



Department of **Planning,**  
**Lands and Heritage**

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# DESIGN WA

## DRAFT MEDIUM DENSITY CODE

### TESTING REPORT

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*The Draft Medium Density Code Testing Report was produced by the Department of Planning, Lands and Heritage on behalf of the Western Australian Planning Commission as part of Design WA Stage Three - Medium Density.*

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# INTRODUCTION

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# Introduction

## Purpose

A series of design and feasibility testing was undertaken during the development of the draft Medium Density Code (the Code) to better understand the effects of draft Code settings on design outcomes and development feasibility. Two phases of testing were undertaken, this report provides a summary of the design concepts and key findings.

The structure of the report follows the scope of the testing. Phase 1 & 2 testing: summary of method and key findings.

Phase 1 & 2 design concepts: floor plans, design description, construction costs / feasibility and implications of draft code settings.

## Street block study

A comparative block study has been undertaken on a typical street block in a 'middle ring' suburb. The study speculates on a business-as-usual approach to infill development in contrast to what may be able to be achieved under the Medium Density Code.

The Medium Density Code block study demonstrates a greater range of building types, improved dwelling orientation and access to usable outdoor space. It contrasts with the business-as-usual with significantly improved tree numbers and deep soil areas.

## Testing phases

### Phase 1 - Early Testing – (Q1 2020)

Phase 1 - Early testing involved commissioning twelve designers with a range of experience and expertise, to prepare designs for six sites. The testing focused on exploring the different built form housing typologies the draft Code could enable, the benefits to typologies currently supported by the existing R-Codes, and to test the implications of preliminary deemed-to-comply provisions for design outcomes and construction costs. The selected sites deliberately varied in terms of street frontage, size/dimensions, topography, orientation and density coding, allowing the draft Code provisions to be tested against a range of conditions. The findings from Phase 1 and associated feedback were used to inform revisions to the draft Code settings.

### Phase 2 Testing – (Q3 2020)

The second phase of testing was undertaken to test the implications of the revised policy settings (that had arisen from Phase 1 testing) for design and project construction costs. Phase 2 testing examined the capacity of the Code settings to deliver a range of housing types, from 'business as usual' villas/grouped dwellings, through to terraces and low-rise apartments. These typologies were then costed by industry. Phase 2 testing had a more clearly defined scope and brief and as a result, the costings were more aligned with market expectations.

Both phases of testing demonstrated how the draft Code provisions impacted on design outcomes and construction costs. This information was then applied to fine-tune the policy so that a balance could be achieved between promoting more diverse, better designed housing and feasible construction.

It is important that the initial policy settings tested in Phase 1 were developed prior to the State of Emergency declared on 16 March 2020 in response to the COVID-19 pandemic. The Phase 2 testing and subsequent adjustments to Code provisions, factored in the altered economic environment and lifestyle priorities that became evident from the pandemic. While this did delay the policy, the additional rigor of this testing has produced settings that are more attuned to the changed circumstances of COVID-19 recovery.

## Next steps

The design testing phases confirmed the capacity of the policy settings to respond to a range of contexts, sites, and to deliver a diversity of housing typologies. The testing also provided good insights into the implications of the policy for construction costs and feasibility across a range of land value areas.

During public consultation period for the Medium Density Code, the policy provisions will be subject to broad stakeholder input and this may result in changes to some settings. This may require further testing to be undertaken to ensure any changes are considerate of construction costs and anticipated market demand, while delivering quality design outcomes.

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# **STREET BLOCK STUDY**

# Street block study

## Block study 1 - Business-as-usual approach

The 'business as usual' street block study represents a street block in suburban Perth where medium density infill is underway, having been rezoned to R40. The original parent lot sizes are around 728sqm, with a grid urban structure of mostly regular shaped lots. The block is representative of areas across Perth that have seen significant infill development, which have resulted in the demolition of the original dwellings, removal of trees on the lot and the construction of detached villa style grouped dwellings (triplexes). The grouped dwelling sites typically have a 40% dwelling footprint and dedicate 40% of the lot to impermeable surfaces for car manoeuvring and parking. Typically up to 15% of the lot is allocated to deep soil areas with a large portion delivered as fragmented space. There is no requirement for tree planting on these sites.

## Block study 2 - Draft Medium Density Code approach

Design concepts from the testing phases demonstrate the benefits of the Medium Density Code at a neighbourhood scale. Requirements for 20% deep soil areas, additional trees per dwelling and reduced requirements for carparking have a cumulative effect when considered across a street block.

This study is speculative, for comparison purposes only and does not represent a 'true' infill scenario, nor represent fully deemed-to-comply outcomes. However, deep soil areas minimums and trees have been calculated to align closely with the Medium Density Code provisions and are in stark contrast to those achieved through business-as-usual approach.

## Yield Comparison

When comparing yields across the street block, higher yields may be achieved with the Medium Density Code approach. Design concepts on amalgamated or large lots may apply site category 2 and 3 minimum and average yields to achieve higher dwelling numbers than business-as-usual. For example, the design concept on lot 18-19 (see keyplan) apply site category 3 average site areas to achieve a yield of 10 dwellings, compared to a 6 dwelling yield for a business-as-usual approach. Additionally, a 4 dwelling yield has been achieved on corner and mid-block lots through small dwelling site area concessions.

### Outcomes from Block study 1 - business-as-usual:





- predominance of single storey 'villa' type grouped dwellings
- limited diversity of building types, size and price points
- very little, if any, tree canopy
- site by site (incremental) development limits planning efficiencies

### Outcomes from Block study 2 - Medium density code:

- significantly more deep soil areas to support tree canopy
- better building orientation and connection to gardens
- mix of single and two storey development
- more diverse building types, sizes and price points
- reduction in impervious surfaces
- flexible car parking, with more space for people and other uses

The table below compares data from the two block studies for significant factors such as yield, building type and trees.

## Street block study comparison

		Block study 1 - Business-as-usual approach	Block study 2 - Medium Density Code approach
 <b>Yield</b>	Building type		
	Grouped (duplex)	4 dwellings	2 dwellings
	Grouped (triplex)	54 dwellings	21 dwellings
	Grouped (quadraplex)	Nil	12 dwellings
	Single attached (terraces)	Nil	30 dwellings
	Apartments	Nil	6 dwellings
<b>TOTAL</b>		<b>58 dwellings</b>	<b>71 dwellings</b>
 <b>Deep soil areas (average)</b>	1,875m <sup>2</sup> (12%)	4,140m <sup>2</sup> (27%)	
 <b>Trees</b>	6 small trees	120 small and medium trees (20x more trees than block study 1)	
 <b>Parking</b>	116 carparking (2:1 parking to dwelling ratio)	126 carparking (1.7:1 parking to dwelling ratio)	

# Block Study 1 - Business-as-usual approach



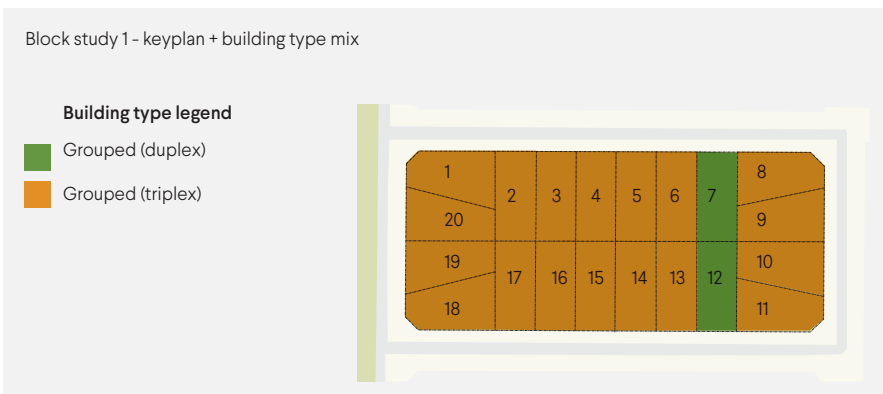
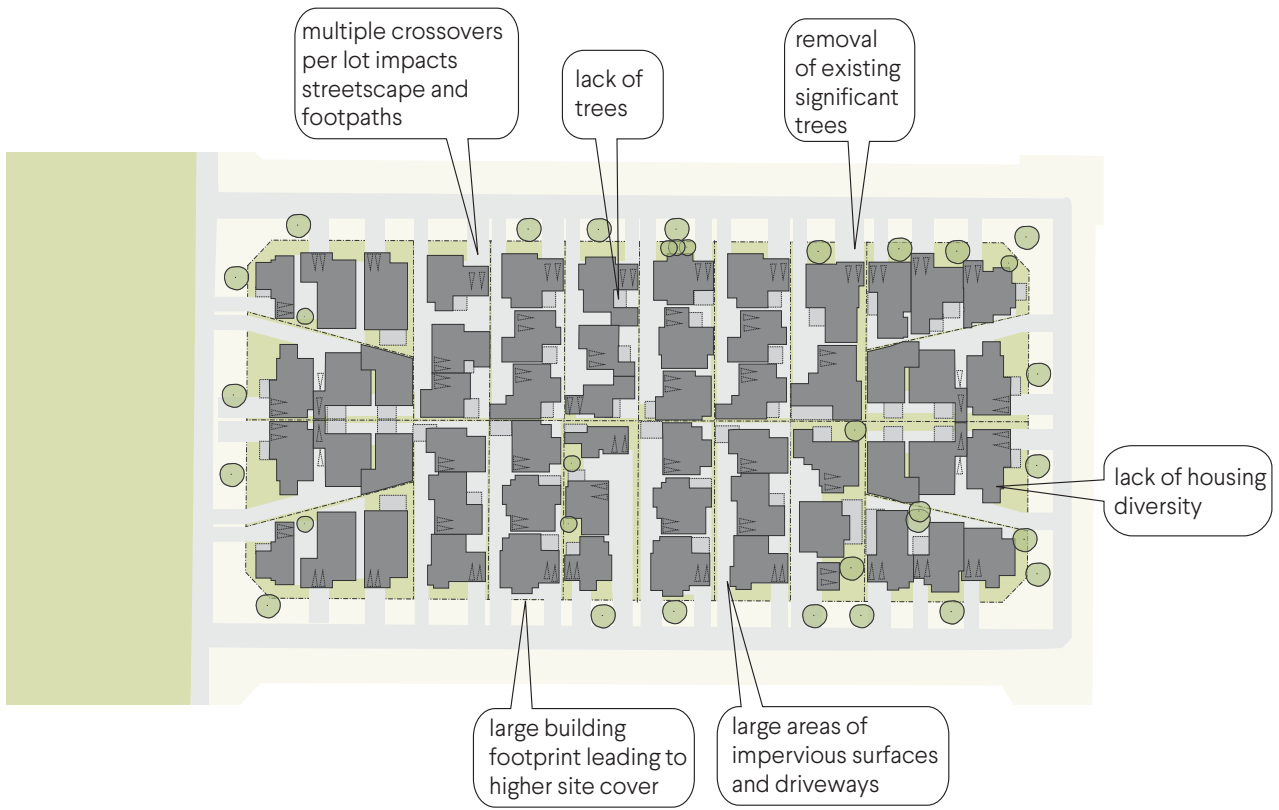
Photo credit: DPLH



Photo credit: DPLH



Photo credit: DPLH





## Block Study 2 - Draft Medium Density Code approach



Photo credit: DPLH



Photo credit: DPLH



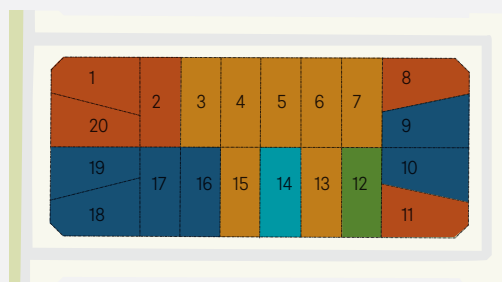
Photo credit: Dion Robeson | MJA Studio | Stock Road Attadale



Block study 2- keyplan + building type mix

### Building type legend

- Grouped (duplex)
- Grouped (triplex)
- Grouped (quadraplex)
- Single attached (terraces)
- Apartments



### Block study 2 reference concepts

**Phase 2 - Current Testing**  
 Site 4, -6, 13: Concept 2 (pg 11)  
 Sites 9, 10, 16-17: Concept 4 (pg 13)  
 Site 14: Concept 5 (pg 14)  
 Sites 2, 20: Concept 6 (pg 15)

**Phase 1 - Early Testing**  
 Site 1: Concept 1E (pg 29)  
 Sites 3, 7, 15: Concept 1D (pg 28)

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# **PHASE 2**

## CURRENT TESTING

# Phase 2 Testing (Q3 2020)

Phase 2 tested the preliminary draft Medium Density Code provisions on one predominant medium density site, with one designer commissioned to produce six typical medium density concepts for design and construction feasibility.

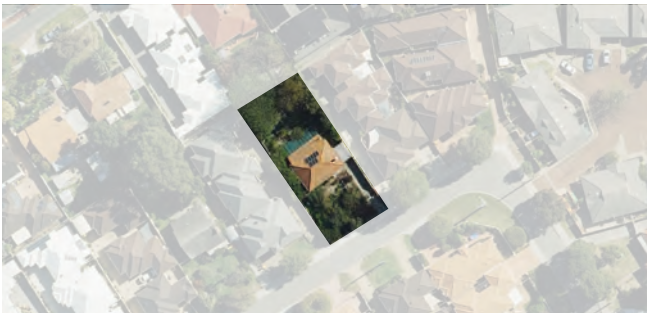
Phase 2 – current testing was aimed at reviewing the revised settings to:

- confirm the draft Code is capable of delivering good design outcomes;
- confirm the draft Code can deliver a range of typical medium density building types within a cost range consistent with industry expectations; and
- better understand the implications of location and land values on project feasibility.

## Method

The Department conducted GIS analysis to establish predominant lot types and coding for medium density development across the Perth and Peel region. This resulted in the selection of the most typical lot type being used for the purpose of Phase 2 testing.

*Phase 2 lot characteristics:* R40  
728m<sup>2</sup> site area  
18m frontage



Peter Hobbs Architects was then engaged to design six concepts on the selected site for cost estimates and feasibility based on two land values. The design briefs for the six design concepts were as follows:

### Concept 1. Grouped dwellings- 15% deep soil area

3 x single-storey grouped dwellings (all 3x2x2\*) designed to achieve 15% deep soil area.

### Concept 2. Grouped dwellings- 20% deep soil area

3 x single-storey grouped dwellings designed to achieve 20% deep soil area and test the implications of the draft Code as a comparison to BAU concept 1.

### Concept 3. Grouped dwellings - two storey

3 x two storey grouped dwellings to demonstrate site area efficiencies of two storey development and compare the project feasibility applying different land values.

### Concept 4. Attached dwellings (terrace typology)

3 x two storey terraces to test feasibility and design benefits of terrace typology compared with BAU triplex.

### Concept 5. Multiple dwellings (suburban apartment)

6 x multiple dwellings to test design, construction cost and feasibility outcomes.

### Concept 6. Grouped dwellings - small dwelling concession

4 x grouped dwellings to test uptake of small dwelling concession and feasibility of additional dwelling yield.

BGC Developments (Now Living) then costed and assessed feasibility of selected concepts to provide an industry led evaluation of the financial implications of the draft Code. Feasibility estimates were based on assumed land values of \$450,000 and \$650,000 to further examine the impacts of location on development viability.

## Key findings

Phase 2 of testing confirmed the assumptions of Phase 1 testing in that two storey development using conventional construction techniques was a key driver of cost. And that the location of the development and land value played a key role in the feasibility of medium density projects.

**Concept 1** demonstrated that at 15% DSA, the draft Code did little to change the business as usual approach to medium density development which is delivering some poor designs and unsustainable development outcomes.

**Concept 2** (20% DSA) was able to achieve amenity benefits for outdoor areas and allowed space for trees. Concept 2 also achieved housing diversity, whilst being single storey to keep construction costs down.

**Concept 3** was in the form of two-storey triplex development that achieved three 3x2x2\* grouped dwellings. It clearly demonstrated that two storey development delivered site efficiencies and provided good amenity for occupants through building separation, solar access, garden size and dwelling room sizes and layout.

**Concept 4** provided a terrace model as an alternative to the traditional triplex. It demonstrated that this building typology could benefit the streetscape and achieve good outcomes for solar access, natural ventilation, garden space and dwelling room sizes and layout. While the construction cost for this typology was higher than BAU, feasibility was dependant on location and underlying land values.

**Concept 5** demonstrated the ability to deliver multiple dwellings using the draft policy settings, achieving communal open space, trees, larger apartment sizes and private open space, while yielding six dwellings.

**Concept 6** tested the small dwelling site concession (35% reduction to required site area) to analyse both impact on design and feasibility. Two storey construction equated to higher construction costs compared to concepts 1 and 2. The feasibility assessment indicated that in higher land value areas, the additional return from an extra dwelling could offset the higher construction costs, whereas in lower land value areas, the return from an additional dwelling may not be sufficient to compensate for these costs.

*\*3 bedroom, 2 bathroom and 2 garage.*

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# **PHASE 2 TESTING**

## DESIGN CONCEPTS

# Concept 01

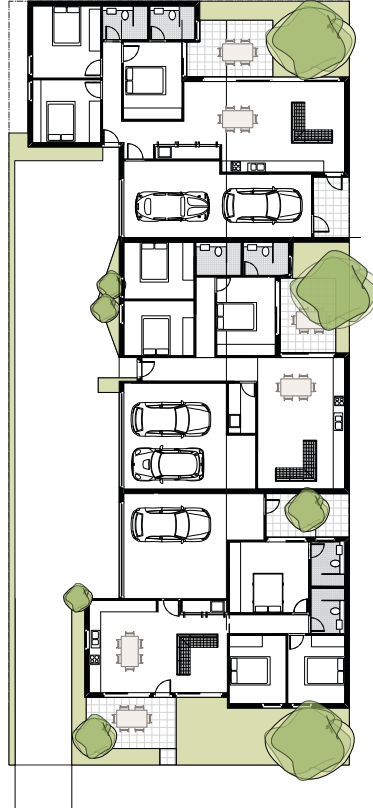
## GROUPED DWELLINGS- 15% DEEP SOIL AREA

### Site description

Predominant R40 Lot

Area: 728m<sup>2</sup>

Frontage: 18m



Ground Floor Plan



### Project Data

Dwelling type:	3 grouped dwellings
Building height: (storeys)	Single storey
Deep soil area:	109m <sup>2</sup> (15%)
Trees:	5
Parking:	3 x double garages

### Product Mix

Dw. No.	Bdrm	Bath	Car
3	2	2	2

### Construction costs

GFA:	428m <sup>2</sup>
Total build cost:	\$422,000
Cost / m <sup>2</sup>	\$986

*as costed by volume builder (August 2020)*

### Feasibility

Single storey development where construction cost is comparable with current industry practice.

### Design Description

Design based on standard industry triplex with a mix of 3 bedroom, 2 bathroom and 2 garaged cars.

Tests the impact of single storey construction and garaged parking on deep soil areas, trees and site cover.

#### Pros

- ✓ reduced cost of single storey construction
- ✓ universal design able to be achieved
- ✓ modest development suits suburban/ semi-urban context

#### Cons

- ✗ deep soil areas are non-compliant, with limited areas for landscaping and trees
- ✗ does not provide dwelling diversity and choice
- ✗ common driveway can be a poor quality space if not designed and executed well
- ✗ vehicle access, parking and manoeuvring dominates site
- ✗ streetscape presence compromised by south-facing primary garden area within the street setback

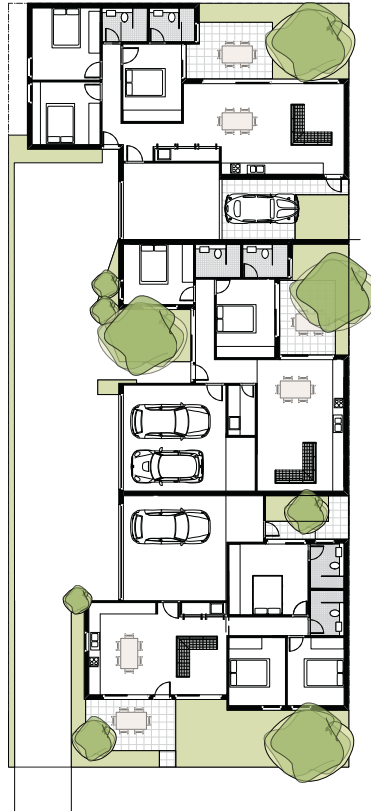
#### Testing supports provisions for:

- ✓ deep soil area encroachments allow for flexibility and functionality
- ✓ primary garden areas
- ✓ boundary walls on multiple boundaries

# Concept 02

## GROUPED DWELLINGS- 20% DEEP SOIL AREA

## Phase 2 Testing



Ground Floor Plan



### Project Data

Dwelling type:	3 grouped dwellings
Building height: (storeys)	Single storey
Deep soil area:	149m <sup>2</sup> (20%)
Trees:	6
Parking:	2 x double garages 1 x single garage 1 x occupant bay

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	2	2	2
2	3	2	2

### Construction costs

GFA:	398m <sup>2</sup>
Total build cost:	\$389,000
Cost / m <sup>2</sup>	\$977

as costed by volume builder  
(August 2020)

### Feasibility

Substitution of 3 bedroom, two garages with two bedroom dwellings and single garage may reduce feasibility of development in areas with lower underlying land values and tighter margins.

### Design Description

Design aims to determine the impact of the 20% deep soil area requirement on the typical triplex model.

Tandem parking to rear triplex. Single car garaging and additional parking proposed as uncovered paved area.

Primary garden areas of rear and middle triplex in northern half of the site.

Primary garden area proposed in the front setback areas in the southern half of the site.

### Pros

- ✓ direct connection between primary living spaces and primary garden areas, with outlook to landscaping and tree.
- ✓ large deep soil areas for mix of trees and landscaping
- ✓ dwelling diversity

### Cons

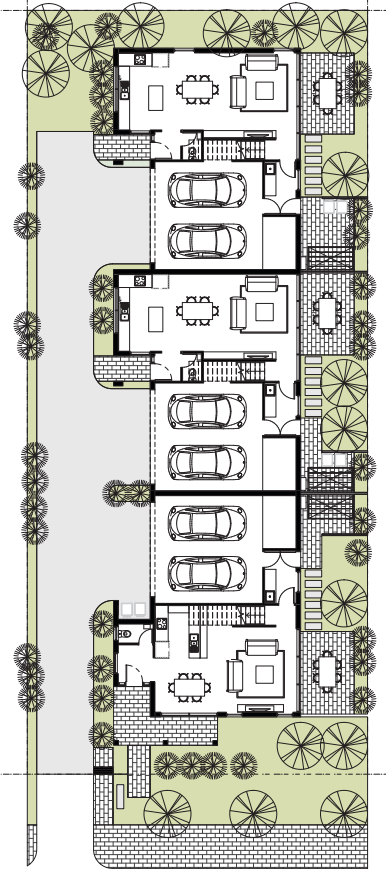
- ✗ common driveway can be a poor quality space if not designed and executed well
- ✗ small dwellings with high proportion of external walls
- ✗ vehicle access and manoeuvring dominates site

### Testing supports provisions for:

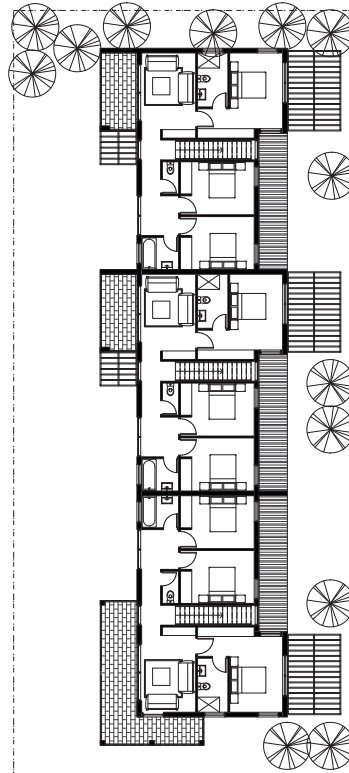
- ✓ deep soil area at 20% per site area with encroachments for flexibility and functionality
- ✓ primary garden areas
- ✓ boundary walls on multiple boundaries

# Concept 03

## GROUPED DWELLINGS - TWO STOREY



Ground Floor Plan



First Floor Plan

### Project Data

Dwelling type:	3 grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	160m <sup>2</sup> (22%)
Trees:	13
Parking:	3 x double garages

### Product Mix

Dw. No.	Bdrm	Bath	Car
3	3	2	2

### Construction costs

GFA:	583m <sup>2</sup>
Total build cost:	\$763,629
Cost / m <sup>2</sup>	\$1,310

*as costed by volume builder (August 2020)*

### Design Description

Design tests the ability for two storey development to deliver better amenity and increased deep soil areas, trees and primary garden areas.

#### Pros

- ✓ large areas of landscaped deep soil areas with trees
- ✓ primary garden areas in the northern half of the site with a direct connection to the primary living space
- ✓ covered entry thresholds with well defined street address
- ✓ good cross-ventilation to capture breeze paths

#### Cons

- ✗ still a large proportion of the site proposed for vehicle manoeuvring.
- ✗ common driveway can be a poor quality space if not designed and executed well

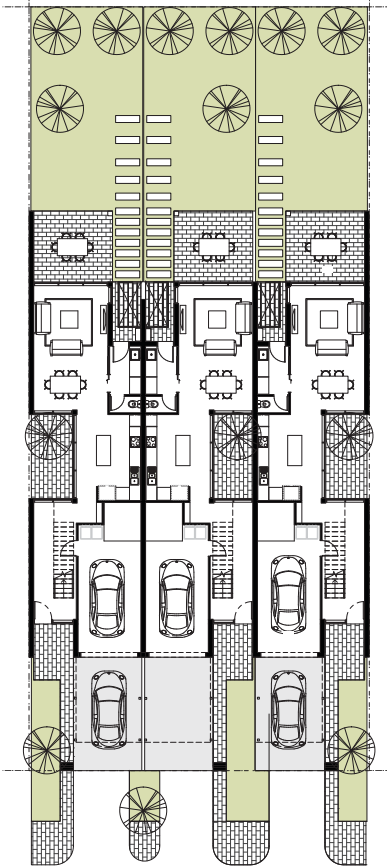
#### Supports provisions for:

- ✓ northern orientation of primary garden area
- ✓ primary garden area connected to primary living area
- ✓ deep soil areas at 20%
- ✓ tree requirement
- ✓ two storey construction

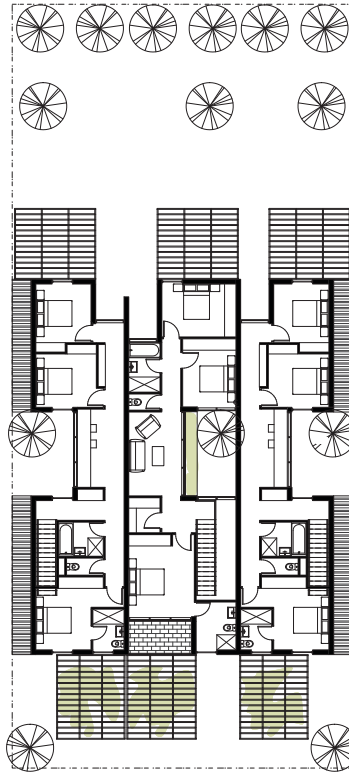


# Concept 04

## ATTACHED DWELLINGS (TERRACE TYPOLOGY)



Ground Floor Plan



First Floor Plan

### Project Data

Dwelling type:	3 single houses
Building height: (storeys)	Two storeys
Deep soil area:	195m <sup>2</sup> (26%)
Trees:	11
Parking:	3 x single garages 3 x tandem bays

### Product Mix

Dw. No.	Bdrm	Bath	Car
3	3	2	2

### Construction costs

GFA:	568m <sup>2</sup>
Total build cost:	\$844,184
Cost / m <sup>2</sup>	\$1,486

as costed by volume builder (August 2020)

### Feasibility

Concept would be considered financially viable in areas with higher land values and less viable in areas with lower land value.

### Design Description

#### Pros

- ✓ efficient parking and access
- ✓ direct connection from primary living space to primary garden area
- ✓ large primary garden areas proposed in northern half of the site
- ✓ rational and functional planning with minimal circulation space
- ✓ proposed light-wells for boundary walls allow for daylighting and natural ventilation at ground level.
- ✓ well considered orientation with solar access to primary living spaces
- ✓ tandem carparking
- ✓ strong street presence
- ✓ efficient use of site through boundary walls

#### Cons

- ✗ multiple cross-overs

#### Supports provisions for:

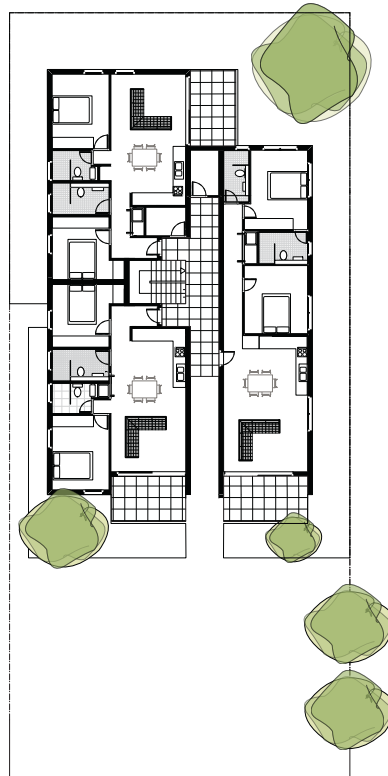
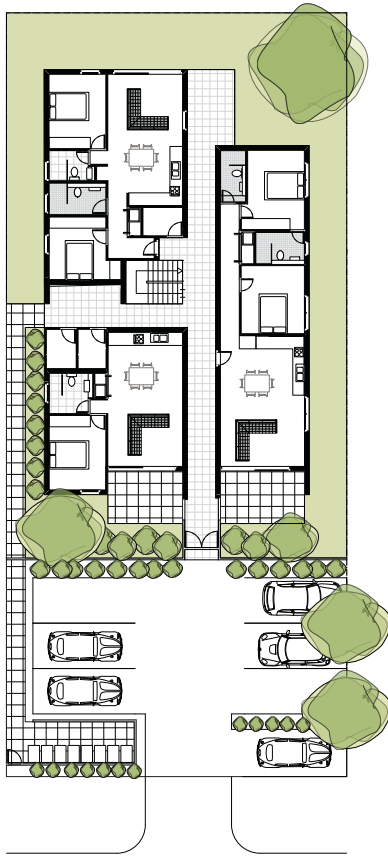
- ✓ setbacks to allow a lightwell every 9m length of boundary wall
- ✓ northern orientation of primary garden area
- ✓ solar access to primary living spaces for climate zones 4,5, and 6

#### Suggested further refinement of provisions as a result of testing:

- two storey boundary walls permitted to the adjacent lot, where each dwelling fronts the street to support terrace typology

# Concept 05

## MULTIPLE DWELLINGS (SUBURBAN APARTMENT)



### Project Data

Dwelling type:	3 multiple dwellings
Building height: (storeys)	Two storeys
Deep soil area:	184m <sup>2</sup> (25%)
Trees:	4 large
Parking:	6 occupant bays 1 uncovered visitor bay
Bicycle Parking:	6 resident 1 visitor

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	1	1	1
5	2	2	1

### Construction costs

GFA:	649m <sup>2</sup>
Total build cost:	\$1,070,000
Cost / m <sup>2</sup>	\$1,649

as costed by volume builder  
(August 2020)

Ground Floor Plan



First Floor Plan

### Design Description

Low rise apartments compatible with a semi-urban or suburban context.

#### Pros

- ✓ rational and functional planning with minimal circulation space
- ✓ large deep soil area to rear of the site
- ✓ good cross-ventilation to capture breeze paths
- ✓ building mass and height in centre of site
- ✓ modest development suits suburban/semi-urban context

#### Cons

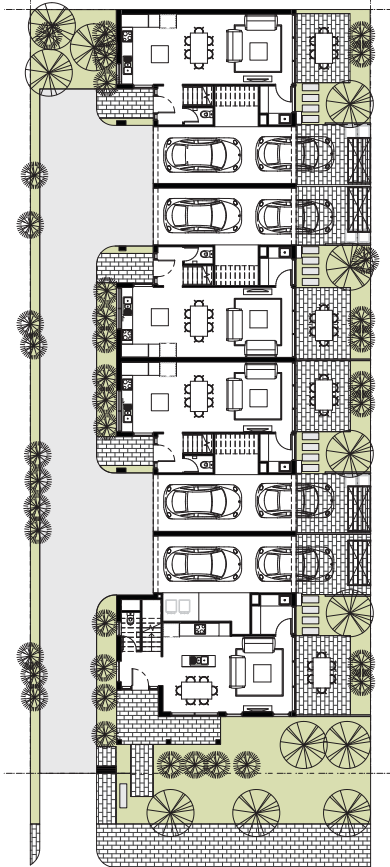
- ✗ parking provided in the front setback has potential to detract from streetscape. Additional set back and landscaping proposed aims to ameliorate the impact. Would not comply with DTC provisions of the draft code

#### Supports provisions for:

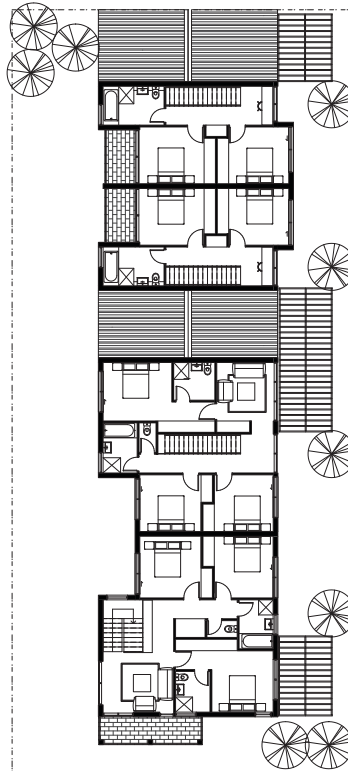
- ✓ average site area instead of plot ratio to determine dwelling yield. Encourages larger family size apartments
- ✓ minimum dwelling and room sizes
- ✓ deep soil areas for gardens and trees
- ✓ tree requirement
- ✓ minimum area and dimensions for private open space

# Concept 06

## GROUPED DWELLINGS - SMALL DWELLING CONCESSION



Ground Floor Plan



First Floor Plan

### Project Data

Dwelling type:	4 grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	145m <sup>2</sup> (20%)
Trees:	9
Parking:	4 tandem resident bays
Special feature:	2 small dwellings qualify for site area concessions

### Product Mix

Dw. No.	Bdrm	Bath	Car
3	2	2	2
1	3	2	2

### Construction costs

GFA:	596m <sup>2</sup>
Total build cost:	\$923,603
Cost / m <sup>2</sup>	\$1,550

*as costed by volume builder (August 2020)*

### Feasibility

Concept is more financially viable due to the increase in yield.

Areas with higher land values would be considered more viable than areas with lower land values.

### Design Description

Additional yield proposed through small dwelling site area concessions.

#### Pros

- ✓ each dwelling provided a primary garden area in the northern half of the site
- ✓ direct access from primary living space to primary garden areas and communal spaces
- ✓ design proposed additional trees to the minimum requirement
- ✓ balcony to primary street supports neighbourliness
- ✓ tandem carparking provides for flexible outdoor use

#### Cons

- ✗ small dwellings with high proportion of external walls
- ✗ common driveway can be a poor quality space if not designed and executed well

#### Supports provisions for:

- ✓ site area incentives for small dwellings
- ✓ primary garden area connected to primary living area
- ✓ solar access to primary living spaces for climate zones 4,5, and 6
- ✓ parking maximums
- ✓ two storey construction
- ✓ flexible parking arrangements

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# PHASE 1

## EARLY TESTING

# Phase 1 Testing (Q1 2020)

Phase 1 tested the preliminary draft Medium Density Code provisions on six different sites. Twelve designers and architects were commissioned to prepare concepts for these sites, with 24 concepts being prepared in total.

Phase 1 testing aimed to achieve the following objectives:

- to establish if a diversity of building typologies could be delivered through the draft deemed-to-comply provisions
- to test the usability of the draft code and to provide feedback on potential application issues
- to establish the construction costs and project feasibility implications of the proposed draft Code provisions compared to base-case scenarios.

The sites were selected to allow draft Code provisions to be tested against a range of conditions including:

- a range of density codings (R30-R60)
- different urban contexts, including inner-city, middle ring and outer suburbs
- a range of lots sizes, based on typical dimensions across the metropolitan area
- varied site characteristics including orientations, terrain and existing features (such as retained dwellings and trees).

The testing sought responses from the following architects and designers:

- Aaron Sice: Residential & Commercial
- ABN Group (Homebuyers Centre)
- All Things Residential
- Bernard Seeber Pty Ltd
- BGC Housing Group (Now Living)
- Klopper & Davis Architects
- Mark Anthony Design
- MDC Architects
- Officer Woods Architects
- Philip Stejskal Architecture
- Residence
- Space Agency: architects

## Method

### 1. Design Testing

*Site selection and design brief:*

Two designers were allocated to each of the six selected sites (refer table below) and provided with a design brief that included details about the site (dimensions, location, coding), required building typology mix, and key site features to be addressed in the design response. They were also given the below design assumptions to consider when developing their concepts and applying the draft Code settings.

*Design assumptions:*

- The design should be site responsive
- The designs should be buildable, feasible and pragmatic
- Assume mixed-occupancy – 50% rental and 50% owner-occupied
- The designs should aim to maximise financial return
- Design should mostly satisfy deemed-to-comply provisions, but with preparedness to challenge these and/or apply design principles where required to address site, context or other considerations.

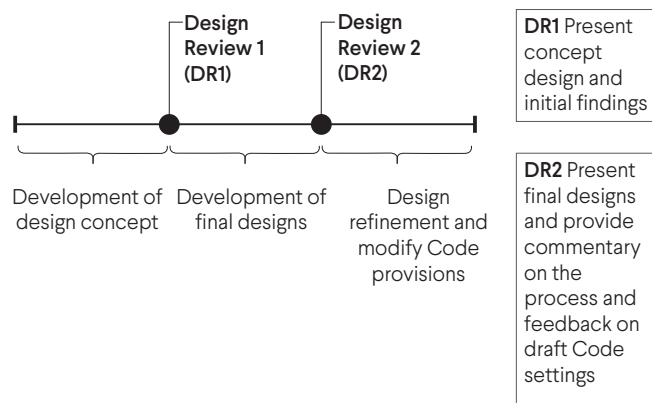
*Site characteristics and design concept brief:*

Site	Suburb	R-Coding	Lot dimensions	Design concept brief
Site 1	Balcatta	R40	Area: 761m <sup>2</sup>   Frontage: 18.25m	R40 grouped dwellings
Site 2	Hamilton Hill	R40	Area: 705m <sup>2</sup>   Frontage: Corner lot	R40 small dwelling concession
Site 3	Claremont	R30	Area: 1,153m <sup>2</sup>   Frontage: 20.1m	R30 retained dwelling + retained tree
Site 4	Tuart Hill	R40	Area: 1,012m <sup>2</sup>   Frontage: 20m	R40 attached dwellings (terrace typology)
Site 5	North Perth	R60	Area: 749m <sup>2</sup>   Frontage: 15.53m	R60 multiple dwellings (urban apartment building)
Site 6	Beldon	R20/40	Area: 683m <sup>2</sup>   Frontage: 21.03m	R40 multiple dwellings (suburban apartment building)

*Design testing process:*

The designers were allocated two weeks to prepare draft concepts that were considered by an design review panel which included representation from Department of Planning, Lands and Heritage (the Department), including the Office of Government Architect (OGA), along with the Department of Communities, and industry professionals.

Following review, the designers were asked to address the feedback in preparing the final concepts.



Each designer also prepared a report outlining benefits of draft Code provisions in supporting positive design responses, as well as those provisions that were difficult to understand and apply, or that may result in unintended built form outcomes.

## 2. Economic testing

*Construction costing:*

For Phase 01 concepts, quantity surveyors Rider Levett Bucknall (RLB), prepared costings for the final designs and the comparison base plan approved for the site (Q2 2020). Construction cost estimates for Phase 02 testing were prepared by BGC Housing Group for the comparison base plan and final concepts to reflect industry rates (Q3 2020).

The costings by RLB and BGC Housing Group allowed comparisons between the cost of development under the draft Code provisions and an existing comparison base plan.

*Feasibility testing:*

The construction costs for Phase 01 testing concepts were provided to Colliers International to prepare a valuation report that provided advice on the market feasibility of each concept and the comparison base development. The feasibility factored in the underlying land values at that time, construction costs and projected market returns based on development yield and mix (bedroom numbers).

## Key Findings

In broad terms, Phase 1 of the design testing demonstrated that the proposed Code objectives, design principles and deemed-to-comply provisions were successful in driving innovative, quality design outcomes across a range of sites.

The results from the Phase 1 economic testing indicated higher construction costs for the majority of concepts that had the potential to impact on development feasibility, particularly in outer metropolitan infill sites where development feasibility is typically more marginal. These results led to a comprehensive review of settings and further Phase 2 testing. The draft provisions of the medium density policy working draft were also reviewed in consultation with a project reference group and other stakeholders between July and September 2020.

### *Design testing key findings:*

The design testing produced a wide variety of design responses that were successful in demonstrating the capacity of the draft policy to facilitate innovative, sustainable, diverse housing. Concepts were site responsive, conducive to quality streetscapes, provided generous garden areas, and minimised space given over to vehicles and vehicular movement.

Some designers leveraged small dwelling concessions to achieve additional yields in concepts. This approach sought to offset construction costs with higher returns from the additional dwelling however this did not always transpire, particularly for the outer metropolitan infill sites where development feasibility is typically more marginal.

The testing also demonstrated that achieving yield did not necessitate compromised deep soil areas nor room sizes. Furthermore, the inclusion of carports, instead of garages, provided opportunity for multipurpose and improved communal spaces. However design outcomes tended toward multi-storey construction and this impacted on the construction costs.

The design testing demonstrated that architects and designers could also apply design principles in-lieu of deemed-to-comply provisions, to meet policy objective and achieve specific design outcomes for their sites. Notwithstanding this, some detailed design issues were identified and clarity was sought on some provisions which prompted further testing and refinements to Code provisions.

### *Construction cost key findings:*

- Deep soil area settings (which during Phase 1 equated to 30% of the development site) necessitated two-storey construction, adding to project costs
- Additional cost of boundary wall construction and suspended slabs
- Increased proportion of external walls increased to construction costs.
- Cost reduction achieved where carports were proposed instead of garages
- Where conveniently located, retaining a tree does not add significant additional construction costs and can greatly improve the amenity of a development

### *Development feasibility key findings:*

Feasibility testing indicated divergent outcomes for project delivery costs and market feasibility. Factors influencing outcomes that were considered and addressed in subsequent iterations of the draft Code included:

- Perceptions of reduced market return for smaller dwellings (1-2 bedroom) and single dwellings and a perceived strength of the 3x2 product
- Land value had a major impact on project feasibility. A concept that was viable in an area with higher land values (e.g. inner-city infill sites) was less viable in a lower land value area (e.g. middle-ring and outer metropolitan infill sites)
- It was much more difficult to deliver viable alternatives to the business-as-usual such as terraces, smaller dwellings and two-storey construction in areas of lower land value
- Nominal industry margins need to be considered closely and feasibility impacts tested for any future changes proposed to draft Code provisions

Implications of Phase 1 testing for the Draft Medium Density Code

Design Element	Design and feasibility testing key findings	Policy response
<b>Site area</b>	<p>Average site area (as opposed to plot ratio) for multiple dwellings supported adequate yields and promoted a range of apartment types, including larger apartments for families.</p> <p>Designs responded well to provisions that supported flexible yields and dwelling diversity.</p>	<p>Retain average site areas instead of plot ratio for multiple dwellings.</p> <p>Introduce site area categories that provide for yield uplift for sites that are most suited to medium density development (e.g. corner sites, amalgamate sites, laneway access).</p>
<b>Primary garden area</b>	<p>Primary garden area provisions achieved integration between internal and outdoor spaces. Requirement for primary living space to connect with primary garden area produced good design outcomes conducive to WA lifestyle requirements.</p> <p>Minimum size requirements for primary garden areas were difficult to achieve on constrained sites, necessitating two-storey construction which added cost.</p> <p>Northern orientation of primary garden area was highlighted by designers as being a key component of achieving good dwelling orientation and sustainable design outcomes.</p>	<p>Minimum size required for primary garden area to be scaleable and commensurate to site area.</p> <p>Tightened the provision for the primary garden area to be located in the northern half of the site.</p>
<b>Trees and deep soil areas</b>	<p>Designs responded well to the deep soil area (DSA) provisions (30% of site), however it led predominantly to two storey proposals. Construction costs increased as a result with some designs becoming not feasible, depending on land value.</p> <p>Designers responded well to permissible encroachments into DSA which provided flexibility for how DSA could be accommodated on smaller sites.</p> <p>Requirement for trees strongly supported, however some confusion on the application of the provisions and recommendations against medium sized trees being required for smaller sites.</p>	<p>Reduced DSA to 20% of site, to allow for a mix of single storey and two storey development.</p> <p>Maintained, but simplified, provisions for DSA encroachments.</p> <p>Simplified tree provisions and adjusted minimum tree size requirement to be more appropriate to a medium density context.</p>
<b>Primary living area</b>	<p>Designs were able to achieve the primary living space. This new element was well received and understood by the designers.</p>	<p>Retained primary living space requirement. Clarified minimum area and dimension requirements.</p>
<b>Solar access</b>	<p>General support for the intent of the provisions, however there was confusion over the application of overshadowing provision: 'maintain solar access to adjoining properties'.</p>	<p>Modified provisions to distinguish between solar access to the development and solar access to adjoining sites.</p> <p>Clarified the measurement for maximum overshadowing not minimum solar access.</p> <p>Simplified the requirement for primary living space to have major opening either north or east as a deemed-to-comply setting.</p>
<b>Size and layout of dwellings</b>	<p>Designs responded well to minimum dwelling and room floor areas.</p>	<p>Retained provisions for minimum dwelling and room floor areas.</p>



# Phase 1 Testing

Design Element	Design and feasibility testing key findings	Policy response
<b>Parking</b>	<p>Designs responded well to maximum parking bay standards and demonstrated how carports and uncovered bays could be integrated into developments for flexible use (e.g. a carport area being an extension to the primary garden area)</p> <p>Some confusion on the application of maximum parking standards, including if the maximum cap applied to all forms of parking (e.g. garages, carports and uncovered spaces)</p> <p>Maximum 1 garage for 3 bedroom houses had feasibility implications.</p> <p>Mixed results for the requirement to consolidate parking for 5 or more dwellings. Context and site dependent leading to some good outcomes, but also some poor outcomes.</p>	<p>Retained maximum parking standard, but with clarification that the cap applied to garages only, and introduced minimum parking standards.</p> <p>Increased the maximum permissible number of garage bays for 3 bedroom dwellings in Location A to 2 spaces.</p> <p>Removed the requirement to consolidate parking for 5 or more dwellings as a deemed-to-comply setting.</p>
<b>Dwelling mix</b>	<p>While the requirement for dwelling mix (i.e. dwellings with different number of bedrooms) was supported and achieved dwelling diversity for all designs, it was found that 2-bedroom dwellings impacted feasibility, particularly for lower land value areas.</p>	<p>Removed deemed-to-comply dwelling mix requirement and incentivised through small dwelling site area concession.</p>
<b>Site cover</b>	<p>Confusion if the common property (driveway) could be included in the site cover calculations.</p> <p>Maximum site cover was easily achieved for terrace typologies and multiple dwellings, however difficult for grouped dwelling triplex configurations.</p>	<p>Reviewed the definition of site cover and clarified the application for grouped dwellings.</p>
<b>Building height</b>	<p>Height in storeys was supported.</p> <p>The additional storey permitted in R40 was well-received and demonstrated thoughtful designs, where the setbacks ensured that the bulk was located towards the middle of the site to have less impact on neighbouring properties.</p>	<p>Retained storeys as measure of building height, but with a breakdown for maximum wall height and roof height to accommodate different roof profiles.</p> <p>Retained 3 storey maximum building heights for R40 coding.</p>
<b>Lot boundary setbacks</b>	<p>Support for ability to provide boundary walls on both side boundaries and increase in the maximum permissible length of boundary walls.</p> <p>Some confusion on application of provisions for calculation of boundary walls.</p> <p>Lot boundary setback provisions generally worked well in most concepts, however the second storey setback of 1m was creating long blank faces without articulation.</p>	<p>Clarified provisions for boundary walls.</p> <p>Increased setbacks for second and third storeys and introduced provisions to require articulation and prevent long blank walls.</p>
<b>Visual privacy</b>	<p>Support for reduced visual privacy setbacks and use of alternative design solutions to setbacks and screening, however difficulty understanding the provisions. Designs would have benefitted from a context-specific approach to this element.</p>	<p>Clarified visual privacy provisions and incorporated provisions for a more context-responsive approach.</p>

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# PHASE 1 TESTING

## DESIGN CONCEPTS

# Site 1

Site description

## R40 GROUPED DWELLINGS

Balcatta R40

Area: 761m<sup>2</sup>

Frontage: 18.25m



## Comparison Base Plan

Typical triplex detached villas with front loaded access via multiple crossovers.

## Project Data

Dwelling type:	3 grouped dwellings
Building height: (storeys)	Single storey
Deep soil area:	~91m <sup>2</sup> (12%)
Trees:	0
Parking:	3 x double garages

## Product Mix

Dw. No.	Bdrm	Bath	Car
2	3	3	2
1	3	2	2

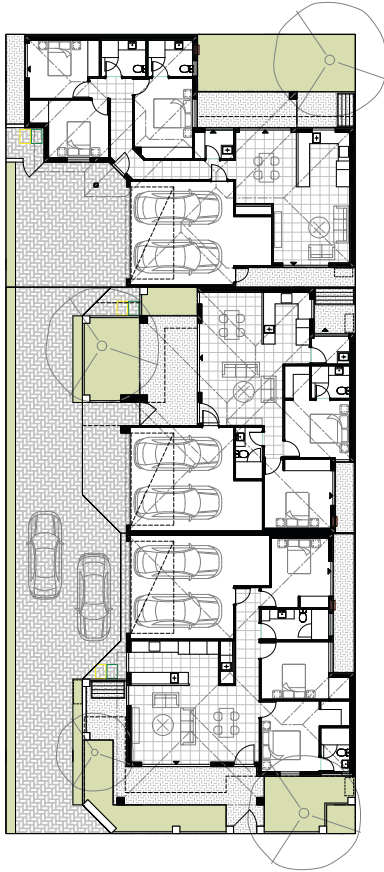
## Construction costs

GFA:	387m <sup>2</sup>
Total build cost:	\$650,710
Cost / m <sup>2</sup>	\$1,683

*as costed by quantity surveyor  
(June 2020)*



## CONCEPT 1A



Ground Floor Plan



### Project Data

Dwelling type:	3 grouped dwellings
Building height: (storeys)	Single storey
Deep soil area:	109.5m <sup>2</sup> (15%)
Trees:	4
Parking:	3 x double garages

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	2	2	2
2	3	2	2

### Construction costs

GFA:	413m <sup>2</sup>
Total build cost:	\$658,230
Cost / m <sup>2</sup>	\$1,594
- \$89/m <sup>2</sup> from comparison base plan	

*as costed by quantity surveyor  
(June 2020)*

### Design Description

Design based on standard industry practice to test the impact of the new policy provisions on single storey construction.

#### Pros

- ✓ direct access from primary living space to primary garden areas
- ✓ multiple boundary wall construction
- ✓ functional primary garden areas with room for a tree

#### Cons

- ✗ unable to achieve deep soil areas and minimum dimensions
- ✗ high proportion of site given over to vehicle parking, access and manoeuvring
- ✗ common driveway can be a poor quality space if not designed and executed well

### Testing Implications

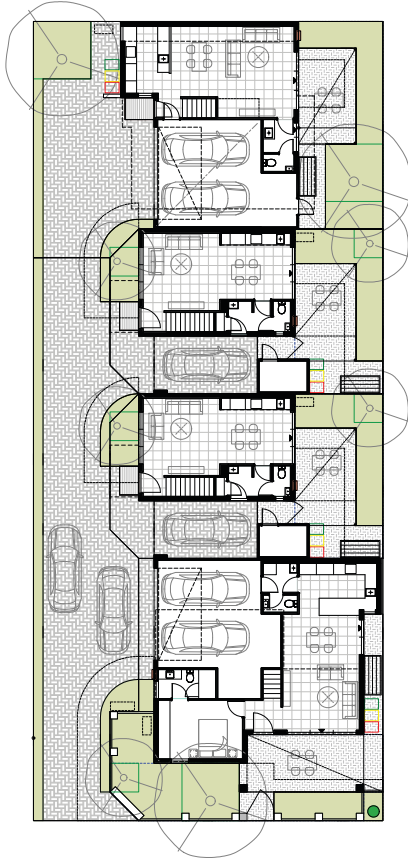
*Testing supports provisions for:*

- ✓ primary garden area connected to primary living area
- ✓ deep soil area encroachments for flexibility and functionality
- ✓ amount of boundary wall increased

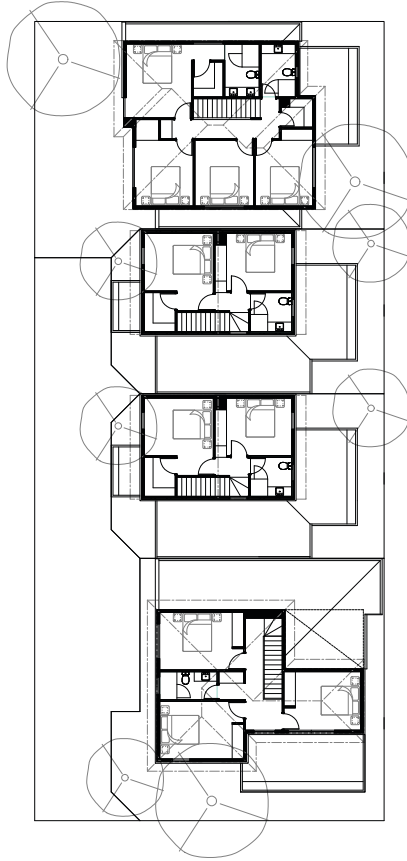
*Further refinement of provisions as a result of testing:*

- tier primary garden area size to site area
- relate number and size of trees to dwelling numbers

# Site 1 (cont.)



Ground Floor Plan



First Floor Plan

## CONCEPT 1B

### Project Data

Dwelling type:	4 grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	202m <sup>2</sup> (26%)
Trees:	8
Parking:	2 x single carports 2 x double garages
Special features:	small dwelling site area concession

### Product Mix

Dw. No.	Bdrm	Bath	Car
2	2	1	1
2	4	2	2

### Construction costs

GFA:	602m <sup>2</sup>
Total build cost:	\$939,480
Cost / m <sup>2</sup>	\$1,563
-\$120/m <sup>2</sup> from comparison base plan	
<i>as costed by quantity surveyor (June 2020)</i>	

### Design Description

Two storey construction with reduced carparking. Concept achieves additional yield.

#### Pros

- ✓ two storey construction achieves more deep soil area, trees and soft landscaping
- ✓ extra dwelling with small dwelling concession
- ✓ carports, undercroft or uncovered spaces instead of garages

#### Cons

- ✗ common driveway can be a poor quality space if not designed and executed well
- ✗ primary garden area in the street setback area is south facing
- ✗ two storey development may increase construction costs

### Testing Implications

*Testing supports provisions for:*

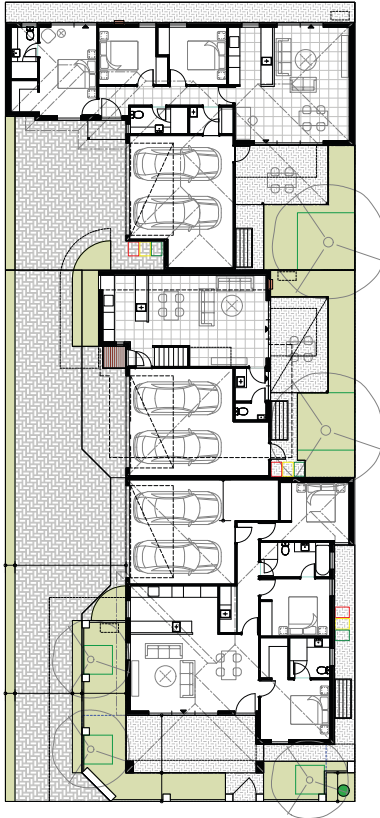
- ✓ site area incentives for small dwellings
- ✓ deep soil area encroachments for flexibility and functionality
- ✓ two storey construction

*Further refinement of provisions as a result of testing:*

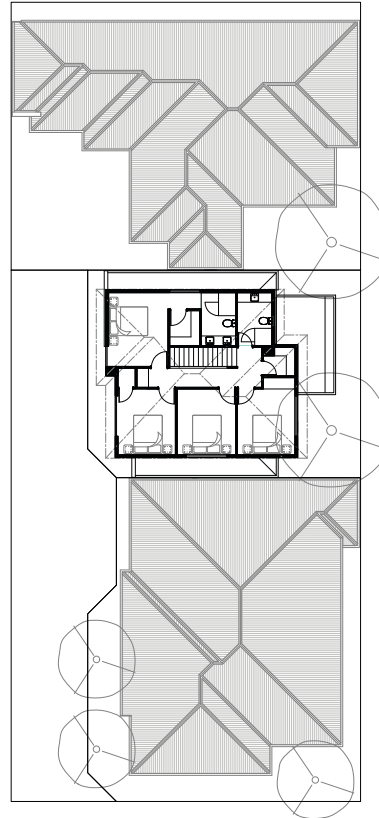
- tier primary garden area size to site area
- locate primary garden area to north half of site

# Phase 1 Testing

## CONCEPT 1C



Ground Floor Plan



First Floor Plan

### Project Data

Dwelling type:	3 grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	162.6m <sup>2</sup> (21%)
Trees:	5
Parking:	3 x double garages

### Product Mix

Dw. No.	Bdrm	Bath	Car
2	3	2	2
1	4	2	2

### Construction costs

GFA:	480m <sup>2</sup>
Total build cost:	\$758,015
Cost / m <sup>2</sup>	\$1,578
- \$105/m <sup>2</sup> from comparison base plan	
<i>as costed by quantity surveyor (June 2020)</i>	

### Design Description

Business-as-usual test case with increased bedrooms for two storey dwelling to offset additional construction cost.

#### Pros

- ✓ two storey construction achieves more deep soil area, trees and soft landscaping
- ✓ functional primary garden areas
- ✓ direct access from primary living space to primary garden areas

#### Cons

- ✗ primary garden area in the street setback area is south facing
- ✗ vehicle access and manoeuvring dominates site

### Testing Implications

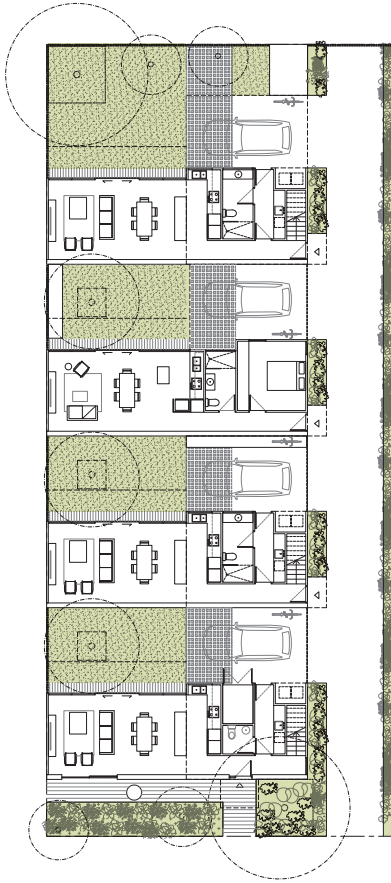
*Testing supports provisions for:*

- ✓ primary garden area connected to primary living area
- ✓ trees requirements

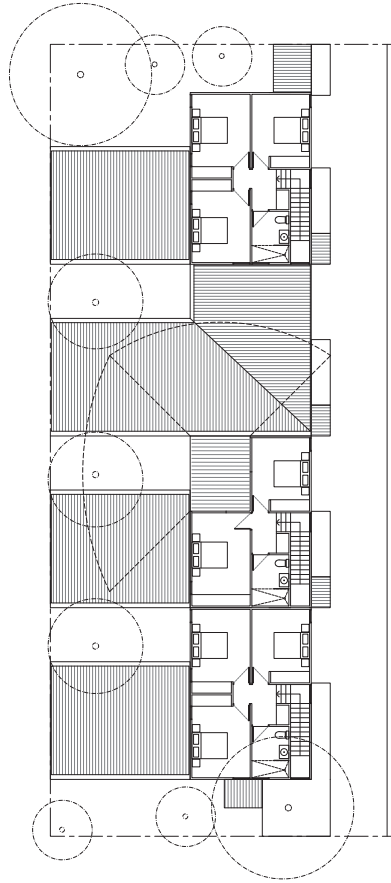
*Further refinement of provisions as a result of testing:*

- deep soil areas to allow single and two storey construction
- primary garden area within northern half of site

# Site 1 (cont.)



Ground Floor Plan



First Floor Plan

## CONCEPT 1D

### Project Data

Dwelling type:	4 grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	242m <sup>2</sup> (31%)
Trees:	9
Parking:	4 x single carports
Special features:	small dwelling site area concession

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	1	1	1
1	2	2	1
2	3	2	1

### Construction costs

GFA:	687m <sup>2</sup>
Total build cost:	\$ 846,520
Cost / m <sup>2</sup>	\$1,233
- \$450/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)

### Design Description

Two storey, row house type construction with reduced carparking. Concept achieves additional yield.

#### Pros

- ✓ two storey construction allows space for generous deep soil areas, trees and soft landscaping
- ✓ extra dwelling with small dwelling concession
- ✓ well considered orientation with solar access to primary living spaces
- ✓ carports, undercroft or uncovered spaces instead of garages

#### Cons

- ✗ common driveway can be a poor quality space if not designed and executed well
- ✗ does not meet overshadowing requirements

### Testing Implications

Testing supports provisions for:

- ✓ site area incentives for small dwellings
- ✓ primary living areas as 'one good room'
- ✓ primary garden area connected to primary living area

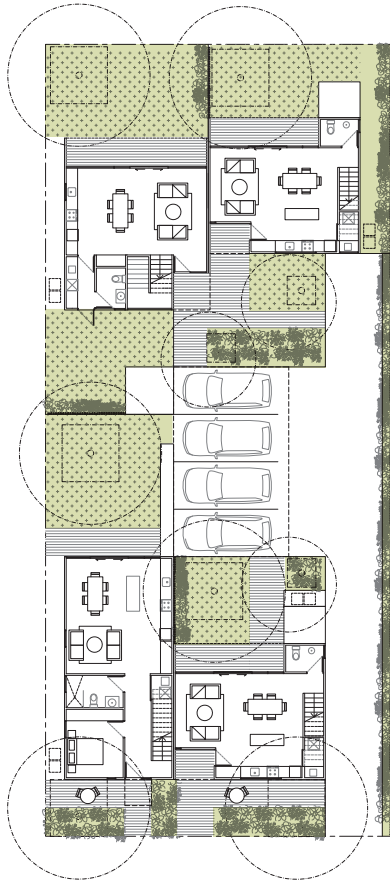
Further refinement of provisions as a result of testing:

- calibrate setbacks and overshadowing for medium density development
- primary garden area minimum widths support useable space

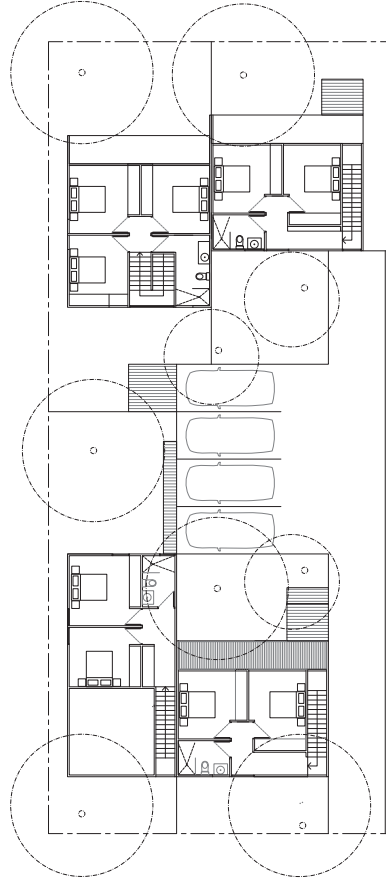


# Phase 1 Testing

## CONCEPT 1E



Ground Floor Plan



First Floor Plan

### Project Data

Dwelling type:	4 grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	335m <sup>2</sup> (44%)
Trees:	9
Parking:	4 x single occupant bays
Special features:	small dwelling site area concession communal car parking

### Product Mix

Dw. No.	Bdrm	Bath	Car
2	2	1.5	1
2	3	2	1

### Construction costs

GFA:	498m <sup>2</sup>
Total build cost:	\$884,772
Cost / m <sup>2</sup>	\$1,777
+ \$94/m <sup>2</sup> from comparison base plan	

*as costed by quantity surveyor (June 2020)*

### Design Description

Courtyard building type with central communal carparking. Development achieves additional yield.

#### Pros

- ✓ consolidated car parking allows space for large deep soil areas, trees and soft landscaping
- ✓ extra dwelling with small dwelling concession
- ✓ development in a landscape setting

#### Cons

- ✗ upper floor bedrooms reduce flexibility for universal design
- ✗ single car space provided regardless of bedroom numbers

### Testing Implications

*Testing supports provisions for:*

- ✓ deep soil areas
- ✓ tree requirement
- ✓ two storey construction

*Further refinement of provisions as a result of testing:*

- remove requirement for outdoor living areas as the primary garden area is sufficient
- incorporate provision for flexible room sizes, dimensions and areas

# Site 2

Site description

## R40 SMALL DWELLING CONCESSION

Hamilton Hill R40

Area: 705m<sup>2</sup>

Frontage: Corner lot



### Comparison Base Plan

Single houses on a corner lot with front-loaded access using the single bedroom site area concession to achieve a 5 yield.

### Project Data

Dwelling type:	Five single bedroom grouped dwellings
Building height: (storeys)	Single storey
Deep soil area:	~100m <sup>2</sup> (14%)
Trees:	nil
Parking:	5 x single garages

### Product Mix

Dw. No.	Bdrm	Bath	Car
5	1	1	1

### Construction costs

GFA:	436m <sup>2</sup>
Total build cost:	\$816,160
Cost / m <sup>2</sup>	\$1,872

*as costed by quantity surveyor (June 2020)*



# Phase 1 Testing

## CONCEPT 2A

### Project Data

Dwelling type:	Six multiple dwellings
Building height: (storeys)	Two storey plus undercroft basement
Deep soil area:	260m <sup>2</sup> (37%)
Trees:	4
Parking:	6 undercroft parking 1 visitor bay

### Product Mix

Dw. No.	Bdrm	Bath	Car
6	1	1	1

### Construction costs

GFA:	815m <sup>2</sup> (including undercroft parking)
Total build cost:	\$1,246,690
Cost / m <sup>2</sup>	\$1,530
- \$342/m <sup>2</sup> from comparison base plan as costed by quantity surveyor (June 2020)	



Ground Floor Plan



First Floor Plan

### Design Description

Single bedroom dwellings as multiple dwellings.

#### Pros

- ✓ well considered orientation, airflow, outlook and 'access to the sky'
- ✓ large deep soil areas for mix of trees and landscaping
- ✓ provision of silver level universally accessible dwellings

#### Cons

- ✗ private open spaces impact solar access provisions to primary living space

### Testing Implications

Testing supports provisions for:

- ✓ context-specific approach to visual privacy
- ✓ primary living areas as 'one good room'
- ✓ 3-storey development permitted in R40

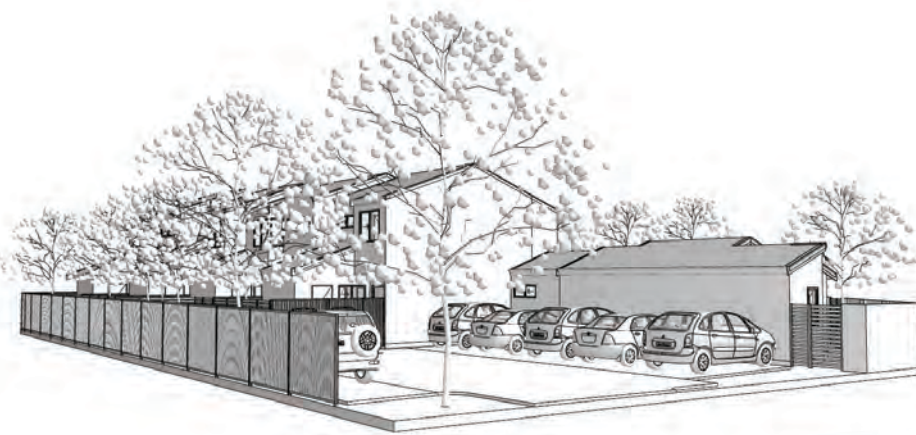
Further refinement of provisions as a result of testing:

- calibrate site area requirements for multiple dwellings to plot ratio yields achieved under Vol2 apartments.
- simplify calculation of solar access to primary living space

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# Site 2 (cont.)

Concept 2B



# Phase 1 Testing

## CONCEPT 2B

### Project Data

Dwelling type:	5 grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	247m <sup>2</sup> (35%)
Trees:	15
Parking:	5 x occupant bays 1 x visitor bay
Special features:	small dwelling site area concession

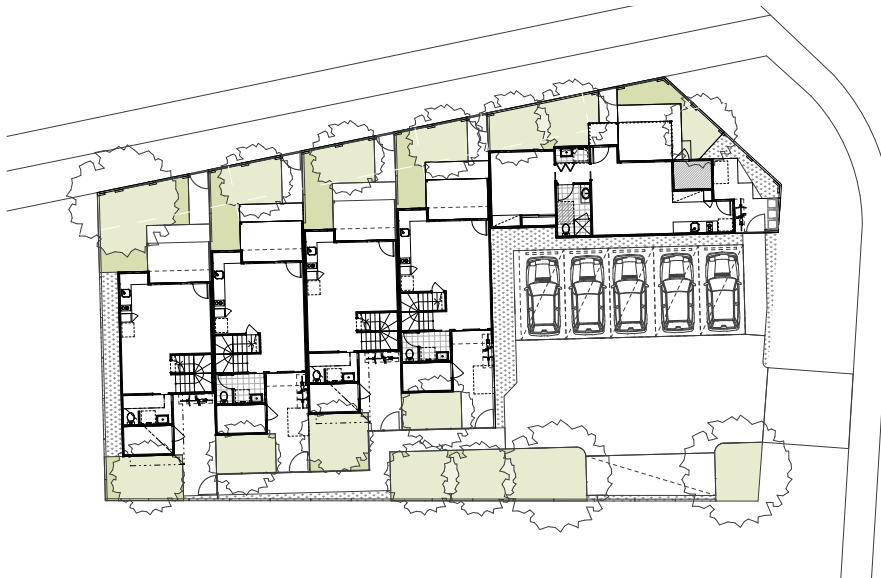
### Product Mix

Dw. No.	Bdrm	Bath	Car
5	1	1.5	1

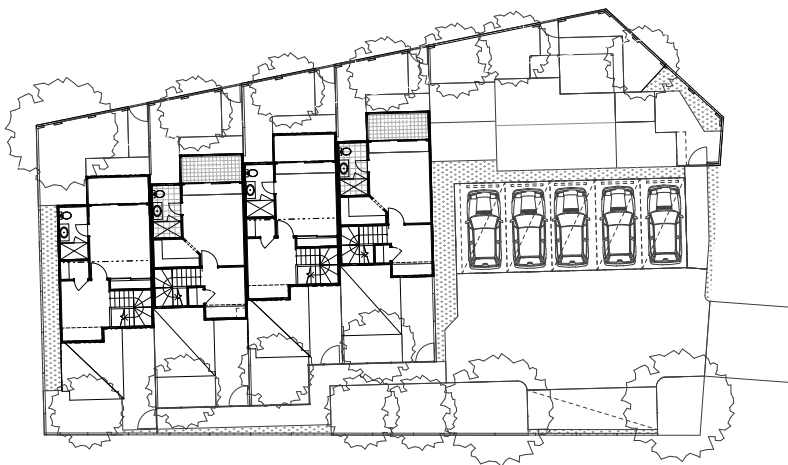
### Construction costs

GFA:	381m <sup>2</sup>
Total build cost:	\$774,440
Cost / m <sup>2</sup>	\$2,031
	-\$159/m <sup>2</sup> from comparison base plan

as costed by quantity surveyor (June 2020)



Ground Floor Plan



First Floor Plan

### Design Description

Single bedroom dwellings as terrace typology with consolidated carparking.

#### Pros

- ✓ primary garden area in northern half of the site
- ✓ two storey construction allows space for generous deep soil area, trees and soft landscaping
- ✓ communal carparking provided as quality flexible space
- ✓ effective design response to irregular corner lot

#### Cons

- ✗ limited streetscape appeal achieved to secondary street



### Testing Implications

Testing supports provisions for:

- ✓ two storey construction
- ✓ solar access to primary living spaces for climate zones 4,5, and 6
- ✓ universal design and dwelling diversity

Further refinement of provisions as a result of testing:

- small dwelling concessions to include two bedroom dwellings
- relate number and size of trees to dwelling numbers

# Site 3

Site description

## R30 RETAINED DWELLING + RETAINED TREE

Claremont R30

Area: 1,153m<sup>2</sup>

Frontage: 20.1m



### Comparison Base Plan

Typical duplex development with retained street front dwelling and retained trees to centre of site.

### Project Data

Dwelling type:	Two grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	unknown
Trees:	5 large
Parking:	2 double garages

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	3	3	2
1	4	2	2

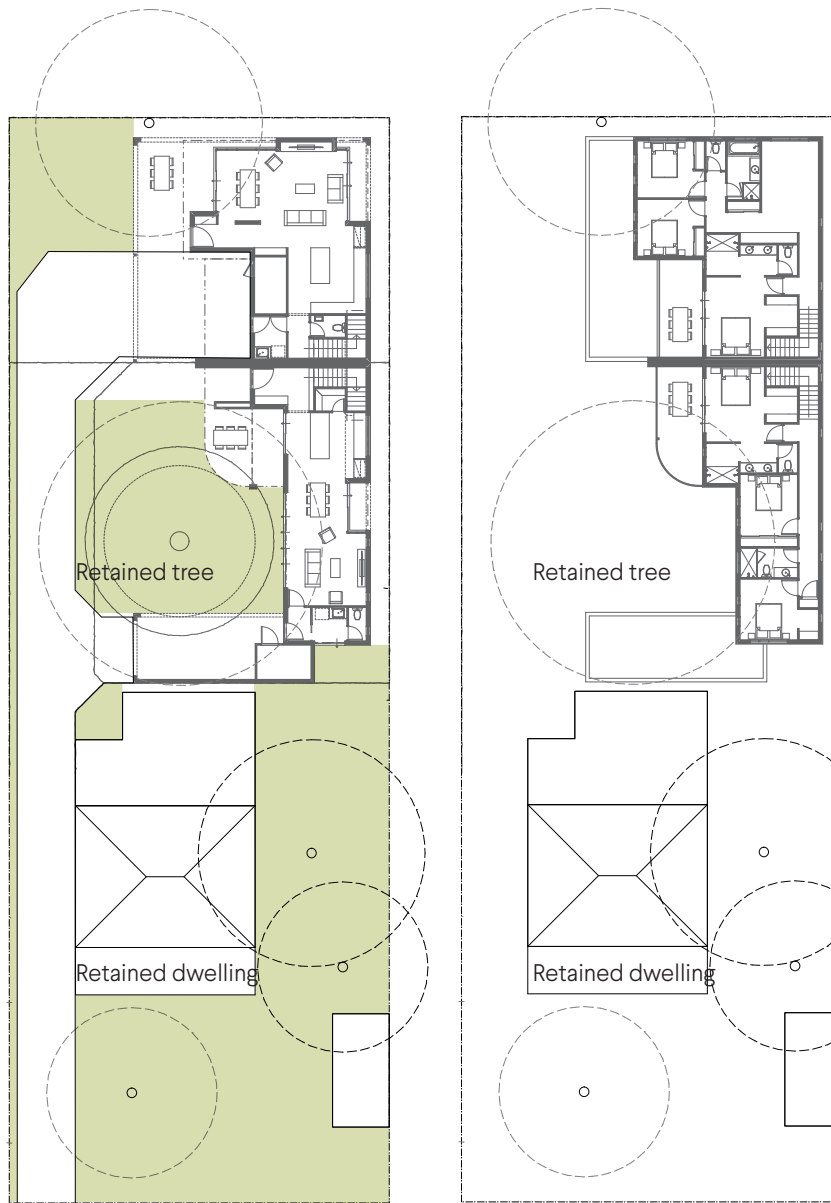
### Construction costs

GFA:	not provided
Total build cost:	not provided
Cost / m <sup>2</sup>	not provided



# Phase 1 Testing

## CONCEPT 3A



Ground Floor Plan

First Floor Plan

### Project Data

Dwelling type:	Three grouped dwellings
Building height: (storeys)	Mix of single and two storey
Deep soil area:	235m <sup>2</sup> (20% with a reduction applied for tree retention)
Trees:	5
Parking:	4x carports
Special features:	Retained trees and house

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	3	2	1
1	3	2	2
1*	3	2	1

\*existing dwelling

### Construction costs

GFA:	364m <sup>2</sup>
Total build cost:	\$677,105
Cost / m <sup>2</sup>	\$1,860

as costed by quantity surveyor (June 2020)

### Design Description

Development with retained tree and retained dwelling.

#### Pros

- ✓ two storey construction allows space for generous deep soil area, trees and soft landscaping
- ✓ carports, undercroft or uncovered spaces instead of garages

#### Cons

- ✗ long, flat walls to side boundary
- ✗ west facing primary living space

### Testing Implications

Testing supports provisions for:

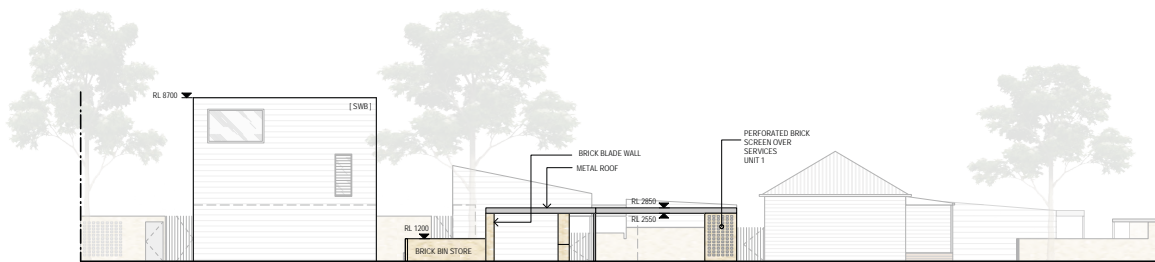
- ✓ deep soil areas
- ✓ two storey construction
- ✓ minimum dwelling and room floor areas

Further refinement of provisions as a result of testing:

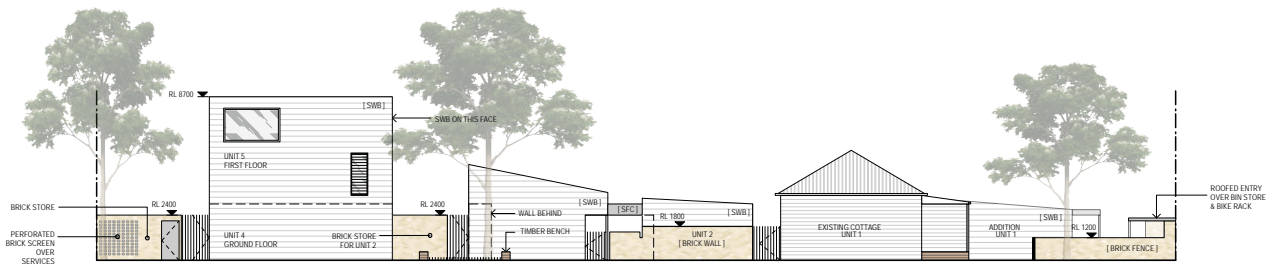
- articulation of long two-storey walls set back from lot boundary
- incentivise carports
- primary garden area to north half of site

# Site 3 (cont.)

## Concept 3B



WEST ELEVATION - CARPORT



WEST ELEVATION

## Elevations



# Phase 1 Testing

## CONCEPT 3B

### Project Data

Typology mix/ yield:	One retained dwelling with an ancillary dwelling One grouped dwelling Three multiple dwellings
Building height: (storeys)	Mix of single and two storey
Deep soil area:	348m <sup>2</sup> (30%)
Trees:	9
Parking:	4x carports 2 occupant bays 1 visitor bay
Special features:	Retained trees and house

### Product Mix

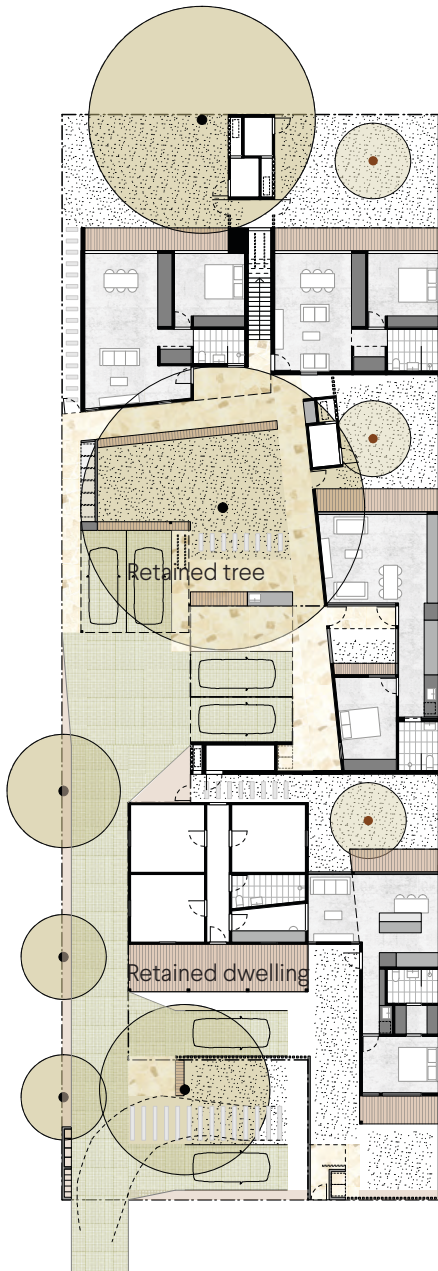
Dw. No.	Bdrm	Bath	Car
4	1	1	1
1*	4	2	2

\*existing dwelling

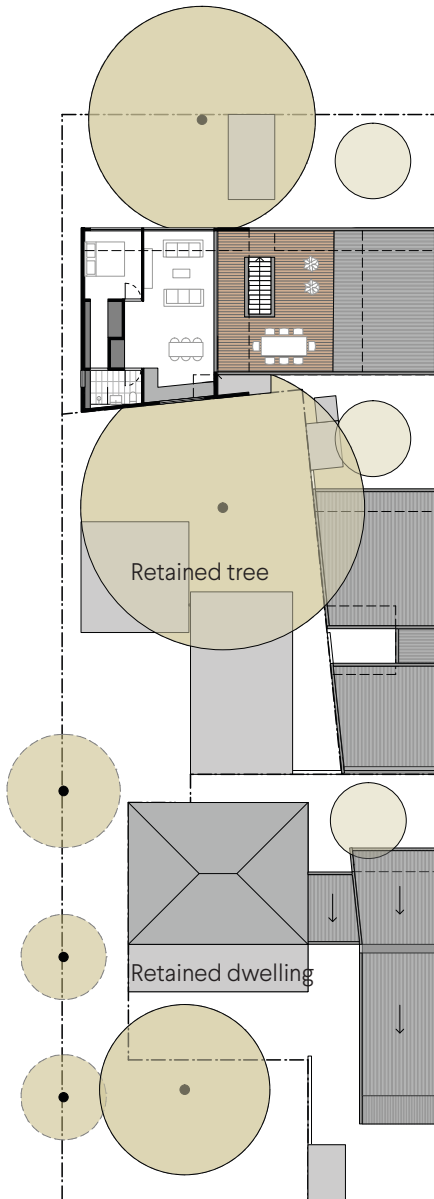
### Construction costs

GFA:	352m <sup>2</sup>
Total build cost:	\$821,020
Cost / m <sup>2</sup>	\$2,333

*as costed by quantity surveyor (June 2020)*



Ground Floor Plan



First Floor Plan

### Design Description

Development with retained tree and retained dwelling.

#### Pros

- ✓ dwelling diversity
- ✓ provision of silver level universally accessible dwelling
- ✓ communal carparking provided as quality flexible space for occupants

#### Cons

- ✗ small dwellings with high proportion of external walls (cost implications)

### Testing Implications

Testing supports provisions for:

- ✓ site area incentives
- ✓ average site area to determine maximum dwelling yield instead of plot ratio
- ✓ primary garden area location
- ✓ flexible parking arrangements

Further refinement of provisions as a result of testing:

- incentives for tree retention
- extent of permitted boundary walls
- outbuildings exclusive of boundary wall calculations

# Site 4

Site description

## R40 ATTACHED DWELLINGS (TERRACE TYPOLOGY)

Tuart Hill R40

Area: 1,012m<sup>2</sup>

Frontage: 20m



### Comparison Base Plan

Typical quadraplex development with front loaded access via two crossovers.

### Project Data

Dwelling type:	Four grouped dwellings
Building height: (storeys)	Single storey (1 double storey)
Deep soil area:	~152m <sup>2</sup> (15%)
Trees:	Nil
Parking:	4x double garages

### Product Mix

Dw. No.	Bdrm	Bath	Car
3	3	2	2
1	3	3	2

### Construction costs

GFA:	485m <sup>2</sup>
Total build cost:	\$872,685
Cost / m <sup>2</sup>	\$1,798

as costed by quantity surveyor  
(June 2020)



# Phase 1 Testing

## CONCEPT 4A



Ground Floor Plan



### Design Description

Terrace typology on a 20m frontage.

#### Pros

- ✓ large deep soil areas allow for mix of trees and landscaping
- ✓ light-wells/courtyards allow for daylighting and natural ventilation
- ✓ well considered orientation, airflow, outlook and 'access to the sky'



First Floor Plan

#### Cons

- ✗ additional dwelling yield resulting in narrow sites with 5m frontages
- ✗ parking provided in the front setback area could potentially detract from the streetscape. The additional set back and landscaping proposed aims to ameliorate the impact but would not comply with deemed-to-comply provisions of the draft code

### Project Data

Dwelling type:	Five grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	485m <sup>2</sup> (48%)
Trees:	15
Parking:	5x occupant bay 1x visitor bay

### Product Mix

Dw. No.	Bdrm	Bath	Car
5	2	2	1

### Construction costs

GFA:	624m <sup>2</sup>
Total build cost:	\$1,174,976
Cost / m <sup>2</sup>	\$1,884
+ \$86/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor (June 2020)

### Testing Implications

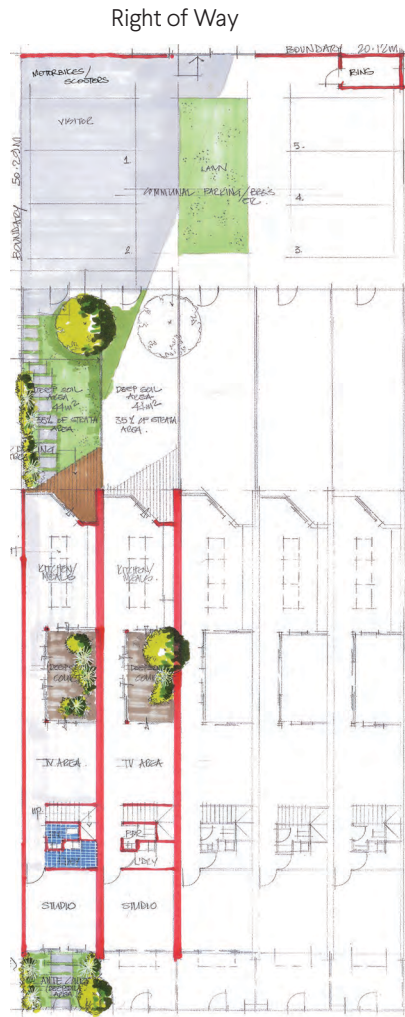
Testing supports provisions for:

- ✓ northern orientation of primary garden area
- ✓ solar access to primary living spaces for climate zones 4, 5 and 6
- ✓ two storey boundary walls, where each dwelling fronts the street to allow terrace typologies

Further refinement of provisions as a result of testing:

- light court requirement for terrace typology
- introduce boundary wall provisions to accommodate terrace typology
- streetscape provisions to address carparking within the street setback area

# Site 4 (cont.)



Ground Floor Plan



## CONCEPT 4B

### Project Data

Dwelling type:	Five grouped dwellings
Building height: (storeys)	Two storey
Deep soil area:	355m <sup>2</sup> 35%
Trees:	15
Parking:	5x occupant bays 1x visitor bay

### Product Mix

Dw. No.	Bdrm	Bath	Car
5	2	2	1

### Construction costs

GFA:	631m <sup>2</sup>
Total build cost:	\$1,207,590
Cost / m <sup>2</sup>	\$1,914
+\$116/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor (June 2020)

### Design Description

Terrace typology on a 20m frontage with rear laneway access.

#### Pros

- ✓ consolidated communal parking accessed from rear laneway
- ✓ large deep soil areas for mix of trees and landscaping
- ✓ light-wells/courtyards allow for daylighting and natural ventilation

#### Cons

- ✗ additional dwelling yield resulting in narrow sites with 5m frontages

### Testing Implications

Testing supports provisions for:

- ✓ primary garden area connected to primary living area
- ✓ deep soil area encroachments for flexibility and functionality
- ✓ two storey boundary walls, where each dwelling fronts the street to allow terrace typologies

Further refinement of provisions as a result of testing:

- introduce boundary wall provisions to accommodate terrace typology

# Phase 1 Testing

## CONCEPT 4C

### Project Data

Dwelling type:	Five green title dwellings
Building height: (storeys)	Two storey
Deep soil area:	314.5m <sup>2</sup> (31%)
Trees:	15
Parking:	5x single garages 2x visitor bays

### Product Mix

Dw. No.	Bdrm	Bath	Car
5	2	2	1

### Construction costs

GFA:	745m <sup>2</sup>
Total build cost:	\$1,260,770
Cost / m <sup>2</sup>	\$1,692
- \$106/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)



For first floor plan see 4A first floor plan (similar)

Ground Floor Plan



### Design Description

Green titled terrace typology on a 20m frontage with rear laneway access.

#### Pros

- ✓ large deep soil areas allow for mix of trees and landscaping
- ✓ light-wells/courtyards allow for daylighting and natural ventilation
- ✓ well considered orientation, airflow, outlook and 'access to the sky'
- ✓ site efficiencies of tandem parking

#### Cons

- ✗ additional dwelling yield resulting in narrow sites with 5m frontages

### Testing Implications

Testing supports provisions for:

- ✓ primary living areas as 'one good room'
- ✓ deep soil area requirement in the street setback area
- ✓ two storey boundary walls, where each dwelling fronts the street to allow terrace typologies

Further refinement of provisions as a result of testing:

- introduce boundary wall provisions to accommodate terrace typology

# Site 4 (cont.)

## CONCEPT 4D

### Project Data

Dwelling type:	Three grouped dwellings and two multiple dwellings
Building height: (storeys)	two storeys
Deep soil area:	329m <sup>2</sup> (32.5%)
Trees:	12
Parking:	5x undercroft parking 1 x visitor bay

### Product Mix

Dw. No.	Bdrm	Bath	Car
4	3	2	1
1	1	1	1

### Construction costs

GFA:	701m <sup>2</sup>
Total build cost:	\$1,319,265
Cost / m <sup>2</sup>	\$1,883
+ \$85/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)

### Design Description

Terrace typology on a 20m frontage with rear laneway access .

#### Pros

- ✓ mix of grouped and multiple dwellings
- ✓ well considered orientation with solar access to primary living spaces
- ✓ carports, undercroft or uncovered spaces instead of garages

#### Cons

- ✗ reduced flexibility for universal design
- ✗ single car space provided regardless of bedroom numbers

### Testing Implications

Testing supports provisions for:

- ✓ average site area to determine maximum dwelling yield instead of plot ratio
- ✓ lightwells/courtyards for daylighting and solar access
- ✓ deep soil areas for gardens and trees
- ✓ flexible parking arrangements

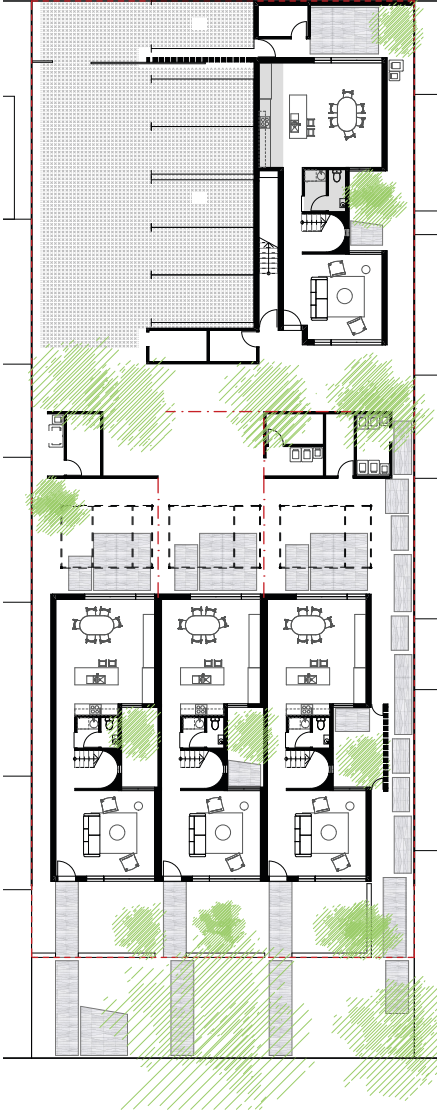
Further refinement of provisions as a result of testing:

- simplify calculation of solar access to primary living space
- two-storey boundary walls for terrace typology

# Phase 1 Testing

Concept 4D

Right of Way



Ground Floor Plan



First Floor Plan

# Site 4 (cont.)

## CONCEPT 4E

### Project Data

Dwelling type:	Three grouped dwellings and three multiple dwellings
Building height: (storeys)	Two storey terraces Three storey apartments
Deep soil area:	329m <sup>2</sup> (32.5%)
Trees:	12
Parking:	6x undercroft parking 1x visitor bay

### Product Mix

Dw. No.	Bdrm	Bath	Car
5	3	2	1
1	1	1	1

### Construction costs

GFA:	843m <sup>2</sup>
Total build cost:	\$1,573,660
Cost / m <sup>2</sup>	\$1,866
+ \$68/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)

### Design Description

Terrace typology on a 20m frontage with front loaded access.

#### Pros

- ✓ mix of grouped and multiple dwellings
- ✓ rational and functional planning with minimal vehicular circulation
- ✓ lightwells/courtyards allow for daylighting and natural ventilation

#### Cons

- ✗ parking provided in the front half of the site detracts from the streetscape

### Testing Implications

Testing supports provisions for:

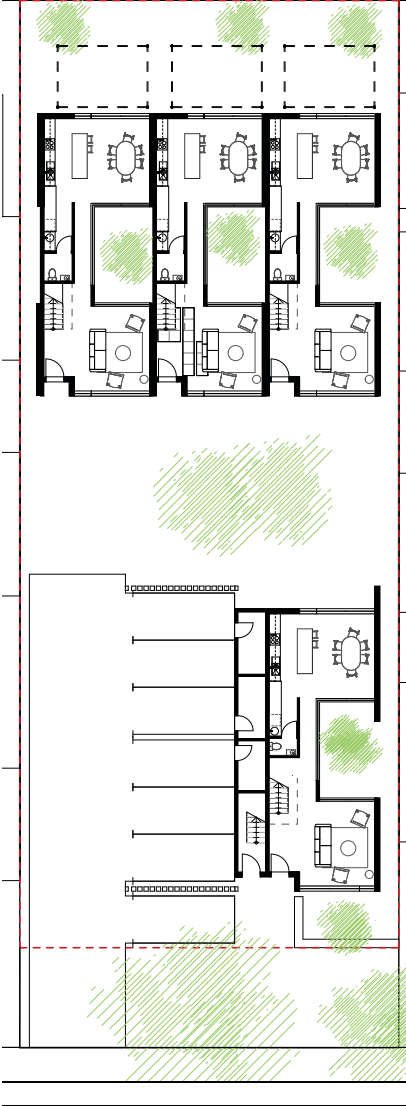
- ✓ average site area to determine maximum dwelling yield instead of plot ratio
- ✓ 3-storey development permitted in R40
- ✓ solar access to primary living spaces for climate zones 4,5, and 6

Further refinement of provisions as a result of testing:

- two-storey boundary wall for terraces
- apply site area incentives to sites with right-of-way access



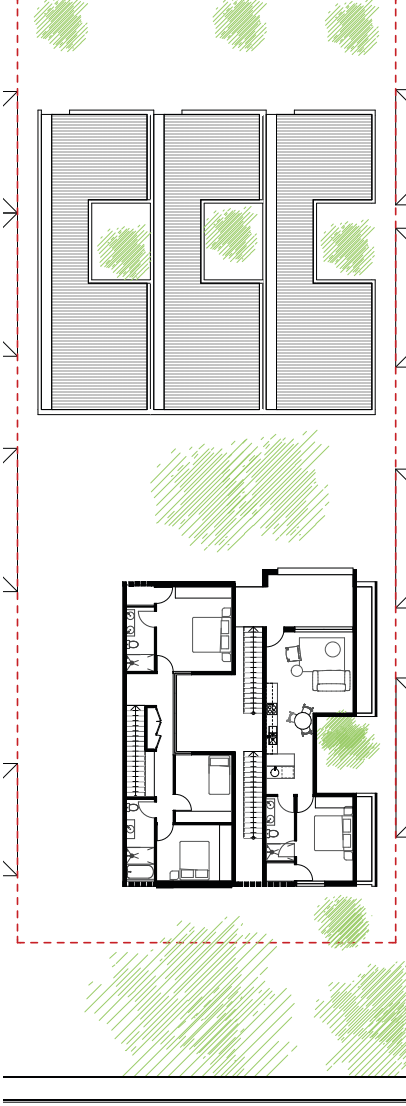
Right of Way



Ground Floor Plan



First Floor Plan



Second Floor Plan

# Site 5

Site description

## R60 MULTIPLE DWELLINGS (URBAN APARTMENT BUILDING)

North Perth R60

Area: 749m<sup>2</sup>

Frontage: 15.53m



### Comparison Base Plan

Typical narrow lot infill apartments.

### Project Data

Dwelling type:	9 apartments
Building height: (storeys)	Three storeys
Deep soil area:	~145m <sup>2</sup> (19%)
Trees:	2
Parking:	9 undercroft parking 2 visitor bays
Bicycle parking:	3 resident 1 visitor

### Product Mix

Dw. No.	Bdrm	Bath	Car
9	2	1	1

### Construction costs

GFA:	1046m <sup>2</sup>
Total build cost:	\$1,497,950
Cost / m <sup>2</sup>	\$1,432

*as costed by quantity surveyor  
(June 2020)*



# Phase 1 Testing

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# Site 5 (cont.)



Street elevation

## CONCEPT 5A

### Project Data

Dwelling type:	7 multiple dwellings
Building height: (storeys)	Three storeys
Deep soil area:	176m <sup>2</sup> (23.5%)
Trees:	19
Parking:	7x undercroft bays 1 visitor bay
Bicycle parking:	8 resident 6 visitor

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	1	1	1
6	2	2	1

### Construction costs

GFA:	1030m <sup>2</sup>
Total build cost:	\$1,486,210
Cost / m <sup>2</sup>	\$1,444
+ \$12/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)

### Design Description

Three storey, narrow lot semi-urban multiple dwelling that achieves seven dual aspect apartments.

#### Pros

- ✓ well considered orientation with potential for good solar access to primary living spaces
- ✓ each primary living space has direct access to a private open space and access or a view to communal space / deep soil area with trees
- ✓ design achieves good cross-ventilation and captures breeze paths
- ✓ ground floor apartment potentially adaptable to silver level Livable Housing Design standards

#### Cons

- ✗ visual privacy screening negatively impacts on solar access
- ✗ parking and vehicle manoeuvring space is inefficient and compromises functionality of communal space

### Testing Implications

Testing supports provisions for:

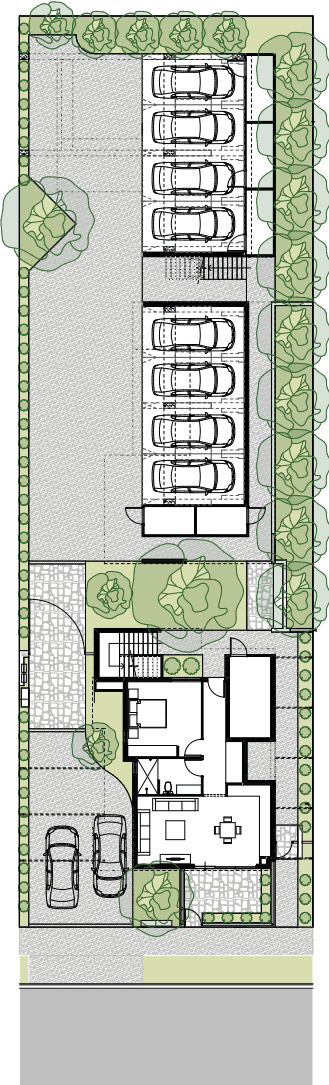
- ✓ deep soil areas for gardens and trees
- ✓ reduced paved areas for vehicle access
- ✓ minimum dwelling and room sizes

Suggested further refinement of provisions as a result of testing:

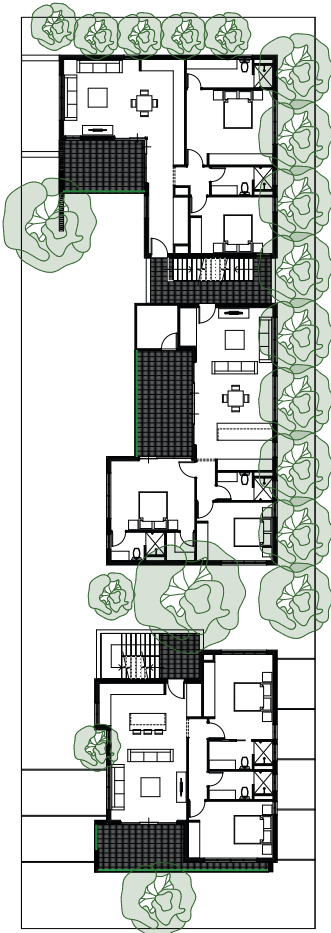
- update visual privacy provisions to allow context specific response
- simplify deep soil area encroachments to impermeable surfaces

# Phase 1 Testing

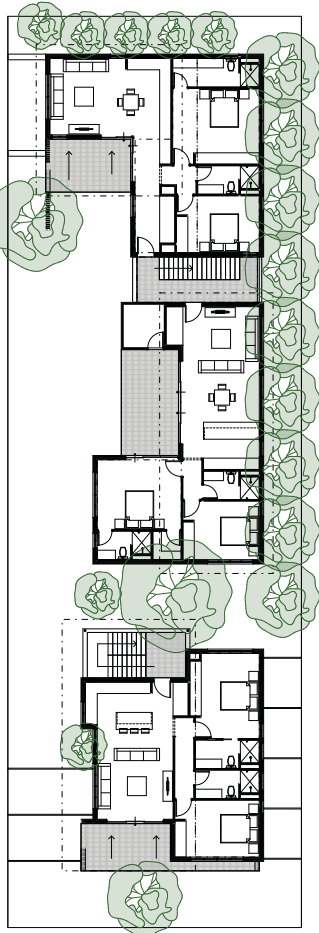
Concept 5A



Ground Floor Plan



First Floor Plan



Second Floor Plan



# Site 5 (cont.)



Street view



Street elevation

## CONCEPT 5B

### Project Data

Dwelling type:	9 multiple dwellings
Building height: (storeys)	Three storeys
Deep soil area:	264m <sup>2</sup> (35%)
Trees:	2 medium 12 small
Parking:	11 undercroft bays 2 visitor bays
Motorcycle parking	2 provided
Bicycle parking:	9 resident

### Product Mix

Dw. No.	Bdrm	Bath	Car
4	1	1	1
4	3	2	2
1	4	3	2

### Construction costs

GFA:	1480m <sup>2</sup>
Total build cost:	\$1,901,840
Cost / m <sup>2</sup>	\$1,285
	-\$147/m <sup>2</sup> from comparison base plan

as costed by quantity surveyor  
(June 2020)

### Design Description

Three storey, narrow lot semi-urban multiple dwelling that achieves nine apartments with a mix of larger 'family' 4 and 3 bedroom apartments and a 'dual-key' ancillary dwelling.

#### Pros

- ✓ dwelling diversity
- ✓ large deep soil areas proposed as communal space for flexible use by occupants
- ✓ trees proposed in the street setback area
- ✓ planter boxes to private open spaces used to limit overlooking to adjoining properties

#### Cons

- ✗ does not comply with overshadowing requirements due to narrow east-west facing lot

### Testing Implications

Testing supports provisions for:

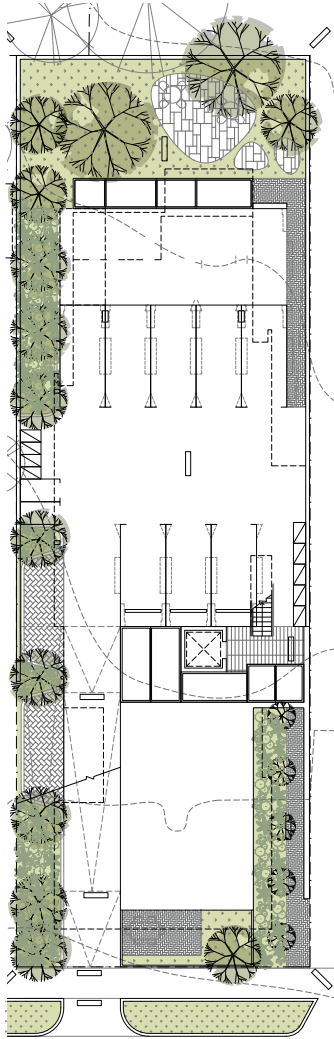
- ✓ consolidated deep soil areas for gardens and trees
- ✓ average site area instead of plot ratio to determine dwelling yield - encourages larger family size apartments
- ✓ context-specific approach to visual privacy

Suggested further refinement of provisions as a result of testing:

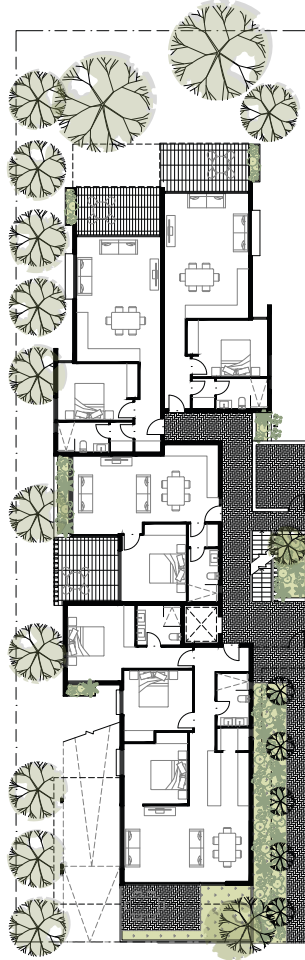
- calibrate overshadowing for medium density development
- ancillary dwellings (dual-key) for apartments

# Phase 1 Testing

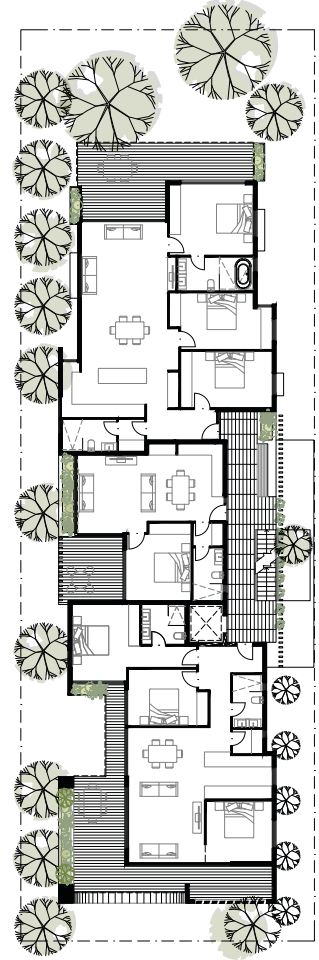
Concept 5B



Ground Floor Plan



First Floor Plan



Second Floor Plan

# Site 6

Site description

**R40 MULTIPLE DWELLINGS (SUBURBAN APARTMENT BUILDING)**

Beldon R20/R40

Area: 683m<sup>2</sup>

Frontage: 21.03m



## Comparison Base Plan

Two storey suburban apartment in outer ring suburb. (Aerial indicates site only, development not yet built)

## Project Data

Dwelling type:	6 multiple dwellings
Building height: (storeys)	Two storeys
Deep soil area:	~117m <sup>2</sup> (17%)
Trees:	7
Parking:	7 undercroft bays 2 visitor bays
Bicycle Parking:	3 resident 1 visitor

## Product Mix

Dw. No.	Bdrm	Bath	Car
4	1	1	1
1	2	1	1
1	2	1	2

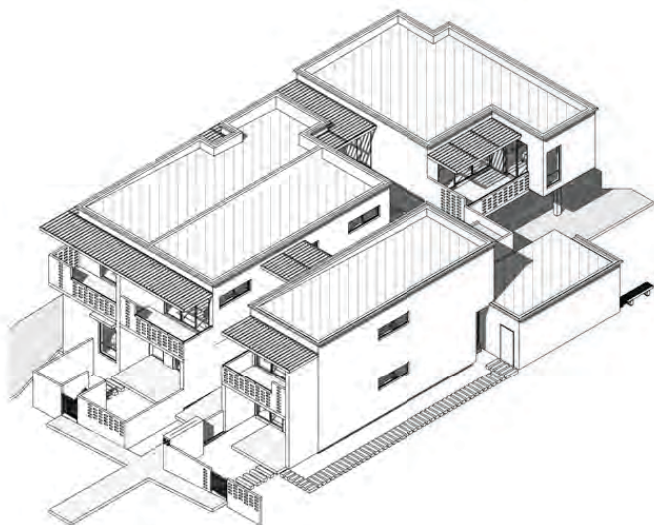
## Construction costs

GFA:	572m <sup>2</sup>
Total build cost:	\$948,395
Cost / m <sup>2</sup>	\$1,657

*as costed by quantity surveyor (June 2020)*



## Concept 6A

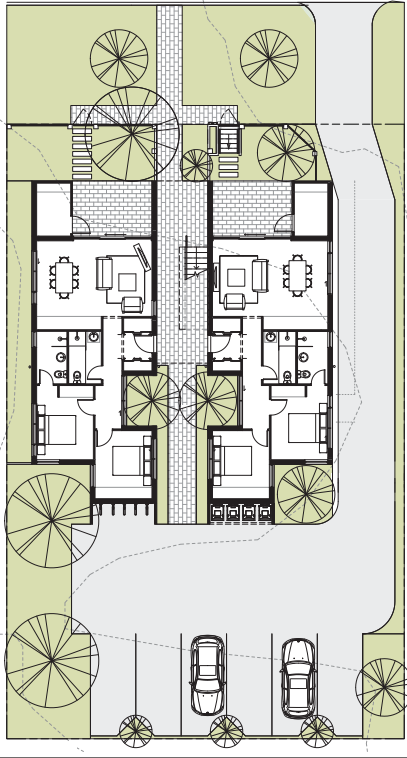


Indicative 3d view of new development

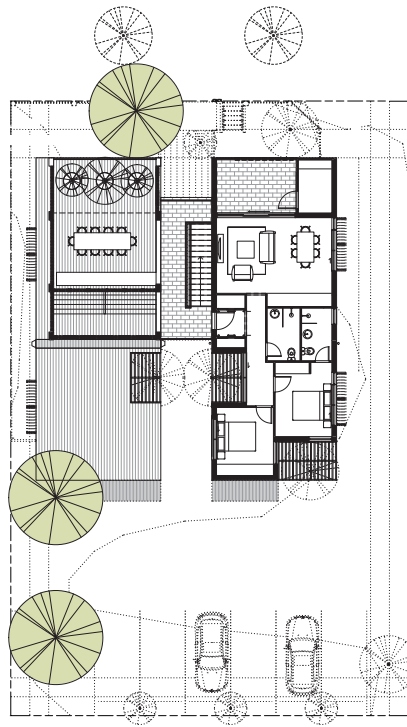


# Phase 1 Testing

## CONCEPT 6A



Ground and First Floor Plan



Second Floor Plan

### Project Data

Dwelling type:	Five apartments
Building height: (storeys)	Three storeys
Deep soil area:	226m <sup>2</sup> (33%)
Trees:	14
Parking:	5x occupant bays 1 visitor bay
Bicycle Parking:	5 resident
Special features:	Retained tree

### Product Mix

Dw. No.	Bdrm	Bath	Car
4	2	1.5	1
1	2	2	1

### Construction costs

GFA:	584m <sup>2</sup>
Total build cost:	\$1,021,050
Cost / m <sup>2</sup>	\$1,750
+ \$93/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)

### Design Description

Suburban apartment with retained tree. Design proposes maximum building heights and roof deck for residents.

#### Pros

- ✓ development in a landscape setting suits suburban context
- ✓ well considered building orientation with living spaces to the north and bedrooms to the south and capturing breeze paths
- ✓ rational and functional floor planning with minimal circulation
- ✓ uncovered parking reduces construction costs and provides generous setback from rear boundary

#### Cons

- ✗ carparking arrangement increases proportion of site area dedicated to vehicle access and manoeuvring (passing points not provided to minimise impact).
- ✗ concept doesn't achieve same yield as comparison base plan due to average site area calculation instead of plot ratio approach

### Testing Implications

Testing supports provisions for:

- ✓ solar access to primary living spaces for climate zones 4,5, and 6
- ✓ deep soil areas for gardens and trees
- ✓ 3-storey development permitted in R40
- ✓ minimum dwelling and room floor areas

Further refinement of provisions as a result of testing:

- calibrate site area requirement for multiple dwellings to plot ratio yields achieved under Vol.2 Apartments
- reduced vehicle access requirements and passing points

# Site 6 (cont.)

## CONCEPT 6B

### Project Data

Dwelling type:	5 multiple dwellings
Building height: (storeys)	Three storeys
Deep soil area:	347m <sup>2</sup> (50%)
Trees:	13
Parking:	5x occupant bays 1x visitor bay
Bicycle parking:	unknown
Special features	Existing retained tree

### Product Mix

Dw. No.	Bdrm	Bath	Car
5	2	1	1

### Construction costs

GFA:	507m <sup>2</sup>
Total build cost:	\$878,850
Cost / m <sup>2</sup>	\$1,735
+ \$78/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)

### Design Description

Suburban apartment with retained tree within a landscaped setting that achieves dwelling diversity with two universally adaptable dwellings.

#### Pros

- ✓ retained tree and high number of additional trees in deep soil areas
- ✓ generous landscaped areas accommodate active, flexible uses for occupants
- ✓ well considered orientation, airflow, outlook and 'access to the sky'

#### Cons

- ✗ building bulk to rear of site potentially has more impact on neighbouring properties
- ✗ consolidated car parking to the street front requires high quality landscaping and ongoing management and maintenance

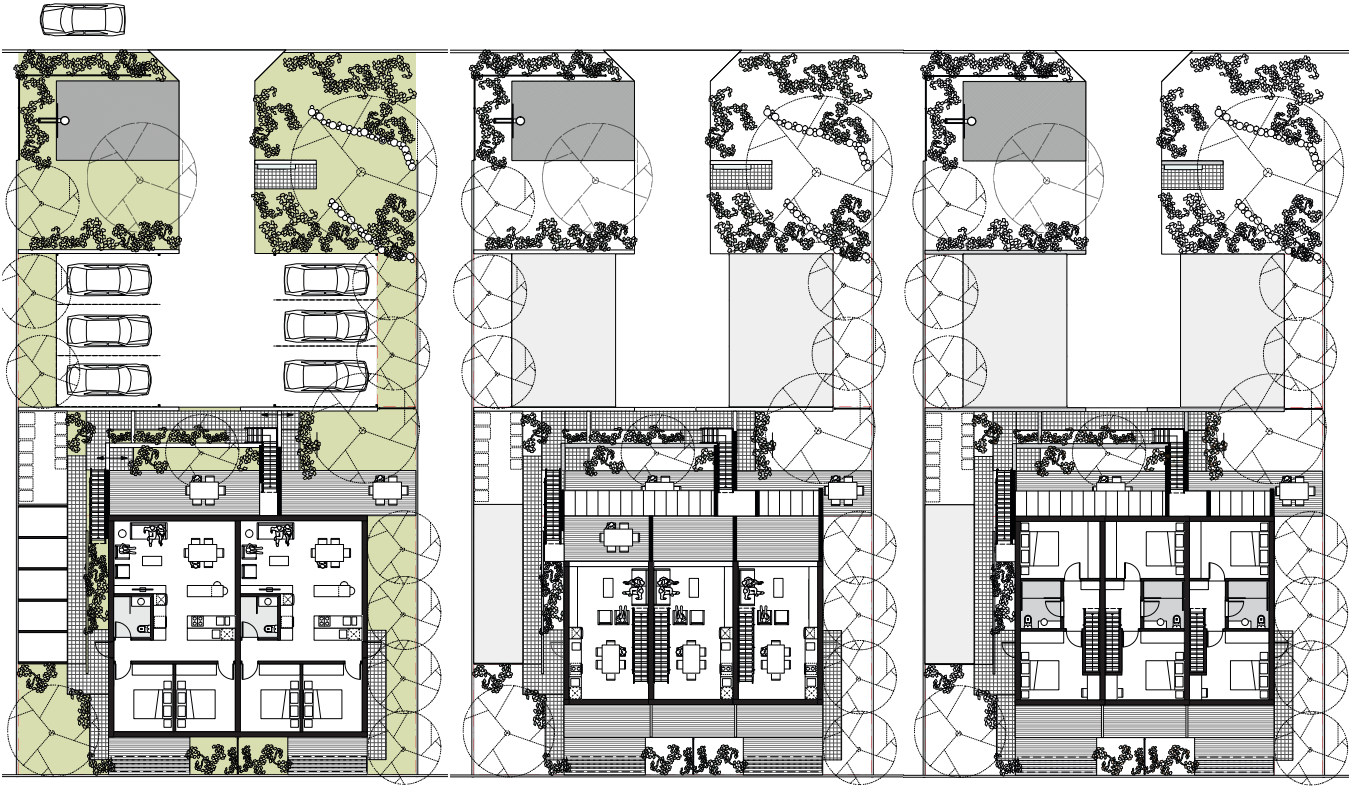
### Testing Implications

Testing supports provisions for:

- ✓ solar access to primary living spaces for climate zones 4,5, and 6
- ✓ 3-storey development permitted in R40
- ✓ universal design and dwelling diversity

Suggested further refinement of provisions as a result of testing:

- provision to address car parking within the street setback area
- tree number to dwelling number
- setbacks relating to storey heights



Ground Floor Plan

First Floor Plan

Second Floor Plan



Street elevation

# Site 6 (cont.)

## CONCEPT 6C

### Project Data

Dwelling type:	5 multiple dwellings
Building height: (storeys)	Three storeys
Deep soil area:	324m <sup>2</sup> (47%)
Trees:	12
Parking:	4x undercroft parking 1x visitor bay
Bicycle parking	5 resident
Special features	Existing retained tree

### Product Mix

Dw. No.	Bdrm	Bath	Car
1	1	1	1
4	2	1	1

### Construction costs

GFA:	866m <sup>2</sup>
Total build cost:	\$1,061,560
Cost / m <sup>2</sup>	\$1,226
-\$431/m <sup>2</sup> from comparison base plan	

as costed by quantity surveyor  
(June 2020)

### Design Description

Suburban apartment with retained tree with undercroft parking appropriate for suburban, semi-urban context. Ground floor apartment capable of universal access.

#### Pros

- ✓ undercroft parking
- ✓ minimises impact on streetscape
- ✓ ground floor apartment has access to generous private courtyard
- ✓ good orientation and cross-ventilation to captures breeze paths

#### Cons

- ✗ three storey wall close to lot boundary

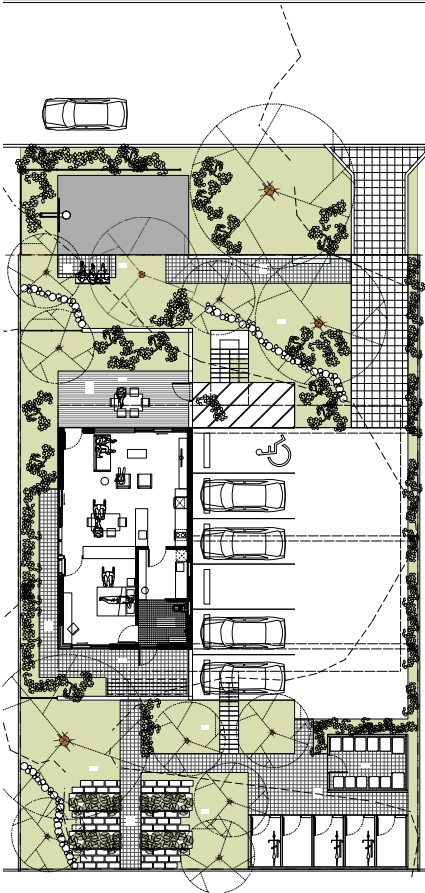
### Testing Implications

Testing supports provisions for:

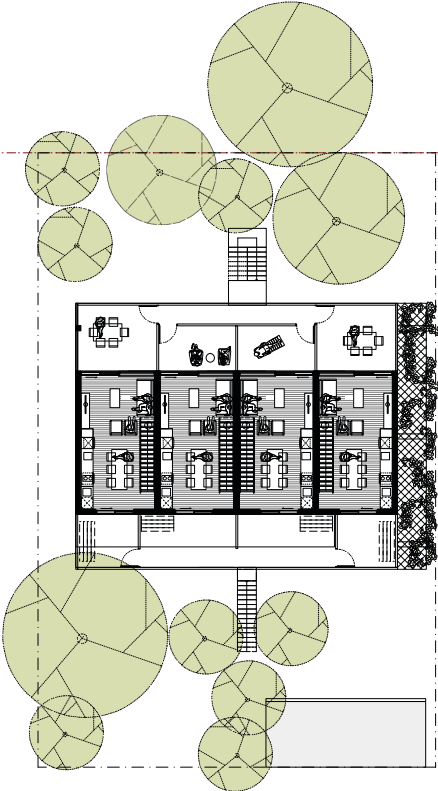
- ✓ average site area instead of plot ratio to determine dwelling yield. Allows for diverse dwelling types
- ✓ deep soil areas for gardens and trees

Suggested further refinement of provisions as a result of testing:

- setbacks calculated according to storey heights
- tree number to dwelling number ratios



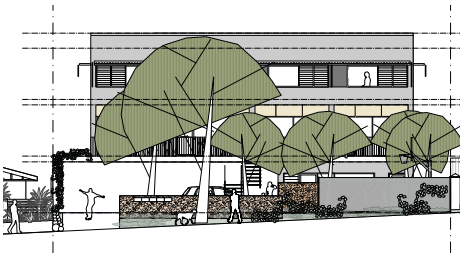
Ground Floor Plan



First Floor Plan



Second Floor Plan



Street elevation