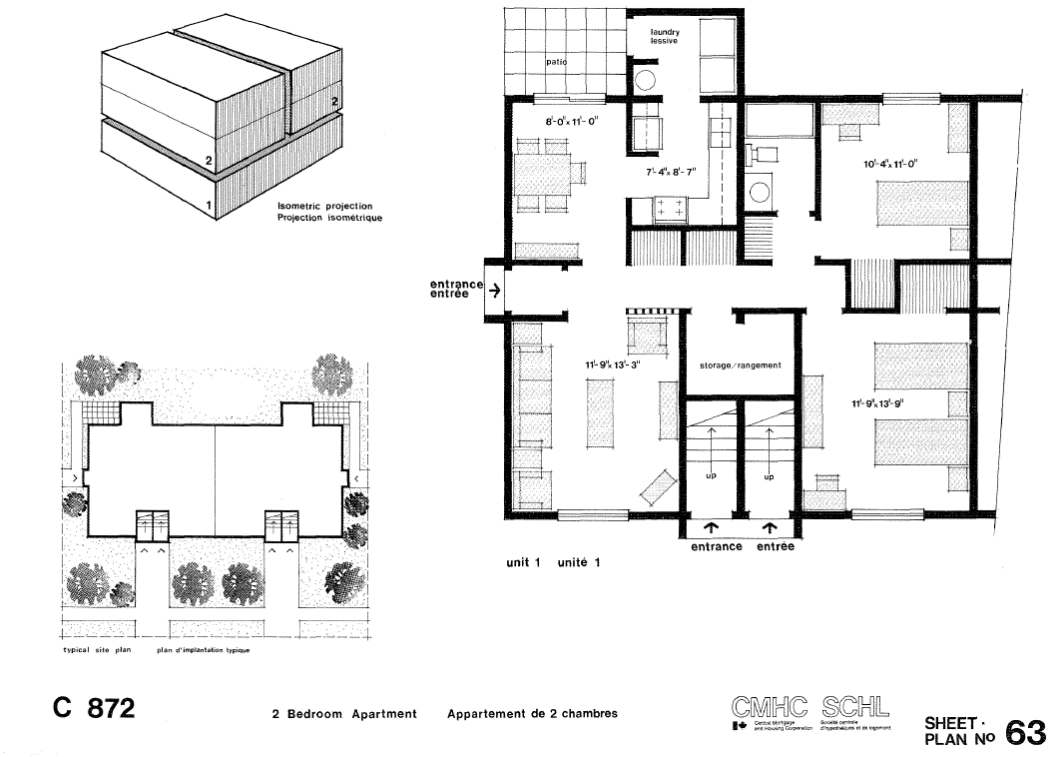
Figure 7. Exemplar MDH site plan CMHC, 1977, p. 13).

Another significant early publication by CMHC was an information paper on MDH. It included discussion about the design features of row housing, semi-detached housing, linked housing, court housing, stacked housing and walk-up apartments. As well as discussing best-practice design principles, the document also provided a range of exemplar plans and images of each typology (CMHC, 1977) (see Figure 8 and Figure 9). Subsequent publications looked at the research history of MDH in parts of Canada (Hanna & Dufaux, 2002) and the trade-offs that people make in transitioning from single family detached houses to MDH (CMHC, 2000).



Source: Canada Mortgage and Housing Corporation (CMHC), reprinted with permission.

Figure 8. Exemplar MDH typology (CMHC, 1977, p. 35).



Source: Canada Mortgage and Housing Corporation (CMHC), reprinted with permission.

Figure 9. Exemplar MDH floor plan (CMHC, 1977, p. 35).

In considering the factors influencing density patterns in Canada, Filion, Bunting, Pavlic and Langlois (2010) discuss the now well established MDH neighbourhoods in Toronto, Montreal, Vancouver and Ottawa. For example, they discuss how Toronto has been "characterized by the medium density stock" (Filion et al., 2010, p. 558) since an apartment housing boom that began in the 1950s and ran through to the 1970s. This contextualises how the Canadian context of MDH experiences and MDH research have a longer history than in New Zealand. While New Zealand has seen apartment buildings since this time, the scale of the boom and its flow-on effects were more significant in Canada. It can be argued that Canadian research is useful for considering the scale of the issues facing MDH as this type of housing continues to increase in prevalence in New Zealand.

The most notable theme in Canadian MDH research is the long history of considering residents' perceptions and ideas about both housing and neighbourhood satisfaction (Bogdanowicz & Eidse, 2006; Meagher, 2008; Randall, 2008). For example, Randall's (2008) study of the housing preference of suburban residents in Ontario focuses on both housing and neighbourhood choices. It also considers the trade-offs residents make when making housing choices. Randall's work was developed in New Zealand by Allen (2016a, 2016b, 2017) who also considers resident perceptions of MDH, neighbourhood satisfaction and the trade-off process when making housing choices.

Randall trialled face-to-face interviews in conjunction with mail-back questionnaires with 125 residents in Ontario. The questionnaires included a visual preference survey with photographs of detached and attached typologies for participants to compare and

rate using and a 5-point Likert scale.[2] The research aim was to identify how residents perceived different housing types. It is useful to note for future BRANZ research that Randall (2008, p. 34) found a problem with his method. Results were inconclusive about the perceptions of different MDH typologies because the images revealed inherent biases based on the interviewees' preferred architectural styles.

In addition to perception-based research on housing needs and choices, another key theme that came through in the Canadian MDH literature was the dynamics of housing affordability (Greater Vancouver Board of Trade, 2017; Rea, Yuen, Engeland & Figueroa, 2008). While some innovative methods are studied, they are predominantly in isolation from one another, and affordability continues to be an issue in Canada.

Moreover, in a similar vein to the New Zealand context, MDH research in Canada has also identified the need to focus on specific demographic groups when looking at the key issues facing MDH. Subsequently, a number of studies have been conducted since 2000 that focus on the changing housing choices of pre-seniors and seniors (CMHC, 2016a). This is because, like New Zealand, Canada is facing housing issues associated with its ageing population, which is simultaneously becoming more diverse in its liveability expectations and preferences. In particular, issues such as the desire to reduce responsibility (low maintenance), the spatial effects of neighbourhood attachment and wanting to age in place and the importance of the availability of help in the neighbourhood/access to urban amenities were all findings from the literature review that are considered to be the key determinants of seniors' housing choices (CMHC, 1989, 2012, 2013, 2015b, 2016a, 2016c).

Other studies considered demographics more broadly and looked at changes in the demographic configurations in geographic areas over time. For example, a study by Grant and Gregory (2016) considers downtown demographic changes in Halifax and identifies the relationships between, social, spatial, political and economic processes and how they affect MDH neighbourhoods.

In Ottawa, a stocktake of housing stock and an investigation of shifts in household formation was conducted by the Office of the Parliamentary Budget Officer (2017). However, this document fails to consider and compare the relationship between diversifying demographics and the need for diverse housing stock. Housing is considered as a singular category whereas it would be useful to know the stocktake of different housing typologies and their locations. Statistics New Zealand (2017) also fails to divide housing stock according to MDH typology categories.[3] This would provide a much richer picture of housing and neighbourhood development and the role of MDH in meeting the needs of diverse demographic groups.

The relationship between housing choices and demand was articulated in a more nuanced way in Canadian literature when compared with much of the New Zealand literature. In large part, this was because the socio-cultural context was considered alongside the economic context (National Association of Realtors, 2015, p. 29). As an

[2] A Likert scale is a psychometric scale commonly used in research to measure either positive or negative responses to a statement.

[3] The three categories of multi-unit housing construction in Statistics New Zealand's building consent series are:

- apartments (of any density)
- townhouses, flats and units
- retirement villages.

example, the key factors that were identified as affecting neighbourhood choice are shown in Table 2.

Table 2. Factors influencing neighbourhood choice.

(Reproduced with permission from National Association of Realtors®, 2015, p. 29).

	Age of home buyer					
	All	≤34	35–49	50–59	60–68	69–89
Quality of the neighbourhood	69%	75%	69%	65%	65%	64%
Convenient to job	52%	74%	62%	53%	20%	8%
Overall affordability of homes	47%	58%	44%	43%	42%	39%
Convenient to friends/family	43%	49%	35%	36%	47%	52%
Convenient to shopping	31%	25%	29%	34%	39%	42%
Quality of the school district	30%	44%	43%	16%	7%	6%
Design of neighbourhood	28%	26%	24%	29%	34%	30%
Convenient to schools	25%	34%	41%	12%	4%	3%
Convenient to entertainment/leisure activities	25%	29%	24%	21%	27%	21%
Convenient to parks/recreational facilities	23%	28%	24%	18%	21%	17%
Availability of larger lots or acreage	19%	23%	21%	19%	16%	10%
Convenient to health facilities	15%	7%	9%	14%	28%	37%
Home in a planned community	10%	6%	9%	10%	17%	18%
Convenient to public transportation	8%	9%	8%	6%	8%	6%
Convenient to airport	7%	4%	7%	10%	10%	8%
Other	6%	4%	6%	11%	9%	6%

Canadian researchers have also been at the forefront of considering MDH within the context of liveability and affordability research (Collins-Williams & Burda, 2015; Barron, Arntfield, Gurstein & Goldstein, 2017; Rea et al., 2008). This has led to research focused on the characteristics of MDH typologies (Beaudreau, 2014) as well as issues of MDH design quality (Brook McIlroy Planning + Urban Design/Pace Architects, 2010). While they discuss mid-rise (defined as 5–11 storeys) rather than medium density, they make some interesting recommendations that are in line with Australian research. For example, they recommend performance standards in a similar vein to those that have been developed by the State Government of Victoria (Office of the Victorian Government Architect, 2016).

Hutton (2011) and Coriolis Consulting Corporation (2007) both discuss the ground-oriented MDH policies of Metro Vancouver and the medium-density apartment zone within the context of street activation, prioritising liveability and having a comprehensive regulatory approach to intensification. Coriolis Consulting Corporation (2007) focuses specifically on increasing housing density through MDH in traditional detached-housing neighbourhoods. There are a number of reports that analyse the policy, market and development issues that affect MDH delivery (Regional Municipality of Peel, 2010). The key drivers of MDH are identified as affordability, transportation accessibility and the potential for greater proximity to high-quality neighbourhoods well served by a range of urban amenities (Pradinuk, 2013; Regional Municipality of Peel, 2010).

In Ottawa, there have been urban design guidelines for MDH since 2005 (updated in 2009 and 2012). The guidelines are governed by design objectives that focus on liveable and sustainable outcomes for both residents and the wider community. They

also consider three key aspects of MDH neighbourhoods – the built form, open spaces and infrastructure (City of Ottawa, 2009, 2012). Similarly, Yang (2008) developed a pivotal study in Canada on the relationship between physical form and quality of life. He used "neighbourhood satisfaction as an empirical definition of quality of life" (p. 307). His findings consider the influence of compact development and mixed uses on residents' quality of life and conclude that these outcomes depend on "the context and may be sensitive to the spatial scales at which urban form is examined" (p. 307). Medium density is divided into two categories in Yang's work – medium low density and medium high density. However, these terms and the typologies associated with them are not identified in the study.

Further, research in Canada has focused on mid-rise development rather than MDH. For example, the Canadian Urban Institute (2010) defines mid-rise as apartments between 4 and 12 storeys. They conducted a survey with key members of industry, including 57 developers, consultants and representatives from municipalities who were asked about the constraints they saw in delivering mid-rise developments. The three most recurrent constraints included building requirements (consenting, most notably parking), "the unpredictability and duration of approval process" (p. 3) and negative public perceptions of MDH. The study found the issues facing the delivery of mid-rise development in Canada to be complex and interrelated. This area of research is a gap that BRANZ is currently working to fill in the New Zealand context (Litten, 2016).

Although not directly targeted at MDH, another Canadian research project that bears parallels to planned BRANZ research is the First Homebuyers Survey conducted by Canada Mortgage and Housing Corporation (CMHC, 2015a). The online survey was conducted among 788 participants who had undertaken a mortgage transaction in the past 12 months, and in terms of finance and mortgages, they were one of the prime decision makers within their household. The key results included:

- that first-time buyers use online resources and engage in mortgage shopping around
- first-time buyers are most influenced by family members and real estate agents
- more than half of first-time buyers used a mortgage broker to arrange their mortgage
- less than half of first-time buyers receive other financial product offers
- first-time buyers receive a wide range of advice
- first-time buyers are satisfied with their experiences of the housing choice process
- most first-time buyers do not receive post transaction follow-up
- first-time buyers need support
- first-time buyers have concerns and feel uncertainty about their housing choices (CMHC, 2015a).

This survey was targeted at understanding the financial processes around purchasing a first home. However, it did not consider the other trade-offs that first-home buyers make when choosing a house. Typological considerations, design features and neighbourhood amenities and features were not integrated into the survey. This is where BRANZ can offer a different perspective and build on the Canadian example without repeating the study. Despite this study, how first-home buyers make their housing choices and how MDH typologies are considered by first-home buyers remains a gap in the international literature. A useful New Zealand study on the determinants of tenure among 20–40-year-olds was conducted 8 years ago (Beacon Pathway Ltd, 2010). However, the housing market has changed significantly since this time.

Another study that included first-home buyers but also considered broader generational trends for both home buyers and sellers was developed by the National Association of Realtors (2015). This study looked at the characteristics of homes purchased, the home search process and the experiences of sellers and real estate professionals alike as well as the finance process. These categories, in addition to a focus on socio-cultural determinants and the complex trade-off processes involved in housing choices can be used as learnings for the BRANZ future first-home buyers research in 2018.

Lastly, recent research in Canada on the need for increased housing supply has developed in line with similar initiatives in New Zealand. Greater Vancouver Board of Trade (2017) produced a report focused on unlocking housing supply and in particular the need to focus on missing middle typologies. Using the standard missing middle definition as developed by Parolek (2010, 2016), the social value of diverse housing forms and tenure models to reflect diverse demographics was at the core of the strategy. This piece of work points to the direction of future research in New Zealand because it considers ideas such as innovative tenure models (including co-housing, community land trusts and shared equity models). It also recommends community amenity contributions, density bonus zoning and a rethink of the consenting process to include the concurrent application for development permits and building permits.

3.3 United Kingdom

There are a number of studies from the United Kingdom that focus on issues around urban density and a lesser number that are specifically focused on MDH (and use the term MDH). For example, research done in England by Smith, Clayden and Dunnett (2009) explores the effect of housing density on different variables but only briefly mentions MDH. This is true of the wider European context where MDH is long established. Another example where there is only a singular reference to MDH is the Finnish work of Kyttä, Broberg, Haybatollahi and Schmidt-Thomé (2016). Their study focuses on the relationships between social sustainability, happiness and urban density.

Boyko and Cooper (2011) clarify some of the issues surrounding density, including MDH. They conducted a literature review across all densities and found a number of sources that have, as a result, been incorporated into this report. For example, research by Bramley et al. (2010) conclude that MDH typologies can produce the highest residual values for developers in London's northeast suburbs. Interestingly, in no case was low density more affordable. The more affordable homes were always at the medium-density scale. However, this context may not be relatable to New Zealand. Investigating the MDH delivery pipeline and feasibility issues is a research gap whereby learnings and research methodologies can be adapted from the United Kingdom context.

Raman (2010) conducts research about the relationship between social life and physical form in six neighbourhoods in the UK. He uses spatial network and visibility graph analysis methods. He concludes that socialising patterns and structures of social networks in high and low density areas are different. It is identified that "when visible social interactions in outdoor public spaces are analysed according to neighbourhood size, they tend to be highest at medium-densities (80–100 households/ hectare) and lowest at both very low and very high densities" (p. 72). Similarly, "low-density areas were associated with widely spread social networks and activities with very few strong relationships. In high-density neighbourhoods, respondents had small networks but

stronger ties were found" (Raman, 2010, p. 63). This is a good example of how research in the United Kingdom compares data across density categories. While this is outside the mandate of the BRANZ research programme, it may be of interest for other research projects in New Zealand.

Raman (2010) adds more detail about the factors that result in medium-density neighbourhoods being the preferred scale for encouraging social interactions. These include:

- the location of public spaces
- visibility from and to these spaces
- visual links between neighbourhoods
- typology and physical form of development rather than density alone. (p. 63).

Another UK example of behavioural research is from Portsmouth. Timlett and Williams (2009) use a survey methodology to question 443 households about their recycling habits and consider the impact of transient populations on recycling behaviour. They adopt a definition of MDH as "25–60 dwellings per hectare, e.g. terraces, medium- and low-rise flats and houses of multiple occupation" (p. 500) and also discuss high density.

In general, research from the United Kingdom proved less relevant to the New Zealand literature than the other regions considered (Australia and North America).

3.4 Summary

To summarise, the strongest similarity is that all regions are looking to increase the variety of MDH typologies available to residents. Australia is more policy focused than New Zealand, both in terms of the amount of policy available that specifically addresses MDH delivery and in terms of the literature available that specifically discusses MDH issues. Australian research was also the most directly comparable with New Zealand when compared to the other countries.

In addition, the following summations can be made about the international MDH research in each of the subsequent locations:

Australia

Research on MDH in Australia could be categorised into six key categories. Studies either focused on the socio-spatial issues and opportunities for intensification typologies (including MDH), the demographic issues aligned to promoting MDH or on questioning or promoting liveability outcomes from MDH. In turn, a body of literature in Australia focuses on the affordability issues currently being experienced in housing markets and the role MDH can play in addressing these issues. MDH was also researched through subjective surveys and interviews that look at perceptions of MDH. Another, popular research field in Australia was the discussion of policy issues and the review of MDH-related policy and strategy.

Canada

MDH research and policy has been widespread in Canada since the 1960s. As a result, a nuanced understanding of neighbourhood satisfaction also comes through in MDH research in Canada. While research on neighbourhood satisfaction in the United States tends to focus more on place making, satisfaction research in Canada tends to focus on policy improvements. Canada also has a variety of research work that has looked at

issues of an ageing population, and this work is directly comparable with the New Zealand context.

United States

In America, research about the reimagining of the American dream and the affinity of residents with traditional stand-alone typologies is directly comparable to the New Zealand context. So too is the identified mismatch between existing housing stock and changing demographic patterns. There is a particular perception that MDH is a large part of the solution to meeting the housing needs of an increasingly diverse population. Missing middle research is widespread in America (the concept was founded in America) and is focused on emphasising the need to provide more diverse housing typologies for 'consumers' across all demographics but in particular to provide a more diverse range of affordable options to recognise the broad demographics for whom both home ownership and renting can be unaffordable.

United Kingdom

The United Kingdom has a long-established history of MDH, and therefore much research includes some MDH but is often more focused on high-density as well (above 6 storeys). The relationship between social life and physical forms (i.e. the neighbourhood environment) is a more established research field in the United Kingdom than in New Zealand. However, New Zealand has been making great progress in this field of late.

4. Key research themes

A number of key themes were identified throughout the review process. While these were outlined in the section 3 as they arose, a summary is also provided here for convenience when using this report as a tool to assist with the development of new research projects.

Six key research themes have been identified.

The impact of intensification policies on housing densities

Within the context of urban growth management research and discussions of urban form, a number of studies were found to focus on the impact of intensification policies on housing densities. MDH is often, but not always, included in this discussion, either directly or by implication. This was most noticeable in Australian and Canadian literature. The Australian research by Alves (2006), for example, addresses issues around why the provision of MDH and higher-density typologies has been difficult to deliver in some of Australia's metropolitan regions. To investigate this issue, he conducted a survey with designers, developers, council officials and some residents, who were involved in the delivery of two case study projects in an eastern suburb of Melbourne. Questioning and examining what works and what does not in the delivery process provides useful material about the key issues and pressure points for key stakeholders in the delivery process. Because each country – and indeed city – has a different consenting context, results are not always comparable. However, the methodologies can be examined. In the case of this research theme, Alves's work would be a useful case study for undertaking research into what can be learned from examining the consenting process for MDH in different contexts.

The relationship between policy and housing outputs was also used as a mechanism to discuss residents' perceptions of density and entrenched preferences for traditional low-density typologies. The growing need for an increasing quantity of higher-density housing to be incorporated into existing neighbourhoods was considered by a number of researchers across Australia and North America (Alves, 2006; Buxton & Tieman, 2005; Fincher & Gooder, 2007; Randall, 2008).

Supply and affordability

Following from this, perceived density was also often connected to housing aspirations research by considering the supply side of housing (McCrea & Walters, 2012; Myers & Gearin, 2001). The second key research theme identified was therefore a prevalence of research about housing supply and demand issues and medium-density solutions. Supply and demand issues were addressed in both academic and market research alike. An understanding of both supply and demand ultimately contributes to an understanding of housing choices because residents cannot buy housing that has not yet been built (Allen, 2016a). Supply and demand issues were most frequently associated with issues of affordability, given the current context of unaffordability for first-home buyers in each of the research areas, whereby increased land prices and construction costs have been affecting all of the countries and cities considered in this review.

Housing supply chain and skills gaps

As a follow-on from the affordability debate, housing supply chain and skills gaps research has also been growing in prevalence. This research area, and the notable

gaps within it, is particularly relevant to the New Zealand context, where skills shortages are proving to be an issue of increasing importance.

Tenure models

Similarly, tenure models, along with research about the management and maintenance associated with MDH, is a research area that is gaining traction but historically has not been prioritised as much as others.

Housing needs and preferences

This research theme centres around the increased prevalence of housing needs and preferences research. There has been a noticeable shift in recent years towards evidence-based research being used to inform housing policy and understanding housing needs is an avenue where data on the complexity of housing choices can be useful. Understanding the subjectivity of housing choices has also become a significant research theme as cities have seen both more mobile populations as well as more diverse demographics. This trend has been noticed both in the international literature as well as the New Zealand literature.

Preferences research is connected to the subjective field of liveability research. The concept of liveability has proven to be popular in Australia, North America and the United Kingdom. The relationship between liveability and medium-density typologies has also gained popularity in recent years. It is this connection between liveability and density that also connects some of the liveability research to MDH neighbourhood research as well as neighbourhood satisfaction research. Maintaining or enhancing liveability while experiencing intensification is a key research focus and policy mandate in New Zealand. This is a mandate that is shared in Australia, North America and the United Kingdom.

Perceptions of density

Lastly, the number of studies that consider resident perceptions of density and intensification has also been increasing. Traditionally, this research has been predominantly in the field of social science. However, more recently, there has been a trend towards design and policy research that also focuses on understanding the complexity of subjective resident perceptions.

5. Technical research

Technical research into MDH typologies is a field of study that has been building momentum in recent years but is less common than social sciences research. This area of research is of particular interest to BRANZ given its existing technical expertise.

The areas of technical research most commonly found when conducting this literature review focused on sustainability assessments. Work by Stephan, Crawford and de Myttenaere (2013) for example concluded that, by intensifying existing neighbourhoods and "using alternative housing types, relying on public transport and renewable energy generation, the total requirements can be curbed and cities might be able to grow with a reduced environmental impact" (p. 48).

However, out of scope in this literature review are the in-house technical research projects conducted by key suppliers of building materials. It is possible that an additional pool of research may be available if the scope was widened to include this type of professional research and development.

There is also a noticeable focus in the literature on energy consumption (Ge & Baba, 2015, 2017; Hachem, Athienitis & Fazio, 2014; Reza, Sadiq & Hewage, 2014; Touchie, Binkley & Pressnail, 2013; Touchie & Pressnail, 2014), energy efficiency (Asfour & Alshawaf, 2015), life cycle assessment (Thiers & Peuportier, 2012), the investigation of passive energy (Yildiz, Korkmaz, Göksal Özbalta & Durmus Arsan, 2012) or zero-energy solutions (Evola, Margani & Marletta, 2014; Newton & Tucker, 2010) and reducing carbon emissions (Beattie, 2014).

In Canada, an example of energy life cycle assessment has been conducted by Reza et al. (2014), which has focused on multi-unit single-family residential typologies. As well as following comparative sustainability assessment methods, they applied both multi-criteria and single-indicator decision analyses. They conclude that, when multi-unit residential dwellings are compared to single-family houses, the life cycle impacts are similar in providing housing for each resident (p. 217). However, they also identify that "the environmental loading ratio (ELR) ... for the single-family house is significantly greater than ELR for the multi-unit residential building" (p. 217), adding that:

> This is because a considerable portion of annual operation energy in the multi-unit residential building in Vancouver is electricity (i.e. hydroelectricity), which is a renewable source of energy. Therefore, the operation of the multi-unit residential building is highly dependent on local renewable energy sources, whereas the main source of energy in the single-family house in Vancouver is natural gas, which is a non-renewable source of energy. As a result, based on the nationally and regionally averaged annual energy use data, the multi-unit residential building consumes energy in a more sustainable manner than the single-family house (p. 217).

Other Canadian research to consider the energy performance of MDH typologies was conducted by Ge and Baba (2015, 2017). Their justification for this research was derived from the observation that multi-unit residential buildings now constitute one-third of the residential buildings in Canada and consume 40–50% of the residential sector's energy use (p. 251). Where Ge and Baba (2015, 2017) focus on Montreal, Touchie et al. (2013) and Touchie and Pressnail (2014) use similar methodological justifications around the increasing numbers of MDH to focus on Toronto and research

their correlation between energy consumption and the characteristics of MDH typologies (identified as multi-unit residential buildings).

Similarly, in France, Thiers and Peuportier (2012) have conducted a life cycle assessment study of two attached (duplex) passive houses and a renovated social housing 5-storey apartment building. They consider four different heating solutions – an electric heat pump, a wood pellet condensing boiler, a wood pellet micro-cogeneration unit and district heating. Their results "show the level of performance as well as the influence of the choice of the heating system on the environmental impacts considered in this assessment" (p. 277).

Evola et al. (2014) investigate cost-effective design solutions for net zero-energy terraced houses in southern Europe. The results identify net zero-energy solutions are possible, "such as high insulation, use of low-emissive glazing and window shadings, free cooling through natural ventilation, solar collectors for DHW, heat pumps for space heating" (p. 18).

Another terraced house study was conducted in Malaysia by Razali, Zaki, Ali and Arai (2016). This study looks at wind flow around terraced houses as a component of the environmental amenity in MDH neighbourhoods. This type of study, which connects the materiality of MDH typologies to experiential factors in MDH neighbourhoods, was the only study of this kind uncovered through the literature review process.

Yildiz et al. (2012) identified an approach for developing design parameter guidelines to reduce the energy requirements of low-rise apartment buildings in Turkey. This study is contextualised by a literature review of the energy issues that affect MDH and a series of interviews with architects. It concludes that "the most sensitive design parameters that affect annual cooling energy loads in low-rise apartment buildings were natural ventilation, window area, and the solar heat-gain coefficient (SHGC) of the glazing" (p. 337).

Another study that is focused on energy consumption is the work of Asfour and Alshawaf (2015). They consider the effects of housing density on energy efficiency in hot climates. The MDH typologies considered include row houses and low-rise apartments of predominantly 3–4 storeys (high-rise apartments are from 6–12 storeys). In this study, horizontally attached housing configurations performed better than vertically attached ones (p. 138).

Hachem et al. (2014) look at energy performance enhancement methods in MDH typologies. Specifically, they consider methods to increase the electricity generation potential of façades. They define three categories of multi-storey residential buildings: low-rise (3–5 storeys), mid-rise (6–9 storeys) and high-rise (up to 12 storeys). The objective of their research was to investigate the effect of increasing residential density in multi-storey buildings on the overall solar potential and energy use of these buildings. The research findings include the observation that, if the roof design is optimised for solar energy generation, a building of 3 storeys can generate about 96% of the total energy used. The research also identifies that electricity consumption is generally lower in apartment buildings when compared to detached houses in the same neighbourhood. They provide an example that "the average heating load is reduced by up to 50 percent in the 12 storey building as compared to the heating load of a single family 2-storey house having identical floor area (Hachem et al., 2014, p. 18).

Considering net zero-energy housing from an Australian perspective, Newton and Tucker (2010) report on the carbon footprints of alternative configurations of hybrid buildings. They divide housing typologies into three categories: detached, medium density and high rise. However, further definition of medium density is not supplied other than to consider medium density to infer walk-up typologies. A key conclusion of the study is that "medium density housing represents the best outcome from a greenhouse gas perspective … and should become the principal vehicle for intensification of urban development in Australian cities" (p. 105).

Energy building performance and carbon dioxide emissions research also takes the form of case study analysis. For example, Beattie (2014) uses a mixed-use medium-density case study in Perth, Western Australia, to consider options for decarbonising new development projects.

While multi-scale life cycle energy analysis for traditional low-density suburban neighbourhoods has been undertaken, little research is available that tracks how these energy demands and outcomes are changing as more neighbourhoods transition to having a great of variety of medium-density housing typologies and thus increased density.

One study does consider the relationship between development patterns and energy demand (Fuller & Crawford, 2011), finding that:

> It appears that the development pattern that has the greatest potential to reduce Melbourne's household-related energy consumption and greenhouse emissions, in line with Melbourne 2030, are the inner-suburban and inner-city apartment type buildings. This study shows that inner-suburban residents may be able to reduce their total annual energy consumption and emissions by 40–50% through improved access to public transport and reduced reliance on car transport alone (p. 181).

In Canada, a body of research has emerged in recent years focused on timber construction technologies, in particular, energy-efficient timber framing (Awad, Gül, Zaman, Yu & Al-Hussein, 2014; CMHC, 2016b). Awad et al. (2014) evaluate the thermal and structural performance of potential energy-efficient wall systems for MDH (mid-rise) timber-frame buildings.

Additional technical research out of Canada includes the work of Urquhart, Richman and Finch (2015) who look at and identify future research potential for air leakage testing in MDH.

While valuable research has been done into exceeding the minimum standards for stand-alone homes (Di Placido, Pressnail & Touchie, 2014), it was found that MDH typologies have received less attention. Studies focused on construction technologies from acoustic systems (Rasmussen, 2010) to issues of air leakage (Urquhart et al., 2015) have been observed in the literature although to a lesser extent than sustainability assessments. Construction technologies also appear to predominantly be the domain of manufacturers looking to improve their products and is therefore seldom available for review in the same way as research published in an academic research journal.

Research into construction technologies, specifically the structural and technical issues associated with MDH, appears to be more widespread in Europe where MDH typologies are much longer established. For example, Rasmussen (2010) has conducted research

into the sound insulation requirements and standards between dwellings across 24 European countries and suggests that “regulatory sound insulation requirements need tightening in some countries” (p. 373). In light of the transition to more lightweight MDH construction methods, Rasmussen (2010) calls for more research into sound insulation between dwellings (p. 373). This is likely a transferable knowledge gap to New Zealand as a more diverse range of MDH construction systems becomes available.

An example to come out of Australia is the work of Eroksuz and Rahman (2010), which examines the water-saving potential of installing rainwater tanks in multi-unit buildings. Another study to consider urbanisation and water consumption took a Barcelona case study and identified water usage comparatively across three densities. Housing was categorised into high density, mid-density and low density. Specific definitions were limited. However, mid-density was considered to represent larger apartments (than higher density apartments) “with more water fixtures and more persons per household” (Domene and Saurí, 2006, p. 1615).

An issue that arose while conducting the searches for the literature review was the considerable breadth and availability of research that was applicable to MDH typologies, albeit not directly focused on them. For example, work by Jim (2017) considers green roof cases studies ranging from stand-alone to high-density examples across Europe, North America and Asia. However, the implications of this research would still be applicable to MDH typologies. Studies of this nature have largely been excluded from this literature review in order to tighten the scope and ensure that the focus remains on MDH-specific research. Also excluded is research undertaken by industry whereby the findings are aligned to product development and include a cost off-set component rather than being focused purely on best practice. However, studies specifically focused on individual technical issues should still consider this work as it can no doubt add value to research being undertaken by BRANZ on MDH issues in the future.

Additionally, some studies from Asia researched ‘low-rise’ energy consumption and environmental quality issues. However, ‘low rise’ in these studies was defined very differently from how it is defined in New Zealand and has therefore not been included in this literature review. For example, Kim, Kang, Choi, Yeo and Kim (2008) look at improving indoor air quality in new apartment buildings in Korea and define ‘low rise’ as less than 30 floors. Their case study was a 25-storey apartment building.

In summary, considering the technical issues facing MDH has proved a useful component of this literature review, and a number of gaps have been identified that could inform further research in New Zealand. Another observation is that there could be stronger links between industry research and academic research on technical issues. This is an area in which New Zealand researchers and industry professions could lead the way.

6. Policy and strategy

In this section, the inclusion of MDH in government plans, strategies and documents from around the world is reported. Focus areas and cities were identified to narrow the scope to the most comparable regions and cities to New Zealand. These included Australia (New South Wales, Queensland, Victoria and Perth), North America (Portland, Seattle, Vancouver and Toronto) and the United Kingdom (London, Manchester and Leeds).

A table to identify how MDH and related concepts are discussed in the key policy and strategy documents of focus areas and cities is available in Appendix B and C. The search terms used to search through these documents included the following:

- Medium-density housing (and medium density housing as the hyphen is a BRANZ standard but not usual in policy documents).
- Higher-density housing.
- Medium-density neighbourhoods.
- Missing middle.
- Multi-unit/multi-family residential development.
- Intensification.
- Infill development.

Variations between the governmental structures of the focus areas provided interesting points of comparison amongst these regions. In Australia and North America, a federal system governs at a national level. Traditionally, federal policies have been very high level and almost all plans and strategies were left up to state governments and then to local city councils. This is slowly changing as the importance of housing and managing growth becomes increasingly politicised and an issue of national importance and debate.

A federal system is not present in New Zealand or the United Kingdom, and local government has a greater role and responsibility in producing their own high-level strategies and plans. The federal system in the United States in some cases allows for greater legislative powers at a federal level, and the authority of local government documents are superseded by state and state by federal. It should be noted, however, that the North America focus cities do function autonomously to an extent. This is in large part due to their sizeable populations and global influence, and therefore they do produce their own guiding plans and strategies more so than smaller North American cities. They also produce their own supplementary supporting housing documents and regulations.

In Australia, state government – a layer of government that isn't present in New Zealand – plays a strong role in providing urban growth guidance and overarching housing policy. For example, the New South Wales Government has produced a draft medium-density design guide (Department of Planning & Environment, 2016a). It aims to encourage "a design-led strategic planning process to determine the type, scale and built form of medium density housing permitted in an area" (p. 6). At its core is the message that "increasing the supply and quality of medium density housing across NSW will provide many benefits and offer more choice for our changing population" (p. 1).

Within these documents, the 'missing middle' – i.e. medium density housing – is again defined in order to meet the needs arising from a depleting house stock and a growing

and diverse population, although it is explicitly defined as 'low rise'. Specific housing types that are included are dual occupancies and semi-detached dwellings, villa and townhouse developments and manor houses. Through the introduction of the medium-density housing design code into the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 (New South Wales Government, 2008), specified low-rise medium density housing proposals are allowed to move more quickly through the planning processes. The document, as well as the subsequent design guide, which provides best-practice examples and standards to ensure high-quality development, are legally enforceable throughout New South Wales. At the city level, the document A Plan for Growing Sydney (Department of Planning & Environment, 2014) extols medium density as a typology for appropriately delivering its goals and actions to help meet consumer demands and lifestyles.

Similarly, at the state level in Queensland, the need for a 'diverse' and increased housing stock is identified within the State Planning Policy 2017 (Queensland Government, 2017b). This must be considered in every local planning scheme. A clear diagram of what is meant by 'diverse' is provided in the South East Queensland Regional Plan 2017 (Queensland Government, 2017a) (see Figure 10) – the missing middle term appears again. MDH is not specifically mentioned or defined, but the definition of the missing middle is in line with the BRANZ definition of attached typologies of up to 6 storeys.

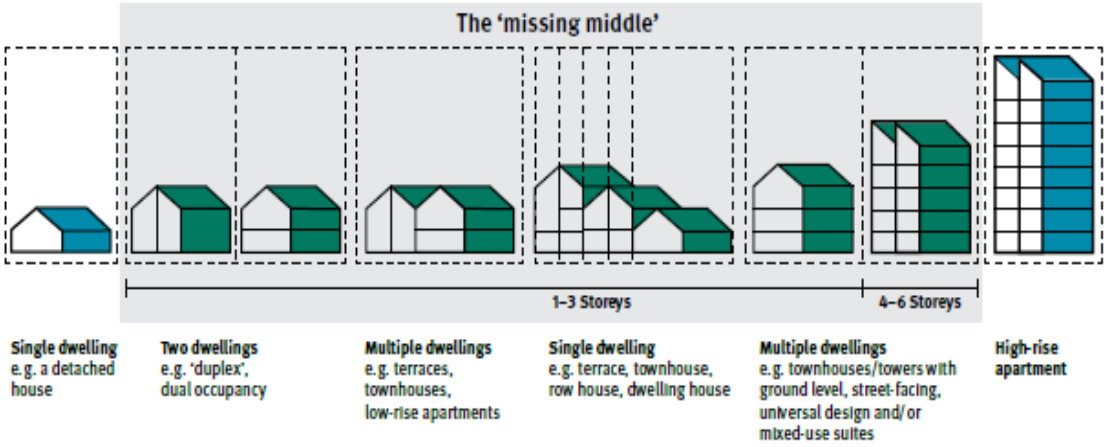


Figure 10. The missing middle (Queensland Government, 2017a).

Both the New South Wales and Queensland State Governments have also run missing middle ideas competitions to encourage the public appetite for missing middle, medium-density typologies. Entrants created new housing designs that responded to the housing challenges, addressed the local context, and supported design excellence and innovation across a range of housing types. These competitions received over 100 entries from either individual or multidisciplinary teams of professionals and students from the built environment area. These competitions provided a platform for government, industry and communities to discuss different housing options in a practical and visual way.

The South East Queensland Regional Plan 2017 (Queensland Government, 2017a) also seeks to consider the missing middle in the subtropical climate of Queensland (see

Figure 11) – not only medium-density typologies but also neighbourhoods, including hidden density through clever spatial planning.

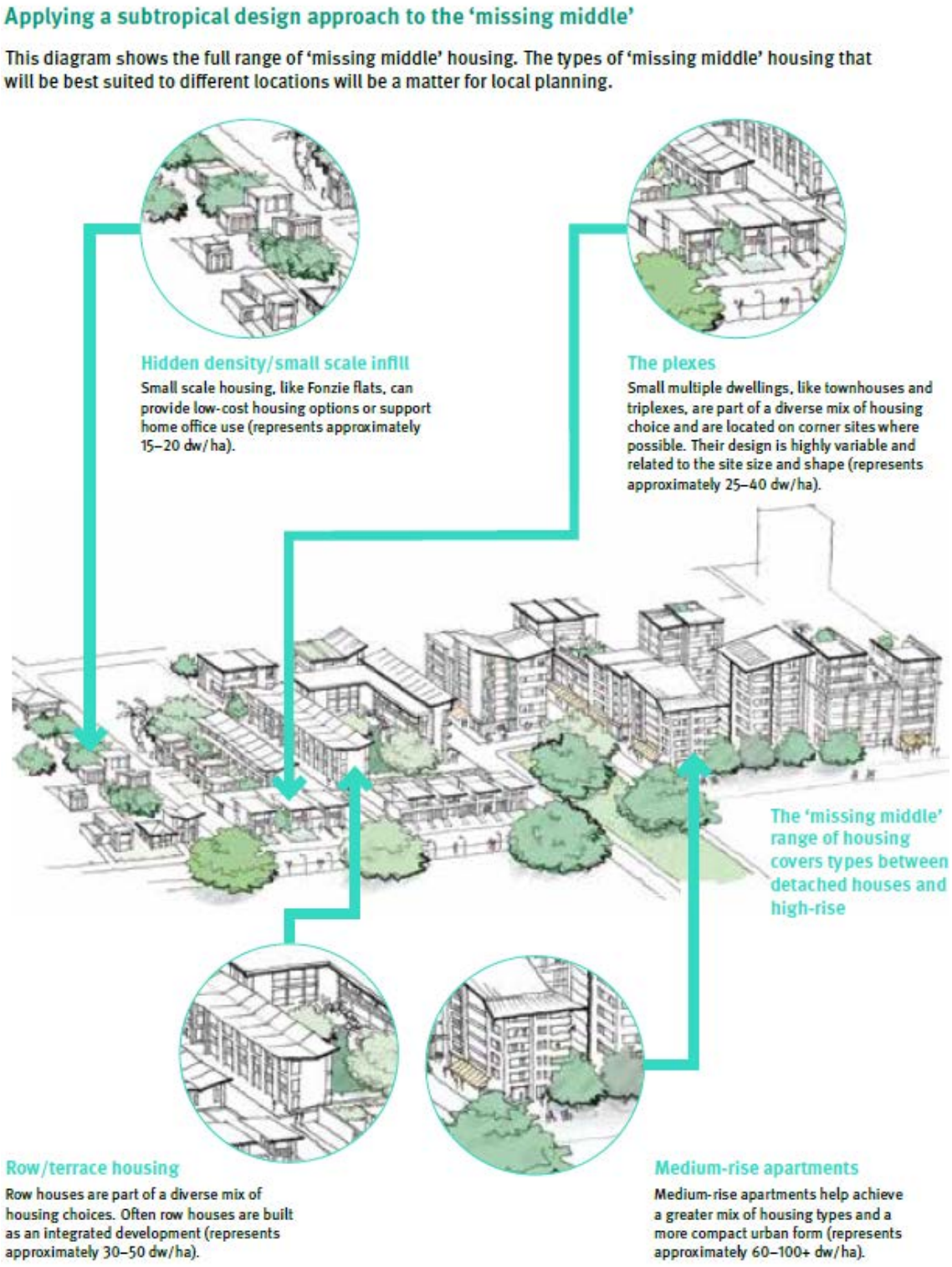


Figure 11. Applying a subtropical design approach to the missing middle (Queensland Government, 2017a, p. 182).

At the city level, Brisbane provides its land use zoning regulations and maps through the Brisbane City Plan (Brisbane City Council, 2014). This plan works much like the current Auckland Unitary Plan where each zone has its zoning regulations that must be adhered to by all new or applied-for developments. It specifies that developments must respond to local characteristics and contexts during the design process. Here, the regional government inherently provides much of the context and framework for MDH within Queensland and Brisbane as opposed to city council or state government as might be expected.

In Victoria, much like other states, within the higher-level documents, there is a consensus that there is need for an increased housing supply and that the large majority of this development should be centred within the inner and middle suburbs in order to connect closely with jobs, education and public transport (Department of Environment, Land, Water and Planning, 2017a). Providing choice is a key goal within the housing strategy for Victoria, while the reform of residential zones will protect neighbourhood character. However, medium-density housing or development is not mentioned at all within this document, but the implications of a cliff or gap between where low densities end before the high density begins is identified and characteristics of MDH are provided for through planned actions and initiatives. As MDH is not defined at the state level, it is unsurprising that, at the city level, there is also no defined version of MDH within Melbourne (Department of Environment, Land, Water and Planning, 2017b). However, there are a variety of initiatives planned that, when put in place, would help to achieve higher densities in some areas, specifically urban renewal areas where medium and higher-density housing and mixed-use development will be encouraged. In comparison to Queensland, Melbourne identifies greyfield sites as potential redevelopment opportunities to provide for MDH. The initiatives outlined within this document aim to be delivered within the next 25 years, and best-practice examples of MDH types are provided.

The need for diversity and choice within an increased housing stock is echoed throughout the North American and UK policy examples to encourage town centre and existing neighbourhood development through their various plans and documents (City of Portland Bureau of Planning, 2008b; Seattle Planning Commission, 2011; City of North Vancouver, 2014; Greater London Authority, 2016). Planning provisions to address the integration of MDH typologies into existing neighbourhoods have been created by deregulating housing policy (Manchester City Council, 2012; Greater London Authority, 2016), allowing more permissive zoning and enabling higher permitted densities.

When compared with the New Zealand context, it was found that many of the international plans considered were similar in principle to local government planning policies. Australian plans were visually more engaging than others and addressed all the major issues facing MDH delivery.

7. Conclusion

This report has reviewed international definitions of MDH and compared them to the definition in use by BRANZ. It was found that the definition developed at BRANZ is largely in keeping with international definitions and is also in line with the definition of the missing middle, which is defined visually in the South East Queensland Regional Plan 2017 (Queensland Government, 2017a) as attached housing forms from 1–3 storeys and 4–6 storeys.

This report has considered literature from Australia, North America (Canada and the United States) and the United Kingdom. It concludes that all regions are looking to increase the variety of MDH available to residents through various policy and strategy mechanisms.

Knowledge gaps relating to MDH were very comparable to the New Zealand context. As in New Zealand, ongoing research will be needed to track and identify future growth and housing needs and preference trends (Bryson & Allen, 2017). Similarly, the success of new tenure models and the process for implementing innovative MDH internationally will require continued study. The relationship between social housing provision and emergency housing may grow as a research field. It is one that has currently received little attention outside of social science fields. Longitudinal research projects were also rare.

Key themes in this literature have included the following:

- The impact of intensification policies on housing densities.
- The relationships between housing supply issues and medium-density solutions, including housing delivery issues and the MDH supply chain.
- New housing tenure models and the importance of the management and maintenance of MDH.
- Housing needs and preferences research, including the relationship between choice and affordability. In particular, understanding housing needs is seen as a key component of understanding how housing supply can be addressed in housing policy.
- Residents' perceptions of density and intensification.

Technical research that looks at sustainability issues and construction technology opportunities and concerns for MDH typologies was also included in this review. It is in this category that the most notable research gaps appear, particularly when considering the interrelationship between construction technologies. For example, given acoustic privacy and fire protection solutions must be delivered in a singular wall panel, it makes sense to research how solutions for both can be delivered to reduce material waste and installation time and improve the quality of delivery. This international issue is relevant to New Zealand.

With this knowledge, BRANZ is well positioned to lead future MDH research in New Zealand. Key learnings that BRANZ can apply to its research work on MDH issues are as follows:

- Although no standard definitions of MDH exist, there is considerable common ground among the definitions. Predominantly, the definitions were in line with BRANZ's identification of MDH as any form of attached housing up to 6 storeys.

- The relationship between supply and affordability as well as the intersecting issues of housing supply chain stability and skills gaps shortages are some of the most topical issues being considered internationally. They are also very relevant to the New Zealand context, and research gaps within these categories provide an opportunity for BRANZ to be a thought leader on the complex planning required to ensure sustained, timely and affordable MDH delivery.
- Research into issues and opportunities when financing MDH as well as innovative housing tenure models is increasing. This research area is currently not being looked into by BRANZ but could be an opportunity for BRANZ to position itself ahead of the curve in New Zealand if research was to commence in this field.
- International housing needs and preferences research, as well as research on perceptions of density, indicate the increased complexity that now comes with responding to housing demand trends in light of the diverse demographic trends and changing lifestyle preferences occurring. The complexity of demand at a national scale remains a research gap in New Zealand, despite some regional studies that have been completed. This is an opportunity for the BRANZ MDH research programme.
- The technical literature related to MDH – from sustainability issues to construction technology opportunities and concerns for MDH typologies – is the field of research that BRANZ is best positioned to respond to. Integrated systems and new construction technologies may be of particular interest and timeliness, and further research with a more precise scope is recommended to confirm the gaps that exist in the New Zealand context.

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Appendix A: Definitions of MDH in international literature

Table 3. MDH definitions – international literature.

Australia	
Alves, 2004	• Central to the consolidation strategy is the development of MDH, defined here as any form of attached housing, low-rise flats and multi-unit detached housing on small allotments. (p. 2)
Alves, 2006	• A basic definition of MDH is any attached housing not requiring lifts. (p. 1)
Buxton & Tieman, 2005	• The terms 'medium density' and 'multi-unit' housing are not necessarily synonymous as "medium density can be achieved with one dwelling per site if the sites are small enough, whereas multi-unit development can be of any density" (Lewis, 1999, p. xv). In practice, a number of terms and definitions are used. The government's strategic planning document, Melbourne 2030, ceases to use the term 'medium density', instead replacing it with the term 'higher-density housing'. This is defined as "housing units on a given area of land that are more numerous than the average in the surrounding locality" (DOI, 2002, p. 182). The government's medium-density residential code, ResCode (Clause 55), applies to two or more dwellings on a site below 4 storeys. (p. 142) • The preferred definition used in this study identifies MDH as any form of attached housing, including residential buildings above 3 storeys and any additional detached dwelling on a single block. (p. 142)
Committee for Sydney, 2016	• 365 people/ha – 55% open space. (p. 7)
Easthope & Judd, 2010	• Medium density developments (e.g. a 2-storey block of six apartments). (p. 2)
Fitzpatrick & Wadley, 2013	**Table 1.** Net dwelling density targets, selected strategic metropolitan plans, Australia (dwellings per hectare, d/ha) Density level (d/ha) State | Document | Very low | Low | Medium | High | Mixed use SA | *Planning South Australia: Understanding Residential Densities* | <17 | 17–33 | 34–67 | >67 | NSW | *Sydney Growth Centres* | | 12.5–20 | 20–40 | 40 | 66 Vic. | *Melbourne 2030* | "Significantly higher than 10 d/ha, for example, 15 d/ha" | | | | Qld | *South East Queensland Regional Plan 2009–2031* | "Achieve minimum dwelling yield of 15 d/ha" | | | 30 | Activity centres 30–120 Transit-oriented developments 30–80 *Sources:* Planning SA (2010); New South Wales (2006); Victoria [Department of Sustainability and Environment] (2005); Queensland Government (2010). (p. 344)
Forster, 2006	• An increasing percentage of new dwellings in recent years have been apartments, townhouses, duplexes or other MDH. (p. 175)
Searle & Filion, 2011	• Medium density – attached dwellings in buildings up to 3 storeys. (p. 1420)

<table>
<tr><td>Kupke, Rossini & McGreal, 2011</td><td>• For the purposes of this paper, MDH is defined as housing that is attached and includes 1 and 2-storey flats, units or apartments (ABS, 2006). (p. 4)</td></tr>
<tr><td>Newton et al., 2011</td><td>• Medium/high-density (1–7 storeys). (p. 51)</td></tr>
<tr><td>Randolph & Freestone, 2012</td><td>• Medium-density forms – semi-detached houses, blocks of flats and townhouses. (p. 2567)</td></tr>
<tr><td>Sajan, 2015</td><td>• Urban consolidation policies in Sydney favoured the development of diverse MDH forms including apartments (Bunker et al., 2002; Buxton & Tieman, 2005). Many researchers (Burke, 1991; Davies & Young, 1976; Judd & Dean, 1983; Roseth, 1983) have highlighted the relative nature of the term ‘medium density’ in relation to either density or built form. Sydney 2036 (NSW Department of Planning, 2010) also denotes ‘medium density’ to symbolise all housing forms other than the detached homes. (p. 503)</td></tr>
<tr><td>Sivam, Karuppannan & Davis, 2012</td><td>• Prior to the introduction of a density definition, there were a large variation in the different interpretations and applications of density, each with very different results. In the absence of a universal definition of density, in South Australia, for example, peri-urban councils determined that housing allotments with a site area of 600 m² were deemed medium density, as such allotments were smaller than those prevailing in the local area (Davis 2008). (p. 478)
• However, at the other end of the spectrum, in another example, planning authorities accepted that a 6-storey apartment building adjacent to a regional shopping centre was consistent with planning policy that advocated medium-density development, even though there were no prescriptive guidelines on building type or height.
• The Planning Strategy for Metropolitan Adelaide 2006 was adopted (refer Table 1) because, at the time of the study, the 30-Year Plan for Greater Adelaide currently in force was not published. However, the 30-Year Plan for Greater Adelaide only provides standards for net density: low density – 35 u/ha, medium density – 35–70 u/ha, high density – more than 70 u/ha (Government of South Australia 2010), which is very similar to standard provided by the Planning Strategy for Metropolitan Adelaide 2006. (p. 479)
Table 1 Density considered for analysis
<table>
<tr><th>Serial number</th><th>Type of density</th><th>Gross density (du/ha)</th><th>Net density (du/</th></tr>
<tr><td>1</td><td>Very low density</td><td><11</td><td><17</td></tr>
<tr><td>2</td><td>Low density</td><td>11–22</td><td>17–33</td></tr>
<tr><td>3</td><td>Medium density</td><td>23–45</td><td>34–67</td></tr>
<tr><td>4</td><td>High density</td><td>More than 45</td><td>More than 67</td></tr>
</table>
Source: Planning Strategy for Metropolitan Adelaide 2006, Government of South Australia</td></tr>
<tr><td>Nematollahi et al., 2016</td><td>• ‘Medium density’ covered 2–3-storey townhouses and single or double-storey grouped dwellings. (p. 139)</td></tr>
<tr><td>Udell et al., 2014</td><td>• Medium density is generally considered to be 25–60 dwellings per hectare. (p. 10)</td></tr>
<tr><td>Kupke, Rossini & McGreal, 2012</td><td>• The housing form that is to be encouraged is described as medium density – attached dwellings, typically but not exclusively units, flats or apartments of up to 3 storeys (ABS, 2006) on allotment sizes of less than 300 m² with net dwelling densities of up to 67 per hectare (SA Government, 2010; DFC & DPC SA, 2011). (p. 276)</td></tr>
</table>

North America	
CMHC, 2014	• The basic architectural form of multi-unit residential buildings is defined by floor plate (or plan) geometry and building height. The building envelope (windows, walls, roof and foundation) encloses the form and separates the interior environment from the exterior. Balconies and other features may also contribute to the architectural form of a building. (p. 1)
CMHC, 2016b	• Buildings of 5 and 6 storeys in height are often referred to as mid-rise construction. (p. 3)
Collins-Williams & Burda, 2015	• Mid-rise buildings – which are 5–11 storeys high – are often more suitable for neighbourhood avenues and main streets as well as along rapid transit corridors. (p. 2)
Consumers Council of Canada, 2015	• Between 2011 and 2014, the City of Toronto received 126 site-specific mid-rise (4–11 storeys excluding townhouses). (p. 28)
Greater Vancouver Board of Trade, 2017	• Missing middle housing is a type of housing first defined by Parolek (2010, 2016). It includes a range of multi-unit or clustered housing types, including: - duplex, triplex and fourplex - courtyard apartments and bungalow courts - townhouses - multiplexes - live/work spaces. • These types of housing are often constructed in a walkable context near amenities, have small building footprints, are high enough density to support transit, consist of smaller, well designed units, and fewer off-street parking requirements. They are often built to transition from single-family home zones to higher-density housing and provide affordable options for increased density. (p. 6)
GHK International et al., 2009	• Medium-density development varied from a low of 22 u/ha to 75 u/ha with maximum heights at 4 storeys. Typical built forms supported were on-street, stacked and block townhouses and apartment buildings. (p. 19)
United Kingdom	
Levitt, 2012	• It concentrates on low to medium-density suburban developments, typically 30–60 u/ha. (p. 1.1)
London First & Savills, 2015	• Medium-rise buildings of 5–10 storeys. (p. 13)
Morgan et al., 2013	• Existing medium-density neighbourhood (terraced and semi-detached properties). (p. 9)
Radeloff, Hammer, & Stewart, 2005	• MDH (4–32 housing units/km^2). (p. 793)
Timlett & Williams, 2009	• MDH 25–60 dwellings per hectare, e.g. terraces, medium and low-rise flats and houses of multiple occupation. (p. 500)

Appendix B: Definitions of MDH in international policy

Table 4. MDH definitions – international policy

Australia	
Draft Medium Density Design Guide (Department of Planning & Environment, 2016a)	• Low-rise medium-density residential development is development that contains more than one dwelling and has a height of less than 10 m. Typically, it results in a net density of 25-45 dwellings per hectare. This includes: - terrace-style housing on Torrens or strata-titled lots - dual occupancies and semi-detached dwellings - villa and townhouse developments - community titled, master-planned and medium-density developments - manor houses and 'one on top of other' dual occupancies - buildings of 2–4 dwellings. (p. 4)
Explanation of Intended Effects: Proposed Medium Density Housing Code (Department of Planning & Environment, 2016b)	• Within this document, MDH has been defined in conjunction with the missing middle. A further definition linked to the NSW concept of MDH is the identified need for diverse housing types and typologies. • Section 1.3 proposes that there a large number of terms along the MDH spectrum. • MDH is described as low-medium density, and multi-dwelling housing is described as three or more dwellings (whether attached or detached) on one lot of land, each with direct access at ground level, but does not include a residential flat building.
Medium Density Housing Guide and Medium Density Housing Design Code: Frequently Asked Questions (Department of Planning & Environment, 2016c)	• No definitions found for MDH specifically. It can be noted that, as a supplement to both the design guide and code, the definitions provided within these documents extend to this publication as well.
A Plan for Growing Sydney (Department of Planning & Environment, 2014)	• Improve housing choice to suit different needs and lifestyles - Require local housing strategies to plan for a range of housing types. - Enable the subdivision of existing homes and lots in areas suited to MDH. (p. 8) • ACTION 2.3.2: Enable the subdivision of existing homes and lots in areas suited to MDH. (p. 77) • Building heights are described in three general categories: low rise – 3 storeys or less, medium rise – 4–5 storeys and high rise – 6 storeys or more. (p. 136)
Sydney Local Environmental Plan 2012 (Department of Planning & Environment, 2012)	• MDH is not specifically mentioned or defined.
State Environmental Planning Policy (New South Wales Government, 2008)	• MDH is not specifically mentioned or defined.

State Planning Policy 2017 (Queensland Government, 2017b)	• MDH is not specifically mentioned or defined.
South East Queensland Regional Plan 2017 (Queensland Government, 2017a)	• MDH is not specifically mentioned or defined. • Row/terrace housing and medium-rise apartments are mentioned. (p. 44) • The missing middle is also discussed: • Missing middle is defined as a form of housing offering greater density and diversity compatible with surrounding lower-density residential environments. This may include 'Fonzie' flats (a small self-contained apartment on the same land as a house), plexes (duplexes, triplexes, quadplexes, etc), row/terrace housing and medium-rise apartments. (p. 182)
Brisbane City Plan 2014 (Brisbane City Plan Council, 2014)	• Medium-density residential zone code. • The purpose of the medium density residential zone is to provide for (a) medium density multiple dwellings and (b) community uses and small-scale services, facilities and infrastructure, to support local residents. • Development provides for a mix of well designed, location-responsive medium-rise and medium-density residential development of up to 5 storeys and located on suitable sites in well located parts of the city, including the inner city and in close proximity to significant centres or along growth corridors or on the periphery of centres. • This plan is online and there are no page numbers available for referencing.
Homes for Victorians (Department of Environment, Land, Water and Planning, 2017a)	• MDH is not specifically mentioned or defined.
Plan Melbourne 2017–2030 (Department of Environment, Land, Water and Planning 2017b)	• MDH is not specifically mentioned or defined.
Plan Melbourne 2017–2050: Five-Year Implementation Plan (Department of Environment, Land, Water and Planning 2017c)	• Has a goal for MDH but it hasn't defined the term.
Guidelines for Higher Density Residential Development (Department of Sustainability and Environment, 2004)	• Instead of MDH being included within this document, multi-dwelling residential developments have been identified to meet the same need. However, the term 'higher density' is common through the document. It is interesting that a different definition is held. A reason why 'medium density' is not used is not included.
Planning Strategy (City of Perth, 2017)	• Draft of plan will be finished in 2018. • On the website, the terms 'medium', 'density', 'mid' and 'multi' weren't used.
Affordable Housing Strategy 2010–2020	• Developing effective design guidelines and standards for apartments and MDH is one of the key actions 2015–2016 and

Action Plan (Department of Communities Housing, 2017b)	2016-2017 in the plan for increasing supply and diversity, but it is just a summary and without definition.
Affordable Housing Strategy 2010–2020 (Department of Communities Housing, 2017a)	• Mentioned but not defined.
Draft Local Housing Strategy (City of South Perth, 2011)	• Mentioned but not defined.
Canada	
Official Community Plan (City of North Vancouver, 2014)	• MDH is not specifically defined but multi-family dwelling is used as a housing type. This inclusion is the same as Seattle's identification of multi-family dwellings as a definition or key housing type in what would be MDH. • However, medium-density developments might not necessarily include any families but multiple single people living alone in a multi-unit dwelling. This definition is exclusive of all individuals. • While not being defined, medium density is included in maps outlining current and future growth initiatives and current residential densities. • MDH types are defined within the document though medium density specifically is not. Residential levels 4a–5 are included within these, where they are categorised by form and density ranging from 1.0 floor space ratio (FSR) to 1.6 FSR.
Increasing housing density in single detached neighbourhoods (Coriolis Consulting Corporation, 2007)	• MDH is not specifically mentioned or defined.
Housing Action Plan (City of North Vancouver, 2016)	• No definition for medium density given. Multi-unit development was mentioned, and this aligns closely with the BRANZ definition of MDH.
The Official Plan (City of Toronto, 2015)	• MDH or development is not mentioned within this document. • Housing types such as townhouses, which generally would be included within MDH, are mentioned within the 'Apartment neighbourhoods' section of the plan.
Townhouse and Low-rise Apartment Guidelines (City of Toronto, 2017)	• Although these are not defined as MDH, the housing types included range from townhouses, through to stacked and back-to-back townhouses and low-rise apartment buildings of 4 storeys or less in height. • These are well within the BRANZ definition of MDH.
United States	
Housing Prototypes (City of Portland Bureau of Planning, 2008a)	• Rather than providing a definition of MDH as a term, examples are given of MDH typologies. These include housing clusters (of which some are stand-alone), courtyard housing of varying configurations and typologies, blocks of flats and rowhouses.
Infill Design Toolkit: Medium-Density Residential Development	• MDH is aligned with the concept of infill housing/development. However, within this document, there is no clear definition of the term MDH.

(City of Portland Bureau of Planning, 2008b)	• Examples of medium-density residential development are given, with the toolkit focused on medium-density residential development such as rowhouses, plexes, courtyard housing, and low-rise multi-family development. (p. vi–vii) • Medium-density zoning and development occurs in areas of diverse architectural character that require differing design approaches if new development is to be compatible or contribute to their desired character. There are four basic types of neighbourhoods that facilitate or include MDH: mixed-use centres and main streets, residential corridors, residential side streets – inner neighbourhoods and residential side streets – outer neighbourhoods. (p. viii) • What can be built in each of the medium-density residential zones (R1, R2, R3) is also visually defined along with information about permitted building heights, building coverage, maximum and minimum units per site and percentage of landscaping that must be included.
Comprehensive Plan 2035 (City of Portland Bureau of Planning, 2016)	• Multi-dwelling designation allows medium-density multi-dwelling development. The scale of development is intended to reflect the allowed densities while being compatible with nearby single-dwelling residential. (p. 5) • The maximum density is generally 43 units per acre, but may be as much as 65 units per acre in some situations. (p. 6)
Adopted Comprehensive Plan 2017 (Seattle Office of Planning and Community Development, 2017)	• Hub urban villages are an example of MDH though these are not specified as such. • The zoning permits: - 15 dwelling units per gross acre - 25 jobs per gross acre - 2,500 total jobs - 3,500 dwelling units. • The specification of these areas by density per acre is similar to that of Australia where MDH zones are identified by permitted dwellings per hectare. However it is different to New Zealand where MDH is defined by BRANZ by height and storeys of buildings. • Medium to high-density residential and employment uses are concentrated within a 10-minute walk of the transit centre, reducing the number and length of vehicle trips and making travel by foot and bicycle more attractive. (p. 355) • ‘Moderate density’ is used in this report multiple times.
Housing Seattle (Seattle Planning Commission, 2011)	• Multi-family dwellings and developments are included in this document in lieu of any mention of MDH. This particular concept is found within the Victoria documents as well. • Typical MDH typologies such as duplexes triplexes, etc. are included as low-rise housing types that create more diversity. There is no mention of a new type of zone of housing, but instead the document tries to fit these new typologies within low-density zones Recommendation #6(i) involves a change in the zoning of an area to allow higher density or less-restrictive development. • Multi-family housing: Structures containing two or more housing units. Examples include duplexes, apartments and condominiums in multi-unit buildings. (p. 7)

Seattle Transit Communities: Integrating Neighbourhoods with Transit (Seattle Planning Commission, 2010)	• The report is about transit and transportation but the terms 'MDH' and 'moderate density' are used in the report. However, they are not defined.
United Kingdom	
The London Plan (Greater London Authority, 2016)	• Higher density is discussed, but MDH is not specifically mentioned or defined.
Draft London Plan (Greater London Authority, 2017b)	• Mentions medium rise but doesn't define MDH. Higher density is also mentioned as one of the main goals but not defined.
Draft London Housing Strategy (Greater London Authority, 2017a)	• Mentions medium rise but doesn't define MDH. Higher density is also mentioned as one of the main goals but not defined.
London Housing Design Guide (Greater London Authority, 2010)	• MDH is not specifically mentioned or defined.
Draft Greater Manchester Spatial Framework (Greater Manchester Combined Authority, 2017)	• Mentions higher density but doesn't define MDH.
Manchester Core Strategy Development Plan (Manchester City Council, 2012)	• Medium density – 40–50 dwellings per hectare). (p. 103) • In general, MDH, at densities of between 40–50 dwellings per hectare, will be appropriate in the strategic housing location. (p. 105)
Housing Strategy 2016–2021 (Leeds City Council, 2016)	• MDH is not specifically mentioned or defined.

Appendix C: Definitions of MDH in international strategy

Table 5. MDH definitions – international strategy

*As guides are increasingly digital, not all of them have page numbers.

Australia	
Medium Density Design Guide (NSW Department of Planning and Environment, 2016a)	**MDH** • The new draft medium density design guide and draft MDH code have been developed to ensure a consistent approach to the design and delivery of quality low-rise MDH in neighbourhoods across NSW. Low-rise MDH types to be assessed as complying development – a fast-track assessment process for development consistent with existing council zoning. Increasing the supply and quality of MDH across NSW will provide many benefits and offer more choice for the changing population. (p. 1) • The future character of an area is to be determined by the local council and community. The design guide encourages a design-led strategic planning process to determine the type, scale and built form of MDH permitted in an area. (p. 6) • The following medium-density development can be assessed as complying development under the MDH code within the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 (Codes SEPP): two dwellings side by side, terraced housing, manor housing. (p. 7) • In most instances, low-rise medium-density housing is proposed in areas that are undergoing a transition from lower-density, single dwelling homes to a higher density. (p. 26) • The size, shape and form of the existing subdivision patterns may restrict certain forms of development or result in negative impacts. Often existing low-density areas have large blocks and street networks that do not encourage walkability and do not easily facilitate MDH. (p. 27) • Car parking and garaging is particularly challenging in MDH as it often requires a large proportion of the building footprint. (p. 50) • The public domain can be designed to attractively accommodate parking by including use of trees and landscaping. Angle parking can increase on-street car parking provision. This should be considered in areas undergoing a transition from low to medium-density housing. (p. 51) • Small swimming pools, spas or plunge pools are sometimes provided within MDH developments. (p. 70) • Multi-dwelling housing is a form of medium-density development that is strata titled. This form of development is differentiated from other MDH in that there is common area that consists of communal open space, private streets and internal circulation networks. These are commonly referred to as townhouses or villas. They are strata titled either because the individual dwellings do not meet the minimum lot size requirements, they have basement car parking or there is a configuration of the lot that does not enable simple Torrens titling. The dwellings can be attached or detached. This form of development cannot be carried out as complying development. (p. 118)

	• MDH is often carried out on large lots in the form of a master-planned community. The individual buildings or groups of buildings containing dwellings are often on separate lots as strata plans or Torrens title. (p. 119) • The building envelope standards for complying development can be found in the MDH code within State Environmental Planning Policy (Exempt and Complying Codes) 2008 (Codes SEPP). Summary as follows: - Minimum site area = 600 m^2 and 15 m wide. - Height of building = 8.5 m. - Primary road setback = 4.5–10 m. - Side setbacks = front half of the lot up to 15 m from front boundary, 1.5 m rear half of the lot or distance >15m from front boundary. - Building envelope defined by 45° plane projected from a height 3.6 m above the boundary. (p. 138) • The following medium-density development can be undertaken as complying development under the MDH code within State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 (Codes SEPP): - Dual occupancies – where both dwellings have a frontage to the street. - Multi-dwelling terraces. - Manor houses. - Complying development under this code is not permitted on certain land in a heritage conservation area, environmentally sensitive land, a heritage item and on certain other land listed in Part 1 of the Codes SEPP. (p. 159) • MDH occurs in a variety of arrangements, configurations and types. Dwellings can occupy different sized lots from small infill sites, redevelopment of existing areas and greenfield housing developments. They can consist of a mix of building types or uses and be situated in suburban, transitional or inner-city locations. • An urban form of MDH used in contexts in close proximity to town centres and areas with high=quality public domain due to the limited amount of landscaped area on the site. Lot sizes can be small due to the compact nature – considered on the merits of the location and proportion of the site. • Side and rear setbacks should allow for privacy with limited use of privacy screens and consider solar access for the reduced site area. (p. 174) • A manor house form of MDH is different to other types of MDH in that one dwelling is above the other. They often have a common entry. However, the entry to the ground floor and upper level apartments may also be separate. This form of dwelling is useful to accommodate affordable housing within a low and medium-density context. The level floor plates also provide good accessibility for seniors or people with a disability. To reduce impact on the streetscape and surrounds, the scale of a manor house is designed to be similar to an oversized double-storey single dwelling. (p. 195)
	HIGHER DENSITY • In most instances, low-rise MDH is proposed in areas that are undergoing a transition from lower-density, single dwelling homes to a higher density. Where planning controls anticipate a change of character for an area, compatibility with the desired future character of the area should be regarded as more relevant than compatibility with the existing character. (p. 26)

	MISSING MIDDLE • Currently, most new housing in NSW falls into two categories – traditional free-standing homes or strata-titled apartments. What is missing are the low-rise, medium-sized homes, like terraces, dual occupancies, manor homes or townhouses. This gap in the housing market has become known as the 'missing middle'. (p. 1)
	NOTES/SUMMARY • This guide, once fully enacted, will be legally enforceable for all developments within NSW that are submitted as complying development. • Interesting to note that this document and support documents such as the FAQs and explanation of intended effects documents, explicitly define MDH as low-rise MDH. • This draft document outlines the issues facing Australia with the missing middle and lack of MDH in the market and creates a plan for New South Wales to address it. Low-rise MDH is identified as a successful approach to this issue and will be increased in supply and quality through the state through its addition to the compliant developments under the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008. As a specialised document, it is able to go into detail about specific housing types and their built forms such as heights, parking, etc. It is legally enforceable.
Medium Density Housing Guide and Medium Density Housing Design Code: Frequently Asked Questions (NSW Department of Planning and Environment, 2016b)	**MDH** • The Department of Planning and Environment has prepared a medium-density design guide to encourage more low-rise MDH to be built in NSW, providing greater housing choice, more housing affordability and better quality design. • The design guide provides benchmarks for designing and assessing low-rise MDH types including: - terrace style housing on small lots (attached dwellings) - dual occupancies and semi-detached dwellings - multi-dwelling housing (strata-titled terrace housing) - community titled master-planned medium-density developments of up to 2 storeys - manor homes (2-storey buildings comprising 3-4 dwellings). • It is proposed that the design guide will be used for both complying developments and development applications to promote good design outcomes for MDH types across NSW. • Better quality design is also important to ensure that new low-rise MDH is well designed, environmentally sustainable and contributes positively to the existing character of an area. • The discussion and background paper 'Options for low rise medium density housing as complying development' was publicly exhibited from 27 November 2015 to 1 March 2016. The discussion paper proposed the expansion of the State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 to include low-rise MDH as complying development. The aim is to make approvals for these housing types faster and more straightforward, providing greater housing supply and choice including more affordable housing. • The discussion paper recommended the development of a design guide for MDH, similar to the apartment design guide established under the State Environmental Planning Policy No 65 – Design Quality of Residential Apartment Development (SEPP 65) to ensure good design outcomes are achieved.

	• The draft design guide has been developed with the input of architects, councils and industry stakeholders, who were supportive of the development of a guide to promote good design outcomes for MDH across the state. • The design guide will be used to promote good design outcomes for MDH for both complying developments and development applications. It will improve the design of MDH with standards that will address design issues such as layout, landscaping and private open space, sunlight, natural ventilation and privacy. A 2-storey height limit will ensure the size and scale of development is low rise and will easily fit into established streetscapes and areas. • MDH will only be able to be carried out as complying development in areas that already allow medium-density development under a council's local environmental plan. • The design guide will be legally enforceable for complying development, and any certifier that assesses a development will also need to ensure the development standards and design principles are met. Whilst the design guide will not be legally enforceable for MDH developments assessed as a development application, it is intended that it will be used by the council as a reference document to guide good design outcomes. • Complying development is a fast-tracked planning and building approval for straightforward development where an application can be determined by an accredited council or private certifier without the need for a development application as long as it meets specific building standards. The State Environmental Planning Policy (Exempt and Complying Development) 2008 (Codes SEPP) commenced in 2009. • The Codes SEPP applies across NSW and allows for certain types of development to be carried out as exempt (without approval) or complying development (projects that can be fast tracked through the approval process). • The new MDH code will be inserted into the Codes SEPP. This new code will contain the development standards that a proposal for MDH must meet in order to be assessed as complying development. • The design guide will supplement the complying development standards.
	NOTES/SUMMARY • The document was created to answer any questions regarding the new guides and codes that will have been drafted. It gives information about what this might mean for the public. • Simple terminology is used. • It outlines the role of the design guide and MDH code in lay terms and in a document that is short in length and easy to read.
Explanation of Intended Effects: Proposed Medium Density Housing Code (Department of Planning & Environment, 2016b)	**MDH** • As a result of the discussion paper, it was decided that a design guide for low-rise MDH should be created, similar to that of the NSW apartment design guide. It has been recommended that this be used as an educational tool for practitioners and designers alike. • Low-rise MDH provides a low cost and sustainable way to achieve higher densities with minimal impact on the existing form. Current housing market trends indicate a preference for people to live closer to the centre and with the amenity that MDH can provide. • Low-rise MDH is characterised by the entry and private open space being at ground level.

	• Complying development under the MDH spectrum is aimed at the simple small-scale low-rise development without the additional design challenges found in residential flat buildings such as common areas, privacy and scale impacts. • The demand for low-rise MDH is rising as people choose to live in areas close to existing centres, but not everyone wants to live in an apartment. • This form of development provides a range of positive outcomes including: - increasing opportunities for affordable housing as a result of simple affordable construction techniques and utilising existing infrastructure - increased density improves viability for more frequent and accessible transport - increased viability for local shops and business as walkability of areas improves and the population of a retail catchment increases - space for a garden to grow veggies or children to play - providing interest and variety in urban areas through a range of dwelling types. • The MDH design guide has been developed for both development applications and complying developments, allowing a range of low-rise MDH types. The design guide encourages good design outcomes for this development across NSW. • The design guide will support the proposed changes to the Codes SEPP to allow a range of low-rise MDH types, including dual occupancies, manor homes and terraces, to be carried out as complying developments. • The design guide is intended to encourage best-practice design of low-rise MDH and will be used as a tool for designers and councils to encourage high-quality, liveable and attractive homes. It is proposed that the design guide will be used for both complying developments and development applications, to ensure a high level of amenity is achieved for low-rise MDH. • MDH can be carried out as a development application where consent is provided by council or a joint regional planning panel. It is not proposed that the design guide should override council controls. For it to have legal enforcement, it would need to be development under a council's development control plan. It is up to a council whether they wish to adopt the design guide. • Where a council might adopt the design guide, it is to be adopted in its entirety, and the requirement for submission including the design verification statement will apply. This will ensure consistency in planning approach across the state. • The design guide has been built to enable diversity within built form and provide these options within best practice forms that are connected to existing communities and infrastructure. • When preparing the design for an MDH development as a complying development, as designer should use part 2 of the design guide as a reference for good design. Part 3 contains criteria that must be met and will be considered as part of the design verification statement required for a complying development. • Over the past few decades, most multi-dwelling and MDH has been delivered as strata-titled development. This form of development is useful to resolve the management of common spaces within a development site. However, it can reduce the independence and flexibility of ownership.
	NOTES / SUMMARY • This introduction of the code will enable an efficient mode of delivery for low-rise MDH.

	• It is interesting to note that NSW defines MDH as low-rise, which has been defined as residential development that contains more than one dwelling and has a height of less than 10 m. Typically, it results in a net density of 25–45 dwellings per hectare. This specification of heights differs to New Zealand, where the BRANZ definition of MDH includes development up to 6 storeys. The definitions of MDH in New Zealand also carries no identification of density per ha or dwellings per ha. • The Codes SEPP provisions already allow for developments of typologies similar to or the same as those outlined as lying within the context of MDH or the missing middle. While it is true that MDH has been possible through the implementation of its own code within the Codes SEPP, barriers and regulations to developments will be removed and complying developments facilitated. • Section 1.5 states that clause 1.18 of the Codes SEPP would apply to all proposed medium-density development types, where the complying development must be permissible on the subject land to be carried out as a complying development. This is similar to the Auckland Unitary Plan whereby zoning premises what type of development and land use is able to occur within that specific area of the city i.e. MDH must be permitted development in the zone that applies to the land. • A manor house is currently exempt as it is a new term being introduced and not currently defined. Therefore it will be permitted under any zones permitting MDH and residential flat development. • The document outlines the NSW Government's aim to introduce the new MDH code into the Codes SEPP. This would allow certain types of MDH (in this case, the low-rise forms) to be included as complying development and flow through the planning process without a development application, removing additional barriers to development and intensification. The document identifies low-rise MDH as having a height of less than 10 m and a density of 25–45 dwellings/ha, with an entrance and private open space at the ground level.
A Plan for Growing Sydney (Department of Planning & Environment, 2014)	**MDH** • Goal 2: A city of housing choice, with homes that meet our needs and lifestyles. ACTION 2.3.2: Enable the subdivision of existing homes and lots in areas suited to medium density housing. Subdividing existing homes and lots in areas that are suitable for MDH can help to meet consumer demand and reduce the cost of housing. By removing the barriers to subdivision of existing homes and blocks of a suitable size, more affordable housing options can be offered. The government will modify the Standard Instrument Local Environmental Plan to make local development controls more consistent across Sydney. (p. 8)
	INFILL DEVELOPMENT • Infill development is new development in areas already used for urban purposes. Infill development can range from granny flats and dual occupancy developments to large-scale, major mixed-use developments. • While significant programmes are in place for large-scale urban renewal projects, small-scale urban infill development can also have an impact on the demand for infrastructure services. Urban infill will be most successful where development is coordinated with social infrastructure delivery • Well planned and well designed infill development can improve the feel of a place, its vitality and sense of community. It can make the local environment more attractive and improve services. • Local housing strategies are the first step towards coordinating local and state-funded infrastructure for local infill development. The strategies can cater for different household sizes such as terraces, townhouses, freestanding houses and apartments in centres and above businesses.

	NOTES / SUMMARY • The plan's focus is on providing more housing with a greater choice of dwelling types in well serviced locations. This will help meet changing household needs, lifestyle choices, population growth and different household budgets. Also emphasises being a strategy for the growth and competitiveness of Sydney as a global city.
Sydney Local Environmental Plan 2012 (NSW Department of Planning and Environment, 2012)	• No information found under search terms **NOTES / SUMMARY** • Zones are defined and include regulations. Works at a similar scale to Auckland Unitary Plan. • Document is designed for the regulation stages of the planning processes. The SEPP Codes (2008) is the legislation that will allow for low-rise MDH to be made a complying development not requiring lengthy planning processes.
State Environmental Planning Policy (Exempt and Complying Development Codes) 2008 (New South Wales Government, 2008)	• No information found under search terms. **NOTES / SUMMARY** • The SEPP Codes (2008) is the legislation that will allow for low-rise MDH to be made a complying development not requiring lengthy planning processes.
State Planning Policy 2017 (Queensland Government, 2017b)	• No information under search terms. **NOTES / SUMMARY** • Infill housing and greenfield development approved as an appropriate type of development. • Mentions flexible planning provisions. • Mentions higher-density development although this is not specific to housing but development and liveable communities as a whole in accessible and well serviced locations. • By mentioning that there is a need for diversity within the housing supply of Queensland and the need to maximise the effective use of existing infrastructure and services, the State Planning Policy (SPP) is implicitly arguing the need for MDH within the state. • To support the delivery of affordable housing and housing choice, local planning instruments will need to incorporate flexible planning arrangements and avoid or minimise regulatory barriers or inefficiencies. • High-quality urban design has been included in the SPP as a key contributor to creating liveable communities. Relates to a lesser extent to the NSW medium-density design guide.

	• The open space provided by MDH aligns with the principles of the SPP's liveable communities. • The SPP outlines 17 state interests that must be considered in every planning scheme across Queensland. Through the SPP, the Queensland Government outlines the need for diverse housing and an increased housing supply but only mentions infill housing and greenfield as a development types that could achieve this. Urban design has been considered as a factor within the delivery of this housing supply.
South East Queensland Regional Plan 2017 (Queensland Government, 2017a)	**MISSING MIDDLE** • Shaping South East Queensland aims to promote supporting better and more diverse housing with a particular emphasis on promoting missing middle forms of housing. • As part of a wider goal of providing housing supply and diversity, plan for and deliver a greater range of missing middle housing forms in suitable locations. • Missing middle is a form of housing that offers greater density and diversity in a manner compatible with surrounding lower-density residential environments. Most missing middle housing is oriented toward the street or laneway. • It covers housing types between detached houses and high-rise, and may include 'Fonzie' flats (a small, self-contained apartment on the same land as a house), plexes (duplexes, triplexes, quadplexes etc), row/terrace housing and medium-rise apartments • Within each subregion, the goal is outlined that, by 2041, these places will be more compact, mixed-use, connected and active, and will provide improved urban amenity. Housing diversity, including a range of missing middle housing forms, will also increase in and around these places. • Plans for delivery include working with community and industry groups to provide innovation in missing middle housing product. • Plans for delivery include: - holding an industry design competition to showcase best examples of the missing middle housing form - delivering catalyst projects in suitable locations to showcase quality built environments, providing new housing diversity and missing middle products. • Minimum densities around major regional centres within 400–800 m are between 40-200 dw/ha, which sit between the MDH dw/ha specifications.
	NOTES/SUMMARY • Housing focused where people can take advantage of existing infrastructure, i.e. the intensification of existing areas – 60% of new housing development in existing areas concentrating on providing a diverse housing supply. • Missing middle is defined to include medium rise as opposed to NSW state plans that define missing middle or medium density as being specifically low rise – this connects more to the New Zealand/BRANZ definition of MDH as up to 6 storeys. • Interesting to note that medium-rise apartments are defined by dwellings per ha as opposed to storeys as in New Zealand. In this case, it is characterised by 60–100+ dw/ha and says 100+ dw/ha would be an example of medium-rise apartments but does not define when this would then become a high-rise apartment.

	• Queensland Government has an aim to provide missing middle outcomes in all subregions within the next 25 years (by 2041), as opposed to New Zealand, where there are few government-mandated targets about specific medium density. Auckland Plan specifies a60/40 split. • As a result of the design and diversity competition, Shaping South East Queensland has been able to provide some best practice examples.
Brisbane City Plan 2014 (Brisbane City Council, 2014)	**MDH** **Low medium-density residential zone** • The purpose of the low medium-density residential zone is to provide for: - a variety of dwelling types, including dwelling houses and low to medium-density multiple dwellings - community uses and small-scale services, facilities and infrastructure to support local residents. • Land in the low medium-density residential zone is contained in either the up to 3 storeys zone precinct, the 2–3-storey mix zone precinct or the 2-storey mix zone precinct. • Development location and uses overall outcomes are that development comprises a mix of low and low medium-rise, low medium-density residential development. • Development reflects and supports the level of comfort, quiet, privacy and safety (including impacts of glare, odour, light, noise, traffic, parking, servicing and hours of operation) reasonably expected within a low medium-density but predominantly permanent residential environment. • Development form overall outcomes are that development for a residential building occurs on appropriately sized and configured lots and is of a height, bulk, scale and form that is tailored to its specific location and to the characteristics of the site within the low medium-density residential zone and the relevant zone precinct and reinforces a distinctive subtropical character of low to low medium-rise buildings with a landscaped streetscape and recreation areas. • 2-storey mix zone precinct overall outcomes are development of low-rise, low medium-density residential buildings that: - are predominantly 1–2 storeys in height - are located on suitable sites, clustered around identified smaller centres, other destinations or facilities in suburban locations or along identified public transport corridors - provide a choice in housing form and size and housing adaptability that meet the needs of a diverse population - are in areas that are often surrounded by low-density detached housing in the low-density residential zone. • 2–3 storey mix zone precinct overall outcomes are development of low medium-rise, low medium-density residential buildings that: - are of predominantly 2 storeys or of up to 3 storeys in height where located within easy walking distance of a public transport node - are located on suitable sites, in accessible locations, near to public transport and larger centres or key destinations. • Up to 3 storeys zone precinct overall outcomes are development of low medium-rise, medium-density residential buildings that: - are predominantly (but no more than) 3 storeys in height

	- are located on suitable sites, in well located parts of the city, in close proximity to or on the periphery of significant centres or along growth corridors. • Development responds to local characteristics, such as protection of view corridors, reinforces a green landscape character and responds to the surrounding character and architecture by having a smaller building envelope than in the medium-density residential zone, acknowledging this zone precinct's role for providing a sensitive transition to low-density residential areas and its location within growth nodes on selected transport corridors. **Medium-density residential zone** • The purpose of the medium-density residential zone is to provide for: - medium-density multiple dwellings - community uses and small-scale services, facilities and infrastructure to support local residents. • Development location and uses overall outcomes are that the development provides for a mix of well designed, location-responsive medium-rise and medium-density residential development of up to 5 storeys and located on suitable sites, in well located parts of the city, including the inner city and in close proximity to significant centres or along growth corridors or on the periphery of centres. • Development reflects and supports the level of comfort, quiet, privacy and safety (including impacts of glare, odour, light, noise, traffic, parking, servicing and hours of operation) reasonably expected within a medium-density but predominantly permanent residential environment. • Development form overall outcomes are that development for a residential building occurs on appropriately sized and configured lots and is of a height, bulk, scale and form that is tailored to its specific location and to the characteristics of the site within the medium-density residential zone and reinforces a distinctive subtropical character of medium-rise buildings with a landscaped streetscape and recreation areas.
	NOTES / SUMMARY • This document works similarly to the Auckland Unitary Plan, providing zones and rules and regulations that guide these zones. • The medium-density residential zone code aims to provide a well designed, location-responsive medium-rise and medium-density residential development that allows for urban consolidation. • Development will support walkable neighbourhoods with the potential for residents to live within walking distance of regular public transport, nearby centres, etc. • Developmental outcomes are identified within this zone aim to provide medium-density developments, 3–5 storeys in height, that reinforce a distinctive subtropical character of medium-rise buildings with a landscaped streetscape and recreation areas.
Homes for Victorians (Department of Environment, Land, Water and Planning, 2017a)	• No information found under search terms.
	NOTES / SUMMARY • Outcome 2. Ensure housing accommodates population growth by facilitating more than 50,000 extra new homes being built each year. Increase development opportunities in the inner and middle suburbs. As our population grows, we need to make sure our housing supply continues to grow too. Even more, these new homes need to be connected to jobs, education and public transport. We will provide more choices about how and where we build our homes. The updated Plan Melbourne 2017–

	2050 will provide a clear framework that encourages affordability and access and ensures Melbourne grows in the right places. This includes focusing growth in the central city, activity centres, urban renewal areas and the outer urban growth areas. Reform of residential zones will protect neighbourhood character while facilitating appropriate development in targeted areas. Activity centres and commercial zones that are close to transport, schools and hospitals will attract more residential and employment development. • All of these aspects included within the document outline features of future development that are characteristics of benefits given by MDH development. MDH is not mentioned specifically within the document • This document provides an outline as to the Victorian Government's proposed action under six outcomes for housing within Victoria – supporting people to buy their own home, increasing the supply of housing through faster planning, promoting stability and affordability for renters, increasing and renewing social housing stock, improving housing services for Victorians in need and looking to the future. • The document identifies the need for an increased housing supply and that the large majority of this development should be centred within the inner and middle suburbs in order to connect closely with jobs, education and public transport. Within this housing supply, Victoria also identifies that the housing stock should be diverse to meet the needs of growing and diverse population while still maintaining neighbourhood characters. Though medium density is not specifically mentioned, the need for diverse housing supply identifies the gap or missing middle that MDH fills.
Plan Melbourne 2017–2030 (Victoria Department of Environment, Land, Water and Planning, 2017b)	• No information found under search terms. **NOTES / SUMMARY** • There will be more affordability and choice, as more of the housing we need is delivered in the right places. Outcome 2 identifies the need for housing choices for people in their local areas so they can downsize or upsize without having to leave behind neighbourhoods and community. • Policies such as the aim to maintain a permanent urban growth boundary around Melbourne to create a more consolidated, sustainable city and facilitate an increased percentage of new housing in established areas to create a city of 20-minute neighbourhoods close to existing services, jobs and public transport aim to achieve this. Facilitate well-designed, high-density residential developments that support a vibrant public realm in Melbourne's central city. • It is interesting to note that, across local plans, medium density is rarely mentioned, yet high density is. This reinforces the missing middle concept whereby low density, i.e. single detached family homes, and high-density apartments are planned for but there is a lack of planning or diversity for typologies that lie between. • Provide greater choice and diversity of housing: - Facilitate housing that offers choice and meets changing household needs. - Provide a range of housing types in growth areas. • Within this document, the need for diversity and choice in housing is linked to residents' sense of place and the importance of neighbourhoods. The facilitation of 20-minute neighbourhoods identifies characteristics of MDH and what it hopes to achieve. These also work to create a more compact city, reducing sprawl and maintaining sustainable outcomes through reduced transport costs and other factors.

Plan Melbourne 2017–2050: Five-Year Implementation Plan (Victoria Department of Environment, Land, Water and Planning, 2017c)	• No information found under search terms. **NOTES/SUMMARY** • Outcome 2: Melbourne provides housing choice in locations close to jobs and services. There are a variety of initiatives being put in place: - Action 19 Metropolitan regional housing plans to guide housing growth. - Action 20 Precinct structure planning guidelines. - Action 21 A clear sequence for growth area development. - Action 24 Planning system reforms for social and affordable housing. - Action 28 Review residential development provisions. • The implementation plan outlines delivery timeframe objectives identified as part of the Melbourne Plan. • A key aspect of these initiatives relating back to intensification and diversity of housing typologies within Victoria and Melbourne specifically can be identified under Actions 19 and 20. The creation of 20-minute neighbourhoods is especially in context with the definitions and outcomes of MDH. • Action 1 Land-use framework plans for each of the metropolitan regions identifies that these plans will identify urban renewal precincts and sites where medium and higher-density housing and mixed-use development will be encouraged. • Action 23 Unlocking the potential of greyfield areas will also enable councils to identify greyfield areas suitable for redevelopment for MDH and lot consolidation.
Guidelines for Higher Density Residential Development (Department of Sustainability and Environment, 2004)	• No information found under search terms. **NOTES/SUMMARY** • The purpose of these guidelines is to set out design guidelines that include context, public realm, landmarks, views and vistas; pedestrian spaces; heritage; consolidation of sites and empty sites; light and shade; energy and resource efficiency; architectural quality and landscape architecture. • The document works similarly to the NSW medium-density design guide and aims to provide best-practice examples for a variety of housing types, including those most commonly associated with MDH.
Canada	
Official Community Plan (City of North Vancouver, 2014)	**MEDIUM-DENSITY DEVELOPMENT** • Area-specific development permit areas (DPAs) allow the city to establish specific guidelines for entire areas on issues such as form and character. The city already has DPAs for the shipyards, streamside protection and coach houses. New DPAs are introduced with this plan to guide new development in Central Lonsdale, the East 3rd Street area and areas of the city that require additional consideration due to steep slopes or vulnerability to flooding. Development permit requirements also now apply to duplexes, medium and high-density land use development (residential levels 5 and 6) and to streamline current processes for rooftop wireless antennae design and consultation.

	• Goal 1.3: Enhance the distinctive sense of place and liveability of the city through high-quality design and maintenance of urban form: 1.3.2 Avoid 'zoning cliffs' at the edges of high and medium-density residential areas by designating lower-density multiple residential development between higher density and single family areas. • 3. Land use designations: - Residential level 4-A: To provide a range of housing types and sizes close to transit and services including smaller, more affordable housing. Includes townhouses, rowhouses, stacked townhouses, garden apartments, fourplexes. Maximum density: 1.0 FSR. - Residential level 4-B: To provide a range of housing types and sizes close to transit and services including smaller, more affordable housing types. Similar in scale and character to residential level 4A but allowing for moderately higher-density development options. Townhouses, rowhouses, stacked townhouses, garden apartments, fourplexes. Maximum density: 1.25 FSR. - Residential level 5: To provide quality multi-family housing with a mix of unit sizes and a focus on creating attractive and active streets. Mid-rise, primarily wood-frame apartment buildings. Maximum density: 1.6 FSR. • Goal 2.2: Integrate land use and transportation planning to reduce the need for car travel. Support redevelopment opportunities for townhouse and medium-density, street-oriented, mixed-use infill that is sensitive to the character of existing residential areas. • While the Lonsdale Regional City Centre will be home to the most intensive growth and employment in the city, the Marine Drive and East 3rd Street FTDAs will serve as focal points for redevelopment from townhouse to medium-density street-oriented mixed-use development on the corridor.
	INFILL DEVELOPMENT • Strategy 1.2.6 dv: Encourage infill development. • Land use categories (section 2.1) and density bonus provisions (section 2.2) have been updated to ensure they can provide adequate floor area and incentives for infill development. • Reducing size to reduce costs – reducing minimum lot sizes and setbacks for duplexes and single family units, increasing the potential for infill development. • Strategy 4.1.7a: Increase diverse supply through infill and increased density. As a mature urban community, much of the city's redevelopment involves infill and increased density in some form. Future growth in the city will be predominantly along key transit and energy utility corridors. • Land use objective 1.1.4: Support the role of the Lonsdale Regional City Centre as the urban core of the city, in part by locating high trip-generating uses such as high-density residential and commercial uses there. • Land use objective 1.5.1: Provide opportunities for a range of housing densities, diversified in type, size and location. There is provision in the city's zoning bylaw for secondary suites/coach houses in residential level 1 areas, and secondary suites are now permitted in duplex zones. Land use categories provide adequate floor area in different residential categories to encourage infill developments. Density bonus and transfer provisions (sections 2.2 and 2.3) provide additional flexibility and incentives for infill development.

	NOTES/SUMMARY • One of the plan's guiding principles is the need for Vancouver to be compact. Specifying the need to be a compact city implies the need for higher-density housing to be accommodated. This will likely be delivered in a variety of ways – one being medium-density typologies. • The need for diverse and affordable housing solutions is also specified as one of the plan's guiding principles. • It is identified that land use decisions play a key role in the city's environmental impacts, as energy-efficient buildings and neighbourhoods with higher density (such as medium-density neighbourhoods and buildings) and a better public transport system can help to reduce emissions and associated environmental costs. • Pursuit of a compact and more complete urban form will increase physical infrastructure efficiencies, support healthy lifestyles and provide the opportunity for more social connections by locating more activity and potential for interaction through enhanced walkability and active streets sidewalks and public spaces. • The plan provides a framework to ensure development activities contribute to the community vision and provide benefit to the local community and city as a whole. • Measurement of MDH types by floor space ratio (FSR) instead of dwelling per ha/acre or density per ha/acre is unique to Vancouver so far within the research.
Increasing Housing Density in Single Detached Neighbourhoods (Coriolis Consulting Corporation, 2007)	**MEDIUM-DENSITY RESIDENTIAL** • Zoned R5, which permits single family dwellings and two-family dwellings on larger lots in medium-density residential areas. • The RM3 medium-density apartment zone would allow multi-family development at an floor area ratio (FAR) of 0.9 (or up to FAR 1.1 providing certain parking requirements are met). • The RM2 zone permits medium density – multi-family, primarily designed for small families or couples at an FAR of 0.7. • The medium-density apartment designation is intended for the RM2 (3-storey, medium-density apartments), RM3 (multi-storey, medium-density apartments) and RT2 (townhouse apartment residential, in areas adjacent to or facing properties designated as one-family residential) zones. • The intent of the City of Vancouver's RM4 zone is to permit medium-density residential development, including a variety of multiple dwelling types, to encourage the retention of existing buildings and good design.
	NOTES/SUMMARY • The document outlines 20 examples of projects that have been successful to provide and publicise best-practice examples in order to demonstrate to municipalities, developers and community groups that this type of development can be viable and attractive. • The RM3 zone was not mentioned in the official community plan, but this zone allows for a slightly lower density than the other zones at 0.9 instead of 1.0. • There are certain provisions for types of housing allowed at the edge of zone to make sure that drastic changes to the urban character of a neighbourhood are avoided. • This document is similar to Seattle's infill design toolkit, where best-practice examples from throughout the city are provided.

Housing Action Plan (City of North Vancouver, 2016)	**MULTI-DWELLING/FAMILY/UNIT HOUSING** • Objective: To increase the number of 3 or more bedroom units appropriate for larger and/or extended families within new multi-unit residential developments. • Alignment with city policy: - OCP 1.4.1: Consider the needs of households with children in the design of multi-family developments. - OCP 1.5.1: Provide opportunities for a range of housing densities, diversified in type, size and location. - CNV4ME 3.1C: Examine bylaws that ensure new developments include a mix of unit sizes that meet the diverse needs of residents. - CNV4ME 3.1E: Include youth and family-specific housing needs when updating the City Housing Action Plan. • Actions include to endorse a family-friendly housing policy that recommends the provision of a minimum of 10% of 3 or more bedroom units in all new multi-unit stratified and rental residential developments. • The family-friendly housing policy recommends all new multi-unit stratified and rental residential developments dedicate a minimum 10% of units to contain 3 or more bedrooms. • The city's adaptable design guideline, initially adopted in 1999, was an innovative policy created to facilitate liveable residences in multi-unit buildings for a wider range of persons than current housing design permits.
	NOTES/SUMMARY • The document outlines strategies and actions that aim to address issues identified within the Vancouver housing market and supply. It works in a similar way to the Melbourne 5-year implementation plan. • Diversity is mentioned as a "big move", but it is specifically aimed at diversification of rental properties rather than diverse housing supply in general. However, this still outlines the city's intent to provide opportunities for a range of housing densities, diversified in type, size and location. Objective 5 aims to increase rental options within lower-density areas. It is assumed this would work in the same way infill developments aim to work by increasing density within established centres and neighbourhoods, allowing for higher densities in both regulation and supply. • The document identifies key organisations to work with in order to achieve outcomes and solutions. • Through the key identifiable goals, there have been clear and measured actions to be implemented in the short, medium and long-term spheres. This deliverable action plan allows for clear guidance both to public and agencies as to what the local government aims to do and provide for housing within the next 3 years at least.
The Official Plan (City of Toronto, 2015)	**HIGHER-DENSITY DEVELOPMENT** • Consistent with the Metrolinx Regional Transportation Plan, this plan supports a system of mobility hubs at key intersections in the regional rapid transit network that provides travellers with enhanced mobility choices and creates focal points for higher-density development.
	MULTI-DWELLING/FAMILY/UNIT HOUSING • The current production of ownership housing, especially condominium apartments, is in abundant supply. What is needed is a healthier balance among high-rise ownership housing and other forms of housing, including purpose-built rental housing,

	affordable rental housing and affordable low-rise ownership housing for large households with children and multi-family households. Policies, incentives and assistance are needed in order to respond to the city's unmet housing needs, especially mid-range and affordable rental housing. More than half of Toronto households rent, yet no new rental housing is being built in quantity.
	NOTES/SUMMARY • Infill development is mentioned as a form of increasing density within established neighbourhoods that are not zoned for apartment neighbourhoods. This would be a form of implementing medium-density neighbourhoods as they move away from low single detached housing. • The document outlines the need for specific policies and plans to address unique housing issues. There cannot be one plan that aims to fix everything but rather specialist advice and policies for each issue. • Of the four issues identified by this plan, none mention diversity of housing stock. Making efficient and effective use of the city's own housing resources to achieve a range of housing objectives is the closest. However, this objective is focused on providing social housing and those in need of rent-geared-to-income housing. • The plan attempts to focus on providing housing increases within centres and along avenues to avoid the changing and uprooting of existing neighbourhoods: "To be successful, our future must also be diverse, inclusive and equitable. Our future is one where housing choices are available for all people in their communities at all stages of their lives." • It is expected that much of the anticipated new housing supply will be implemented through mixed-use areas rather than the densification of existing neighbourhoods. • It is interesting that Toronto's official plan does not identify the need for diverse housing stock but provides it through its other initiatives and that the planners/government feel the need to specify the lack of change that will be occurring at the neighbourhood level even though it is clear that changes will occur as the city's population increases.
Townhouse and Low-rise Apartment Guidelines (City of Toronto, 2017)	**INFILL DEVELOPMENT** • The purpose of the guidelines is to illustrate how the public realm and built-form policy objectives of the official plan can be addressed by establishing a balance between the protection of stable residential neighbourhoods and heritage features while allowing for appropriate infill development and intensification. • Infill developments with low-rise buildings on existing tower sites can help to redefine and animate the street edge, create new amenity spaces and improve overall site conditions.
	NOTES/SUMMARY • This document is essentially a medium-density guide as these housing types are examples of MDH. They offer higher density than single detached dwellings but are not as high density as apartment complexes typically found in a city centre. • It also provides best practice according to building types in a similar way to the NSW medium-density design guide. Townhouses, stacked townhouses, back-to-back townhouses, stacked and back-to-back townhouses, low-rise apartment buildings and low-rise hybrid buildings are included.

United States	
Housing Prototypes (City of Portland Bureau of Planning, 2008a)	**MDH** • The housing prototypes of this section are intended to serve as a problem-solving tool to help improve the design of medium-density infill housing projects, particularly in the R2 and R1 multi-dwelling zones. • The prototypes highlight MDH types and configurations that are suitable for common infill situations, meet city regulations and design objectives and are feasible from a market perspective.
	NOTES/SUMMARY • MDH has been mentioned in conjunction with infill housing – different to this, Victoria advocates the use of greyfield developments and other areas call for redevelopment or new development all together. • It is unclear what is meant by infill housing, but this might be informed by the infill design toolkit. • Multiple housing typologies are mentioned within this document as prototype examples have been explored as part of a problem-solving exercise to enable better design solutions and best practice surrounding MDH in Portland. • Solutions for balancing parking need with pedestrian-friendly design are mentioned as well as balancing the need for open space while meeting density goals. • Prototypes have been chosen because they are common to different areas of the city and so provide information and solutions specific to their locations. • The document provides best-practice prototypes from throughout the city as examples of development that fit within a local context and maintain character while increasing density. The aim of the document is to enable design solutions that promote liveable and attractive urban design throughout Portland.
Infill Design Toolkit: Medium-Density Residential Development (City of Portland Bureau of Planning, 2008b)	**MDH** • Developers, builders and designers of medium-density infill housing developments need to balance the number of units, open space and parking requirements with the neighbourhood and city's desires for a project. • The initial components of the infill design toolkit are focused on medium-density residential development (such as rowhouses, plexes, courtyard housing and low-rise multi-family development • Structured or podium parking is a valuable alternative to surface parking for medium-density infill housing projects. The podium allows for increases in parking ratios while maintaining or increasing open space on the site. • Common greens are particularly appropriate at medium densities, such as for development in the R2 and R3 multi-dwelling zones
	INFILL DEVELOPMENT • This guide is intended to serve as a resource for community members – builders, designers, neighbours and others – all who are involved in designing, building or participating in dialogue about the new development that continues to shape the form of Portland's neighbourhoods. Its focus is on new infill development in established neighbourhood areas, particularly where continuation of positive aspects of existing character is a community priority. Infill development can take place as construction on vacant land or as redevelopment that replaces pre-existing buildings.

	• Portland's design policies, including comprehensive plan goal 12.6, call for infill development in established neighbourhoods to be designed to respect positive aspects of neighbourhood context. • While it is one of the most frequently recurring terms associated with community objectives for the design of infill development, the vagueness of compatibility has also been the source of much contention, especially as it relates to new, higher-density infill development that is typically larger in scale than existing housing. • The residential streets of Portland's neighbourhoods often include a diversity of architectural styles and housing types, yet present a sense of cohesion due to recurring patterns. There are also challenges resulting from the space limitations typical of higher-density infill development, highlighting strategies for limiting privacy impacts and creating usable outdoor spaces • Basic neighbourhood patterns to look for to inform the design of infill development include street frontage characteristics, rhythm of development along the street, building orientation, front setback patterns, landscaping and trees, backyard patterns and topography and architectural features. • Most residential areas zoned for medium-density development have established patterns of backyards, which create a much-valued private realm of outdoor spaces that contrast functionally with the public realm of street frontages. Infill development that intrudes significantly into the backyard realm can have substantial privacy and solar access impacts and is often a key concern of neighbours. • Privacy impacts caused by infill development, such as windows and balconies that compromise the privacy of adjacent residents, are often significant concerns for neighbours. Thoughtful design can minimise such impacts.
	NOTES / SUMMARY • This has sections on strategies, prototypes, technical pages and neighbourhood design policies. The document aims to work similarly to the NSW medium-density design guide and Victoria's guidelines for higher-density residential development and provides best-practice design standards. • It identifies problematic aspects of design for different typologies and prototypes and then offers solutions to these as best possible. This would be of great help to designers and planners and actively works to identify as many ways as possible to deliver medium-density infill housing developments. • Visual representations of the types of development allowed within the MDH zones makes the document accessible to all members of the public as well as developers etc. and allows transparency and ease of information. This has implications for the development of these zones because, when people know what type of development constituted MDH, these typologies are more likely to then be constructed because people know what to provide to meet standards and strategy outcomes. • There is an emphasis on maintaining context-specific design outcomes and for MDH developments and design to meet the standards of cohesion within a specific location. • While focused specifically on infill housing types such as rowhouses (terraced), duplexes and triplexes, low-rise multi-family development etc., this document also works to provide similar outcomes to that of the housing prototypes document by illustrating best-practice examples to planners, designers, developers and the public..

Comprehensive Plan 2035 (City of Portland Bureau of Planning, 2016)	**MDH** • This designation allows medium-density multi-dwelling development. The scale of development is intended to reflect the allowed densities while being compatible with nearby single dwelling residential. The designation is intended for areas near, in and along centres and corridors and transit station areas, where urban public services, generally including complete local street networks and access to frequent transit, are available or planned. Areas within this designation generally do not have development constraints. The maximum density is generally 43 units per acre but may be as much as 65 units per acre in some situations. The corresponding zone is R1.
	NOTES/SUMMARY • Chapter 5 of the plan indicates the city's intent to ensure adequate access to housing for a socially and economically diverse population. It concentrates new housing in and around centres and corridors near transit and services to reduce the housing/transportation cost burden. The identification of the burden that transportation costs place on residents and the need to displace this burden creates the gap that MDH helps to fill. • Goal 5.A Housing diversity: Portlanders have access to high-quality affordable housing that accommodates their needs, preferences and financial capabilities in terms of different types, tenures, density, sizes, costs and locations and its subsequent supporting policies aim to provide MDH through an emphasis on diversity within the housing supply market. • Policies of particular interest to achieve MDH outcomes: - Policy 5.4 Housing types: Encourage new and innovative housing types that meet the evolving needs of Portland households and expand housing choices in all neighbourhoods. These housing types include but are not limited to single dwelling units, multi-dwelling units. accessory dwelling units, small units, prefabricated homes such as manufactured, modular and mobile homes, co-housing and clustered housing/clustered service. - Policy 5.5 Housing in centres: Apply zoning in and around centres that allows for and supports a diversity of housing that can accommodate a broad range of households, including multi-dwelling and family-friendly housing options. - Policy 5.6 Middle housing: Enable and encourage development of middle housing. This includes multi-unit or clustered residential buildings that provide relatively smaller less-expensive units, more units and a scale transition between the core of the mixed-use centre and surrounding single family areas. Where appropriate, apply zoning that would allow this within a quarter mile of designated centres, corridors with frequent service transit, high-capacity transit stations and within the inner ring around the central city.
Adopted Comprehensive Plan 2017 (Seattle Office of Planning and Community Development, 2017)	• No information found under search terms.
	NOTES/SUMMARY • The plan outlines similar aspirations to many of the others – to provide a diverse housing supply in the future to meet the needs of a diverse population, This identification of a gap within the current market is the basis of the missing middle concept. The gap is not specifically acknowledged but is inadvertently implied. • To address these issues, the city will consider allowing different types of housing than some zoning rules currently permit. Courtyard housing, row housing and apartments are examples of potentially affordable and family-friendly housing options.

	• Up zoning is mentioned whereby density limits of low-rise zones are increased or relaxed to include these new types of development and housing types. It is interesting to note that Seattle has chosen to do this instead of creating a new zone with its own bylaws and regulations, as New Zealand and much of Australia have. An example of this intent is policy H 3.5: Allow additional housing types in areas that are currently zoned for single-family development inside urban villages; respect general height and bulk development limits currently allowed while giving households access to transit hubs and the diversity of goods and services that those areas provide. • Infill development in this case is also similar to that of brownfield/infill development in New Zealand, to that of Portland and to greyfield development in Australia. • Urban village strategies are an extension of the intent to create a more diverse housing supply, as hub villages provide housing at a higher density than single family residential zones, but typically have less density than an urban centre, therefore providing a mid-range MDH area. • The Seattle comprehensive plan, as with other high-level documents, outlines the need for diversity within the city's housing stock to meet the needs of a growing and diverse population.
Housing Seattle (Seattle Planning Commission, 2011)	• No information found under search terms.
	NOTES/SUMMARY • Document recommendations include to: - link housing affordability to transportation costs - give more attention to Seattle's housing along and near arterials - promote and encourage housing production that addresses gaps in the market for families with children - revise the land use code, design review process and development standards with an eye towards affordability through their concepts and implementation into this plan/strategy. • Multi-family housing is a limited commodity in Seattle, particularly in frequent transit areas and near parks and schools. The aim is to look for strategic, context-appropriate rezoning opportunities in single-family areas and other areas to allow more multi-family or neighbourhood commercial developments. • The document outlines key issues that face Seattle in terms of its housing supply and current stock and identifies key recommendations that aim to address these issues. Linkages of housing to transport, rezoning and the encouragement of low-rise higher-density housing developments works to provide MDH within Seattle.
Seattle Transit Communities: Integrating Neighbourhoods with Transit. (Seattle Planning Commission, 2010)	**MDH** • Medium-density neighbourhoods are identified within data and high-level maps to illustrate the need for high transit in areas to reduce transportation costs for residents of Seattle.
	NOTES/SUMMARY • It is interesting to note that MDH is used as a term to describe zones within the maps provided but there is a lack of definition and lack of mention of MDH in any other Seattle documents. MDH has been implied but not specifically mentioned.

	• The document outlines the need for high transport particularly in centre and centre fringe areas as a way to connect areas and neighbourhoods, providing higher amenity values to the city and convenience as well as access. • It outlines Seattle's ambition to create transit-oriented neighbourhoods, where development would be focused around the transport system. As a result, densities are heightened within close proximity to the transport hub, and in this case, MDH has been identified as being part of this density scale.
United Kingdom	
The London Plan (Greater London Authority, 2016)	**INTENSIFICATION** • There are parts of London in real need of development, particularly in east London and the areas for intensification identified in this plan. • Rejuvenation of inner London's town centres (policies 2.15, 4.7 and 4.8) will be central to opening up these opportunities and complemented by better physical access to those of the central activities zone (CAZ) and the opportunity and intensification areas (policy 2.13). • Bring forward and implement development frameworks for CAZ opportunity and intensification areas (policy 2.13) to benefit local communities as well as providing additional high-quality, strategic development capacity. • Intensification areas are typically built-up areas with good existing or potential public transport accessibility, which can support redevelopment at higher densities. They have significant capacity for new jobs and homes but at a level below that which can be achieved in the opportunity areas.
	NOTES/SUMMARY • This plan sets out an integrated economic, environmental, transport and social framework for the development of London over the next 20–25 years. It recognises the need for increased housing supply and real choice to be given to London's residents within their housing stock. London aims to meet the challenges of a growing population by using its limited sources of land to the greatest efficiency. • The Mayor recognises the pressing need for more homes in London in order to promote opportunity and provide a real choice for all Londoners in ways that meet their needs at a price they can afford. There is identification of a need for diversity to meet the diverse needs of the population. • Taking into account local context and character, the design principles in chapter 7 and public transport capacity, development should optimise housing output for different types of location within the relevant density range. Development proposals that compromise this policy should be resisted. Densities range from suburban to urban to central. It can be assumed that, within the urban areas, MDH of some type would be provided whether it be through low-rise apartments, townhouses or duplexes. Urban is defined as areas with predominantly dense development such as terraced houses, mansion blocks, a mix of different uses, medium building footprints and typically buildings of 2–4 storeys, located within 800 metres walking distance of a district centre or along main arterial routes. Densities are measured by habitable rooms per unit and dwellings per ha. Much of Australia uses dwelling/ha and America uses dwelling/acre, which is viably the same as unit/ha. The plan emphasises that densities are broad ranges and cannot be applied mechanically but instead with a clear context/location analysis and understanding.

	• The specification of the plan that it is important that higher-density housing is not automatically seen as requiring high-rise development indicates that the city's intent is to provide MDH through what it aims not to provide. • The document discusses specific built form aspects such as minimum size standards for new dwellings, ceiling heights, etc. • Diversity is again mentioned through strategic policy 3.8: Londoners should have a genuine choice of homes that they can afford and that meet their requirements for different sizes and types of dwellings in the highest-quality environments. • There is identification that surplus industrial land could be used for higher-density redevelopment. This is similar to greyfield development in Australia and brownfield development within New Zealand. • Areas in and around town centres will be most appropriate for higher-density development in line with the locational strategy. The plans for this type of development focus around centres fits with the intentions of the Auckland Unitary Plan where centres and the areas surrounding them usually incur higher-density zoning than residential areas further away from these areas. • Certain case study areas around London have been included as areas for opportunities and intensification.
Draft London Plan (Greater London Authority, 2017b)	• No information found under search terms.
	NOTES/SUMMARY • The identifies the need for 66,000 additional homes per year. • Because of London's ability to plan strategically, boroughs are not required to carry out their own housing needs assessment but must plan for and seek to deliver the housing targets in this Plan. • The plan aims to make areas higher density but does not specify what this means specifically for the housing stock or types within the inner city or boroughs. • It sets 10-year targets for housing increases though how these will be implemented is generally left to the discretion of the boroughs and their own secondary and supplementary plans. • Town centres are again mentioned as sites to support higher-density development though how high is not mentioned. • Small housing developments are expected to be the best way to supply much of the needed housing around London. It is unclear whether this might mean MDH but it is specified that this means development of approximately up to 25 homes. • The plan is very similar to the current London Plan and, through its high level strategic direction and hierarchy of documents, creates targets that local boroughs must plan for and aim to achieve. To this end it provides a.. • The need for intensification is mentioned but not specified in any great detail.
Draft London Housing Strategy (Greater London Authority, 2017a)	**MDH** • In the majority of cases, it will mean medium-rise new developments across a much broader swathe of London, from high streets to transport hubs, on brownfield land and in and around town centres
	NOTES/SUMMARY • This strategy sets out an approach that will start to rebalance housing supply in London. • Much of the diversification within this document relates to diversifying of contractors and developers that supply the housing and construction, rather than the diversification of the housing stock itself.

	• To protect the green belt, the Mayor will promote higher-density schemes and prioritise development on brownfield sites, in and around town centres and on smaller sites in areas that have traditionally contributed less to London's supply of new homes. Higher density is again mentioned, but it is unclear whether this is specific to High density or just higher than other types of density, i.e. medium density. • Building the right number and the right mix of new homes and addressing the consequences of the housing crisis are essential parts of the Mayor's vision for good growth. The document identifies that much of London's housing stock remains low rise and low density. • The Mayor's commitment to protecting London's green belt and open spaces means new homes must be provided within the city's existing built-up area, which inevitably means building at a higher density than the existing stock. Attempts to build up existing neighbourhoods and centres seems to be driven by a desire to avoid moving into green open space rather than identification of the amenities provided to cities living within well serviced areas. • Building more densely in the right places will not just enable the delivery of more homes but will also improve access to jobs and services, while helping to fund desperately needed social and physical infrastructure. • When compared to many of its major international peers, London is a relatively low-density city. Delivering significantly more new homes will require higher densities in many locations as well as a move towards greater co-location of different types of buildings and land uses. For London to accommodate growth in an inclusive and responsible way, including protecting the green belt and other open space, every development needs to make optimum use of land. This will necessarily mean using land more efficiently and developing new homes at densities that will often be higher than those in the surrounding area. • Local councils will identify areas best suited for intensification. • This plan also emphasises the need for good growth through design. This follows other cities' identification of a similar strategy, sparking many design manuals.
London Housing Design Guide (Greater London Authority, 2010)	**INFILL DEVELOPMENT** • For projects creating new dwellings in existing buildings and developments in sensitive historic contexts, including infill developments within conservation areas, lower ceiling heights may be permitted by the local borough.
	NOTES/SUMMARY • This guide aims to ensure that every area of London accommodates the diversity of the city's population and encourages new development to consider not just the initial occupiers of a home but possible future tenants and owners. • London has a great diversity of urban and suburban contexts, and we need to ensure that all new housing is built at a sustainable density, appropriate to its location • The plan identifies the need for appropriate densities for locations. This has been emphasised through other documents but not in such a specific way with a whole section on this issue. It references the density matrix found in the London Plan. • When a housing type is developed to the upper limit of its possible density range, the result can be a loss of privacy and amenity space. Certain types of low-rise housing such as terraced or semi-detached housing with parking at grade only work

	well within a particular density range. It is specified that the low-density make-up of the city make privacy and amenity space particularly cherished and that increased density housing types sometimes infringe on this. • The last decade has been characterised by high-rise, high-density housing providing predominantly 1 and 2- bedroom flats often marketed towards young professionals. We cannot assume that people will follow a pattern of starting out in a flat, moving to a house when they have children and moving back into a smaller dwelling in old age. New housing needs to be designed with a range of people of different ages and backgrounds in mind who may occupy the home over its lifetime. To make dwellings built for smaller households suitable for a wider range of people including families with children, we need to explore different models of housing. These will include maisonettes – a type that can deliver successful family housing at moderate densities. Where family flats are included in higher-density development, developers must ensure that these provide at least some of the amenity afforded by houses, including private outdoor space. These provisions ensure that MDH is being built within London. • The document goes on to mention specific built-form aspects of housing such as car parking, cycle storage, storage, dwelling space and standards, etc. • This guide aims to work similarly to the NSW medium-density design guide, the infill design toolkit, the townhouse and low-rise apartment guidelines and Seattle's housing prototypes. It aims to provide best-practice examples as well as guidelines for development of particular housing types.
Draft Greater Manchester Spatial Framework (Greater Manchester Combined Authority, 2017)	• No information found under search terms. **NOTES / SUMMARY** • The framework in itself does not deliver development – rather, it defines what may or may not be developed in particular locations. It therefore works in conjunction with other documents to then provide delivered outcomes. • This is an overarching spatial plan for the entirety of Greater Manchester and sets out how it should develop within the next two decades. • It looks at strategic locations for growth to provide opportunities for development across the whole of Greater Manchester. It is interesting to note that, when considering its land supply deficiency, Greater Manchester has sought to ask neighbouring communities for supply of their land, and when this was refused, its secondary option is to sprawl into its green belt instead of looking at first intensifying its housing supply. • The delivery of higher-density dwellings are largely fixed around transport hubs such as train stations and centres, while high-end low-density dwellings are still being provided for at a large scale. • The density of development should reflect the relative accessibility of the site by walking, cycling and public transport, enabling more people to live and work in the most accessible locations. Opportunities should be taken to increase densities close to public transport stops with high-frequency services, where this is consistent with the design context and the delivery of a broad mix of dwellings and employment space. • Various areas have been identified as areas prime for growth and development.

Manchester Core Strategy Development Plan (Manchester City Council, 2012)	**MDH** • Diversifying the housing offer with particular emphasis on providing medium-density (40–50 dwellings per hectare) family housing including affordable housing. In locations close to the city centre, such as the Lower Irk Valley and Holt Town, higher densities will be appropriate. However, the provision of family homes should remain an emphasis in these areas, too. • Housing provision in Manchester should reflect the housing market, and with this in mind, there should be some flexibility to support developments providing they contribute to the regeneration of the city. In general, MDH, at densities of between 40–50 dwellings per hectare will be appropriate in the strategic housing location. This housing must be suitable for families with children.
	INFILL DEVELOPMENT • Wythenshawe was developed along the principles of the 'garden city' movement. The wider area represents a phased series of predominantly social housing dating from the 1920s to the 1960s, with some later infill developments and industrial zones.
	NOTES/SUMMARY • The main strategy establishes a vision for Manchester in 2027 and outlines strategic objectives including providing for a significant increase in high-quality housing provision at sustainable locations throughout the city to both address demographic needs and to support economic growth. • The council wishes to diversify the housing offer in Manchester through a policy framework that supports economic growth and the outcomes expressed within the sustainable community strategy, in particular target of creating a more balanced housing market by increasing levels of owner occupation from 46% to 60% by 2015. It is interesting to note that Manchester City's core strategy is more explicit in its identification of creating a more balanced housing market and diverse housing stock. • The council is committed to the development of new housing that meets and where possible exceeds the current Code for Sustainable Homes requirements, providing a range of house types and tenures to meet the needs of a diverse and growing population. • The strategy identifies that medium-density low-rise developments cater to the needs of not only families but elderly people and those with mobility issues. • It outlines a delivery strategy for housing increases across Manchester City and especially within strategic housing locations. • The core strategy development plan establishes a vision for Manchester by 2027 and outlines strategic objectives that can be implemented in order to achieve aspirations and goals. The city has, with good company, identified the need for a significant increase in the demand for high-quality housing and wishes to diversify the housing on offer within their city.