HILLAM
ARCHITECTS

DEVELOPMENT APPLICATION

Issued 07.12.2017

20-22 KINTAIL RD
APPLECROSS
DECEMBER 2017

CONTENTS

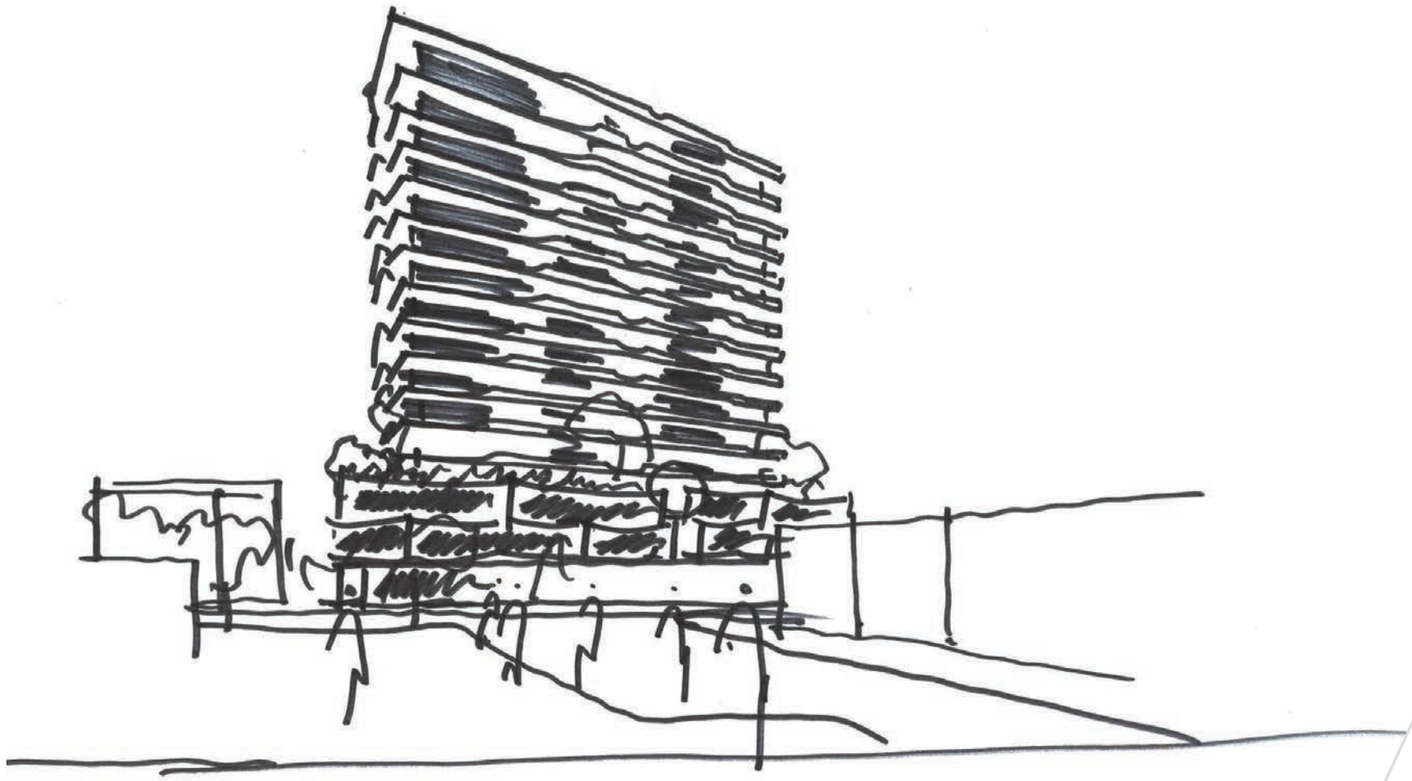
Table REPORT REGISTER

ISSUE	STATUS	DATE	REVISION

1.0 INTRODUCTION

1.1 SITE INFORMATION

Address	20-22 Kintail Rd, Applecrosss 6153
Developer	Norup + Wilson
Architect	Hillam Architects
Local Gov. Area	City of Melville
Site Area	2,022m² (1,011 + 1,011m²)
Zoning	Centre; Refer Local Planning Scheme No. 6
Precinct	Q1 - Kintail Quarter
R-Coding	R-AC0
Plot Ratio	5.52
Boundary Setbacks	Podium; 3.5m front, Nil sides & rear. Tower; 8.2m front, 5.0m west boundary 5.15m east boundary 5.6m rear
Building Height	Proposed: 16 Storeys Allowed: 10 Storeys + bonus.
Finished Floor Levels	Various; Refer to architectural drawings
Access & Service	Kintail Rd



1.2 THE ARCHITECT

Our ethos is simple; to design and create stylish and imaginative buildings. Ones in which form and function work together in perfect partnership.

Our story begins in 1993 when David Hillam, Hillam Architects' owner and Principal, opened his doors to clients who were looking for a residential Architect who could offer distinctive, high-quality design. David founded this firm on the belief that the quality of our built-environment, whether in the work-place, at home, or in the public spaces between, directly influences the quality of lives.

David's passion for understanding how people use and live in buildings, as well as his exceptional eye for design and obsession with detail, established Hillam Architects as one of Perth's leading design firms. Awards followed, and the business grew.

Having built an enviable portfolio over the past 20 years, Hillam Architects sees opportunity for extraordinary design at every scale, from multi-residential, mixed-use and commercial developments through to bespoke, high-end single residential dwellings. We aim to produce spaces that inspire, elevate and exceed the lifestyle expectations of the people who interact with them.

Directly responsive to the needs of the client, the parameters of the site and climate, our projects reinforce the role of architecture in creating a sustainable future.

Experience gained through working for and with developers, has ensured we've adopted a pragmatic, hands-on approach to our commercial projects. We welcome the challenge of combining the business needs of stakeholders and developers with our passion for producing buildings that are innovative, exciting and enduring.

Our continued practice in this area, coupled with our excellent relationships with local authorities, consultants and contractors, allows us to push the boundaries and ensure projects are delivered on-time and on budget, without compromising on quality or aesthetics.

1.3 PROJECT OVERVIEW

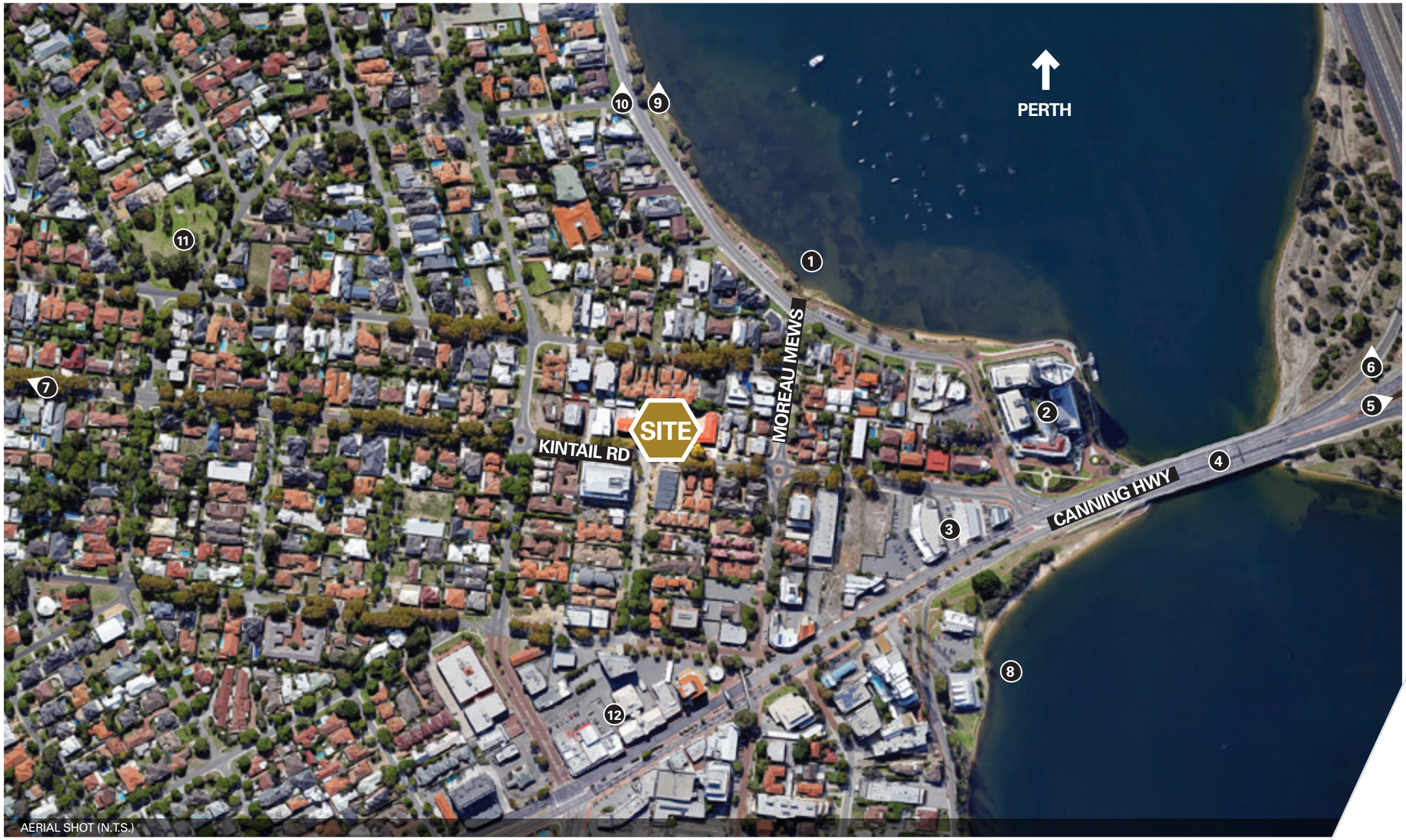
This application seeks approval for a mixed-use development comprising of 97 residential apartments, 1 café and parking configured over a 16 story building. The proposed design provides a good mix of apartment types with a primary focus on providing a diverse range of housing.

Careful attention has been given to satisfy with the Bonus Provisions Requirement outlined in the Canning Bridge Activity Centre Plan in order to achieve additional building height.

In summary the proposed design consists of:

- 97 Residential apartments
- 175sqm of café area on ground floor
- Public secured bicycle parking and end of trip facilities on ground floor
- A community function room is located on ground floor
- An open public piazza on ground floor provides amenity for general public
- Carparking from basement to level 2.
- Residential communal amenities include Lounge, Kitchen/Dining, Swimming Pool, BBQ area and garden space on level 15.

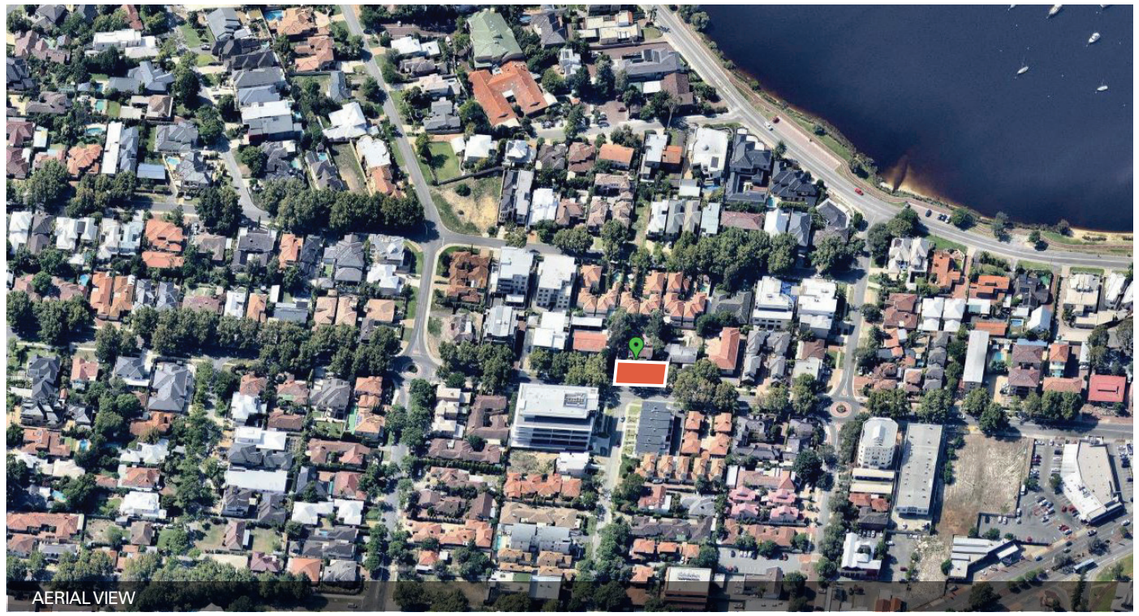
2.1 LOCALITY



Applecross Foreshore	1.
Raffles Hotel Perth	2.
IGA	3.
Canning Bridge	4.
Canning Bridge Stn	5.
Kwinana Fwy	6.
Applecross P. School	7.
Rowing Club	8.
S. Perth Yacht Club	9.
Heathcote Reserve	10.
Warwick Wild Park	11.
Various Retail	12.

AERIAL SHOT (N.T.S.)

2.2 SITE CONTEXT & EXISTING CONDITIONS



AERIAL VIEW

AERIAL VIEW

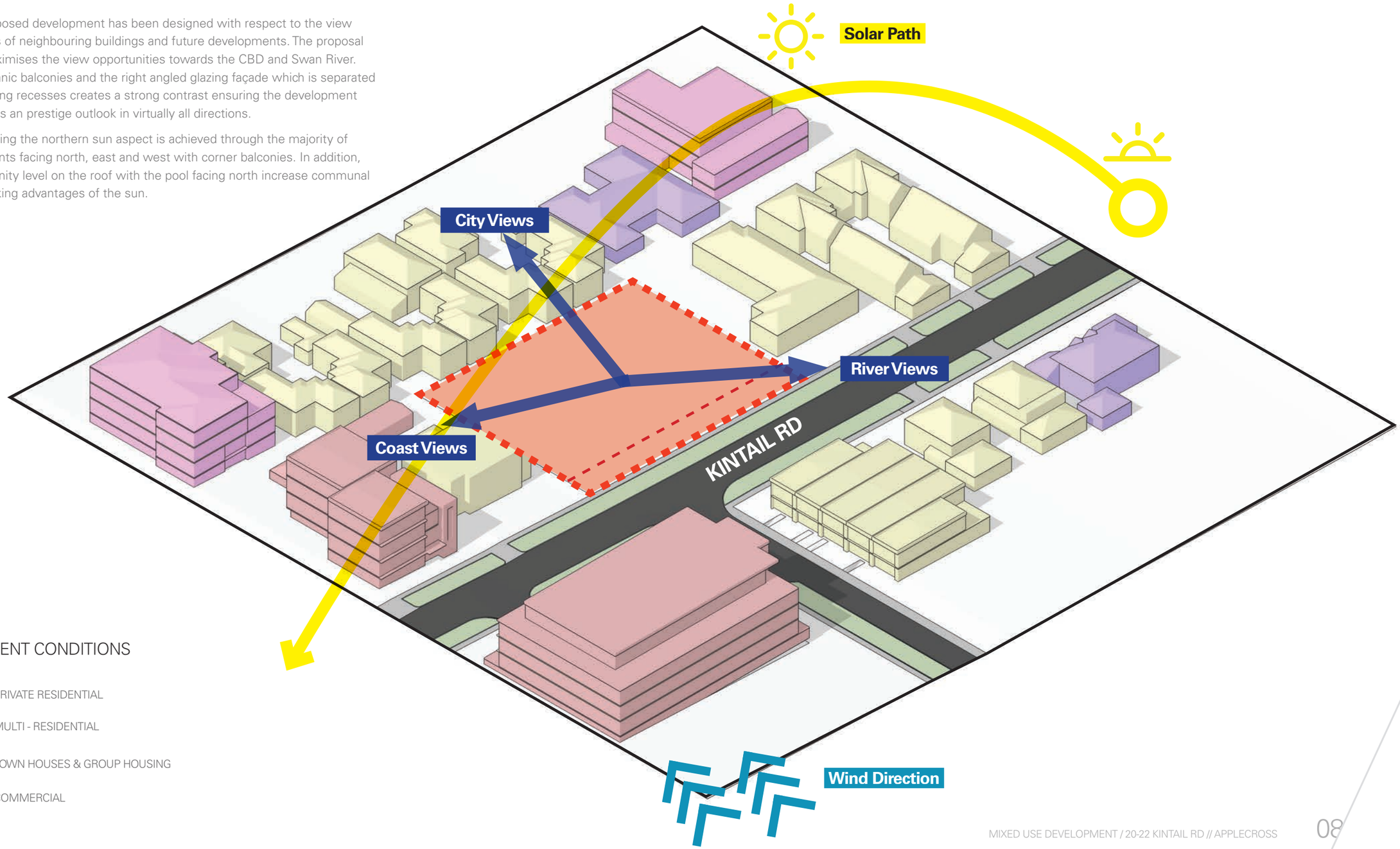
VIEW FROM CORNER

VIEW FROM KINTAIL RD

2.3 SITE LAYOUT & ORIENTATION

The proposed development has been designed with respect to the view corridors of neighbouring buildings and future developments. The proposal also maximises the view opportunities towards the CBD and Swan River. The organic balconies and the right angled glazing façade which is separated by planting recesses creates a strong contrast ensuring the development maintains an prestige outlook in virtually all directions.

Maximising the northern sun aspect is achieved through the majority of apartments facing north, east and west with corner balconies. In addition, the amenity level on the roof with the pool facing north increase communal living taking advantages of the sun.



CURRENT CONDITIONS

- PRIVATE RESIDENTIAL
- MULTI - RESIDENTIAL
- TOWN HOUSES & GROUP HOUSING
- COMMERCIAL

3.1 DESIGN CONCEPT SUMMARY

TThe concept for the proposal takes its cue from the rich local context. The design offers a transparent glazed tower contrasting with the solid podium with street scales building finishes.

The tower design breaks the massing using deep planter recesses on each elevation. The organic form of the balconies on one end contrast with the solid glazing on the other end further reduces the visual scale of the tower. A hint of slight purple colour glazing on the tower signifies the blossom of Jacaranda on the local streets in the spring season.

The podium has apartment fronting the street activates the street. Some screening elements are introduced on the podium façade providing some degree of privacy to the apartments and yet permitting street surveillance to occur.

A large landscaped open piazza is located on the ground floor outside the café allowing wider community to gather and interact with local residences. The piazza is weather protected by a highly artistic canopy which will be designed in collaboration with a local artist.

Raw concrete and renders are predominately used on the ground floor. The simplicity and honesty of these materials blends well in the local context.

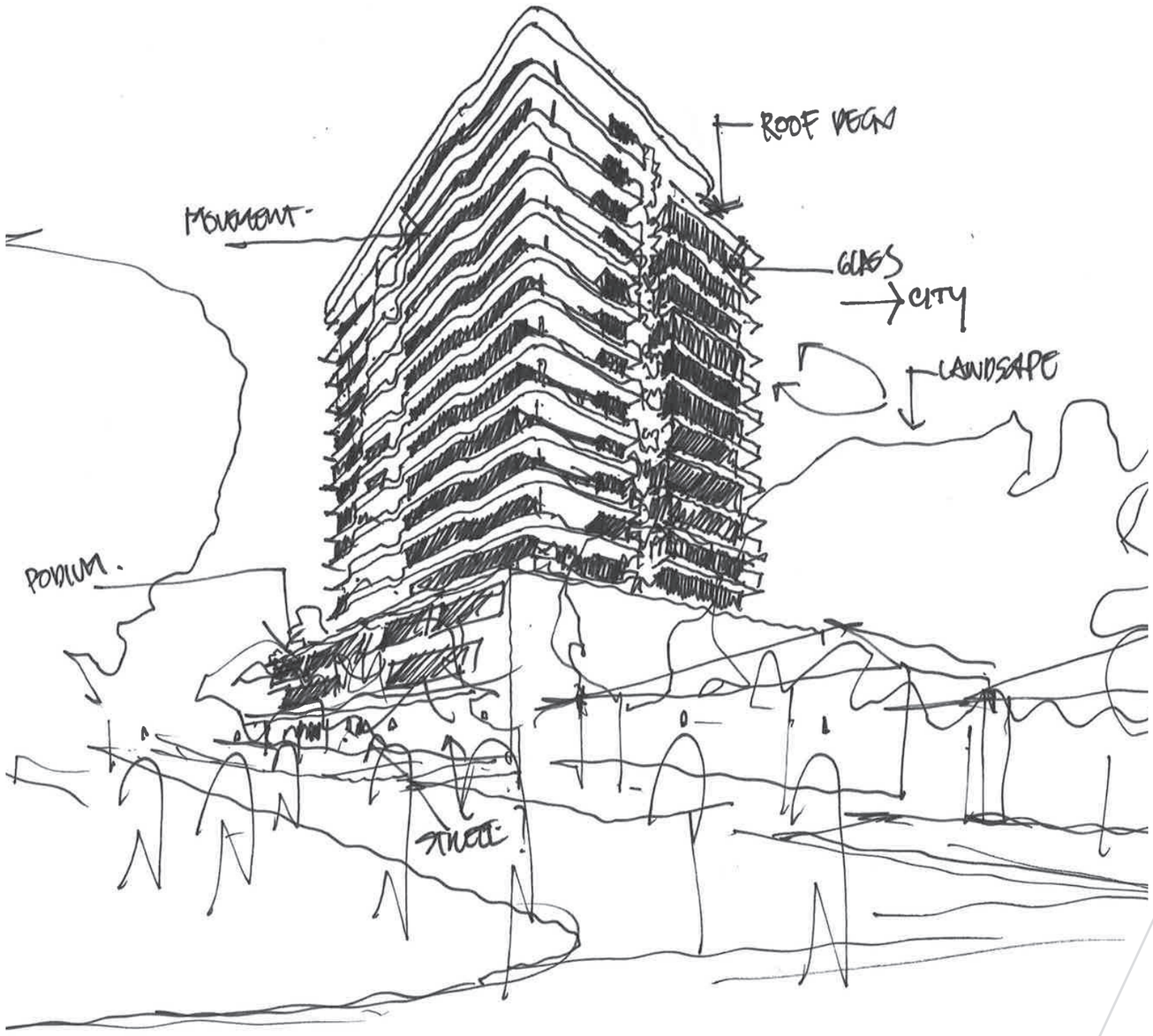
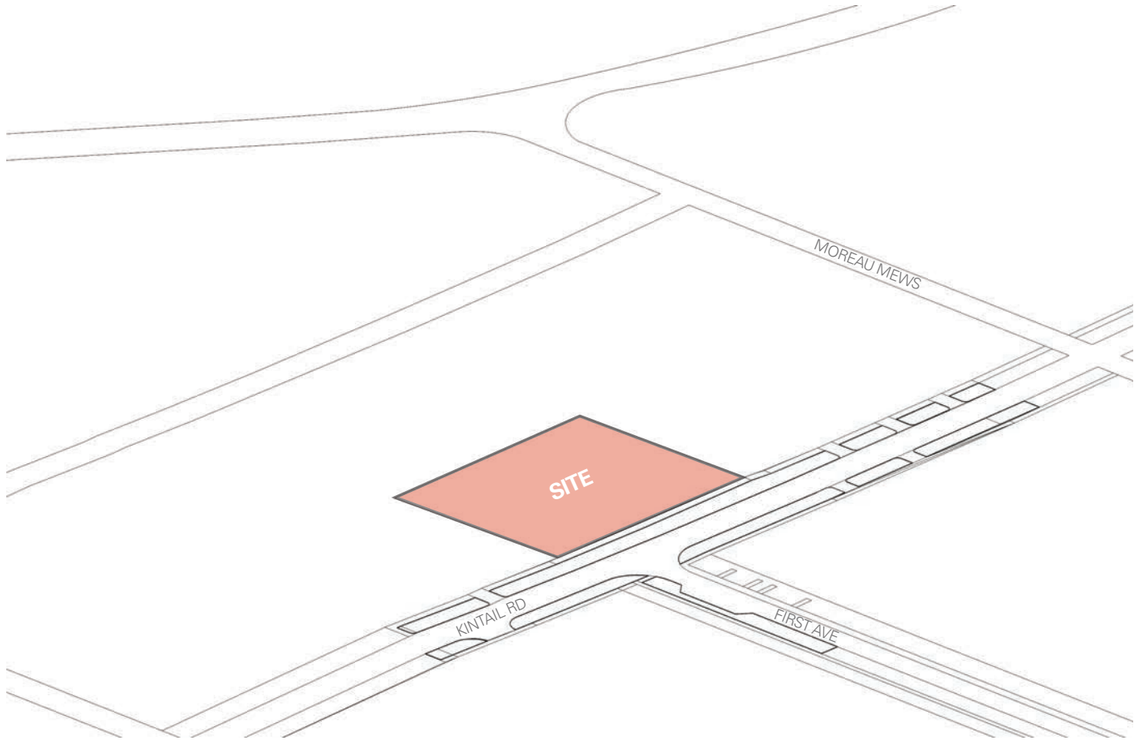
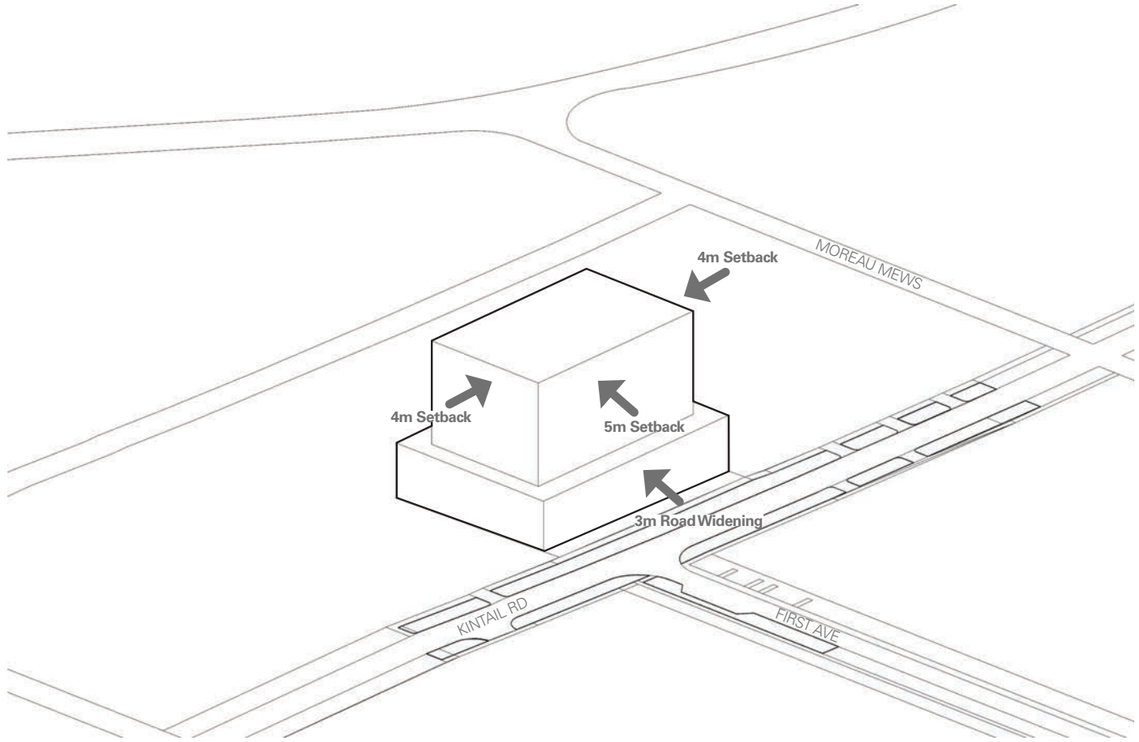


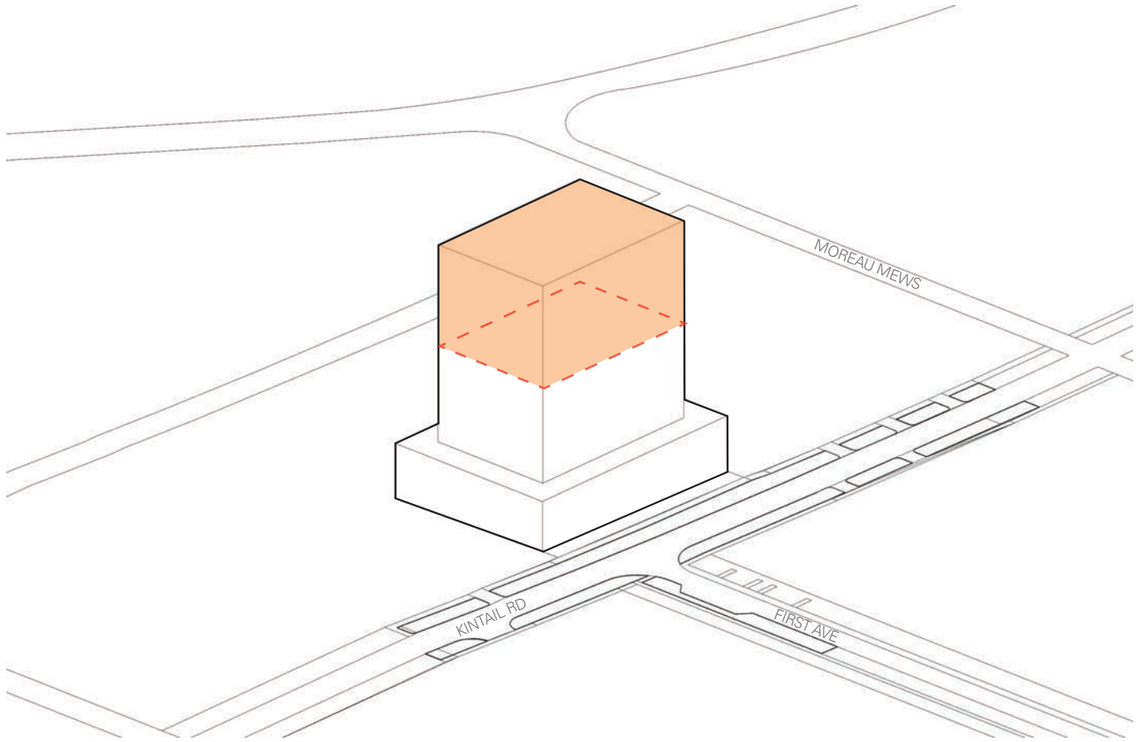
IMAGE 3.1.1:VIEW EAST WEST ALONG KINTAIL ROAD



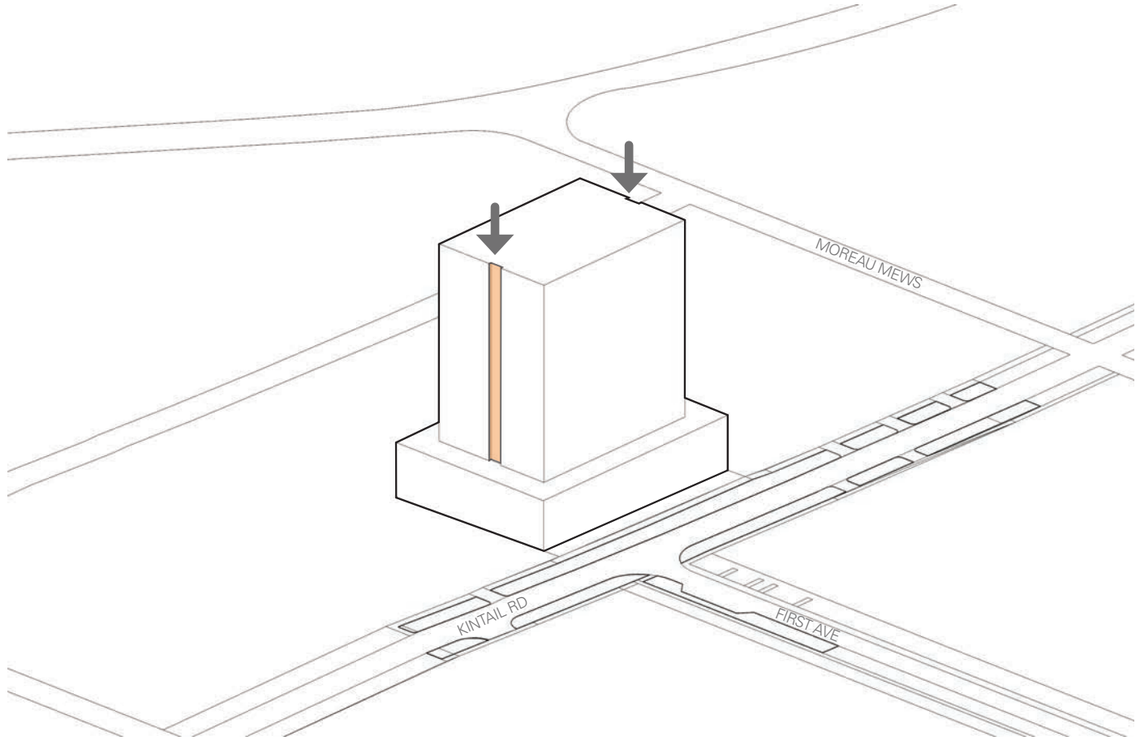
A THE SUBJECT SITE IS LOCATED ON KINTAIL ROAD, ADJACENT TO THE INTERSECTION WITH FIRST AVENUE



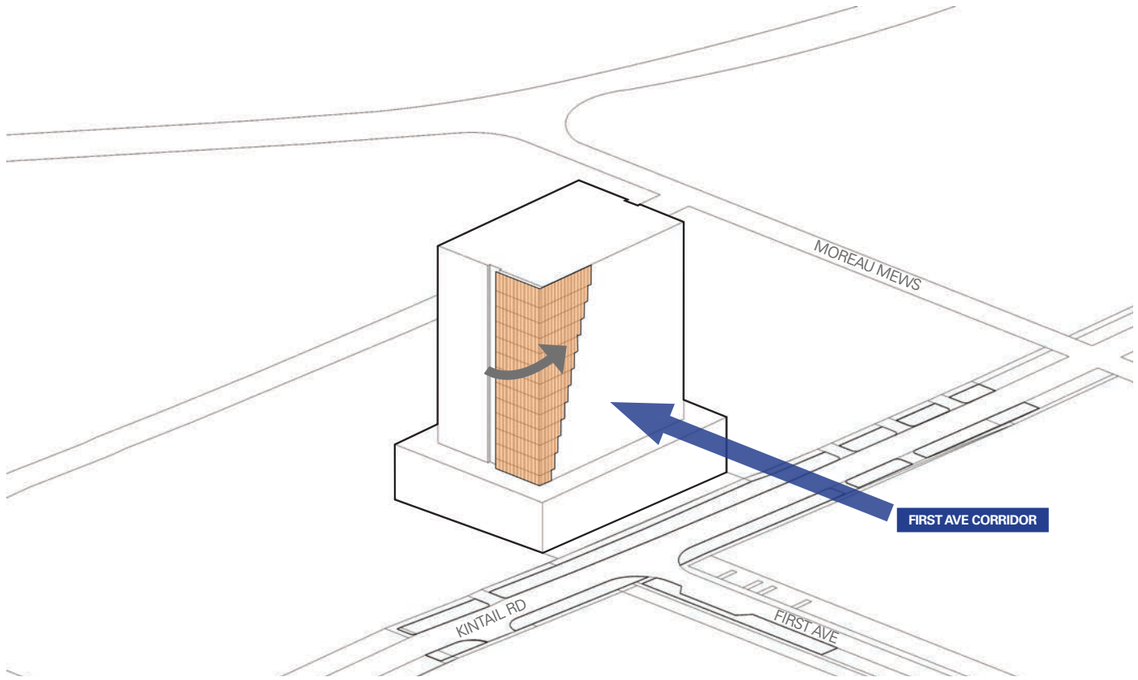
B MASSING AS PER DESIGN GUIDELINES.



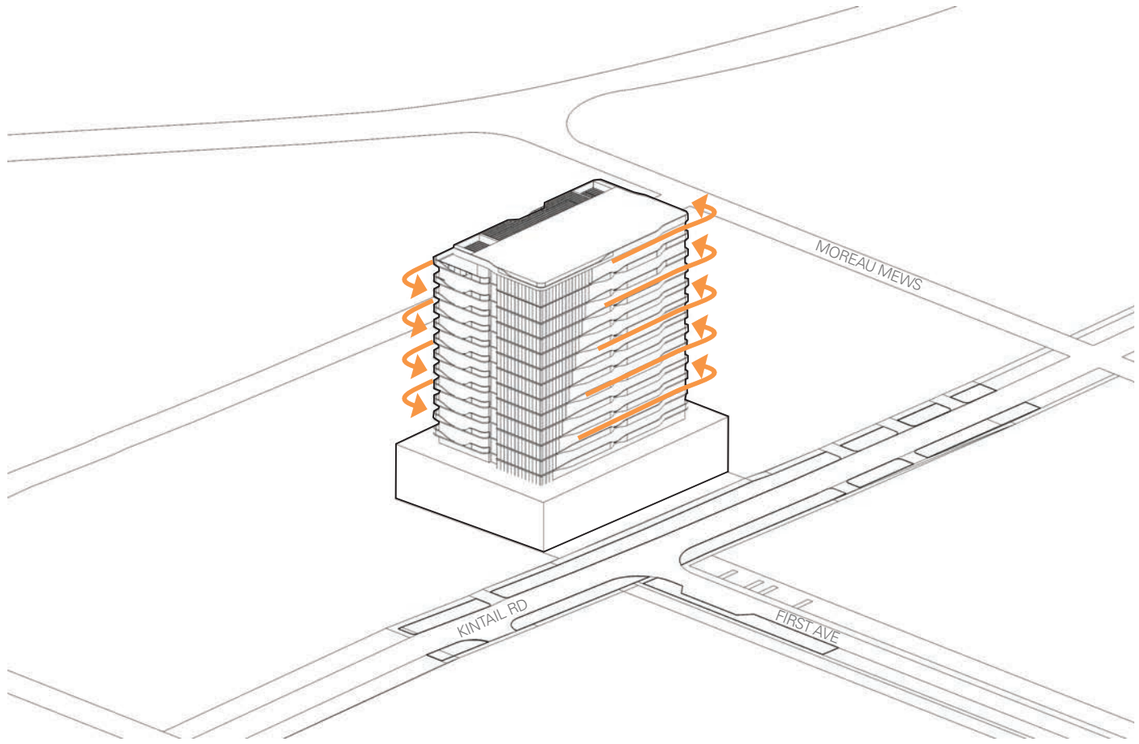
C **PROPOSED BUILDING ENVELOPE ASSUMING BONUS HEIGHT REQUIREMENTS ARE SATISFIED**



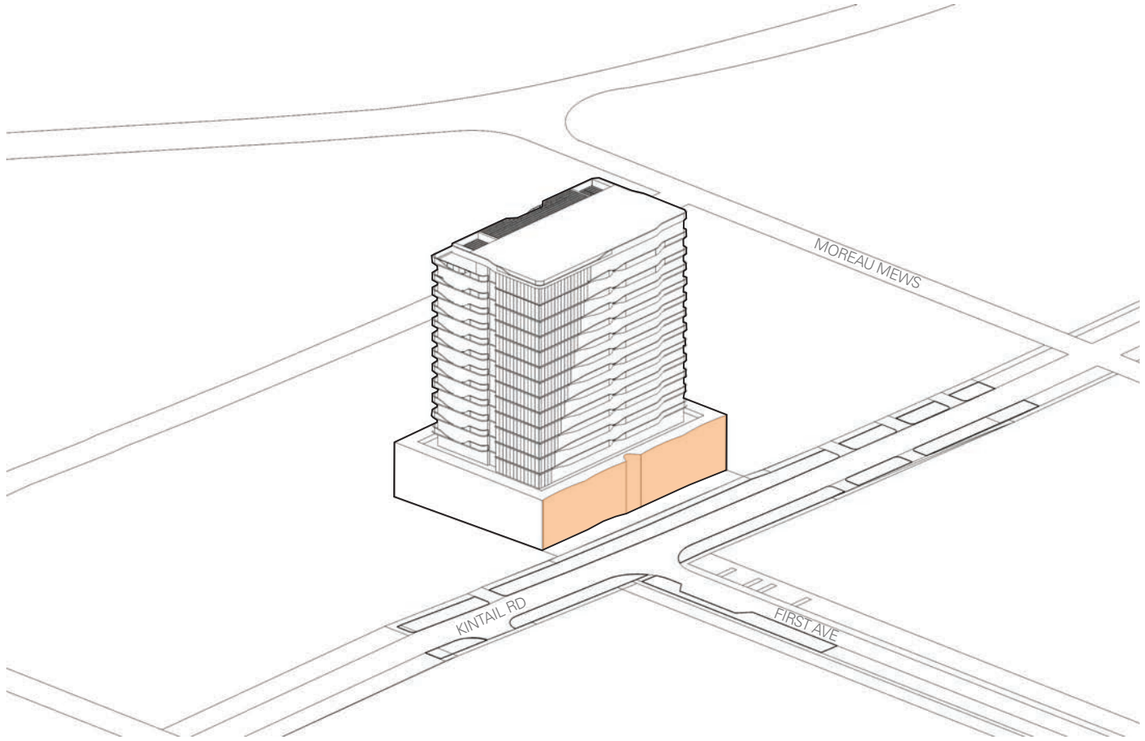
D **BUILDING MASS IS VERTICALY DIVIDED ON BOTH SIDE ELEVATIONS**



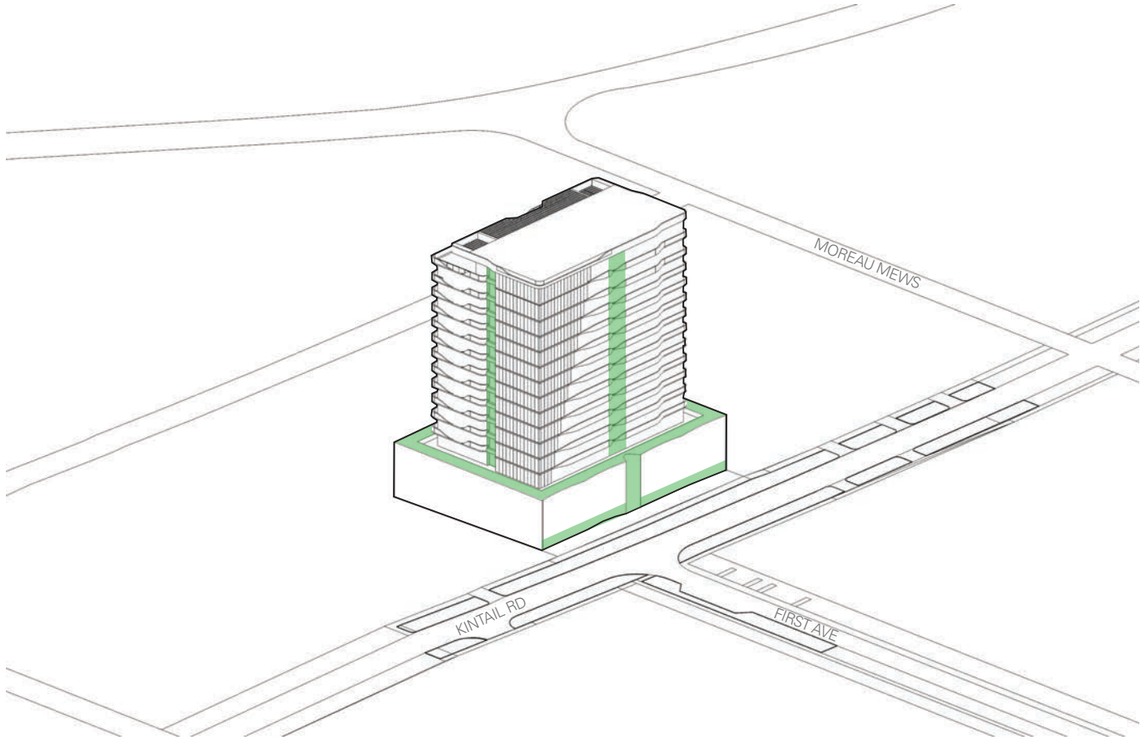
E ANGLED SHEAR GLAZED CORNERS RUN UP ALONG TWO FACADES, RESPONDING TO THE VIEW CORRIDOR FROM FIRST AVENUE.



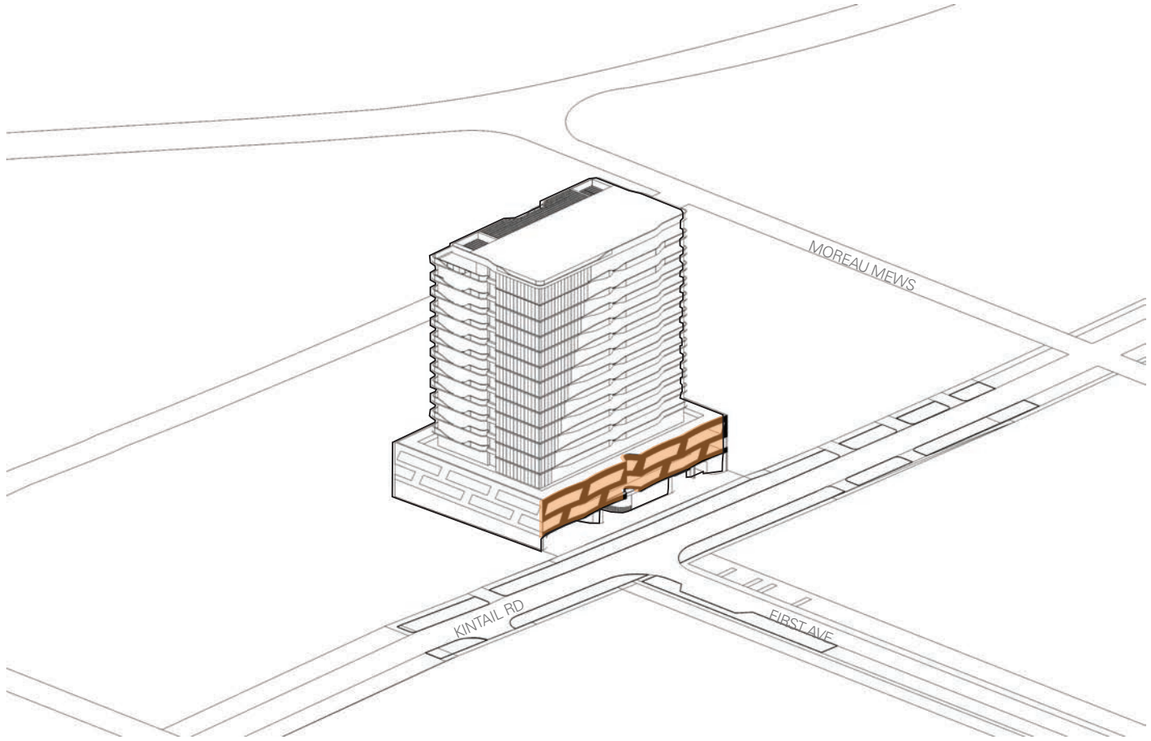
F THE GLAZED CORNERS ARE COMPLIMENTED BY SWEEPING BALCONIES WHICH CURVE AROUND THE BUILDING



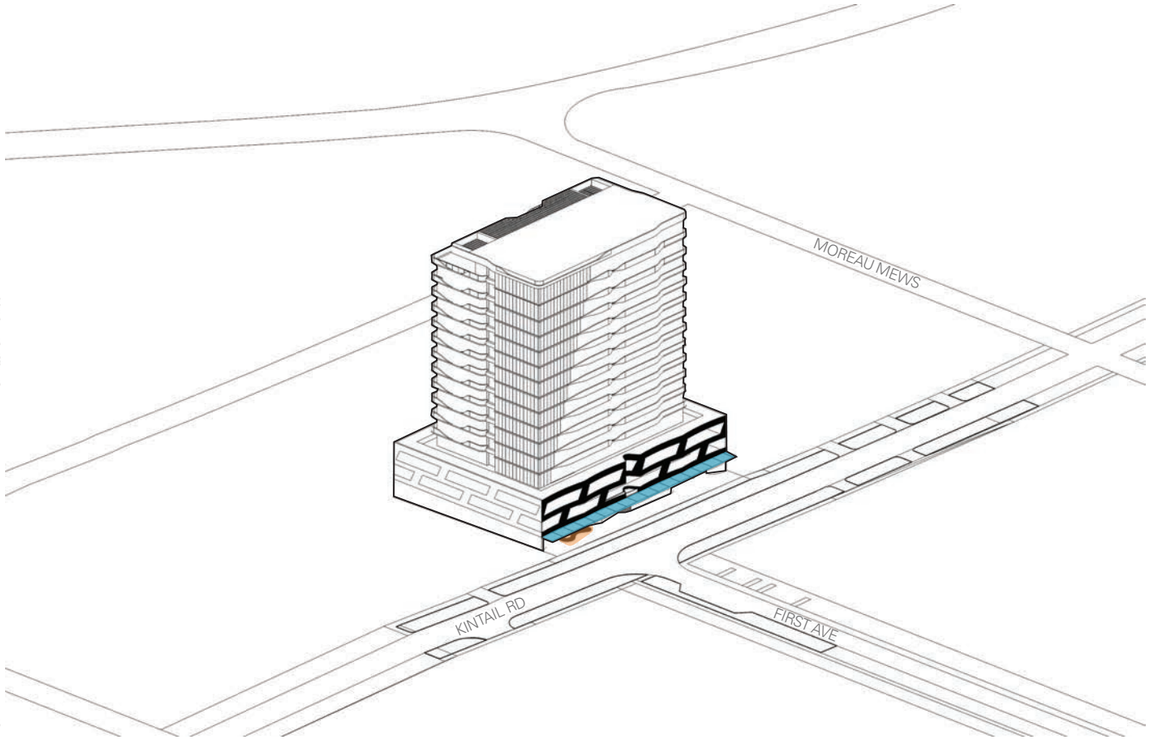
G **PODIUM FORM IS SCULPTED TO COMPLIMENT THE ABOVE TOWER**



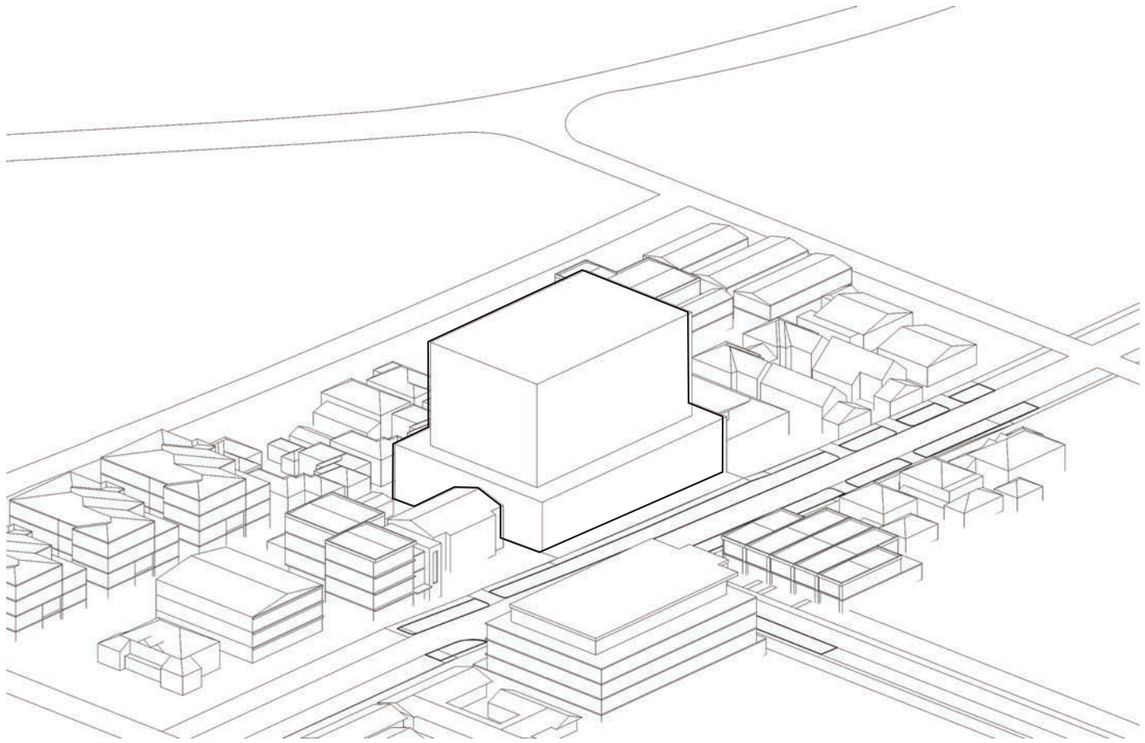
H **GREEN SPACES AND PLANTING ON EACH FACADE & ON PODIUM**



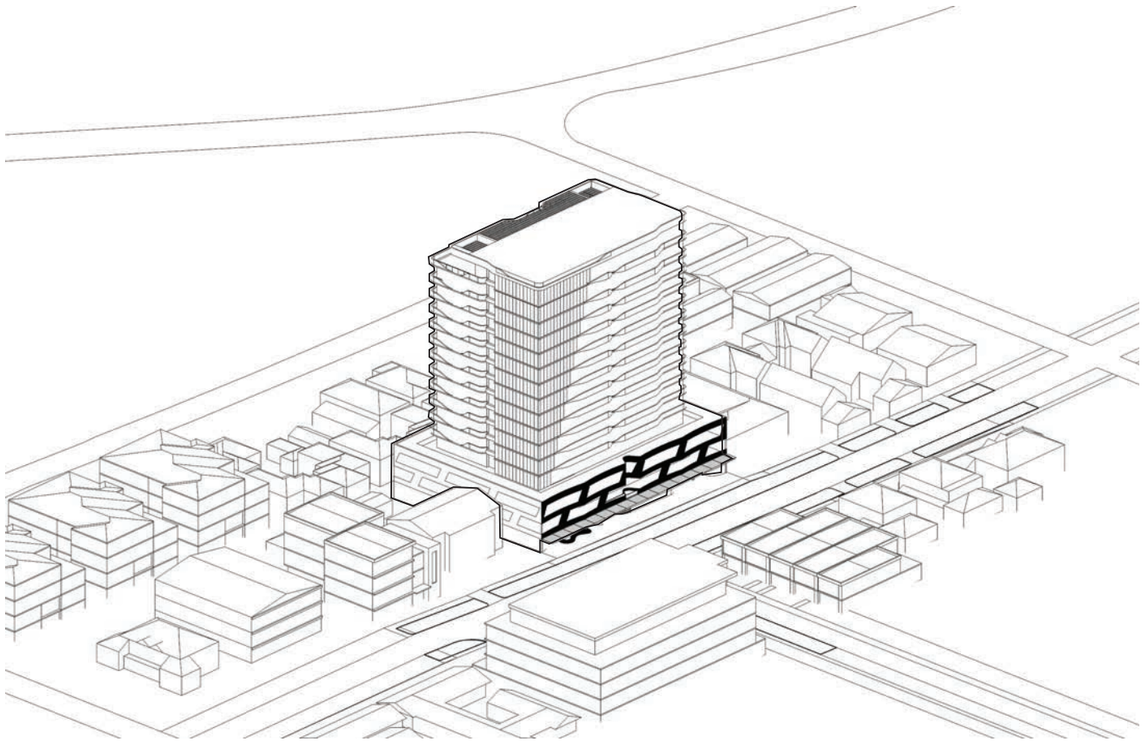
I **ADDITIONAL FINE-GRAIN FACADE TREATMENT TO PODIUM LEVELS**



J **A CONTINUOUS 3.0M FEATURE CANOPY PROVIDES VISUAL INTEREST AND WEATHER PROTECTION FOR PEDESTRIANS. A GENEROUS PUBLIC SPACE IS LOCATED AT GROUND LEVEL AT THE INTERSECTION WITH FIRST AVENUE.**

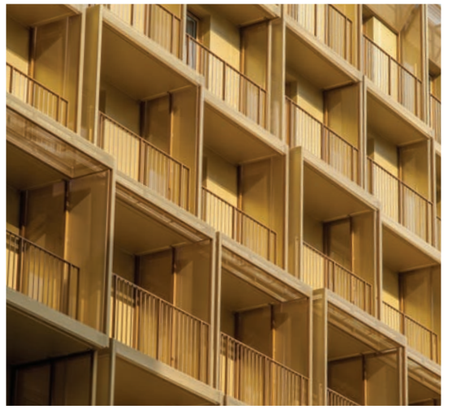


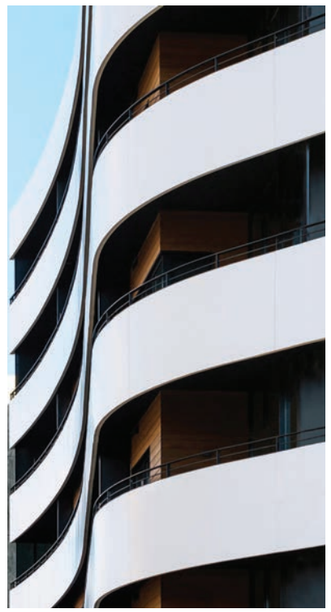
GUIDELINES SCHEME



PROPOSED SCHEME

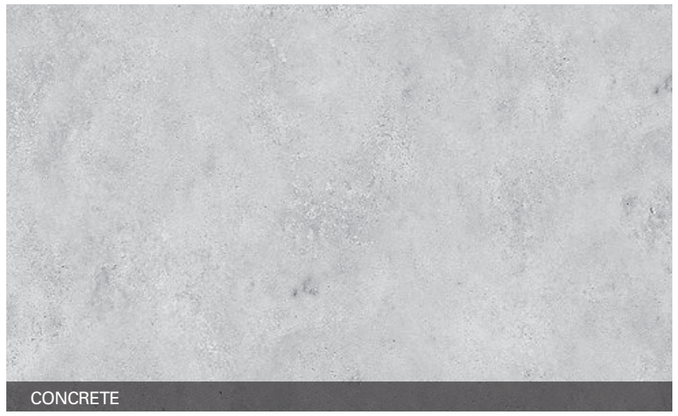
3.3 DESIGN EXEMPLARS



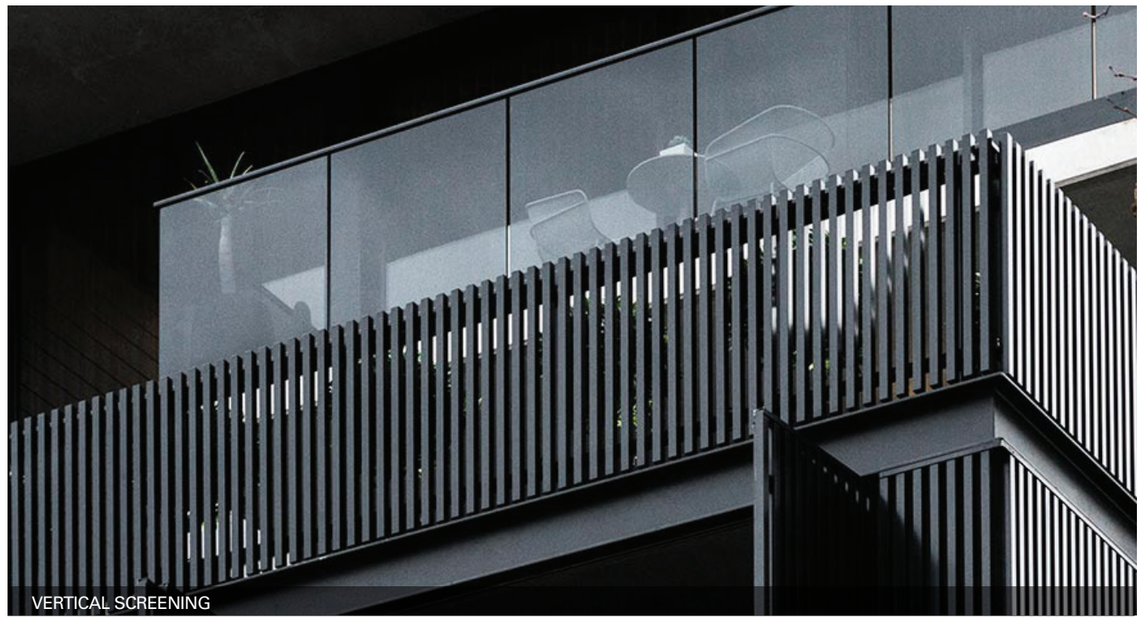


3.4 MATERIAL PALETTE


COMPOSITE ALUMINIUM CLADDING


CONCRETE


VEGETATION


VERTICAL SCREENING


DARK FRAMED GLAZING SYSTEMS


ANODISED PERFORATED SCREENS

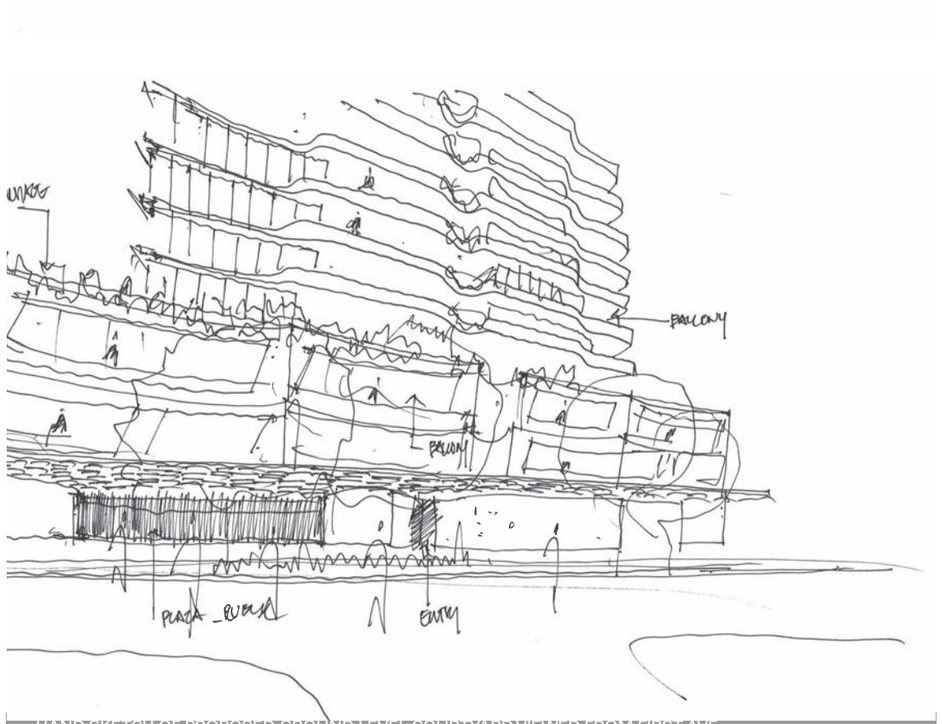

FEATURE CANOPY

3.5 STREETSCAPE & ACTIVATION

The open piazza on the ground floor has been designed to activate the footpath encouraging both residents, office workers and the public to interact in a pedestrian friendly environment. Built-in seating, landscaping and public art is used to enliven the public piazza whist creating a comfortable space in which to sit. The entrances to both the café and residential lobby are set back to allow pedestrians to walk through the landscaped piazza.

The podium has apartments fronting the street further activate the street contributing to an improved and lively urban environment.

HAND SKETCH OF PROPOSED GROUND LEVEL COURTYARD VIEW FROM KINTAIL ROAD



HAND SKETCH OF PROPOSED GROUND LEVEL COURTYARD VIEWED FROM FIRST AVE

3.6 LANDSCAPE CONCEPT

The design incorporated a large extend of landscape throughout the building. The built-in seating, hard and soft landscaping and public artwork on the ground floor piazza, the vertical planter recesses on all 4 elevations of the tower, the heavily landscaped podium roof plays a vital role to mitigate the urban heat island effect through appropriate mature planting selection.

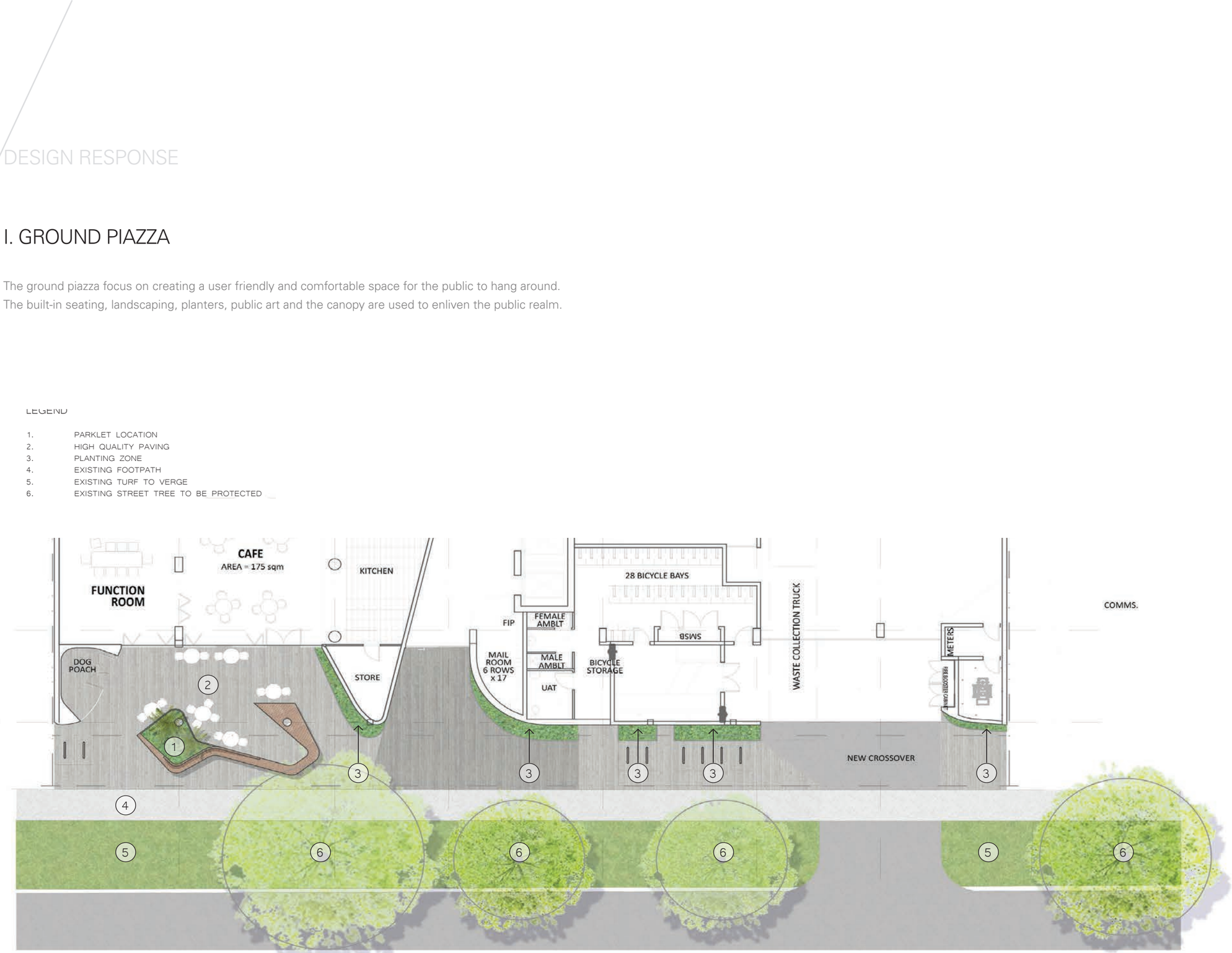
The design and incorporation of any irrigation and rainwater management will be in line with the Water Corporations Water Wise Development criteria.

I. GROUND PIAZZA

The ground piazza focus on creating a user friendly and comfortable space for the public to hang around. The built-in seating, landscaping, planters, public art and the canopy are used to enliven the public realm.

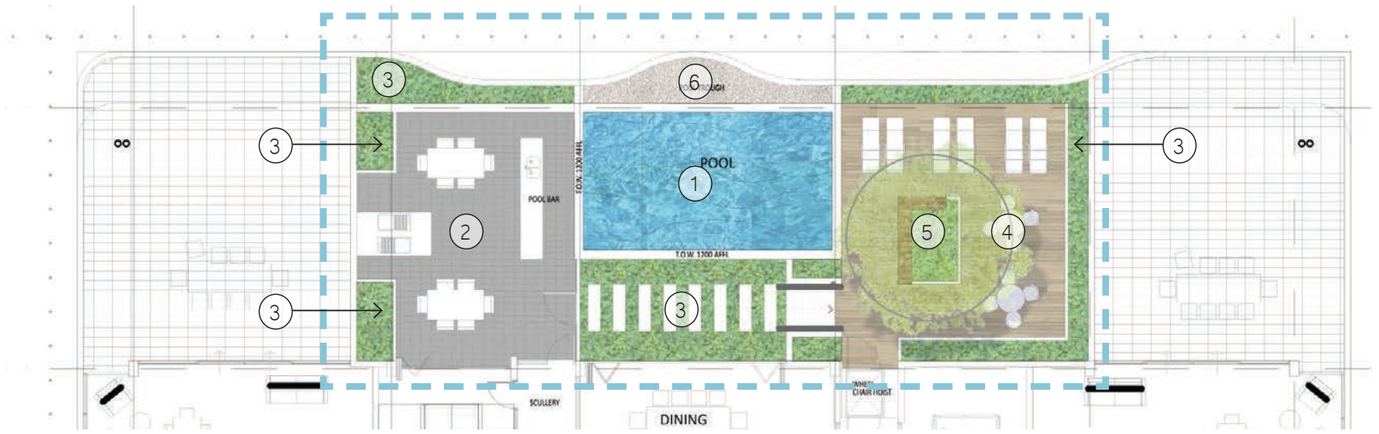
LEGEND

1. PARKLET LOCATION
2. HIGH QUALITY PAVING
3. PLANTING ZONE
4. EXISTING FOOTPATH
5. EXISTING TURF TO VERGE
6. EXISTING STREET TREE TO BE PROTECTED



II. COMMUNAL OPEN SPACE & AMENITY

The proposal focus on creating highly attractive and functional outdoor spaces. Facilities include a sundeck, shaded deck, pool, alfresco dining area, alfresco lounge area and BBQ. Adjacent to the pool is the indoor lounge and dining space for the exclusive use of residences.



LEGEND

1. POOL
2. ALFRESCO DINING ZONE WITH BBQ'S
3. PLANTING ZONE
4. COMPOSITE TIMBER DECKING ZONE
5. SEMI MATURE TREE WITH BENCH SEATING
6. POOL TROUGH

3.7 PUBLIC ART

In accordance to the Canning Bridge Activity Centre Plan, we support the vision for the inclusion of public art for the development.

In previous apartment projects including The Foundry Apartments, Subiaco and Verde Apartments, East Perth we have successfully worked with nationally acclaimed local artist Stuart Green who has created excellent artworks integrated into the publicly visible elements of these projects.

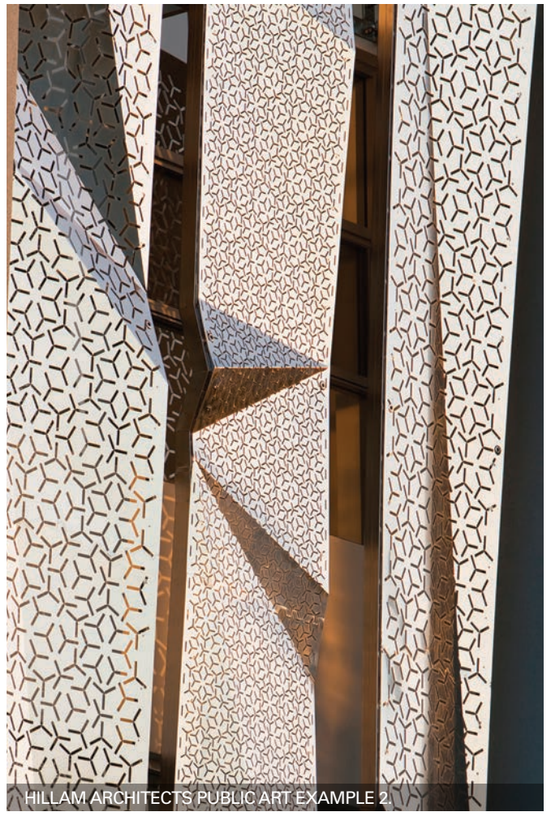
Collaboration with artists Rick Vermey at The Collective Apartments, Rivervale and John Terry at Fusion Apartments, Burswood have created unique responses that are reflective of each site.

In keeping with this approach we will work with an artist whose work fits with the design philosophy and who has demonstrated an appropriate understanding for the facade and the canopy treatments.

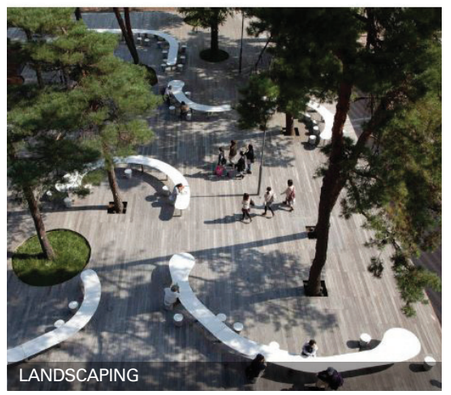
It is currently envisaged that public artwork will be incorporated in the treatment of the canopy awning as well as the street furniture and paving design on the ground floor piazza.

Detailed public art proposals will be provided prior to submission for building permit.

HILLAM ARCHITECTS PUBLIC ART EXAMPLE 1.



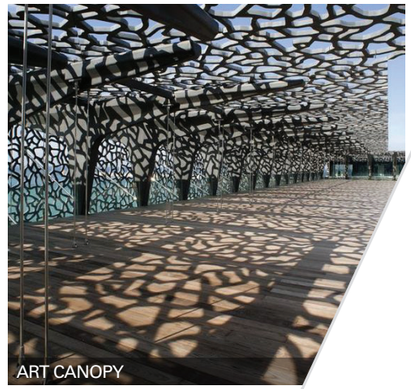
HILLAM ARCHITECTS PUBLIC ART EXAMPLE 2.



LANDSCAPING

CUSTOM PAVING PATTERN

STREET FURNITURE



ART CANOPY

3.7 PUBLIC ART CONTD.

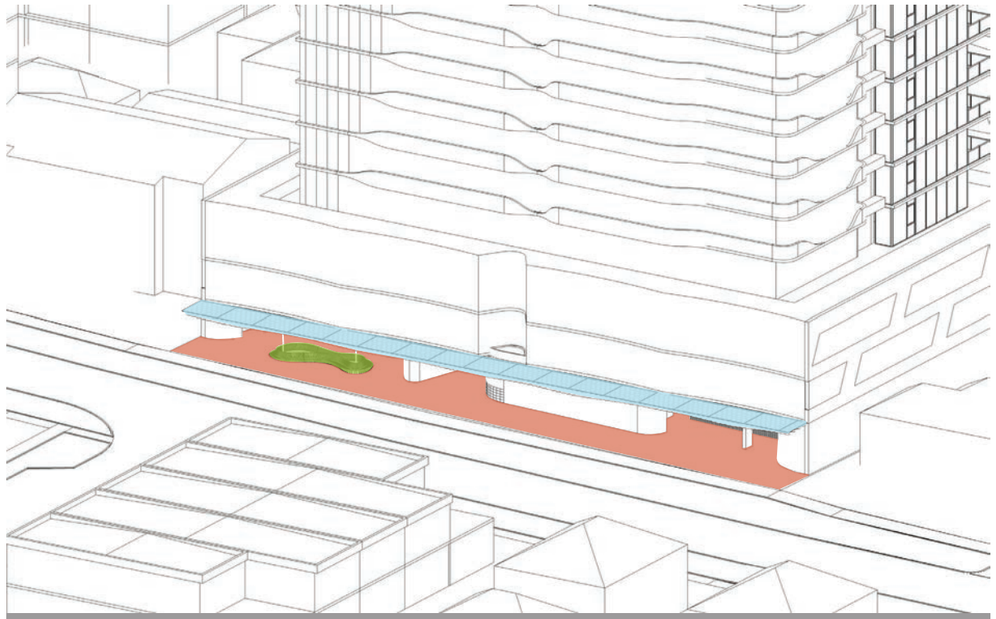


DIAGRAM 3.7.1 PUBLIC ART AERIAL VIEW

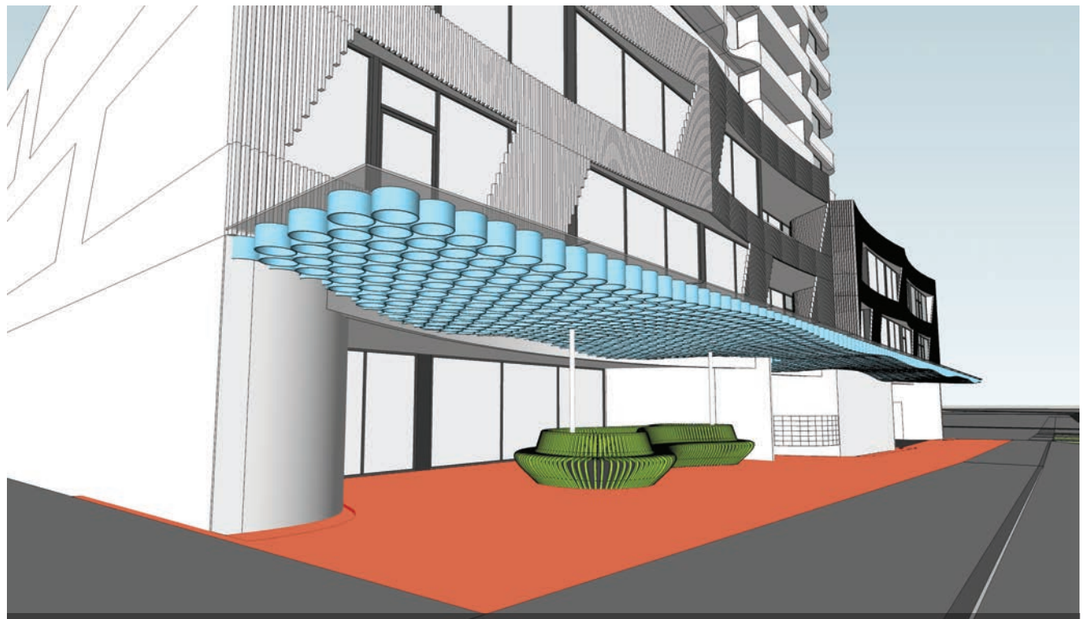


DIAGRAM 3.7.2 PUBLIC ART KINTAIL ROAD

PROPOSED PUBLIC ART & LOCATIONS

- Perforated Screening
- Custom Ground Plane Design
- Sculptural Street Furniture

4.1 YIELD AND PLOT RATIO

The Canning Bridge Activity Centre Plan does not have a plot ratio limit. The development scale is controlled by setback and height. Height bonus is permitted provided that the Bonus Provisions criteria are met.

The proposed development meets the mix requirement as per the Canning Bridge Activity Centre Plan.

Unit Type	Quantity	Min Size	Max Size	Mix (%)
1x1	22	54 sqm	54 sqm	23%
2x2	46	88 sqm	98 sqm	47%
3x2	25	120 sqm	178 sqm	26%
4x3	4	207 sqm	245 sqm	4%
Total	**97**			**100%**

4.1 YIELD AND PLOT RATIO CONTD.

PLOT RATIO TABLE

		Commercial - Plot ratio area	Residential - strata area	Residential - plot ratio area	1x1 bed	2x2 bed	3x2 bed	4x3 bed	Total
Ground Floor		175							
Mezz									
Level 1			213	228	0	1	1	0	2
Level 2			213	228	0	1	1	0	2
Level 3			736	779	2	4	2	0	8
Level 4			736	779	2	4	2	0	8
Level 5			736	779	2	4	2	0	8
Level 6			736	779	2	4	2	0	8
Level 7			736	779	2	4	2	0	8
Level 8			736	779	2	4	2	0	8
Level 9			736	779	2	4	2	0	8
Level 10			736	779	2	4	2	0	8
Level 11			736	779	2	4	2	0	8
Level 12			736	779	2	4	2	0	8
Level 13			736	779	2	4	2	0	8
Level 14			664	691	0	0	1	2	3
Level 15			410	425	0	0	0	2	2
TOTAL		***175***	***9596***	***10141***	***22***	***46***	***25***	***4***	***97***
TOTAL PERCENTAGE (%)					***23%***	***47%***	***26%***	***4%***	***100%***
Plot Ratio Area	*10316*								
PLOT RATIO	*5.10*								
SITE AREA	*2024*								

4.2 SETBACKS

In response to the Canning Bridge Activity Centre Plan, the proposal setback further than the minimum setback requirement to all boundaries in order to reduce the massing of the development.

The podium has zero setback to the side and rear boundary which complies with the design guideline. The podium street elevation is setback 2.9m from the boundary to accommodate for future road widening.

The design guideline request for 4m setback to the side and rear boundary and 8m to the street boundary. The residential tower provides more setback than the requirement.

- 5m setback to the west boundary
- 5.15m setback to the east boundary
- 5.6m setback to the north boundary
- 8.2m setback to the south boundary (Street boundary)

As per the Canning Bridge Activity Centre Plan, open sided balconies which are not within the structure of the building façade and do not add to the overall bulk of the building are allowed to extend into the setback. To the south boundaries, the design proposes architecturally decorated open balconies projecting 0.86m into the setback.

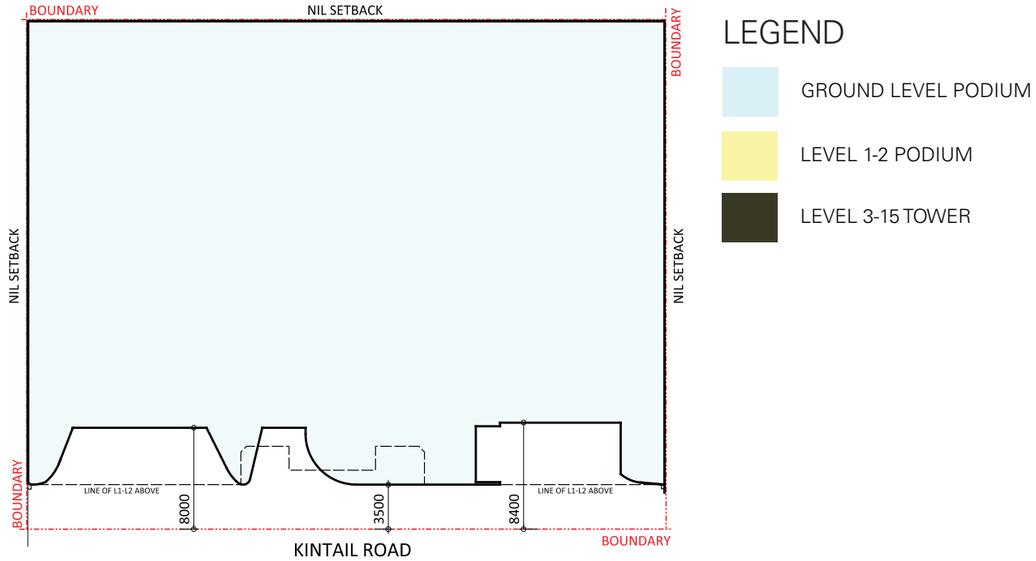


DIAGRAM 4.2.1 GROUND LEVEL SETBACKS

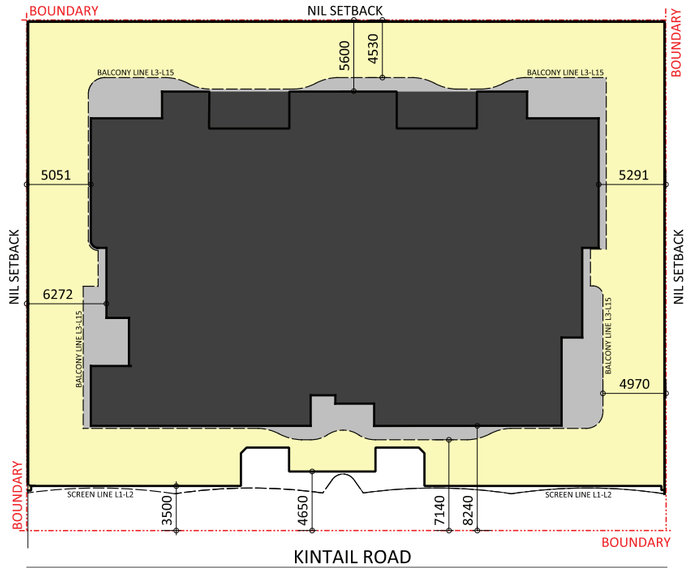


DIAGRAM 4.2.2 L1-15 SETBACKS

4.3 HEIGHT

The Canning Bridge Activity Centre Plan permits a height limit of 10 storey for the development. Notwithstanding that for properties within the M10 zone consideration of greater height than permitted may be approved where the relevant Desired Outcomes of all Elements are met or exceeded and where exemplary design is proposed in the opinion of the Design Advisory Group and where the development includes the provision of a significant benefit to the community.

The development is seeking a variation of additional 6 storey height variation. Please refer to the detailed description in Section 6 Bonus Provisions demonstrating the development propose significant benefit to the community.

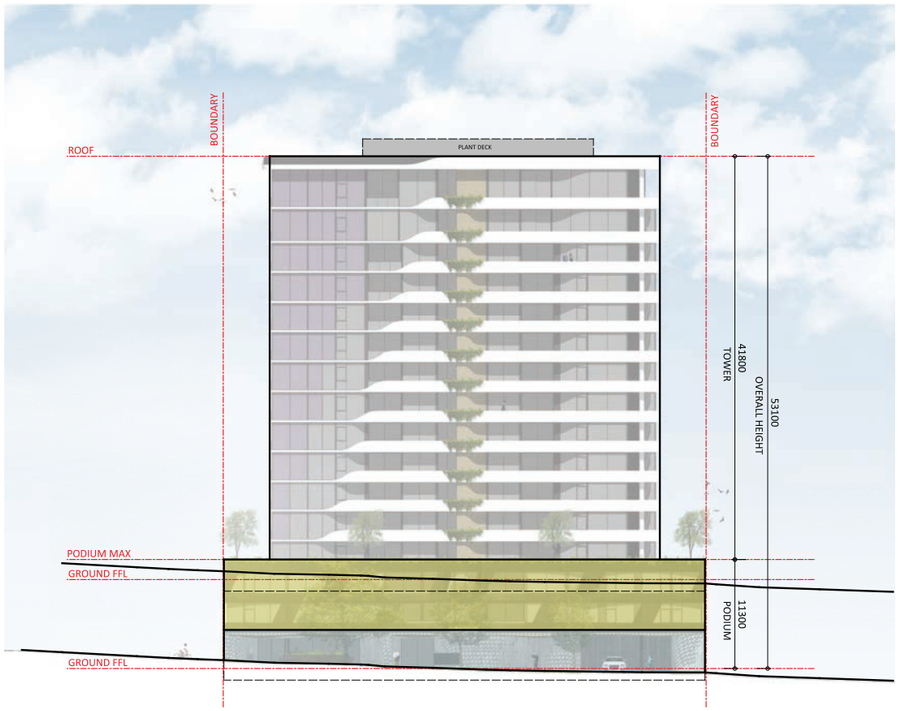


DIAGRAM 4.3.1 BUILDING HEIGHT - EAST ELEVATION

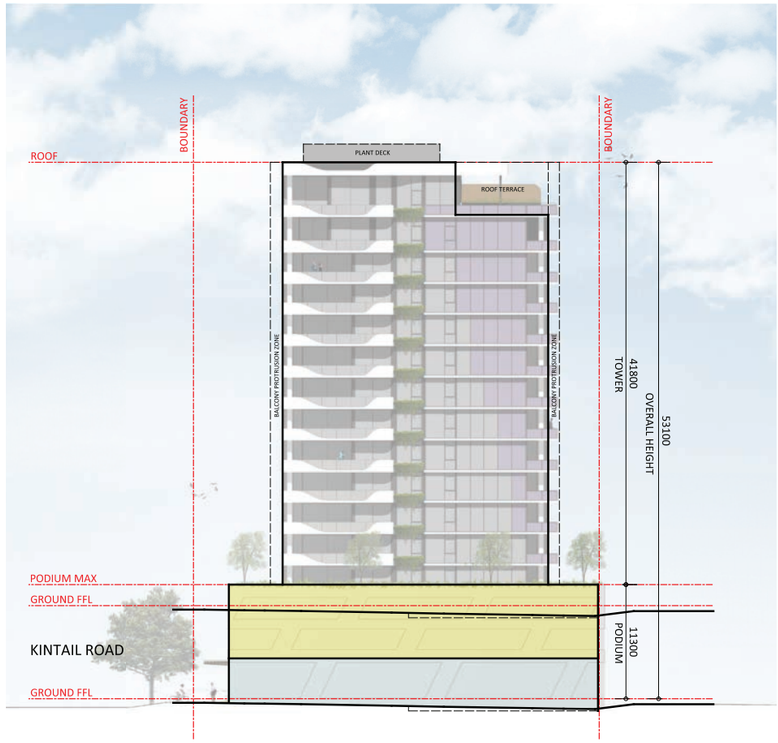


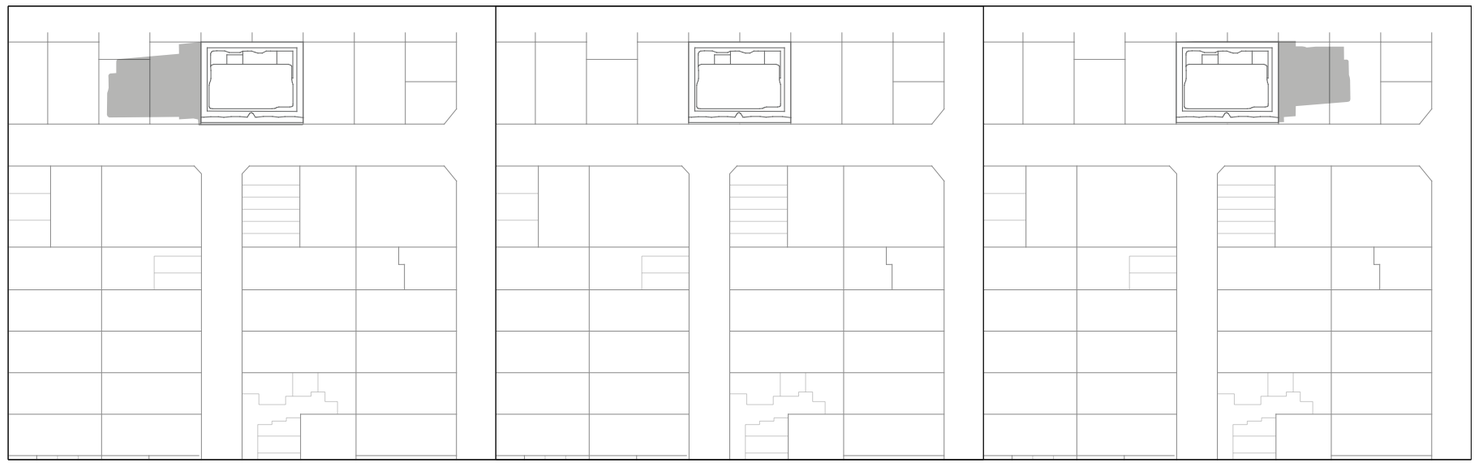
DIAGRAM 4.3.2 BUILDING HEIGHT - EAST ELEVATION

4.4 OVERSHADOWING

Due to the unique orientation and positioning of the site, the overshadowing at 12pm on the 21st of June does not impact any adjoining properties.

The overshadowing is in line with the design concept depicted in the Canning Bridge Activity Centre Plan.

PROPOSED SCHEME (SUMMER)



PROPOSED SCHEME (WINTER)

OVERSHADOWING DIAGRAMS

4.5 TRAFFIC AND PARKING

The proposal provides a total of 144 car bays for 97 apartments and a café. It complies with the parking criteria as stated in the Canning Bridge Activity Centre Plan. Please refer to the Traffic Impact Statement from Traffic Engineer Shawmac in the Appendix for a detailed assessment of the traffic and parking impact.

4.6 ACOUSTIC

The proposal does not propose any acoustic issue to the neighbour properties. Please refer to the Acoustic Statement prepared by Acoustic engineer Cundall in the Appendix for a detail analysis on acoustic.

4.7 WIND

The proposal does not propose wind issue to the neighbour properties. Please refer to the Wind Impact Statement prepared by Wind consultant Cundall in the Appendix for further detail.

4.8 WASTE MANAGEMENT

Waste generated from the development will be handled fully within the development. Please refer to the Waste Management Plan prepared by Waste Consultant Talis in the Appendix for a detail waste management strategy proposed for the development.

5.0 SUSTAINABILITY & BUILDING SERVICES

5.1 5 GREEN STAR

The development will meet 5 Star Green Star design rating under the Green Building Council of Australia. Please refer to the Green Star Strategy Statement prepared by ESD consultant Cundall in the Appendix for a detail description of the development ESD strategy meeting 5 Green Star rating.

5.2 PASSIVE SOLAR

Good solar orientation and appropriate opening sizes and locations have been considered in determining the apartment layout with an emphasis given to the northern orientation, where the deep set external facing balconies provide significant shading to glazing to living areas in apartments.

5.3 CROSS VENTILATION

The draft WAPC Apartment Design Guide propose at least 60% of the dwellings are to provide effective natural cross ventilation. The diagrams below indicate with of the apartments achieve this. A total of 63 out of 97 apartments, which equates to 63% provide cross ventilation.

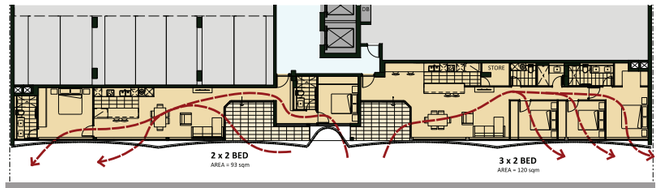
In recognition of outdoor lifestyle opportunities afforded by the Perth climate, apartments are provided with generous private outdoor balconies with dimensions exceeding minimum requirements set out in the design guidelines.

The balconies that face the street encourage passive surveillance as well as express the sophistication of the facade by their integration into the building envelope. Each residential unit in the development has a balcony depth of at least 3m and some units have up to 9.5m. This allows many units to have both dining and lounge areas on balconies, encouraging outdoor living and passive surveillance of the area. Bedrooms are supplied with operable windows and the interior living spaces open out to the balconies.

As a fundamental requirement all habitable rooms are provided with direct access to fresh air. The overall design maximizes the building perimeter, providing many corner apartments with cross ventilation.

Mechanical ventilation will be incorporated into the bathroom spaces that do not have an external facing wall. A large south facing window will provide internal circulation corridors on upper levels with great views and natural ventilation.

The proposed development also has extensive glazing to the lift lobbies throughout the commercial and residential levels. This enables natural ventilation and lighting to the communal corridors whilst providing spectacular views to the south.



SHALLOW APARTMENTS SUBJECT TO CROSS VENTILATION

DIAGRAM 5.3.1 CROSS VENTILATION TYPICAL L1-L2

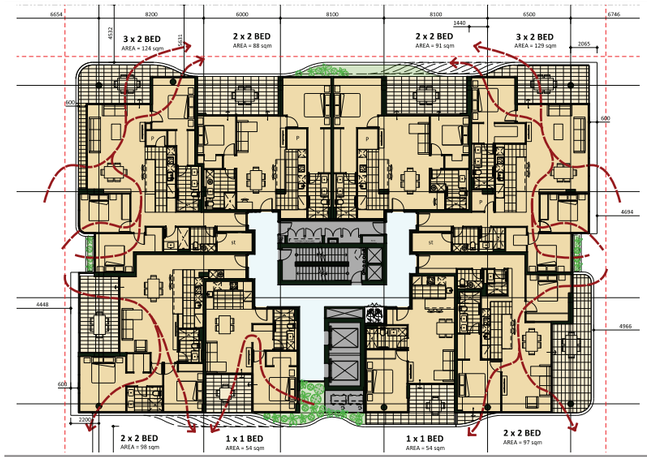


DIAGRAM 5.3.2 CROSS VENTILATION TYPICAL L3-L13

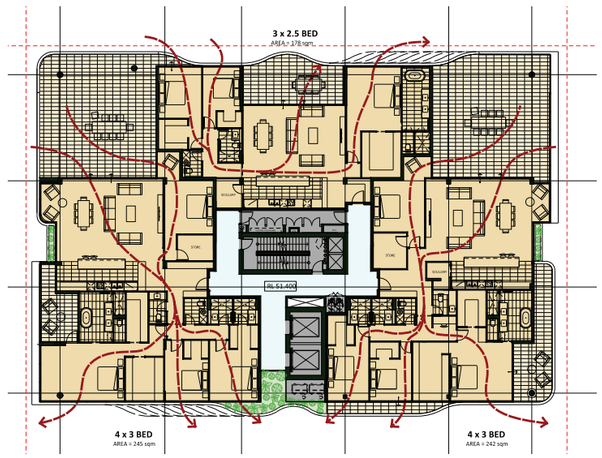


DIAGRAM 5.3.3 CROSS VENTILATION TYPICAL L14-L15

5.4 SAFETY & SECURITY

Safety and security principles adopted by the proposed development include but are not limited to:

- Providing a sense of place that is responsive to CPTED (Crime Prevention Through Environmental Design) principles
- Access control systems providing secure access to apartments and parking areas.
- Clear signage of pathways, entrances and exits differentiating public and private spaces.
- Building form to visually link to and create interaction with adjacent public areas allowing for casual surveillance
- Integrated specialist lighting design providing well illuminated spaces that create ambience while eliminating uncontrolled shadow areas.
- Vandal proof and passive security measures. Robust materials to prevent vandalism and graffiti.
- Areas designated for passive recreational uses to incorporate safe and accessible activities for all age groups.
- Universal accessible design.
- Security gates to car parking area

It is proposed that the streetscape at ground level will be open and highly activated. Articulated commercial tenancy will provide opportunities for casual surveillance to the street.

On the upper floors, habitable rooms and balconies address all sides of the development providing a continuous passive surveillance of the area.

5.5 BUILDING SERVICES

All services are positioned to ensure they provide no adverse visual impact on the overall aesthetic of the development and streetscape.

AIR CONDITIONING

Residential air-conditioning units have been located on the roof level, set back from line of site and surrounded by screening elements to ensure they are unobtrusive from adjacent residential developments and the public view.

The remaining commercial condenser units are located on the ground floor, screened by the building and accessible from the car park.

STORES

All dwellings are provided with lockable storage rooms at or in excess of the minimum 4m² requirement.

LETTERBOXES

Letter boxes are conveniently provided at the residential lobby entrance off Kintail Road.

6.1 ELEMENT 21

For properties within the M10 zone consideration of greater height than permitted in Element 3 may be approved where the relevant Desired Outcomes of all Elements are met or exceeded. The table below demonstrate that the design meets and exceed all the Element 21 items.

ELEMENT	REQUIREMENT	JUSTIFICATION	OUTCOME
21.1	Exemplary design is proposed in the opinion of the Design Advisory Group	The comments from DAG is positing and supporting. We believe that the proposed design satisfy this requirement.	Complies
21.2	For development in the M15 Zone, the site shall have a minimum area of 2,600 m2	Not Applicable, The development is located in the M10 zone.	Not Applicable
21.3	For development in the M10 Zone, the site shall have a minimum area of 2,000 m2	The development site area is 2022sqm.	Complies
21.4.1	The proposed development has been designed with regard for solar access for adjacent properties taking into account outdoor living areas, major openings to habitable rooms, solar collectors and balconies	The proposed design increased setback to all 4 boundaries reducing the overall bulk and scale of the development. The increase setback allows better solar access for adjacent properties. The additional height have negligible impact to the neighbour properties' amenity.	Complies
21.4.2	The proposed development meets or 5 Star Green Star design rating under the Green Building Council of Australia in Quarter 1. As evidence in support of compliance with the required rating, applicants shall submit as part of their development application either a Green Star Design Review Certificate or a qualified consultant's report supporting the developments achievement of the required level of performance. Under either approach any development approval granted will be conditional upon submission of a Green Star certificate, prior to commencement of the development, which confirms achievement of the required rating.	The design incorporates a number of green star initiatives. The design will achieve 5 Star Green Star rating. Refer to the 5 green star letter prepared by Cundall for green star strategies.	Complies
21.4.3	A traffic statement is submitted showing that the additional floor space allowed will not unduly impact on the surrounding centre.	The level 10 to 15 of the proposed development includes 37 residential units and accounts for approximately 1/3 of the development. Since traffic impact of the whole development is considered low, the additional 6 floors from level 10 to level 15 are unlikely to unduly impact on the activity centre. Refer to Traffic Impact Statement for detail.	Complies
21.4.4	The proposed development includes the provision of infrastructure which supports area wide resource efficiency, such as plant and equipment required to reduce the demand for either building or area wide service infrastructure.	The design incorporates Greenstar design which invariably reduces the demand on the local infrastructure. Furthermore to the items noted in the ESD report we also confirm the following: **a) Centralised Hot Water Plant** The proposed hot water plant system for the development is commonly known as a centralised bulk hot water system using electric heat pump technology. Generally, a multi-residential development of this size would typically utilised single 3 phase electric instantaneous hot water systems in each apartment. The instantaneous hot water systems consist of a 3 phase hot water heating element in a small storage tank providing hot water on demand and as such use large power loads to heat the water required. This is particularly true during peak load times between 7.00-9.00AM and 5.00- 7.00PM (Peak power load times generally). A bulk hot water plant using electric heat pumps technology for its heat source by contrast consists of multiple refrigerator type condensing units connected to bulk hot water storage tanks that in turn are used to circulate hot water throughout the building from a main plant room usually located on the roof of the building. As the heat pump technology uses a continuous yet low power demand the peak loading is also low when comparing to high demand of instantaneous units. The low power demand over a longer period transfers the stored energy into the hot water storage tanks for ready use by building occupants. The main benefits of using an electric heat pump and bulk hot water plant system is that it's a very high energy efficiency system with reduced up front purchase costs and of course a much lower demand on the power grid during peak hot water demand periods.	

6.1 ELEMENT 21 CONT.

		b) Shared Condensers to A/C Units The proposed air conditioning system for development is classified as a centralised Variable Refrigerant Flow (VRF) system. Generally, a multi-residential development of this size would typically utilised single reverse cycle split air conditioning systems. These systems consist of a single indoor fan coil unit (FCU) being connected to a single external condensing unit (CU). The condensing unit located either on the associated apartment's balcony, on a dedicated floor by floor plantroom, or on the development roof. The typical COP for this type of system is 3.0. A VRF systems consists of multiple indoor FCU being connected to a single larger external condensing unit. In this type of system the condensing unit is either located in a dedicated floor by floor plantroom or on the development roof. Given the VRF system is serving multiple individual holdings, it is required to be able to provide simultaneous heating and cooling. This results in the use of a Heat Recovery VRF system. A heat recovery VRF system allows the indoor units to independently operate in either heating or cooling. This arrangement allows greater energy efficiency within the system, as the mixed usage allows for the compressor within the condenser to do less work. Another benefit of using a heat recovery VRF system is that the overall capacity of the system is typically much lower than individual split systems would be. This is due to load diversity being able to be applied when sizing the system. With a single split scenario, each unit must be sized for the peak loading requirements of that particular apartment, whereas a VRF system can be sized for the peak loading requirement over a whole floor which will typically be much lower. This is primarily due to that not all units will peak at the same time, ie the east and west apartments will have significantly different peak times. This allows that condenser unit to be reduced in size, which in turn reduces materials required and the total refrigerant capacity of the systems. Another outcome of using a centralised system is that the condenser will typically operate in part load more often, resulting in better operating efficiencies The main benefits of using a VRF system is high energy efficiency (COP of 3.1+), reduced materials through pipework runs, cable runs and condenser construction materials, reduced total refrigerant capacities and reduce plant footprint. c) **Shared bicycles and Public Toilets** The building provide 28 secured bicycle parking facilities and 3 toilet facilities that are a shared resource for the occupants of the building and for the general public. d) **Solar Power Panels** The building incorporate solar panels on the roof to provide renewable power to communal facilities.	Complies
21.4.5	In addition to the requirements of Element 10, proposed development within the Kintail quarter demonstrates a mitigation of urban heat island effects through the provision and maintenance of landscaping which includes the planting of mature shade trees.	The design incorporates significant amount planting throughout the entire building. Mature trees are proposed on top of the podium and the top floor amenity area. Further A number of vertical planters are proposed on all 4 elevations to mitigate the urban heat island effects. Please refer to the landscape plan in the appendix for further detail.	Complies

6.2 ELEMENT 22

For properties within the M10 zone consideration of greater height than permitted in Element 3 may be approved where the relevant Desired Outcomes of all Elements are met or exceeded. The table below demonstrates that the design meets and exceeds at least 5 of the requirement of Element 22.

ELEMENT	REQUIREMENT	JUSTIFICATION	OUTCOME
22.1.1	Design comprising high quality active street frontages, furniture and landscaping which contribute to the character of the centre and are kept and maintained by agreement with the owners and/or strata company of the building in perpetuity.	• The entire building is highly articulated to enhance the quality of street frontage. • The podium is highly activated by apartments enhancing street surveillance. • The canopy which will be in design collaboration with a local artist will further activate the street. • A café is proposed at ground floor to introduce activity at street level. • Built-in street furniture, hard and soft landscaping and public artwork on the ground floor piazza has been designed to activate the footpath and street frontage encouraging both residents, office workers and the public to interact in a pedestrian friendly and weather proof environment.	Complies
22.1.2	Provision of landscaped spaces and/or other facilities accessible to the public such as rooftop and/or podium level gardens and/or incidental recreation spaces and/or equipment and entertainment facilities such as rooftop cinema.	• The ground floor café shopfront is further pushed back to maximise landscaped spaces at the front of the building for general public. • The ground floor piazza will be decorated by highly articulated street furniture and other hard and soft landscaping. • Pet friendly facilities are proposed in the development. A dog poach area is proposed on ground floor allowing general public to enjoy a cup of coffee with their pet in the public piazza area.	Complies
22.1.3	Provision of public facilities such as toilets, showers and sheltered bike storage.	• 3 public toilets and 1 shower facilities are provided at ground floor for public use. • 28 secured bicycle bays and lockers are provided at ground floor for public use. • General public can park their bicycle in the facilities and then walk to the train station. • Provision of 10 community bicycles that can be hired and can be returned at this location, or even at The Precinct, and other potential locations which can be discussed with the City of Melville.	Complies
22.1.7	Provision of community, communal and/or commercial meeting facilities.	• The landscaped public piazza on the ground floor which is accessible to the public 24 hours 7 days a week provide a great place of local residences and general public to meet and socialise anytime of the year. • The landscaped public piazza is weather protected by the canopy. The furniture in this area including table and chairs will be fixed furniture. • Public Wi-Fi access and drinking water fountains are proposed at street level for general public use, including a suitable area for dogs in a safe space • The café design has an adjoining meeting room, which can be utilised free of charge and can be booked by local clubs, charity organisations etc. When not utilised the café will utilise the space, and therefore maintain it, pay all costs associated with the space. It is a free facility for the community to hire.	Complies
22.1.10	Where the development is located adjacent to Canning Highway and where road widening is required; the applicant proposes to cede land free of charge to the State of Western Australia for the purposes of road widening. In such a case, the area ceded will be included in the total area calculations for the purpose of Clause 2.2 and 2.3 and/or Clause 21.2 and 21.3.	• There is a 2.9m road widening requirement on this side of Kintail Road and this land will be ceded free of charge for the purpose of the road widening.	Complies

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APPENDIX D
LANDSCAPE PLANS

20-22 KINTAIL ROAD DEVELOPMENT
APPLECROSS, WA

LANDSCAPE ARCHITECTURE REPORT

26.09.2017

SEE DESIGN

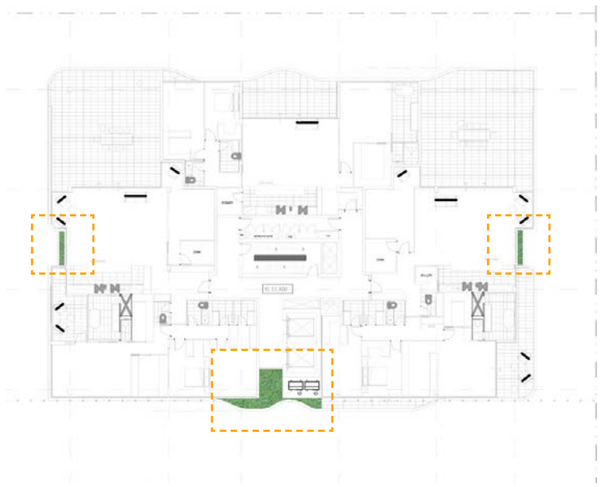
Contents

01. LANDSCAPED ZONES

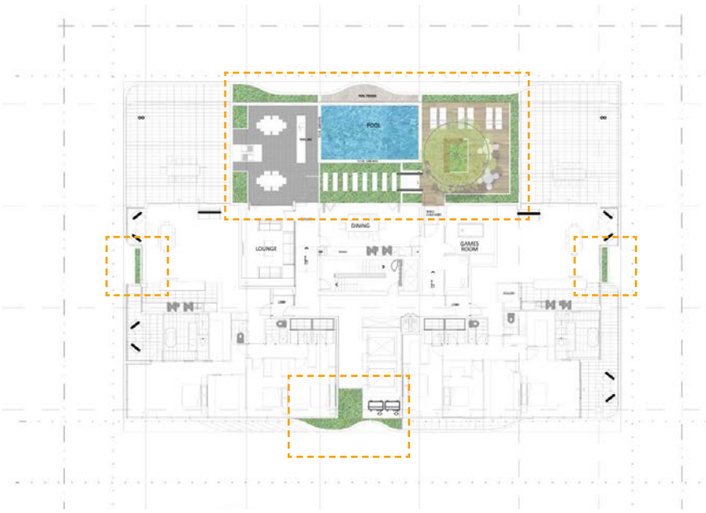
GROUND FLOOR

LEVEL 3_PODIUM

LEVELS 4 TO 13



LEVEL 14



LEVEL 15

02. GROUND FLOOR_LANDSCAPE PLAN

N

1:200 @ A3

LEGEND

1. PARKLET LOCATION
2. HIGH QUALITY PAVING
3. PLANTING ZONE
4. EXISTING FOOTPATH
5. EXISTING TURF TO VERGE
6. EXISTING STREET TREE TO BE PROTECTED

03. GROUND FLOOR_PARKLET + MATERIAL PALETTE

WHAT IS A PARKLET?

A parklet is a sidewalk extension that provides more space and amenities for people using the street. Parklets are intended for people. Parklets offer a place to stop, to sit, and to rest while taking in the activities of the street. Parklets are designed to provide a public place for passersby to relax and enjoy the atmosphere of the city around them, in places where either current urban parks are lacking or where the existing sidewalk width is not large enough to
accommodate vibrant street life activities.

DESIGN INTENT FOR KINTAIL ROAD

The design of the parklet is intended to be multi-funtional and offer a distinct street presence to Kintail Road. Additionally, the parklet will have a strong connection to the proposed cafe, and provide additional seating opportunities for passersby.

In addition to the above, the parklet will be designed to be a beautifully crafted piece of furniture and act as a strong way finding element leading from the street into the building.

Indicative Concept Parklet Design

MATERIAL SELECTIONS

Imported Granite Paving
Type 01

Imported Granite Paving
Type 02

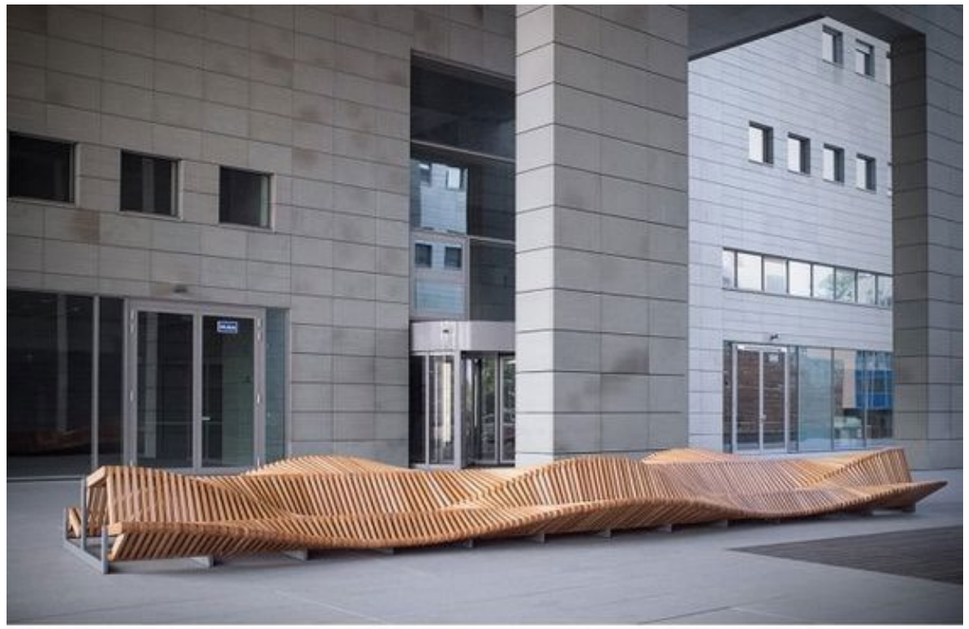
Timber Battens to Parklet

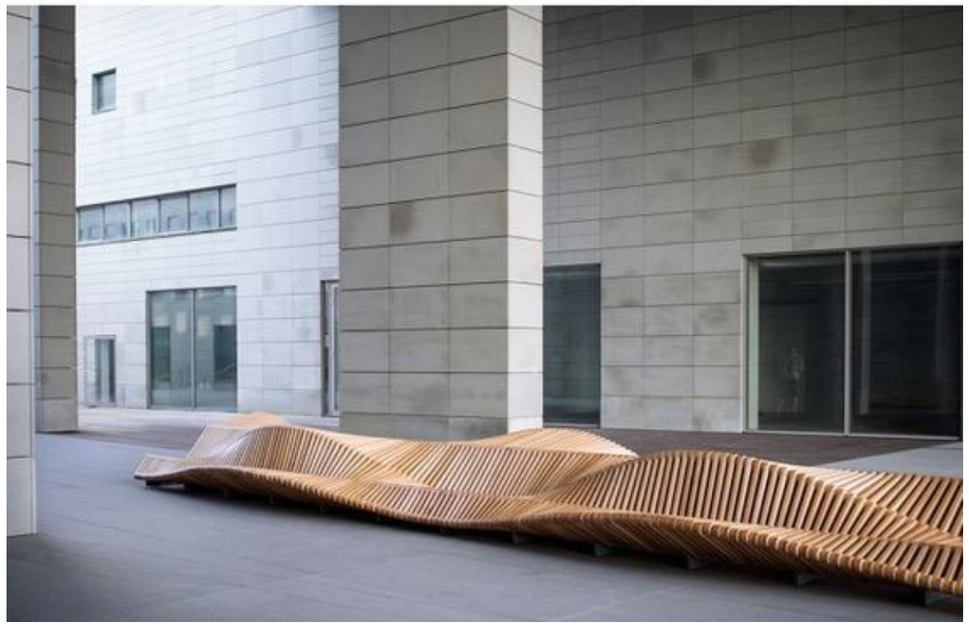
Black Steel Edging

Material selections have been chosen for their ability to enhance the building materiality.

Materials, generally, have been selected for their prolonged life cycles, and ease of maintenance.

04. GROUND FLOOR_DESIGN INSPIRATION





05. GROUND FLOOR_PLANTING PALETTE

PLANT SELECTIONS


Tree Ferns


Ficus pumila


Sansevieria trifasciata


Hibbertia scandens


Philodendron Little Phil


Spathiphyllum Petite


Philodendron ‘Xanadu’


Ajuga reptans

Plants have been selected for their ability to thrive in a heavily shaded urban environment.

Given the majority of the allocated planting zones are under permanent shading structures, specialised UV lighting will be considered where appropriate to ensure that all planting zones have the ability to thrive.

06. PODIUM LEVEL_LANDSCAPE PLAN

N

1:200 @ A3

LEGEND

1. MATURE TREE TRANSPLANTS IN 1200MM HIGH PLANTERS
2. 1000MM RAISED PLANTERS WITH CASCADING PLANTS
3. SCREENING ELEMENT
4. ALFRESCO AREA
5. SEMI MATURE TREES WITH SHRUB PLANTING UNDERNEATH

07. PODIUM LEVEL_MATERIAL PALETTE

SURFACE FINISHES

Rectangular Charcoal Tiles

WALL FINISHES

Rendered Masonary Walls

Charcoal Timber Cladding

Timber Battens

Material selections have been chosen for their ability to enhance the building materiality.

Materials, generally, have been selected for their prolonged life cycles, and ease of maintenance.

08. PODIUM LEVEL_PLANTING PALETTE

TYPE A TREES

TYPE B TREES

Gleditsia tricanthos (Mature Transplants)

Fraxinus griffithii (Semi Mature Stock)

Magnolia Little Gem

CASCADING GROUND COVERS

Dichondra Silver Falls

Rosmarinus officinalis "Prostratus"

Acacia cognata 'Cousin It'

SHRUBS/GROUND COVERS

Hibbertia scandens

Senecio mandraliscae

Anigozanthos big red

Westringia fruiticosa

Lomandra tanika

Hebe wiri Veronica

Sansevieria trifasciata

Myoporum yareena

Eremophila Kalbarri Carpet

Olearia axillaris mini

Festuca glauca

09. LEVELS 4 TO 13_TYPICAL LANDSCAPE PLAN

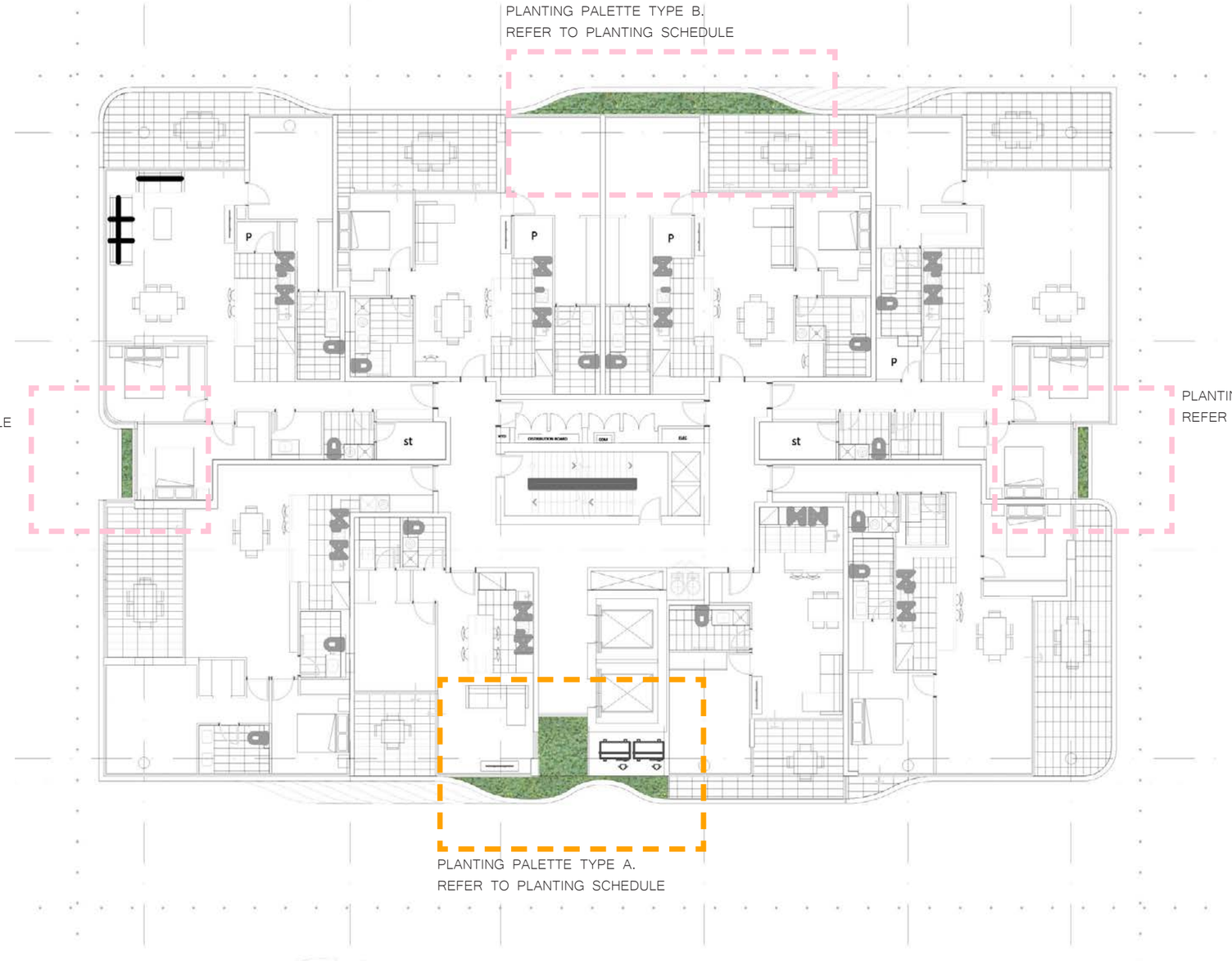
N

1:200 @ A3

PLANTING PALETTE TYPE B.
REFER TO PLANTING SCHEDULE

PLANTING PALETTE TYPE B.
REFER TO PLANTING SCHEDULE

PLANTING PALETTE TYPE B.
REFER TO PLANTING SCHEDULE



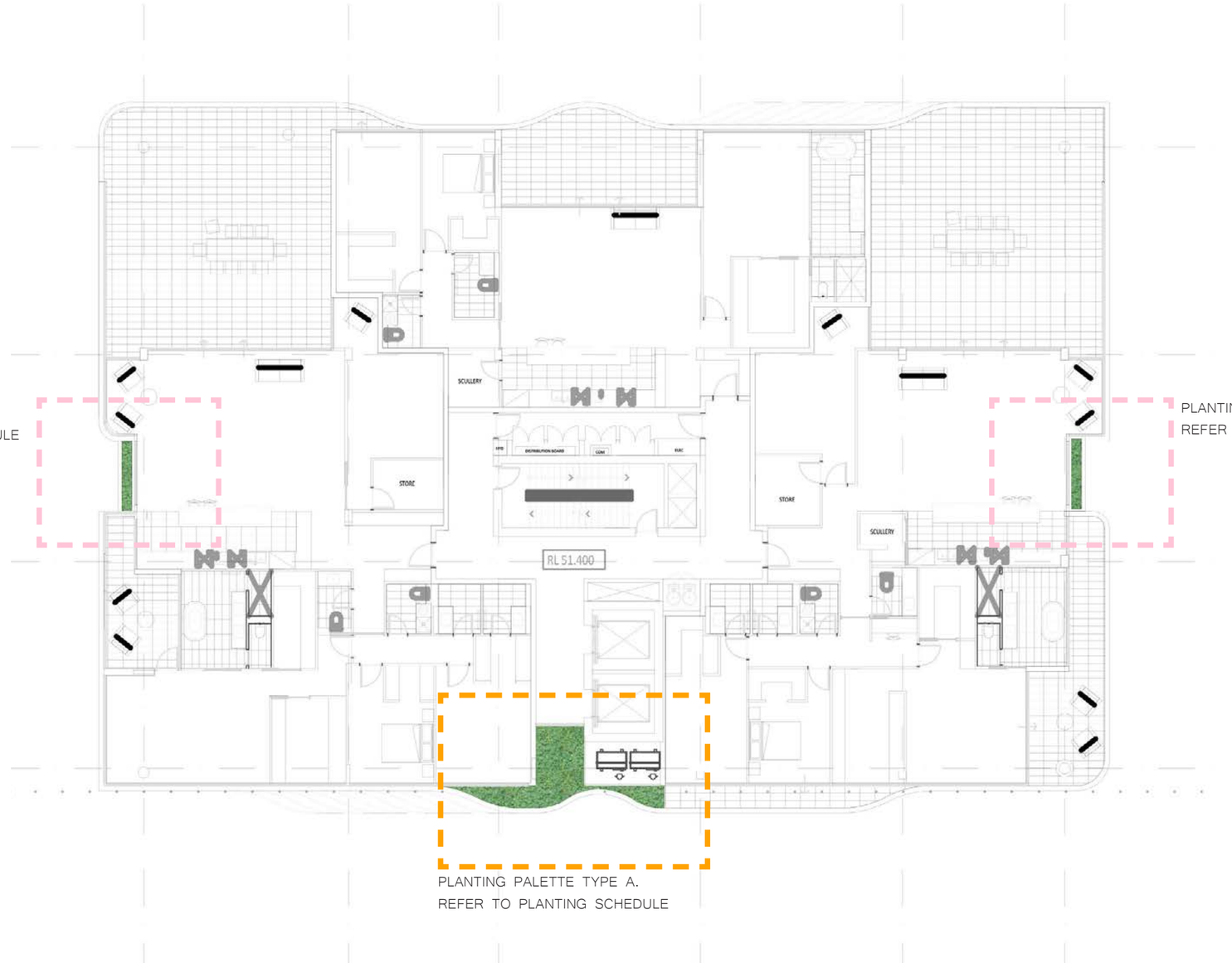
PLANTING PALETTE TYPE A.
REFER TO PLANTING SCHEDULE

10. LEVEL 14_LANDSCAPE PLAN

N

1:300 @ A3

PLANTING PALETTE TYPE B.
REFER TO PLANTING SCHEDULE



PLANTING PALETTE TYPE B.
REFER TO PLANTING SCHEDULE

PLANTING PALETTE TYPE A.
REFER TO PLANTING SCHEDULE

11. LEVELS 3 TO 14_PLANTING PALETTE

TYPE A PLANTING

Epipremnum aureum

Cascading Ivy

Dichondra Silver Falls

TYPE B PLANTING

Dichondra Silver Falls

Rosmarinus officinalis “Prostratus”

Acacia cognata ‘Cousin It’

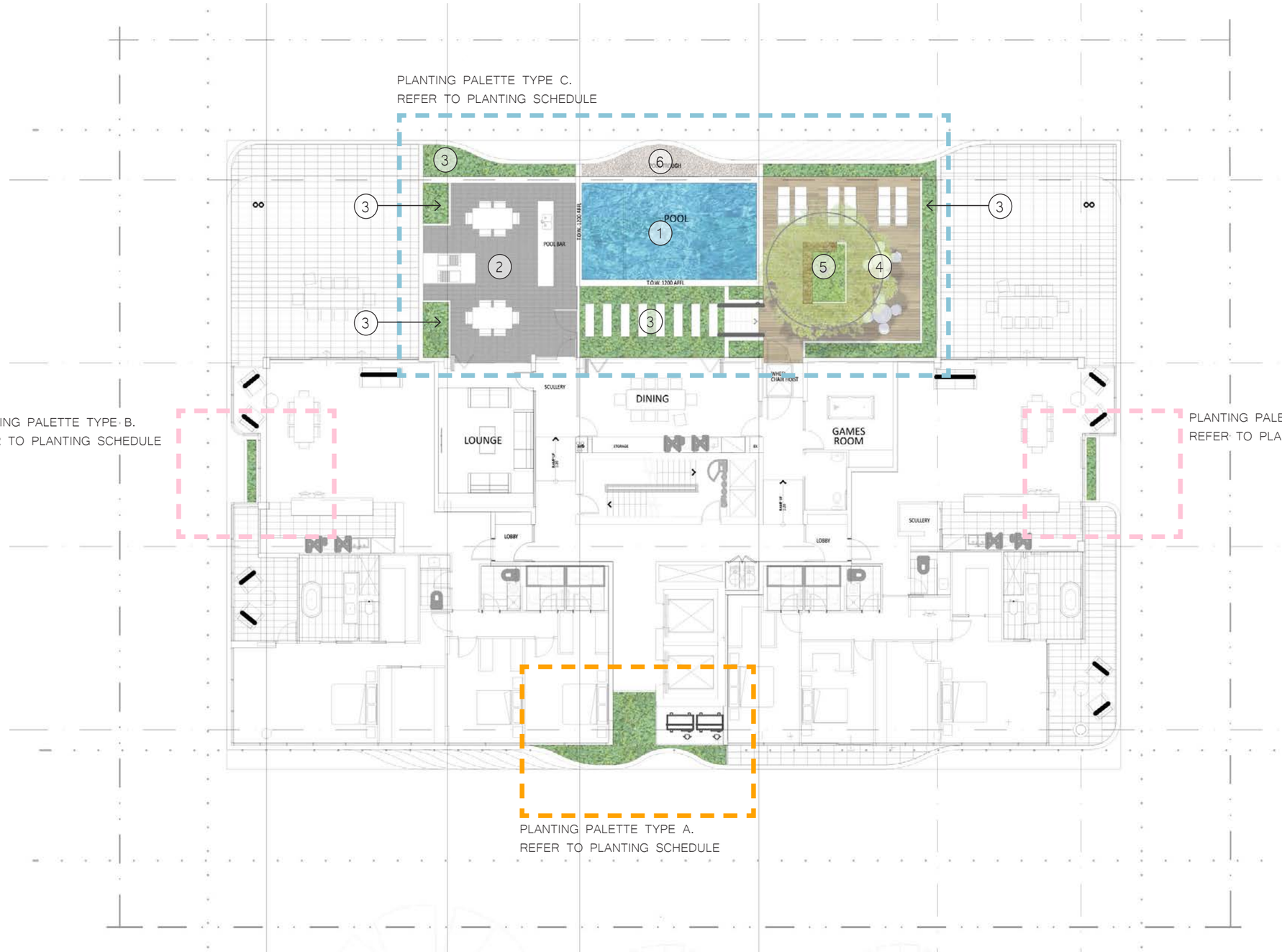
12. LEVEL 15_LANDSCAPE PLAN

N

1:200 @ A3

LEGEND

1. POOL
2. ALFRESCO DINING ZONE WITH BBQ'S
3. PLANTING ZONE
4. COMPOSITE TIMBER DECKING ZONE
5. SEMI MATURE TREE WITH BENCH SEATING
6. POOL TROUGH



13. LEVELS 15_MATERIAL PALETTE

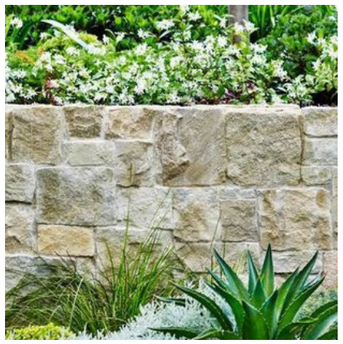
SURFACE FINISHES

Rectangular Charcoal Tiles

Composite Timber Decking

WALL FINISHES

Rendered Masonary Walls



Stone Cladding to Walls

Timber Battens

Material selections have been chosen for their ability to enhance the building materiality.

Materials, generally, have been selected for their prolonged life cycles, and ease of maintenance.

14. LEVEL 15_PLANTING PALETTE

TYPE A PLANTING


Epipremnum aureum


Cascading Ivy


Dichondra Silver Falls

TYPE B PLANTING


Dichondra Silver Falls


Rosmarinus officinalis “Prostratus”


Acacia cognata ‘Cousin It’

TYPE C PLANTING


Sansevieria trifasciata


Lomandra tanika


Hebe wiri Veronica


Myoporum yareena


Carpobrotus glaucescens


Olearia axillaris mini


Eremophila Kalbarri Carpet


Festuca glauca


Senecio mandraliscae

SEE DESIGN

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ARCHITECTS

APPENDIX E
TRAFFIC REPORT

Transport Impact Assessment

Project:	20 – 22 Kintail Road Development Proposed Apartment Development
Client:	Norup + Wilson
Author:	Keli Li / Rian McIlduff
Date:	15th September 2017
Document #	1708006-002

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Version	Document Status	Prepared By	Reviewed By	Approved By	Date
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2	Final	K Li / R McIlduff		L Dawson	15/09/17

Disclaimer

File Reference: Y:\Jobs Active 2017\T&T - Traffic and Parking\Norup+Wilson_Kintail Road_TIA_1708006\Report\20-22_Kintail Road_TIA_V2.docx

Contents

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Figures

1. Summary

Shawmac was commissioned to assess the impacts associated with parking and traffic generation from the proposed apartment development located at 20 – 22 Kintail Road in Applecross comprising of the following land uses:

- 1 café - 160 sqm;
- 97 residential apartments including;
    - 22 one-bedroom apartments;
    - 46 two-bedroom apartments;
    - 25 three-bedroom apartments; and
    - 4 four-bedroom apartments.

The assessment follows the recommended outline contained in the Western Australian Planning Commission's (WAPC) Transport Impact Assessment Guidelines for Developments: Volume 4 – Individual Developments (2016). Potential traffic flow from the site was estimated by applying generation rates recommended by the New South Wales Roads and Traffic Authority publication "Guide to Traffic Generating Developments" and the Institute of Transportation Engineers, "Trip Generation". Traffic was assigned to the adjacent existing road network and flows used as a basis for assessing traffic impacts associated with the site.

2. Introduction

2.1. Background

Shawmac has been commissioned to prepare a Transport Impact Assessment to assess the potential traffic impacts and car parking and access issues associated with the proposed mixed-use development to be located at 20-22 Kintail Road, Applecross, in the City of Melville. This assessment has been prepared in accordance with the WAPC Transport Impact Assessment Guidelines: Vol 4 – Individual Developments and the City of Melville's Planning Scheme No. 6, Car Parking and Access Policy LPP-1.6and the Canning Bridge Activity Centre Plan.

2.2. Site Location

The site is located approximately 700m west of Kwinana Freeway/Canning Bridge interchange and 350m north-west of the Canning Highway / Sleat Road intersection. The proposed development is to be sited on the northern side of the Canning Highway opposite the intersection of First Avenue and Kintail Road at 20 – 22 Kintail Road, Applecross. The proposed site is currently developed as two detached residential dwellings. The general site location and in Figure 1.

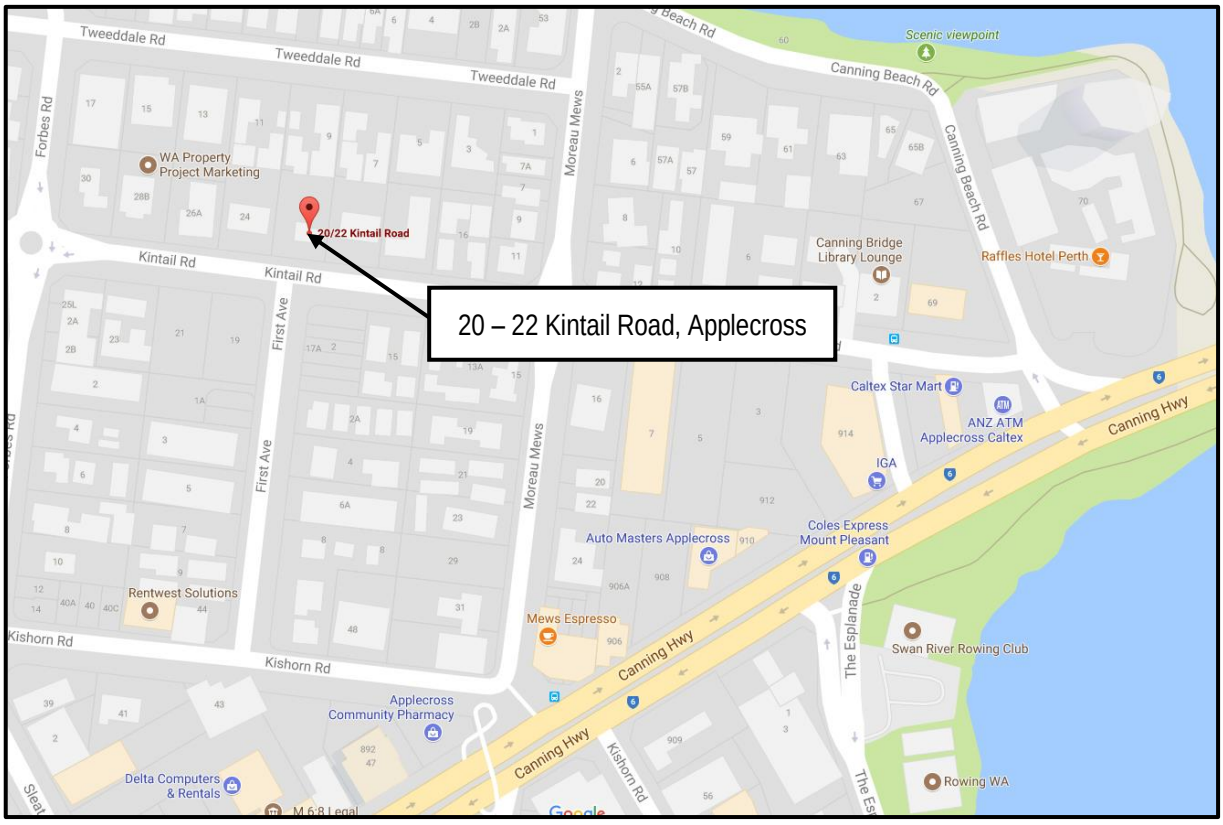


Figure 1 - Site Location

The proposed site is currently developed as two detached residential dwellings and the aerial view of the subject site is indicated in Figure 2.

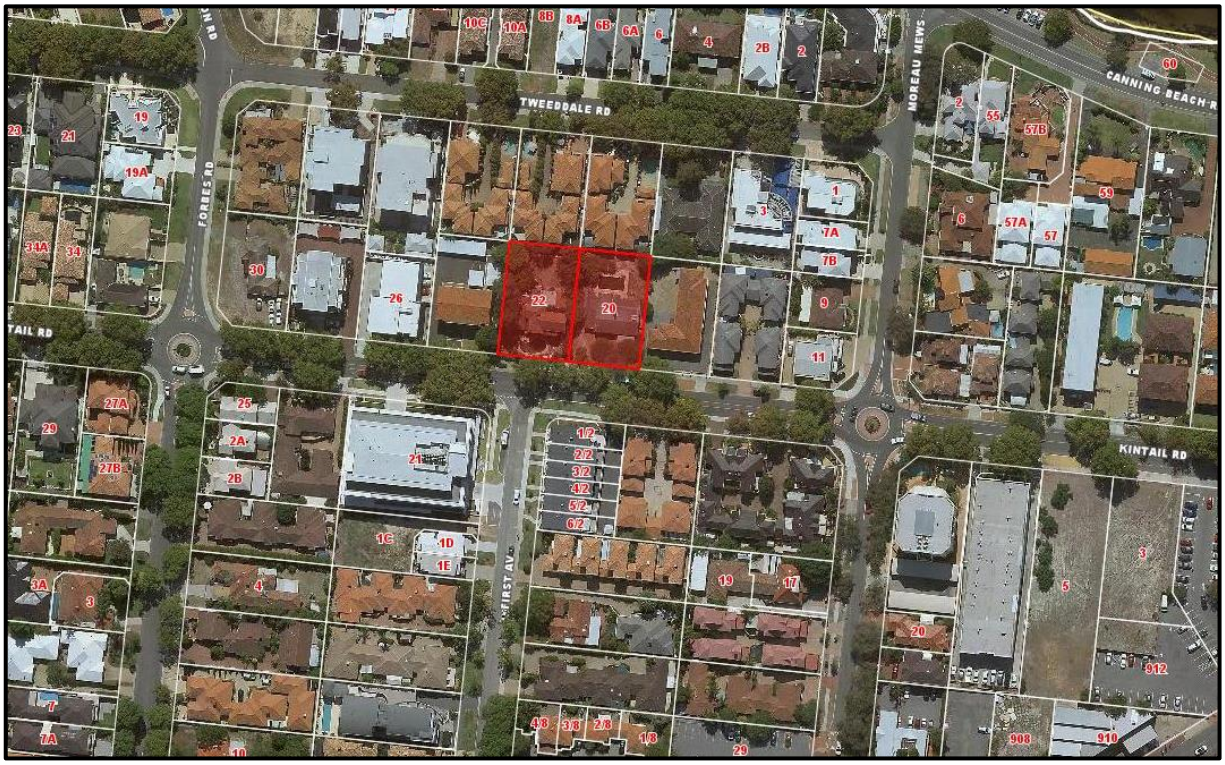


Figure 2 - Aerial View

2.3. Reference Information

In undertaking the study, the information listed below was referenced.

- MRWA Functional Hierarchy Criteria;
- Livable Neighbourhoods Guidelines 2009;
- Guide to Traffic Generating Developments Version 2.2, October 2002 – Roads and Traffic Authority, New South Wales;
- South Perth Station Precinct Trip Rate Policy, November 2016 – Cardno
- Canning Bridge Activity Centre Plan 2016; and
- Department of Transport Local TravelSmart Map - City of Melville (East)

3. Site Proposal

3.1. Regional Context

The site is located within the City of Melville to the north of Kintail Road and First Avenue T-junction intersection. This location is surrounded by residential properties with retail & commercial land use in close proximity. Local shopping strips are available within 200m of this location and the associated train station, the Canning Bridge Railway Station, is situated approximately 750m away. Figure 3 shows the site location in a regional context.

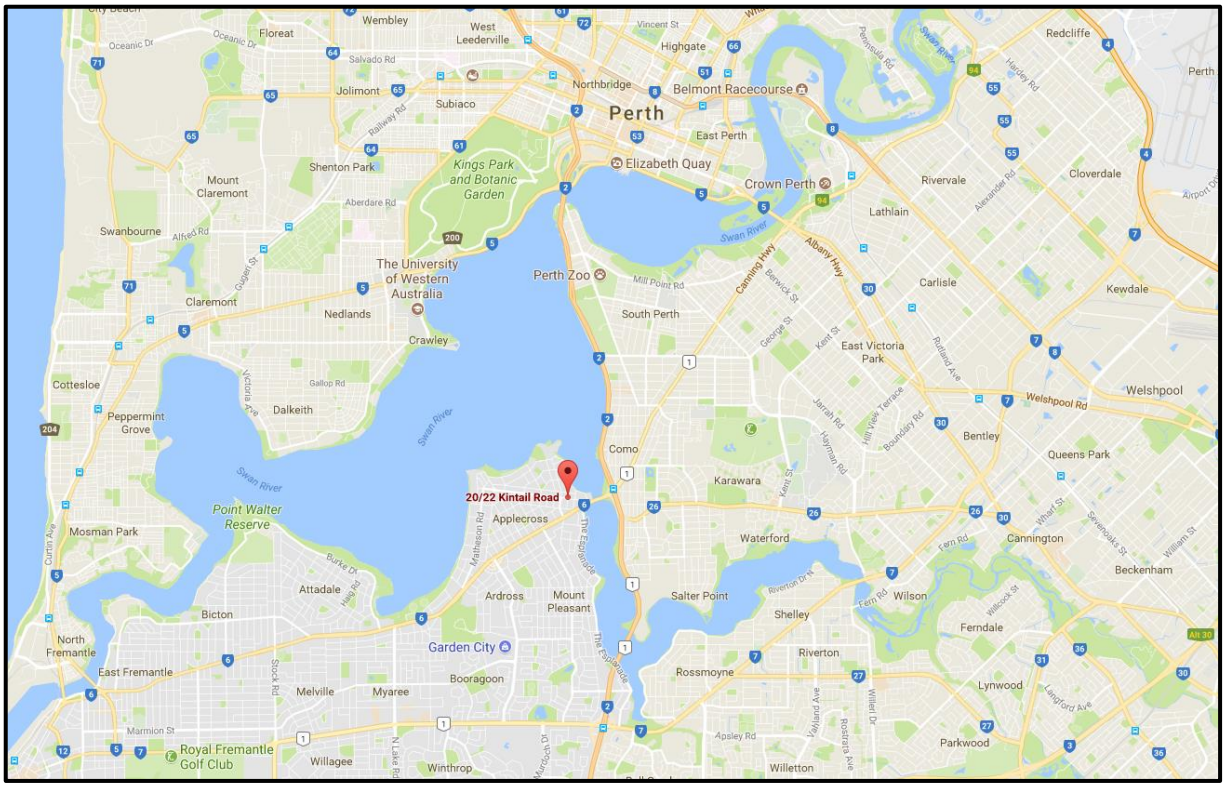


Figure 3 - Regional Context

3.2. Land Use

The proposed development comprises the following.

- 1 café - 160 sqm;
- 97 residential apartments including;
    - 22 one-bedroom apartments;
    - 46 two-bedroom apartments;
    - 24 three-bedroom apartments; and
    - 4 four-bedroom apartments.

An extract of the development site layout is shown in Appendix A.

3.3. Site Access

There are two existing crossovers serving 20 and 22 Kintail Road, both of which are proposed to be removed. Access to the proposed carpark will be via a new crossover on Kintail Road, at the south-eastern boundary of the site. Pedestrian access is via a separate foyer entry from the existing footpath along Kintail Road.

3.4. Parking

The proposed parking supply for the development consists of four levels of car parking. Total car parking on the site consists of 144 bays, including 105 single bays, 11 long bays and 28 shifting parking platforms. Parking of bicycle, motorcycle and dedicated storage facilities for each residential apartment are also provided in accordance with CBACP.

3.5. Planning Framework

The subject lot is within the Kintail Quarter (Q1) of Canning Bridge Activity Centre. According to the Activity Centre Plan (CBACP), the subject site is zoned "Mixed Use" with up to 10 storeys building height and residential and employment development are preferred categories of use. The proposed development generally matches to the preferred land use with the ground floor café only accounts for a small proportion of the development.

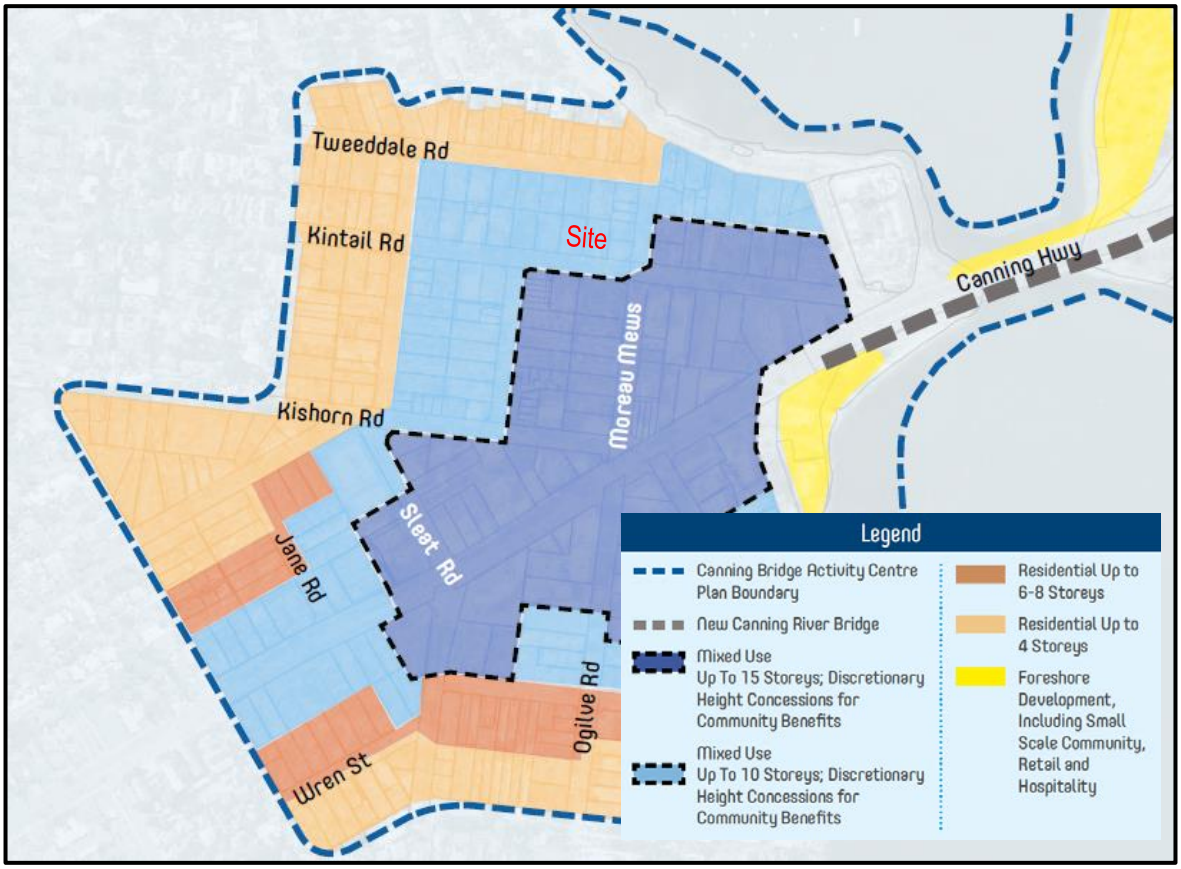


Figure 4 - Zoning - Extract from CBACP

3.6. Major Attractors and Generators of Traffic

The development site is mainly a traffic generator. The main attractors and generators expected to influence traffic flows are likely to be to and from Perth CBD. Figure 5 shows the main desire lines to and from the site.

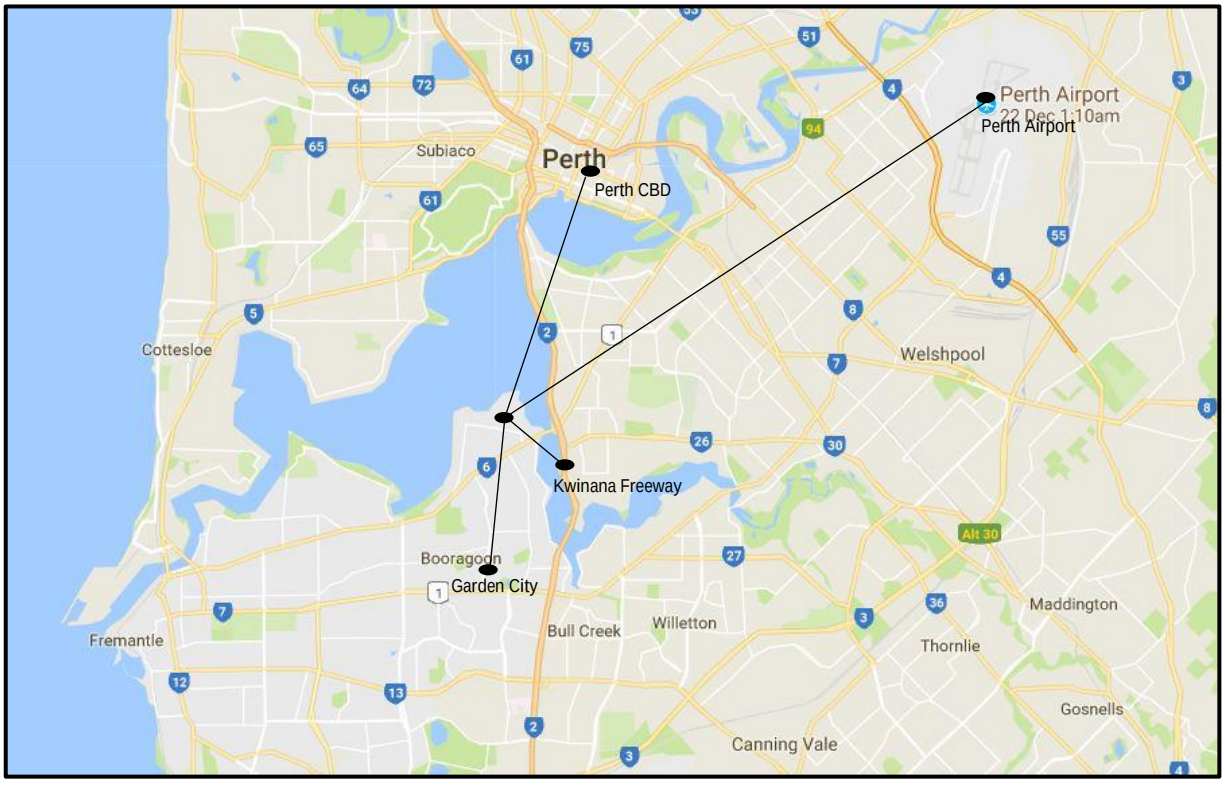


Figure 5 - Major Attractors and Generators

Since the CBACP aims to facilitate transit oriented developments (TOD), travelling between the site and location with good public transport connectivity are likely to shift from car mode to public transport mode and with the development of the activity centre, residents will use active transport modes to access the facilities and amenities within the close proximity of the site.

4. Existing Situation

4.1. Existing Roads

An extract of the Main Roads *Road Information Mapping* web tool is shown in Figure 6 and shows the road hierarchy surrounding the site.

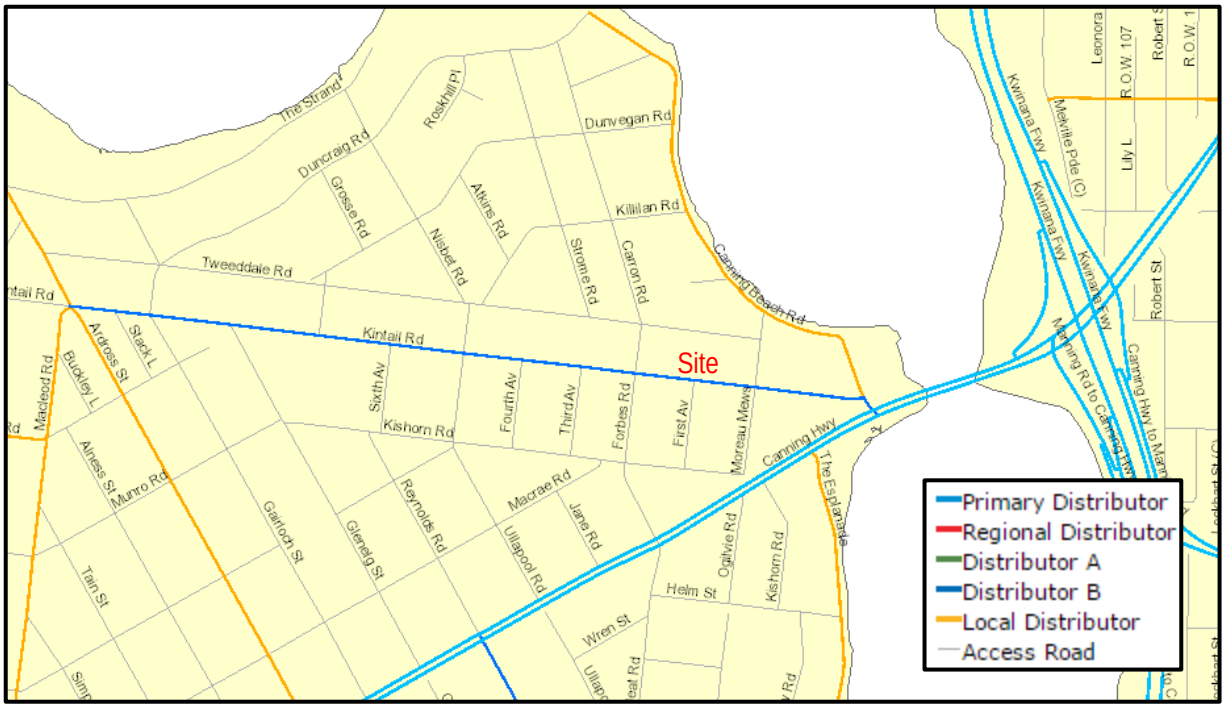


Figure 6 - Road Hierarchy

Kintail Road

Kintail Road is located across the southern boundary of the site and runs a total distance of approximately 1.95km spanning from Canning Beach Road to Fraser Road. Kintail Road is classified as a Distributor B under the MRWA Functional Road Hierarchy. Kintail Road is a two-way, single-lane street with approximately 7.9m wide kerb-to-kerb width. There are two roundabouts on Kintail Road located 120m to the east and west of the propose site. Street parking is not available in the immediate vicinity of the proposed site. Kintail Road has a posted speed limit of 50km/hr.

Canning Highway

The proposed development site is to be constructed on the north side of Canning Highway. Canning Highway is classified as a Primary Distributor under the MRWA Functional Road Hierarchy. In the vicinity of the site, Canning Highway is a three-lane east-bound and two-lane west-bound major road with extra turning pockets provided at intersections. Eastbound and westbound carriageway widths are 10m and 6.5m respectively excluding turning lane and they are separated by a 5m wide raised central median. A significant portion of traffic entering and

leaving the development site is expected to travel via Canning Highway. Canning Highway has a posted speed limit of 60km/hr.

First Avenue

The proposed site is located immediately north of a T-Junction formed by First Avenue and Kintail Road. First Avenue is a two-way, one-lane street spanning approximately 175m. First Avenue is classified as an Access Road under the MRWA Functional Road Hierarchy. Paid street parking is available along First Avenue.

Forbes Road

Forbes Road connects to Kintail Road via a roundabout located approximately 120m west of the proposed development site. Forbes Road is a two-way, one-lane street classified as an Access Road under the MRWA Functional Road Hierarchy. Forbes Road discontinues at Kishorn Road / Sleat Road intersection with Sleat Road continues south and intersects with Canning Highway via a four-way signalised intersection. Forbes Road operates at a 50km/hr speed limit. Paid street parking is available along Forbes Road.

Moreau Mews

Moreau Mews connects to Kintail Road via a roundabout located approximately 120m east of the proposed development site. Moreau Mews is a two-way, one-lane street classified as an Access Road under the MRWA Functional Road Hierarchy.

Canning Beach Road

Canning Beach Road connects to Kintail Road via a priority controlled intersection and this intersection is located 30m north of the Canning Highway / Canning Beach Road signalised intersection. The layout of these two intersections is shown in Figure 7 and shows that there are 2 eastbound lanes designated for east-bound traffic from Kintail Road (and one eastbound lane for Canning Beach Road). East-bound traffic from Kintail Road have to give-way to north-bound traffic which is mainly generated via the left-turn from Canning Highway and right-turn pocket on Canning Highway.

Figure 7 - The intersection of Canning Beach Road, Kintail Road and Canning Highway

4.2. Road Hierarchy vs Actual Flows

Table 1 details the comparison of current traffic volumes against the maximum desirable volumes provided within the MRWA Functional Hierarchy and Liveable Neighbourhoods criteria. MRWA and City of Melville's most recent data set for Canning Highway and Kintail Road was taken in 2015/16 but traffic counts at these locations has shown a tendency to fluctuate up and down over recent years. As such, the latest traffic count will be used for the purposes of this report. The latest traffic data for Forbes Road and Canning Beach Road was 2012 City of Melville traffic count and a comparison with latest SCAT count at signalised intersections indicated minimal increase in traffic and the latest count data is considered applicable for the purpose of this assessment.

Table 1 - Road Classification and Indicative Traffic Volumes

Location of Count	MRWA Classification & Indicative Traffic Volume. (vpd)		Liveable Neighbourhoods Classification & Indicative Traffic Volume (vpd)		Traffic Volume (vpd)	Source
Kintail Rd - East of First Ave	District Distributor B	>6,000	Integrator Arterial B	15,000	7,936	City of Melville (2016)
Canning Hwy - At Canning Bridge	Primary Distributor	50,000	Primary Distributor	50,000	69,587	MRWA (2015)
Canning Hwy - west of Riseley St	Primary Distributor	50,000	Primary Distributor	50,000	43,319	MRWA (2015)
Forbes Rd - South of Kintail Rd	Access Road	<3,000	Access Road	3,000	4,221	City of Melville (2012)
Canning Beach Rd - North of Kintail Rd	Access Road	<3,000	Access Road	3,000	2,502	City of Melville (2012)

As shown, most of these roads currently operates beyond the indicative traffic volume of their classification. As the CBACP aims to facilitate transit oriented developments, travelling between the site and location with good

public transport connectivity are likely to shift from car mode to public transport mode and with the development of the activity centre, residents tend to utilise active transport modes to access the facilities and amenities within the close proximity of the site. Table 2 below lists the projected transport mode splits of current and future Activity Centre scenarios.

Table 2 - Target Mode Splits for Canning Bridge Activity Centre Plan Area - Extract from CBACP

Mode	Current Zoning	CBACP to 2031	CBACP to 2050
Car Driver/Car Passenger	63.7%	50%	35%
Train, light rail, BRT, Bus, Ferry	15.1%	20%	25%
Walking, cycling	3%	7%	12%
Telework (work from home) / shop (internet retail) etc	16.3%	20%	25%
Taxi/motorbike	1.8%	3%	3%

4.3. Changes to the Surrounding Network

The Canning Bridge Activity Centre Plan was released in February 2016 outlining planning and development for areas flanking both sides of Canning Bridge to the north and south of Canning Highway within both the City of Melville and the City of South Perth. The subject site is located within what is denoted as Q1 – Kintail Quarter. Issues relating to the broader movement network within the area of the site as noted within the CBACP relate to the potential modifications to Canning Highway to incorporate a dedicated high frequency bus lane as well as upgrades to existing pedestrian and cycling infrastructure in order to encourage a significant shift to non-motorised transport into the future. No major road improvements apart from localised widening of Canning Highway abutting the northern boundary of the site are identified in the vicinity of the development and an indicative Canning Highway Cross-section is shown in Figure 8.

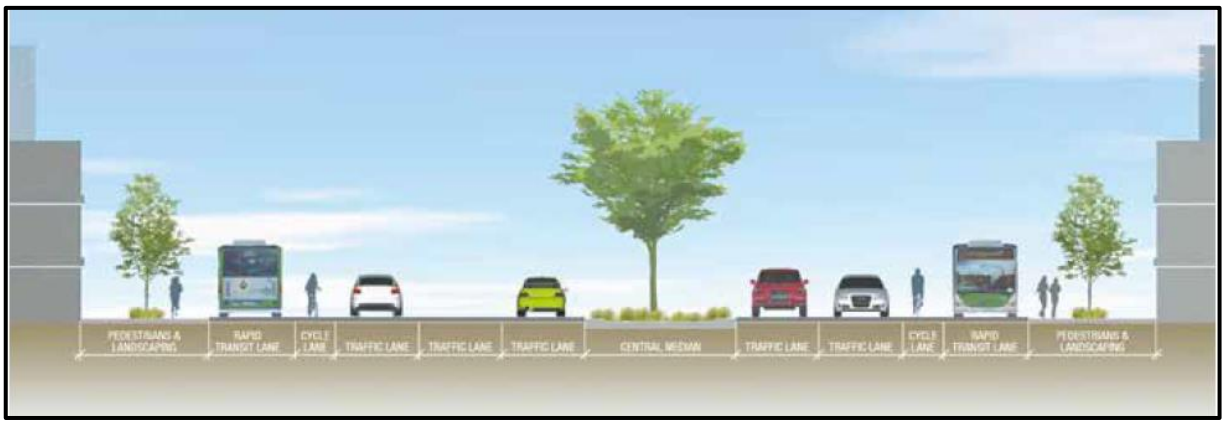


Figure 8 - Indicative cross section – Canning Highway

4.4. Existing Traffic Generation

The existing site consists of two dwelling houses and generates minimal traffic. The existing traffic generation has been estimated via data provided by the Road and Traffic Authority (RTA) and is approximately 18 vehicles per day and a peak hour rate of 2 vehicles per hour. Table 3 shows the generation from these two structures.

Table 3 - Existing Traffic Generation

Land Use	Quantity	Daily Trip Generation Rate	Peak Hour Trip Generation Rate	Daily Trips (vpd)	Peak Hour Trips (vph)	Source
Dwellings houses	2	9.0 per dwelling	0.85 per dwelling	18	1.7	RTA
Total				18	2	

5. Transport Assessment

5.1. Assessment Years

The assessment is based on the full development of the site by 2031. Although it is anticipated that the Canning Bridge Activity Centre will accommodate more residential and commercial developments, the CBACP estimates a reduction in vehicle demand despite the projected increase in overall traffic demand.

the most recent traffic data were used to represent the post-development scenario due to the following reasons:

- Traffic data for Canning Highway has shown a tendency to fluctuate up and down over recent years;
- The CBACP aims to facilitate Transit Oriented Developments (TOD) and promote the use of public transport as well as active transport modes such as walking and cycling to decrease vehicle demand;
- Future traffic generation will be reduced due to the synergy between the different land uses within the activity centre.

5.2. Time Periods for Assessment

The peak period for the proposed residential and commercial uses corresponds with the AM and PM Peak hours of the surround road network which are 8:00 to 9:00 (AM Peak) and 17:00 to 18:00 (PM Peak).

5.3. Development Generation

In order to estimate the impact of traffic generated by the proposed development, Reference was made to "South Perth Station Precinct Trip Rate Policy" (SPSP Trip Rate Policy) prepared by Cardno as the proposed development location shares great similarities to South Perth Station Precinct in terms of surrounding developments, level of public transport connectivity and pedestrian/cycling amenity. It should be noted that, South Perth Station Precinct is not a typical "Transit Oriented Development" (TOD) that is built right over a railway station while the Kintail Bus Boulevard and Canning Bridge bus and trains station carries a significant proportion of traffic from the activity centre and therefore the rates adopted from SPSP Trip Rate Policy should be considered as conservative trip rates for the purpose of this assessment.

The trip generation has been determined for both daily and peak hour. Detailed explanations of the trip generation are summarised Table 4 and Table 5.

Table 4 - Weekday Daily Trip Generation

Land Use	Units	Quantum	Daily Trip Generation Rate			Estimated Generation			Source
			ADT	AM Peak	PM Peak	ADT	AM Peak	PM Peak	
Café*(Restaurant)*	GFA ('00m^2)	175	43.4*	8.68	8.23	76	15	14	SPSP
Residential Apartments	Units	97	4.5	0.28**	0.39**	437	27	38	SPSP
Total						513	42	52	

Note*: Assumed value. No daily trip generation rate for "café" is available from SPSP, it is recognised that café generally operate 10 hours a day from 7am to 5pm, so daily trip generation rate is assumed to be 5 times the AM Peak rates.

Note**: For comparison purpose, the peak hour trip rates from Roads and Traffic Authority (RTA) Guide to Traffic Generating Developments (2002) is 0.29 trips per unit for High density residential development in Metropolitan Sub-Regional Centres.

Table 5 - Peak Hour Distribution

Land use	Peak Distribution			
	AM Peak In	AM Peak Out	PM Peak In	PM Peak Out
Cafe *(Restaurant)*	52%	48%	61%	39%
	8	7	9	5
Residential Apartments	22%	78%	62%	38%
	6	21	24	14
Total	14	29	33	19

It is estimated that the proposed development will generate 513 additional trips per day with 42 trips and 52 trips during weekday AM and PM peak hours. To be conservative, all trips have been set as vehicle trips

5.4. Distribution

Based upon the existing traffic patterns in the area and spatial distribution of adjacent land uses, the following distribution for the developed site generated traffic has been assumed:

- 60% of site-generated traffic is originating from and destined to the east via Kintail Road and Canning Highway; and
- 40% of site-generated traffic is originating from and destined to the west via Canning Highway, of which:
    - 20% of traffic access Canning Highway via Sleat Road intersection, and
    - to avoid traffic congestions at Sleat Road / Canning Highway intersection, 20% of traffic continue Kintail Road to the west and access Canning Highway via other intersections.

The site-generated traffic is expected to be distributed as shown in Figure 9.

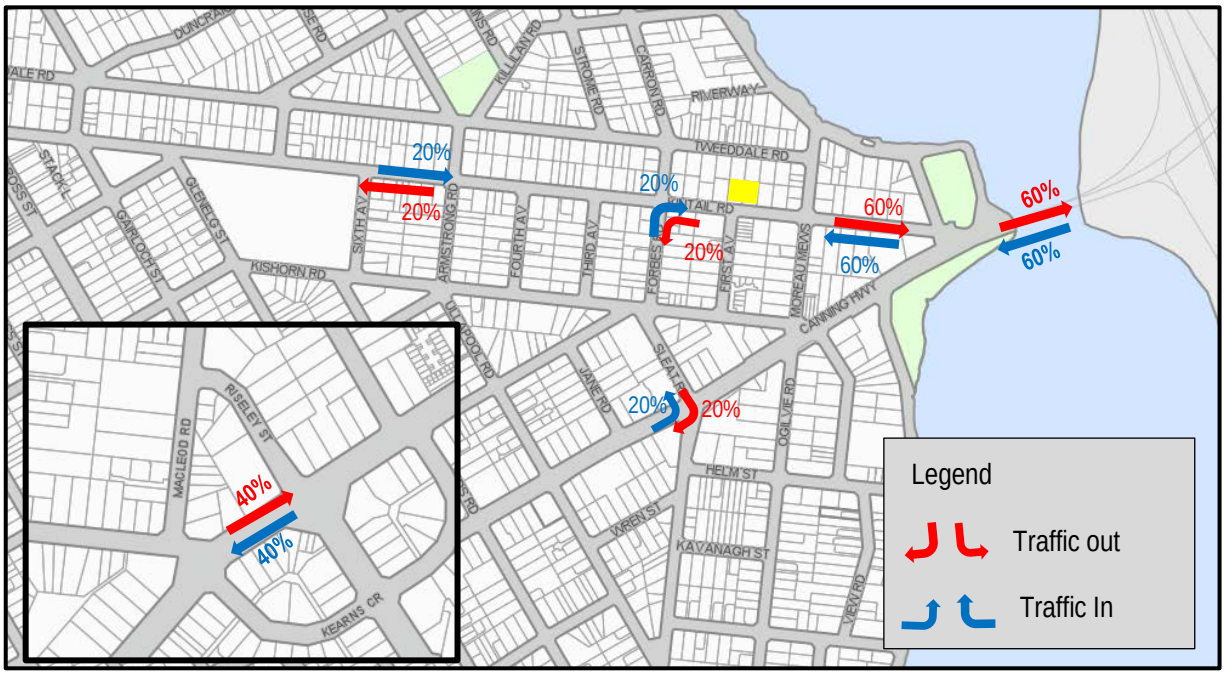


Figure 9 - Trip Distribution

Predicted flows on the adjacent roads are shown in Table 7.

Table 6 - Predicted Daily Volume

Location of Count	MRWA Indicative Traffic Volume (vpd)	Liveable Neighbourhoods Indicative Traffic Volume (vpd)	Existing Daily Traffic Volume (vpd)	Predicted Daily Traffic Volume (vpd)	Predicted Increase
Canning Hwy - At Canning Bridge	< 50,000	50,000	69,587	69,895	308
Canning Hwy - West of Riseley St	< 50,000	50,000	43,319	43,524	205
Kintail Rd - East of First Ave	> 6,000	15,000	7,936	8,244	308
Forbes Rd - South of Kintail Rd	< 3000	3,000	4,221	4,324	103

Table 7 - Predicted Peak Hour Volumes

Location of Count	Existing AM Peak Volume (vph)	Predicted AM Peak Volume (vph)	AM Peak Increase (vph)	Existing PM Peak Volume (vph)	Predicted PM Peak Volume (vph)	PM Peak Increase (vph)
Canning Hwy - At Canning Bridge	5,746	5,771	25	5,375	5,406	31
Caning Hwy - West of Riseley St	3,084	3,100	16	3,313	3,334	21
Kintail Rd - East of First Ave	635	660	25	772	803	31
Forbes Rd - South of Kintail Rd	393	401	8	416	426	10

5.5. Impact on Intersections

Canning Highway / Sleat Road intersection and Canning Highway / Canning Beach Road intersection were modelled based on the predicted flows using Sidra Intersection software. Detailed vehicle movement at these intersections were based on SCATS traffic count sourced from MRWA. The results of analysis are summarised in Table 8 and Table 9 with the detailed movement summaries shown in Appendix B.

Note: both intersections were modelled with their current intersection layout as the proposed additional kerb lanes are dedicated for buses.

Table 8 - SIDRA Output - Canning Highway / Sleat Road Intersection

Canning Hwy / Sleat Rd intersection*	AM Peak		PM Peak	
	Existing	Predicted	Existing	Predicted**
Degree of Saturation**	0.911	0.912	0.977	0.977
Worst Delay	98.3 seconds	98.3 seconds	90.5 seconds	91.2 seconds
Worst Queue	74.2 vehicles	74.4 vehicles	90.2 vehicles	76.9 vehicles
Worst LOS	LOS F More than 1 movement	LOS F More than 1 movement	LOS F More than 1 movement	LOS F More than 1 movement

* Optimum Cycle times were set to 120-180 seconds and 180 seconds was selected by SIDRA.

** Basic Saturation Flows for Canning Highway Through Lanes were calibrated to 2050 tcu/h due to Degree of Saturation exceeds 1.0 during modelling of existing traffic.

Table 9 - SIDRA Output - Canning Highway / Canning Beach Road Intersection

Canning Hwy / Canning Beach Rd*	AM Peak		PM Peak	
	Existing	Predicted	Existing	Predicted
Degree of Saturation	0.802	0.802	0.713	0.723
Worst Delay	53.6 seconds	54.8 seconds	36.6 seconds	36.1 seconds**
Worst Queue	42.9 vehicles	42.9 vehicles	31.1 vehicles	31.6 vehicles
Worst LOS	LOS D Canning Hwy Right-turn	LOS D Canning Hwy Right-turn	LOS D Canning Hwy Right-turn	LOS D Canning Hwy Right-turn

* Optimum Cycle time was set to 120-180 seconds and 120 seconds was selected by SIDRA.

** More Phase Time was assigned to the turning phase (There are only two phases for this intersection) and although the average delay increased from 20.4 seconds to 20.8 seconds, the worst delay reduced from 36.6 seconds to 36.1 seconds.

The analysis shows that traffic from the site will have minimal impact on the operation of the surrounding intersections under the future traffic demand scenario, as the additional traffic travelling through these two intersections accounts for less than 1% of existing intersection traffic.

The Canning Highway/Sleat Road intersection currently operates at a Level of Service F during the critical weekday AM and PM peak hours with significant queuing experienced on Sleat Road north and south approaches. The addition of the site-generated traffic travelling through this intersection (9 and 10 vph during each of the AM and PM peak hours, respectively) will have a negligible impact on traffic.

Also, the development is a small percentage of the likely increase in traffic generated by the CBACP, upgrades due to this development are not considered necessary, especially at the Canning Highway / Sleat Road intersection.

The Road Network Plan for Transperth at 3.5 million identifies that Canning Highway will be grade-separated with Sleat Road by 2050 to improve the intersection operation. As CBACP develops, the need for this intersection upgrade will be triggered but this development doesn't trigger it.

It should be noted that, the maximum building height of proposed site is up to 10 storeys according to the CBACP zoning map which shown previously in Figure 4. The level 10 to 15 of the proposed development includes 37 residential units and accounts for approximately 1/3 of the development. Since traffic impact of the whole development is considered low, the additional 6 floors from level 10 to level 15 are unlikely to unduly impact on the activity centre

6. Pedestrian and Cycle Networks

Cycle facilities in the general vicinity of the site are shown on Figure 10. The development is closely connected to the Perth Bicycle Network (PBN) and multiple bicycle boulevards. There is also a high quality shared path running along the river and towards Canning Bridge.

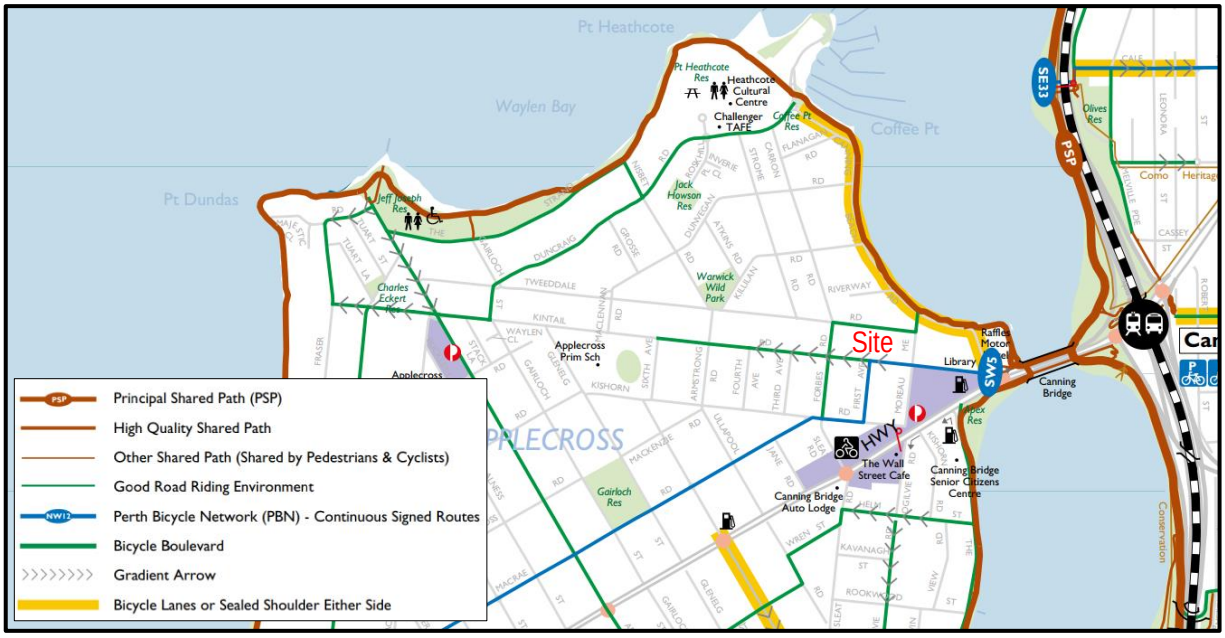


Figure 10: Local Pedestrian and Cycle Networks

The City of Melville's Bike Plan prepared by Aurecon (2012), proposes a number of projects to promote safe and convenient cycling and pedestrian access system to, from and within the city centre. The propose projects that are relevant to the proposed development are as follows:

- Install bicycle lanes along Canning Highway as it is upgraded to include bus lanes.
- Add an additional commuter friendly Perth Bicycle Network (PBN) route along Reynolds Road / Moolyeen Road and Coomoora Road.

The pedestrian and cycling network is considered adequate to cater for this development.

7. Public Transport

The site is approximately 750 metres west of the Canning Bridge railway station. There are also a number of bus routes in the vicinity including Transperth-operated bus routes.

- Bus Route 910; which operates between Elizabeth Quay Bus Station, Victoria Park Transfer Station, Canning Highway, and Fremantle Station with 15-minute headways.
- Bus Route 111; which operates between Hale Street/WACA, Elizabeth Quay Bus Station, Canning Highway, and Fremantle Station with 1-hour headways.
- Bus Route 114; which operates between Elizabeth Quay Bus Station, Booragon Bus Station, Marmion Reserve, Fremantle Cemetary, and Asquith Street/Beckett Close with 30-minute headways.
- Bus Route 115; which operates between Elizabeth Quay Bus Station, Booragoon Bus Station, Kardinya Shopping Centre, Hamilton Senior High School, and Hamilton Hill Hall with 15-minute headways.
- Bus Route 150; which operates between Terrace Road/Bennett Street, Elizabeth Quay Bus Station, Canning Highway, and Booragoon Bus Station with 1-hour headways.
- Bus Route 160; which operates between Terrace Road/Bennett Street, Elizabeth Quay Bus Station, Canning Highway, Booragoon Bus Station, and Fremantle Station with 1-hour headways.
- Bus Route 158; which operates between Hale Street/WACA, Elizabeth Key Bus Station, and Fremantle Station with 30-minute headways.

Figure 11 summarises the location of these bus routes and the respective public transport facilities adjacent to the site. It is concluded that the existing public transport network is sufficient to supply this development and no improvements are required.

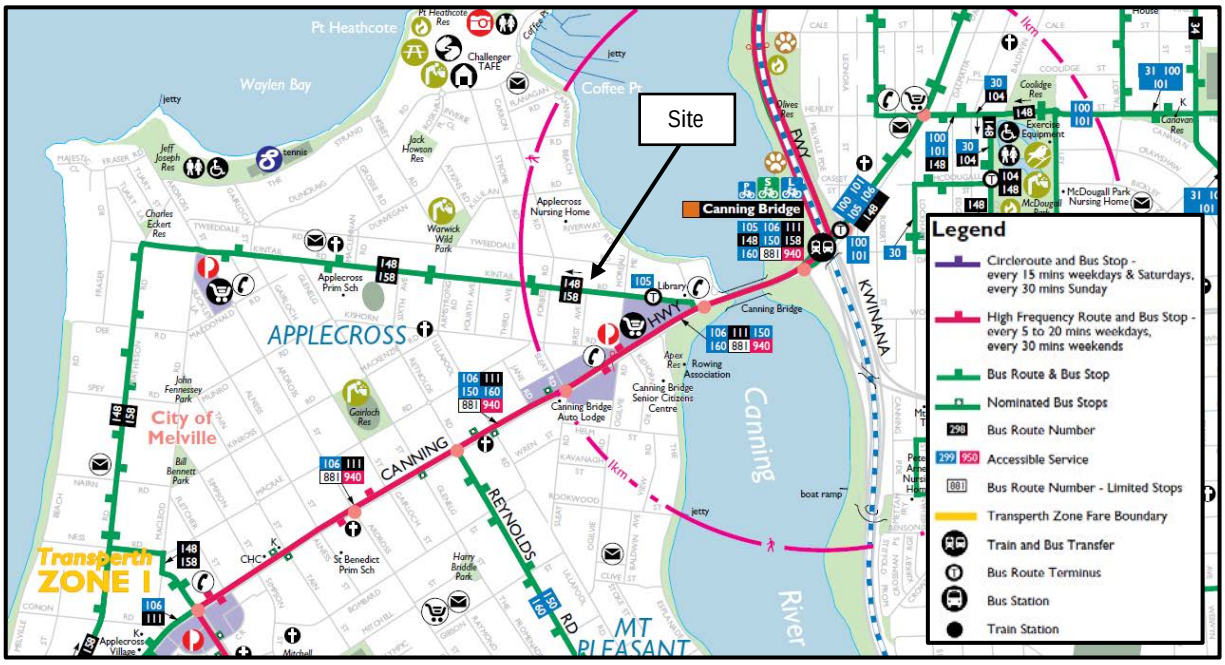


Figure 11 - Public Transport Network

8. Parking

8.1. Parking Provision

The Canning Bridge Activity Plan sets out the following parking requirements as shown in Table 10.

Table 10 - Canning Bridge Activity Plan Parking Requirements

Car Parking				
Land use	Parking Rate	Quantum	Parking Requirement	
			Min	Max
Commercial	More than 1 bays per 50m² NLA No more than 1 bays per 25m² NLA	175m²	3 bays	7 bays
Residential	0.75 - 1 bay per dwelling with 1 bedroom	22	17 bays	22 bays
	1 - 1.5 bay per dwelling with 2-3 bedrooms	71	71 bays	107 bays
	1.25 - 2 bays per dwelling with 4+ bedrooms	4	5 bays	8 bays
Residential - Visitor	Not Specified in (CBACP)		0 bays	0 bays
		Total Required	97 bays	144 bays
		Total Supplied	144 Bays including 105 Single car bays, 11 Long bays, and 28 Pallets (Parking Platform),	
Motorbike Parking				
Non-Residential	1 bay per 5 commercial bays provided	3	1 space	
		Total Supplied	4 scooter bays	
Bike Storage				
Commercial	1 bays per 100m² NLA	175m²	2	
Residential	1 per dwelling	97 dwellings	97	
		Total Required	99	
		Total Supplied	101 Bicycle Bays	

The Development satisfies the minimum requirements for car parking, motor cycle parking as well as bike storage. As the Development is within the Canning Bridge Activity Centre, the Canning Bridge Activity Centre Plan specifies no on-site visitor parking should be provided.

The proposed parking supply involves provision of 28 pallets (Wöhr Parking Platform 501) supplied by Wöhr. These pallets can slide horizontally and save parking space. A desktop review indicates no difficulties for vehicles access and egress from these platforms as well as the single bays to the south of these pallets.

8.2. Parking Layout

The bay dimensions for a Class 1A car parking facility according to AS2890.1 (Residential, Domestic and employee) are shown below in Table 11 and based on the site plan provided, the proposed parking bays comply with the Australian Standards requirements.

Table 11 - AS 2890.1 Parking Bay Dimension Requirements

Bay Details	Bay Dimension Required	Bay Dimension Provided	Comment
Ninety-degree bays	5.4 x 2.4 x 5.8m aisles.	5.4 x 2.5x 5.8m aisles.	Complies
Long Bays	5.4 x 2.4 x 5.8m aisles.	10.0 x 2.5 x 5.8m aisles	Complies, Not suitable for two B85 cars

It is also noted that the proposed pallets width complies with the minimum recommended platform width (including safety flaps) according to the data sheet of Wöhr Parking Platform 501.

9. Site Access

9.1. Development Accesses

The Development has one proposed access onto Kintail Road which is 6.4m wide. There is no specified crossover dimension set out in Canning Bridge Activity Plan and City of Melville Policy LPP 1.6: Parking and Access. however vehicular access points to parking facilities are to be located and designed to ensure safe and efficient movement for vehicles and clear visibility to pedestrian movements.

A review of the proposed site plan identified potential conflict in the ground floor carpark, just inside the entrance and as shown in Figure 12 below, vehicles access to upper parking levels and vehicles egress from B1 carpark need to negotiate the column. A swept path analysis was therefore conducted using B85 cars with 300mm clearance to access the access and egress movements.

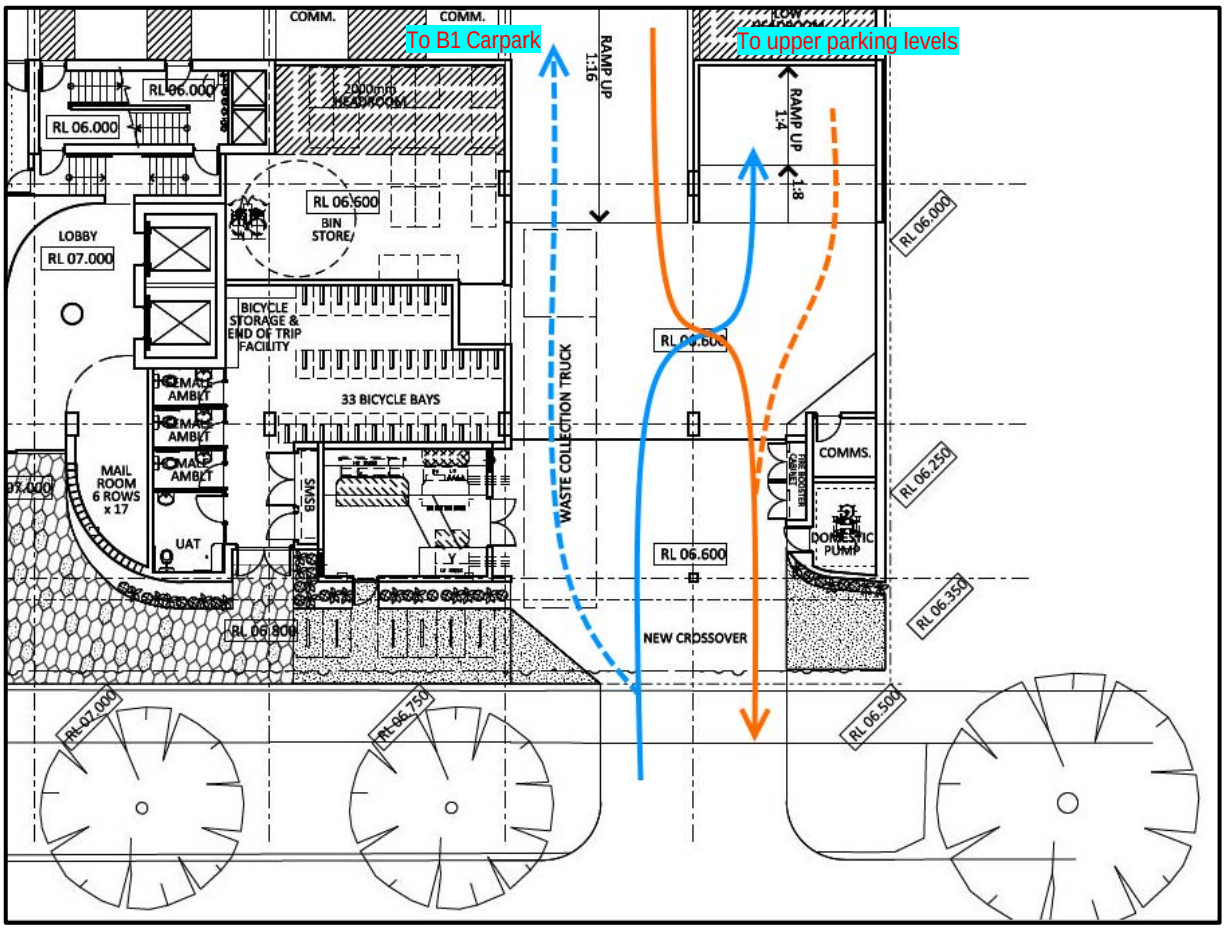


Figure 12 - Access and Egress Movements

Based on the swept path diagrams (as shown in Appendix C) the movements are considered appropriate, however the carpark should be managed as follows to reduce conflicts and prevent lane-incorrect movements:

- Vehicles access to and egress from upper parking levels should be prioritised and appropriate system should be in place to alert vehicles egress from B1 carpark to give-way to all other vehicles;
- A convex mirror should be installed (potentially on the column which fronts ramps) to allow vehicles egress from B1 carpark to view vehicles egress from the ramp to upper parking levels;
- Appropriate delineation (e.g. line marking) and signages should in place to guide vehicles access to upper parking levels and vehicles egress from to B1 level carpark using correct lanes.

9.2. Ramp Access

The access ramps are considered straight ramps for residential car parks. AS2890.1-2004 Clause 2.5.3 outlines the requirements for ramps and access driveways, and a comparison of these requirements and the proposed ramp design are provided in Table 12.

Table 12 - Ramp Requirements

Ramp Details	Ramp Slope Required	Dimension Provided	Comment
Public carpark less than 20m in length	1 in 4 (20%)	1 in 4 (20%)	Complies
Change of grade	1 in 8 (12.5%) summit 1 in 16.7 (15%) sag	1 in 4 (20%) to 1 in 8 (10%) at crest and sag	Complies
Two-way ramp with >150mm obstruction	5.5m plus 0.3 m clearance on each side	Total width 6.1m	Complies
Grade transitions	Minimum 2m length for transitions up to 18%	2m transition provided for ramps steeper than 18% (1 in 5.55)	Complies

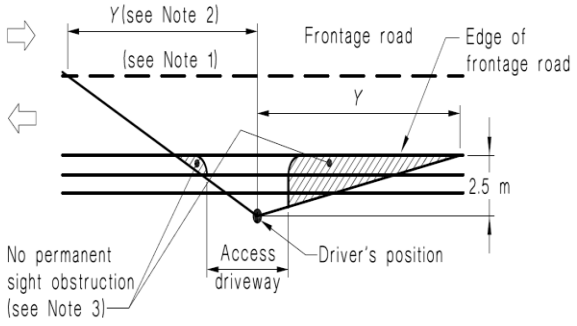
9.3. Service Vehicles

Waste collection is proposed on-site. The waste collection vehicles will reverse from Kintail Road and manoeuvre in front of the bin store and operatives will enter the bin stores to retrieve and service the bins and then replace the empty bins into the bin stores. During collection time, the waste vehicle will block half of the ramp to access B1 carpark for a short period of time. Cars can still manoeuvre around the waste truck during collection time. A swept path analysis was conducted using Austroad 8.8m long service vehicle turning template and the access movement is considered appropriate. The swept path diagram is included in Appendix C.

It is recommended that rubbish collection takes place outside of peak hours to reduce conflict.

9.4. Access Vehicle Sight Distance

Sight distance from the car park egress along the street is defined in Figure 3.2 of AS2890.1 which is reproduced in Figure 13. A desktop review concluded that the minimum sight distance is achieved the crossover.



Frontage road speed	Km/h	Desirable (5s) gap (m)	Minimum sight distance (m)
	60	83	65

NOTES:
1 Centre-line or centre of road (undivided road), or right-hand edge of right hand through lane (divided road)
2 A check to the left is not required at a divided road where the median is wide enough to shelter a vehicle leaving the driveway.
3 Parking on this side of the frontage road may need to be restricted on either side of the driveway so that the sight distance required by the above table to an approaching vehicle is not obstructed.

Figure 13 - Sight Distance Requirements

9.5. Access Pedestrian Sight Distance

The Australian Standard AS2890.1:2004 also provides details for sight lines and distances for pedestrian movements across an access to a carpark. Those details are shown in the AS2890.1 Figure 3.3 extract on Figure 14.

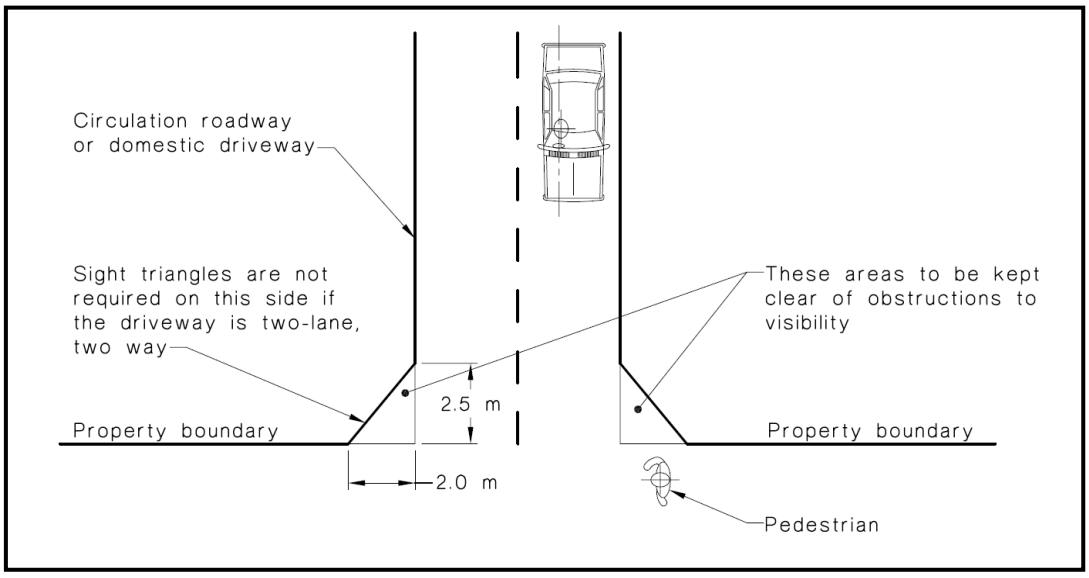


Figure 14 - AS 2890 Requirements for Pedestrian Sight Lines

The site plan indicated low landscaping features next to the pedestrian footpath, vehicle drivers and pedestrians will be able to sight each other over the landscaping. It can therefore be concluded that sight distance of the proposed crossover in accordance with AS2890.1.

10. Site Specific or Safety Issues

The crash history of the roads surrounding the site for the five-year period ending December 2016 was accessed via the MRWA Crash Analysis Reporting System (CARS). For the purposes of this report the intersection between Kintail Road and Moreau Mews, the intersection between Kintail Road and Forbes Road, and the section of Kintail Road between these two intersections have been examined. Based on the report provided, a summary of each of these locations regarding the number of crashes, types of crashes, and severity of these crashes is provided below.

- There were 5 recorded crashes at the Kintail Road/Moreau Mews intersection including;
    - 4 “Rear End” crashes; and
    - 1 “Right Angle” crash.
- There were 12 recorded crashes at the Kintail Road/Forbes Road intersection including;
    - 4 “Rear End” crashes;
    - 7 “Right Angle” crashes; and
    - 1 “Hit Object” crashes.
- There were 6 recorded crashes in between these two intersections on Kintail Road including;
    - 2 “Rear End” crashes;
    - 3 “Right Angle” crashes; and
    - 1 “Hit Object” crashes.

Of the total 23 crashes within the examined area over this duration no fatalities have occurred with only 1 crashes requiring hospital attention and 2 requiring medical attention. A majority of these crashes, 20, resulted in property damage only.

There are no recorded crashes at the intersection between Kintail Road and First Avenue. The crash records indicate that the intersection between Kintail Road and Forbes Road, has higher concentration of crashes within the area. However due to the minor nature of crashes, there is no indication of particular safety issues for the surrounding road network.

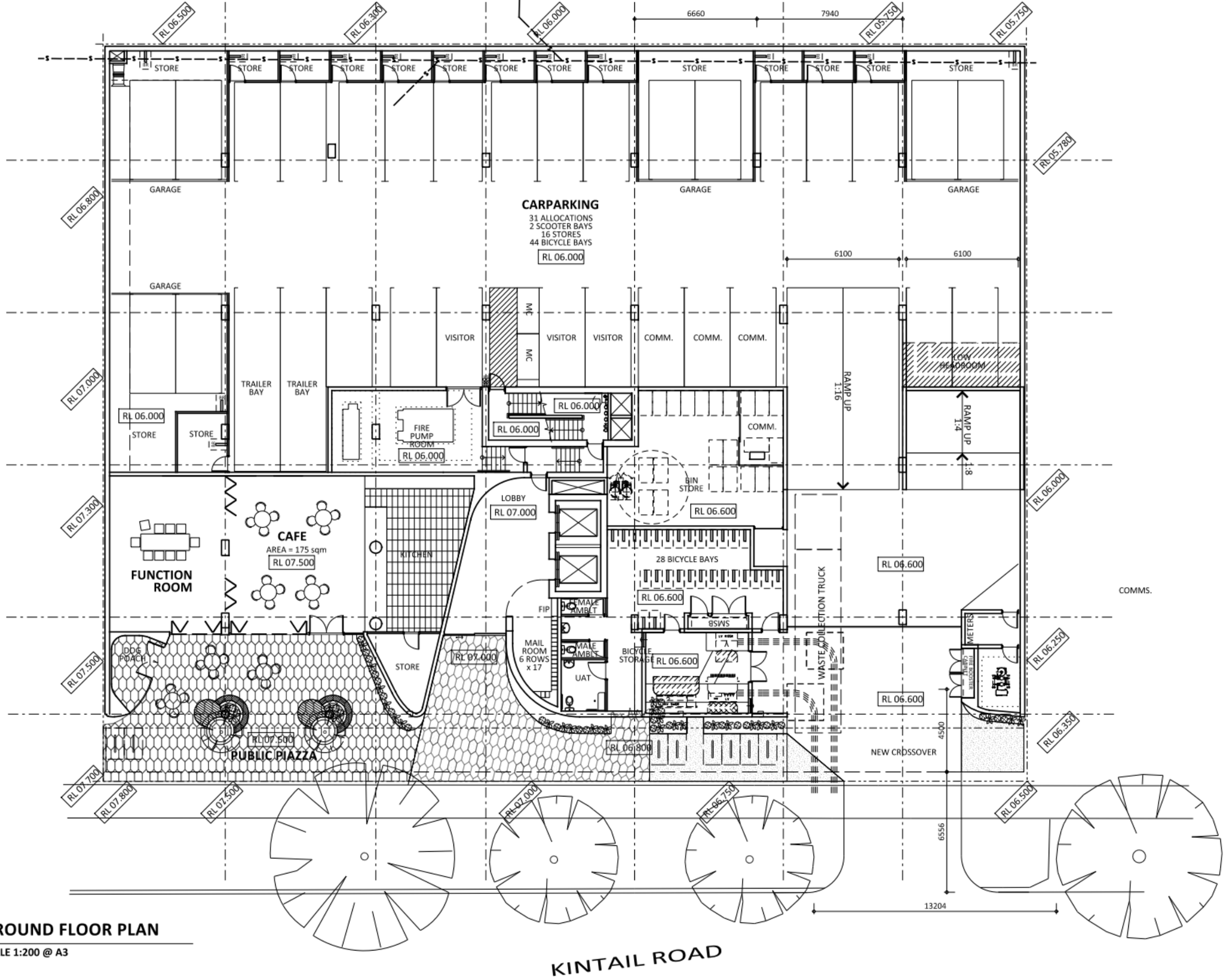
11. Conclusion

Based on the assessment of traffic generation it is predicted that there will be no unacceptable impact on the adjacent road segments.

With respect to the proposed development, the following is concluded;

- The surrounding roads can accommodate the forecast increase in traffic from the proposed development, and the additional 6 floors from level 10 to level 15 are unlikely to unduly impact on the activity centre;
- The Canning Highway/Sleat Road intersection currently operates at a Level of Service F during the critical weekday AM and PM peak hours with significant queuing experienced on Sleat Road north and south approaches. However, the addition of the site-generated traffic was found to have a negligible impact on the intersection operations. The intersection will be upgraded in the future but the upgrade is not triggered by this development;
- Access to and from the site:
  - 60% of traffic is predicted to travel to and from east via Kintail Road and Canning Highway; and
  - 40% of traffic is predicted to travel to and from west, of which, 20% will access Canning Highway via Canning Highway/Sleat Road intersection which accounts for less than 1% of existing intersection traffic;
- The required car parking provision generally satisfies the Canning Bridge Activity Centre Plan. The proposed provision of parking bays is considered to be sufficient to service the proposed development and the oversupply of 1 bay is considered insignificant in regard to the traffic impact;
- The site is well serviced by public transport with bus and train services accessible within reasonable walking distance from the subject site;
- The existing and proposed pedestrian/cyclist infrastructure in the vicinity of the site is considered to be adequate to facilitate the safe movement of pedestrians and cyclists around and within the proposed development;
- The locations and geometry of the proposed accesses are considered acceptable. However, the area between the ramps and the site entrance should be managed to give priority to inbound vehicles and vehicle egress from upper parking levels and appropriate delineation (e.g. line marking), signages and installation of a convex mirror will be required to ensure the safety of access and egress movements
- Proposed waste collection will be accommodated via a designated rubbish collection area near the site entrance. Waste truck will access the site using reverse gear from Kintail Road and it is recommended that waste collection takes place outside of peak hours to reduce conflict.

Appendix A - Site Layout over Parking Levels



GROUND FLOOR PLAN

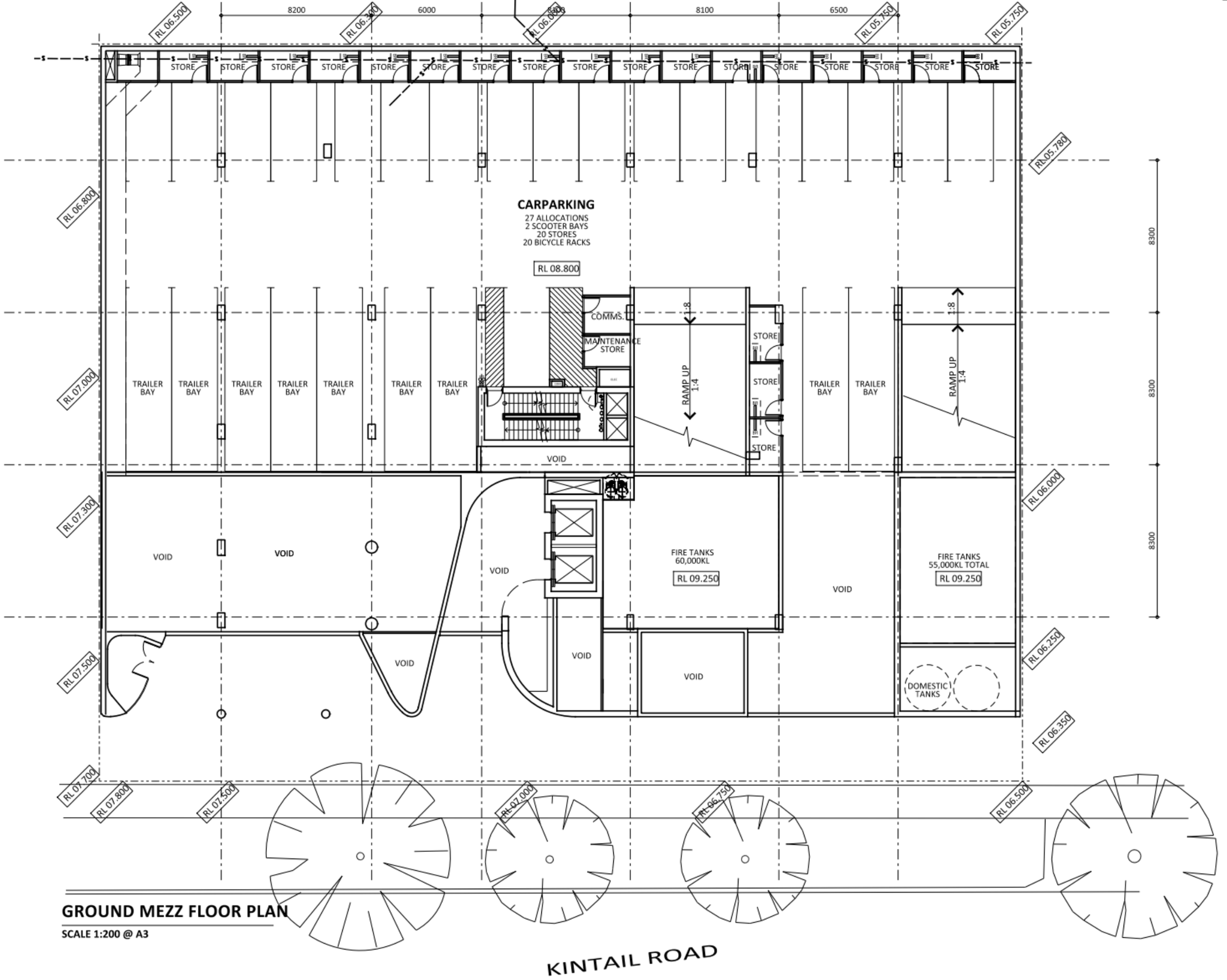
SCALE 1:200 @ A3

MIXED-USE DEVELOPMENT
20-22 KINTAIL ROAD APPLECROSS
FOR NORUP + WILSON

NORUP+WILSON

HILLAM ARCHITECTS

SCALE	NP	DATE ISSUED	DWG. NAME	DWG No.	REV
1:200 @ A3		08.09.17	SK03 GROUND FLOOR PLAN	A2-02	J



GROUND MEZZ FLOOR PLAN

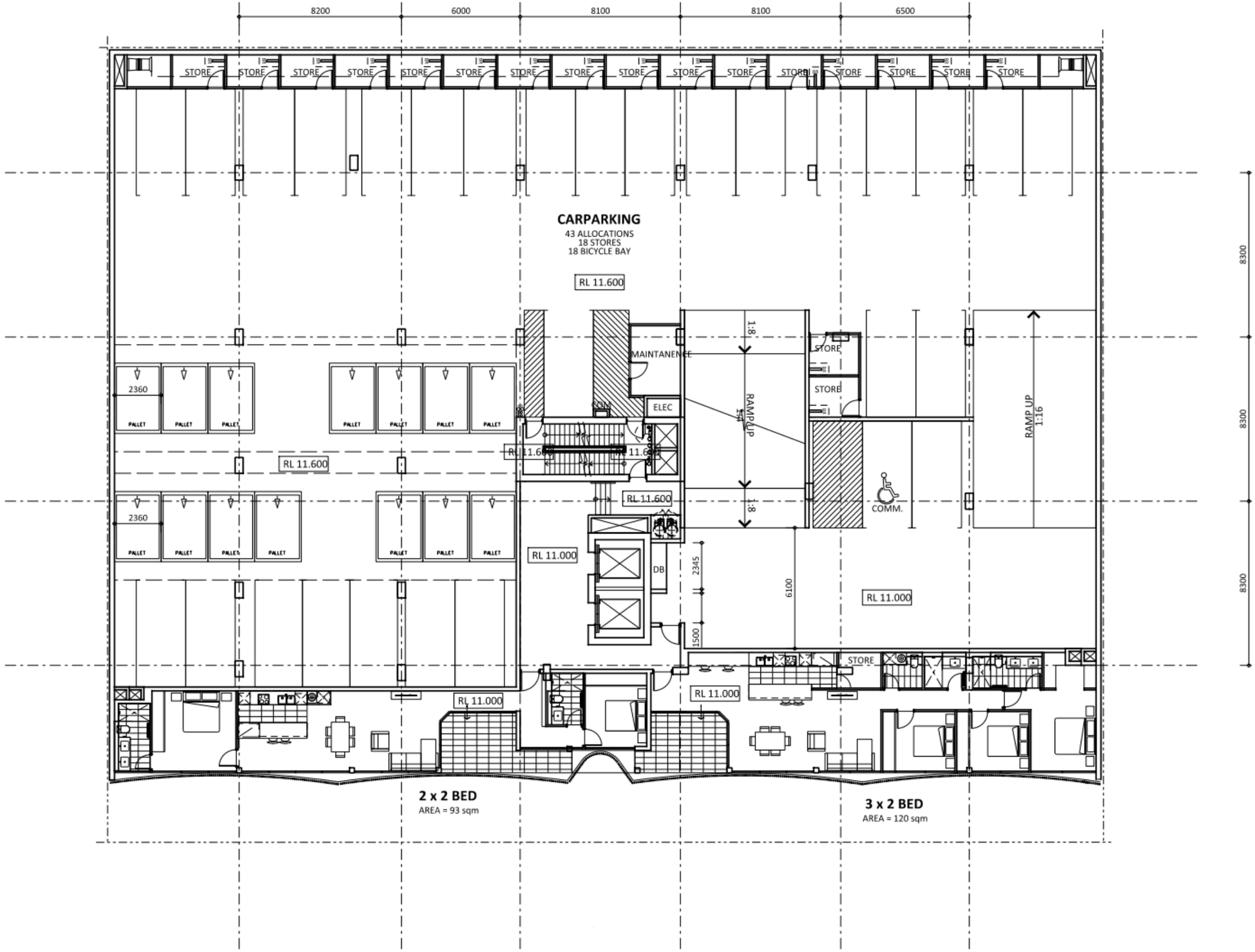
SCALE 1:200 @ A3

KINTAIL ROAD

MIXED-USE DEVELOPMENT
20-22 KINTAIL ROAD APPLECROSS
FOR NORUP + WILSON

HILLAM ARCHITECTS

SCALE	NP	DATE ISSUED	DWG. NAME	DWG No.	REV
1:200 @ A3		08.09.17	SK03 MEZZANINE FLOOR PLAN	A2-03	J



LEVEL 1 FLOOR PLAN

SCALE 1:200 @ A3

MIXED-USE DEVELOPMENT
20-22 KINTAIL ROAD APPLECROSS
FOR NORUP + WILSON

HILLAM ARCHITECTS

SCALE
1:200 @ A3

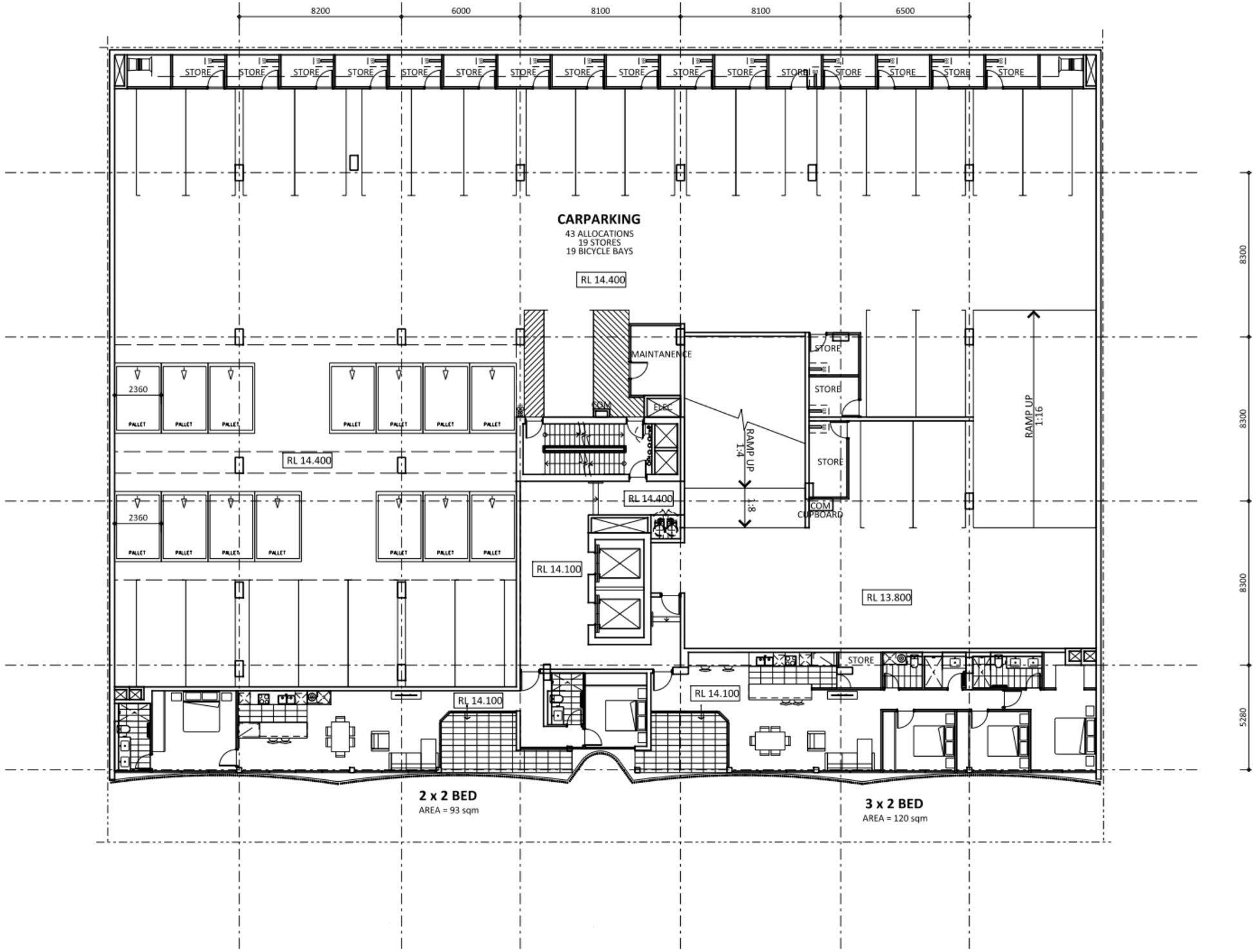
NP

DATE ISSUED
08.09.17

DWG. NAME
SK03
LEVEL 1 PLAN

DWG No.
A2-04

REV
J



LEVEL 2 FLOOR PLAN

SCALE 1:200 @ A3

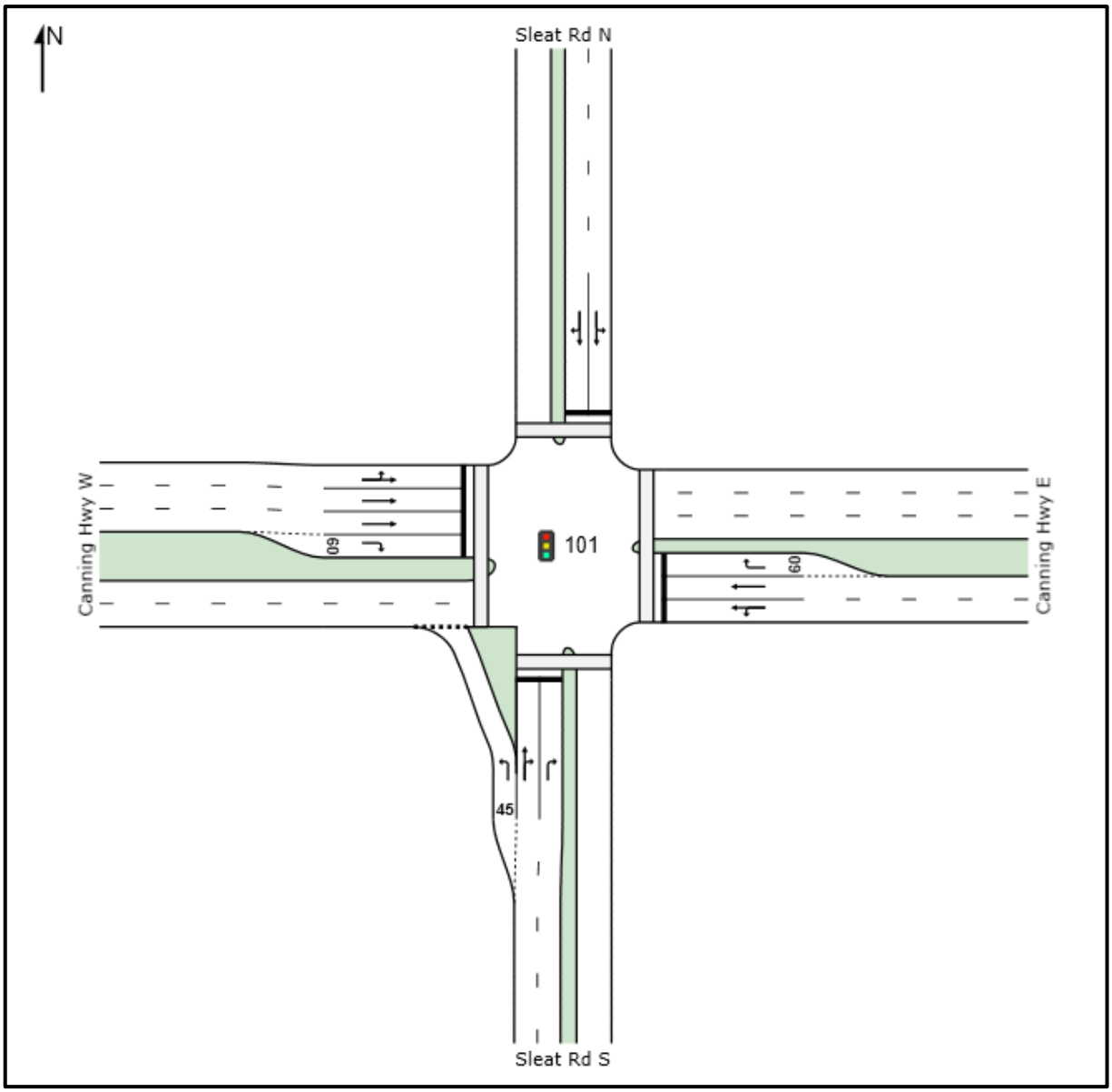
MIXED-USE DEVELOPMENT
20-22 KINTAIL ROAD APPLECROSS
FOR NORUP + WILSON

HILLAM ARCHITECTS

SCALE	NP	DATE ISSUED	DWG. NAME	DWG No.	REV
1:200 @ A3		08.09.17	SK03 LEVEL 2 PLAN	A2-05	J

Appendix B - SIDRA Results

Canning Highway / Sleat Road intersection



MOVEMENT SUMMARY

Site: 101 [Existing Canning Hwy / Sleat RD AM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 180 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sleat Rd S											
1	L2	14	0.0	0.018	21.9	LOS C	0.5	3.4	0.47	0.64	43.8
2	T1	12	0.0	0.877	92.7	LOS F	20.9	146.0	1.00	0.93	23.1
3	R2	436	0.0	0.877	98.3	LOS F	21.4	149.7	1.00	0.93	22.8
Approach		461	0.0	0.877	95.9	LOS F	21.4	149.7	0.98	0.92	23.2
East: Canning Hwy E											
4	L2	343	0.0	0.908	44.0	LOS D	61.1	427.5	1.00	0.95	35.4
5	T1	1348	0.0	0.908	38.3	LOS D	61.1	427.5	0.96	0.92	36.5
6	R2	102	0.0	0.471	49.1	LOS D	5.2	36.1	0.98	0.78	32.9
Approach		1794	0.0	0.908	40.0	LOS D	61.1	427.5	0.97	0.92	36.1
North: Sleat Rd N											
7	L2	91	0.0	0.418	86.0	LOS F	7.5	52.3	0.97	0.78	24.6
8	T1	18	0.0	0.394	80.2	LOS F	7.1	49.7	0.97	0.77	25.2
9	R2	68	0.0	0.394	85.8	LOS F	7.1	49.7	0.97	0.77	25.0
Approach		177	0.0	0.418	85.3	LOS F	7.5	52.3	0.97	0.78	24.8
West: Canning Hwy W											
10	L2	41	0.0	0.911	60.6	LOS E	74.0	518.2	1.00	0.97	31.0
11	T1	2521	0.0	0.911	54.9	LOS D	74.2	519.1	1.00	0.96	31.6
12	R2	21	0.0	0.170	51.0	LOS D	0.9	6.6	0.97	0.70	32.4
Approach		2583	0.0	0.911	55.0	LOS D	74.2	519.1	1.00	0.96	31.6
All Vehicles		5015	0.0	0.911	54.5	LOS D	74.2	519.1	0.99	0.94	31.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Pridicted Canning Hwy / Sleat RD AM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 180 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sleat Rd S											
1	L2	14	0.0	0.018	22.3	LOS C	0.5	3.5	0.47	0.64	43.5
2	T1	12	0.0	0.877	92.7	LOS F	20.9	146.0	1.00	0.93	23.1
3	R2	436	0.0	0.877	98.3	LOS F	21.4	149.7	1.00	0.93	22.8
Approach		461	0.0	0.877	95.9	LOS F	21.4	149.7	0.98	0.92	23.2
East: Canning Hwy E											
4	L2	343	0.0	0.908	44.0	LOS D	61.1	427.5	1.00	0.95	35.4
5	T1	1348	0.0	0.908	38.3	LOS D	61.1	427.5	0.96	0.92	36.5
6	R2	102	0.0	0.471	49.1	LOS D	5.2	36.1	0.98	0.78	32.9
Approach		1794	0.0	0.908	40.0	LOS D	61.1	427.5	0.97	0.92	36.1
North: Sleat Rd N											
7	L2	91	0.0	0.418	86.0	LOS F	7.5	52.3	0.97	0.78	24.6
8	T1	18	0.0	0.419	80.4	LOS F	7.6	52.9	0.97	0.78	25.2
9	R2	74	0.0	0.419	86.0	LOS F	7.6	52.9	0.97	0.78	25.0
Approach		182	0.0	0.419	85.5	LOS F	7.6	52.9	0.97	0.78	24.8
West: Canning Hwy W											
10	L2	43	0.0	0.912	60.8	LOS E	74.3	519.8	1.00	0.97	31.0
11	T1	2521	0.0	0.912	55.1	LOS E	74.4	520.7	1.00	0.97	31.5
12	R2	21	0.0	0.170	51.0	LOS D	0.9	6.6	0.97	0.70	32.4
Approach		2585	0.0	0.912	55.2	LOS E	74.4	520.7	1.00	0.96	31.5
All Vehicles		5022	0.0	0.912	54.6	LOS D	74.4	520.7	0.99	0.94	31.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing Canning Hwy / Sleat RD PM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 180 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sleat Rd S											
1	L2	35	0.0	0.053	33.0	LOS C	1.6	11.4	0.60	0.68	38.7
2	T1	8	0.0	0.711	83.8	LOS F	13.5	94.7	1.00	0.83	24.4
3	R2	309	0.0	0.711	89.4	LOS F	14.0	97.8	1.00	0.83	24.2
Approach		353	0.0	0.711	83.7	LOS F	14.0	97.8	0.96	0.82	25.1
East: Canning Hwy E											
4	L2	366	0.0	0.977	75.2	LOS E	76.9	538.3	1.00	1.13	27.2
5	T1	1549	0.0	0.977	68.7	LOS E	76.9	538.3	1.00	1.15	28.1
6	R2	66	0.0	0.131	33.0	LOS C	2.3	16.2	0.79	0.73	38.4
Approach		1982	0.0	0.977	68.7	LOS E	76.9	538.3	0.99	1.13	28.2
North: Sleat Rd N											
7	L2	116	0.0	0.534	87.3	LOS F	9.7	68.0	0.99	0.80	24.4
8	T1	27	0.0	0.713	84.9	LOS F	13.6	94.9	1.00	0.84	24.4
9	R2	128	0.0	0.713	90.5	LOS F	13.6	94.9	1.00	0.84	24.2
Approach		272	0.0	0.713	88.6	LOS F	13.6	94.9	1.00	0.82	24.3
West: Canning Hwy W											
10	L2	33	0.0	0.908	79.4	LOS E	55.2	386.3	1.00	0.99	26.8
11	T1	1736	0.0	0.908	73.7	LOS E	55.3	387.2	1.00	0.99	27.2
12	R2	36	0.0	0.289	56.1	LOS E	2.1	14.7	0.99	0.72	31.0
Approach		1804	0.0	0.908	73.5	LOS E	55.3	387.2	1.00	0.98	27.2
All Vehicles		4411	0.0	0.977	73.1	LOS E	76.9	538.3	0.99	1.03	27.2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Predicted Canning Hwy / Sleat RD PM Peak]

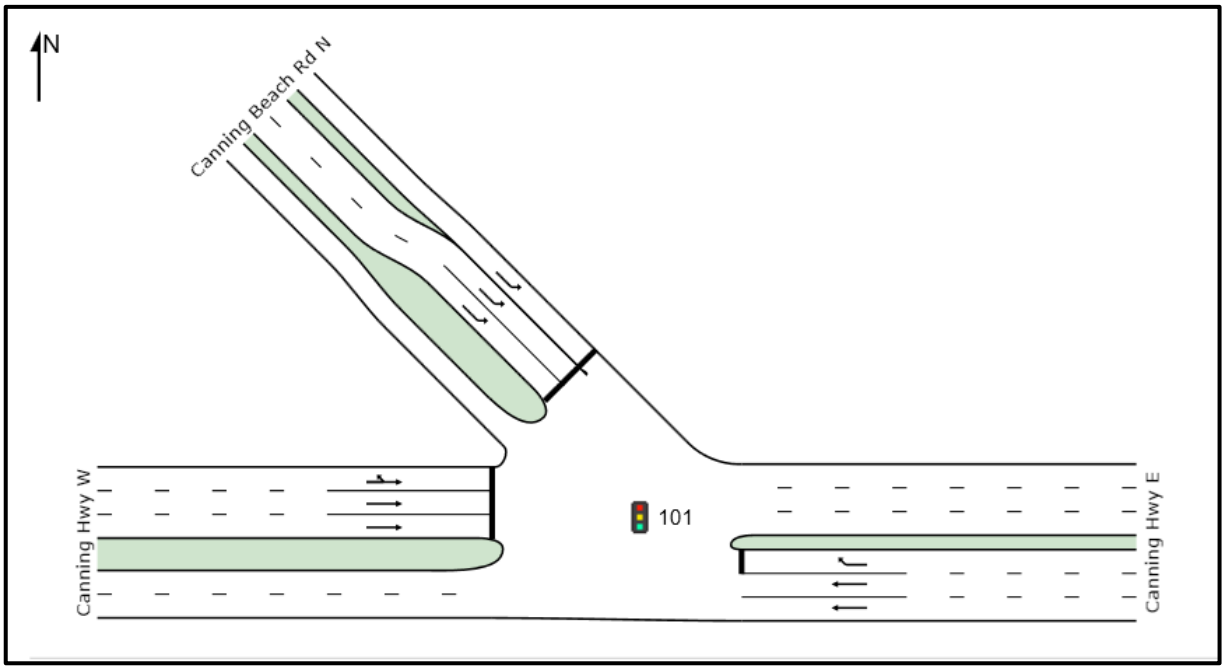
New Site
Signals - Fixed Time Isolated Cycle Time = 180 seconds (Optimum Cycle Time - Minimum Delay)
Variable Sequence Analysis applied. The results are given for the selected output sequence.

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Sleat Rd S											
1	L2	35	0.0	0.053	33.0	LOS C	1.6	11.4	0.60	0.68	38.7
2	T1	8	0.0	0.711	83.8	LOS F	13.5	94.7	1.00	0.83	24.4
3	R2	309	0.0	0.711	89.4	LOS F	14.0	97.8	1.00	0.83	24.2
Approach		353	0.0	0.711	83.7	LOS F	14.0	97.8	0.96	0.82	25.1
East: Canning Hwy E											
4	L2	366	0.0	0.977	74.9	LOS E	77.3	541.3	1.00	1.13	27.3
5	T1	1549	0.0	0.977	68.5	LOS E	77.3	541.3	1.00	1.14	28.1
6	R2	66	0.0	0.134	33.5	LOS C	2.3	16.4	0.79	0.73	38.3
Approach		1982	0.0	0.977	68.5	LOS E	77.3	541.3	0.99	1.13	28.2
North: Sleat Rd N											
7	L2	116	0.0	0.534	87.3	LOS F	9.7	68.0	0.99	0.80	24.4
8	T1	27	0.0	0.732	85.6	LOS F	14.0	98.1	1.00	0.85	24.3
9	R2	133	0.0	0.732	91.2	LOS F	14.0	98.1	1.00	0.85	24.1
Approach		276	0.0	0.732	89.0	LOS F	14.0	98.1	1.00	0.83	24.2
West: Canning Hwy W											
10	L2	40	0.0	0.896	76.1	LOS E	54.1	378.4	1.00	0.97	27.4
11	T1	1736	0.0	0.896	70.4	LOS E	54.2	379.4	1.00	0.97	27.9
12	R2	36	0.0	0.289	55.8	LOS E	2.1	14.6	0.99	0.72	31.1
Approach		1812	0.0	0.896	70.2	LOS E	54.2	379.4	1.00	0.97	27.9
All Vehicles		4422	0.0	0.977	71.7	LOS E	77.3	541.3	0.99	1.02	27.5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Canning Highway / Canning Beach Road intersection



MOVEMENT SUMMARY

Site: 101 [Existing Canning Hwy / Canning Beach Rd AM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Canning Hwy E											
5	T1	1648	0.0	0.423	0.1	LOS A	0.0	0.0	0.00	0.00	59.9
6a	R1	347	0.0	0.779	53.6	LOS D	20.0	140.1	1.00	0.90	31.9
Approach		1996	0.0	0.779	9.4	LOS A	20.0	140.1	0.17	0.16	51.9
NorthWest: Canning Beach Rd N											
27a	L1	542	0.0	0.405	46.6	LOS D	9.0	63.0	0.90	0.79	33.6
Approach		542	0.0	0.405	46.6	LOS D	9.0	63.0	0.90	0.79	33.6
West: Canning Hwy W											
10b	L3	29	0.0	0.802	21.6	LOS C	42.7	298.8	0.78	0.73	47.1
11	T1	3092	0.0	0.802	15.1	LOS B	42.9	300.4	0.78	0.73	48.0
Approach		3121	0.0	0.802	15.2	LOS B	42.9	300.4	0.78	0.73	48.0
All Vehicles		5659	0.0	0.802	16.2	LOS B	42.9	300.4	0.58	0.53	47.3

MOVEMENT SUMMARY

Site: 101 [Predicted Canning Hwy / Canning Beach Rd AM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Canning Hwy E											
5	T1	1648	0.0	0.423	0.1	LOS A	0.0	0.0	0.00	0.00	59.9
6a	R1	356	0.0	0.798	54.8	LOS D	20.8	145.9	1.00	0.91	31.6
Approach		2004	0.0	0.798	9.8	LOS A	20.8	145.9	0.18	0.16	51.6
NorthWest: Canning Beach Rd N											
27a	L1	560	0.0	0.418	46.8	LOS D	9.3	65.4	0.90	0.79	33.5
Approach		560	0.0	0.418	46.8	LOS D	9.3	65.4	0.90	0.79	33.5
West: Canning Hwy W											
10b	L3	29	0.0	0.802	21.6	LOS C	42.7	298.8	0.78	0.73	47.1
11	T1	3092	0.0	0.802	15.1	LOS B	42.9	300.4	0.78	0.73	48.0
Approach		3121	0.0	0.802	15.2	LOS B	42.9	300.4	0.78	0.73	48.0
All Vehicles		5685	0.0	0.802	16.4	LOS B	42.9	300.4	0.58	0.54	47.1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing Canning Hwy / Canning Beach Rd PM Peak]

New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Canning Hwy E											
5	T1	1046	0.0	0.268	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6a	R1	545	0.0	0.713	36.6	LOS D	26.6	186.5	0.90	0.85	37.4
Approach		1592	0.0	0.713	12.6	LOS B	26.6	186.5	0.31	0.29	49.6
NorthWest: Canning Beach Rd N											
27a	L1	382	0.0	0.167	29.0	LOS C	4.7	33.1	0.68	0.72	40.1
Approach		382	0.0	0.167	29.0	LOS C	4.7	33.1	0.68	0.72	40.1
West: Canning Hwy W											
10b	L3	21	0.0	0.711	31.2	LOS C	30.9	216.3	0.84	0.76	41.9
11	T1	2054	0.0	0.711	24.7	LOS C	31.1	217.6	0.84	0.76	42.6
Approach		2075	0.0	0.711	24.8	LOS C	31.1	217.6	0.84	0.76	42.6
All Vehicles		4048	0.0	0.713	20.4	LOS C	31.1	217.6	0.62	0.57	44.8

MOVEMENT SUMMARY

Site: 101 [Predicted Canning Hwy / Canning Beach Rd PM Peak]

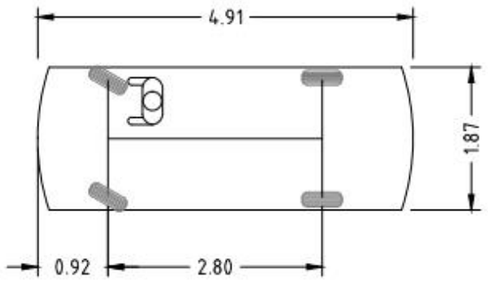
New Site
Signals - Fixed Time Isolated Cycle Time = 120 seconds (Optimum Cycle Time - Minimum Delay)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Canning Hwy E											
5	T1	1046	0.0	0.268	0.0	LOS A	0.0	0.0	0.00	0.00	59.9
6a	R1	564	0.0	0.723	36.1	LOS D	27.6	192.9	0.90	0.85	37.6
Approach		1611	0.0	0.723	12.7	LOS B	27.6	192.9	0.32	0.30	49.5
NorthWest: Canning Beach Rd N											
27a	L1	394	0.0	0.168	28.4	LOS C	4.8	33.6	0.67	0.72	40.3
Approach		394	0.0	0.168	28.4	LOS C	4.8	33.6	0.67	0.72	40.3
West: Canning Hwy W											
10b	L3	21	0.0	0.723	32.1	LOS C	31.4	220.1	0.85	0.78	41.5
11	T1	2054	0.0	0.723	25.6	LOS C	31.6	221.4	0.85	0.77	42.2
Approach		2075	0.0	0.723	25.7	LOS C	31.6	221.4	0.85	0.77	42.2
All Vehicles		4079	0.0	0.723	20.8	LOS C	31.6	221.4	0.62	0.58	44.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix C - Swept Path Diagrams



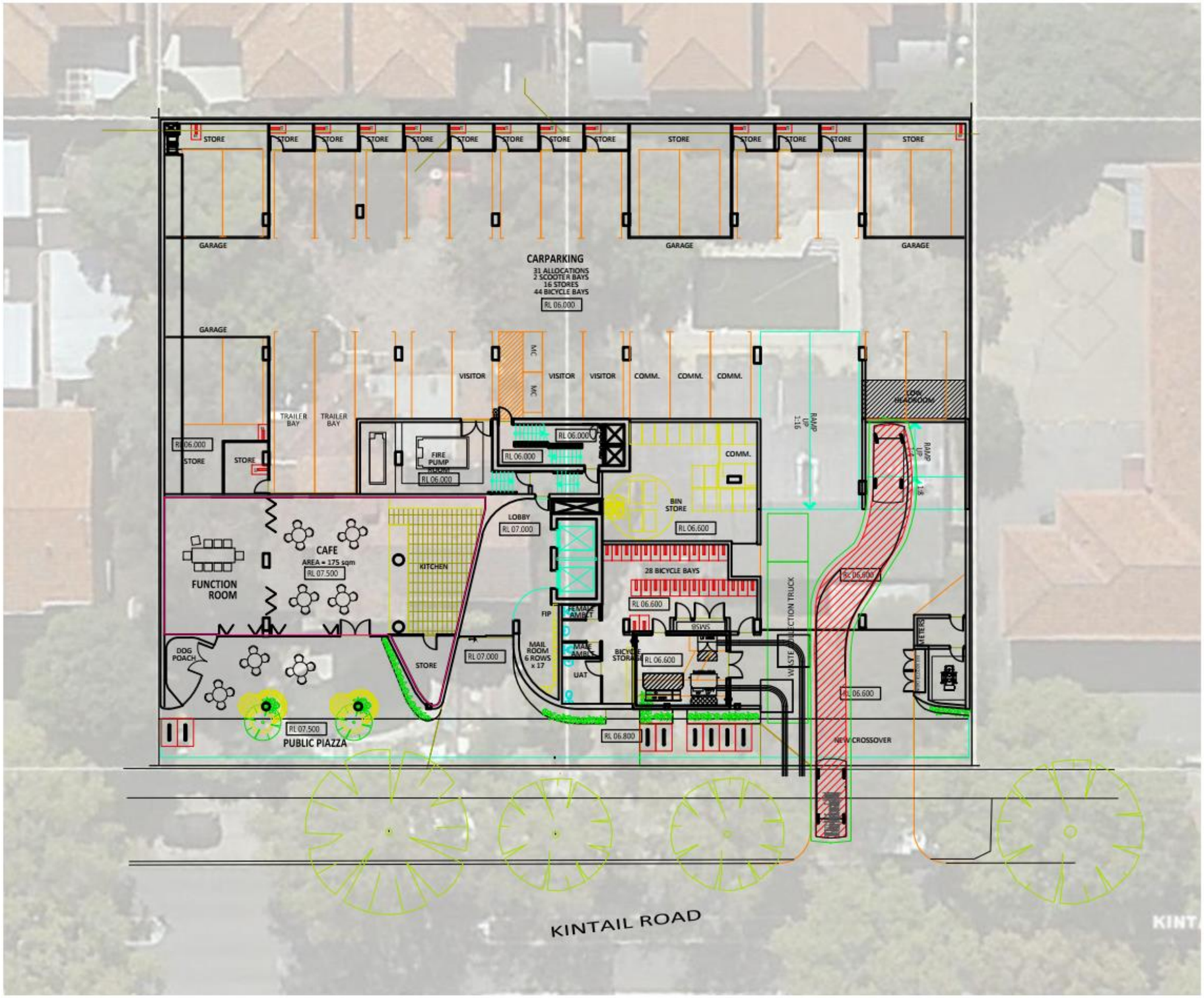
B85 VEHICLE (REALISTIC MIN RADIUS)

OVERALL LENGTH	4.91m
OVERALL WIDTH	1.87m
OVERALL BODY HEIGHT	1.42m
MIN BODY GROUND CLEARANCE	0.16m
TRACK WIDTH	1.77m
LOCK-TO-LOCK TIME	4.00sec
KERB-TO-KERB TURNING RADIUS	5.75m

LEGEND:

FORWARD MOVEMENT

REVERSE MOVEMENT



No.	DATE	DESCRIPTION	APPR.
A	-	ISSUED FOR CLIENT REVIEW	-

ISSUE AND REVISION HISTORY

CLIENT: HILLAM ARCHITECTS

SCALE: HORIZ: 1:250 VERT:

SHAWMAC

ISSUED FOR INFORMATION

RTM: -

DATE DRAWN: 13.09.2017
DESIGNED: N/A
DRAWN: KL
CHECKED: LD
APPROVED: LD

TITLE: 20-22 KINTAIL ROAD
VEHICLE TURNING SWEPT PATH
GROUND FLOOR
B85 ACCESS TO MEZZ CARPARK

DRAWING NUMBER: 1708006-SK-001

REV. A

File Ref: Y:\Jobs Active 2017\T&T - Traffic and Parking\Norup+Wilson_Kintail Road_TIA_1708006\Drawings\Sketches\1708006-SK-001-003 new.dwg

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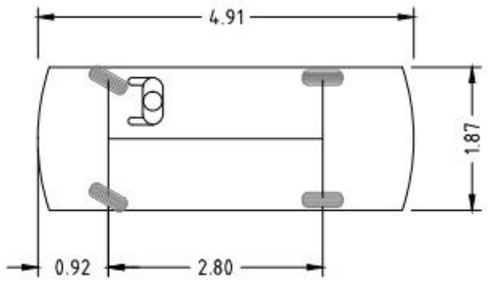


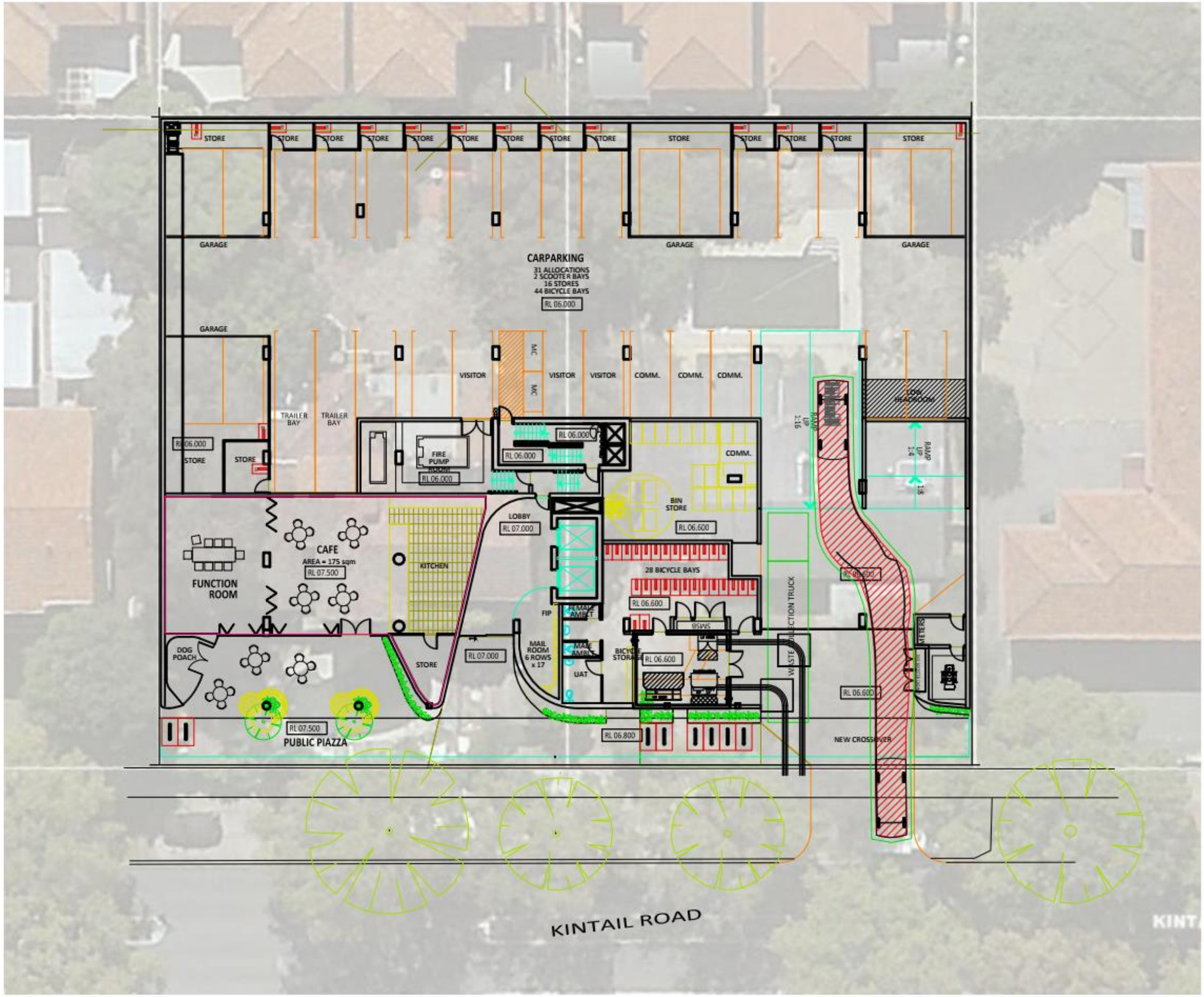
B85 VEHICLE (REALISTIC MIN RADIUS)

OVERALL LENGTH	4.91m
OVERALL WIDTH	1.87m
OVERALL BODY HEIGHT	1.42m
MIN BODY GROUND CLEARANCE	0.16m
TRACK WIDTH	1.77m
LOCK-TO-LOCK TIME	4.00sec
KERB-TO-KERB TURNING RADIUS	5.75m

LEGEND:

FORWARD MOVEMENT

REVERSE MOVEMENT



No.	DATE	DESCRIPTION	APPR.
A	-	ISSUED FOR CLIENT REVIEW	-

ISSUE AND REVISION HISTORY

CLIENT: HILLAM ARCHITECTS

SCALE: HORIZ: 1:250 VERT:

SHAWMAC

ISSUED FOR INFORMATION

RTM: -

DATE DRAWN: 13.09.2017
DESIGNED: N/A
DRAWN: KL
CHECKED: LD
APPROVED: LD

TITLE: 20-22 KINTAIL ROAD
VEHICLE TURNING SWEPT PATH
GROUND FLOOR
B85 EGRESS FROM GROUND FLOOR CARPARK

DRAWING NUMBER: 1708006-SK-002

REV. A

File Ref: Y:\Jobs Active 2017\T&T - Traffic and Parking\Norup+Wilson_Kintail Road_TIA_1708006\Drawings\Sketches\1708006-SK-001-003 new.dwg

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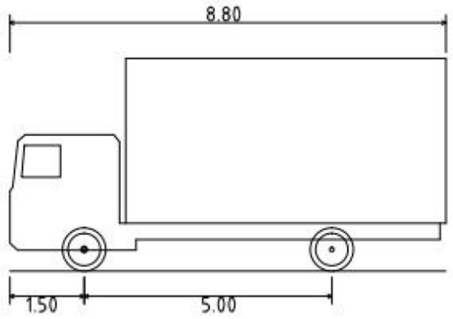


SERVICE VEHICLE (8.8 m)

OVERALL LENGTH	8.800m
OVERALL WIDTH	2.500m
OVERALL BODY HEIGHT	4.300m
MIN BODY GROUND CLEARANCE	0.427m
TRACK WIDTH	2.500m
LOCK TO LOCK TIME	4.00sec
CURB TO CURB TURNING RADIUS	12.500m

LEGEND:

FORWARD MOVEMENT

REVERSE MOVEMENT

				CLIENT: HILLAM ARCHITECTS		DATE DRAWN: 13.09.2017	TITLE: 20-22 KINTAIL ROAD VEHICLE TURNING SWEPT PATH GROUND FLOOR 8.8m WASTE COLLECTION VEHICLE ACCESS MOVEMENT
						DESIGNED: N/A	
						DRAWN: KL	
						CHECKED: LD	
A	-	ISSUED FOR CLIENT REVIEW	-		ISSUED FOR INFORMATION	APPROVED: LD	
No.	DATE	DESCRIPTION	APPR.	SCALE: HORIZ: 1:250 VERT:	RTM: -		DRAWING NUMBER: 1708006-SK-003 REV. A
		ISSUE AND REVISION HISTORY					

HILLAM
ARCHITECTS

APPENDIX F
WASTE MANAGEMENT

talis
delivering solutions

Assets | Engineering | Environment | Noise | Spatial | Waste

Waste Management Plan

20-22 Kintail Road, Applecross

Prepared for Norup & Wilson Projects Pty Ltd

July 2017

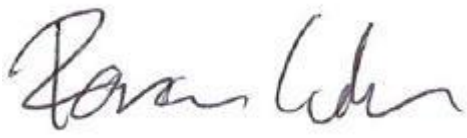
Project Number: TW17040

DOCUMENT CONTROL

Version	Description	Date	Author	Reviewer
0a	Internal Review	28/08/17	CF	RPC
1a	Draft Released to Client	28/08/17	CF	Client
1b	Released to Client	29/08/17	CF	Client

Approval for Release

Name	Position	File Reference
Ronan Cullen	Director	TW17040 - Waste Management Plan.1b
Signature		



Executive Summary

Norup and Wilson Project Pty Ltd (N&W) are currently involved in a mixed use development at 20-22 Kintail Road, Applecross (the Proposal). To satisfy the conditions of the Development Application for the project, the City of Melville (the City) requires N&W to prepare a Waste Management Plan (WMP).

The anticipated quantities of refuse and recyclables for residential apartments was based on the City's guidelines for multiple unit developments (MUD) and the commercial tenancies were generated using the Western Australian Local Government Association's (WALGA) *Commercial and Industrial Waste Management Plan Guidelines* (2014) and the City of Melbourne's *Guidelines for Preparing a Waste Management Plan* (2014).

Proposed Waste Collection Summary

Waste Type	Generation (L/week)	Bin Size (L)	Number of Bins	Collection Frequency	Collection
Residential Apartments					
Refuse	7,760	660	12	1 x per week	The City
Recycling	3,880	660	6	1 x per week	The City
Commercial Tenancies					
Refuse	5,452	660	3	3 x per week	The City
Recycling	1,074	660	2	1 x per week	The City

The City will service the Bin Storage Areas at the Proposal. The City's waste collection vehicle will reverse into the Proposal off Kintail Road into the waste collection truck area adjacent to the Bin Storage Areas and City waste collection staff will ferry receptacles to and from the Bin Storage Areas. Once collection is complete the waste collection vehicle will exit the Proposal in forward gear.

The ability of the City's waste collection vehicle to access the Proposal will be determined by the appointed traffic engineer within the traffic management plan.

A suitably qualified Property Manager will be engaged to oversee all relevant aspects of waste management at the Proposal.

Table of Contents

Tables

Figures

1 Introduction

Norup and Wilson Project Pty Ltd (N&W) are currently involved in a mixed use development at 20-22 Kintail Road, Applecross (the Proposal). To satisfy the conditions of the Development Application for the project, the City of Melville (the City) requires N&W to prepare a Waste Management Plan (WMP). The Proposal is bordered by the Kintail Road to the south and residential properties to the north, east and west as shown in Figure 1.

As part of this process, the City requires the development of a WMP that identifies how waste is to be stored and collected from the Proposal. N&W has therefore engaged Talis Consultants Pty Ltd (Talis) to prepare this WMP to satisfy the City's requirements.

1.1 Objectives and Scope

The objective of this WMP is to outline the equipment and procedures that will be adopted to manage all waste (both refuse and recycling waste) at the Proposal. Specifically, the WMP demonstrates that the Proposal should be designed to:

- Adequately cater for the anticipated quantities of waste and recyclables to be generated;
- Provide suitable Bin Storage Area(s) including appropriate receptacles; and
- Allow for efficient collection of receptacles by appropriate waste collection vehicles.

To achieve the objective, the scope of the WMP comprises:

- Section 2: Waste Generation;
- Section 3: Waste Storage;
- Section 4: Waste Collection;
- Section 5: Property Management Activities; and
- Section 6: Conclusion.

2 Waste Generation

2.1 Proposed Tenancies

The anticipated quantities of refuse and recyclables were estimated based on the number of apartments and floor space of the commercial tenancies'. The Proposal consists of the following tenancies:

- Residential Tenancies consisting of:
  - Multiple Dwelling Apartments – 97.
- Commercial Tenancies consisting of:
  - Café – 118m² (internal seating area).

2.2 Waste Generation Rates

The anticipated quantities of refuse and recyclables for residential apartments was based on the City's guidelines for multiple unit developments (MUD) and the commercial tenancies were generated using the Western Australian Local Government Association's (WALGA) *Commercial and Industrial Waste Management Plan Guidelines* (2014) and the City of Melbourne's *Guidelines for Preparing a Waste Management Plan* (2014).

Consideration was also given to the City of Perth's *Waste Guidelines for New Developments* (2017), City of South Perth Draft *Waste Guidelines for New Developments* (2015), City of Sydney's *Policy for Waste Minimisation in New Developments* (2005), and Randwick City Council's Waste Management *Guidelines for Proposed Developments* (2004).

2.3 Waste Generation Volumes

Waste generation is estimated by volume in litres (L) as this is generally the influencing factor when considering receptacle size, numbers and storage space required. The waste generation volumes in litres per week (L/week) of refuse and recyclables adopted for this waste assessment for each of the uses are shown in Table 2-1, Table 2-2, and Table 2-3.

Table 2-1: Estimated Waste Generation for the Proposals Residential Apartments

Apartment Tenancies	Number of Apartments	Waste Generation Rate (L/week)	Waste Generation (L/week)
Refuse			
Multiple Dwelling Apartments	97	80	7,760
		Total	**7,760**
Recycling			
Multiple Dwelling Apartments	97	40	3,880
		Total	**3,880**

As shown in Table 2-1, it is anticipated that the apartment tenancies at the Proposal will generate a total of 7,760L of refuse and 3,880L of recyclables per week.

Table 2-2: Estimated Waste Generation for the Commercial Tenancies

Commercial Tenancies	Area (m²)	Waste Generation Rate (L/100m²/day)	Waste Generation (L/Week)
Refuse			
Café	118	660	5,452
		Total	**5,452**
Recycling			
Café	118	130	1,074
		Total	**1,074**

As shown in Table 2-2 it is anticipated that the café tenancy at the Proposal will generate a total of 5,4520L of refuse and 1,074L of recyclables per week. These waste generation quantities are based on seven days of operation per week for the café.

Table 2-3: Summary of Estimated Waste Generation for each Development use

Tenancy	Waste Generation (L/Week)
Refuse	
Apartment Tenancies	7,760
Commercial Tenancies	5,452
Total	**13,212**
Recycling	
Apartment Tenancies	3,880
Commercial Tenancies	1,074
Total	**4,954**

As shown in Table 2-3, it is anticipated that the Proposal will generate a combined total of 13,212L of refuse and 4,954L of recyclables per week.

3 Waste Storage

To ensure that waste is managed appropriately at the Proposal, it is important to allow for sufficient space to house the required receptacles within the designated Bin Storage Areas. The procedure and receptacles to be used in these areas are described in the proceeding sections.

3.1 Apartment Internal Receptacles

To promote positive recycling behaviour and maximise diversion from landfill, the Proposal should have a minimum of two receptacles for the disposal of refuse and recycling separately within each apartment. Refuse and recyclable materials from the apartments will be placed in these receptacles, where refuse and recycling materials will be transferred by the resident and/or their authorised representative to the waste chute system.

3.2 Commercial Internal Receptacles

The Proposal will have a minimum of two receptacles for the disposal of refuse and recycling within each commercial unit. In the future the Proposal may provide additional receptacles for waste streams such as organics, glass/paper and cardboard for source separation of waste. Refuse and recyclable materials generated within the Proposal by commercial tenancies will be taken by tenants or their authorised representatives and placed in the appropriate receptacles in the Commercial Bin Storage Area.

3.3 Bin Storage Areas

The following section details the capacity and design requirements of the Bin Storage Areas.

3.3.1 Receptacle Sizes

The information in Table 3-1 below presents the dimensions of receptacle sizes ranging from 240L to 1,100L. It should be noted that these receptacle dimensions are approximate and can vary slightly between suppliers.

Table 3-1: Typical Receptacle Dimensions

Receptacle Size (L)	Depth (m)	Width (m)	Area (m²)
240	0.715	0.580	0.415
660	0.765	1.360	1.040
1,100	1.070	1.360	1.455

Reference: SUEZ Rear Lift Bin Specification Data Sheet

3.3.2 Residential Bin Storage Area Size

To ensure sufficient area is available for storage of the waste receptacles, the quantity of receptacles required for the Bin Storage Area was modelled utilising a range of receptacle sizes from 240L to 1,100L as shown in Table 3-2. This was based on weekly collections of refuse and recyclables from the residential apartments.

Table 3-2: Receptacle Requirements for the Residential Bin Storage Area

Waste Stream	Waste Generation (L/week)	Number of Receptacles Required		
		240L	660L	1,100L
Refuse	7,760	33	12	8
Recycling	3,880	17	6	4

Based on receptacle dimensions specified in Table 3-1, the Residential Bin Storage Area has been sized to accommodate the following receptacles:

- 12 x 660L refuse receptacles; and
- 6 x 660L recycling receptacles.

The configuration of these receptacles within the Bin Storage Areas is shown in Figure 2.

3.3.3 Commercial Bin Storage Area Size

To ensure sufficient area is available for storage of the waste receptacles, the quantity of receptacles required for the Bin Storage Area was modelled utilising a range of receptacle sizes from 240L to 1,100L as shown in Table 3-2. This was based on three collections per week of refuse and one collection per week of recyclables from the commercial tenancies.

Table 3-3: Receptacle Requirements for the Commercial Bin Storage Area

Waste Stream	Waste Generation (L/week)	Number of Receptacles Required		
		240L	660L	1,100L
Refuse	5,452	8	3	2
Recycling	1,074	5	2	1

Based on receptacle dimensions specified in Table 3-1, the Commercial Bin Storage Area has been sized to accommodate the following receptacles:

- 3 x 660L refuse receptacles; and
- 2 x 660L recycling receptacles.

The configuration of these receptacles within the Bin Storage Areas is shown in Figure 2.

3.3.4 Design

The Bin Storage Areas will be located at ground level of the Proposal. The design of the Bin Storage Areas should consider the following:

- A physical barrier to separate the residential and commercial Bin Storage Areas;
- Impervious floors draining to the sewer;
- A tap for washing of Bins and Bin Storage Area as required;
- Adequate aisle width for easy manoeuvring of receptacles;
- No double stacking of receptacles;
- Doors to the Bin Storage Areas must be self-closing and are proposed to be vermin proof;
- Doors to the Bin Storage Areas must be wide enough to fit bins through;
- Ventilated to a suitable standard;
- Appropriate signage;
- Bin Storage areas should be undercover where possible and be designed to not permit stormwater to enter into the drain;
- The Bin Storage Area shall be located behind the building setback line;
- Receptacles are not visible from the property boundary or areas trafficable by the public; and
- Receptacles are reasonably secured from theft and vandalism.

It is worth noting that the number of receptacles and corresponding placement of receptacles as shown in Figure 2 represent the maximum requirements based on the assigned collection frequency. An increased collection frequency would therefore lower the number of receptacles required for the Proposal.

Receptacle and storage space within the Bin Storage Areas will be monitored during the operation of the Proposal to ensure that the receptacles are sufficient.

3.4 Waste Chute System

In order to ensure the efficient disposal of waste to the Bin Storage Areas, a Waste Chute System will be utilised at the Proposal. The Proposal will utilise a Dual (refuse and recycling) Chute System, which uses separate waste chutes for refuse and recycling waste.

The waste chute will be located in close proximity to the elevators and be accessible on each level. Chutes are typically 610mm in diameter. To reduce odour the chute system is ventilated with an extraction fan at the top of the chute and will be routinely cleaned via chute flushing operations. Chutes are required to be noise insulated.

The onsite caretaker will be required to exchange full receptacles with empty receptacles at the terminus of the waste chute system.

3.4.1 Carousel or Linear Systems

The Proposal is aiming to utilise carousels or linear track systems at the terminus of waste chute systems to reduce the amount of work required by the onsite caretaker to manoeuvre waste receptacles within the Bin Storage Areas. The carousel and linear track systems can be designed to automate the rotation of receptacles through the use of sensors under the waste chute which is activated when the receptacle is full. The carousel or linear systems will then move the full receptacle and place an empty receptacle under the waste chute. Carousel and linear systems can accommodate between two to five receptacles depending on the system used.

4 Waste Collection

The City will service the Proposal by providing 660L receptacles for refuse and recyclables for residential and commercial tenancies, which are to be collected by the City's rear lift waste collection vehicle. The City's waste collection vehicle will collect waste adjacent to the Bin Storage Areas once per week for residential refuse, residential recycling and commercial recycling, and three times per week for commercial refuse.

The City's waste collection vehicle will reverse into the Proposal off Kintail Road into the waste collection truck loading area adjacent to the Bin Storage Areas, from where the City's waste collection staff will ferry receptacles to and from the Bin Storage Areas. Once collection is complete the waste collection vehicle will exit the Proposal in forward gear.

The ability of the City's waste collection vehicle to access the Proposal will be determined by the appointed traffic engineer within the traffic management plan.

4.1 Bulk Verge Collection

The City offers its residents one junk/whitegoods and multiple greenwaste verge collections throughout the year. Any bulk waste material to be collected through this service will require placement along the property verge in line with the City's requirements. Further information regarding bulk verge collections and other waste disposal options can be obtained from the City's website.

5 Property Management Activities

A Strata Manager or assigned resident will be engaged to complete the following tasks:

- Monitoring of receptacles, waste chute system and Bin Storage Areas;
- Maintenance of receptacles, waste chute system and Bin Storage Areas;
- Clean receptacles, waste chute system and Bin Storage Areas when required;
- Ensure that bulk waste will be deposited on the verge in accordance with the City's requirements;
- Monitoring bulk verge collection areas during collection periods; and
- The occupants of the development will be made aware of the WMP and their responsibilities under the Plan.

6 Conclusion

As demonstrated within this WMP, the Proposal provides sufficiently sized Bin Storage Areas for refuse, and recyclables based on a suitable configuration of receptacles. This indicates that satisfactorily designed Bin Storage Areas have been provided and collection of refuse and recycling receptacles can be completed from the Proposal.

The above is achieved using the following receptacles for refuse and recyclable collections:

- **Residential Bin Storage Area** – Twelve (12) 660L refuse receptacles and six (6) 660L recyclable receptacles collected once per week from residential apartments; and
- **Commercial Bin Storage Area** – Three (3) 660L refuse receptacle collected three times per week and two (2) 660L recycling receptacle collected once per week from the commercial tenancy.

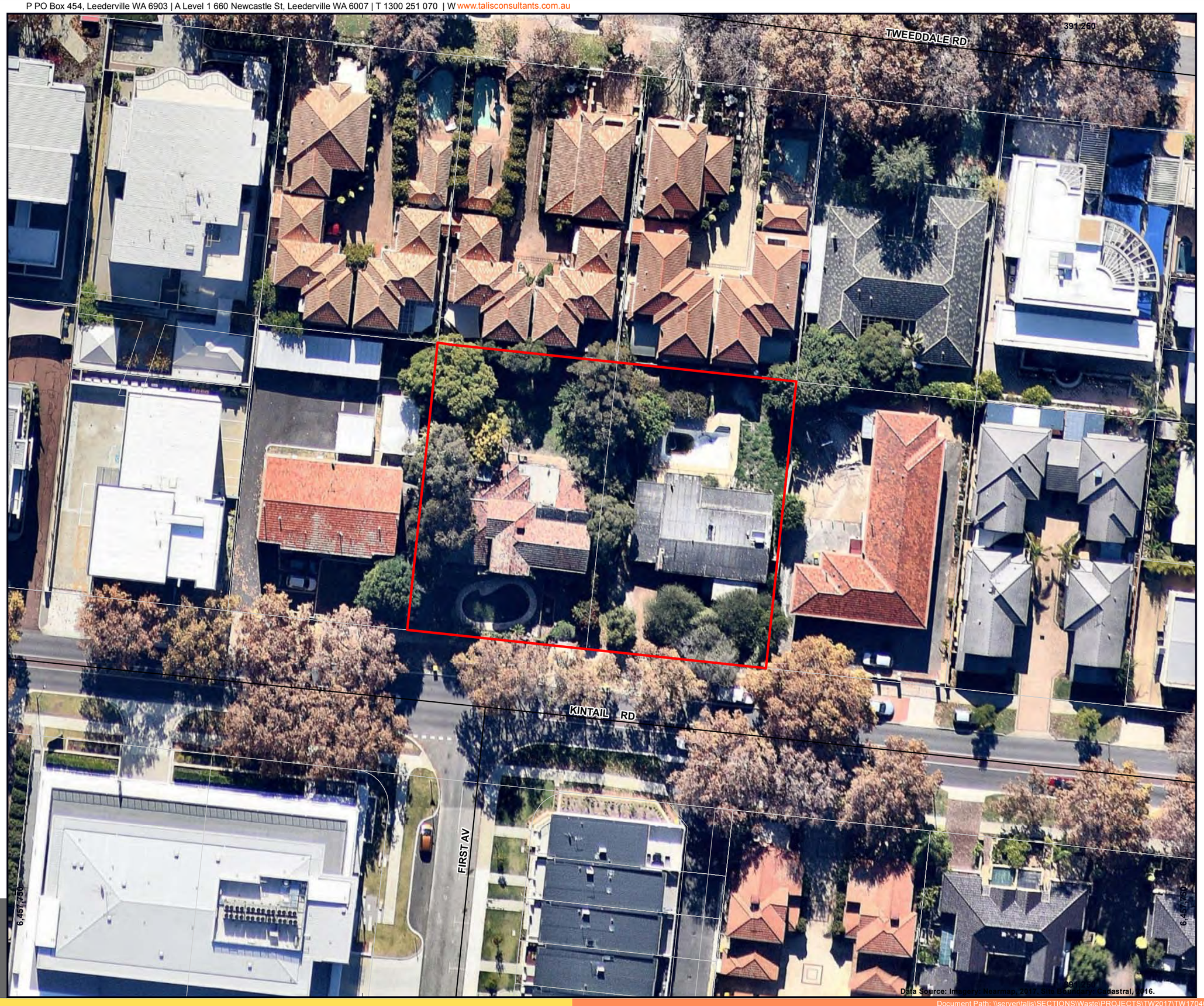
The City will service the Bin Storage Areas at the Proposal. The City's waste collection vehicle will reverse into the Proposal off Kintail Road into the waste collection truck area adjacent to the Bin Storage Areas and City waste collection staff will ferry receptacles to and from the Bin Storage Areas. Once collection is complete the waste collection vehicle will exit the Proposal in forward gear.

The ability of the City's waste collection vehicle to access the Proposal will be determined by the appointed traffic engineer within the traffic management plan.

A suitably qualified Property Manager will be engaged to oversee all relevant aspects of waste management at the Proposal.

Figures

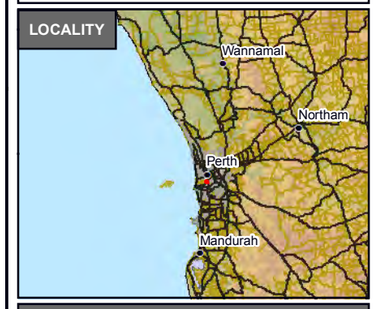
P PO Box 454, Leederville WA 6903 | A Level 1 660 Newcastle St, Leederville WA 6007 | T 1300 251 070 | W www.talisconsultants.com.au



LEGEND

- Site Boundary
- Cadastre
- Road network

LOCALITY



SITE LOCALITY

20-22 Kintail Road
Applecross, WA

N
0 2.5 5 10 15 20 metres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994
Scale @ A3:1:500

Prepared:	R. Cullen	Date:	29/08/2017
Checked:	N. King	Project No:	TW17040
Reviewed:	E.Porter	Revision:	A

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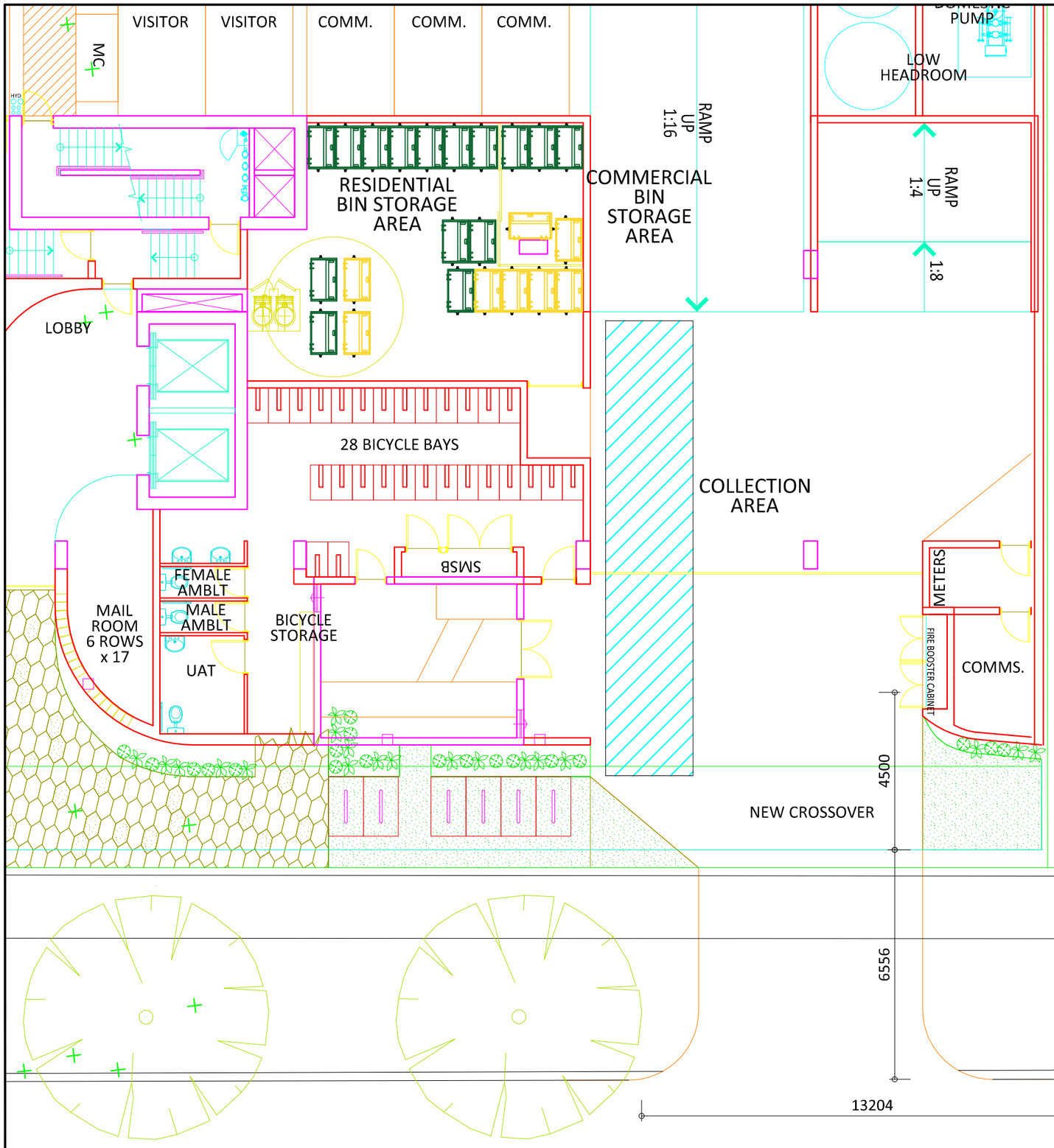
Figure 01

Document Path: \\server\talis\SECTIONS\Waste\PROJECTS\TW2017\TW17040 - Kintail Road WMP\GIS\Maps\TW17040_01_Locality_RevA.mxd



LEGEND:

Residential Bin Storage Area

4 x 660L refuse receptacles (0.765m x 1.360m)

4 x 660L recycling receptacles (0.765m x 1.360m)

Carousel System

Commercial Bin Storage Area

4 x 660L refuse receptacles (0.765m x 1.360m)

4 x 660L recycling receptacles (0.765m x 1.360m)

Waste Collection Area

Note: A physical barrier separates the residential and commercial Bin Storage Areas.

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PO Box 454, Leederville WA 6903

Client: Norup & Wilson Projcts Pty Ltd

NOTES

1. This drawing is the property of Talis Consultants Pty Ltd, It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels refer to Australian Height Datum.
3. DO NOT SCALE, use figured dimensions only, if in doubt please contact Talis Consultants.

No.	Date	Drwn / Chk	Amendment / Issue	App.
A	29/08/17	CF / RC	FIRST ISSUE	RC

Project: 20-22 Kintail Road, Applecross

Title: Bin Store Area and Collection Area

Drawn by:	CF	Job No:	TW17040
Checked by:	RC	File No:	TW17040DG001
Approved by:	RC	Fig. No: 002	Rev: A
Scale: NTS			
Date: 29/08/2017			

HILLAM ARCHITECTS

APPENDIX G
ACOUSTIC STATEMENT

20-22 Kintail Road,

Acoustic Design Report

For: Norup + Wilson

Job No:	1015656
Doc Ref:	1015656-RPT-AS01
Latest Revision:	-
Date:	27/09/2017

CUNDALL

Project Name:	20-22 Kintail Road
Client:	Norup + Wilson
Report Title:	Acoustic Design Report
Job Number:	1015656

Document Revision History

Revision Ref	Issue Date	Purpose of issue / description of revision
-	22/09/2017	First Issue
A	27/09/2017	Revised as per architect's comments

Document Validation (latest issue)

Author	Patrick Carpenter	
Checked by	Mark Evans	
Validated by	Patrick Carpenter	

Executive Summary

This report provides acoustic design advice relating to the town planning applications for the mixed use development to be located at 20-22 Kintail Road, Applecross.

Cundall has completed attended noise surveys of the existing ambient noise environment in the vicinity of the site.

Recommendations for façade glazing to control external noise intrusion have been developed based upon measurements of traffic noise in the vicinity of the development. Noise to the development is predicted to be adequately controlled using standard single or double glazed systems.

Details and recommendations to achieve compliance with Part F(5) of the Building Code of Australia have been provided.

CUNDALL

Contents

1. Introduction

Norup Wilson Projects Pty Ltd are project managing the 20-22 Kintail Road Development on behalf of the developing entity '22 Kintail Road Pty Ltd.'.

Cundall has been engaged to provide acoustic design advice for the project.

1.1 Site description

The proposed development site is located at 20-22 Kintail Road, Applecross. Figure 1 shows the location of the site and its immediate surroundings.

Figure 1: Proposed site and surrounds

The site is in an area made up predominantly of commercial and mixed-use buildings, and is bounded to the west, north and the east by two storey residential dwellings, and to the south by Kintail Road with a mix of residential and commercial properties beyond.

1.2 Proposed development

The development is to be constructed upon the site of two existing residential properties. It is proposed to be 15-storeys tall and will include the following:

- a residential tower containing 97 apartments
- four floors of car parking (ground, mezzanine, L1 and L2)
- café, function space and amenities on ground floor
- pool and associated deck on L15
- roof plant deck (pool plant, exhaust fans, base building AC condensers and boilers).

We understand that AC for the development is to be provided by condenser units located adjacent to the lift core on each floor.

A typical apartment level is illustrated in Figure 2.

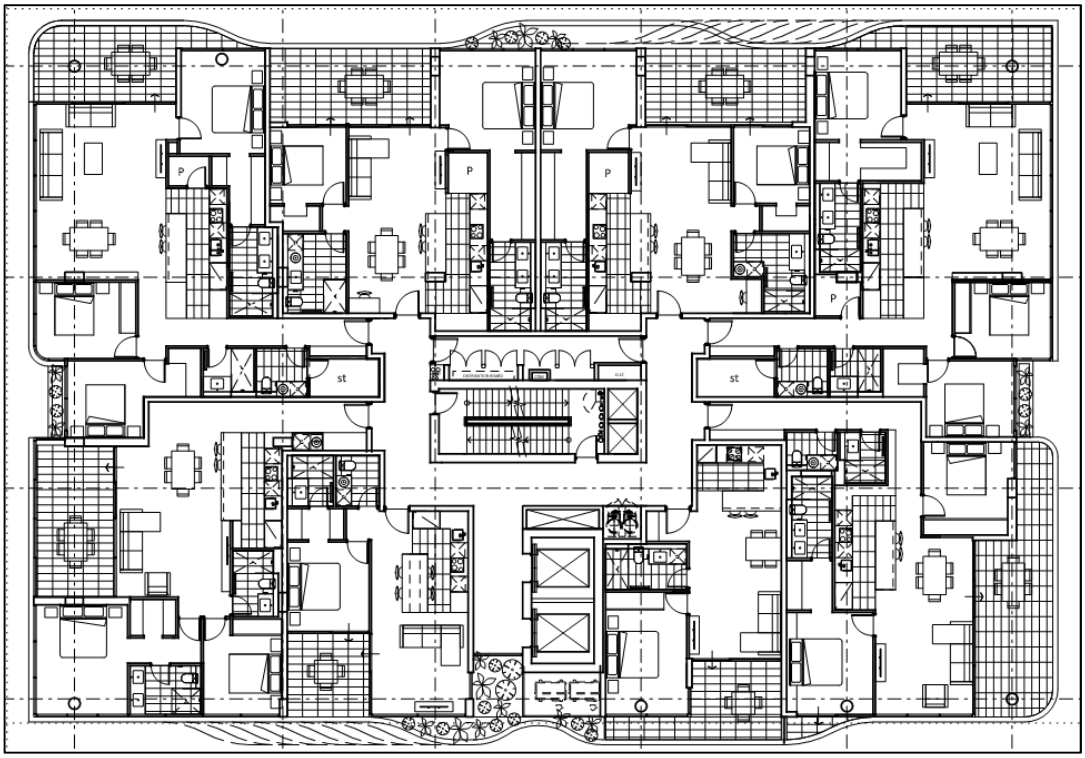

Figure 2: Proposed typical apartment floor layout.

2. Existing noise environment

2.1 Attended acoustics surveys

Measurements of traffic noise in the vicinity of the site were conducted between 1630-1640 hrs on 21 September 2017 at the Kintail Road interface of the site.

The measured traffic noise level at this time was 64 dB L_{Aeq} and is considered representative of the typical peak hour noise level at the site.

An inspection of the surrounding area identified major mechanical plant on adjacent buildings, though if this plant was operating during our survey, it was not audible at the boundary of the proposed site.

A door alarm associated with 19 Kintail Road was clearly heard twice at the survey location during our site inspection. This appears to operate whenever the car park door opens, and sounds for approximately 40 seconds.

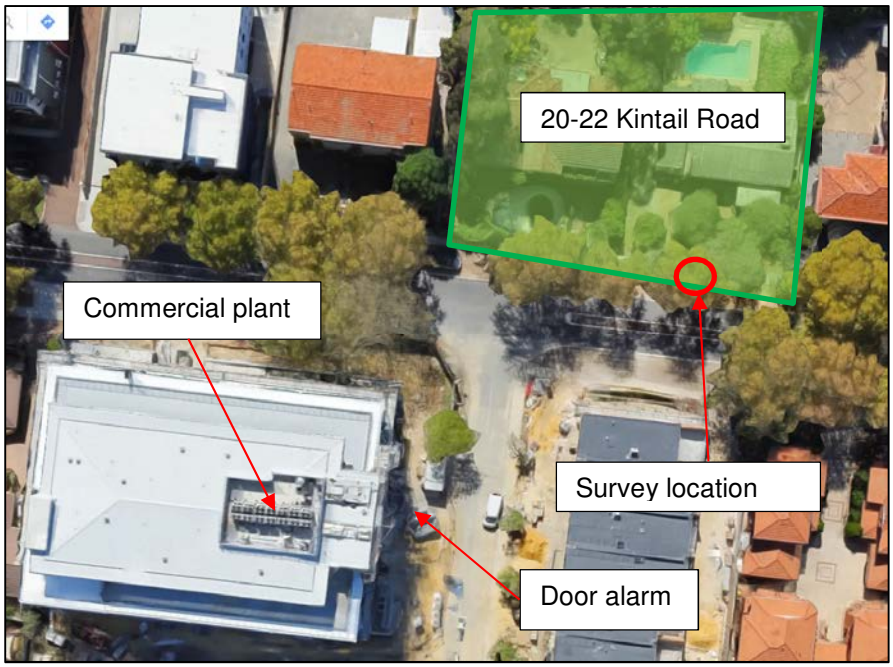

Figure 3: Plant on the roof of 19 Kintail Road (PDC Group)

3. External noise intrusion

3.1 Acoustic criteria

Internal noise levels within residential apartments due to external noise sources such as traffic are to be designed in accordance with Australian Standard *AS2107:2016 Acoustics – Recommended design sound levels and reverberation times for building interiors* internal noise recommendations as detailed in

Space	Design sound level, dB L_{Aeq}
Apartment common areas	45-50
Living areas	30-40
Sleeping areas (night time)	30-35

Table 1.

Space	Design sound level, dB L_{Aeq}
Apartment common areas	45-50
Living areas	30-40
Sleeping areas (night time)	30-35

Table 1 – AS2107 recommended internal noise levels, developments near a minor road

3.2 Noise surveys

Our calculations and predictions are based upon the measured noise levels detailed in Section 2.

3.3 Façade glazing

It is not confirmed at this stage whether windows for the development will be single or double glazed. Based upon the measured noise levels and reviewed drawings, all glazing directly exposed to traffic noise from Kintail Road must be a minimum of:

- 8.38 mm thick laminated glass; or 6.5 mm thick Veridian Vlam Hush
- 10 mm / 12 mm / 4 mm double glazed units.

Table 2 provides a summary of the acoustic performance requirements of the recommended glazing systems.

Glazing type	Octave Band Centre Frequency, Hz						
	63	125	250	500	1000	2000	4000

Single glazing	21	24	27	33	34	36	43
Double Glazing	21	26	23	33	40	44	43

Table 2 – Glazing acoustic performance requirements

For other sections of facade, glazing may be 6 mm float glass or 612/6 double glazed units.

Other glazing systems may be acceptable, but must be reviewed by Cundall prior to approval. These glazing recommendations are subject to approval for thermal comfort by the services engineer for the project. The framing and seals of the glazing must not limit the sound insulation performance of the system overall.

3.4 Wind noise from façade elements

We have not, at this stage, been provided with details of the façade construction for review.

Based upon the current elevations and renders provided by the architect, there does not appear to be any fins or shading elements which may result in significant wind generated noise.

We will revisit this issue as the design progresses and raise any concerns we may have.

4. Internal sound insulation

4.1 Building Code of Australia (BCA) requirements

Condition 11 of the Planning Permit requires that the apartments must be constructed to limit noise transmission in accordance with Part F (5) of the Building Code of Australia. This section of the BCA details that the acoustic criteria in Table 3 apply to partitions and floors within the proposed development.

Partition/Floor	BCA minimum sound insulation criteria (dB)		Comments
	Laboratory	In-situ	
Wall separating habitable rooms	$R_w + C_{tr} \geq 50$	$D_{nT,w} + C_{tr} \geq 45$	Discontinuous construction not required
Wall separating wet areas	$R_w + C_{tr} \geq 50$	$D_{nT,w} + C_{tr} \geq 45$	Discontinuous construction not required
Wall separating a wet area or kitchen and a habitable room	$R_w + C_{tr} \geq 50$	$D_{nT,w} + C_{tr} \geq 45$	Discontinuous construction required
Wall separating a sole-occupancy unit from a stairway, public corridor, public lobby, etc.	$R_w \geq 50$	$D_{nT,w} \geq 45$	Discontinuous construction not required
Wall separating a sole-occupancy unit from a plant room or lift shaft	$R_w \geq 50$	$D_{nT,w} \geq 45$	Discontinuous construction required
Floor separating sole-occupancy units	$R_w + C_{tr} \geq 50$ $L_{n,w} \leq 55$[1]	$D_{nT,w} + C_{tr} \geq 45$ $L_{nT,w} \leq 55$[1]	Floor impact isolation required
Floor separating a sole-occupancy unit from a commercial tenancy, plant room, lift shaft, stairway, public corridor, public lobby or the like	$R_w + C_{tr} \geq 50$ $L_{n,w} \leq 55$[1]	$D_{nT,w} + C_{tr} \geq 45$ $L_{nT,w} \leq 55$[1]	Floor impact isolation required
Door separating a sole-occupancy unit from a public corridor, public lobby, etc.	$R_w \geq 30$	$D_{nT,w} \geq 25$	

Table 3 – BCA minimum sound insulation requirements

Note that where a kitchen is open to a living area, the kitchen is considered a habitable room by the BCA.

[1]In our experience, the minimum BCA requirement of $L_{n,w} + C_l \leq 62$ is insufficient for apartments of even moderate quality. We instead recommend that a rating of $L_{n,w} \leq 55$ be targeted.

4.2 Reviewed drawings

We have reviewed the current architectural drawings set dated 8 September 2017, Rev J, provided by Hillam Architects.

4.3 Internal partitions

Table 4 details our acoustic construction recommendations for internal walls to achieve compliance with the minimum BCA sound insulation criteria.

Wall type	Construction	Predicted acoustic performance (dB)	Discontinuous
Masonry			
Inter-tenancy	• 13 mm thick plasterboard • 22 mm furring channels with 25 mm thick, minimum 11 kg/m³ acoustic insulation • 110 mm brick, concrete or filled concrete block (1,800 kg/m³) • 20 mm clear gap • 64 mm stud with insulation • 13 mm thick plasterboard	R_w+C_{tr} 55	Yes
Inter-tenancy	• 13 mm standard plasterboard • 22 mm furring channels on 15 mm resilient wall mounts with insulation • 140 mm concrete or filled concrete block (1,800 kg/m³) • 22 mm furring channels • 13 mm standard plasterboard	R_w+C_{tr} 50	No
Lightweight			
Inter-tenancy	• 2x 13 mm fire rated plasterboard • 64-70 mm timber or steel studs • 75 mm thick, 11 kg/m³ acoustic insulation • 20 mm clear gap • 75 mm thick, 11 kg/m³ acoustic insulation • 64-70 mm timber or steel studs • 1x 13 mm fire-rated plasterboard	R_w+C_{tr} 50	Yes
Corridor wall	• 2x 13 mm thick fire rated plasterboard • Staggered steel studs in a 90 mm track • 75 mm thick, 11 kg/m³ acoustic insulation • 1x 13 mm thick fire rated plasterboard	R_w 50	

Table 4 – Wall Types - Acoustic treatment recommendations

4.4 Garbage chutes

Garbage chutes, see Figure 4, are located adjacent to the lift core and abut apartments. They must be designed to minimise structure borne noise to apartments.

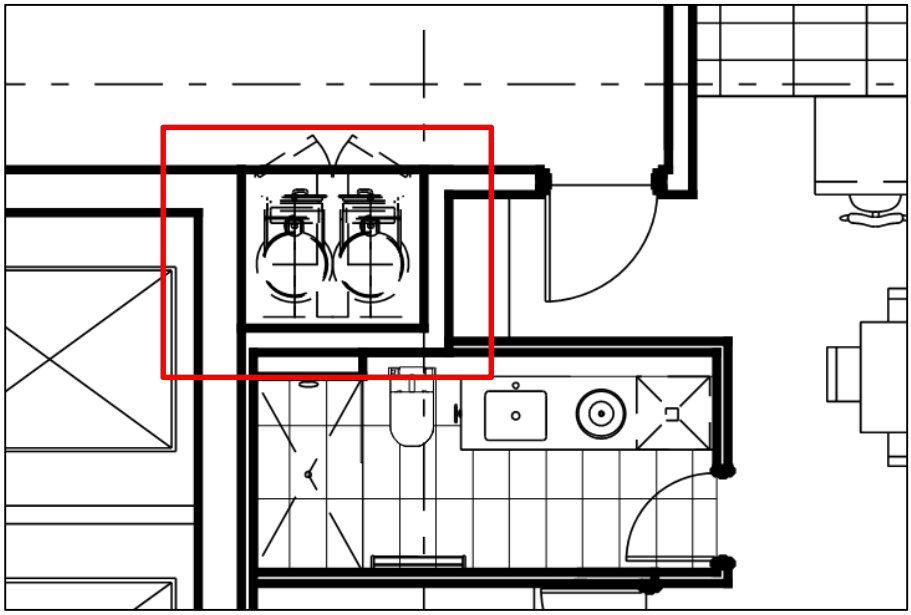

Figure 4: Garbage chute location

Connections between the chute and the building structure must be minimised, and only provided at floor slab level.

Where a metal chute is used, all such connections are required to be structurally isolated and the chute itself may require cladding to dampen noise.

A transition at the bottom of chutes should be avoided to stop impact noise.

We recommend the use of a plastic chute such as Wastech Smoothtube, or similar.

4.5 Floor-ceiling constructions

For floors between apartments, we understand that the client is proposing a skim coat ceiling below a 250 mm thick concrete slab. To achieve the requirements of the BCA, the following construction is recommended:

- Floor finish (carpet, timber or tiles);
- Acoustic underlay below all hard floor finishes;
- 250 mm thick concrete floor slab;
- Skim coat ceiling.

Acceptable acoustic underlay products include 3 mm Damtec Standard or 4.5 mm Regupol 4515.

4.6 Tiled external areas

External apartment areas are tiled, and often located adjacent to or directly above habitable rooms of other apartments, all pavers must be provided with a resilient underlay or proprietary mounting system which provides resilience.

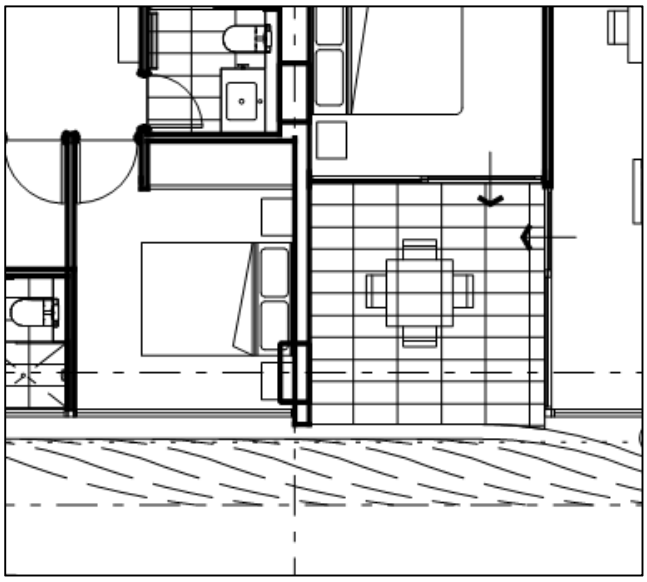

Figure 5: Paved external areas

4.7 Walls between apartments and building cores

As far as is practicable, lifts should be structurally isolated from the building structure. Rails should be supported from the structure only at floor slab level.

Walls separating apartments from the building cores (lifts, stair wells, risers etc.) should be a separate stud construction to minimise footfall, services and lift noise intrusion, as shown in Figure 6.

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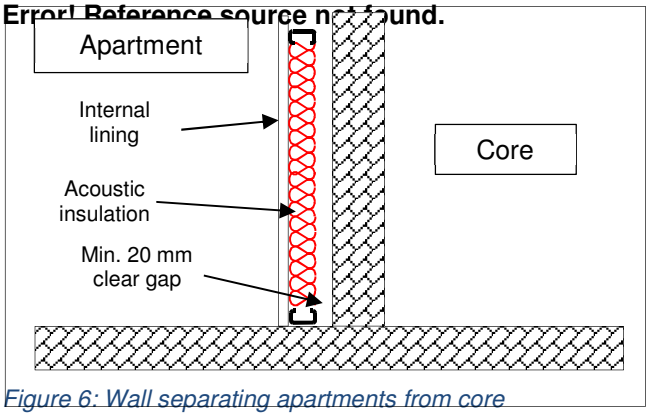


Figure 6: Wall separating apartments from core

4.8 **Level 15 pool**

Figure 7 shows the layout of the pool area for the development.

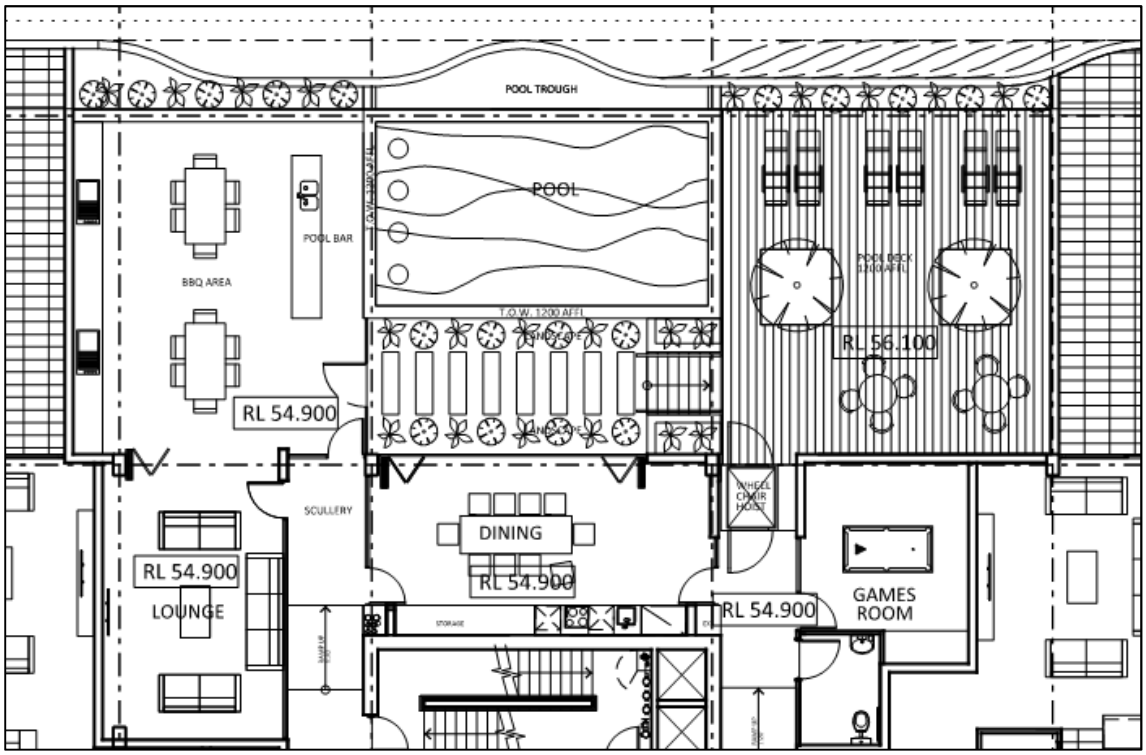


Figure 7: Level 15 pool

As with balconies, any hard floor surface in this area must be provided with a resilient acoustic underlay.

The pool itself must also be isolated from the building structure, by building the pool “tub” itself on an isolated formwork. A schematic example of the recommended isolation is shown in Figure 8.

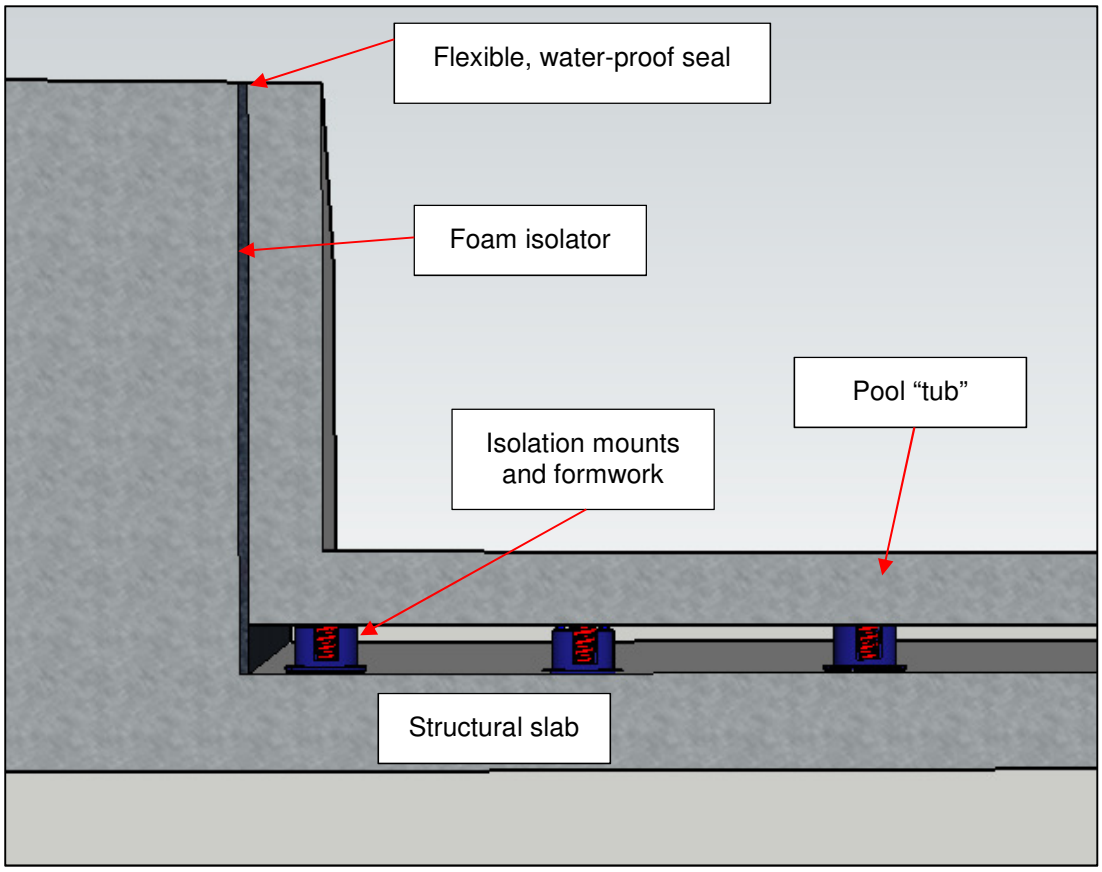


Figure 8: Pool structural isolation

Isolation mounts should be selected to be static under the full load of the filled pool tub. The final selection and specification of mounts should be completed by the supplier.

All pool plant, connections and pipework must be structurally isolated from both the structural slab and the pool tub.

The design of this isolation can be discussed in further detail during the documentation stage of the project.

5. Noise from commercial tenancies

5.1 Noise from sites outside the development

It is not part of our scope of works for the project to assess the environmental noise impact of nearby noise generating sites on the development.

The developer should be informed, however, that noise from commercial premises (such as mechanical plant and door alarms) are subject to the requirements of the Environmental Protection Act 1986 (WA).

5.2 Noise from ground floor tenancies to apartments

To comply with the requirements of the BCA, floor/ceilings between commercial tenancies must be constructed in a manner similar to that detailed in Section 4.5.

The deletion of ceiling between ground floor tenancies and apartments on Level 1 may be acceptable, provided the Level 1 slab is a minimum of 150 mm thick concrete.

5.3 Noise from ground floor tenancies to nearby noise sensitive uses

We understand that the ground floor tenancies are to be operated by other parties and, as such, noise from these tenancies will not be the direct responsibility of the developer. Activity noise from the ground floor tenancies will be subject to the requirements of the Environmental Protection Act 1986 (WA), and a reference to this document should be provided within any future tenancy agreements.

6. Mechanical services

6.1 Mechanical services noise to internal spaces

AS2107 recommends the internal noise levels detailed in Table 5 for developments in suburban areas.

Space	Design sound level, dB L_{Aeq}
Apartment common areas	45-50
Living areas	30-40
Sleeping areas (night time)	30-35
Car park	< 65

Table 5 – AS2107 recommended internal noise levels

All mechanical services equipment must be designed to achieve the internal ambient levels in Table 5.

Acoustic treatment recommendations for typical mechanical plant systems will be developed during the Construction Documentation stage of the project, however the following preliminary recommendations should be considered.

6.1.1 Location of AC condensers

The location of condenser units shown in Figure 9 is considered appropriate for the project, however consideration must be given to noise from the units to the adjacent apartments.

The privacy screen provided to the balcony to the south must be continuous, free of gaps (including at the bottom) and extend to full height, slab to slab.

The units must also be appropriately vibration isolated from the structure.

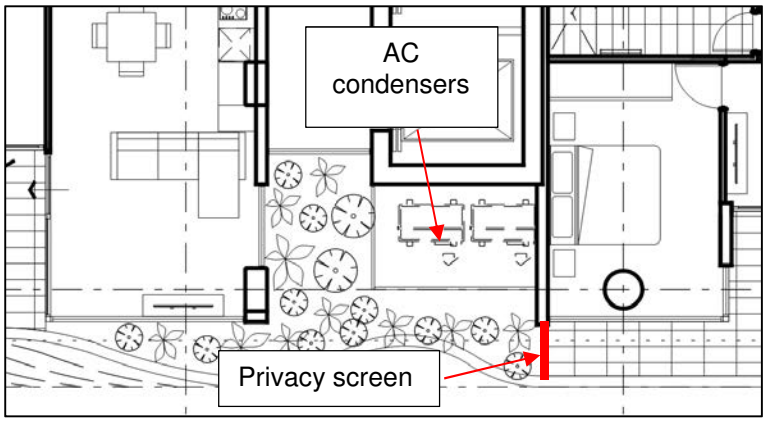


Figure 9: Location of AC condenser units

6.1.2 Noise from internal AC units

In practice, it is difficult for split system air conditioning systems to comply with the recommendations of AS2107 at all times. Our recommendation is that internal units should be selected so as to comply in living areas at medium speed and in sleeping areas when operating at low speed. This is likely to minimise significant adverse impact in the majority of cases.

6.2 Vibration control

Vibration levels arising from the operation of the building (plant, car stackers, car park doors and lifts) must be limited to prevent undue disturbance to building occupants.

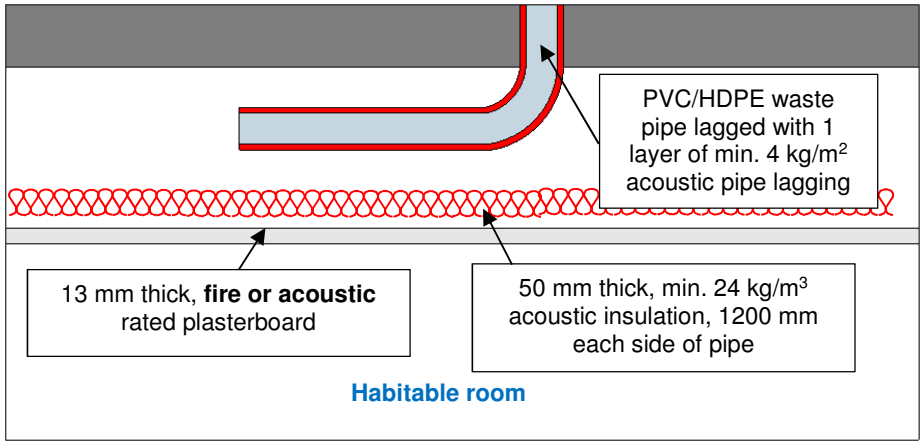
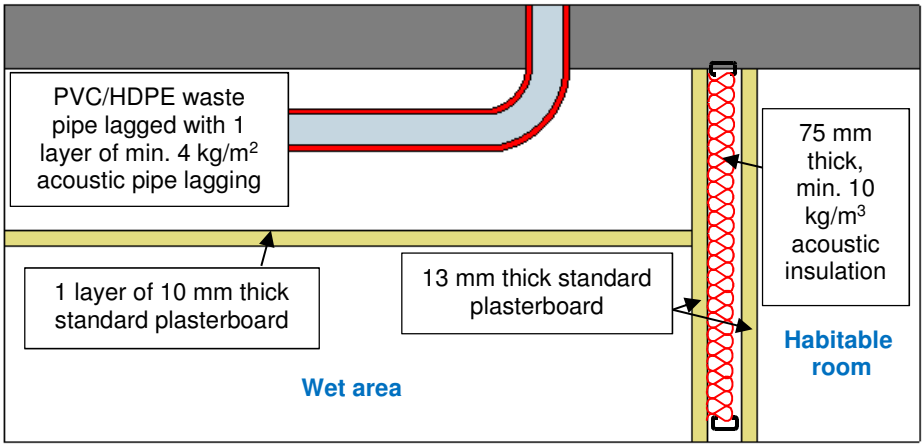
Based on the requirements of AS2670.2-1990 *Evaluation of human exposure to whole-body vibration – Continuous and shock-induced vibration in buildings (1 to 80 Hz),* surface vibration velocity levels in occupied areas must not exceed 0.14 mm/s Root Mean Squared (RMS) (taken to be Curve 1.4 of the combined-direction vibration velocity limit). These vibration levels are unlikely to cause adverse comment in residential apartments.

All equipment must be resiliently isolated from the building structure and flexible connections used between all mechanical plant and duct/pipework. Table 47 of the ASHRAE Handbook, provided in Appendix B, details the recommended isolation systems.

7. Hydraulic services

7.1 Services treatment in walls and ceilings

To achieve the minimum requirements of the BCA, the acoustic treatment detailed in Table 6 is required.

Condition and BCA requirement	Minimum acoustic treatment
Pipework above habitable spaces $R_w + C_{tr}$ 40 dB	
Pipework above wet areas $R_w + C_{tr}$ 25 dB	

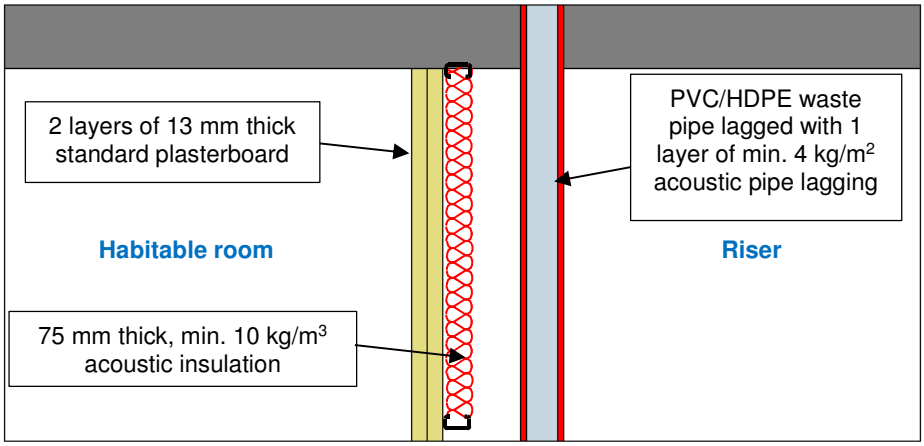
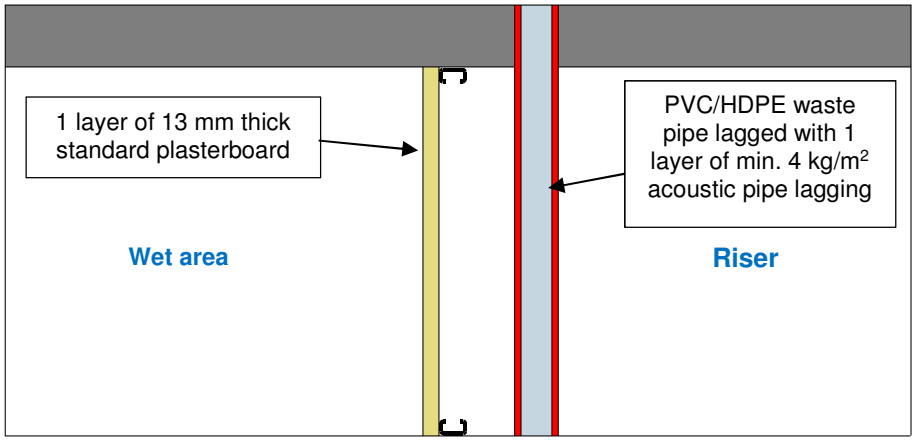
Condition and BCA requirement	Minimum acoustic treatment
Pipework in riser adjacent to habitable room $R_w + C_{tr}$ 40 dB	
Pipework in riser adjacent to wet area $R_w + C_{tr}$ 25 dB	

Table 6 – Hydraulic services - Acoustic treatment recommendations

7.2 Water supply pipes

Copper and steel pipework should be avoided, and flexible plastic pipework be used to reduce the likelihood of flow generated noise being audible in adjacent spaces.

7.3 Support and fixing of pipework

There must be no physical contact between pipework and lightweight elements of the building structure, including studwork walls and suspended ceilings. Pipework must be suspended and fixed only to the concrete slab above.

Where pipework is located within discontinuous cavity walls, they must only be tied to the side of the partition served by the pipework and not in contact (or by movement come into contact) with studwork on the opposite side of the wall.

7.4 Penetrations

All pipe penetrations through acoustically rated floors, ceilings, and walls must be acoustically sealed.

Penetrations should be no greater than 10 mm larger than required for the pipework, and sealed with a flexible, non-setting acoustic sealant such as mastic. Where larger penetrations occur, they must be reduced to within 10 mm of the pipe using materials of equivalent acoustic performance of the floor, ceiling or wall penetrated, prior to sealing.

Care must be taken to ensure there is no contact between pipes and the surrounding structure.

8. Appendix A – Acoustic terminology

WEIGHTED SOUND REDUCTION INDEX (R_w)
The laboratory sound insulation performance usually provided by manufacturers and suppliers is the **weighted sound reduction index**, R_w. The higher the rating, the better the sound reduction between spaces.

WEIGHTED STANDARDISED LEVEL DIFFERENCE ($D_{nT,w}$)
The in-situ sound insulation performance usually measured on site is the **weighted standardised level difference**, $D_{nT,w}$. This rating is normalised to the reverberation time measured in the receiving room during testing. The higher the rating, the better the sound reduction between spaces.

C_{tr}
C_{tr} is an adjustment factor to a sound insulation rating which allows for the intrusion of low frequency noise, like noise from trucks and subwoofers. This term is used to provide information about the acoustic performance at different frequencies, as part of a single number rating system.

'A'-WEIGHTED SOUND LEVEL dBA
The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dBA. An A-weighting network can be built into a sound level measuring instrument such that sound levels in dBA can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. An increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise. A change of 2 to 3 dB is subjectively barely perceptible.

EQUIVALENT CONTINUOUS SOUND LEVEL (L_{Aeq})
Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level, which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure level.

REVERBERATION TIME (RT_{60})
The time, in seconds, taken for a sound within a space to decay by 60 dB after the sound source has stopped is denoted at the reverberation time. The RT is an important indicator of the subjective acoustic within an auditorium. A large RT subjectively corresponds to an acoustically 'live' or 'boomy' space, while a small RT subjectively corresponds to an acoustically 'dead' or 'flat' space.

NOISE REDUCTION COEFFICIENT (NRC)
A single number rating between 0 and 1 of the ability of a material to absorb sound. It is the average of the absorption coefficients in the 250-2000 Hz octave bands. The larger the number, the more absorptive the material.

L_{A90}
Refers to the sound pressure level measured in dBA, exceeded for 90% of the time i.e. measured noise levels were greater than this value for 90% of the time interval. This is also often referred to the background noise level, or ambient noise level.

9. Appendix B – ASHRAE Table 47

Table 47 Selection Guide for Vibration Isolation

			Equipment Location (Note 1)												
						Floor Span									
			Slab on Grade			Up to 6 m			6 to 9 m			9 to 12 m			
Equipment Type	Shaft Power kW and Other	RPM	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Reference Notes
Refrigeration Machines and Chillers															
Reciprocating	All	All	A	2	6.4	A	4	19	A	4	38	A	4	64	2,3,12
Centrifugal, scroll	All	All	A	1	6.4	A	4	19	A	4	38	A	4	38	2,3,4,8, 12
Screw	All	All	A	1	25	A	4	38	A	4	64	A	4	64	2,3,4,12
Absorption	All	All	A	1	6.4	A	4	19	A	4	38	A	4	38	
Air-cooled recip., scroll	All	All	A	1	6.4	A	4	38	A	4	38	A	4	64	2,4,5,12
Air-cooled screw	All	All	A	4	25	A	4	38	B	4	64	B	4	64	2,4,5,8,12
Air Compressors and Vacuum Pumps															
Tank-mounted horiz.	≤7.5	All	A	3	19	A	3	19	A	3	38	A	3	38	3,15
	≥11	All	C	3	19	C	3	19	C	3	38	C	3	38	3,15
Tank-mounted vert.	All	All	C	3	19	C	3	19	C	3	38	C	3	38	3,15
Base-mounted	All	All	C	3	19	C	3	19	C	3	38	C	3	38	3,14,15
Large reciprocating	All	All	C	3	19	C	3	19	C	3	38	C	3	38	3,14,15
Pumps															
Close-coupled	≤5.6	All	B	2	6.4	C	3	19	C	3	19	C	3	19	16
	≥7.5	All	C	3	19	C	3	19	C	3	38	C	3	38	16
Large inline	3.7 to 19	All	A	3	19	A	3	38	A	3	38	A	3	38	
	≥22	All	A	3	38	A	3	38	A	3	38	A	3	64	
End suction and split case	≤30	All	C	3	19	C	3	19	C	3	38	C	3	38	16
	37 to 93	All	C	3	19	C	3	19	C	3	38	C	3	64	10,16
	≥110	All	C	3	19	C	3	38	C	3	64	C	3	89	10,16
Packaged pump systems	All	All	A	3	19	A	3	19	A	3	38	C	3	64	
Cooling Towers	All	Up to 300	A	1	6.4	A	4	89	A	4	89	A	4	89	5,8,18
		301 to 500	A	1	6.4	A	4	64	A	4	64	A	4	64	5,18
		501 and up	A	1	6.4	A	4	19	A	4	19	A	4	38	5,18
Boilers															
Fire-tube	All	All	A	1	6.4	B	4	19	B	4	38	B	4	64	4
Water-tube, copper fin	All	All	A	1	3	A	1	3	A	1	3	B	4	6.4	
Axial Fans, Plenum Fans, Cabinet Fans, Fan Sections, Centrifugal Inline Fans															
Up to 560 mm diameter	All	All	A	2	6.4	A	3	19	A	3	19	C	3	19	4,9
610 mm diameter and up	≤500 Pa SP	Up to 300	B	3	64	C	3	89	C	3	89	C	3	89	9,8
		300 to 500	B	3	19	B	3	38	C	3	64	C	3	64	9,8
		501 and up	B	3	19	B	3	38	B	3	38	B	3	38	9,8
	≥501 Pa SP	Up to 300	C	3	64	C	3	89	C	3	89	C	3	89	3,8,9
		300 to 500	C	3	38	C	3	38	C	3	64	C	3	64	3,8,9
		501 and up	C	3	19	C	3	38	C	3	38	C	3	64	3,8,9
Centrifugal Fans															
Up to 560 mm diameter	All	All	B	2	6.4	B	3	19	B	3	19	B	3	38	9,19
610 mm diameter and up	≤30	Up to 300	B	3	64	B	3	89	B	3	89	B	3	89	8,19
		300 to 500	B	3	38	B	3	38	B	3	64	B	3	64	8,19
		501 and up	B	3	19	B	3	19	B	3	19	B	3	38	8,19
	≥37	Up to 300	C	3	64	C	3	89	C	3	89	C	3	89	2,3,8,9,19
		300 to 500	C	3	38	C	3	38	C	3	64	C	3	64	2,3,8,9,19
		501 and up	C	3	25.4	C	3	38	C	3	38	C	3	64	2,3,8,9,19
Propeller Fans															
Wall-mounted	All	All	A	1	6.4	A	1	6.4	A	1	6.4	A	1	6.4	
Roof-mounted	All	All	A	1	6.4	A	1	6.4	B	4	38	D	4	38	
Heat Pumps, Fan-Coils, Computer Room Units	All	All	A	3	19	A	3	19	A	3	19	A/D	3	38	
Condensing Units	All	All	A	1	6.4	A	4	19	A	4	38	A/D	4	38	
Packaged AH, AC, H and V Units															
All	≤7.5	All	A	3	19	A	3	19	A	3	19	A	3	19	19
	≤11	Up to 300	A	3	19	A	3	89	A	3	89	C	3	89	2,4,8,19
	≤1 kPa SP	301 to 500	A	3	19	A	3	64	A	3	64	A	3	64	4,19
		501 and up	A	3	19	A	3	38	A	3	38	A	3	38	4,19
	>1 kPa SP11,	Up to 300	B	3	19	C	3	89	C	3	89	C	3	89	2,3,4,8,9
	>1 kPa SP	301 to 500	B	3	19	C	3	38	C	3	64	C	3	64	2,3,4,9
		501 and up	B	3	19	C	3	38	C	3	38	C	3	64	2,3,4,9

Table 47 Selection Guide for Vibration Isolation (*Continued*)

Equipment Type	Shaft Power kW and Other	RPM	Equipment Location (Note 1)												Reference Notes
			Slab on Grade			Floor Span: Up to 6 m			Floor Span: 6 to 9 m			Floor Span: 9 to 12 m			
			Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	Base Type	Isolator Type	Min. Defl., mm	
Packaged Rooftop Equipment	All	All	A/D	1	6.4	D	3	19	See Reference Note 17						5,6,8,17
Ducted Rotating Equipment															
Small fans, fan-powered boxes	≤300 L/s	All	A	3	12.7	A	3	12.7	A	3	12.7	A	3	12.7	7
	≥301 L/s	All	A	3	19	A	3	19	A	3	19	A	3	19	7
Engine-Driven Generators	All	All	A	3	19	C	3	38	C	3	64	C	3	89	2,3,4
Piping and Ducts (See sections on Isolating Vibration and Noise in Piping Systems and Isolating Duct Vibration for isolator selection.)															

Base Types:
A. No base, isolators attached directly to equipment (Note 28)
B. Structural steel rails or base (Notes 29 and 30)
C. Concrete inertia base (Note 31)
D. Curb-mounted base (Note 32)

Isolator Types:
1. Pad, rubber, or glass fiber (Notes 20 and 21)
2. Rubber floor isolator or hanger (Notes 20 and 25)
3. Spring floor isolator or hanger (Notes 22, 23, and 26)
4. Restrained spring isolator (Notes 22 and 24)
5. Thrust restraint (Note 27)
6. Air spring (Note 25)

Notes for Table 47: Selection Guide for Vibration Isolation

These notes are keyed to the column titled *Reference Notes* in Table 47 and to other reference numbers throughout the table. Although the guide is conservative, cases may arise where vibration transmission to the building is still excessive. If the problem persists after all short circuits have been eliminated, it can almost always be corrected by altering the support path (e.g., from ceiling to floor), increasing isolator deflection, using low-frequency air springs, changing operating speed, improving rotating component balancing, or, as a last resort, changing floor frequency by stiffening or adding more mass. Assistance from a qualified vibration consultant can be very useful in resolving these problems.

Note 1. Isolator deflections shown are based on a reasonably expected floor stiffness according to floor span and class of equipment. Certain spaces may dictate higher levels of isolation. For example, bar joist roofs may require a static deflection of 38 mm over factories, but 64 mm over commercial office buildings.

Note 2. For large equipment capable of generating substantial vibratory forces and structureborne noise, increase isolator deflection, if necessary, so isolator stiffness is less than one-tenth the stiffness of the supporting structure, as defined by the deflection due to load at the equipment support.

Note 3. For noisy equipment adjoining or near noise-sensitive areas, see the section on Mechanical Equipment Room Sound Isolation.

Note 4. Certain designs cannot be installed directly on individual isolators (type A), and the equipment manufacturer or a vibration specialist should be consulted on the need for supplemental support (base type).

Note 5. Wind load conditions must be considered. Restraint can be achieved with restrained spring isolators (type 4), supplemental bracing, snubbers, or limit stops. Also see Chapter 55.

Note 6. Certain types of equipment require a curb-mounted base (type D). Airborne noise must be considered.

Note 7. See section on Resilient Pipe Hangers and Supports for hanger locations adjoining equipment and in equipment rooms.

Note 8. To avoid isolator resonance problems, select isolator deflection so that resonance frequency is 40% or less of the lowest normal operating speed of equipment (see Chapter 8 in the 2009 *ASHRAE Handbook—Fundamentals*). Some equipment, such as variable-frequency drives, and high-speed equipment, such as screw chillers and vaneaxial fans, contain very-high-frequency vibration. This equipment creates new technical challenges in the isolation of high-frequency noise and vibration from a building's structure. Structural resonances both internal and external to the isolators can significantly degrade their performance at high frequencies. Unfortunately, at present no test standard exists for measuring the high-frequency dynamic properties of isolators, and commercially available products are not tested to determine their effectiveness for high frequencies. To reduce the chance of high-frequency vibration transmission, add a 25 mm thick pad (type 1, Note 20) to the base plate of spring isolators (type 3, Note 22, 23, 24). For some sensitive locations, air springs (Note 25) may be required. If equipment is located near extremely noise-sensitive areas, follow the recommendations of an acoustical consultant.

Note 14. Compressors: When using Y, W, and multihead and multicylinder compressors, obtain the magnitude of unbalanced forces from the equipment manufacturer so the need for an inertia base can be evaluated.

Note 15. Compressors: Base-mounted compressors through 4 kW and horizontal tank-type air compressors through 8 kW can be installed directly on spring isolators (type 3) with structural bases (type B) if required, and compressors 10 to 75 kW on spring isolators (type 3) with inertia bases (type C) with a mass 1 to 2 times the compressor mass.

Note 16. Pumps: Concrete inertia bases (type C) are preferred for all flexible-coupled pumps and are desirable for most close-coupled pumps, although steel bases (type B) can be used. Close-coupled pumps should not be installed directly on individual isolators (type A) because the impeller usually overhangs the motor support base, causing the rear mounting to be in tension. The primary requirements for type C bases are strength and shape to accommodate base elbow supports. Mass is not usually a factor, except for pumps over 55 kW, where extra mass helps limit excess movement due to starting torque and forces. Concrete bases (type C) should be designed for a thickness of one-tenth the longest dimension with minimum thickness as follows: (1) for up to 20 kW, 150 mm; (2) for 30 to 55 kW, 200 mm; and (3) for 75 kW and up, 300 mm.

Pumps over 55 kW and multistage pumps may exhibit excessive motion at start-up ("heaving"); supplemental restraining devices can be installed if necessary. Pumps over 90 kW may generate high starting forces; a vibration specialist should be consulted.

Note 17. Packaged Rooftop Air-Conditioning Equipment: This equipment is usually installed on low-mass structures that are susceptible to sound and vibration transmission problems. The noise problems are compounded further by curb-mounted equipment, which requires large roof openings for supply and return air.

The table shows type D vibration isolator selections for all spans up to 6 m, but extreme care must be taken for equipment located on spans of over 6 m, especially if construction is open web joists or thin, low-mass slabs. The recommended procedure is to determine the additional deflection caused by equipment in the roof. If additional roof deflection is 6 mm or less, the isolator should be selected for 10 times the additional roof deflection. If additional roof deflection is over 6 mm, supplemental roof stiffening should be installed to bring the roof deflection down below 6 mm, or the unit should be relocated to a stiffer roof position.

For mechanical units capable of generating high noise levels, mount the unit on a platform above the roof deck to provide an air gap (buffer zone) and locate the unit away from the associated roof penetration to allow acoustical treatment of ducts before they enter the building.

Some rooftop equipment has compressors, fans, and other equipment isolated internally. This isolation is not always reliable because of internal short-circuiting, inadequate static deflection, or panel resonances. It is recommended that rooftop equipment over 135 kg be isolated externally, as if internal isolation was not used.

Note 9. To limit undesirable movement, thrust restraints (type 5) are required for all ceiling-suspended and floor-mounted units operating at 500 Pa or more total static pressure.

Note 10. Pumps over 55 kW may need extra mass and restraints.

Note 11. See text for full discussion.

Isolation for Specific Equipment

Note 12. Refrigeration Machines: Large centrifugal, screw, and reciprocating refrigeration machines may generate very high noise levels; special attention is required when such equipment is installed in upper-story locations or near noise-sensitive areas. If equipment is located near extremely noise-sensitive areas, follow the recommendations of an acoustical consultant.

Note 13. Compressors: The two basic reciprocating compressors are (1) single- and double-cylinder vertical, horizontal or L-head, which are usually air compressors; and (2) Y, W, and multihead or multicylinder air and refrigeration compressors. Single- and double-cylinder compressors generate high vibratory forces requiring large inertia bases (type C) and are generally not suitable for upper-story locations. If this equipment must be installed in an upper-story location or at-grade location near noise-sensitive areas, the expected maximum unbalanced force data must be obtained from the equipment manufacturer and a vibration specialist consulted for design of the isolation system.

Note 18. Cooling Towers: These are normally isolated with restrained spring isolators (type 4) directly under the tower or tower dunnage. High-deflection isolators proposed for use directly under the motor-fan assembly must be used with extreme caution to ensure stability and safety under all weather conditions. See Note 5.

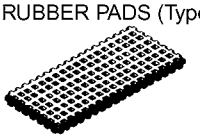
Note 19. Fans and Air-Handling Equipment: Consider the following in selecting isolation systems for fans and air-handling equipment:

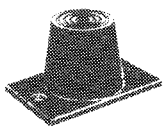
1. Fans with wheel diameters of 560 mm and less and all fans operating at speeds up to 300 rpm do not generate large vibratory forces. For fans operating under 300 rpm, select isolator deflection so the isolator natural frequency is 40% or less than the fan speed. For example, for a fan operating at 275 rpm, $0.4 \times 275 = 110$ rpm. Therefore, an isolator natural frequency of 110 rpm or lower is required. This can be accomplished with a 75 mm deflection isolator (type 3).
2. Flexible duct connectors should be installed at the intake and discharge of all fans and air-handling equipment to reduce vibration transmission to air duct structures.
3. Inertia bases (type C) are recommended for all class 2 and 3 fans and air-handling equipment because extra mass allows the use of stiffer springs, which limit heaving movements.
4. Thrust restraints (type 5) that incorporate the same deflection as isolators should be used for all fan heads, all suspended fans, and all base-mounted and suspended air-handling equipment operating at 500 Pa or more total static pressure. Restraint movement adjustment must be made under normal operational static pressures.

Vibration Isolators: Materials, Types, and Configurations

Notes 20 through 32 include figures to assist in evaluating commercially available isolators for HVAC equipment. The isolator selected for a particular application depends on the required deflection, life, cost, and compatibility with associated structures.

RUBBER PADS (Type 1)

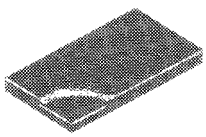




RUBBER MOUNTS (Type 2)

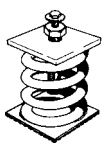
Note 20. Rubber isolators are available in pad (type 1) and molded (type 2) configurations. Pads are used in single or multiple layers. Molded isolators come in a range of 30 to 70 durometer (a measure of stiffness). Material in excess of 70 durometer is usually ineffective as an isolator. Isolators are designed for up to 13 mm deflection, but are used where 8 mm or less deflection is required. Solid rubber and composite fabric and rubber pads are also available. They provide high load capacities with small deflection and are used as noise barriers under columns and for pipe supports. These pad types work well only when they are properly loaded and the mass load is evenly distributed over the entire pad surface. Metal loading plates can be used for this purpose.

GLASS FIBER PADS (Type 1)



Note 21. Glass fiber with elastic coating (type 1). This type of isolation pad is precompressed molded fiberglass pads individually coated with a flexible, moisture-impervious elastomeric membrane. Natural frequency of fiberglass vibration isolators should be essentially constant for the operating load range of the supported equipment. Mass load is evenly distributed over the entire pad surface. Metal loading plates can be used for this purpose.

SPRING ISOLATOR (Type 3)

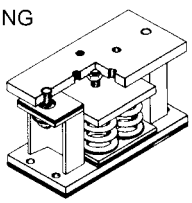


Note 22. Steel springs are the most popular and versatile isolators for HVAC applications because they are available for almost any deflection and have a virtually unlimited life. Spring isolators may have a rubber acoustical barrier to reduce transmission of high-frequency vibration and noise that can migrate down the steel spring coil. They should be corrosion-protected if installed outdoors or in a corrosive environment. The basic types include the following:

Note 23. *Open spring isolators* (type 3) consist of top and bottom load plates with adjustment bolts for leveling equipment. Springs should be designed with a horizontal stiffness of at least 80% of the vertical stiffness (k_x/k_y) to ensure stability. Similarly, the springs should have a minimum ratio of 0.8 for the diameter divided by the deflected spring height.

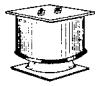
Note 24. *Restrained spring isolators* (type 4) have hold-down bolts to limit vertical as well as horizontal movement. They are used with (a) equipment with large variations in mass (e.g., boilers, chillers, cooling towers) to restrict movement and prevent strain on piping when water is removed, and (b) outdoor equipment, such as condensing units and cooling towers, to prevent excessive movement due to wind loads. Spring criteria should be the same as open spring isolators, and restraints should have adequate clearance so that they are activated only when a temporary restraint is needed.

RESTRAINED SPRING ISOLATOR (Type 4)



Closed mounts or *housed spring isolators* consist of two telescoping housings separated by a resilient material. These provide lateral snubbing and some vertical damping of equipment movement, but do not limit the vertical movement. Care should be taken in selection and installation to minimize binding and short-circuiting.

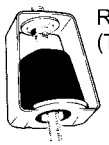
AIR SPRINGS



ROLLING LOBE

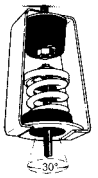
BELLOWS

Note 25. Air springs can be designed for any frequency, but are economical only in applications with natural frequencies of 1.33 Hz or less (150 mm or greater deflection). They do not transmit high-frequency noise and are often used to replace high-deflection springs on problem jobs (e.g., large transformers on upper-floor installations). A constant air supply (an air compressor with an air dryer) and leveling valves are typically required.



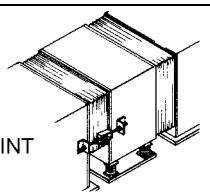
RUBBER HANGER
(Type 2)

SPRING HANGER
(Type 3)



Note 26. Isolation hangers (types 2 and 3) are used for suspended pipe and equipment and have rubber, springs, or a combination of spring and rubber elements. Criteria should be similar to open spring isolators, though lateral stability is less important. Where support rod angular misalignment is a concern, use hangers that have sufficient clearance and/or incorporate rubber bushings to prevent the rod from touching the housing. Swivel or traveler arrangements may be necessary for connections to piping systems subject to large thermal movements.
Precompressed spring hangers incorporate some means of precompression or preloading of the isolator spring to minimize movement of the isolated equipment or system. These are typically used on piping systems that can change mass substantially between installation and operation.

THRUST RESTRAINT
(Type 5)

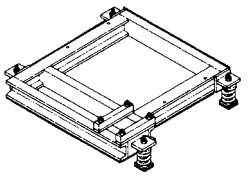


Note 27. Thrust restraints (type 5) are similar to spring hangers or isolators and are installed in pairs to resist the thrust caused by air pressure. These are typically sized to limit lateral movement to 6.4 mm or less.

DIRECT ISOLATION (Type A)

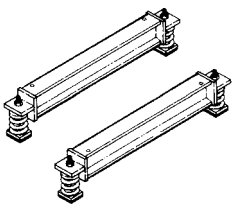
Note 28. Direct isolation (type A) is used when equipment is unitary and rigid and does not require additional support. Direct isolation can be used with large chillers, some fans, packaged air-handling units, and air-cooled condensers. If there is any doubt that the equipment can be supported directly on isolators, use structural bases (type B) or inertia bases (type C), or consult the equipment manufacturer.

STRUCTURAL BASES (Type B)



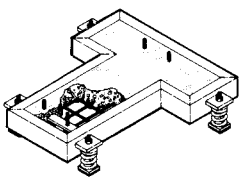
Note 29. Structural bases (type B) are used where equipment cannot be supported at individual locations and/or where some means is necessary to maintain alignment of component parts in equipment. These bases can be used with spring or rubber isolators (types 2 and 3) and should have enough rigidity to resist all starting and operating forces without supplemental hold-down devices. Bases are made in rectangular configurations using structural members with a depth equal to one-tenth the longest span between isolators. Typical base depth is between 100 and 300 mm, except where structural or alignment considerations dictate otherwise.

STRUCTURAL RAILS (Type B)



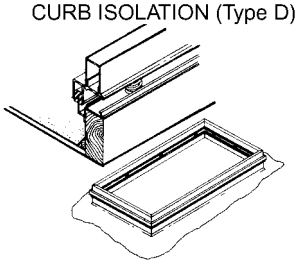
Note 30. Structural rails (type B) are used to support equipment that does not require a unitary base or where the isolators are outside the equipment and the rails act as a cradle. Structural rails can be used with spring or rubber isolators and should be rigid enough to support the equipment without flexing. Usual practice is to use structural members with a depth one-tenth of the longest span between isolators, typically between 100 and 300 mm, except where structural considerations dictate otherwise.

CONCRETE BASES (Type C)



Note 31. Concrete bases (type C) are used where the supported equipment requires a rigid support (e.g., flexible-coupled pumps) or excess heaving motion may occur with spring isolators. They consist of a steel pouring form usually with welded-in reinforcing bars, provision for equipment hold-down, and isolator brackets. Like structural bases, concrete bases should be sized to support piping elbow supports, rectangular or T-shaped, and for rigidity, have a depth equal to one-tenth the longest span between isolators. Base depth is typically between 150 and 300 mm unless additional depth is specifically required for mass, rigidity, or component alignment.

CURB ISOLATION (Type D)



Note 32. Curb isolation systems (type D) are specifically designed for curb-supported rooftop equipment and have spring isolation with a watertight, and sometimes airtight, assembly. *Rooftop rails* consist of upper and lower frames separated by nonadjustable springs and rest on top of architectural roof curbs. *Isolation curbs* incorporate the roof curb into their design as well. Both kinds are designed with springs that have static deflections in the 25 to 75 mm range to meet the design criteria described in type 3. Flexible elastomeric seals are typically most effective for weatherproofing between the upper and lower frames. A continuous sponge gasket around the perimeter of the top frame is typically applied to further weatherproof the installation.

HILLAM
ARCHITECTS

APPENDIX H
WIND STUDY

CUNDALL

September 2017

Kintail Road

Desktop Wind Analysis

Prepared for

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Report	Desktop Wind Analysis	**Revision:**	B	**Date:**	29/09/2017
Author:	Oliver Grimaldi				
Checker & Approver:	Mathuran Marianayagam				

Revision	Description	Date
A	Issued For Development Application	22/09/2017
B	Issued For Development Application – updated following Hillam comments	29/09/2017

The success and realisation of the proposed initiatives will be dependent upon the commitment of the design team, the development of the initiatives through the life of the design and also the implementation into the operation of the building. Without this undertaking the proposed targets may not be achieved. The use of computer simulation is by its nature predictive with output based on historic weather data and standard assumptions. The results of any computer simulations within this report do not guarantee future performance.

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Executive Summary

Cundall have been engaged by Norup + Wilson to assess the impact of the proposed Kintail Road design located in Applecross, Perth. This desktop assessment considers the impacts of the proposed building on the local wind environment. This report summarises the method, results and conclusions of the desktop wind impact assessment that has been conducted.

The assessment looked at the local site, proposed building design and local wind climate. The key factors which influence the wind microclimate in the area were investigated qualitatively including:

- The proposed building form and height;
- The nature and distribution of wind obstructions surrounding the site;
- The proximity to nearby buildings, outdoor retail areas and pedestrian areas;
- Wind mitigation design features, such as awnings, overhangs and rooftop shelters.

The building design includes awnings, overhangs and balconies, as well as a podium, which can mitigate some potential negative impacts from wind. Wind conditions around the site are expected to be appropriate for use at ground level and podium terrace level. The proposed Kintail Road design is considered to respond appropriately to wind comfort principles.

Contents

1 Introduction

1.1 Project Background

Cundall was engaged by Norup + WIlson to provide a desktop study wind analysis of the impact of the proposed Kintail Road design on the local pedestrian wind environment located in Applecross, Perth.

The Kintail Road development will be a 16-storey residential tower, with car parking located within the podium levels, and will also contain ground floor retail units.

The current site contains existing single storey residential buildings that are to be demolished. This study has also considered the adjacent buildings around the site.

1.2 Site location

The Kintail Road site is located southeast of the Perth CBD, on the other side of the Swan River. Figure 1 below shows a satellite image of the site, highlighted in blue. There are, however, challenges inherent to the site.

The Swan River is to the north and Canning River is to the east, whilst there are low density residential areas surrounding the site. The PDC building is located to the southwest of the site, and is a 5-storey commercial office building. An appreciation of the site context is important to the consideration of the local winds for The Kintail Road development.

Figure 1 – Aerial view of the proposed site location highlighted in blue

Figure 2 – Close up aerial view of the proposed site location highlighted in blue

The areas considered in this assessment are illustrated in Figure 3 below. These areas are:

1. The public walkway immediately to the south on Kintail Road; and
2. The podium terrace outdoor areas on Level 3.

Figure 3 – 3D render of proposed development showing key areas considered in this assessment

1.3 Disclaimer

The following assessment is based on drawings provided by Hillam architects and is a desktop study based on Cundall's prior experience.

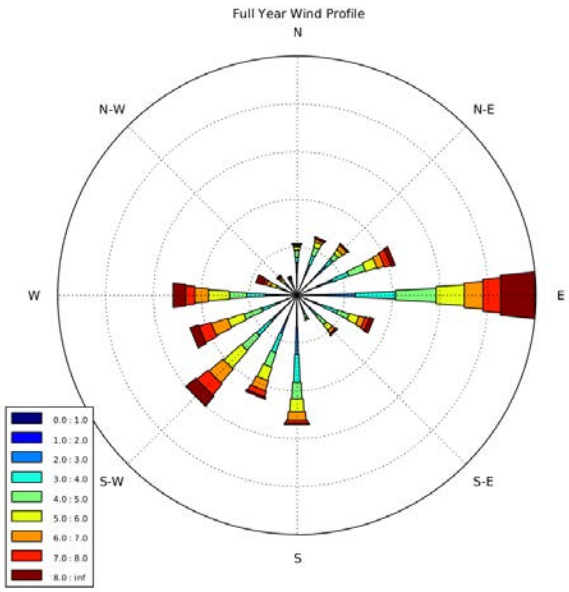
No modelling or wind tunnel testing has been carried out as a part of this assessment. To quantify the advice provided in this qualitative report it is recommended that computer based simulation and / or wind tunnel testing be carried out at later design stages.

2 Perth Wind Climate

Figure 4 shows an annual wind rose for Perth. This is a graphical representation of the wind conditions in Perth, for a typical reference year. The wind roses for each season of the year are shown in Figure 5, these show the prevailing wind direction, speed and frequency for summer, autumn, winter and spring and are broken down into morning, afternoon and evening.

It can be seen that Perth has a strong prevailing south-westerly wind throughout the spring and summer midday and afternoons with a very strong prevailing easterly wind in the mornings for a large part of the year.

Occasional northerly winds occur during autumn and winter seasons. It should be noted that these northerly winds, although not as common as easterly and south-westerly winds, generally occur as a result of storm activity and as such are very strong in intensity when they do occur.



The wind rose diagram shows three key pieces of information:

1. **Wind direction**

   The various orientations relate to wind direction (i.e. 90 degrees means East).

2. **Wind strength**

   Colour shows wind strength (i.e. yellow is 5.0-6.0 m/s, orange is 6.0-7.0 m/s etc.).

3. **Wind frequency**

   Length of each wedge indicates a fraction of time. The radial divisions are 2.5% of the total hours in the period.

For example, the outer most (reddish-brown) sector on the east telescope shows that for ~2% of the year the wind blows from the east with a strength of greater than 8m/s.

As shown in Table 1 below, an 8m/s wind is a Force 5, known as a fresh breeze and can cause small trees to sway.

Figure 4 – Wind rose diagram for a typical reference meteorological year (RMY) in Perth. This information is based on RMY weather file data as licensed by ACADS-BSG

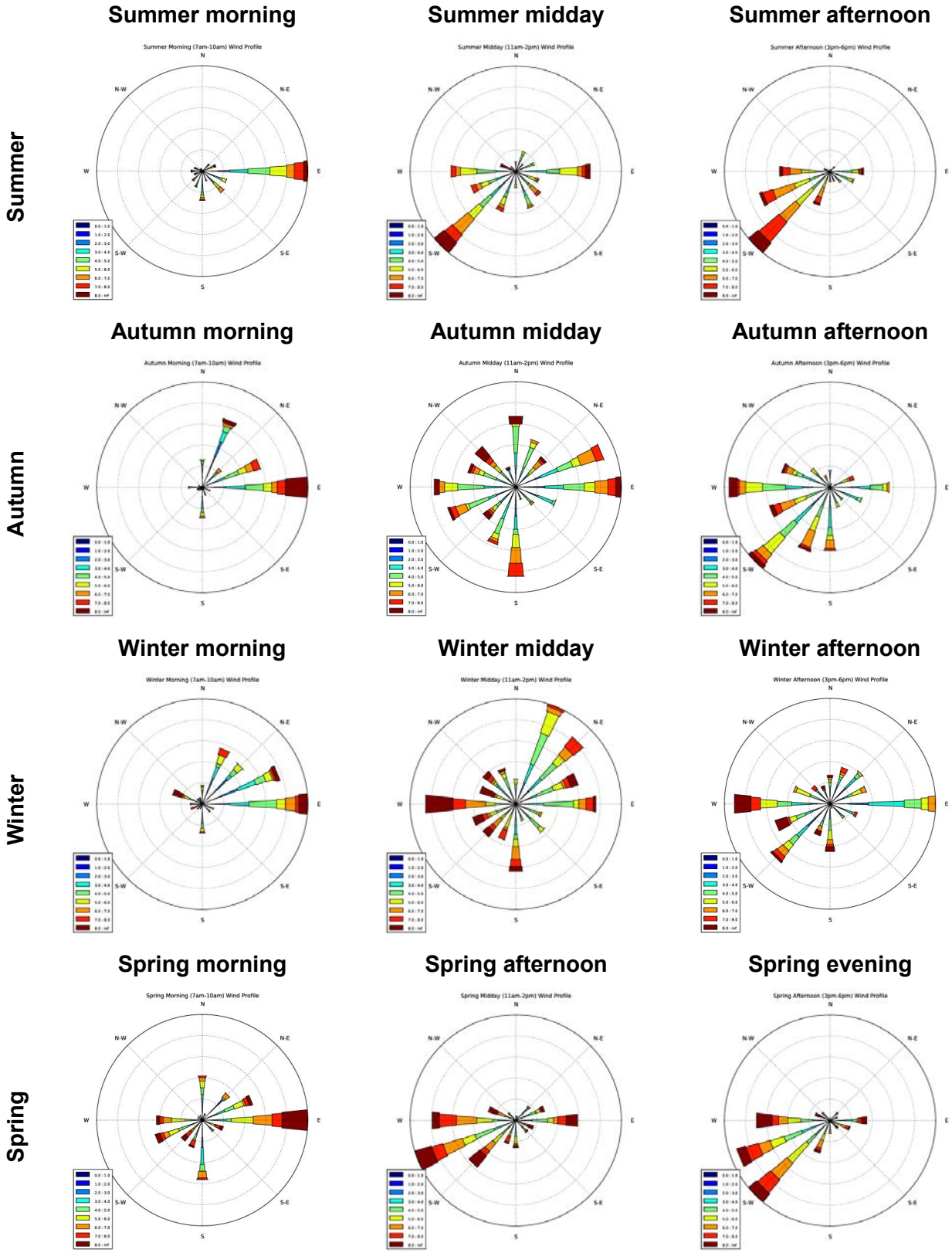


Figure 5 – Wind roses for each time of the day and season

3 Environmental Wind Speed Criteria

Wind speed and frequency of wind occurrence are the primary parameters used in the assessment of pedestrian wind impact. Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers. Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is remarkably good agreement.

3.1 The Beaufort Scale

Wind criteria for pedestrian comfort are related to the Beaufort Wind Scale as described in Table 1 below. Sir Francis Beaufort was an Irish Hydrographer and Officer in the Royal Navy and Beaufort Street in Perth was named in his honour.

Table 1 – The Beaufort scale for wind strength and comparison with commonly sensed outcomes

Force	knots	Km/h	m/s	Name	Relative Conditions
0	<1	<2	0 - 0.5	Calm	Smoke rises vertically
1	1 - 3	1 - 5	0.5 - 1.5	Light air	Smoke drifts and leaves rustle
2	4 - 6	6 - 11	1.5 - 3	Light breeze	Wind felt on face
3	7 - 10	12 - 19	3 - 5.5	Gentle breeze	Flags extend, leaves move
4	11 - 16	20 - 29	5.5 - 8	Moderate breeze	Dust, leaves and loose paper lifted
5	17 - 21	30 - 39	8 - 11	Fresh breeze	Small trees sway
6	22 - 27	40 - 50	11 - 14	Strong breeze	Large tree branches move, wires whistle
7	28 - 33	51 - 61	14 - 17	Near gale	Whole trees in motion, inconvenience in walking.
8	34 - 40	62 - 74	17 - 21	Gale	Difficult to walk against wind, small branches blown off tree.
9	41 - 47	76 - 87	21 - 24	Strong gale	Minor structural damage may occur (shingles blown off roofs).

3.2 Lawson's Criteria

This report refers to the Lawson criteria developed over a period of some 30 years at the University of Bristol in the UK. These criteria are probably the most widely used in environmental impact assessments across the UK.

Six usage categories are defined by the criteria which are summarised in Table 3. The usage categories represent varying levels of activity as well as duration of that activity.

“Tolerable” conditions indicate a level at which pedestrians will be conscious of the wind but will put up with it. Conditions that are tolerable for a particular activity can be improved upon but don’t require remedial action if conflicting design constraints make this impossible or uneconomical.

“Unacceptable” conditions indicate that wind strength and potential duration will not be tolerated by pedestrians and may have an impact on pedestrian comfort.

Table 2 – Summary of Lawson Criteria for various space usage categories

Prescribed usage		Threshold values	
Description	Letter	Unacceptable	Tolerable
Road and Car Parks	A	6% > B5	2% > B5
Business Walking	B	2% > B5	2% > B4
Pedestrian Walk-through	C	4% > B4	6% > B3
Pedestrian Standing	D	6% > B3	6% > B2
Entrance Doors	E	6% > B3	4% > B2
Sitting	F	1% > B3	4% > B2

4 Wind Flow Mechanisms

Fluid flows such as air or wind is driven from high pressure to low pressure regions in a similar way to current flows from higher voltage to lower voltage and water flows in a river from a higher level to a lower level.

As the wind moves around a building it broadly tends to convert its kinetic energy (motion) into pressure. Upstream faces where the wind strikes the building may form a stagnation region where the pressure is the highest. Downstream faces experience lower pressure in the turbulent wake of the building. This pressure differential from the windward to the leeward sides of the building has the potential to drive high velocity air (wind) through or around the building.

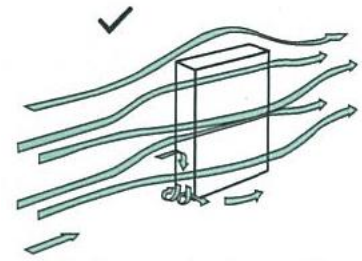
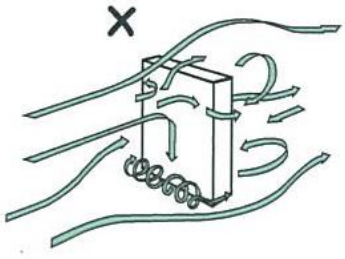
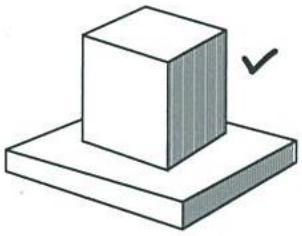
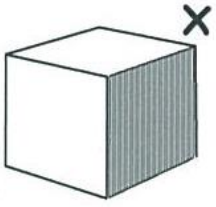
Wind will generally follow the path of least resistance to get from the higher-pressure region to the lower pressure. Thus, if there is a narrow passageway or pedestrian arcade connecting the windward side of the building to the leeward side then a lot of air will be forced into this space potentially creating a wind tunnelling problem in this area. Wind effects may be reduced by either:

- Increasing the wind resistance through the passageway; or
- Providing an alternative, more favourable path for the wind to take.

Typically for a building that is isolated, the majority of the wind is accelerated down and around the windward corners. This is called downwash and causes windy conditions at ground level on the windward sides of the building. Techniques to mitigate the effects of downwash winds on pedestrians include the provision of horizontal elements, the most effective being a podium to divert the flow away from pavements and building entrances. Awnings along street frontages perform a similar function and the deeper the horizontal element generally the more effective it will be in diverting the flow.

At mid and upper levels on a building winds can be significantly accelerated around the corners of the building. When balconies are located on these corners they are likely to be breezy, and will be used less by the owner due to the regularity of stronger winds. Owners quickly become familiar with when and how to use their balconies. If the corner balconies are deep enough, articulated, or have regular partition privacy fins then local calmer conditions can exist.

Below are some examples[1] of wind flow around buildings:

 	Orientate the long axis parallel to the prevailing wind. Avoid large flanking walls facing the prevailing wind.
 	Use podiums to prevent downwash reaching ground level. Avoid large cubical buildings with plain façades.

[1] 'Wind Microclimate Around Buildings' p. 8, 2011 Digest DG 520, BRE Press and IHS

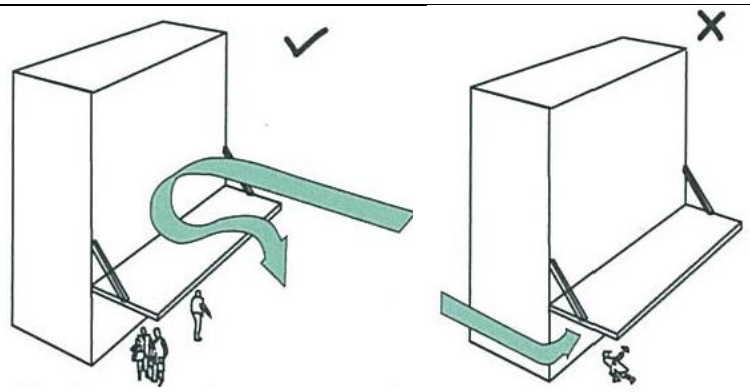
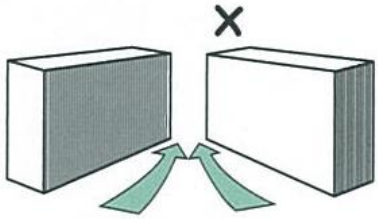
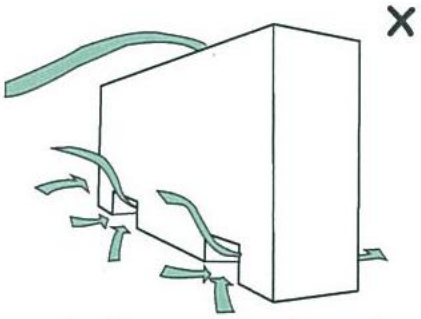
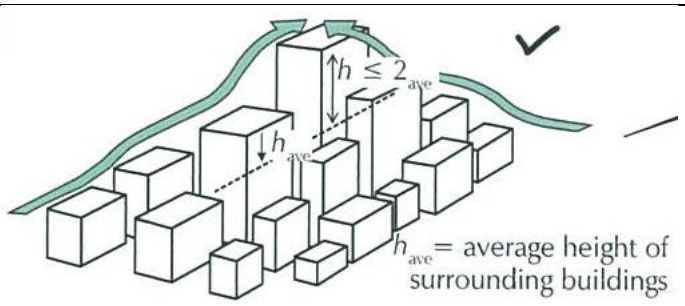
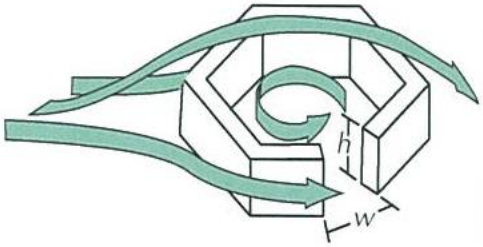
	Avoid potential issues with transverse wake flow using finger blocks on the rear face.
	Use large canopies to mitigate downwash. However, be aware that this can trap and accelerate horizontal flows.
	Avoid funnel-like gaps between buildings.
	Avoid passageways beneath buildings at ground level.
	Group buildings so that the height differential is minimised; idelly, the protruding building height should be less than twice the average height.
	Shelter in courtyards depends on area, gap width and building height.

Figure 6 – Examples of wind flow around buildings and how to minimise the impact

5 Environmental Wind Assessment

The following assessment considers the site factors, proposed building design and the prevailing winds in Perth.

5.1 Site Factors

The site of the proposed Kintail Road development is in a low urban density area and is in a somewhat wide-open location. It is to be situated on the site not too far from the Canning Highway River which is to the east, and Swan River which is to the north. The site is somewhat exposed to strong winds, particularly from the east and southwest. To the southwest of the site is the PDC building which will provide some shelter from the southwesterly winds.

In Figures 7-12 below, the wind effects of the four prevailing winds are illustrated.

5.1.1 Northerly Wind

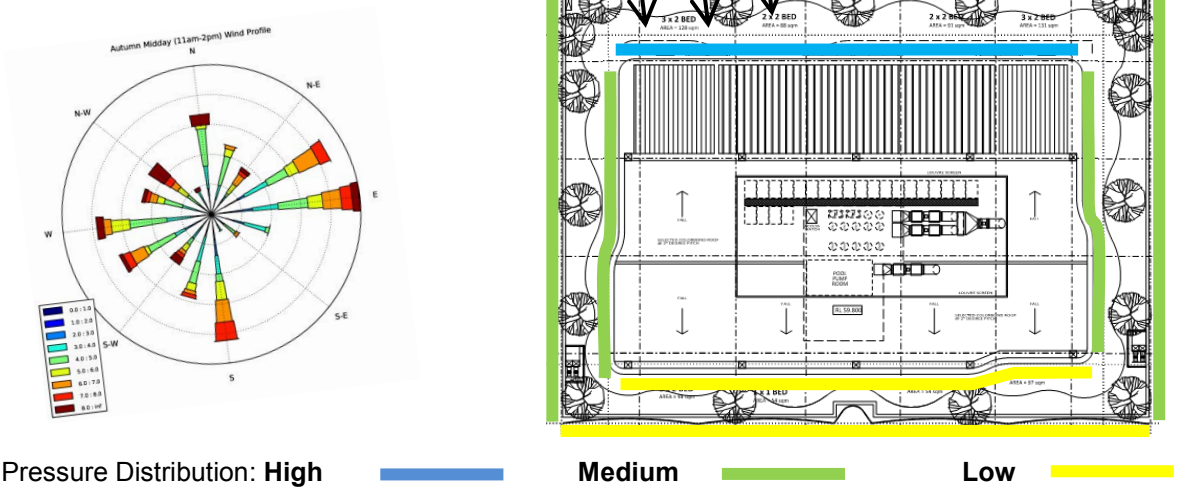


Figure 7 – Wind impact under effect of northerly wind

Figure 7 above illustrates the effect of a northerly wind on the building and the surrounding environment. The northerly wind will blow across the river and the low density suburban developments to the north of the site, with slight obstruction from the low buildings. Northerly winds occur much less often throughout the year than westerly, easterly and southerly winds but can blow strong when they do occur.

The tower could potentially have beneficial effects on the wind for the south of the podium by reducing strong northerly winds. However, the tower may redirect the northerly winds down the north and west facades of the tower, onto the north and west sides of the podium terrace affecting comfort in this area. The ground level public walkways are protected from the north winds by the tower and the podium due to the building's orientation, and the awnings above the public walkways will help protect from potential downwash from the podium and the tower.

5.1.2 Easterly wind

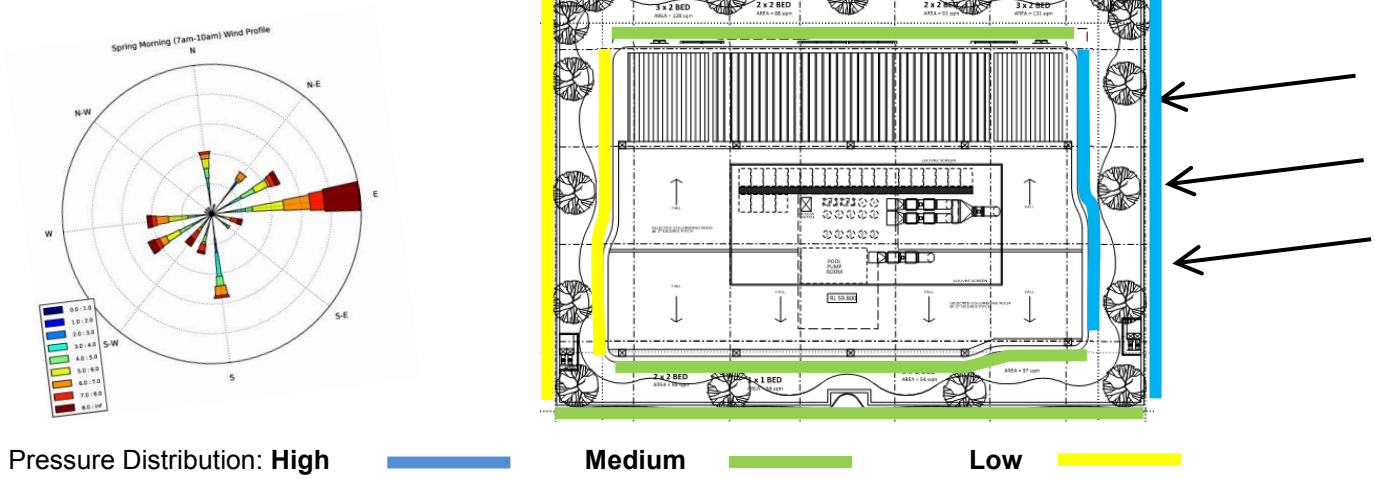


Figure 8 – Wind effects under easterly wind

Figure 8 above illustrates the effect of the easterly wind on the building and the local wind environment. The easterly wind will be somewhat obstructed by the low residential buildings as it arrives at the east and southeast sides of the building, however, it is expected that these winds will generally arrive at the site relatively unhindered.

Easterly winds mostly occur during the morning in Perth and any easterly wind that reaches the building will likely affect the balconies and podium level on the east. Some winds may flow down the building as downwash which could cause morning discomfort to some users. The retail units on ground level will feel some effects of easterly winds as it travels down Kintail Road, however, the current design provides some good protection from the easterly winds.

5.1.3 South-westerly Wind

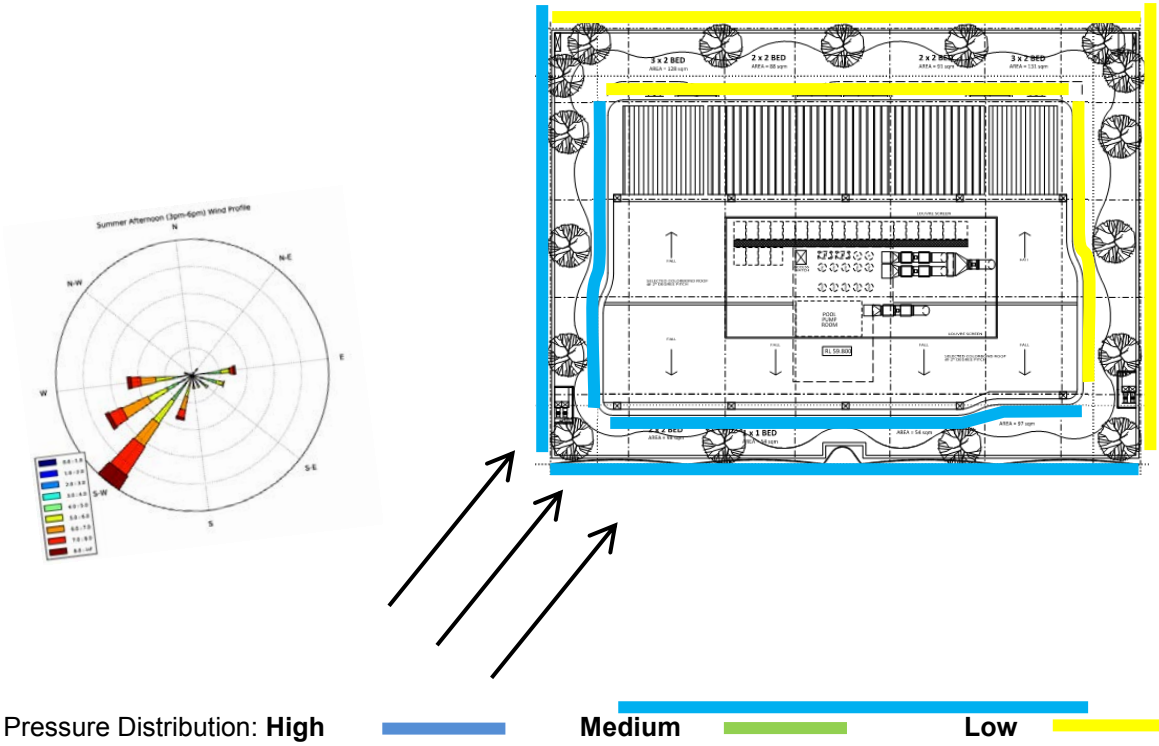


Figure 9 – Wind impacts under a south-westerly wind

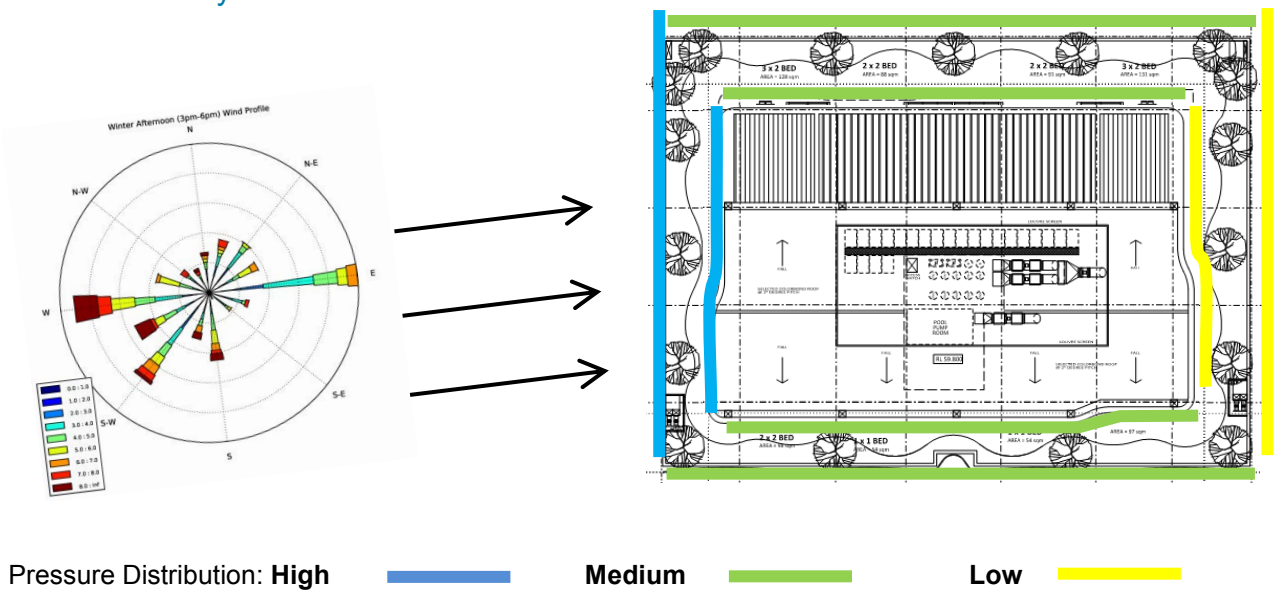
Figure 9 above illustrates the effect of a south-westerly wind on the building and the local wind environment. The building is somewhat exposed to the south-westerly winds due to the open First Avenue road and low suburban density of buildings to the west and southwest. However, the 5-storey PDC building will provide some protection from the south-westerly winds due to its height and location. The south-westerly are Perth's most frequent wind direction and typically occur in the afternoon through to late evening, which could benefit the terrace podium level users on hot afternoon days.

The tower is also orientated in a suitable direction to minimise the impact the building has on its users and the surrounding environment. The sharp corner will mean that building will avoid large flanking walls facing the prevailing wind, which will prevent some downwash, transverse wake flows and high pressure vortexes.

The retail units on ground level will likely be fairly windy on some afternoons due to the south-westerly winds, and may require some manual protection such as drop-down screens / louvres. The current proposed vegetation and landscaping, and also café furniture will assist with reducing wind speeds in this area.

The southwest winds are likely to cause the wind to travel along the southeast facing podium level wall un obstructed which may cause some discomfort to users of the podium on the northeast of the terrace in the afternoons.

5.1.4 Westerly wind



Pressure Distribution: **High** **Medium** **Low**

Figure 10 – Wind impacts under a westerly wind

Figure 10 above illustrates the effect of a westerly wind on the building and the local wind environment. Like the south-westerly winds, the westerly winds tend to arrive in the afternoons in Perth. The westerly winds are slightly less frequent, though they can blow very strong in Perth.

The west and northwest walls of the tower could create some downwash to the balconies and podium below. Users of the podium level on the southeast and east sides are likely to be largely protected by westerly winds.

The retail units may also be somewhat affected by westerly winds in the afternoons, however, the current design shows that some protection has been provided. There is little to obstruct or slow down the westerly wind at ground level, where design solutions such as fins can create further friction, and hence, reduce wind speeds from this direction.

5.1.5 Cross-sectional wind – North / South

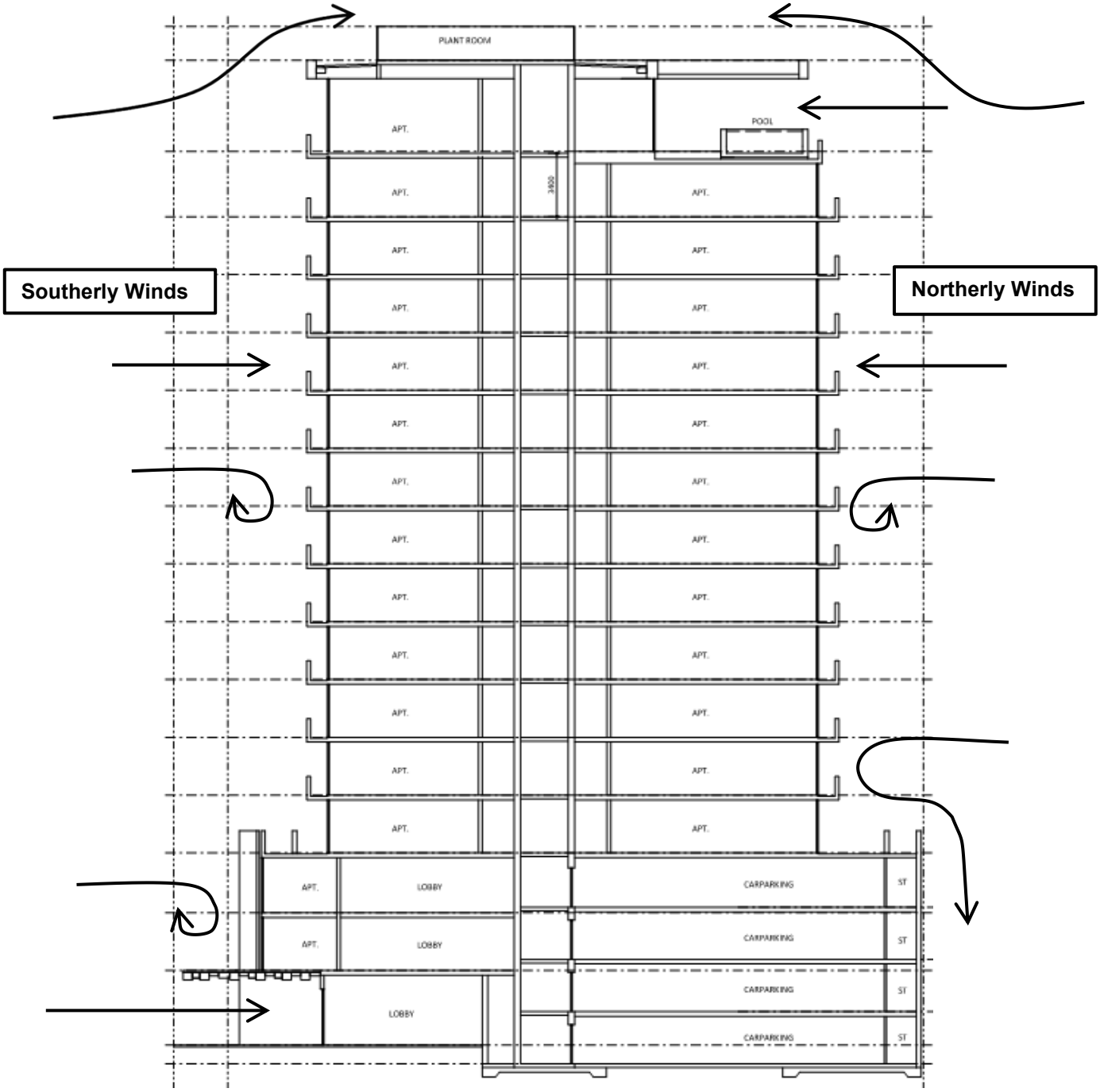


Figure 11 – Wind impacts under a northerly or southerly wind

Figure 11 above is a section that illustrates the effect of a northerly and southerly winds on the building and the local wind environment. There is little to obstruct or slow down the southerly wind against the building, as the south side is relatively unobstructed as the incoming winds travel across the low density suburban buildings. Northerly winds are also relatively unobstructed as they reach the building. From either direction, these winds may be redirected down the northern or southern façades of the building creating downwash onto the ground and podium levels. The building has balconies and awnings which reduces this effect and increases comfort the building users.

5.2 Mitigation Measures

The below summarises the key wind mitigation features that the proposed Kintail Road development currently has incorporated into its proposed design:

- The proposed development will be taller than some of the surrounding buildings within the surrounding area which may reduce wind impacts on the public walkways and on other proposed surrounding buildings in some directions;
- The tower is orientated to reduce the effects of the south-westerly winds will have on the building users and the surrounding environment. As this is Perth's most common wind direction this is a huge benefit that the building will have;
- Viewing the building in section, the building's form is composed of two parts, a tower and a 3-storey podium, which will prevent potential downwash reaching the podium and the ground level;
- In plan, the current tower design is well shaped to allow prevailing easterly and westerly winds to pass. This will help prevent winds accelerating around the tower which can cause low pressure turbulence and transverse flows.
- Awnings exist on the north side for the ground level, which will reduce the effects of potential downwash;
- The proposed balconies will also help prevent downwash onto the ground level walkways and onto the accessible podium terrace;
- The proposed design has an accessible podium terrace and the tower will help shield easterly and westerly winds respectively;
- The PDC building to the southwest of the development may help shield strong afternoon winds on the podium and balconies on this side of the proposed Kintail Road building.

6 Conclusion

The proposed Kintail Road design to be located in Applecross, Perth, has been assessed for potential negative wind impacts on the local environment.

This desktop wind impact study assessed the building against the Lawson's Criteria and has highlighted the possibility that the tower design has incorporated a large amount of design elements which will reduce the impacts that the wind may cause on the building users and the local environment. The building design includes awnings, overhangs and balconies, as well as a podium, which can mitigate some potential negative impacts from wind. The tower is also orientated southwest to northeast which will also help ensure that winds from the southwest in the afternoons will pass over the building as much as possible.

Buildings are generally limited in opportunity to completely mitigate negative effects from the prevailing winds, given the relatively exposed location close to the Swan and Canning rivers. Though wind conditions around the site are expected to be suitable for use at ground level and podium terrace level. The proposed design is considered to respond appropriately to these principles. In order to quantify the advice provided in this qualitative report computer based simulation and/or wind tunnel testing could be carried out.

Appendix A Documents List

The above was assessed based on the below documentation provided by Hillam architects:

Reference	Title	Revision	Date
Architectural Documentation			
A2-02	SK03 Ground Floor Plan	J	08/09/17
A2-03	SK03 Mezzanine Floor Plan	J	08/09/17
A2-04	SK03 Level 1 Floor Plan	J	08/09/17
A2-05	SK03 Level 2 Floor Plan	J	08/09/17
A2-06	SK03 Level 3 Floor Plan	J	08/09/17
A2-07	SK03 Levels 4 – 13 Floor Plan	J	08/09/17
A2-08	SK03 Level 14 Floor Plan	J	08/09/17
A2-09	SK03 Level 15 Floor Plan	J	08/09/17
A2-10	SK03 Roof Plan	J	08/09/17
A4-01	SK03 Section AA	C	08/09/17
A4-02	SK03 Section BB	C	08/09/17
A4-03	SK03 Section CC	C	08/09/17
Binder 11	3d render views		19/09/17

HILLAM ARCHITECTS

APPENDIX I
GREEN STAR STATEMENT

Level 1, 1 Howard Street
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Ref: Preliminary 5 Star Green Star Strategy [B]
Date: 5 September 2017

Mandy Leung
Hillam Architects
1/15 Roydhouse St,
Subiaco WA 6008

Dear Mandy,

Re: Kintail Road – 5 Star Green Star

Further to your email and our preliminary review of the current concept design documentation of the above-mentioned development below is a preliminary outline of the possible Green Star strategy for the project.

As required by the City of Melville council, the building must be designed to achieve a 5 Star Green Star Design & As-Built rating, which is seen as Australian Excellence for sustainability. Our preliminary assessment is based on the current design documentation, and also based on a recent Norup + Wilson project that we have worked on in the City of Melville which is also targeting a 5 Star Green Star rating. This preliminary assessment indicates that a total point score of 64 points could be achieved which is above the required minimum 60 points to meet a 5 Star Green Star rating. Below is a summary of the preliminary Green Star strategy:

	Require credits for 5 Star rating	Targeted credits
Green Star Design & As-Built v1.1	**60**	**64**

This is a preliminary assessment and we recommend that a Green Star workshop takes place as soon as possible to confirm the agreed targeted strategy.

Attached is the full preliminary score matrix showing the targeted Green Star credits, which will be updated following the Green Star workshop and confirmation from the design team of achievable credits.

We trust the foregoing is adequate for your purpose, but should you have any questions please do not hesitate to contact the undersigned.

Regards,
For and on behalf of Cundall,

Oliver Grimaldi
Associate
e: o.grimaldi@cundall.com
t: 08 9421 3700

	Achievable	Achieved	Targeted
Total weighted score:	**93/110**	**0**	**64**
Management			
01: Green Star Accredited Professional			
1.1: Accredited Professional	1	0	1
02: Commissioning and Tuning			
2.0: Environmental Performance Targets	0	0	0
2.1: Services and Maintainability Review	1	0	1
2.2: Building Commissioning	1	0	1
2.3: Building Systems Tuning	1	0	1
2.4: Independent Commissioning Agent	1	0	1
03: Adaptation and Resilience			
3.1: Implementation of a Climate Adaptation Plan	2	0	2
04: Building Information			
4.1: Building Operations and Maintenance Information	1	0	1
4.2: Building User Information	1	0	1
05: Commitment to Performance (C. Multi-unit Residential)			
5.1: Building Reporting (1. Building Performance Metrics)			
5.1.1C: Environmental Building Performance	1	0	1
5.2C: End of Life Waste Management	1	0	0
06: Metering and Monitoring			
6.0: Metering Strategy	0	0	0
6.1: Monitoring Strategy	1	0	1
07: Construction Environmental Management			
7.0: Environmental Management Plan	0	0	0
7.1: Formalised EMS (B. Contract value > $10 Million)			
7.1.B: Environmental Management System (>$10M)	1	0	1
08: Operational Waste (A. Waste Management Plan)			
8.1A: Waste Management Plan	1	0	1
Total unweighted:			**13 / 14**
Total weighted:			**13 / 14**
Indoor Environment Quality			
09: Quality of Indoor Air			
9.1: Ventilation System Attributes	1	0	1
9.2: Provision of Outdoor Air (A. Comparison to Industry Standards)			
9.2A: Provision of Outdoor Air (Comparison to Industry Standards)	2	0	2
9.3: Exhaust or Elimination of Pollutants	1	0	0
10: Acoustic Comfort			
10.1: Internal Noise Levels	1	0	1
10.2: Reverberation	1	0	0
10.3: Acoustic Separation	1	0	1
11: Lighting Comfort			
11.0: Minimum Lighting Comfort	0	0	0
11.1: General Illuminance and Glare Reduction	1	0	1
11.2: Surface Illumination	1	0	1
11.3: Localised Lighting Control	1	0	1
12: Visual Comfort			
12.0: Glare Reduction	0	0	0
12.1: Daylight	2	0	2
12.2: Views	1	0	1
13: Reduced Exposure to Pollutants			
13.1: Paints, adhesives, sealants and carpets	1	0	1
13.2: Engineered wood products	1	0	1
14: Thermal Comfort (3. Residential Spaces)			
14.1.3: Thermal Comfort (Residential)	1	0	1
14.2.3: Advanced Thermal Comfort (Residential)	1	0	0
Total unweighted:			**14 / 17**
Total weighted:			**14 / 17**
Energy			
15: Greenhouse Gas Emissions (B. NatHERS Pathway)	**12 / 20**		
15-B.0: Conditional Requirement: NatHERS Rating Pathway	0	0	0
15.B.1-1: Thermal and Energy Performance : NatHERS Pathway	6	0	4
15.B.1-2: Building Services, Sealing, Testing and Appliances			
15.B.1-2A: Lighting	1	0	1
15.B.1-2B: Ventilation and air-conditioning	2	0	1

15.B.1-2C: Domestic Hot Water	2	0	0
15.B.1-2D: Building Sealing	1	0	0
15.B.1-2E: Appliances and Equipment	1	0	1
15.B.1-2F: Accredited GreenPower	2	0	0
16: Peak Demand Reduction (A. Reference Building Pathway)			
16.1-A: Reference Building Pathway	2	0	0
Total unweighted:			**7 / 22**
Total weighted:	**14 / 22**		**7 / 22**

Transport

17: Sustainable Transport (B. Deemed-to-Satisfy Pathway)	**7 / 10**		
17-B.1: Access by Public Transport	3	0	3
17-B.2: Reduced Car Parking Provision	1	0	1
17-B.3: Low Emission Vehicle Infrastructure	1	0	1
17-B.4: Active Transport Facilities	1	0	1
17-B.5: Walkable Neighbourhood	1	0	1
Total unweighted:			**7 / 10**
Total weighted:	**7 / 10**		**7 / 10**

Water

18: Potable Water (B. Deemed-to-Satisfy Pathway)	**6 / 12**		
18-B.1: Sanitary Fixture Efficiency	1	0	1
18-B.2: Rainwater Reuse	1	0	1
18-B.3: Heat Rejection	2	0	2
18-B.4: Landscape Irrigation	1	0	1
18-B.5: Fire System Test Water	1	0	1
Total unweighted:			**6 / 12**
Total weighted:	**6 / 12**		**6 / 12**

Materials

19: Life Cycle Impacts (A. LCA Modelled Pathway)			
19.A.1: Comparative Life Cycle Assessment	6	0	4
19.A.2: Additional Life Cycle Impact Reporting	1	0	1
20: Responsible Building Materials			
20.1: Responsible Steel Maker and Fabricator	1	0	1
20.2: Timber	1	0	1
20.3: Permanent Formwork, Pipes, Flooring, Blinds and Cables	1	0	1
21: Sustainable Products			
21.1: Product Transparency and Sustainability	3	0	0
22: Construction and Demolition Waste (B. Percentage Benchmark)			
22.1.B: Reduction of Waste (Percentage Benchmark)	1	0	1
Total unweighted:			**9 / 14**
Total weighted:			**9 / 14**

Land Use & Ecology

23: Ecological Value			
23.0: Conditional Requirement: Endangered Species	0	0	0
23.1: Ecological Value	3	0	1
24: Sustainable Sites			
24.0: Conditional Requirement	0	0	0
24.1: Reuse of Land	1	0	1
24.2: Contamination and Hazardous Materials	1	0	1
25: Heat Island Effect			
25.1: Heat Island Effect Reduction	1	0	1
Total unweighted:			**4 / 6**
Total weighted:			**4 / 6**

Emissions

26: Stormwater			
26.1: Peak Discharge To Sewer	1	0	1
26.2: Pollution Targets	1	0	0
27: Light Pollution			
27.0: Light Pollution to Neighbouring Properties	0	0	0
27.1: Light Pollution to Night Sky (A. Upward Light Output Ratio)			
27.1A: Control of Upward Light Output Ratio (ULOR)	1	0	1
28: Microbial Control (B. Waterless Heat Rejection)			
28.1B: Waterless Heat Rejection Systems	1	0	1
29: Refrigerant Impacts			
29.1: Refrigerant Impacts	1	0	1
Total unweighted:			**4 / 5**
Total weighted:			**4 / 5**

Innovation

30.A: Innovative Technology or Process		1	0	0
30.B: Market Transformation		1	0	0
30.C: Improving on Green Star Benchmarks		1	0	0
30.D: Innovation Challenge		1	0	0
30.E: Global Sustainability		1	0	0
	Total unweighted:			**0 / 5**
	Total weighted:			**0 / 5**

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APPENDIX J
CERTICICATE OF TITLES

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