residential density guide

For Landcom project teams

May 2011

LANDCOM

Density measures are useful tools for planning and development practitioners, to help ensure project objectives are met.

This guide explains the different measures of density, what they describe, and how they should be used to help achieve well-designed, sustainable places.

Front Cover Images: *(Clockwise from top left)*
Rouse Hill Town Centre, Rouse Hill
Green Square Town Centre, Zetland (artist's impression)
Park Central, Campbelltown
The Ponds

residential density guide

contents

1.0 Introduction

1.1 The purpose of this guide

The purpose of this document is to provide guidance to Landcom project teams on the concept of residential density. Landcom has produced this guide because we are conscious that there is often confusion about the various measures of density, what they describe, and how they should be used.

The idea of 'density' very often also causes angst with local communities and local government, because there is a perception that more dense development means 'bad' development. The reality is that when done well, more dense development can result in several economic, environmental and social benefits. This guide provides information and advice to help address these issues.

1.2 Who this guide is for and how it is structured

This guide has been written specifically for Landcom project teams. It may also be useful for local councils and other government agencies that are involved in urban planning and development. Because it is a practitioners' guide, it is necessarily technical.

This guide describes:

- definitions of different residential density measures and the purpose of each
- how the different residential measures can be used in planning
- issues to be considered when applying density measures in your work
- the implications of planning practices and requirements, and how they may be addressed.

The guide is accompanied by some practical tools that can be used at various stages of the planning and development process. These tools explain the relationships between building controls, densities and the built form that is actually delivered on the ground. The toolkit includes:

- reference charts
- housing typology charts, and
- case studies.

Density is only one piece of the puzzle when creating or improving urban centres

1.3 Density – 10 point summary

Not all problems are the same and each person will have a different level of understanding when it comes to issues around density. For these reasons, Landcom has summarised most of the information contained in this guide under the following points. If you have a particular interest or concern, you are likely to find a reference to it in the following 10 point summary. You will also find section references directing you to further information under each point.

1. **There are different measures of density – population, residential and activity density – for different planning and design purposes.**

   Population and activity densities measure the concentration of people. Residential density measures the concentration of dwellings in a given land area. This guide is focussed on residential density.

   Residential density definitions see Sections 2.1-2.3.

2. **The land uses included in the land area determine which type of residential density you are working with – site, net, gross, urban or metropolitan.**

   Site and net residential densities are used at the smaller scale of lots, blocks and precincts. Gross and urban residential densities are used at the neighbourhood or district level, and metropolitan density at the city scale. Because site and net densities omit the non-residential land uses, they are theoretical measures. Gross and urban densities are better indicators of what happens 'on the ground'.

   See Sections 2.1 - 2.4

3. **Residential density is only a proxy measure for population or activity density.**

   If your purpose is to assess service viability or urban centres, then population or activity density is a more reliable measure than residential density. Net residential density does not correlate directly with net population density because occupation rates vary for different housing types and socio-economic factors. A higher net residential density does not always deliver a higher population density.

   See Section 3.4

4. **Residential density is not always a reliable measure of built form intensity, nor is it a reliable indication of how a place feels.**

   A higher residential density does not always mean higher buildings. A given housing type can yield different net residential densities depending on site coverage, dwelling size and street layout. Residential density does not measure the qualitative factors that affect the feel of a place such as mature trees, landscaping, traffic or architectural quality.

   See Sections 3.3, 3.5 and 3.6

5. **Density is only a measure, not a design recipe.**

   Achieving a certain net residential density in itself will not guarantee a viable urban centre or deliver benefits such as viable public transport. Successful urban centres are the product of many factors including the quality of public transport, a diversity of land uses and fine-grained street patterns, and land ownership in a compact area.

   See Sections 3.1

6. You should distinguish between using a density measure as an overall planning average on the large scale and using it as a place specific indicator of development intensity.

A density measure used over a large area is an averaging statistic. A district with a planned net residential density of 25dw/ha may have many component building types and actual net residential densities ranging from 10 to 50 dw/ha for example. An overall residential density target should not be used to derive blanket controls which may lead to monotonous building types and flat, featureless density profiles.

See Sections 2.4, 3.1 and 3.2

7. Density mesures can be useful planning tools at the beginning of a project, and can be used for assessing outcomes at the end, but are difficult to use progressively.

A target density may only be achieved after 10-20 years of development, yet the component development parcels may deliver very different densities along the way. Large-scale density plans can be wrongly administered as site-by-site, instant net residential density controls without regard to the role of time in achieving the project vision.

See Sections 3.2 and 4.3

8. Lot size, maximum height and FSR standards are de-facto density controls.

Problems can arise when a narrow band of permissible housing types prevents small lot, semi-detached or attached housing types - polarizing housing options into low density detached houses and higher density apartments.

See Sections 3.8 and 4.3

9. Density measures can help explain the impact of development standards on built outcomes.

Development controls impact on residential density in different ways. For example, on site car parking requirements effectively reduce net densities and call for careful design to protect amenity. In neighbourhood and village centres, the challenge is to re-interpret the traditional zero lot, semi and attached housing types with acceptable car parking solutions, while retaining density and construction cost advantages.

See Sections 3.8 and 4.2

10. In greenfield developments, planned population gains intended to be delivered through denser housing types can often be diluted by suburban land practices that require large areas of open space.

Land for conservation, drainage, leisure and education uses are often provided through individual parcels of land – each fulfilling a separate function and with no credit given for similar provision elsewhere or the possibility of dual-use. This means that higher net residential densities may not yield the gross residential densities necessary to support viable neighbourhood centres or public transport.

See Section 4.1

2.0 The rules for residential density

2.1 What is residential density?

Residential density can be measured in five ways: *site, net, gross, urban and metropolitan.* All five residential density measures are calculated using the same basic ratio formula: the number of dwellings divided by the area of land they occupy.

It is the **land uses** that are included in the land area which determine the *type* of density being described.

Residential density | Basic equation for describing residential densities

- **SITE** density includes only the **residential** component of the land area. It is the most concentrated measure of density.
- **NET** residential density includes the residential component plus **local roads.**
- **GROSS** residential density includes residential uses, local roads plus **local non-residential land uses** such as parks and schools.
- **URBAN** residential density includes all the above land uses plus **regional land uses** such as employment, transport and regional open space.
- **METROPOLITAN** density is a macro measure, often used in international comparisons and includes **all land** (i.e. including non-urbanised land within what are often arbitrary administrative boundaries).

Site, net, gross and urban residential densities are covered in this guide. These are the density types that are most relevant to the planning and development industry.

2.2 Definitions

The Australian Model Code for Residential Development (AMCORD) definitions of site and net residential density are widely accepted as the industry standard. However, there is currently no overall agreement on what defines gross and urban residential densities[1]. Much of the confusion about residential density centres on two things: exactly what constitutes a 'local' land use (particularly when categorising open space) and whether or not to include or exclude high schools.

The definitions used in this guide are based on AMCORD wherever possible. The definitions in the diagram on page 10 include clarifications in italics, where required.

1 Bamford (2007)

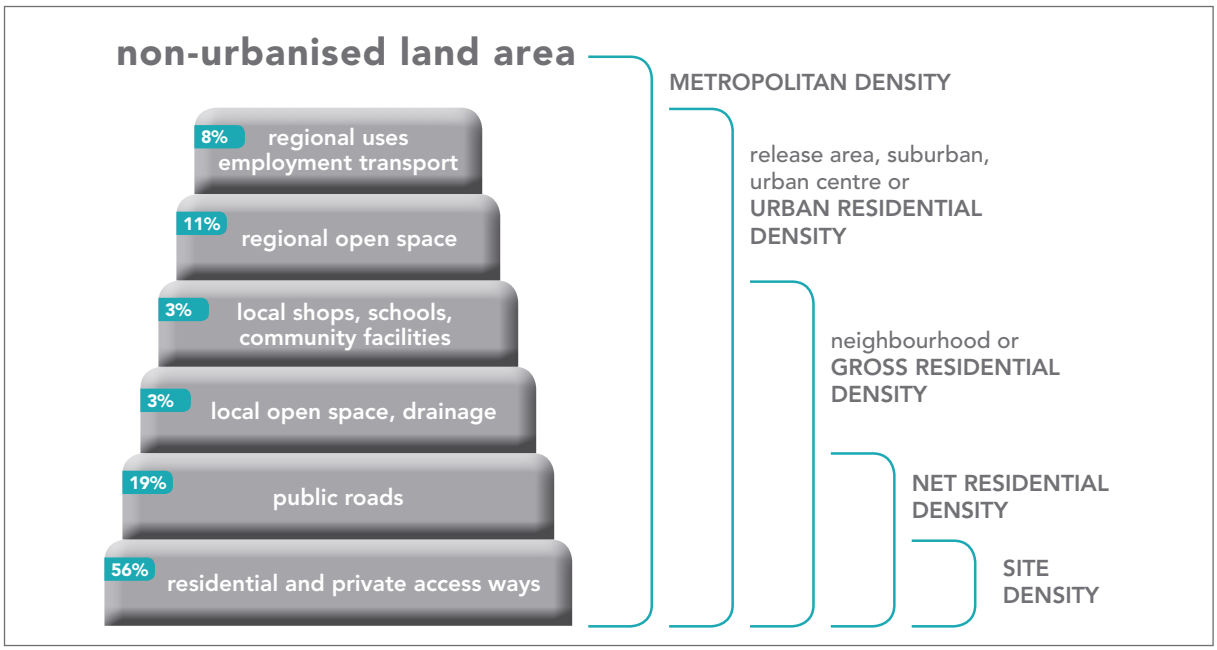
2.3 The need to clarify terms

The four main measures of residential density are often referred to inconsistently and in different ways, particularly gross and urban density. This can lead to confusion. For example, AMCORD uses the term 'neighbourhood' to refer to 'gross residential density'. It also uses the terms 'suburban', 'release area density' and 'urban centre dwelling density' to refer to urban residential density.

To minimise confusion, this document adopts the following rules:

- 'Site density' and 'net residential density' are used in accordance with their almost universally accepted definitions.
- 'Gross residential density' is used in favour of other terms because it is the more commonly used term in NSW and 'gross' is the next logical step up the hierarchy after 'net'.
- 'Urban residential density' is used instead of 'suburban', 'release area' or 'urban centre' since it is a more generic term for development at the urban scale.

In addition, the terms used to describe population density are often confused with residential density. 'Urban density' is a population measure of people/ha. 'Urban residential density' measures dwellings/ha. In order to avoid confusion complete terms should always be used.



5 measures of density | Simple definitions of residential density by land area.
(Percentages of urbanised land use areas are approximate for greenfield release areas: Cardew 1996)

Urban residential density

'the district'

The ratio of the number of dwellings to the area of land they occupy including all the land areas included in gross residential density, plus regional uses such as education (universities, TAFEs), open space (regional parks, environmental protection reserves), larger scale commercial uses (employment, shopping centres) and transport (railways, arterial roads).

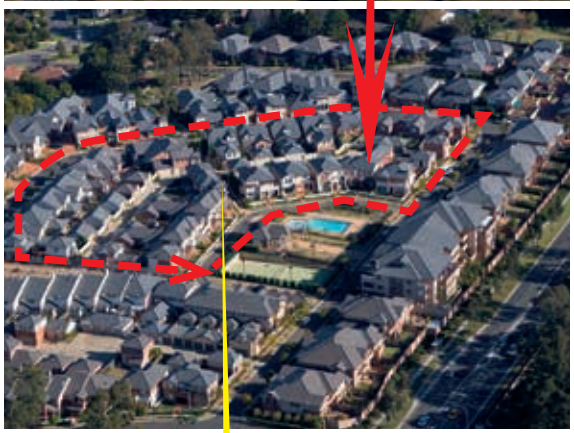
SOURCE Based on Cardew (1996)

Gross residential density

'the place'

The ratio of the number of dwellings to the area of land they occupy. The area includes internal public streets, all areas of local open space *(including parks, sports fields, drainage reserves, landscape buffers, bushfire asset protection zones)* local or neighbourhood shops, primary and secondary schools, local community services, local employment areas and half the width of adjoining arterial roads.

SOURCE AMCORD Practice Note 6 – with additions in italics, as shown

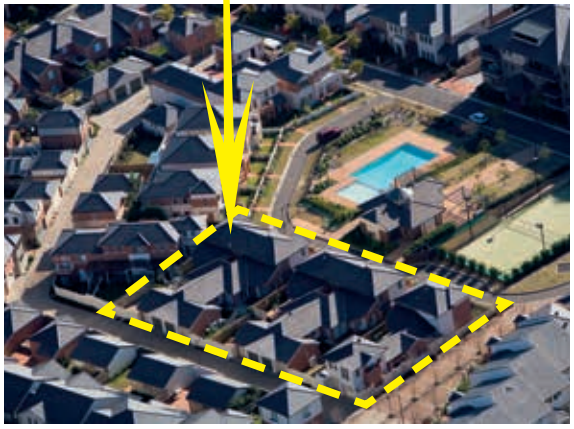


Net residential density

'the built form'

The ratio of the number of dwellings to the area of land they occupy including internal public streets, plus half the width of adjoining access roads that provide vehicular access to dwellings.

SOURCE AMCORD Practice Note 6



Site density

'the lots'

The ratio of the dwellings to the area of the site they occupy.

SOURCE AMCORD Practice Note 6

Residential density at varying scales | Four measures of density applied at varying scales

2.4 Choosing the density measure to suit the scale and your purpose

Determining which measure of density to use depends on two things:

1. **The scale** at which you are working (e.g. at the lot, street, neighbourhood, suburb or urban centre level), and
2. **Your purpose,** or what you are trying to understand, demonstrate or compare. Further discussion about how density measures can be used follows in section 2.6

SCALE	MEASURE	WHAT IT DESCRIBES	PURPOSE – WHAT IT CAN BE USED FOR
LOT		• The intensity of built form on site only - a theoretical measure • A rule of thumb density figure for a single built form typology	• Comparative tool (e.g. for detached housing it correlates strongly with lot size and for apartments it correlates strongly with height) • Estimating yield (aligns closest to 'net developable area')
STREET OR PRECINCT		• The intensity of built form in street context • The relationship between net residential density, development standards and typology • The average effect of residential mix in a precinct	• Evaluating options for street design and built form typologies • Understanding the impacts of development standards • Securing a 'broad brush' understanding of precincts/ neighbourhoods (e.g. for activity centre analysis)
NEIGHBOURHOOD		• Neighbourhood intensity (dwellings and non-residential land use) • The daily lived experience of a place	• Meeting planning targets at the local level for neighbourhood intensity • Estimating local population density or meeting minimum threshold targets (e.g. for public transport) as people actually experience a place
SUBURB		• The overall picture of a place including impacts of regional open space and uses	• Providing a 'big picture' planning tool (e.g. estimating population density for utilities, regional services) • Understanding existing places or evaluating the end product of regional planning (e.g. is the vision achieved?)

Which measure of density do I use? I Choosing the correct measure

To help you to choose the best measure, a description of the applications of the four main types of residential density is set out below.

Site density

Site density is used at the individual lot level either as a measure of a single housing type, or as a purely statistical measure of residential yield.

It has a close correlation with lot area for houses and height for apartments. However, it is less reliable than net residential density when comparing different building types because it excludes the area required for street access.

This can be important when comparing, say, integrated developments (with internal access ways) against houses that are accessed from the street front or small lot housing that is accessed from rear lanes.

Net residential density

Net residential density is the most versatile measure of density to use in the design and development process. This is because it can be applied from the scale of the single lot up to the precinct or even suburb level.

Net residential density will provide a *reasonable* indication of the intensity of built form. This is the measure to use when trying to understand the impact of development on streetscape scale.

Net residential density can also be used as an *averaging statistic* over a larger area. This can be useful when evaluating a mix of building types across a precinct or working with population density thresholds. For example, if your aim is to encourage housing diversity, a precinct with a planned *average* net residential density of, say, 25dw/ha may be made up of many different building types that are constructed at different *actual* net residential densities. These could range from 10dw/ha to 50dw/ha on a site by site basis. When applied over the entire precinct, however, the *average* net residential density achieved would be 25dw/ha.

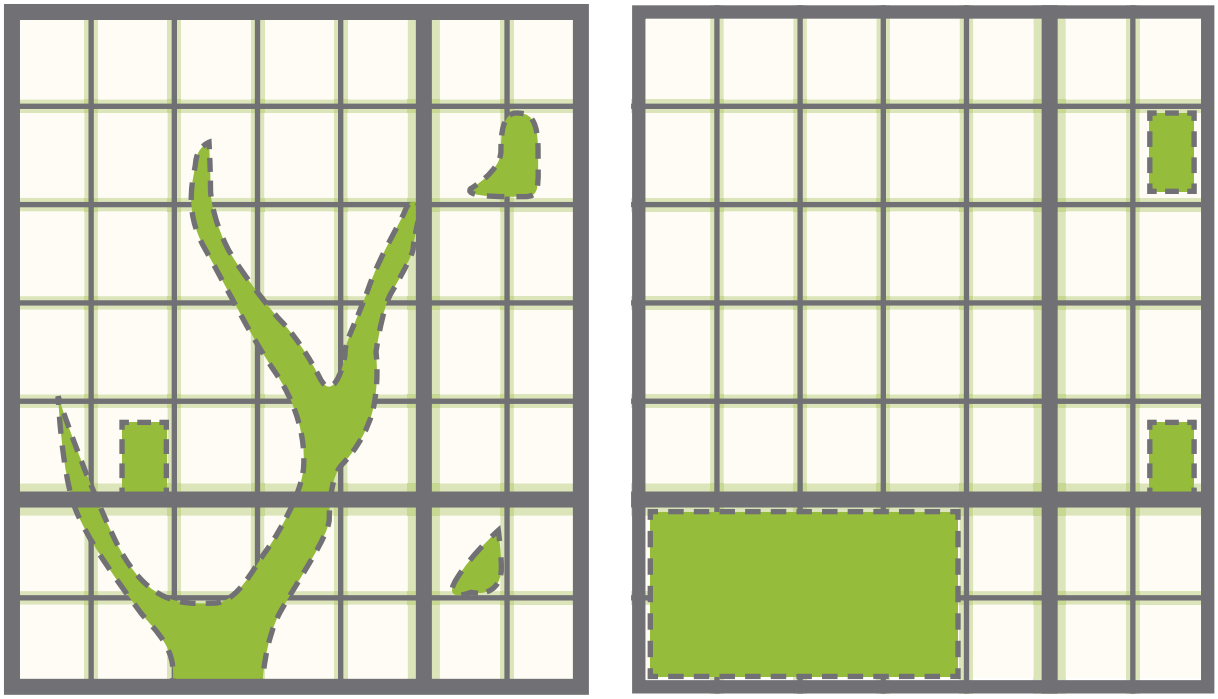
Gross residential density

Gross residential density measures the overall net residential density, combined with the impact of local land use at the neighbourhood scale.

This measure better reflects the actual human experience of a place than net residential density, and can be useful if your purpose is to understand broader issues such as walkability.

Gross residential density is best calculated when the physical or psychological boundaries of the neighbourhood or suburb are clearly defined. These boundaries might include the edges created by arterial roads or large conservation reserves. Regional uses themselves should not be included in the area being measured.

While gross residential density can be a useful measure, it is important to remember that this measure of density will include the overall area of open space, but not its distribution. In the example on the following page, two suburbs may yield the same gross residential density of, say, 15dw/ha. That means they will have the same overall quantity of local land uses. However, in Suburb A, open space is distributed as several small parks, linear drainage reserves and landscape buffers, whereas in Suburb B, the open space is distributed quite differently - as a large set of playing fields on the edge of the suburb and one town park. Suburb B would feel more urban and walkable compared to Suburb A, and Suburb A would feel more suburban. However, these qualities would be hidden in the gross residential density figures.



Suburb A Suburb B

Same gross density, different open space | Two suburbs with the same areas of open space and gross residential density, but different distribution of open space.

Urban residential density

Urban residential density is usually applied at a large scale (i.e. sufficient to capture regional land uses) and is suitable when trying to understand issues at the macro level, such as travel behaviour.

Urban residential density is the precursor to calculating urban density, a population density measure used to estimate service provision and to compare the performance of cities.

If your interest is in urban centres and your purpose is to understand the threshold population required to make a centre viable, then activity density is the more meaningful measure. Further information about activity density is provided in Section 3.9.

2.5 Tips for calculating residential density

The process for calculating the two most common measures of residential density (net and gross) is the same. Define the sample area, determine and measure the appropriate land uses, count the dwellings and then calculate the ratio. In practice, this is often not as straight forward. Set out below are some tips to follow and pitfalls to avoid to help ensure you always calculate density correctly.

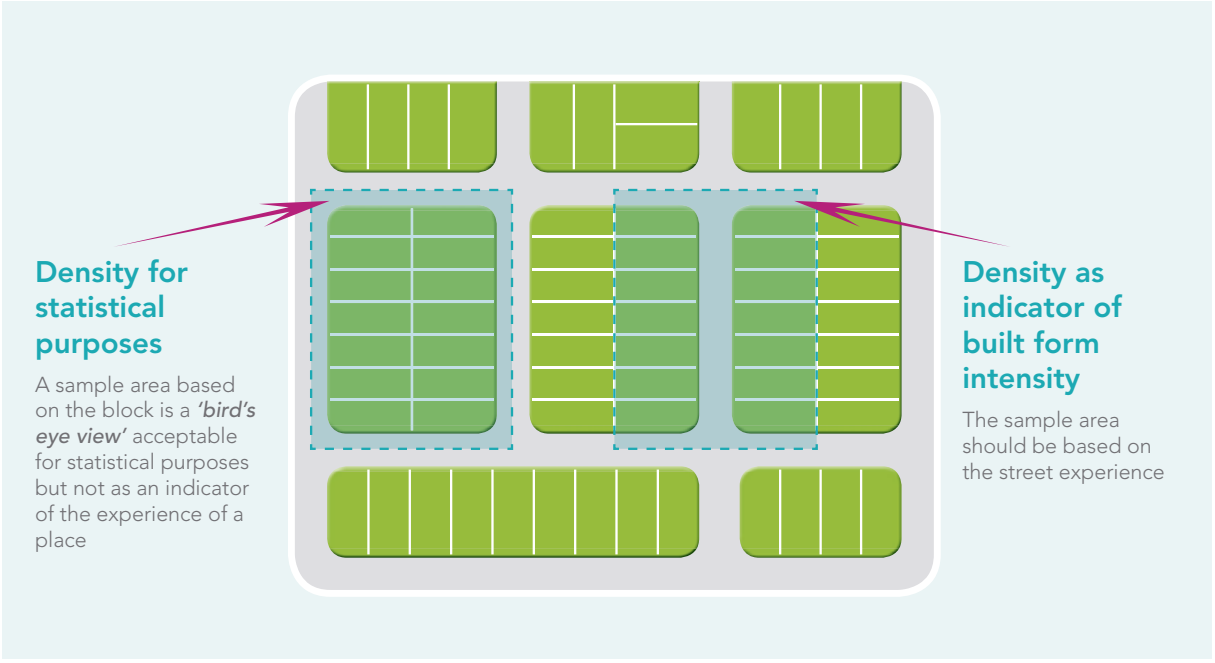
Defining a sample area properly

For net residential density, the sample area you choose will depend on your purpose.

For example, if your purpose is purely statistical (such as applying an averaging tool over many blocks), then the conventional method of drawing a line down the middle of a road and counting everything inside is justified (the sample area on the left in the diagram below).

However, if you are using net residential density to measure the built intensity of a development type or the 'feel' of a place, then the sample area you choose should approximate the streetscape experience as closely as possible (the sample area on the right in the diagram below). This method reinforces good urban design principles by encouraging well proportioned, architecturally consistent streets, rather than planning block by block.

As discussed earlier, gross residential density is more appropriate to use at a larger scale (i.e. at the neighbourhood or suburb level). When using gross residential density, the sample area you choose should correlate with the experience of the place you are measuring. Use *natural* boundaries (such as bush reserves) or *urban* boundaries (such as large arterial roads). Sample areas that are too large will tend to include significant areas of regional uses such as transport and employment uses, and these are best accounted for with urban residential density measures.



Sample areas for net residential area | The way you determine the sample area will depend on your purpose.

Determining and measuring the land uses

When measuring net residential density, include all residential land including communal open space[2] and surface parking areas for integrated or strata development. Also include all streets and lanes located within the sample area including any access ways that provide access to dwellings (irrespective of the titling arrangement).

No other land uses (local parks, drainage reserves, community title recreation facilities and so on) should be included in your calculations.

For calculations involving gross residential density, only 'local' land uses should be included. You may find that it is often difficult to determine if a particular land use is 'local' or 'regional'. For example, a small collection of five to ten neighbourhood shops would be easily identified as a local land use, and a large enclosed shopping mall would be regional. However, for a larger 'high street' of shops and related land uses, you may need to get agreement from your project team and stakeholders, as to how it should be counted.

Open space presents a similar problem. Playing fields may perform a regional function for weekend sports clubs, but could nevertheless be categorised as 'local open space'.

To avoid confusion, always remember to record the way you categorise land uses so that others will be aware of your assumptions and be able to make similar comparisons.

2 This includes resident only open space areas as well as publicly accessible areas (such as internal courtyards in apartment blocks).

Counting the dwellings

As a general rule, if a dwelling is separately occupied, it should be counted. For example, an accessory unit above a rear garage of a main house should be counted separately to the main dwelling. However, you may need to use your discretion for more complex sites with unusual tenures (e.g. boarding houses, aged care facilities).

As above, always record the way you determine the number of dwellings, so that others will be aware of your assumptions and be able to make similar comparisons.

Use of census data

Census data can be useful for sourcing information on dwelling numbers and population density by statistical district. Nevertheless, care should be taken since census figures are based on total land area and take no account of local land uses.

This means that census data is more likely to be useful for calculating urban residential density for contiguous urban areas. However, at the metropolitan fringe (where rural land or large, non-urban land uses such as national parks may be included in the statistical district), then the measure is likely to be of metropolitan density.

2.6 How density measures can be used

Density measures can be used to:

- estimate the intensity of built form on a particular site or a place
- model the impacts of development standards
- keep track of how well a development is performing against the original 'vision'
- calculate population densities.

Each of these applications are explained below.

Density measures can indicate the 'intensity' of built form

Net residential density is often used as a shorthand way of describing the perceived intensity of built form. For example, we can usually assume that detached housing on lots greater than 450m^2 is typical of development at a net residential density of less than about 15dw/ha.

The 'Reference chart for net residential density' provided in the tools section of this guide gives you a quick feel for what a given net residential density figure means, in terms of typical housing types and the overall intensity of a place. The 'Reference chart for gross residential density' provides a feel for what gross measures represent, in terms of overall intensity.

Density catalogues are often useful for matching density figures to actual development on the ground. They illustrate and compare various built densities using maps, plans and photographs. However, care needs to be taken because density catalogues usually illustrate only one type of density[3]. It is often more useful to examine the relationship *between* different measures of density for each place.[4]

Density measures can be used to model the impact of development standards

Policy or planning controls can combine in unintended ways to adversely impact on a project. You can use density measures to model the impacts that development controls (such as lot size, floor space ratio or car parking) may have on a proposal. For example, controls on minimum lot size can sometimes prohibit low intensity, semi-detached housing, even when this might be a good design choice for a particular neighbourhood.

Density analysis is one way to demonstrate impacts like this and model variations. Several density case studies are included in the toolkit provided with this guide. These may assist you to plan the best outcome for your project.

Density measures can help you to keep track of your project 'vision'

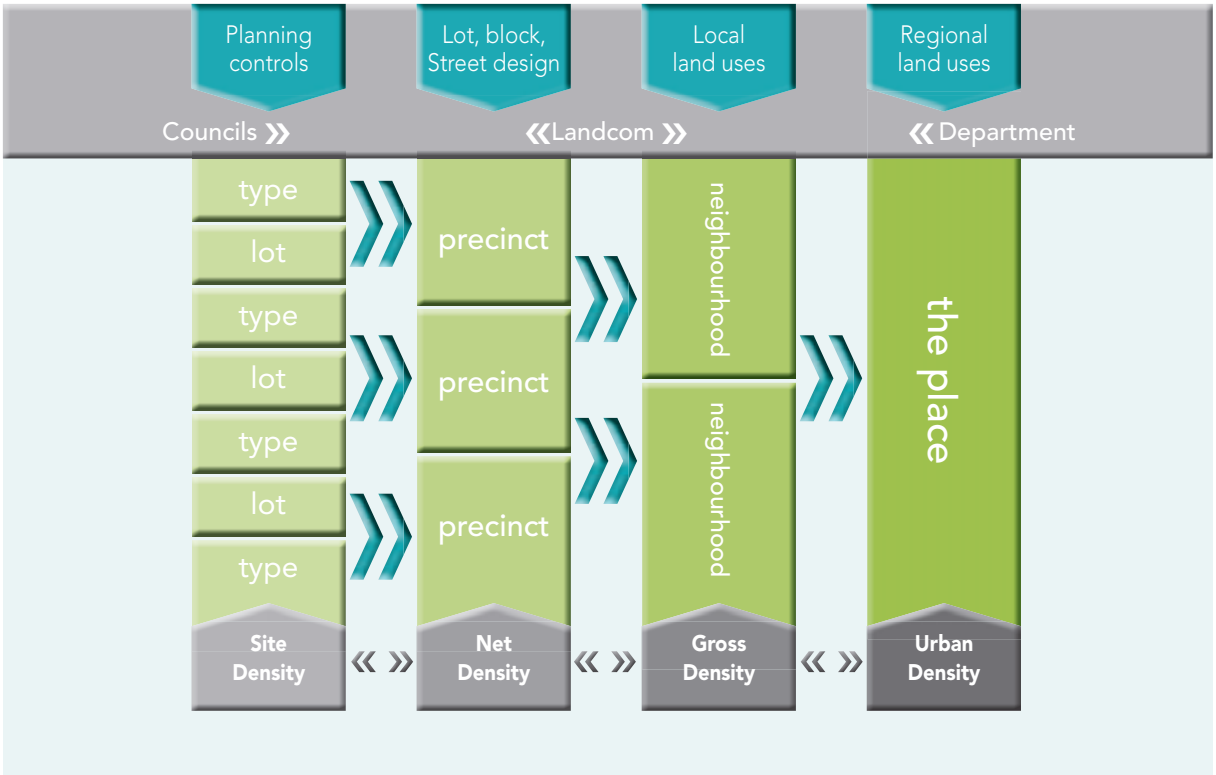
The four main measures of density (site, net, gross and urban) can provide a chain of indicators that can link development controls with your 'vision' for a place.

Not only can each density measure tell you something about your development at a particular scale, the relationships between the different measures can also tell you about the cumulative impact of planning decisions that might influence the built form outcome of your project.

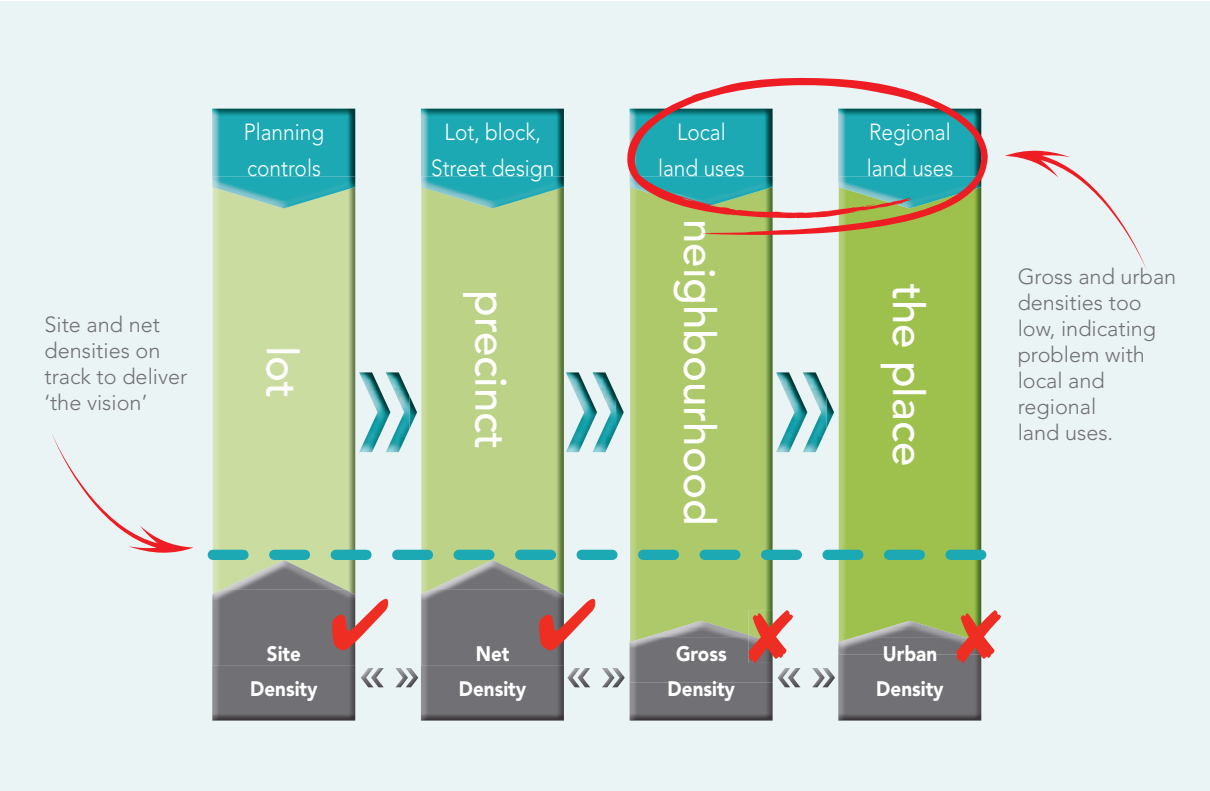
The diagram at the top of the next page shows the relationship of the different density measures and the decision-makers involved in the different planning stages.

3 For example, Western Australia's *Residential Design Codes* use site density but South Australia's *Pictorial Handbook of Adelaide Examples* uses net density.

4 The UDAS publication *Residential Densities* is a good example of this approach.



Density as an indicator | A systems diagram showing how density measures can act as indicators at each scale of the project



Density as an indicator | The density hierarchy indicating a broken link between the vision and the qualities of the final place.

Density measures can also act as *indicators* to help show where things might be going right or wrong for your project. The concept is shown in the diagram at the bottom of the previous page. If you start with a vision for your project, e.g.

"to create an attractive neighbourhood where people can make sustainable transport choices, live locally and feel part of a vibrant community",

then you can search for successful places or project examples that already have some or all of the qualities you are seeking. From these existing places, you can then derive performance indicators for your project, including preferred densities.

On analysis, your project may include a variety of housing types yielding the site and net densities you want, but the overall masterplan might show that the project's gross residential density (and then urban density) has dropped below what is required to achieve the vision. If we can understand this early, we can review the decisions or assumptions that have been taken about local and regional land uses and get the project back on track.

Density measures can be used to calculate population densities

For mixed-use urban centres to be successful, they require a critical population threshold to ensure services like public transport and retail services are viable.

We can use residential density as a planning tool for population density, as population density is derived from residential density, multiplied by the occupancy rate.

Occupancy rates in Sydney are approximately 3.0 people for each detached house, 2.4 people for a semi-attached house and 2.0 people per apartment[5]. Note though, that occupancy rates vary depending on the size and type of dwelling and, sometimes, with the socio-economic profile of the area[6].

To assess the viability of centres, we also need to take into account non-residents that use the centre. Activitiy density includes an employment component that enables us to do this. This is introduced in Section 3.9.

5 SOURCE: ABS 2001 Sydney occupancy rates: houses 3.04, semi/attached 2.36, and apartments 1.93

6 In some countries, other measures of density are used to give a more accurate indication of dwelling size and occupancy. For example, habitable rooms per hectare or HRH are used in the UK.

Residential density is used to calculate population density.

3.0 Using density measures in your work

Residential density measures can be blunt tools if improperly applied. They can never replace good architectural and urban design skills. However, if you use density measures with care, they can help inform good decision-making.

This section outlines some lesser known facts and common misconceptions about density that you should keep in mind in your day to day work. The section also provides some advice on the mistakes to avoid when working with density measures.

3.1 Density measures are only indicators, not design tools

Achieving a certain net residential density will not in itself guarantee a certain design outcome. For example, the viability and identity of a good urban centre depends on many factors including the detailed design of street patterns, the quality of public transport, the mix of land uses and land ownership, and a design that creates different 'places' with different 'experiences'.

A varying density profile across neighbourhoods and suburbs is one of the best ways to encourage alternating built intensity and openness, social activity and solitude, urban forms and access to nature. The most successful places are those where the built form creates consistent streetscapes and where higher density development is concentrated in a way that creates special places or reinforces urban centres.

When combined, it is these variations which produce an identifiable urban structure.

Therefore, neighbourhoods should be composed of various housing types that are appropriate to the surrounding local amenity. The best greenfield neighbourhoods are those made up of many component net residential densities - selected depending on local features such as proximity to a centre, open space and the topography.

Similarly, an urban infill site should respond to its context (heritage considerations, existing buildings, overshadowing and so on). For large infill sites, the impact of higher density development on lower density neighbouring sites needs to be considered. Built form that transitions from lower to higher density is often required.

Development controls should enable this flexibility because it is often these variations in the built form that give a place its distinctive identity.

3.2 The 'right' density evolves over time

Density targets can be useful planning tools at the beginning of a project and to measure outcomes at the end. But targets should not be applied as blanket controls on individual sites within a broader precinct. This results in monoculture rather than variety.

A target density may only be achieved after ten or twenty years of development. Yet the component development parcels that make up the entire project may well deliver different densities along the way.

'One-size-fits-all' density plans that are applied across large areas can work against a project vision. This is because they can often be administered incorrectly as site by site controls without regard to the role that time plays in achieving the longer term vision.

Problems can occur when an area-wide net residential density target is translated into one building type and used as the overriding development standard. This building type is then rolled out across an entire project area or site, leading to flat and featureless urban form.

In short, density targets should be used as long-term goals, not generic, 'one-size-fits-all' planning controls.

Density is not a 'one-size-fits-all' control | Avoid blanket density controls – aim for variety not monoculture

3.3 Higher density does not always equal higher buildings

While it is true that higher buildings often result in increased net residential densities, the same result can be achieved with different housing types. This is because factors other than height (such as site coverage) also influence net residential density.

The correlation between density and site coverage is best illustrated at net residential densities of 40-60 dwellings per ha.

Traditional Victorian terraces in Paddington achieve a net residential density of around 56dw/ha. This is similar to three storey block-edge apartments. This is because, while the dwelling arrangement is different, site coverage and built form is very similar (attached two to three storey housing built to the boundary).

If the site coverage is reduced, more height is needed to achieve the same net residential density. So, a five-storey apartment building within generous landscaped areas and including recreation facilities, surface visitor parking and driveways, can also yield the same net residential density as terraces.

Terrace
- Minimum setbacks
- High site coverage

Urban Apartment
- Minimum setbacks
- High site coverage

Suburban Apartment
- Large setbacks
- Low site coverage

Height is not necessarily the same as density | Three different building types – terrace, urban apartment and suburban apartment - can result in approximately the same net residential density, depending on site coverage.

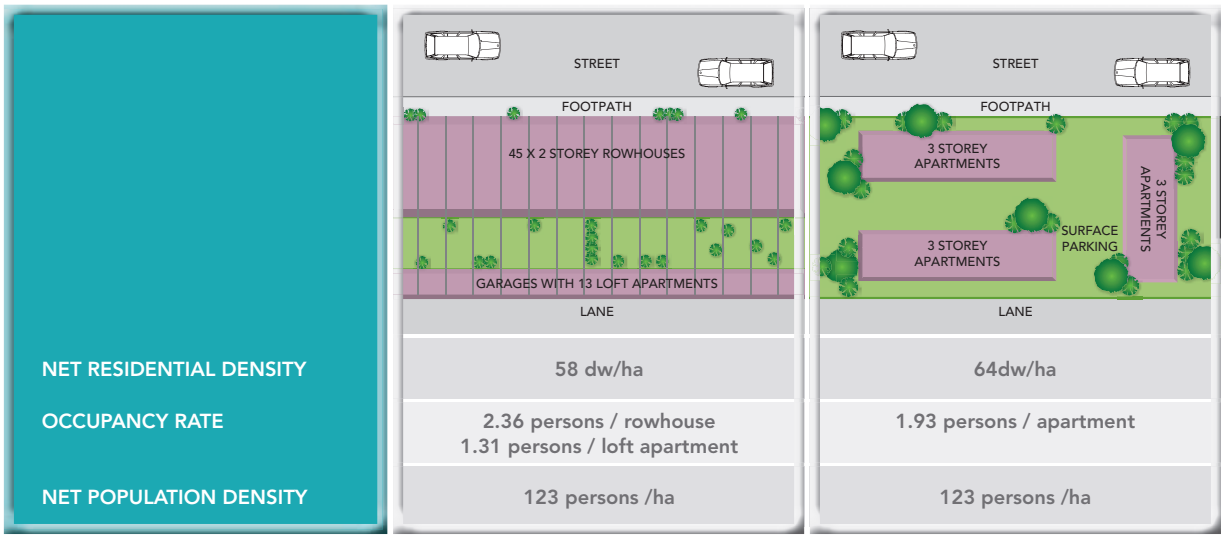
3.4 Higher net residential density does not always equal more people

Occupancy rates will vary for different residential building forms. Apartments usually have fewer occupants. This means that a higher net residential density does not always guarantee a higher population density.

The example on the next page demonstrates that if you had a 1ha site (made up of a 8,150m^2 development site plus a street component of 1,850m^2) and you planned to develop it with 45 two storey row-houses (each 5m wide) and 13 loft apartments above garages, this would yield a net residential density of 58dw/ha. At an occupancy rate of 2.36 people/row-house and 1.31 people/loft, this would result in a net residential density of 123 people/ha.

The same site could be developed with 64 apartments in three storey buildings and would yield a higher net residential density of 64dw/ha. But because the occupancy rate for apartments is lower (1.93 people per apartment), the net population density would remain at 123 people/ha.

In this case, a higher density development would house the same overall number of people.



Population density depends on occupancy rates | Different house types and net residential densities can yield the same population density, due to varying occupancy rates.

3.5 The same building type can yield different net residential densities

You can apply a shorthand approach to understanding density by grouping different housing forms into types, each of which has an approximate net residential density. For example, a detached house on a 15m wide lot normally equates to a net residential density of around 15dw/ha[7].

However, rules of thumb will only be useful if they relate to local development controls and conventions. This is because the measured net residential density of any place will depend on a range of other factors such as street design and block layout, site coverage and dwelling size[8].

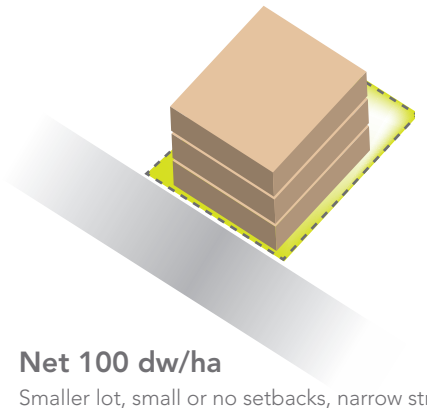
The following examples demonstrate how some of these other factors can directly influence density.

The higher the site coverage, the higher the net residential density.

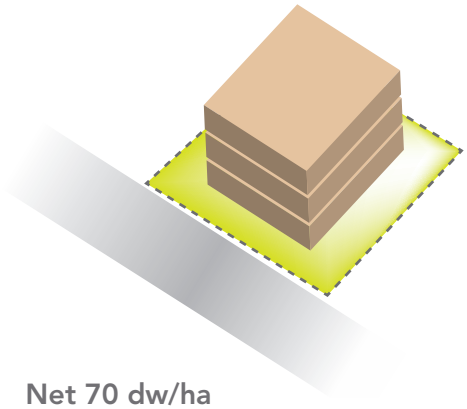
A three storey apartment building on a large site (one which includes extensive landscaped setbacks, surface parking and common open space) can yield a net residential density of 70dw/ha. But the same building form and height located on a smaller inner-urban site (one which has no setbacks) could yield up to 100dw/ha.

7 Further examples can be found in the 'Net residential density reference chart' provided with this guide.

8 The density resources provided with in this guide are based on current development practices in NSW (e.g. street widths are as recommended in Landcom's Street Design Guidelines).



Net 100 dw/ha
Smaller lot, small or no setbacks, narrow street



Net 70 dw/ha
Larger lot, landscaped setbacks, wide street

Same sized building, different net densities | The same sized building with different site coverage and street layout will result in different net residential densities.

The larger the size of each dwelling, the lower the net residential density for the same building type.

An apartment building on a 1,400m² site configured as 27 two bedroom units will yield a net residential density of 116dw/ha. However, if exactly the same building on the same site was configured as 21 three bedroom units, this would only yield a net residential density of 90dw/ha (Bamford, 2007).

Net 116 dw/ha

Net 90 dw/ha

Same sized building, different net densities I The same sized building configured with a different mix of dwellings will result in different net residential densities.

The smaller the land area allocated to roads, the higher the net residential density for the same land area[9].

Narrower streets, longer blocks and fewer rear lanes often result in an increased net density. This is because street and block design directly impacts on dwelling forms. Designers should be aware that if you narrow public roads, this may reduce available street parking which may, in turn, lead to a requirement for more on site parking. For housing types with surface parking, this would most likely reduce net residential density.

9 NOTE - this assumption only holds true if all other controls are kept constant

3.6 Density is not intensity

Density does not necessarily describe the intensity or 'feel' of a place. Density is dependent on lot size, floor space ratio, building height, street width and parking requirements. But the intensity of a place is also affected by things such as the width of lot frontages, the topography, the maturity of trees and landscaping, front setbacks and gardens, street design, and traffic for example.

While density measures may be used as indicators of intensity, they are never complete descriptors.

Density is not intensity | Many of the factors that affect how we feel about a place cannot measured by residential density.

3.7 Use caution when making comparisons

Be aware of the following 'dangers' when comparing projects or places using residential density measures.

Always compare similar sized study areas.

This should ensure a roughly equivalent sample size of dwellings. As a general rule, the larger the area you choose, the more density becomes useful only as an average statistic. Comparing the net residential density of a single lot against an entire precinct is usually meaningless.

Always check that the land uses used to calculate the density have been determined consistently.

This is particularly important when comparing gross residential densities and especially when selecting 'local' land uses such as parks and drainage areas. Refer to Section 2.5 for more details.

If you are comparing integrated developments with internal access roads against street accessed dwellings, always use net residential density and not site density.

Always check that variables such as dwelling size and height are roughly equivalent so that you are comparing 'like-with-like'.

For example, in NSW detached houses are usually assumed to be no more than two storeys in height. But in the United Kingdom, three storey homes are common. This means that UK detached houses could, in theory, achieve net residential densities of about 25dw/ha whereas in NSW the maximum net density for detached houses is around 20 dw/ha[10].

Always be careful using 'net developable area'.

The common industry term 'net developable area' usually excludes parks and roads and therefore corresponds to site density, not net residential density.

10 The same confusion can occur over assumptions on average dwelling size. For example, the average size of housing in Denmark is 92m^2. Compare this with the average new detached house in NSW, which is about 275m^2 or 132m^2 for an apartment/terrace (Census 2006).

Park Central, Campbelltown | A case study is provided in the tools section of this guide.

3.8 Be aware of step changes

Labels such as 'low', 'medium' and 'high' density can sometimes be confusing and their use can be misleading. This is because one person's 'medium' can be another person's 'high' and so on. To further complicate things, as stated previously, there is no state or national standard where density measures are concerned.

Policy regulators like local councils and state authorities sometimes also apply different standards. In NSW, the Growth Centres Commission has nominated the following net residential density ranges.

NET DENSITY	NUMBER OF DWELLINGS PER HECTARE
Residential component in mixed use configurations	66 dwellings per hectare
High density development	40 dwellings per hectare
Medium density development	20-40 dwellings per hectare
Low density development	12.5-20 dwellings per hectare

Density range | Minimum net residential density ranges from the Growth Centres Development Code, Section 2, pA-4.

Even if density standards were all consistent, practitioners still find it difficult to picture what these figures mean in terms of development on the ground. Community members often find the figures meaningless. For these reasons, a simple 'rules of thumb' chart can be useful. The chart on the following page shows the relationship between net residential density and built form.

Changes in density drive changes in built form.

The most important feature of this chart is the area where building forms change. Increases in net residential density will always drive changes in the character of built form to meet the standard. However, it is those areas where a small increment in density will often drive a significant 'step change' in the built form that are least understood. These are the areas where confusion, misunderstanding and problems are most likely to occur.

Where are these step changes?

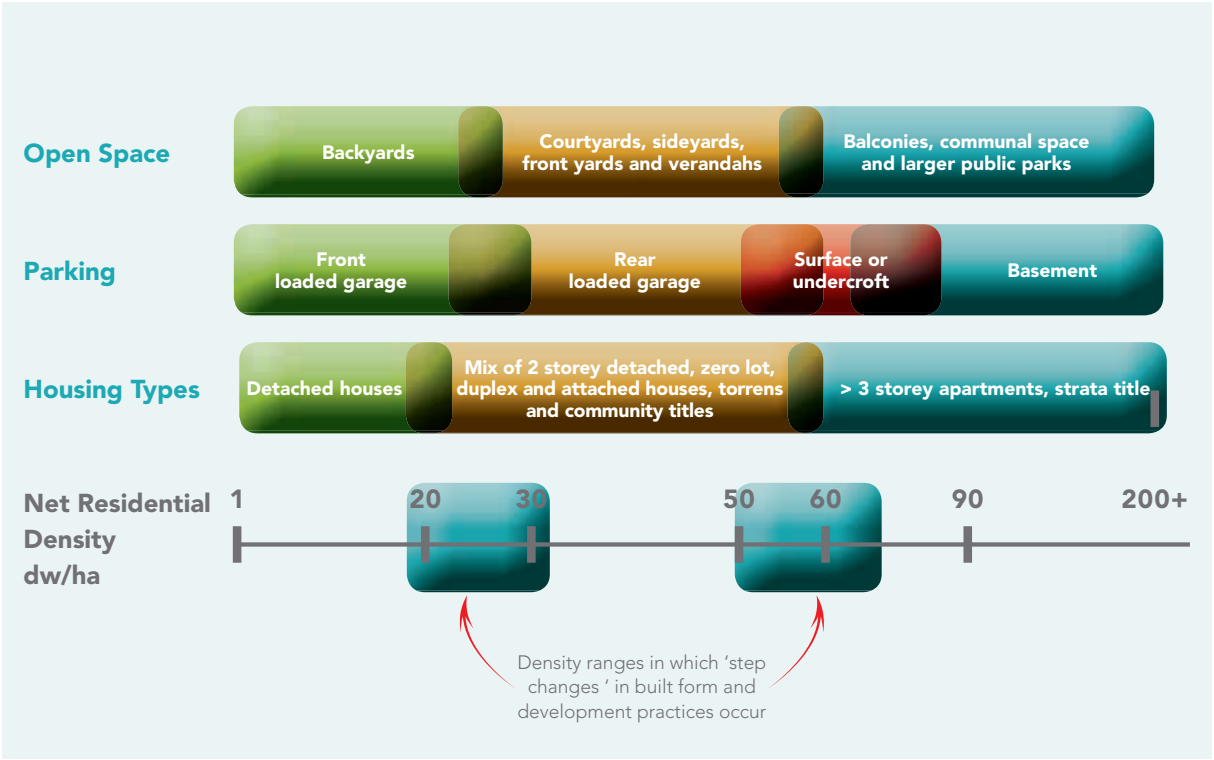
In the lower density range (detached houses on lots over 450m^2) and higher density range (multi-unit apartments), the relationship between built form and density is fairly predictable. However it is in the mid-range densities, especially 20-80dw/ha, that building types and design solutions are most sensitive to small changes in density controls, especially when combined with other development controls. Within these mid-range densities, it is the overlap areas that are shown in the diagram that are the most sensitive.

For example, if you were working on a Growth Centres project that was in a 'medium' net density precinct, i.e. 20-40dw/ha, a quick check of the rules of thumb chart would give you an idea of where your project sits on a 'sliding scale'. It would show that detached houses will not achieve the required density in this precinct. It will also show that front garages will need to be limited (meaning that rear lanes are likely to be necessary).

Associated development controls will also have to be flexible enough to cater for a variety of private open space options, not just backyards.

It is no coincidence that development within this range often generates the most community concern. It is also where unintended or unexpected development outcomes are most likely to occur, often caused by the complex interplay of density and other controls like floor space ratios, car parking requirements or height limits.

Be aware of where step changes occur. If you use rules of thumb, remember they are only a guide. In order to use them effectively, you will need a good understanding of density as outlined in the first section of this guide.



Rules of thumb

3.9 A complementary measure – activity density

This guide is focussed on measures of residential density, which is concerned with numbers of dwellings. However, if your purpose is to assess the viability or demand for services generated by a project, it often isn't the number for dwellings that is most important, but the number of people. For this, we need to determine the activity density.

Activity density (sometimes referred to as activity intensity) measures both the resident population and the number of jobs, to provide an indicator of the intensity of human activity in an area over time.

Activity density is a useful measure when planning or assessing mixed use centres. By including jobs, activity density recognises the contribution of in-bound and home-office workers to the viability and vitality of a centre. It also allows us to measure whether new residential development in a predominantly commercial area will increase activity outside normal business hours, and enhance the viability of the centre.

For further information on activity density, refer to Newman (2007) and Cardew (1996). There is also a case study (for Park Central, Campbelltown) provided in the tools section of this guide that includes activity density.

4.0 Policy issues that may arise in your work

Some planning practices and controls sometimes have unintended consequences that can combine to undermine good objectives. This section describes some of these, and includes suggestions for how they may be addressed.

4.1 The unintended impacts of over-allocating land for non-residential uses

What is the situation?

Simply meeting net residential density targets does not guarantee that gross residential targets will be met. This is because the same net residential density can yield different gross densities depending on the proportion of non-residential land use that is required and included in density calculations.

Areas of higher net residential density are often touted as very 'liveable' places because, when well planned, they offer benefits such as: a variety of housing options, walkable neighbourhoods, easy access to transport options and shops, and access to employment.

However, when areas for non-residential landuses are over-allocated in these neighbourhoods, this can have the unintended impact of undermining the very urban advantages that higher net residential densities were intended to provide.

While landscaped buffer zones, open space areas, and car parks etc may be justified, they need to be very carefully planned, particularly when increased population density is an objective.

Why this is a problem

Any population density gains that might result from more compact residential building forms in greenfield developments may be lost due to the 'suburban' land use practices referred to above.

What is the solution?

One of the simplest ways to address this issue is to ensure open space provision is not excessive and encourage the multiple use of any open space that is provided. Better quality flexible, and well designed space is far better than just 'more space' (refer to Landcom's Open Space Design Guidelines for more on this).

Using the chart on the next page, you could fill in your own project details in the blank spaces to illustrate the impact that land use has on gross residential density. The larger the residential slice of the land use pie, the more likely it is that the population gains made by higher density housing will be retained in a correspondingly high gross residential density. On the other hand, excessively large slices of local open space in the land use pie will push down gross residential densities, and require you to force net residential densities up in order to reach a threshold gross residential density target.

Same net density, different gross densities | The same net residential density can yield different gross residential densities depending on the proportion of local land uses.

Land use allocations affects gross residential density | Template for illustrating the effect of local land use allocation practices on gross residential density

4.2 The impact of car parking requirements for neighbourhoods with small-lot and semi-detached houses

What is the situation?

The way that on-site parking is designed affects the net density of a precinct and the character of a neighbourhood.

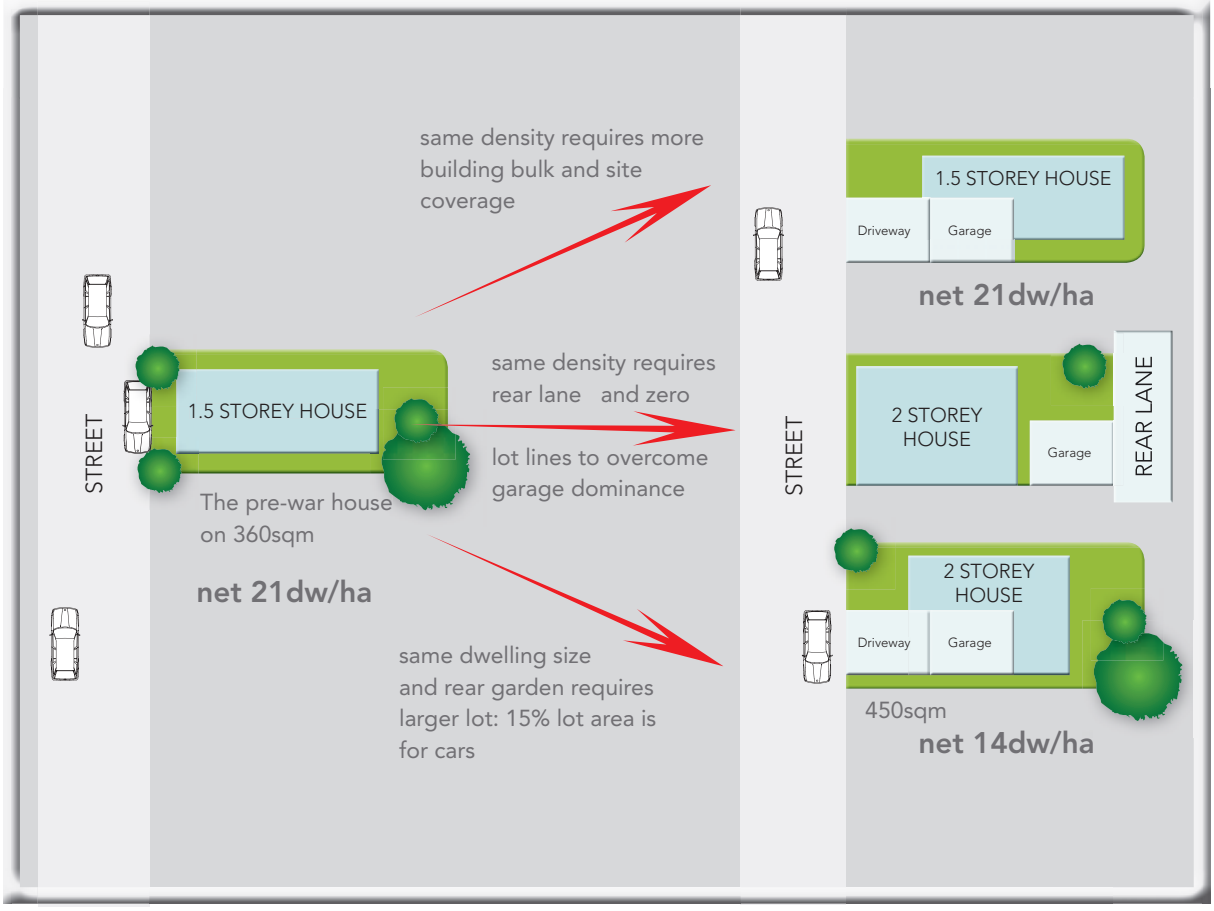
When garages are built on lots larger than 450m^2 , the visual impact is generally low. For smaller lot housing on lots of about 250-450m^2 (about 25-16dw/ha) the design of on-site parking needs to be carefully considered.

Why this is a problem

For smaller lots with smaller houses, the way that garages are designed can impact on the visual amenity of the streetscape. It may also result in garages being used for storage, leading to driveway and on-street parking. Options for rear lanes may need to be considered.

What is the best approach?

Finding the best approach will depend on local circumstances. The aim is to design small-lot and semi-detached housing with appropriate car parking solutions, that do not compromise amenity and any original density advantages. Some suggestions are outlined on the next page.



Car parking requirements affect net residential densities | On site parking requirements either reduce the net residential density or push the typology 'up' in intensity to achieve the same net density.

Option One

One solution might be to consider wider, shallower lots. Although slightly less 'efficient', wider lots can accommodate front and/or double garages more readily.

However, there are disadvantages such as smaller backyards and closer rear facades. It should also be noted that for any given lot area, the wider the lot frontage, the longer the street frontage of the house and, the lower the density will be. For example, in the case of 300m^2 lots in a 124m block length:

i. lots @ 10m wide x 30m long = 22dw/ha

ii. lots @ 12m wide x 25m long = 21dw/ha

iii. lots @ 13.5m wide x 22.2m long = 20.5dw/ha

Option Two

The provision of rear lanes in conjunction with accessory dwellings may also be an option.

While rear lanes tend to improve the front presentation of a development, they do add street area. However if rear lanes are provided in conjunction with accessory dwellings over rear garages, they may actually increase overall net residential density for a given development.

Option Three

Consider the design of streets and housing forms together and tailor each according to need.

Experience shows that higher density residential forms generate higher on-street parking demand, regardless of any on-site parking provision. This means that streets with lots that are less than 15m wide will need on-street parking lanes on both sides with few kerb cuts to maximise on-street parking spaces.

This is why Landcom's Street Design Guidelines recommend that, wherever lot widths of less than 15m are proposed, a 'local street' type should be used (i.e. with a total reserve 17.4m wide made up of two parking lanes and two travel lanes).

Garage-top studios | Garden Gates, Mt Annan

4.3 Development controls that stifle variety

What is the situation?

Some development standards and subdivision controls like minimum lot size, minimum block width or the prohibition of rear lanes, can unintentionally preclude attached and semi-detached housing forms and may limit housing forms to detached houses or residential flat buildings (assuming these are permitted).

However, attached and semi-detached housing forms offer the greatest potential to achieve higher density targets while still meeting many consumer and community preferences. Attached and semi-detached houses can be built on Torrens title, and they have their own front door, letterbox, garbage collection and ground level private open space.

If these forms of housing are precluded, equivalent net residential densities may only be achieved through strata titled apartment buildings.

Why this is a problem

Practitioners working on greenfield projects where development controls favour detached houses still need to meet overall dwelling or density targets. In this case, the residential mix may be polarised into either detached houses (which are easier to build under the Housing Code) and/or apartments[11].

However, a mix of housing options is one of the fundamental requirements for mixed communities, which, in turn, is a key requirement for socially sustainable places.

In addition, residential flat buildings tend to generate more community opposition than other housing forms, particularly for infill developments in existing low density urban areas. This is because they are sometimes inconsistent with the prevailing neighbourhood character. If there was wider choice in the housing forms available to achieve a given density, it may be possible to design new buildings that were more consistent with established characters.

What is the solution?

Always undertake a careful analysis of prevailing development controls to ensure that, wherever housing diversity is intended, all housing types will actually be permitted (refer to the Density Tools provided with this guide).

There may be situations where the local council sees existing controls as a way of protecting the quality of detached housing. Under these circumstances, one way of addressing this issue may be to require a separate set of standards for attached and semi-attached dwellings.

11 See also Landcom's Housing Diversity Guide, Section 2.

Minimum lot size affects housing mix | If the minimum lot size control rules out these mid-range housing types, then the housing mix is polarized into detached houses and strata title apartments.

5.0 Density tools

This guide is accompanied by some practical tools that can be used at various stages of the planning and development process. These tools explain the relationships between building controls, densities and the built form that is actually delivered on the ground. This toolkit includes:

Reference Charts

- Net residential density
- Gross residential density
- Residential density and planning controls

Housing typology charts

- Front access houses (lot depth 30m)
- Front access houses (lot depth 20m)
- Rear access houses
- Multi-unit buildings (2-3 storeys)

Case studies

Remember that the information provided in this document is a guide only. The particular site, its purpose and context, should always guide the planning and design of specific projects.

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