14.4 **Structural System**

Stepping columns

The key structural features for the tower are as follows;

- Foundations: pad footings founded on Sandstone;
- Lateral stability system: a reinforced concrete core and outrigger system utilizing the full building footprint to optimize overall building stiffness and to minimize wind induced accelerations. Outrigger wall connections to the perimeter Mega-Columns have been located to avoid conflict with the proposed apartment and hotel layouts;
- Typical tower floor framing: generally 200mm / 220mm thick post-tensioned flat plate slabs spanning up to 10m with cantilevers up to 3m;
- Non-typical tower floor framing: generally 250mm thick post-tensioned flat plate slabs at plant floors, heavy load floors and column transition levels;
- Podium floor framing: generally banded post-tensioned slabs comprising 180 to 250mm thick slab panels and 350 to 500 thick beams;
- Gravity Columns: typically blade columns located to align with party walls. To suit the sloping and twisting building profile whilst maintaining vertical continuity the structural solution is to 'step' the blades as required along their longer axis. Rationalization of the column stepping is being undertaken to minimize induced horizontal thrusts into the floors and the core;
- Interface with existing structure: the tower podium is to be isolated from the existing structure via a permanent movement joint. Room planning and floor efficiency require the tower core to be located adjacent to an existing operational goods lift; and
- Wind loading: the building has been analyzed under wind loading in accordance with the Australian Standard, AS/NZS 1170.2, further development and optimization of the lateral load resisting system will be undertaken following wind tunnel testing.

Study physical model showing interlocking tower volumes

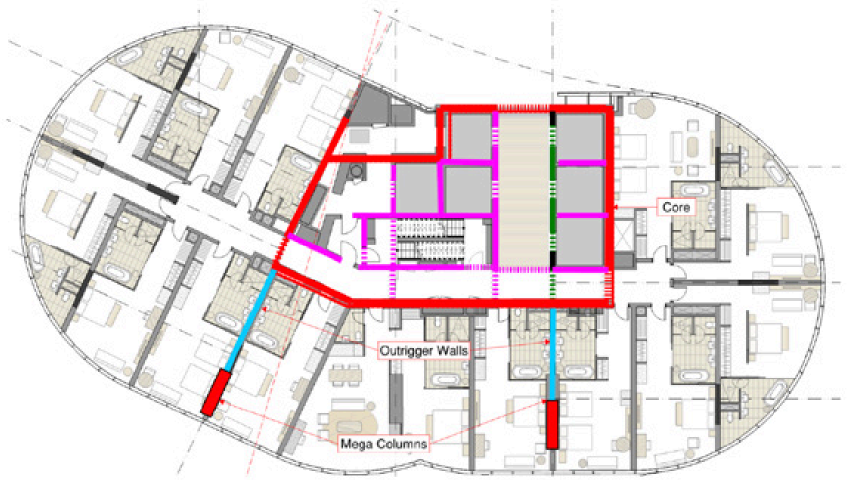
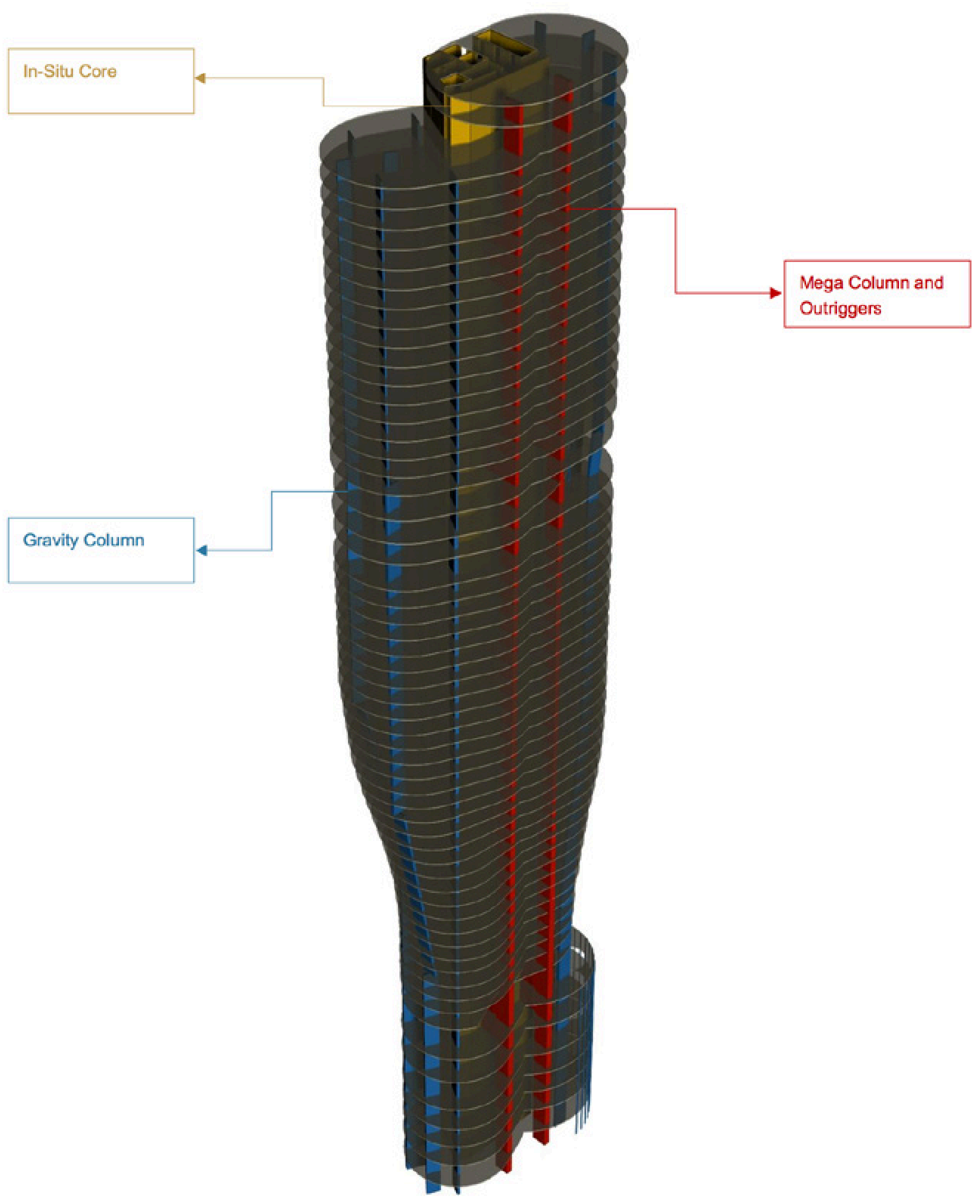


FIGURE 4.2.1 CORE LAYOUT

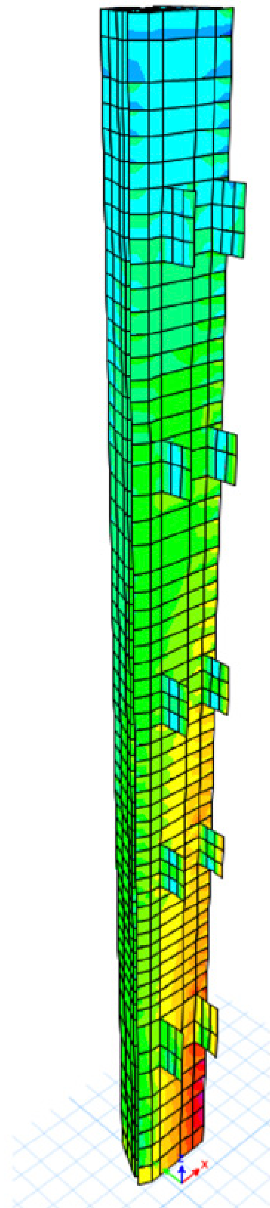
Legend	Base to Level 19	Level 20 to Level 41	Level 42 to Top
	600 thick Walls, N80 Concrete	500 thick Walls, N65 Concrete	400 thick Walls, N50 Concrete
	500 thick Walls, N80 Concrete	500 thick Walls, N65 Concrete	400 thick Walls, N50 Concrete
	250 thick Walls, N80 Concrete	250 thick Walls, N65 Concrete	250 thick Walls, N50 Concrete
	500 thick Walls, N80 Concrete*	500 thick Walls, N65 Concrete*	400 thick Walls, N50 Concrete*

TABLE 4.2.1 WALL THICKNESSES

Core layout on a typical floor



Structural CAD model. Red columns denote 'mega columns' for outrigger walls

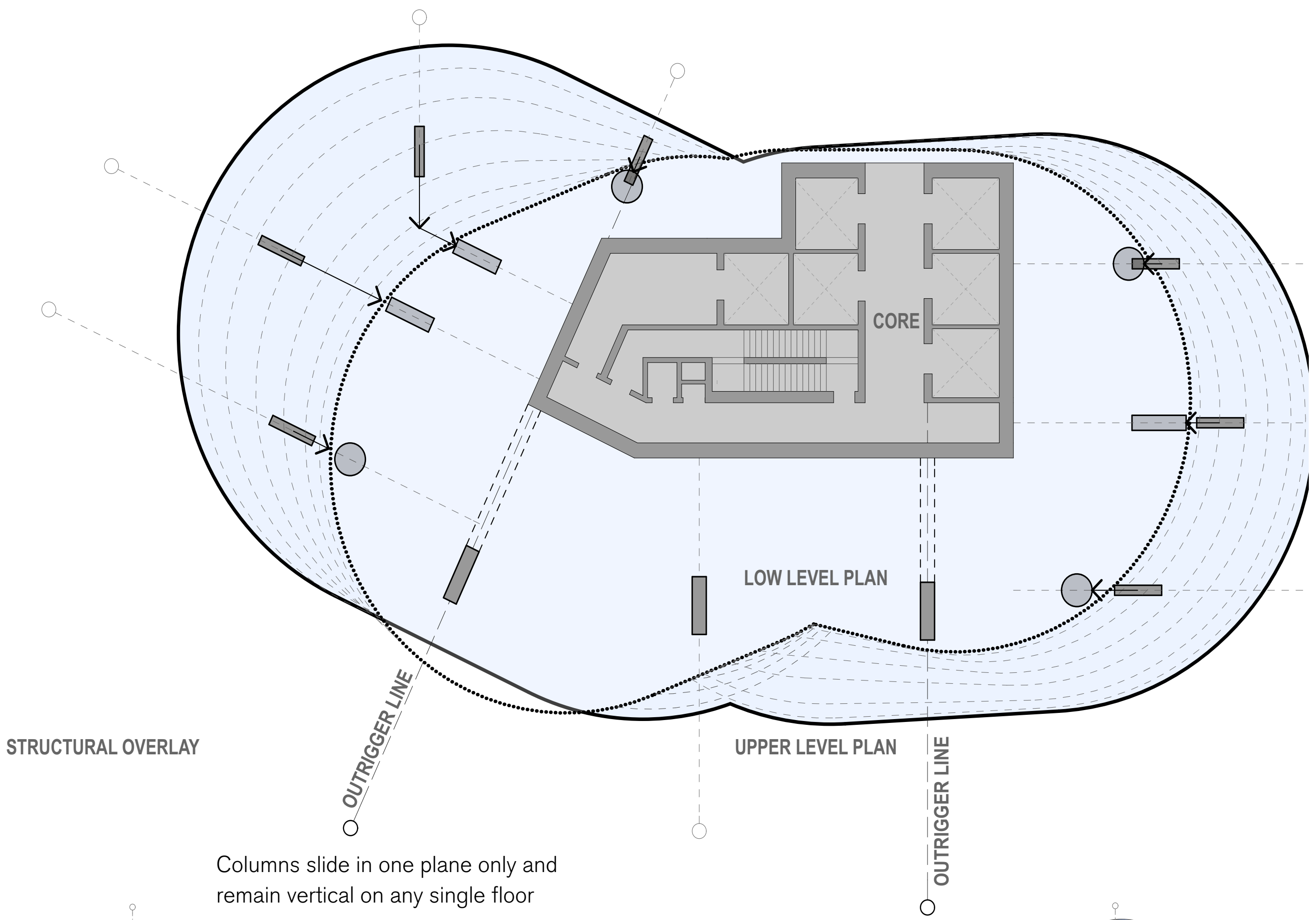


Core box and outrigger walls

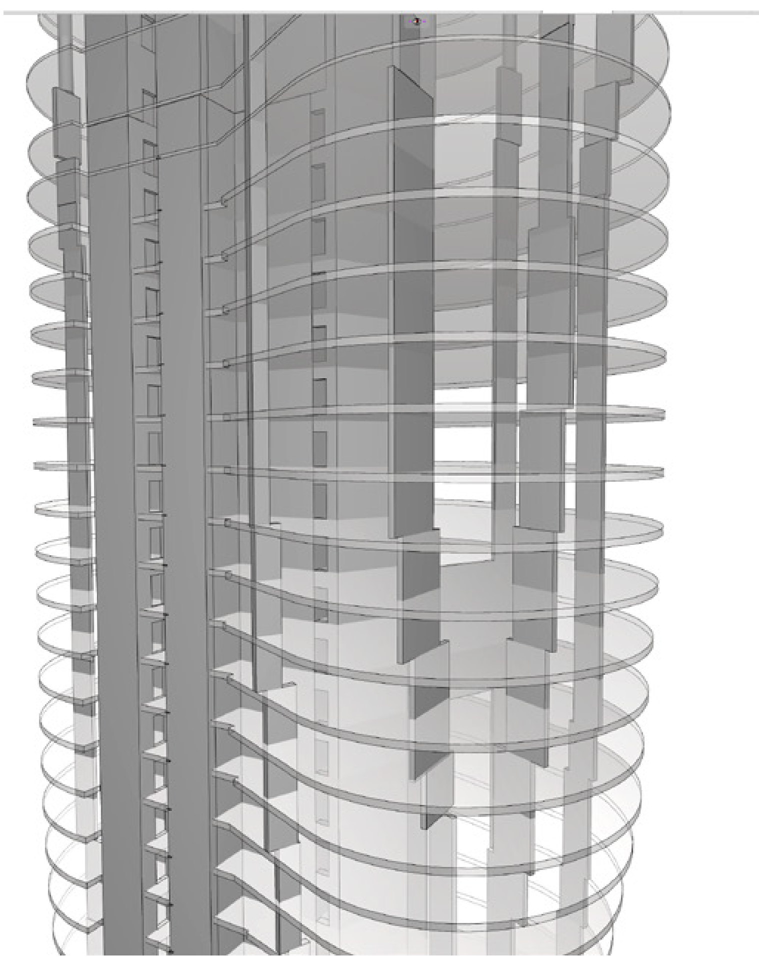
14.5 **Column Shifting**

Columns slide in one plane only

The diagrams to the right highlight those columns to the south and north of the central zone which step in a linear manner (along their long axis) as the form of the tower steps in and out. These columns are typically blade columns such that they can offset between floors within the party walls of the apartments.



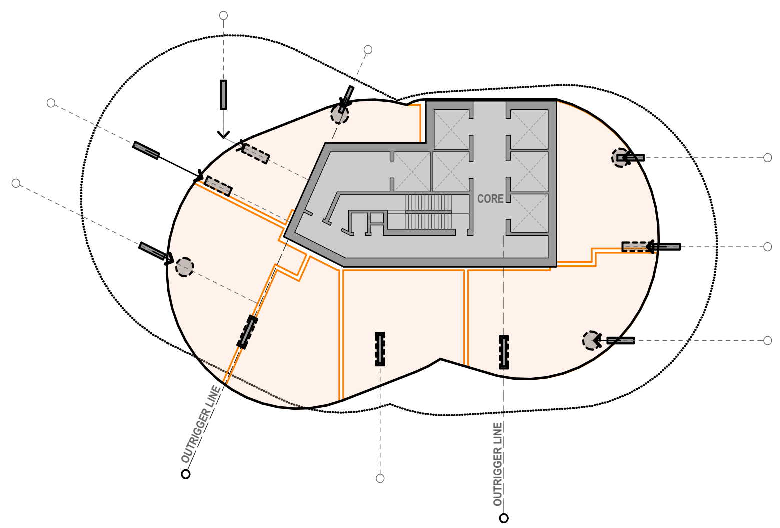
Columns slide in one plane only and remain vertical on any single floor



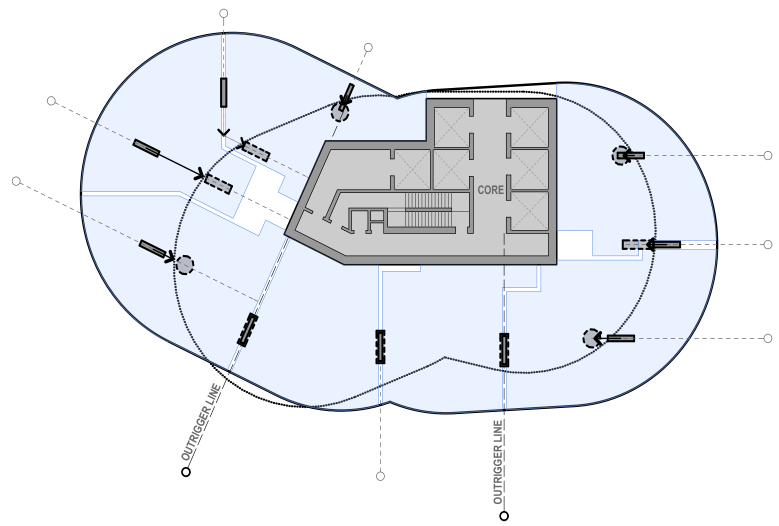
Study model of structure showing side core and columns stepping between floors

Stepping structure

One Blackfriars, South Bank, London



Lower level tower plan showing column positions



Upper level tower plan showing column positions

14.6 **Car Parking**

Given the spatial restrictions imposed by site boundaries and the light rail network an automated car stacker solution has been proposed. Automated stackers are highly flexible and increasing a good option for maximising parking in otherwise compromised locations.

Access is from the existing service lane on Basement Level 2. Entry to this service lane is from Pirrama Rd. and exit is via the service road to the north. Three entry cabins (car park lifts incorporating turntables) are located between the taxi drop off and the event centre loading dock. Residents park their car into a entry room, turn off their car, gather their belongings, and then leave the room to either walk via a bollard protected passage to the hotel area or a private lift, stair and corridor system dedicated to residents which connects into the Jones Bay Road residential lobby at Level 00.

221 hotel and resident car spaces are proposed in the system, spread between three separate stacker machines, all side by side and within the same 10 level/ circa 25m deep basement enclosure. Hotel valet and Residential breakup is according to the table below.

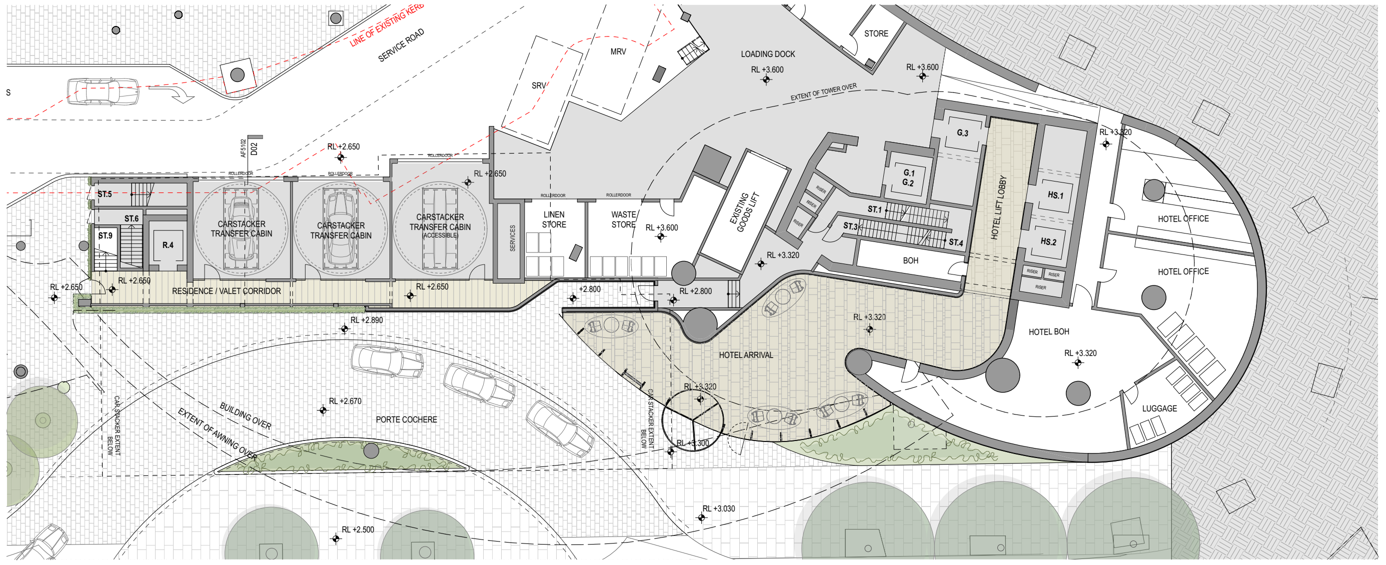
The nature of the carstacker means only inducted persons or parties can operate it - any visitors to the hotel or residences can utilise the central car park.

A single entry room for system 3 (northern most) has been sized to be fully accessible for wheel chair users.

For Further operation details, refer to the Car Stacker Management Plan (CSMP).

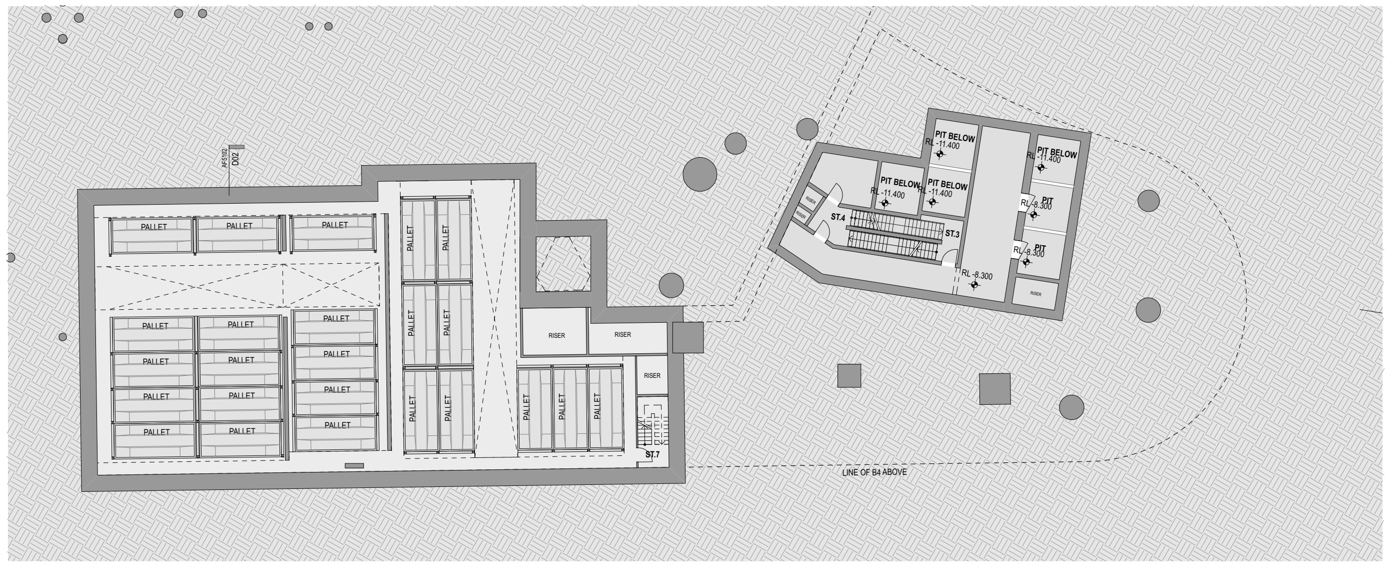
CARSTACKER		SYSTEM 1			SYSTEM 2			SYSTEM 3 (ACCESSIBLE)			
Level	RL (AHD)	RESIDENTIAL	HOTEL VALET	TOTAL SPACES	RESIDENTIAL	HOTEL VALET	TOTAL SPACES	RESIDENTIAL	HOTEL VALET	TOTAL SPACES	
B3 TRANSFER	-0.990										
SEDAN	-2.880	10		10	5		5	9		9	
SEDAN	-4.610	10		10	5		5		9	9	
SUV	-6.740	10		10	5		5	9	9	9	
SEDAN	-8.720	10		10		5	5			9	
SEDAN	-10.450	5	5	10	5		5	9		9	
SUV	-12.580	5	5	10		5	5	9		9	
SUV	-14.960		10	10	5		5	8	1	9	
SUV	-17.090	10		10	5		5	9		9	
SUV	-19.470	7		7	5		5	9		9	
SUV/PLANT	-21.600	-	-	-	2		2	6		6	
LIFT PIT	-25.100										TOTALS
	RESIDENTIAL	67			37			68			172
	HOTEL VALET		20			10			19		49
	TOTALS	SYSTEM 1		87	SYSTEM 2		47	SYSTEM 3 (ACCESSIBLE)		87	221

Carstacker parking level breakdown & indicative stacker images below

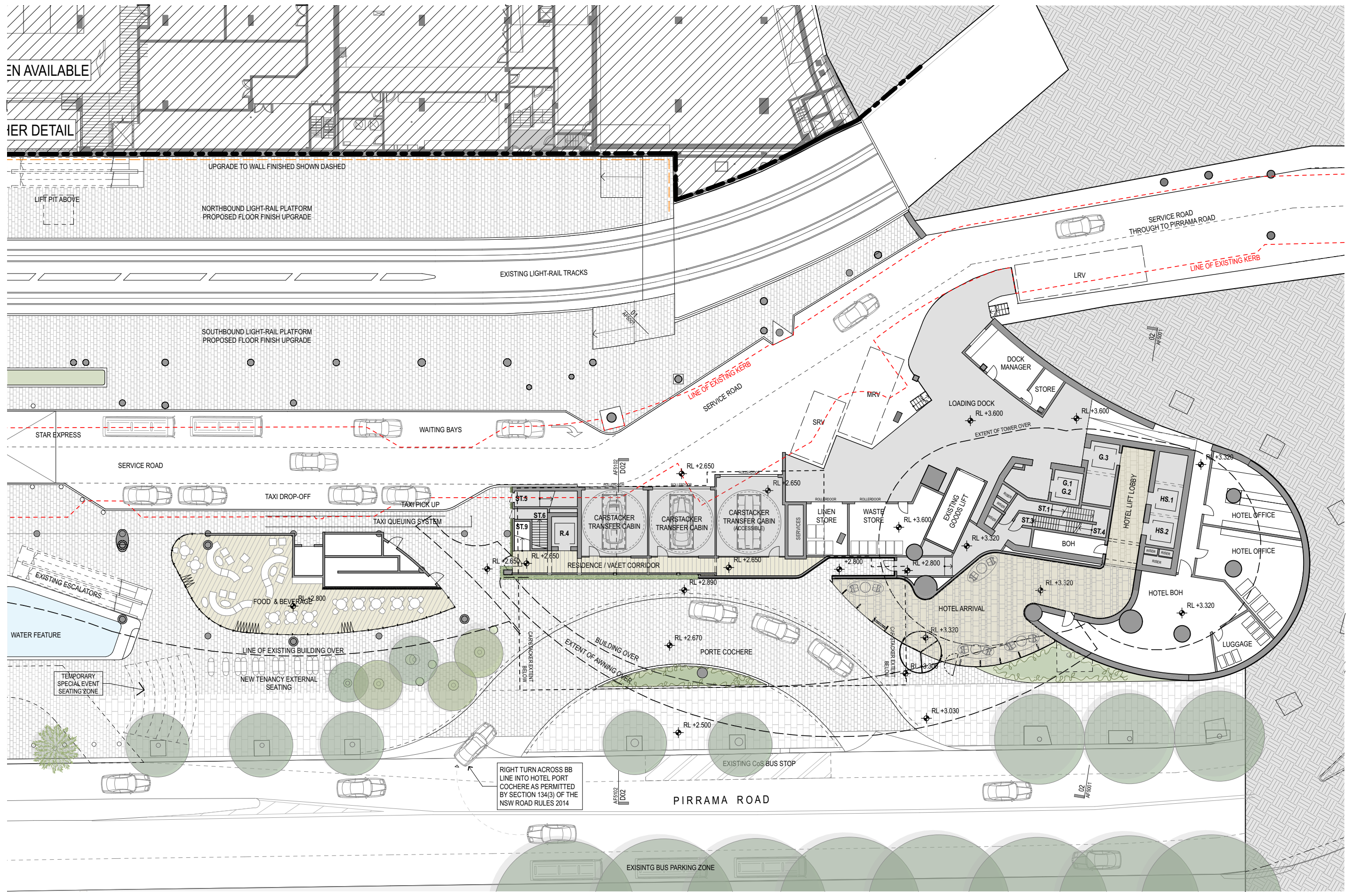


Basement Level 2 - Carstacker entry cabins and turntables

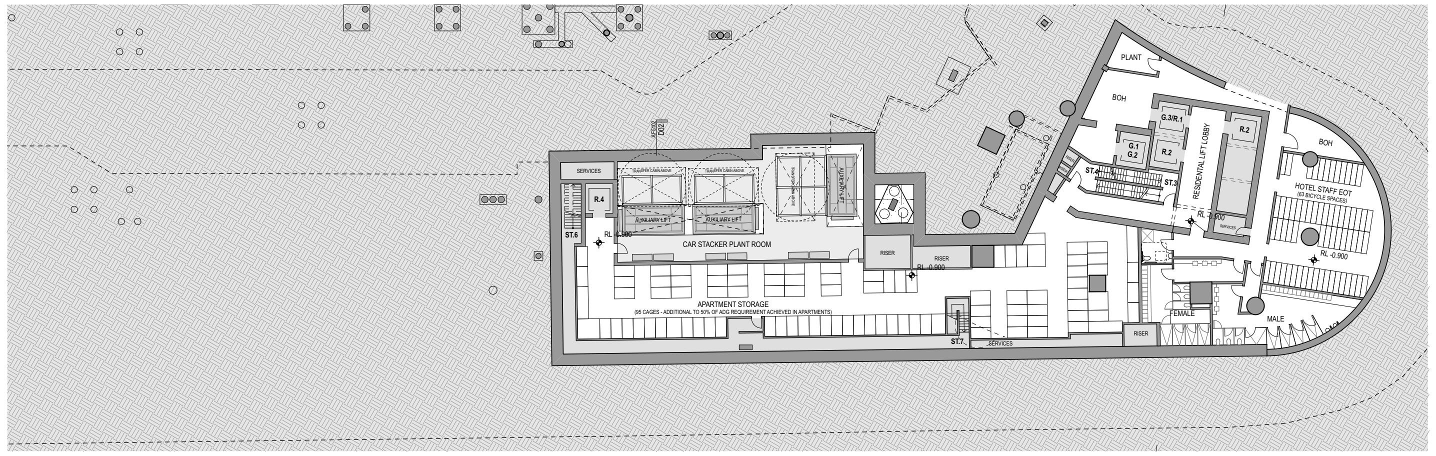
Basement Level 3 - Carstacker transfer level



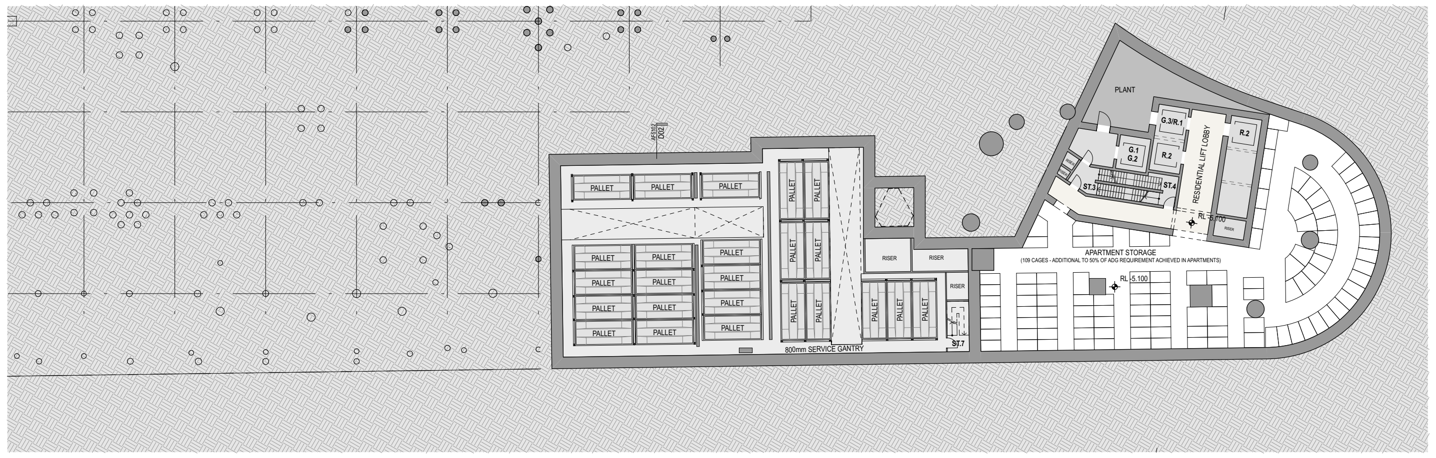
Basement Level 5 - Carstacker Typical level



Pirrama Road Level (Basement Level 2)



Basement Level 3



Multi-story automated car stacker (entirely within site boundaries)

14.7 Bicycle Parking

The following cycle parking provisions are proposed under Modification 13:

- 61 x Class 1 spaces for employees; and

- 73 x visitor spaces

The SEGL strategy for visitor cycle parking provision is:

- 20 rental bikes in the Pirrama Road forecourt

- 13 bike lockers adjacent to the Light Rail platform

- 29 bike racks located in groups at the major entry points

The class 1 spaces for employees is situated on Basement Level 3, and accessed via the hotel goods lift and the staff entry off Jones Bay road. Proportionate end of trip facilities, including changeroom lockers, showers, and toilets, have been provided adjacent to the bike parking.

Use	Staff per shift[3]	Rate	Provision
Hotel	92	1 per 4	23
Apartments	-	-	-
Star	118[4]	1 per 10	12
Total			35

Employee cycle parking spaces

Use	Measure	Rate	Provision
Hotel	220 keys	1 per 20	11
Apartments	198 keys	1 per 10	20
Star	9,435sqm	1 per 300	31
Total			62

Visitor cycle parking spaces

14.8 Loading Dock

Upgrades to the event centre loading dock are planned to accommodate the F&B, hotel and residential servicing loads of the proposed tower. The event centre dock is located off the wholly internal service lane on Basement level 2. This is an ideal outcome for concealing, visually and acoustically, the loading dock use from neighboring residents. The internal dock will also enable 24 hour use where required to sufficiently service all resort programme corresponding to the dock.

The dock will accommodate independent SRV, MRV, and a LRV bays, with space for another 4 service vehicle bays. There is availability to utilise the taxi drop off spaces in off peak times for loading dock waiting and management.

In major event modes, the service road is designed to take a row of stationery vehicles along the eastern edge whilst maintaining through traffic.

For further operational details please refer to the Loading Dock Management Plan.

14.9 Waste

Daily general waste and recycling collection is envisioned for both the hotel and residential tower functions. Independent waste collection rooms will be located within the event centre dock.

Hotel floors will accommodate on-floor recycling storage and a general waste chute system terminating at the mid-level plant room on level 41. General waste and recycling will be transported by hotel staff to the dock collection rooms via the hotel goods lifts on a daily basis.

A similar strategy is proposed for the residential floors wherein a waste room enclosure is accommodated on each floor incorporating recycling bins and a independent chute terminating at Level 01. Residential waste will be transported by building management staff to the dock collection rooms via the residential goods lifts on a daily basis for collection.

A vacuum waste collection system has also been explored to reduce vehicular load on the event centre dock and the ongoing operational expense of the daily handling of multiple waste streams. The suction waste system would include two tower gravity chutes (recycling and general waste) consistent from top to bottom through both resi and hotel floors, feeding a single horizontal vacuum duct terminating via an alternating bifurcated header into a recycling and a waste compactor within either the Jones Bay Rd dock or the Event dock off the service road.

14.10 **Introduction of Residential Use**

The residential use is proposed for a sunny corner of the site not impacted by casino-related activity, and in a prototypical Pyrmont setting; surrounded by residential and commercial neighbours.

Arrival & Address - Jones Bay Rd

The address for the residential apartments is Jones Bay Road which has a leafy, calm and neighbourly character.

Consistent with nearby apartment buildings in Pyrmont, the base of the residential tower appears contiguous with adjacent development to maximise valuable street frontage and preserve street front activity. The proposed activity adjacent to the residential lobby will contribute to and reinforce the residential and neighbourly setting, with a small cafe with morning sun to the west and the neighbourhood centre to the east.

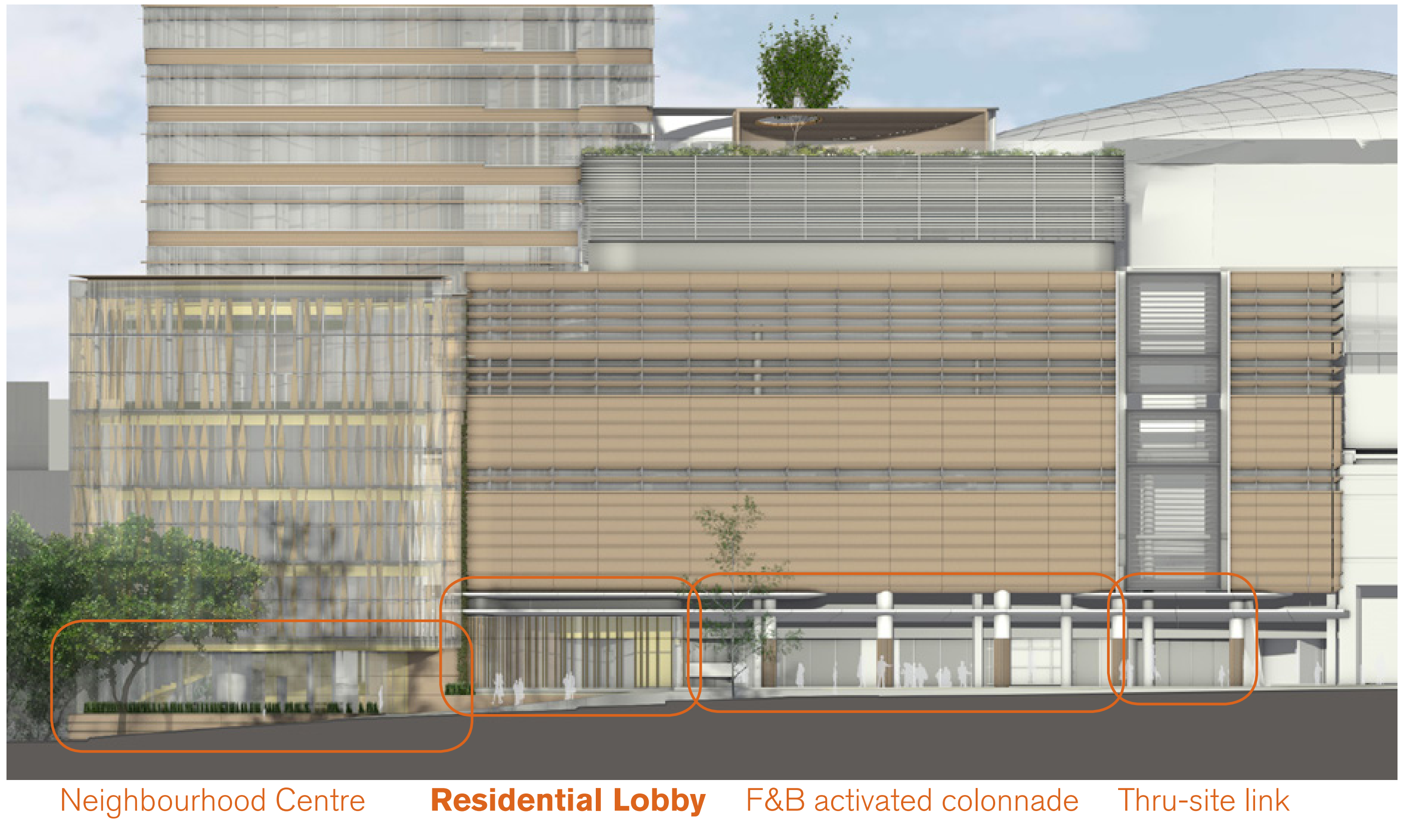
Interconnectivity

There are no internal pedestrian connections to Star facilities from the residential portion of the tower. Rather, it has been designed in many ways to act and feel as a separate building to establish and emphasise a residential character. The residential communal facilities on Level 7 are only accessible from residential-only floors within the tower and are screened from with no connectivity to the Star Facilities.

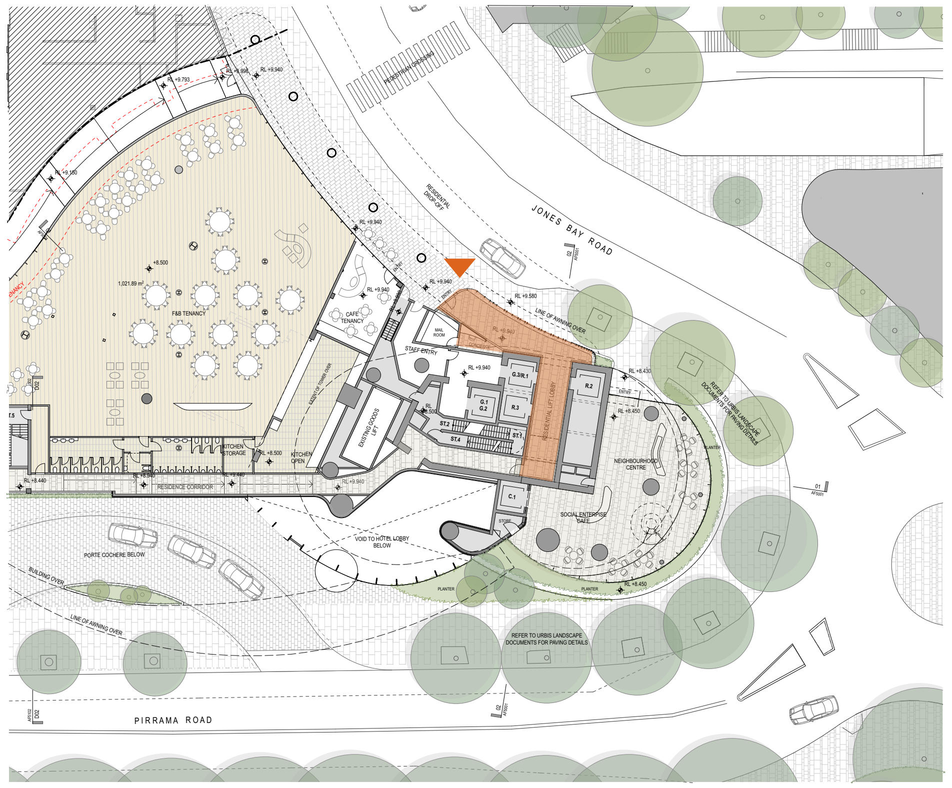
The residential car park is shared with the hotel, and separate from the primary Star car park. A shared car park is not uncommon for city-based residential development, and the automated car stacker removes any of the inconveniences typically experienced by shared parking facilities.

Map extract identifying the residential properties within the vicinity of the Star. The orange circles denote the residential tower location and the residential precinct it corresponds to.

Jones Bay Rd. address



Residential Lobby via Jones Bay Rd.



Building Separation

Though the tower base is contiguous with the Star resort, the building separation afforded to the tower apartments surpasses the ADG and the typical separations experienced by other residential developments around Pyrmont.

The residential apartments are separated from the Astral hotel tower by 47m to the west. This nearly doubles the 24m min setback stipulated in the NSW ADG, and is 50% greater than the separation to the Watermark apartments, the closest adjacent building.

There is 55m of separation between the residential apartments and the edge of the Level 07 Ritz-Carlton hotel open-to-air pool deck, which is the closest Star-related facility with potential for noise generation. There is 110m of separation to the open-air Level 05 terrace. 110m separation is a significant separation distance for any residential use in a dense urban environment.

Apartment Flexibility & Amenity

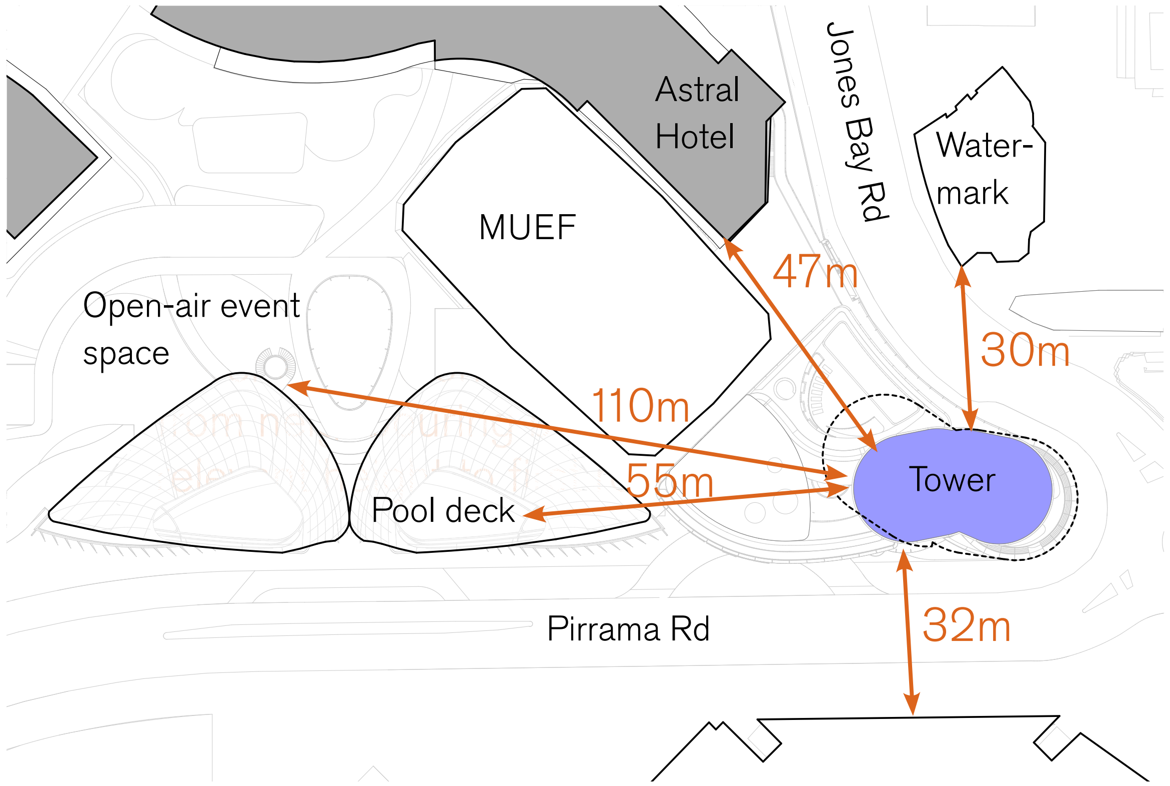
Apartment amenity has driven the design of the tower floor plates. The lift and services core has been situated to the west of the floor plate to reduce the number of apartments overlooking the Star facility and direct the predominant outlook outward to the scenic east and north.

The apartments potentially impacted by Star event facilities have been designed to permit a high degree of occupant environmental flexibility and amenity. Juliet and wintergarden balconies with 100% sealable and acoustic facades will provide great control. The facade system toward the base of the tower also includes increased spandrel heights and projecting horizontal louvres for privacy and special event light management. The internal facade skin adds a fabric black-out curtain for further privacy and special event response control. This will be a dynamic, intuitive and very high performance residential facade.

Limited Environmental Impact

The separate lobby situated sympathetically in a residential character area, the separation of residential facilities from Star facilities, tower siting to maximise building separations, careful tower internal planning and a high degree of facade performance and flexibility for environmental control combines to create an ideal location for residential land use complimenting and enlivening the overall Star resort and the surrounding Pyrmont precinct.

Tower separation diagram



Typical low rise facade system including internal curtain skin, horizontal louvre and increased spandrel height for increased privacy

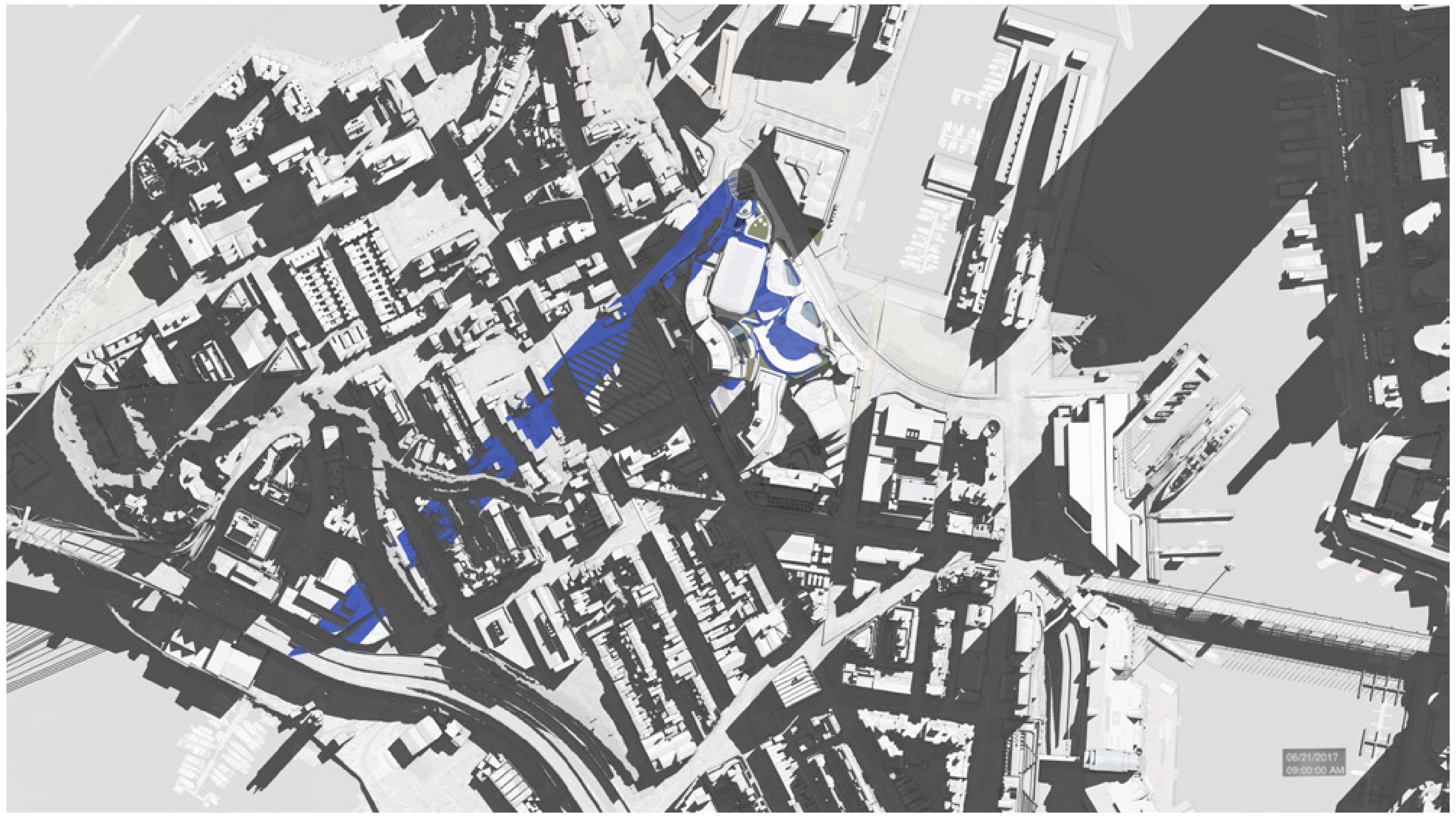
Northern aerial perspective

14.11 **Pyrmont Wide shadow impacts**

Shadow analysis

Shadow diagrams are shown at 1 hours intervals between 9.00am and 3.00pm on 21 June. Additional, larger scale shadow studies are provided in Appendices 17.5-17.7 of this document, and reflect the winter solstice, summer solstice, and March equinox Mod13 shadows beyond what has already been assessed (up to and including Mod14).

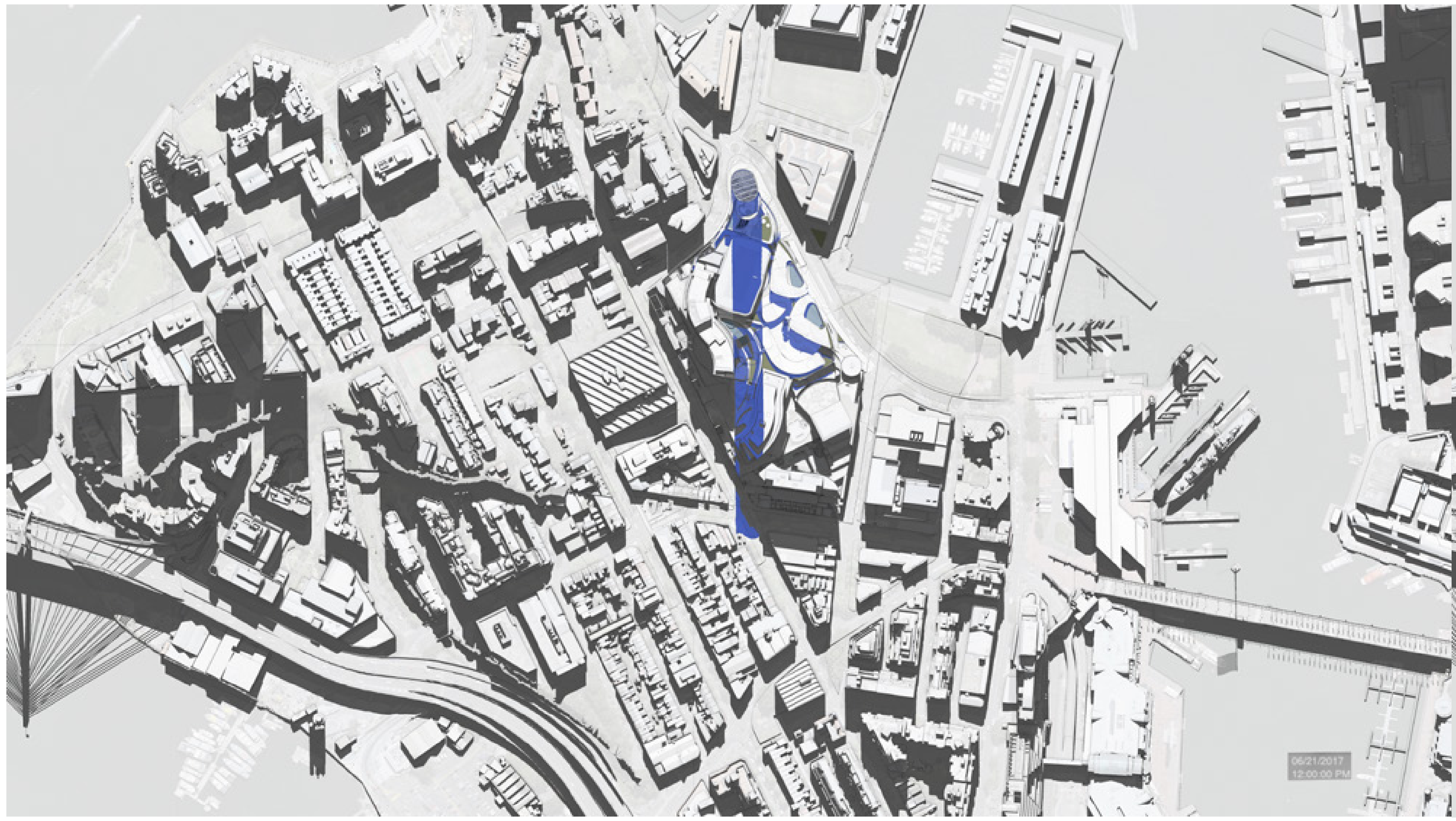
These diagrams emphasise the fast moving nature of the tower shadow across Pyrmont and how the tower shadow is predominately over the existing Star resort through the sensitive lunchtime hours of 11am-2pm rather than adjacent properties and public spaces.



June 21 - 9.00am

June 21 - 10.00am

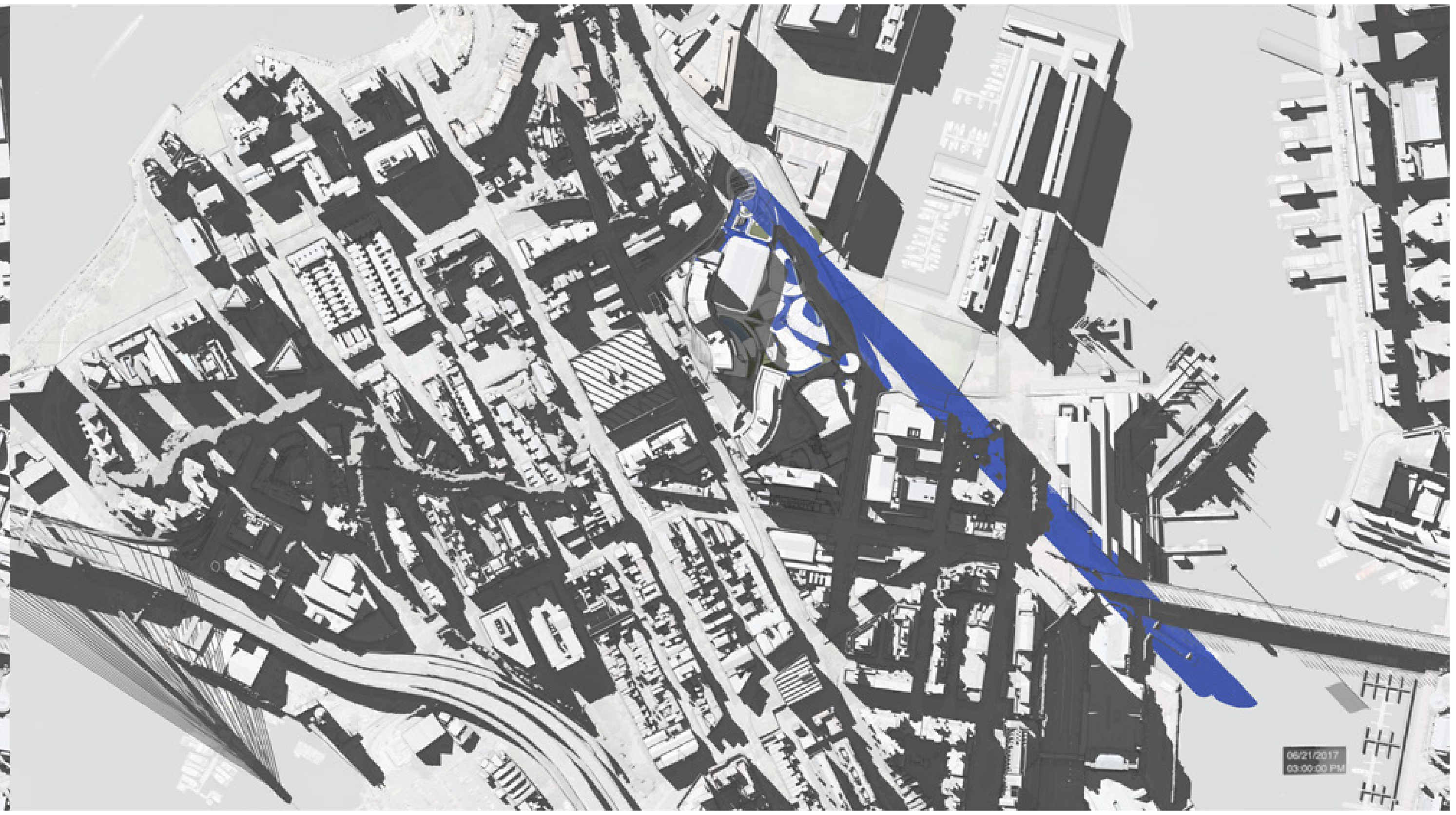
June 21 - 11.00am



June 21 - noon

June 21 -1.00pm

June 21 - 2.00pm



June 21 - 3.00pm

14.12 **Public Space Solar Analysis**

Overview

One of the key Design Principles as noted in Section 7.0 of this report notes that:

This project should enhance the public spaces of Pyrmont. It should limit winter overshadowing of the squares and parks of Pyrmont, particularly during the middle of the day. The protection of these important public spaces should be a determinant of the form and height of the new building.

As stated in Section 7.1 of this report Union Square and Pyrmont Bay Park are important public spaces within Pyrmont. In addition to the detailed shadow analysis as included within this report, a further solar study has been undertaken. This analysis informed the design process and allowed the tower form to be developed such that it results in limited environmental impact within these public spaces.

This analysis measures the existing and future direct solar access within public spaces between the hours of 9.00am and 3.00pm across the duration of a year. Specialist software (Grasshopper for Rhino with custom plug-ins) was used. This software allows a 'heat map' to be produced illustrating hours of direct solar access across the extent of the public spaces.

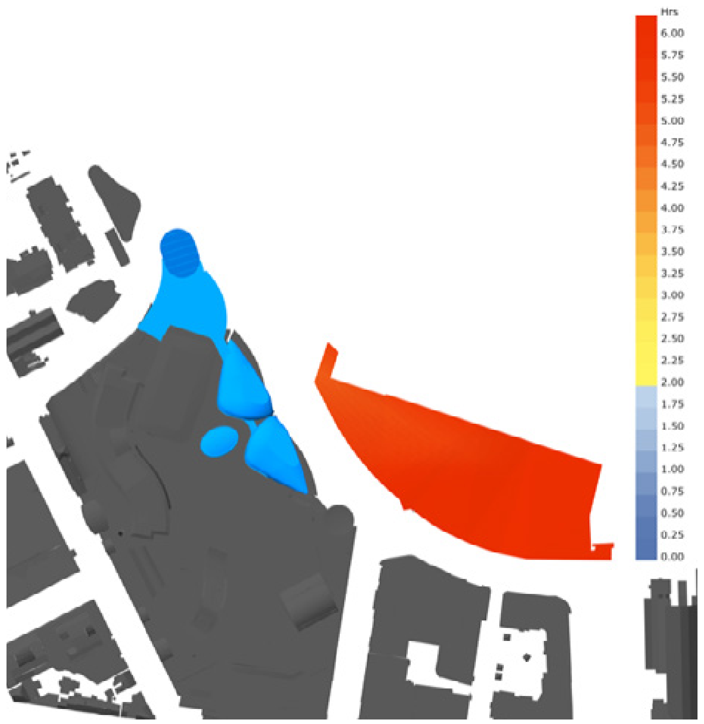
Before-and-after data extracted and converted into a graphic format allows a clear illustration of impact on direct solar access to these spaces across the duration of a year. The Y axis in these graphs is a product of public space surface area X hours of direct solar access between 9.00am and 3.00pm. For example, an area that receives 100% direct solar access between 9.00am and 3.00pm will record a Y axis value of 100. However, if only 50% of an area receives direct solar access for 50% of the time between 9.00am and 3.00pm this will record a Y axis value of 25.

As is typical of shadow and solar analysis, the study excludes the existing or proposed shading impacts from trees. It is however noted that both Union Square and Pyrmont Bay Park are currently substantially shaded by existing, mature trees. If the impact of tress were factored in, the variance between existing and proposed solar access figures is reduced further.

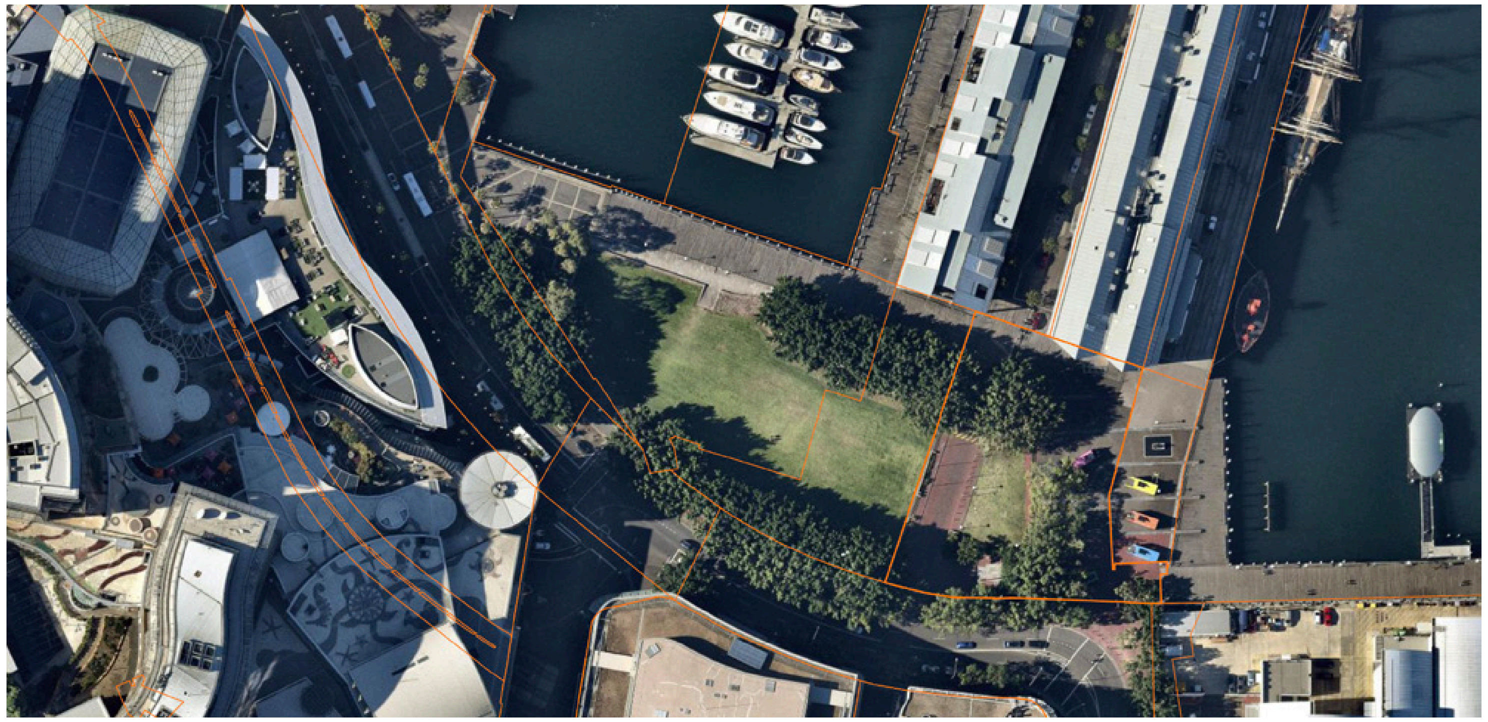
For the purposes of the analysis the extent of Union Square and Pyrmont Bay Park is as per the associated Cadastre Boundaries as extracted from Nearmap and shown in the illustrations to the right.

Extract from study model showing proposed tower and extent of Union Square and Pyrmont Bay Park as modelled.

Union Square showing cadastre boundary as adopted for solar analysis



Heat map analysis showing direct solar access to Pyrmont Bay Park at equinox upon completion of tower.



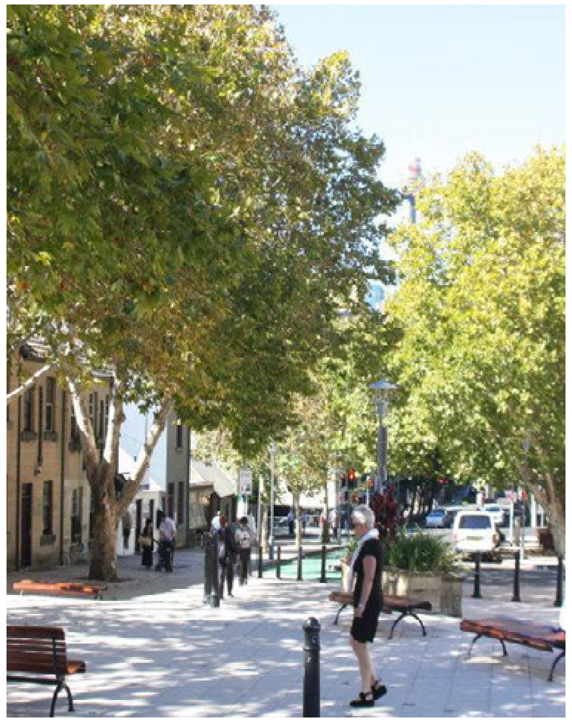
Pyrmont Bay Park showing cadastre boundaries as adopted for solar analysis

Union Square

The analysis of Union Square determined that the square currently receives 92.8% direct solar access between 9.00am and 3.00pm during summer, dropping to 64.4% during mid winter. The solar analysis verified the shadow analysis finding that the tower will have nil impact to Union Square outside the 19 May and 24 July window (refer to Appendix 17.8 for related shadow diagrams). During these 66 days, the proposed tower has a limited impact upon the direct solar access to Union Square, with the largest impact being at mid winter, ie: June 21. On this day the solar analysis determined that the direct solar access to Union Square between 9.00am and 3.00pm was reduced from 64.4% to 59.8%. This 4.6% reduction represents the largest solar impact to Union Square on a single day, and even taken in isolation is considered to be a limited environmental impact.

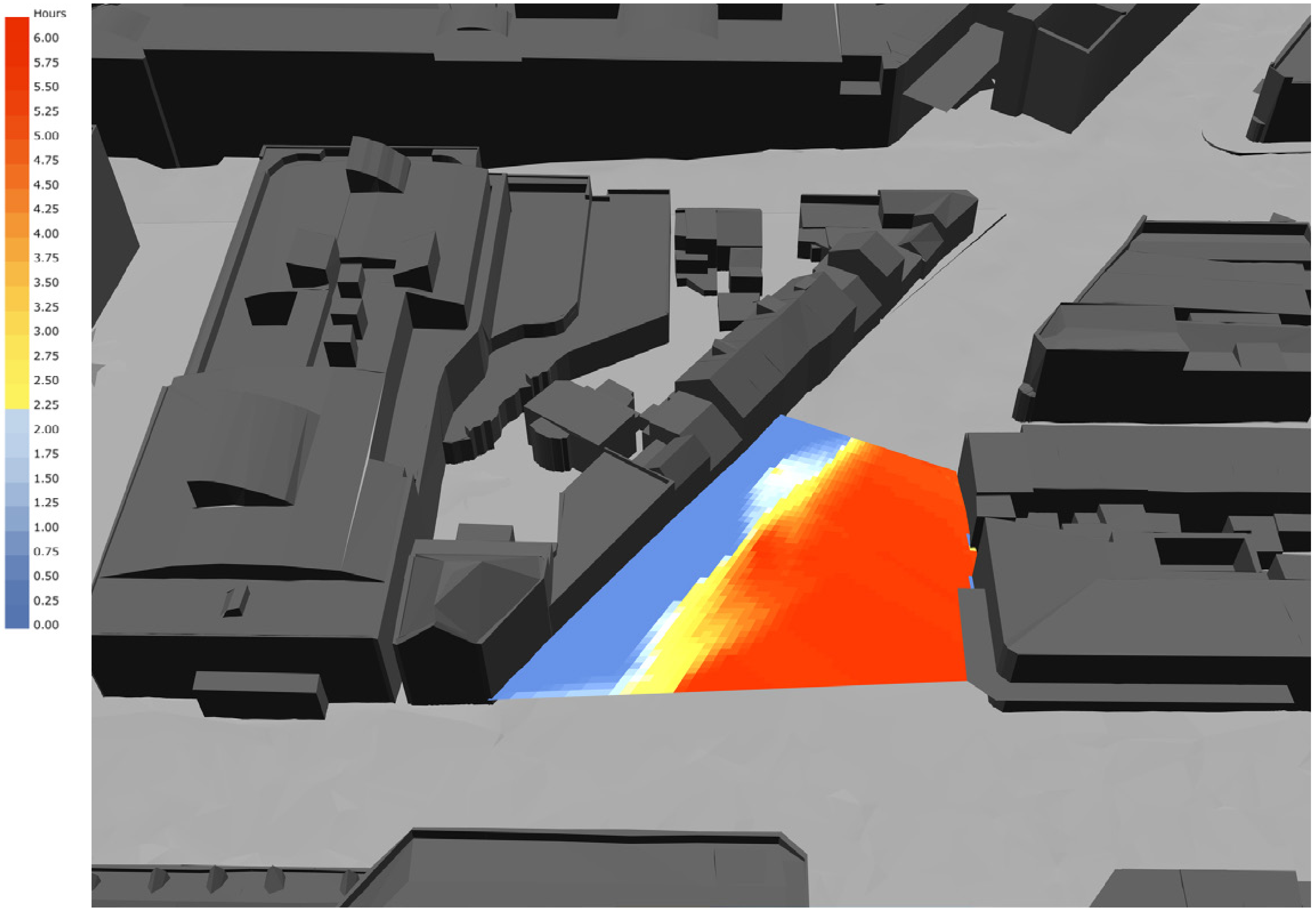
The low percentage figure results from the fast moving shadow as resultant from the tower which fully passes across Union Square between 10.30am and 11.30am at mid winter. This limited impact on mid winter direct solar access thus occurs outside the key lunchtime period.

Over the period of a year the current average figure for direct solar access to Union Square between 9.00am and 3.00pm is 82.1%. The additional shadow from the proposed tower sees this annual figure reduced to 81.5%, a reduction of 0.6%.



Union Square - street level view

Union Square - elevated view



June 21

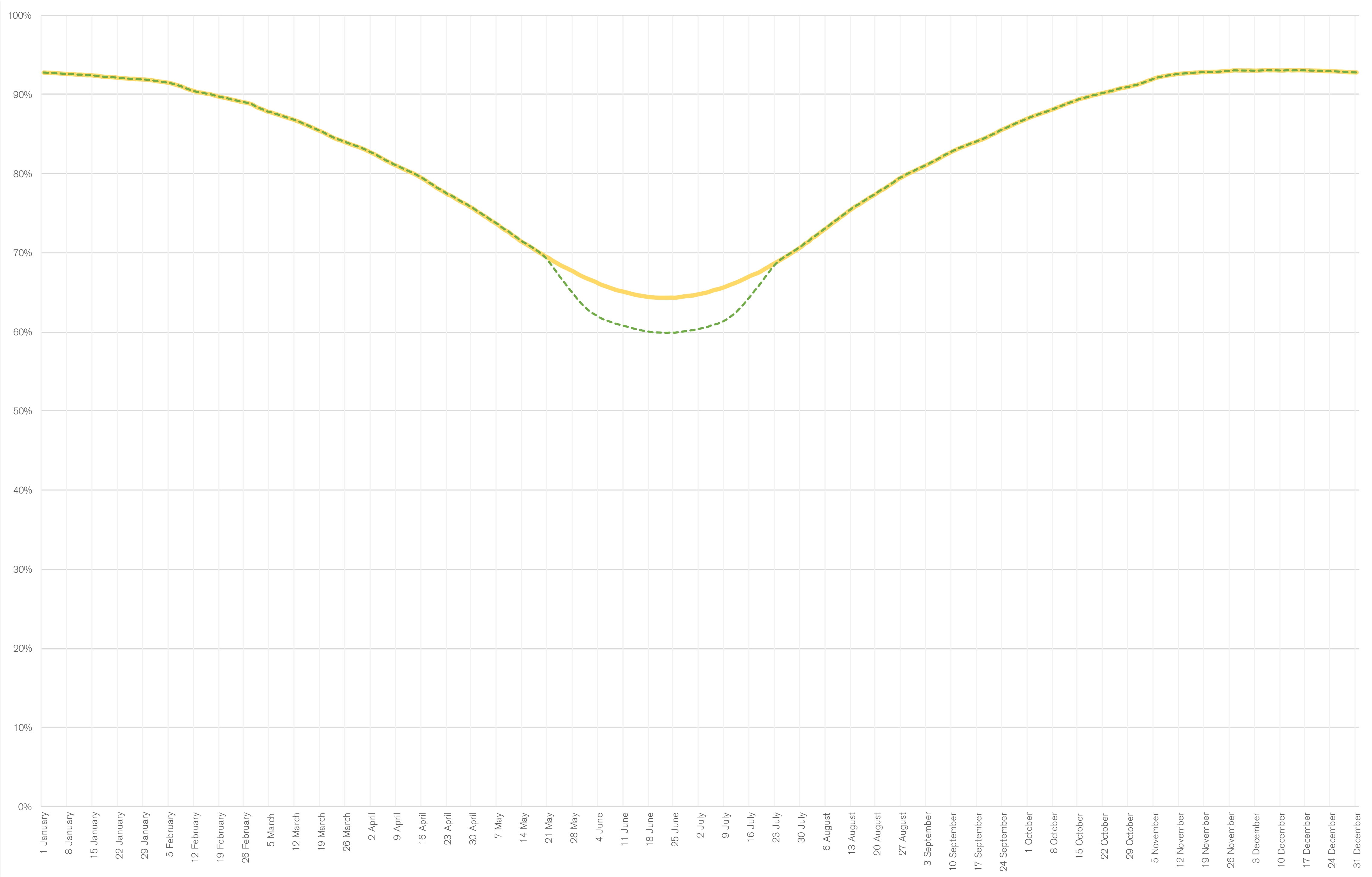
Union Square 'heat map' analysis showing direct solar access at ground level upon completion of proposed tower. Blue zone indicates areas receiving less that 2 hours direct solar access. These areas are attributed to existing overshadowing resulting from the exiting built edge to Union Square.

Union Square

In conclusion, Union Square currently benefits from a high degree of direct solar access. The loss in direct solar access as resultant from the proposed tower is minimal and has been determined by close analysis to result in a limited environmental impact. As such, the tower form as proposed is consider to align with the above stated Design Principle.

Union Square - street level view.

equates to % of public space area with direct solar access x % of time between 9.00am and 3.00pm



Annual values for direct solar access to Union Square

Existing — With proposed tower

Pyrmont Bay Park

The analysis of Pyrmont Bay Park determined that the park currently receives 100% direct solar access between 9.00am and 3.00pm at all times during the year. In contrast to Union square, the largest impact upon the direct solar access to Pyrmont Bay Park as resultant from the proposed tower and ribbon occurs not at mid winter but at the equinoxes.

At the September equinox the solar analysis determined that the direct solar access to Pyrmont Bay Park between 9.00am and 3.00pm was reduced from 100% to 91%. This 9% reduction represents the largest solar impact to Pyrmont Bay Park on a single day, and even taken in isolation is considered to be a limited environmental impact.

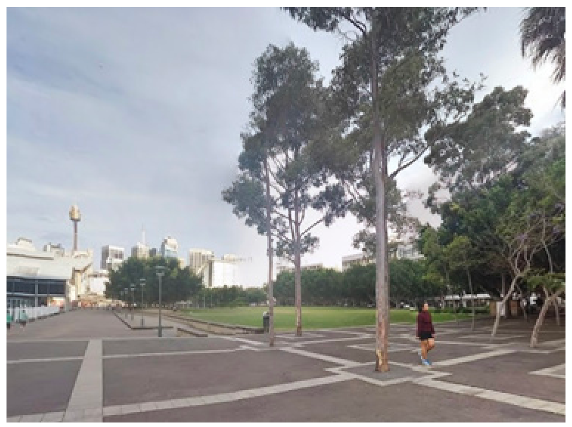
It is noted that at mid winter when direct solar access to a park is generally desirable, the impact is nil. The impact remains less than 2% between and May 23 and August 01.

Additionally, there is a further period during summer from October 17 to February 25 when the impact is less than 2%.

As noted above, over the period of a year the current average figure for direct solar access to Pyrmont Bay Park between 9.00am and 3.00pm is 100%. The additional shadow from the proposed tower and ribbon sees this annual figure reduced to 97.20%, a reduction of 2.8%.

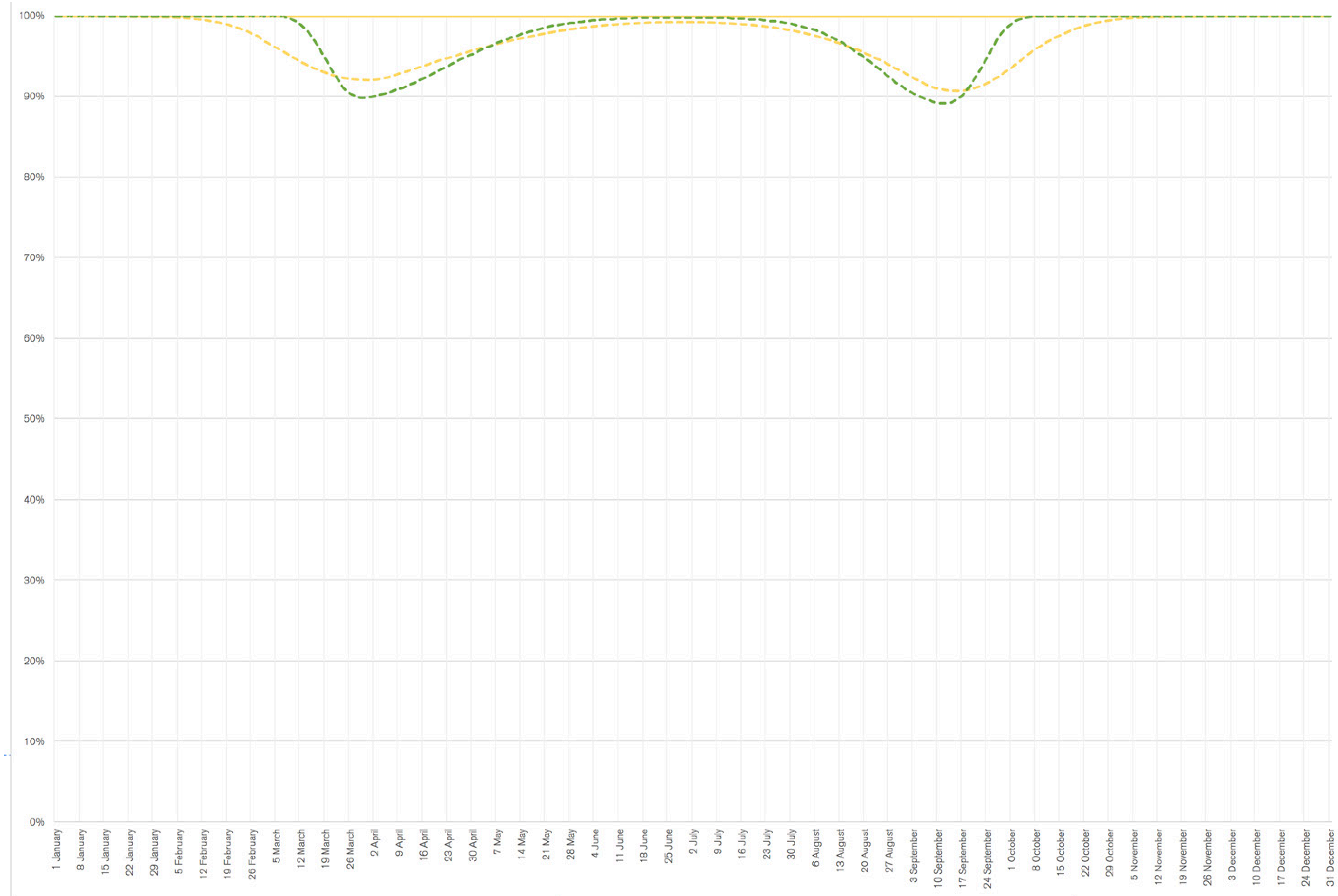
An further analysis was undertaken for the playing field area within Pyrmont Bay Park. This analysis sees this annual figure reduced to 97.7% for the playing field area, a reduction of 2.3%.

In conclusion, Pyrmont Bay Park currently benefits from a high degree of direct solar access. The loss in direct solar access as resultant from the proposed tower is minimal and has been determined by close analysis to result in a limited environmental impact. As such, the tower and ribbon form as proposed is considered to align with the above stated Design Principle.



Pyrmont Bay Park

equates to % of public space area with direct solar access x % of time between 9.00am and 3.00pm



Annual values for direct solar access to Pyrmont Bay Park

Existing — Overall Park with proposed tower - - - Playing field area with proposed tower - - -

14.13 **Sun access impacts on adjacent properties**

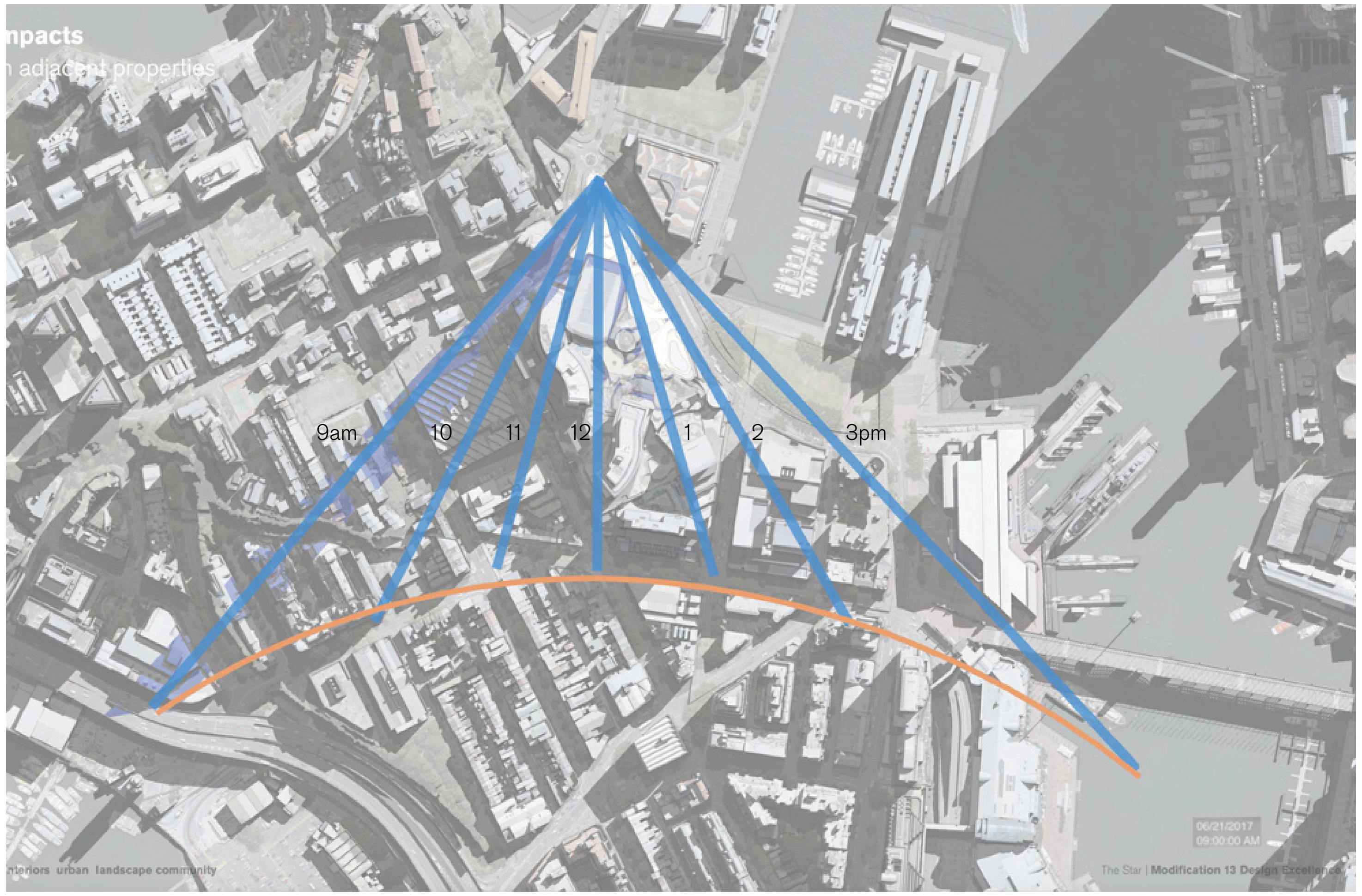
A detailed sun access impact analysis has been undertaken to evaluate the impact of the proposed tower on adjoining property sun access.

The analysis over the following 5 pages is based on the worst-case time of year when the day is shortest and shadows longest; the winter equinox on June 21st between 9am and 3pm.

The analysis seeks to identify any apartments that currently achieve 2 hours of sun access to balconies and living spaces, that may drop below 2 hours as a result of the proposed tower.

The analysis identifies only three instances where 2 hours sun access to any part of an apartment is reduced below 2 hours, none of which are living areas or balconies. This emphasises the fast moving nature of the shadow across Pyrmont and the minimal impact to adjacent property sun access.

Aerial view identifying the mid-winter shadows at hourly intervals as they move across Pyrmont



Map extract identifying the residential properties within the vicinity of the tower. The orange line denotes the total combined extent of the proposals overshadowing footprint in mid-winter.