The Problem of Catchment in Centres-Based Residential Growth Planning

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Centres-based residential intensification is a common policy in New Zealand's main urban areas. Theoretical catchments oriented around convenient walking distance and the iconic 800m radius circle have come to dominate this thinking. It is proposed that these circles are not entirely suitable for this task given the significant oversimplifications they rely on about what is walkable, and what is developable.

This article is the first of three hoping to provoke greater discussion around our thinking about centres and growth management planning. A second article focussing on development viability issues within growth centres, and a third on how these centres-based growth challenges together might be confronted, will be released in 2010 editions of *Urban*.

Centres-based growth planning under the spotlight

The proposition that intensification around centres will bring benefits and efficiencies to low-density settlements has been corroborated repeatedly in international research. These locations offer the best opportunities for people to engage in social, economic, environmental, and cultural exchange with the least amount of energy input. Newman and Kenworthy, 1999[1], have succinctly summarised the issue (p 58):

> *"The economic analysis… suggests that something fundamental has gone wrong with our approach to cities when we plan them around automobiles. It is quite simply the biggest part of the sustainability agenda for cities to reverse these patterns and achieve an approach that reduces the environmental and social impacts of excessive automobile usage while simultaneously improving the city's economy."*

Such settlements appear to typify the New Zealand dream to date: the Auckland Regional Council, 2009[2] (p 14) has stated that current development patterns are part of a "*…private car culture*". The Ministry for the Environment, 2005[3], has outlined some of the problems these patterns have been associated with (p 9):

> *"…traffic congestion, unsustainable energy use, overloaded urban infrastructure, a lack of distinctive identity, social isolation, and reduced physical activity with its associated problems such as obesity, diabetes and heart disease."*

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[1] P Newman, and J Kenworthy, 1999, '*Sustainability and Cities: Overcoming Automobile Dependence*', Washington: Island Press.
[2] Auckland Regional Council, 2009, '*Long Term Council Community Plan 2009 – 2019*', Auckland: ARC.
[3] Ministry for the Environment, 2005, '*New Zealand Urban Design Protocol*', Wellington: MfE.

It is not proposed to revisit these arguments here; suffice to say that policies calling for consolidated urban forms anchored around centres (and passenger transport spines) have been adopted widely across New Zealand. As one example, the Reasons for Objective 6.1 of the Christchurch City Plan, 2005[4], state:

> *"Studies undertaken by the Council point to urban consolidation being the most sustainable urban growth option. … consolidation is more energy efficient and has the least adverse effects…."*

The 800m Radius Circle

The 800m circle has become accepted as representing a convenient 10 minute walk for most people in a community (based on a walk speed averaging 1.3m/s across the journey and including minor delays). This is of course a normative, average journey. People walking slower at 1m/s average will cover around 600m; those walking faster at 1.5m/s average may cover around 900m.

Climate and in particular topography also play a part - walking speed will reduce by 15% or more once gradient exceeds 10% (Ladetto, et. al., 2000[5]). Perceived safety, route quality and interest, and land use attractors are also critical. Ewing, 1999[6], has summarised a number of other factors which can encourage pedestrian activity.

If walkability is to be a key determinant of where intensification should be favoured, then catchments should be based on some reasonable, realistic measure appropriate to the whole community and applied through a wide filter of local geospatial characteristics. Auckland City, in its *Growth Management Strategy* 2003[7], identified a number of 'Areas of Change' to concentrate new growth (**Figure 1**). These are defined by an 800m radius circle. 1,000m radius circles have been applied to the Newmarket and Otahuhu Areas of Change, identifying that these centres offer particular amenities and services whereby people are assumed to be willing to walk farther to access them.

For the purposes of this article, the 10 minute / 800m distance will be adopted as an appropriate, robust measure for a community walking catchment.

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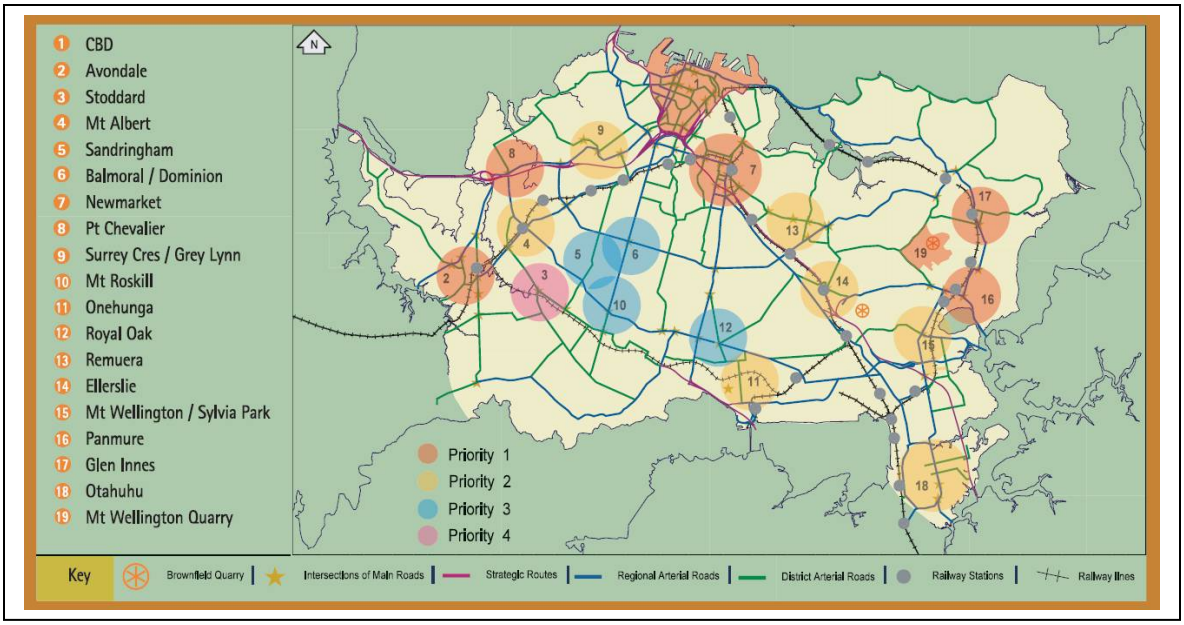
[4] Christchurch City Council, '*Christchurch City Plan*', Christchurch: CCC, Partially Operative from 21 November 2005, http://www.cityplan.ccc.govt.nz/NXT/gateway.dll?f=templates&fn=default.htm.

[5] Q Ladetto, et. al., 'Human Walking Analysis Assisted by DGPS', research paper, Geodetic Laboratory, Swiss Federal Institute of Technology, Lausanne, Switzerland.

[6] R Ewing, 1999, '*Pedestrian and Transit Friendly Design: A Primer for Smart Growth*', Washington: Smart Growth Network.

[7] Auckland City Council, 2003, '*Growth Management Strategy*', Auckland: ACC.

FIGURE 1: Areas of Change, from Auckland City Growth Management Strategy, 2003.



Deconstructing the 800m Radius Circle

The 800m radius circle encompasses approximately 200ha of land. But it is worth contemplating the nature of circles. A doubling of radius will generally quadruple the area within it; a 400m radius circle encompasses 50ha, and a 200m radius circle 12.5ha. The implication for growth planning is clear – the greatest amount of area (and hence land possible for intensification) will always exist at the periphery.

The emphasis must be in ensuring that people can walk as much of the 800m as possible. Severances including highways, rivers, and indeed large urban blocks will limit the 'as the crow flies' distance inside that 800m radius circle which can actually be traversed by the pedestrian. Second to outright physical severance is major route delay, usually manifested at very busy road crossings. A major arterial road geared towards vehicle movement efficiency with a one minute signal delay for pedestrians will reduce walkability by 78m (or more), or around 10% of the trip length.

Not all Land can be Developed

Roads, open spaces, schools and the like, will not tend to be developed for residential activities. This necessary infrastructure can require 30% to 40% of gross land area - the finest-grain grid structures can see up to 36% of available land used *just for roads* (CMHC, 2002[8]). Critical employment or business areas which are not highly compatible with residential development should also be subtracted from the residential development pool, including in some instances generically zoned 'mixed use' land. Large undeveloped blocks should have some additional provision for these inefficiencies made.

[8] Refer to Canada Mortgage and Housing Corporation, 2002, http://www.cmhc-schl.gc.ca/publications/en/rh-pr/tech/socio75.html.

Once the land area has been corrected around actual walkability an understanding of the amount of land that is developable for residential activities will become clearer. Experience suggests that in many centres this may be as little as 30 – 40ha. This will still be a misleading figure. Orientation, historical boundary alignments, building stock issues, and topography will in particular work to limit the efficiency at which land can be developed.

It may also be unrealistic to assume that the available land will all be developable within a 20 or even 30 year timeframe. Once these have been factored in, less than 50% of the land identified as theoretically developable may be realistically available. This can feasibly drop well below 10% of the initial 200ha circle.

Additional Limitations of Residential Buildings

Despite generous site coverage, height limits, and floor area ratio controls, residential units require circulation space; visual separation; daylight access; and some outlook area. There is often additional demand for surface area such as for private open space or car parking / manoeuvring. Much of a theoretically developable site will not be occupied by residential buildings.

The North Shore City Council, in its *Good Solutions Guide to Mixed Use Development in Centres*, 2005[9] (p 29), recommends that around 14m is the maximum ideal depth of a residential building before more complex solutions for daylight access are required (such as central light shafts whereby habitable room windows must face internal common hallways). Depths of up to 8m can deliver acceptable levels of daylight if coupled with appropriate stud and window heights. Combined with a circulation core this can deliver building depths of 20m or more.

To achieve visual outlook as an appealing amenity rather than just an absolute minimum privacy space, it is suggested a separation of at least 20m between buildings be encouraged. When this is factored with maximum residential building dimensions, a residential building site coverage of between 30% to 50% may be at best all that is possible. Residential towers commonly represent 10% or less site coverage. An estimate of 40% is proposed as a generous rule of thumb for intensive residential building coverage. While some solutions can exceed this coverage, they tend to be on smaller blocks that are well served by roads and voids (i.e. the land inefficiency has been addressed previously in the urban structure). Multiplied by an estimate of likely habitable levels this will then identify a gross floor area (GFA) which approaches what may be a realistic estimate.

There should then be one final discount, being the internal circulation and other common spaces within buildings which should not be considered as net habitable residential floor area. This can range from anywhere between 10% to 20% of the total area. This final residential GFA can then be divided by an average unit size to give an estimate of likely unit numbers possible.

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[9] North Shore City Council, 2005, '*Good Solutions Guide for Mixed Use Development in Town Centres*', Takapuna: NSCC.

Summary: Only a Fraction of Land will be Built On

These come together to reduce the amount of residential floor area plausible within a growth centre. It is this heavily reduced figure that should form the basis of growth capacity modeling and planning. In summary:

1. The 800m radius circle needs to be reduced to an 800m walkable catchment;
2. The walkable catchment needs to be reduced to a gross developable area;
3. The gross developable area needs to be reduced to a net developable area;
4. The net developable area needs to be reduced to a gross building area;
5. The gross building area needs to be reduced to a net residential floor area; and then
6. This can be used to give a more realistic estimate of units deliverable in the catchment.

A Case Study: Albany Sub Regional Centre.

Albany is a (rapidly developing) Greenfield centre in North Shore City identified by the North Shore City Council as one of two sub-regional centres in that city. The other is Takapuna. The Council has identified a target of 30,000 people (12,000 households) to be accommodated in these two centres by 2039[10]. Given that Albany is partially vacant whereas Takapuna has been historically developed, one might look for more than 50% of that allocated growth to locate in Albany. But assuming a 50/50 split, this suggests that up to 15,000 people or 6,000 households should be provided in Albany by 2039. This article will work with this estimate. In an 800m radius circle, this equates to a rather modest average density of 30 households per hectare (hh/ha), excluding for the moment land required for non residential activities.

As shown in **Figure 2**, the actual walkable catchment is around 122ha. The required residential density now becomes 49hh/ha. Once roads, reserves, and community uses including the North Harbour Stadium have been removed this becomes 75ha, requiring a density of 80hh/ha (**Figure 3**). In **Figure 3**, land which has been already developed for non-residential uses has also been removed, leaving 33ha and a required density of 182hh/ha.

[10] North Shore City Council, 2009, '*City Plan 2009 – 2024*', Takapuna: NSCC, Module 2: City Direction, p 42.

FIGURE 2: Walkable catchment of Albany centre.

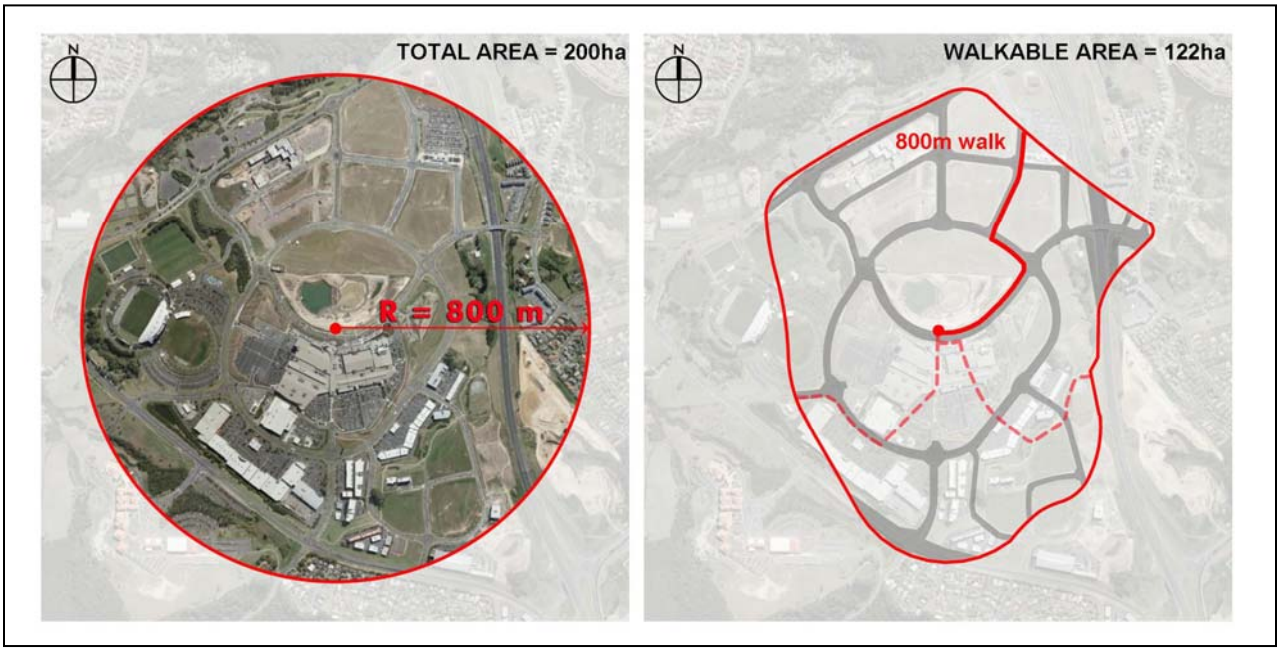


FIGURE 3: Land not available for residential development.

Figure 4 factors in land on which development consents have been approved, with an assumption that these will be given effect to. These include around 1,500 residential units. None have yet been built.

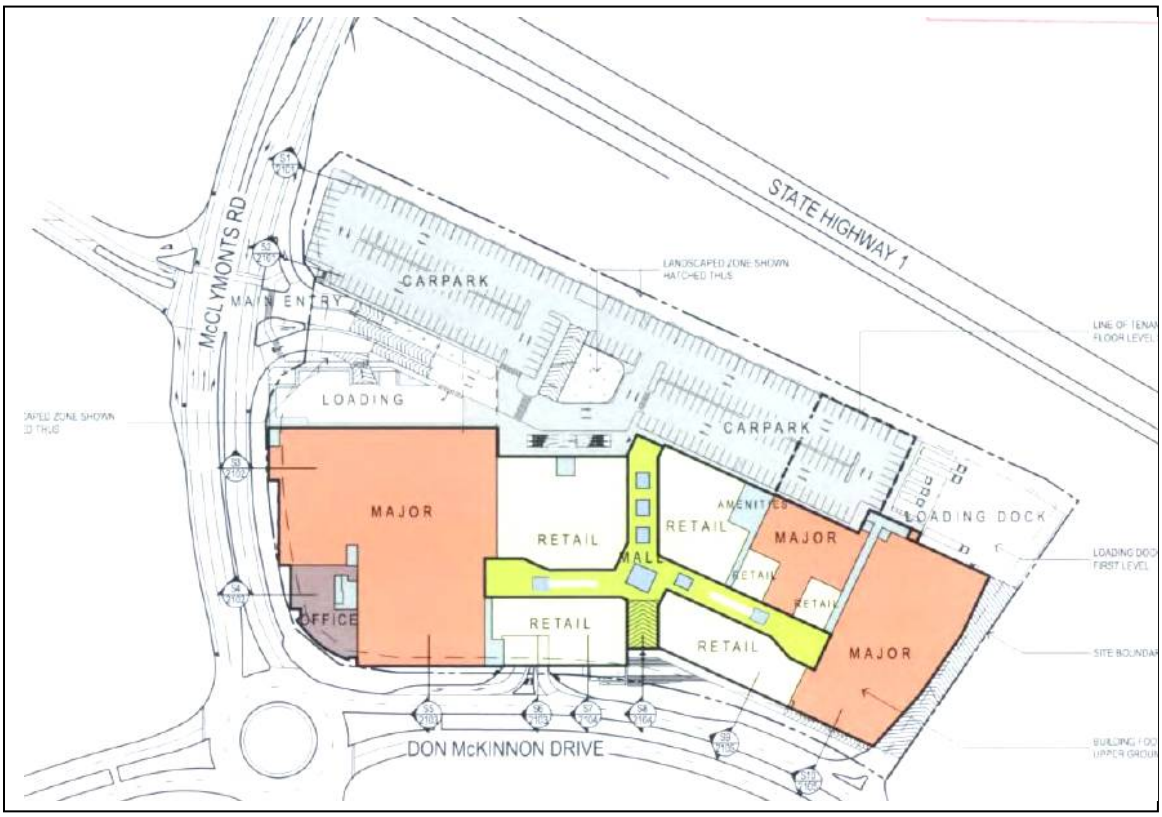
FIGURE 4: Land consented for development or likely to be non-residential in use.

This leaves some 23ha of land still vacant to accommodate approximately 4,500 units (a density of 196hh/ha). However 6ha of this is zoned Business 6 or 7, intended for office park-type development. While residential activities could be applied for as a Discretionary Activity, current indications seem to be that this land will be developed purely for business uses. Another 2.55 ha is zoned Business 11D, a car-oriented commercial and entertainment zone where residential is a Non Complying Activity. This in turn leaves 14.45ha of vacant land, zoned a combination of Area D: Varied Residential (0.46ha), Business 11A (11.88ha), and 11B (2.11ha). The required average density is now some 311hh/ha.

The Business 11A and 11B land is mixed use, with compulsory requirements on business activity (for instance at the ground level), but no compulsory requirement for any residential activity. In July 2009, a land use consent was approved for a site zoned Business 11A at 98 McClymonts Rd. This development was for a retail and business activity with no residential component included[11] (**Figure 5**).

[11] Please refer to North Shore City Council Land Use Consent Application no. LN 2128283.

FIGURE 5: Non-residential development approved in July 2009 in the Albany Business 11A Zone.



This is worth particular consideration as it is the most recent indication of where the market sits. That site enjoys provision for an unlimited building height / 6:1 floor area ratio control. Significant development outcomes could eventuate. One might therefore think that the land was worth more than a few levels of low intensity retail, and commercial. But a peculiarity of the Albany centre is that the land structure is currently leasehold rather than freehold. This may have an impact on the nature and mix of land uses which are attractive to consumers of particular activities. It is also possible that with approximately 1,500 residential units already approved but not constructed, there may be a natural market saturation point or congestion that discourages further consents being sought. If this was the case, it may make equally little sense to simply leave expensive land sitting vacant until that congestion clears over time if there are other uses which would give a satisfactory return in the mean time. Pragmatism and timing may ultimately prove as much of a factor in what land uses are delivered in Albany as theoretically ideal ones or even possible market-ideal ones. This does not mean that residential may not eventually locate on those sites, but it may push its delivery back by several decades.

Significant Development Likely Required on Land Used for Residential

It is therefore suggested that based on current circumstances (which may change) up to or even more than half of this vacant land may not be used for residential purposes. This would leave some 7.23ha of land available for residential development, with around 4,500 units to be accommodated at a required density of 622hh/ha. By way of reference a

significant residential-dominant development at 80 Don McKinnon Drive, Albany provides for 503 residential units including two towers over 25 levels high on 1.6ha – a density of 314hh/ha.

If that 7.23ha were multiplied by 40% as an indicative but generous residential site coverage (leaving 2.9ha of actual residential buildings), and then again by 90% to subtract circulation and communal floor-space, an estimated residential floor area of 2.61ha net remains. This equates to a required density of 2,298 units per hectare of land occupied by residential floor space. Indicatively, if an average unit size is 70m^2, then up to 143 units could be deliverable per net hectare of residential floor space (assumed to be in a configuration of buildings which allowed this optimum to occur). It would take at least 16 levels of uniform residential floor space to accommodate this (distinct from sporadic tower forms), plus at least one ground level commercial floor. This would equate to buildings of around 52m height. The height limit in the Area D residential Zone is 9m. In the Business 11A and 11B Zones a combination of 20 and 30m height limits applies (6 – 9 levels including a 4m commercial ground level). As noted earlier in respect of the business development at 98 McClymonts Rd, part of the 11A zoned land comes with an opportunity via land use consent to enjoy an unlimited height at a floor area ratio of up to 6:1.

The Current Rules May Not Prove Sufficient

The Area D zone is a full residential zone. The Business 11A zone requires business activity on the ground floor, and in the 11B zone business is required on the ground, first and second floors. If the 2.61ha net residential floor space is divided *pro rata* between the three zones, and development yield (i.e. building height) is based on permitted District Plan rules, then:

- → Area D Zone: 0.09ha x 3 residential levels = 0.27ha residential floor space;
- → 11A Zone: 2.13ha x 8 residential levels average = 17.04ha residential floor space; and
- → 11B Zone: 0.39ha x 4 residential levels average = 1.56ha residential floor space.

This sums to a total residential floor space of 18.87ha. At an average unit size of 70m^2, a total of around 2,696 units could eventuate. Combined with those units already approved, this would suggest a total of almost 4,200 units. This would be a shortfall of up to 1,800 units or 30% of the possible target of 6,000 households. While that part of the Business 11A Zone subject to an unlimited height / 6:1 floor area ratio provision may be utilised to boost unit numbers, it would need to be heavily geared for tower outcomes.

Reflecting the building constraints discussed earlier, an approved residential tower at 80 Don McKinnon Drive provides 212 units over 28 residential levels (plus additional podium levels) at a building height in the order of 130m. It has an average of 7.5 units per level. Using this average a single 30-level residential tower located above the 8 residential levels already accounted for in the Business 11A zone calculations above would add an additional 22 x 7.5 = 165 units. To address a shortfall of 1,800 units up to 11 x 30 level residential towers could be required. It is difficult to see how this could be

feasible on the land available while delivering the sense of openness, views, and outlook likely to be demanded by the market for units at such heights.

Reality Always Different

These calculations have been simple, and could be rightly criticised for using any number of assumptions. But they are by no means a worst case scenario for Albany. The point here has not been to categorically analyse Albany centre; it has been to highlight the difficulties of basing strategic planning around over-simplistic land area based yield assumptions. Ultimately, theoretical residential floor area and unit yields cannot be separated from practical building design and amenity constraints. The calculations suggest that under a certain feasible scenario growth in Albany may fall well short of the level apparently hoped for.

There are of course many other variables, and several circumstances could eventuate to see the 6,000 unit target met or exceeded in Albany, including:

- → much more of the currently vacant land being developed for residential uses than has been estimated (especially in the Business 11A zone);
- → average unit size being smaller than 70m^2 per unit;
- → occupancy per household may change in a way not predicted;
- → active redevelopment of land for residential uses that has already been developed for business uses, for instance some of the areas of large format retailing (the oldest being the Albany Mega Centre). It would indeed seem that this may be a necessary process if Albany is to eventually accommodate 6,000 or more units. The question remains whether that process could sufficiently cycle through within a timeframe of just 30 years given how young much of the building stock is.

In conclusion it is not being asserted that Albany centre will not meet current residential growth targets by 2039. But at the least this seems a far from certain prospect, and there is a risk that a considerable unit shortfall may indeed result.

Does It Really Matter if a Growth Target Isn't Met?

This becomes a problem if that risk manifests across many centres together. North Shore City, 2009[12], has identified that to 2039, intensification in its 2 sub regional and 9 larger town centres will accommodate some 50% of residential growth. An additional 35% is planned for intensification corridors including the Wairau Rd spine along the city's geographic centre. This is some 80,000 people. There appears to be no scenario for what would happen if a third or more of that growth simply cannot be accommodated as is hoped should current unit capacity estimates prove over-optimistic.

The impact of a growth planning shortfall of several thousand households in centres and corridors will have severely negative ramifications, especially if other locations for possible development have been constrained. Affordability, if actual housing supply does become unintentionally restricted due to a substantial net overestimate in what can actually be delivered in centres, would be an obvious one.

[12] North Shore City Council, 2009, op. cit.

Centre-based intensification is being heavily relied on in growth planning. On the evidence, there are sound reasons for this. North Shore's approach is entirely consistent with that being taken in several other New Zealand cities. It would seem to be a critical imperative that growth targets in centres are made with confidence that the targets will be achievable (akin to a minimum-deliverable rather than a maximum-ideal). But the robustness of current methodologies is not clear at this time.