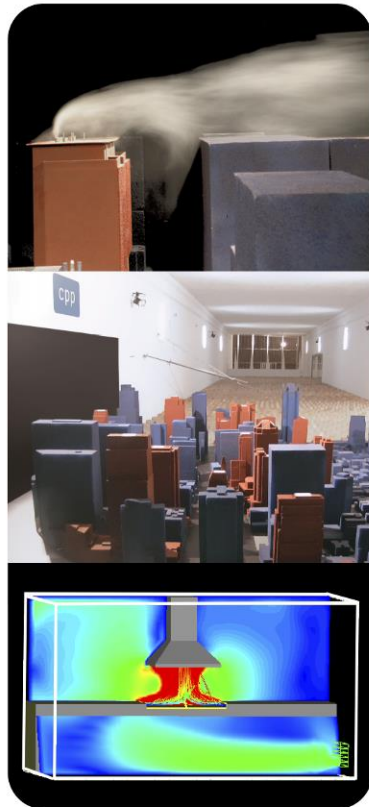




CERMAK  
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WIND ENGINEERING AND AIR QUALITY CONSULTANTS

## FINAL REPORT



Wind Assessment for:

### **HARBOURSIDE SHOPPING CENTRE**

Sydney, Australia

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## **Client Provided Information**

### **Introduction**

This report provides a response to submissions (as relevant) and assessment of the proposed amended Concept Proposal in relation to the State Significant Development (SSD) Development Application (DA) for the redevelopment of the Harbourside Shopping Centre (Harbourside) (SSD 7874).

The SSD DA was publicly exhibited for a period of 62 days from 15 December 2016 to 14 February 2017. During this time, ten (10) submissions were received from government agencies and City of Sydney Council and over 140 submissions were received from the general public.

This report should be read in conjunction with the original assessment prepared by CPP Wind Engineering Consultants dated November 2016 to support the Harbourside Concept Proposal Square (SSD 7874).

### **Proposed Amended Development**

Since exhibition of the proposal and given the nature and range of submissions made from agencies and the public, Mirvac has been reviewing the overall approach and elements of the Concept Proposal. This has accordingly led to developing an Amended Concept Proposal. The final Concept Proposal therefore includes substantial amendments made by Mirvac pursuant to Clause 55 of the Environmental Planning & Assessment Regulation, in the main to address matters raised in the submissions and deliver an overall significantly improved outcome on the site and for the broader Darling Harbour precinct.

The following key amendments have been made to the proposal:

#### **Relocation of the Tower**

The tower element of the Concept Proposal has been relocated from the north of the site to the centre of the site (the widest part of the site) to allow for an increased setback from the heritage listed Pyrmont Bridge, improved relationship to the waterfront and ICC Hotel, to minimise view impacts from 50 Murray Street, together with reducing overshadowing impacts on the public domain and improved solar amenity to the northern end of the retail centre.

#### **Reduction in Height of the Tower**

The height of the tower has also been reduced from RL 166.35 to RL 153.75. The reduction in the height will minimise overshadowing impacts to the public domain as well better relate to the height of the ICC Hotel.

#### **Reduction in Height of the Podium**

A portion of the podium height at its northern extent has been partly reduced from 30.5 RL to RL 25. The reduction in height provides for improved view sharing from 50 Murray Street.

**Removal of Tower ‘Tail’ element**

As part of the relocation of the tower and refinement of the podium, the stepped form of the lower tower element has now been removed. This design move has been made in order to again improve views from adjacent buildings from the west.

**Building Footprint of the Tower**

The building footprint of the tower has increased in width, to accommodate the floorspace from the reduction in height of the tower and removal of the ‘tail’.

**Gross Floor Area / Land Use Mix**

The amended proposal retains the same overall 87,000sqm of GFA, however there is a minor adjustment in the split between non-residential and residential:

- Non-residential uses floor space – 49,000sqm; and
- Residential uses floor space – 38,000sqm

In response to market demand and the focus of local and regional strategic planning policies, it is proposed for the podium to include both retail and commercial land uses. Indicatively, comprising 23,000sqm net lettable area of commercial and 15,000sqm gross lettable area of retail.

The podium enables large campus sized commercial floor plates that are favoured by large multinational tech, finance and professional services companies.

**Apartment numbers**

As a result of a review of the mix and sizing of apartments, there is a minor reduction in the indicative number of apartments, from 364 to 357. Note, this yield is on the ‘Indicative Design’ only and will be subject to future design development and a Stage 2 DA. This Stage 1 DA only seeks approval for land uses and the building envelope comprising a total of 87,000sqm GFA.

**Car Parking Spaces**

The extent of the basement will remain the same, but there has been an increase of 11 car parking spaces from 295 spaces to 306 spaces. As above, this is based on the ‘Indicative Design’ only.

A more detailed and comprehensive description of the amended proposal is contained in the Response to Submissions and Amended Concept Proposal prepared by Ethos Urban.

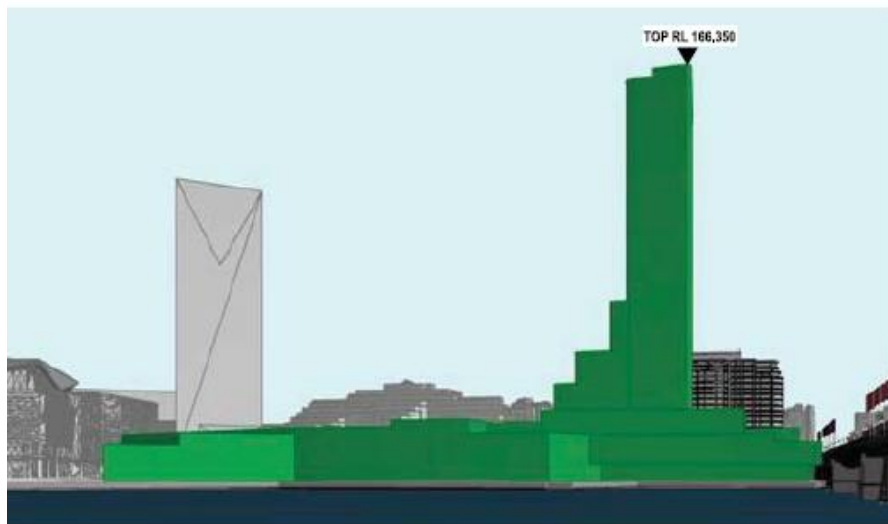


Figure 1: Original submitted concept proposal.

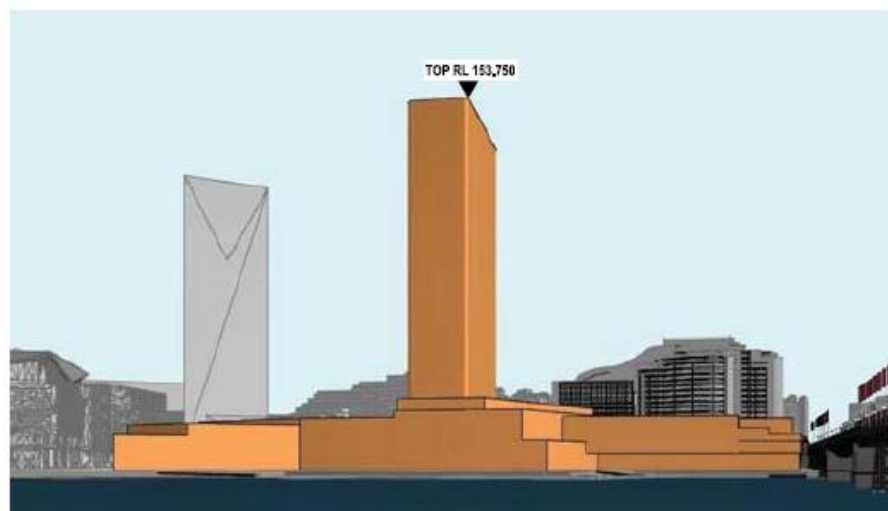


Figure 2: Amended concept proposal.

### **Landscaped Open Space and Public Domain**

All of the key concepts and public benefits as originally proposed are retained under the amended Concept Proposal, with the addition of further landscaping opportunities on the northern rooftop extent of the retail podium, further enhancing views and outlook from 50 Murray Street.

The final Concept Proposal seeks approval for the following key components and development parameters:

- Demolition of existing site improvements, including the Harbourside Shopping Centre, pedestrian bridge link across Darling Drive, obsolete monorail infrastructure, and associated tree removal;

- A network of open space areas and links generally as shown within the Public Domain Concept Proposal, to facilitate re-integration of the site into the wider urban context;
- Building envelopes;
- Land uses across the site, non-residential and residential uses;
- A maximum total Gross Floor Area (GFA) across the Harbourside site of 87,000m<sup>2</sup> for mixed use development (49,000sqm non-residential and 38,000sqm residential development);
- Basement car parking;
- Car parking rates to be utilised in subsequent detailed (Stage 2) Development Applications);
- Urban Design and Public Realm Guidelines to guide future development and the public domain; and
- Strategies for utilities and services provision, drainage and flooding, and ecological sustainable development

## Introduction

Cermak Peterka Petersen Pty. Ltd. has been engaged by Mirvac Projects Pty. Ltd. to provide an opinion based assessment of the impact of the proposed Harbourside Shopping Centre redevelopment, Sydney, on the pedestrian level local wind environment in and around the proposed development.

The report assesses the concept envelope for the Stage 1 DA and also provides commentary on the current indicative design by FJMT. It is noted that the final design will all be subject to a future design excellence and detailed design process

The site is located to the west of Sydney CBD in Darling Harbour and is surrounded by medium- to high-rise buildings, including the neighbouring SICEEP site, Figure 3.



Figure 3: Site location for the proposed Harbourside Shopping Centre development

## Sydney Wind Climate

To enable a qualitative assessment of the wind environment, the wind frequency and direction information measured by the Bureau of Meteorology at a standard height of 10 m at Sydney Airport from 1995 to 2017 have been used in this analysis, Figure 4. It is noted from Figure 4 that strong prevailing winds are organised into three main groups which centre at about north-east, south, and west. This wind assessment is focused on these prevailing strong wind directions.



Strong summer winds occur mainly from the south quadrant and the north-east. Winds from the south are associated with large synoptic frontal systems and generally provide the strongest gusts during summer. Moderate intensity winds from the north-east tend to bring cooling relief on hot summer afternoons typically lasting from noon to dusk. These are small-scale temperature driven effects; the greater the temperature differential between land and sea, the stronger the breeze.

Winter and early spring winds typically occur from the south and west quadrants. West quadrant winds provide the strongest winds affecting the area throughout the year.

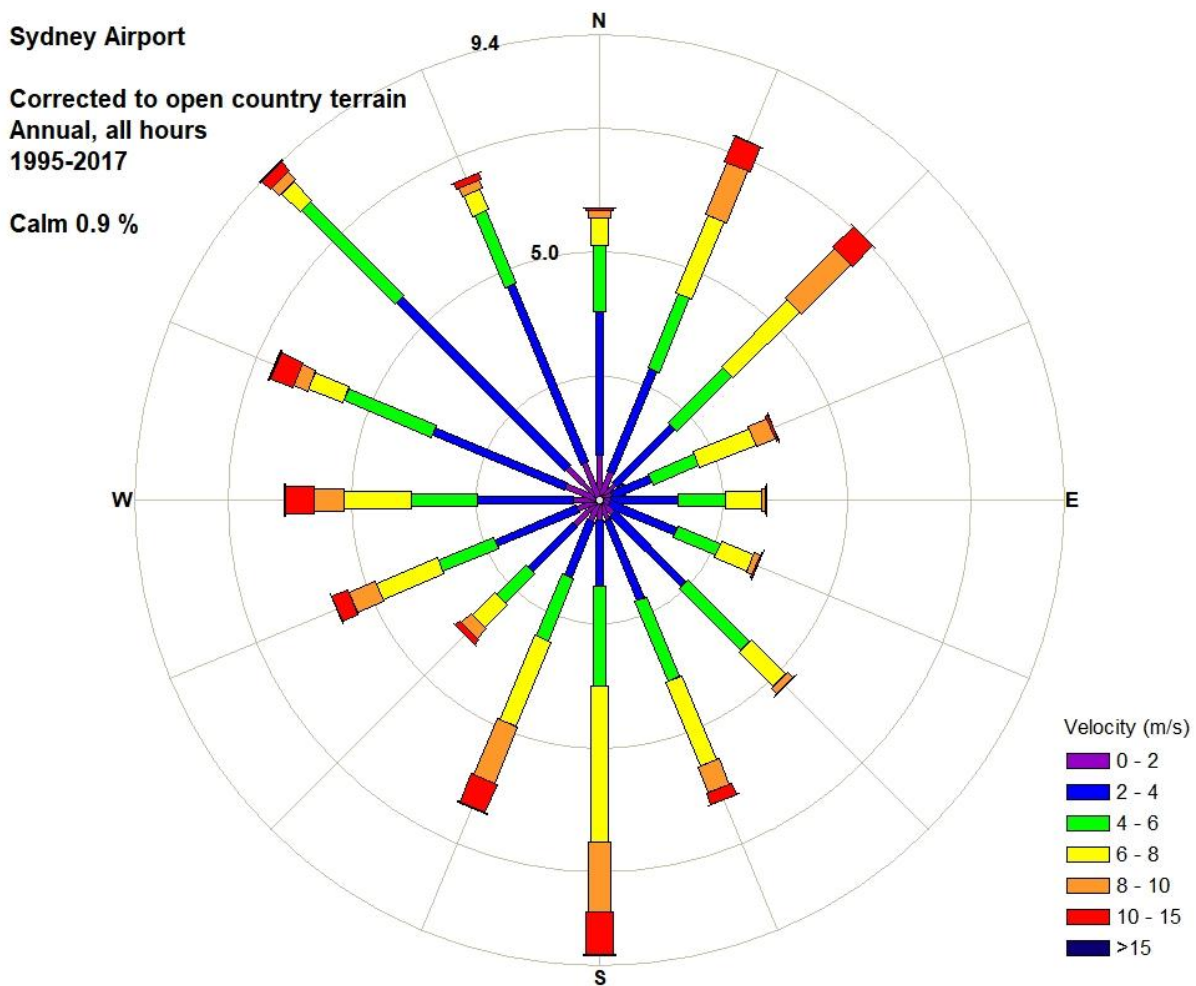


Figure 4: Wind rose of direction and speed for Sydney Airport

### Wind Flow Mechanisms

When the wind hits a large isolated building, the wind is accelerated down and around the windward corners, Figure 5; this flow mechanism is called downwash and causes the windiest conditions at ground level on the windward and sides of the building. In Figure 5 smoke is being released into the wind flow to allow the wind speed, turbulence, and direction to be visualised. The image on the left shows smoke



being released across the windward face, and the image on the right shows smoke being released into the flow at about third height in the centre of the face.

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.

Channelling occurs when the wind is accelerated between two buildings or along straight streets with buildings on either side.

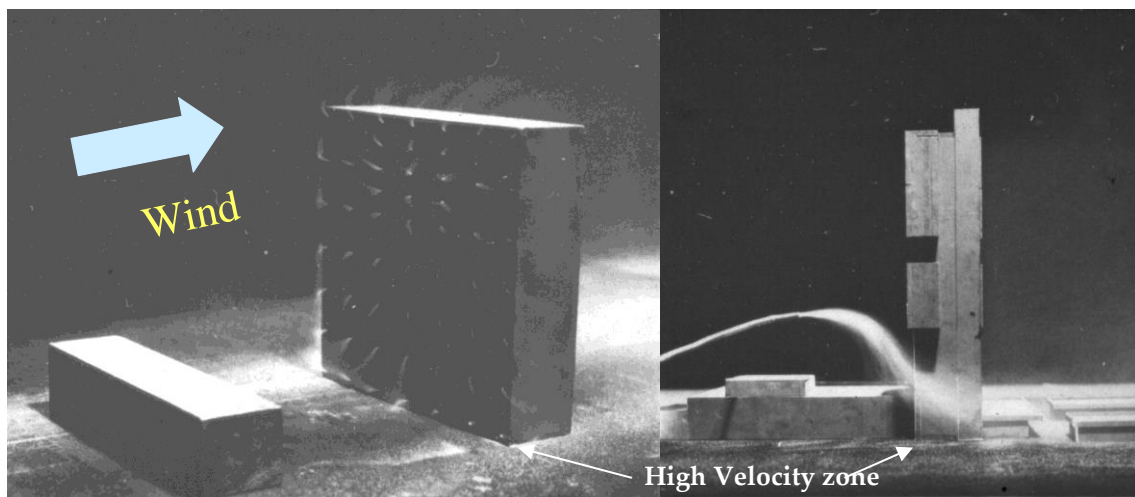


Figure 5: Flow visualisation around a tall building

### Environmental Wind Speed Criteria

It is generally accepted that wind speed and the rate of change of wind velocity are the primary parameters that should be used in the assessment of how wind affects pedestrians. Over the years, a number of researchers have added to the knowledge of wind effects on pedestrians by suggesting criteria for comfort and safety. Because pedestrians will tolerate higher wind speeds for a smaller period of time than for lower wind speeds, these criteria provide a means of evaluating the overall acceptability of a pedestrian location. A location can further be evaluated for its intended use, such as for an outdoor café or footpath.

The current City of Sydney (2012) DCP specifies wind effects not to exceed 16 m/s, as the area around the site is not classified as an ‘active frontage’. With reference to the wind rose in Figure 4, there are few locations in Sydney that would meet this criterion without some level of shielding from surrounding buildings, or local treatments. From discussions with Council this is a once per annum gust wind speed similar to the wind criteria in City of Sydney 2004 DCP, but is meant to be interpreted as a

comfort level criterion and is not intended to be used as a distress requirement. The once per annum gust wind speed criterion used in the City of Sydney (2012) DCP is based on the work of Melbourne (1978), and the 16 m/s level is classified as generally acceptable for use as a main public accessway. This criterion gives the once per annum wind speed, and uses this as an estimator of the general conditions at a site, which may be more relevant. To combat this limitation, as well as the once per annum maximum gust wind speed, this study is based upon the criteria of Lawson (1990), which are described in Table 1 for both pedestrian comfort and distress. The limiting criteria are defined for both a mean and gust equivalent mean (GEM) wind speed. The criteria based on the mean wind speeds define when the steady component of the wind causes discomfort, whereas the GEM wind speeds define when the wind gusts cause discomfort.

From ongoing findings using the criteria and clients who have issues with strong wind, a more stringent criterion is required for outdoor dining style activities and a value of 2 m/s for 5% of the time is recommended for such intended use. As the 5% of the time wind speed recorded at the airport is about 9 m/s, and even with the benefits of shielding from the city compared with the airport, any location in the city requires significant shielding to meet such a criterion.

Assessment using the Lawson criteria provides a similar classification as using the once per annum gust, which is the basis of the City of Sydney (2011) DCP, however also provides information regarding the serviceability wind climate.

<b>Comfort</b> (maximum of mean or gust equivalent mean (GEM <sup>+</sup> ) wind speed exceeded 5% of the time)	
< 4 m/s	Pedestrian Sitting (considered to be of long duration)
4 - 6 m/s	Pedestrian Standing (or sitting for a short time or exposure)
6 - 8 m/s	Pedestrian Walking
8 - 10 m/s	Business Walking (objective walking from A to B or for cycling)
> 10 m/s	Uncomfortable
<b>Distress</b> (maximum of mean or GEM wind speed exceeded 0.022% of the time)	
<15 m/s	not to be exceeded more than two times per year (or one time per season) for general access
<20 m/s	not to be exceeded more than two times per year (or one time per season) where only able bodied people would be expected; frail or cyclists would not be expected

The wind speed is either a mean wind speed or a gust equivalent mean (GEM) wind speed. The GEM wind speed is equal to the 3 s gust wind speed divided by 1.85.

Table 1: Pedestrian comfort criteria for various activities

### Environmental Wind Assessment

The development site is situated on the west side of Darling Harbour, adjacent to Pyrmont Bridge and the SICEEP development, Figure 3. The proposed Harbourside Shopping Centre development comprises a 25 m high retail podium with partial rooftop recreational areas, and a single residential tower rising approximately 130 m above the centre of the podium, Figure 6 and Figure 7. The proposed

development is surrounded by medium to high-rise buildings, which will provide some shielding for certain wind directions. Topography surrounding the site is relatively flat.

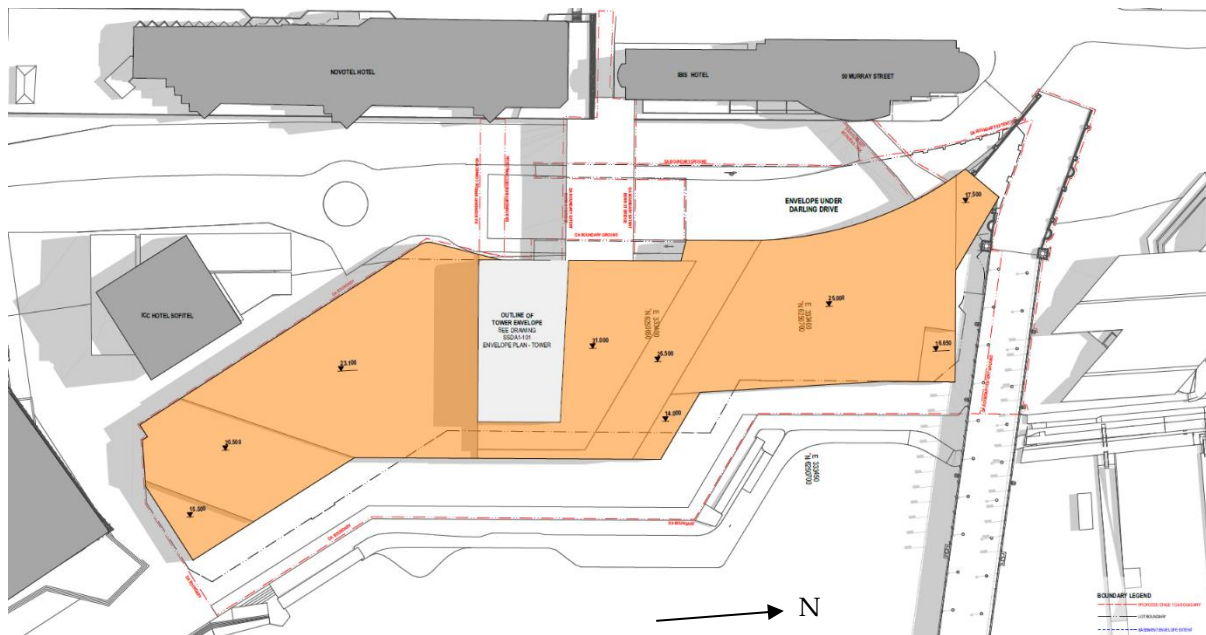


Figure 6: Ground floor plan for the proposed Harbourside Shopping Centre development

### **Winds from the north-east**

Winds from the north-east will be somewhat ameliorated by the massing of the city, but accelerate across Darling Harbour. On reaching the site, winds from the north-east would impinge on the north-east corner of the tower at an oblique angle, encouraging the flow to pass around the tower horizontally thereby reducing the quantity of downwash. Flow will accelerate around the north-west and south-east corners of the tower, with any downwash discharging over the podium roof. It is understood that the current indicative design does not foresee for the podium rooftop around the base of the tower to be generally accessible.

The podium to the north and south of the tower will also be exposed to winds from the north-east. The relatively long, low podium, that steps down in height to the south, is expected to divert the majority of flow over the roof rather than accelerate it around the south corner towards the SICEEP Hotel. The wind conditions on this corner would be expected to be similar to the existing conditions.

For winds from the north-east, the difference in wind conditions around the proposed development between the originally submitted and amended proposal are expected to be minor. The wind conditions along the waterfront and along Darling Drive are expected to remain similar to the existing wind conditions.

The through site links to the north and south of the tower, as shown in the current indicative design, have potential to experience windy conditions for strong winds from the north-east due to pressure driven flow. The central courtyard of the southern portion of the podium is understood to be enclosed

on both entrances, and hence well shielded and would experience calm wind conditions. It is understood that the through site links are indicative only and subject to future detailed design.

### **Winds from the south**

The neighbouring SICEEP development to the south will effectively shield the podium of the proposed development for winds from the south quadrant. As these winds reach the tower, downwash will result, which will impact and deflect off the podium roof, with flow accelerating around the south-east and south-west corners before discharging along Darling Drive respectively. Given the lack of pedestrian access to this region of Darling Drive, the increase in flow is unlikely to be of concern. A portion of this downwash is also expected to impact the podium rooftop, creating gusty wind conditions in these areas, which is not an issue as that area is understood to not be trafficable.

For winds from the south, the amended proposal is expected to result in similar wind conditions to the originally submitted proposal, with slightly improved wind conditions around the waterfront area. Wind conditions in the amended proposal are expected to be similar to the existing wind conditions, with marginally stronger wind conditions expected along Darling Drive.

### **Winds from the west**

Winds from the west will be partially shielded by the neighbouring hotels to the west. However, the proposed tower significantly exceeds the height of these neighbouring buildings. As the upper levels of the tower are exposed to winds from the west quadrant, a significant amount of downwash off the upper levels of the west façade of tower is expected. This mechanism would direct high level flow towards ground level. However, the narrow tower face, presented to incoming flow would be expected to minimise the effect of downwash winds on Darling Drive. Further measures to minimise the amount of downwash reaching ground level can be addressed during future detailed design.

The two through site links to the north and south of the tower would experience windy conditions due to their alignment with this wind direction. Some downwash winds would also be expected to reach ground level and dissipate through these spaces.

For winds from the west, the difference in wind conditions around the proposed development between the originally submitted and amended proposal are expected be minor, with wind conditions being expected to be similar to the existing wind conditions.

### **Winds conditions within the proposed development**

Within the envelope of the proposed development, it is understood that a set of event steps will be present and publicly accessible. Based on the locations in the indicative design, this area is expected to

experience wind conditions that are suitable for the intended use of space. The wind conditions within these spaces will be subject to further assessment during detailed design.

Some locations within the development may experience higher wind velocities at times, which may necessitate local amelioration depending on how these areas are to be used. The retail spaces in the podium levels show outdoor seating on several levels. The wind conditions in these areas will be assessed during detailed design, when mitigation measures can be developed for these areas, if needed. As the rest of the podium is not trafficable, wind speeds will not be an issue in these spaces.

It is understood that private balconies are planned to be located within the development. Wind conditions within the balconies are expected to be mostly calm provided they are recessed within the façade. Balconies at building corners, however, can experience strong cross flow. Full height screening on one side of these balconies provides for calmer conditions for the residents on these balconies. This can be addressed at the detailed design stage.

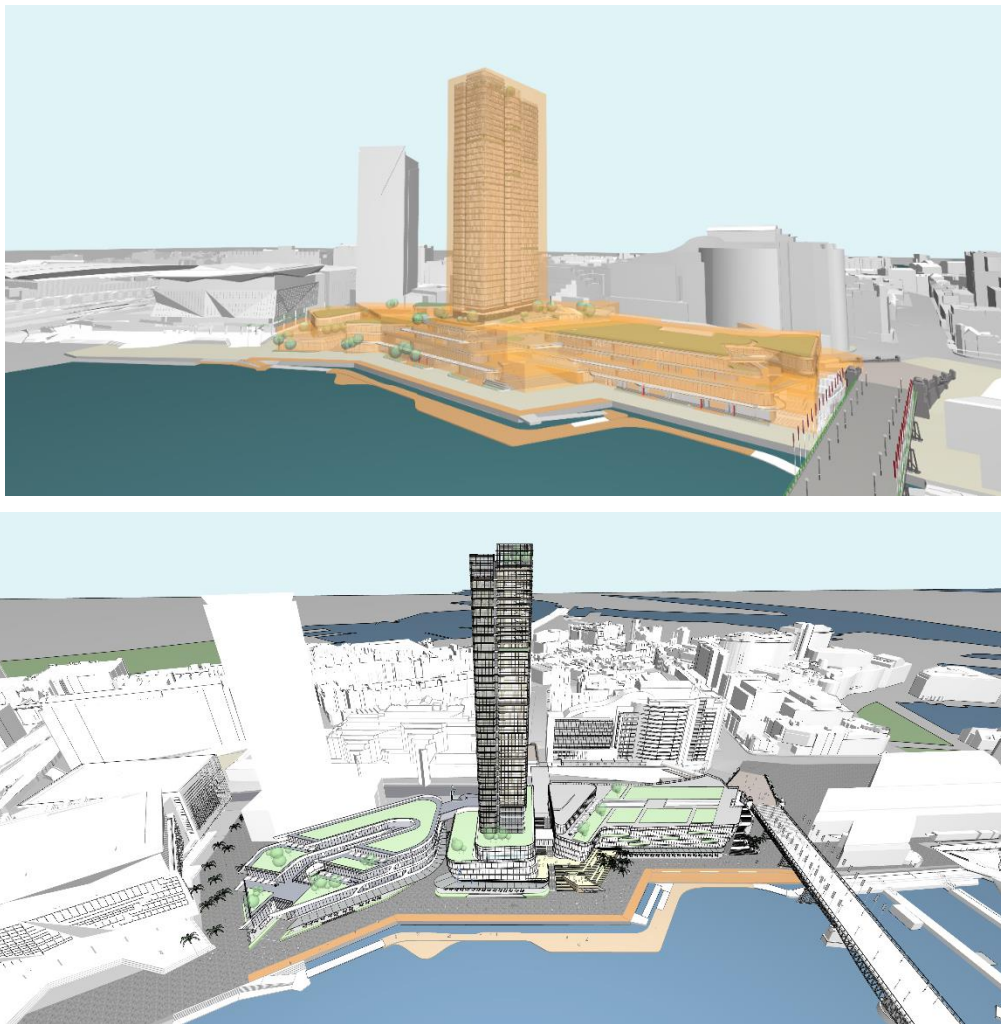


Figure 7: Aerial view of the stage 1 DA envelope (T) and the indicative design (B).



## Summary

Qualitatively, integrating the expected directional wind conditions around the site with the wind climate, it is considered that wind conditions at the majority of locations around the site would be classified as suitable for pedestrian standing or walking under the Lawson criterion from a comfort perspective and pass the distress criterion.

Overall, the amended proposal is expected to result in similar wind conditions to the originally submitted proposal, with slightly improved wind conditions around the waterfront area. The wind conditions around the proposed development resulting from the amended proposal is expected to be similar to or marginally stronger than the existing wind conditions. The two through site links are expected to be subject to windy conditions for strong winds from the east or west quadrants, and wind conditions are generally expected to remain suitable as general pedestrian accessways. These spaces are not recommended for any stationary use.

## Conclusions

Cermak Peterka Petersen Pty. Ltd. has provided an opinion-based assessment of the impact of the proposed Harbourside Shopping Centre development, Sydney on the local wind environment. The assessment was based on the concept envelope as well as the FJMT indicative design. It is noted that the design will be subject to a future design excellence process and detailed design. Our summary assessment of the proposed development is as follows:

Wind conditions around the site for the proposed development are generally expected to be similar to existing conditions. It is considered that the design would meet the intended use of space for pedestrian comfort and safety. The wind conditions along the waterfront are expected to remain similar to the existing wind conditions and are likely to be suitable as a public accessway and for short-term stationary activities. The event steps will likely experience similar wind conditions as the wind conditions along the waterfront. The through site links to the north and south of the tower are expected to experience relatively windy conditions for winds from the west and east quadrants and are recommended for transitory use only. The through site links including any wind mitigation, if required, can be dealt with through detailed design.

The portion of the publicly accessible areas on the podium roof are expected to experience stronger wind conditions. Additional amelioration measures may be required for specific locations such as for outdoor seating areas on the podium roof, which would be further assessed during detailed design.

Overall, the amended proposal is expected to result in similar wind conditions to the originally submitted proposal, with slightly improved wind conditions around the waterfront area. The wind



conditions around the proposed development resulting from the amended proposal is expected to be similar to or marginally stronger than the existing wind conditions.

A wind tunnel test is not considered essential for the building envelope subject to the Stage 1 DA, but would be recommended during future design development to quantify the wind advice provided herein, and to develop local wind mitigation for areas intended for outdoor seating.

**References**

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Melbourne, W.H., (1978), Criteria for environmental wind conditions, *J. Industrial Aerodynamics*, 3, 241-249.