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Vipac Engineers & Scientists

8 Parkers Street Pty Ltd

8 Parker Street, South Perth

Wind Impact Assessment



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EXECUTIVE SUMMARY

8 Parkers Street Pty Ltd commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the ground level areas adjacent to the proposed development at **8 Parker Street, South Perth**. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Drawings of the proposed development were provided by 8 Parkers Street Pty Ltd in **September 2020**. The findings of this study can be summarized as follows:

- With the proposed design, the adjacent footpaths would be expected to have wind levels within the walking comfort criterion.
- With the proposed design, all building entrances would be expected to have wind levels within the recommended comfort criteria of standing.
- With the proposed design, the featured seating areas would be expected to have wind conditions within the recommended comfort criterion of sitting.
- With the proposed design, various level terraces are expected to have wind levels within the walking comfort criterion. Most of these areas could achieve the more stringent criteria of standing to sitting comfort.
- With the proposed design **and recommendation**, the Level 1N pool deck is expected to have wind conditions within the recommended comfort criterion for walking.

As a general statement, educating occupants about wind conditions at open terrace/balcony areas during high-wind events and fixing loose, lightweight furniture on the terrace are highly recommended.

The assessments provided in this report have been made based on experience of similar situations in Perth and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity. Considering the dimensions and exposure of the proposed development, Vipac recommends a scaled wind tunnel study in the detail design stage to verify the predictions and determine the optimal wind controls.

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1 INTRODUCTION

8 Parkers Street Pty Ltd commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the proposed development at **8 Parker Street, South Perth**. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

The proposed development consists of a 4 storey south building and a 15 storey north tower. The site is bounded by Parker Street to the northwest, river bank to northeast and the existing developments in the other directions (see Figure 1). The Contextual East Elevation of the development is shown in Figure 2.

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level public areas and access-ways adjacent to the development as proposed. No wind tunnel testing has been carried out for this development at this stage. Vipac has carried out wind tunnel studies on a large number of developments of similar shape and having similar exposure to that of the proposed development. These serve as a valid reference for the prediction of wind effects for this development. Empirical data for typical buildings in boundary layer flows has also been used to estimate likely ground level wind conditions adjacent to the proposed development [2] & [3].

Drawings of the proposed development were provided by 8 Parkers Street Pty Ltd in **September 2020** as listed in Appendix C of this report.

The assessments provided in this report have been made based on experience of similar situations in Perth and around the world.



Figure 1: Aerial view of the proposed development site at 8 Parker Street, South Perth.

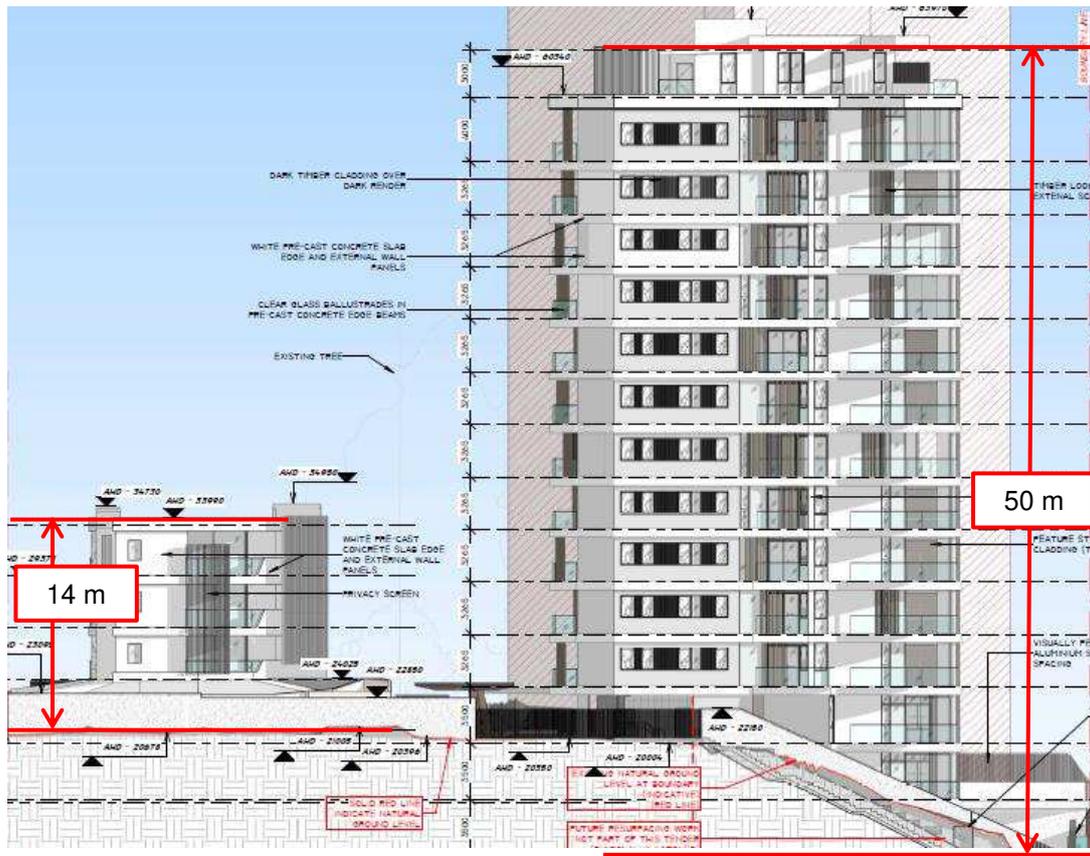


Figure 2: East Elevation of the proposed development showing the overall height

2 ANALYSIS APPROACH

When considering whether a proposed development is likely to generate adverse wind conditions in adjacent ground level areas, Vipac considers five main points:

- The exposure of the proposed development to wind;
- The regional wind climate;
- The geometry and orientation of the proposed development;
- The interaction of flows with adjacent developments;
- The assessment criteria, determined by the intended use of the public areas affected by wind flows generated or augmented by the proposed development.

The pedestrian wind comfort at specific locations around a site may be assessed by predicting the worst annual 3-second wind gust expected at that location. The location may be deemed generally acceptable for its intended use if the annual 3-second gust is within the threshold values noted in Section 2.5. For cases where Vipac predicts that a location would not meet its appropriate comfort criterion we may recommend the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, Vipac recommends scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

2.1 SITE EXPOSURE

The proposed development is located on sloping terrain, with the Perth CBD to the North across the Swan River. The site is predominantly surrounded within a 3 km radius by suburban housing, low rise residential and the Swan River.

Therefore, for the current study, considering the distance to Perth's CBD and the immediate presence of the Swan River, the site of the proposed development is considered to be Terrain Category 2.5 from West through North to east-east-north; Terrain Category 1.5 from South to West, and Terrain Category 3 for all other wind directions [1] (see Figure 3).

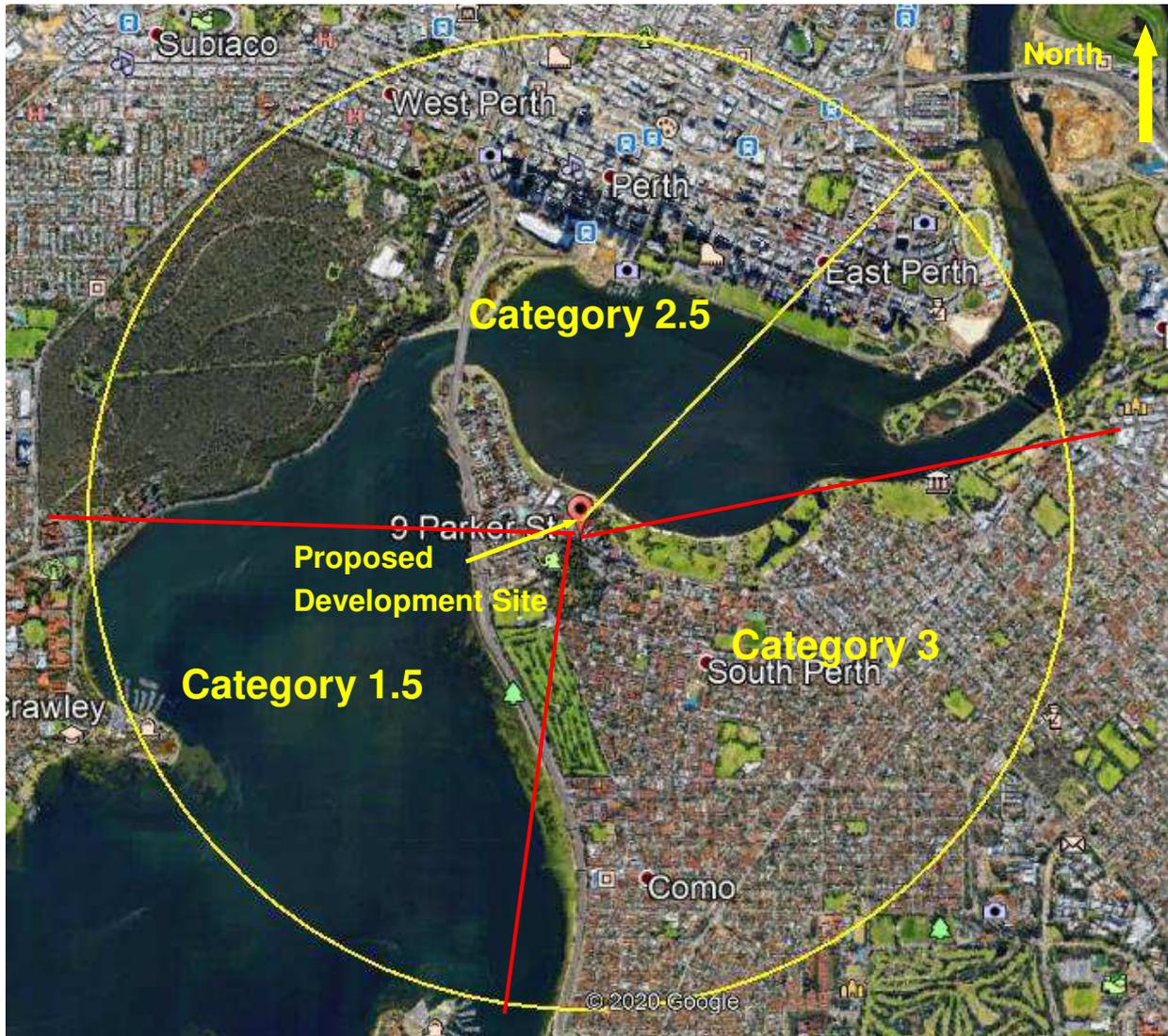


Figure 3: Assumed terrain categories for wind speed estimation.

2.3 BUILDING GEOMETRY AND ORIENTATION

The proposed development consists of a 4 storey south tower and a 15 storey north tower. The overall plan-form dimensions are approximately 38 m x 67 m (See Figure 5).

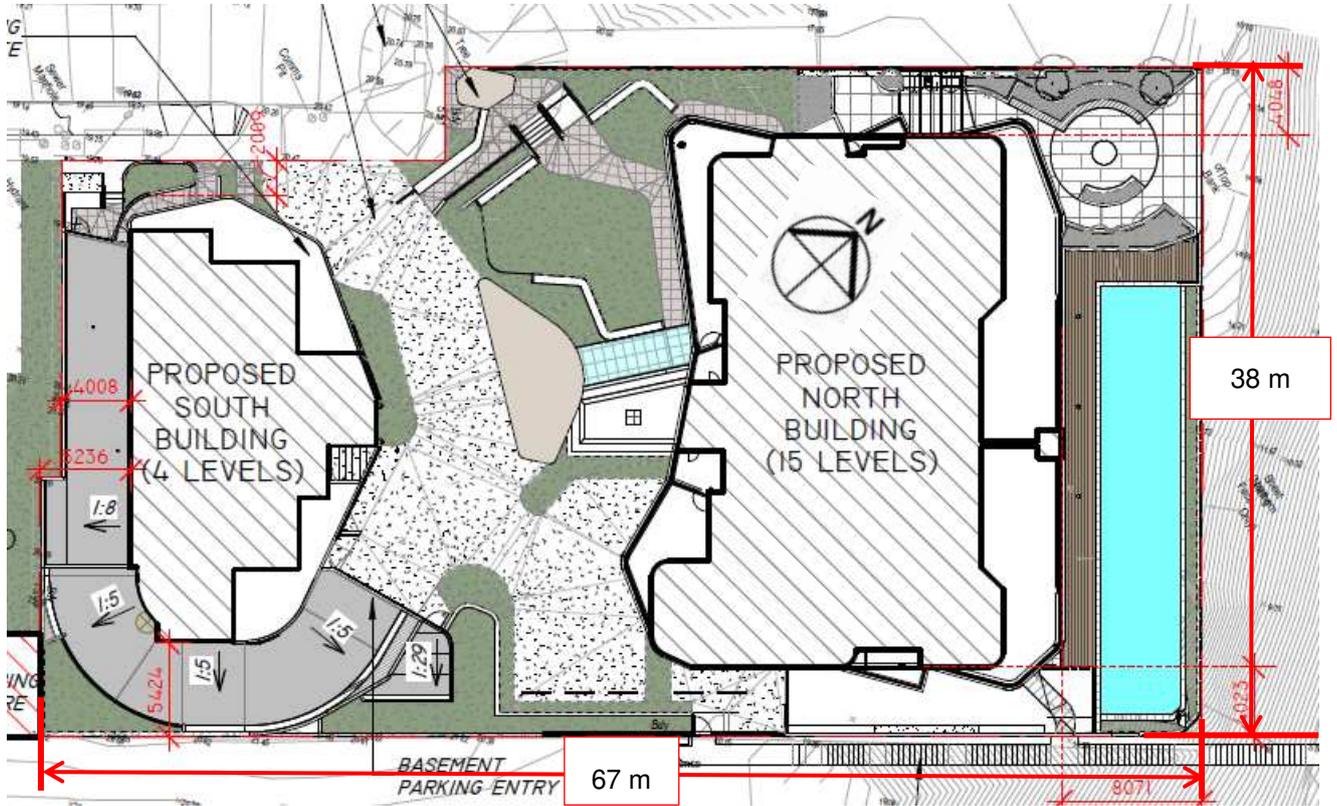


Figure 5: Ground floor plan of the proposed development.

2.4 FLOW INTERACTIONS WITH ADJACENT DEVELOPMENTS

The buildings immediately adjacent to the proposed development site, with their approximate height in metres are shown in Figure 6.

The proposed development is surrounded by 4 to 20 storey buildings. The foot path at Parker Street is sheltered by neighbouring buildings. The north tower highly exposed to north to east sectors.



Figure 6: Immediately adjacent buildings and their approximate height in storeys (F).

2.5 ASSESSMENT CRITERIA

With some consensus of international opinion, pedestrian wind comfort is rated according to the suitability of certain activities at a site in relation to the expected annual peak 3-second gust velocity at that location for each wind direction. Each of the major areas around the site are characterized by the annual maximum gust wind speeds. Most patrons would consider a site generally unacceptable for its intended use if it were probable that during one annual wind event, a peak 3-second gust occurs which exceeds the established comfort threshold velocity (shown in Table 1). If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions would result, and the windiness of the location would be considered as unacceptable.

Table 1: Recommended Wind Comfort and Safety Gust Criteria

Annual Maximum Gust Speed	Result on Perceived Pedestrian Comfort
>23m/s	Unsafe (frail pedestrians knocked over)
<20m/s	Acceptable for fast walking (waterfront or particular walking areas)
<16m/s	Acceptable for walking (steady steps for most pedestrians)
<13m/s	Acceptable for standing (window shopping, vehicle drop off, queuing)
<11m/s	Acceptable for sitting (outdoor cafés, gardens, park benches)

In a similar manner, a set of hourly mean velocity criteria (see Table 2) with a 0.1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

Table 2: Recommended Wind Comfort and Safety Mean Criteria

Mean Speed in 0.1% of Time	Result on Perceived Pedestrian Comfort
>15m/s	Unsafe (frail pedestrians knocked over)
<13m/s	Acceptable for fast walking (waterfront or particular walking areas)
<10m/s	Acceptable for walking (steady steps for most pedestrians)
<7m/s	Acceptable for standing (window shopping, vehicle drop off, queuing)
<5m/s	Acceptable for sitting (outdoor cafés, gardens, park benches)

The Beaufort Scale is an empirical measure that related the wind speed to observed conditions on the land and sea. Table 3 describes the categories of the Beaufort Scale. The comparison between these observed conditions and the comfort criteria described above can be found in Table 4.

Table 3: Beaufort Scale - empirical measure relating wind speed to observed conditions on land

Beaufort Number	Descriptive Term	Wind Speed at 1.75 m height (m/s)	Specification for Estimating Speed
0	Calm	0-0.1	
1	Light Air	0.1-1.0	No noticeable wind
2	Light Breeze	1.1-2.3	Wind felt on face
3	Gentle Breeze	2.4-3.8	Hair disturbed, clothing flaps, newspapers difficult to read
4	Moderate Breeze	3.9-5.5	Raises dust and loose paper; hair disarranged
5	Fresh Breeze	5.6-7.5	Force of wind felt on body, danger of stumbling when entering a windy zone
6	Strong Breeze	7.6-9.7	Umbrellas used with difficulty, hair blown straight, difficult to walk steadily, sideways wind force about equal to forwards wind force, wind noise on ears unpleasant
7	Near Gale	9.8-12.0	Inconvenience felt when walking
8	Gale	12.1-14.5	Generally impedes progress, great difficulty with balance in gusts
9	Strong Gale	14.6-17.1	People blown over

Table 4: Comparison between Mean comfort criteria and the observed conditions

Comfort Criteria	Beaufort Scale Equivalent
Safety	9 – Strong Gale
Walking	5 – Fresh Breeze
Standing	4-5 – Moderate to Fresh Breeze
Sitting	<4 – Moderate Breeze

2.6 USE OF ADJACENT PEDESTRIAN OCCUPIED AREAS & RECOMMENDED COMFORT CRITERIA

The following table lists the specific areas adjacent to the development and the corresponding recommended criteria.

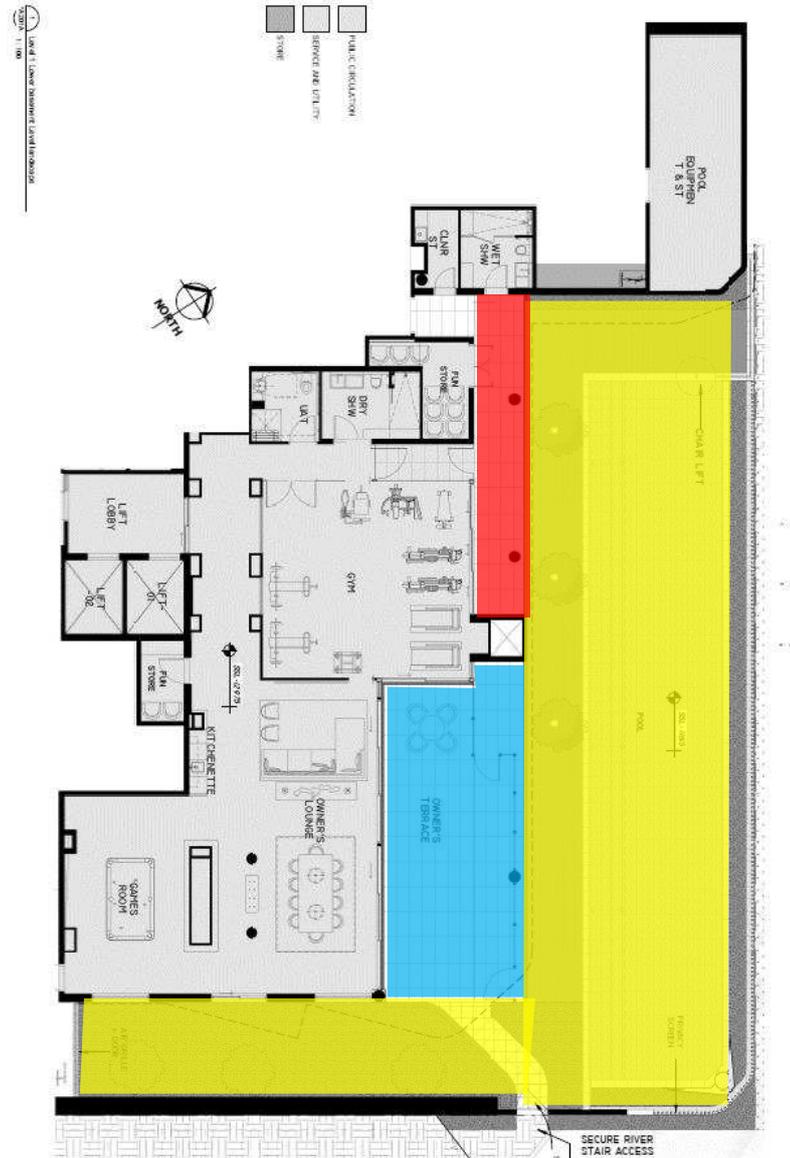
Table 5: Recommended application of criteria

Area	Specific location	Recommended Criteria
Public Footpaths and Access ways	On Parker Street, Access way to the Swan River	Walking
Building entrances	Commercial Lobby Entrances, Residential Lobby Entrances,	Standing
Outdoor Pool and Open Terraces	Outdoor pool in L 1N, terraces from L2 to Roof	Walking (See Discussion Below)

2.6.1 APARTMENT BALCONY AND ROOFTOP AREAS RECOMMENDED CRITERION DISCUSSION

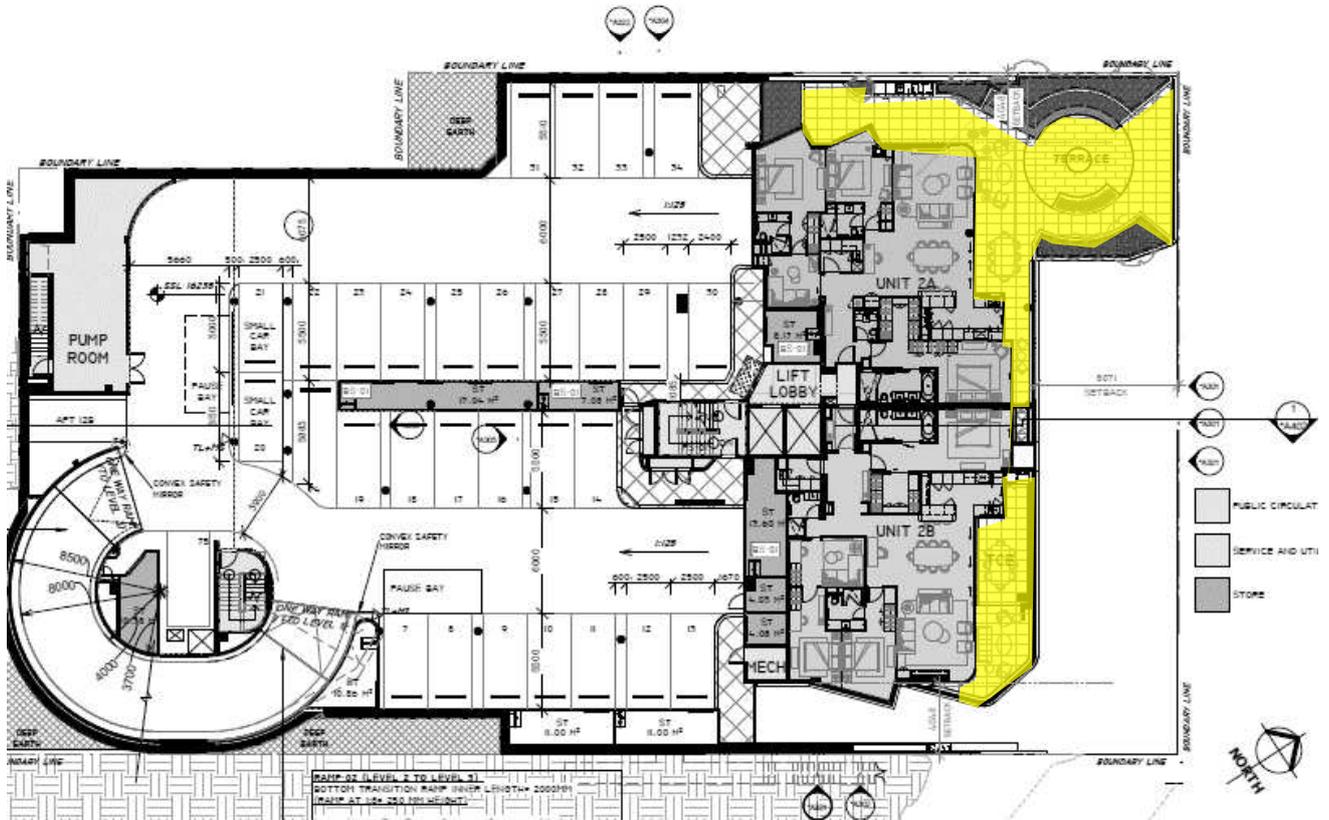
Apartment terraces are located on most facades of the proposed towers. Vipac recommends as a minimum that apartment balcony/rooftop terrace areas meet the criterion for walking since:

- these areas are not public spaces;
- the use of these areas is optional;
- many similar developments in Perth and other Australian capital cities experience wind conditions on balconies and elevated deck areas in the vicinity of the criterion for walking.



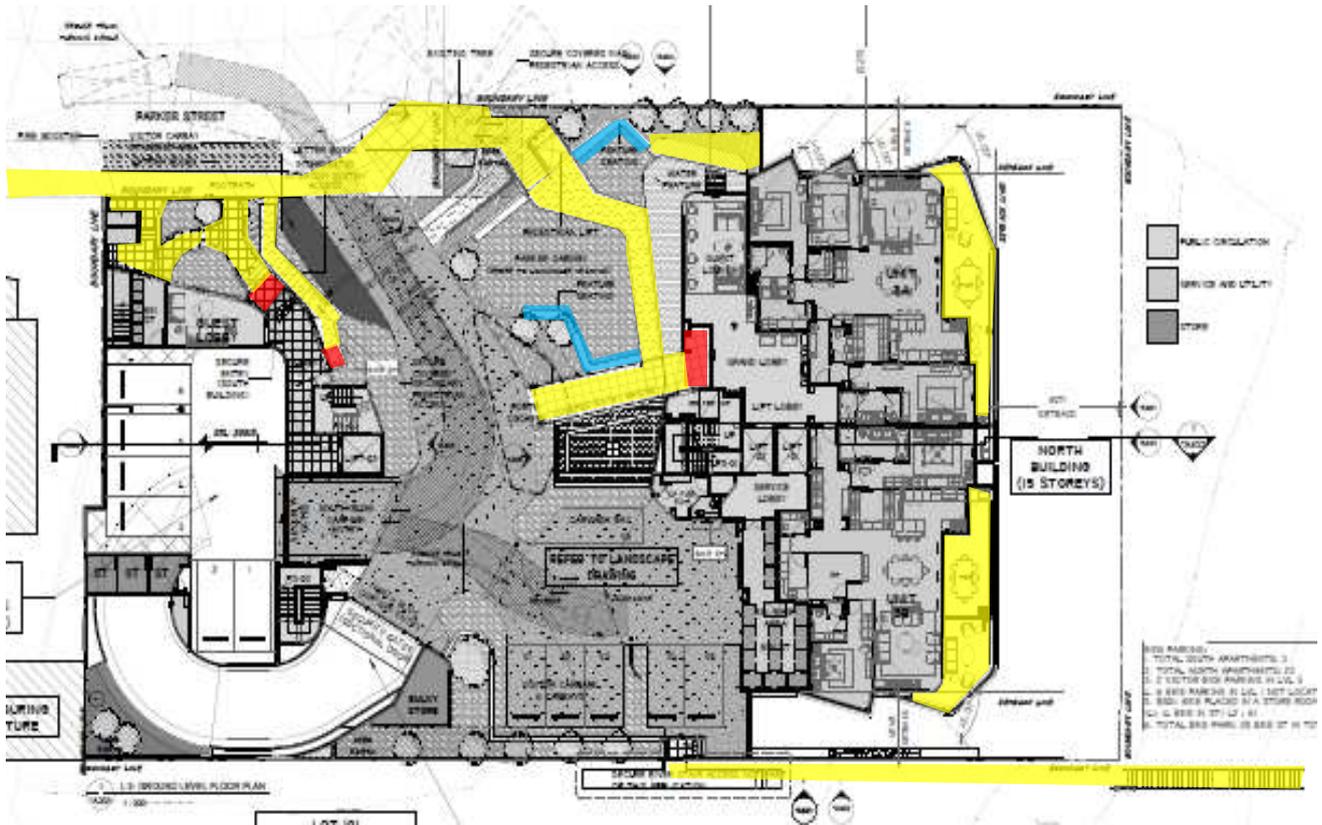
Recommended to fulfil Walking Recommended to fulfil Standing Recommended to fulfil Sitting

Figure 7: Plan view of Level 1 Lower basement of the north tower with the recommended wind criteria overlaid.



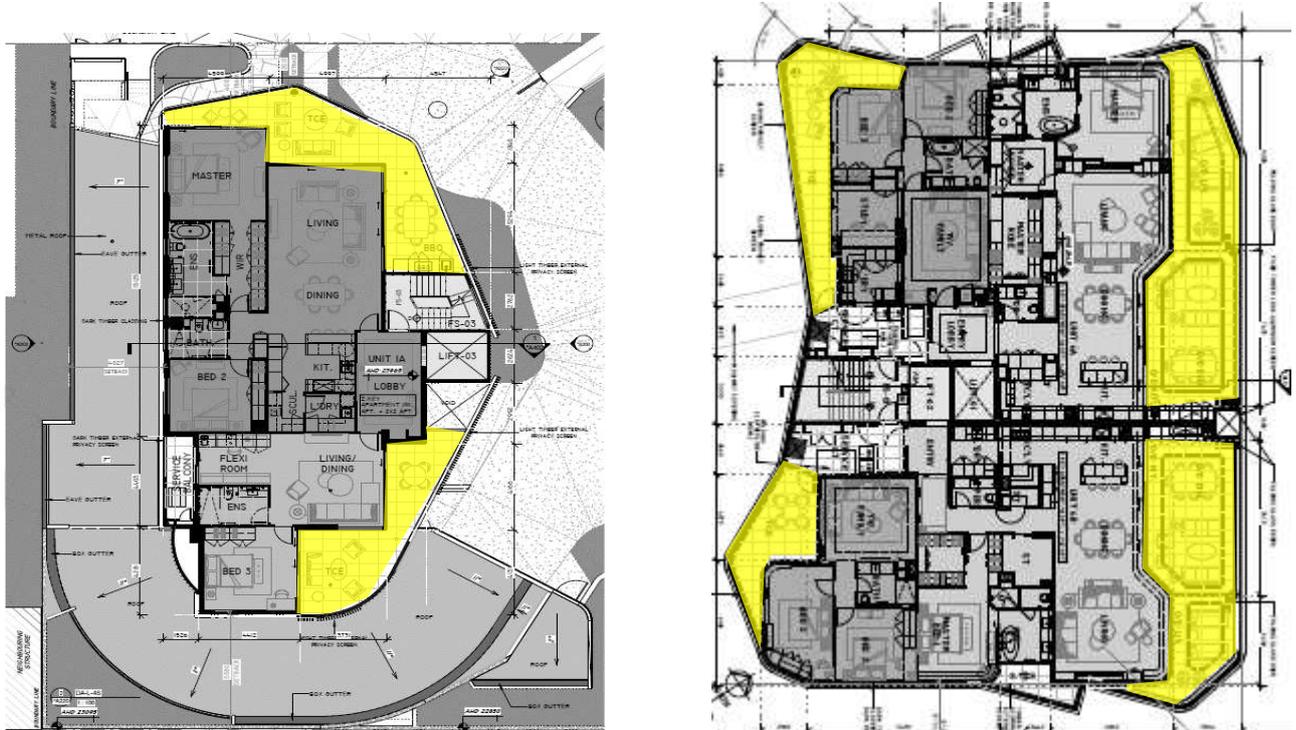
 Recommended to fulfil Walking

Figure 8: Plan view of the Level 2 basement of the proposed with the recommended wind criteria overlaid.



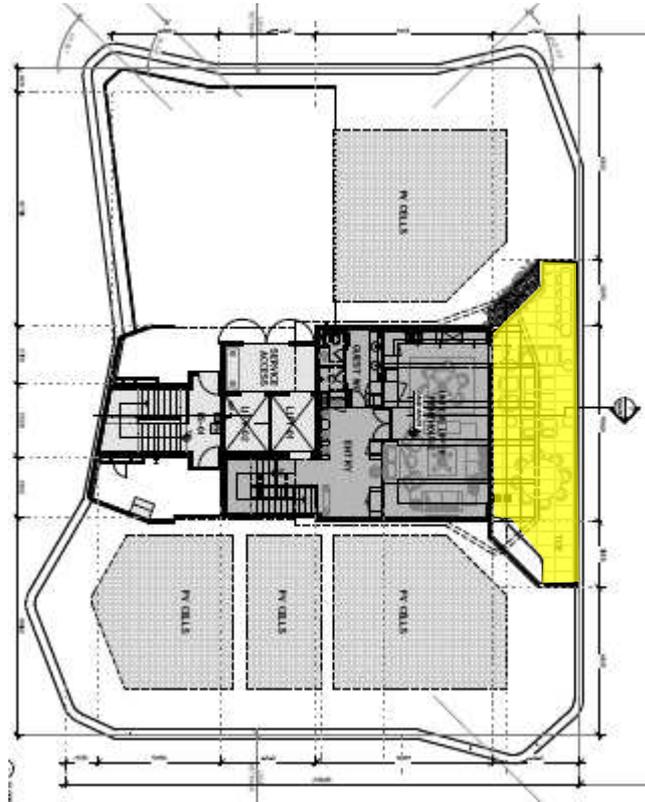
Recommended to fulfil Walking Recommended to fulfil Standing Recommended to fulfil Sitting

Figure 8: Plan view of ground level of the proposed development with the recommended wind criteria overlaid



Recommended to fulfil Walking

Figure 10: Plan view of Level 4S (left) and 4N (right) with the recommended wind criteria overlaid
 (Similar to Levels 5 to Level 14)



 Recommended to fulfil Walking

Figure 11: Plan view of Level 15N (Roof) with the recommended wind criteria overlaid

3 PEDESTRIAN LEVEL WIND EFFECTS

3.1 DISCUSSION

Key Points

- With the proposed design, the adjacent footpaths would be expected to have wind levels within the appropriate walking comfort criterion.
- The wind conditions at the main entrances would be within the criterion for standing.
- The wind conditions in the proposed seating areas would be expected to be within the sitting comfort criterion.
- The terraces with the proposed design are expected to have wind levels within the walking comfort criterion, most of these areas could achieve the more stringent criteria of standing to sitting.
- The Level 1N pool deck area is expected to have wind levels exceeding the recommended walking criterion.

Ground Floor (L3)

There are a number of existing features that are beneficial to reducing the environmental wind speeds induced by the proposed development, including:

- Curved geometry of the towers
- Landscaping;
- Setback main entrance.

Wind conditions at most of the footpath areas along Parker Street and surrounding the development are relatively sheltered from westerly winds. With the proposed landscaping, the proposed development is not expected to generate wind levels in this area in excess of the criterion for walking comfort.

The proposed entrances are expected to be within the criterion for standing comfort. The feature seated areas are expected to have wind levels within the sitting comfort criterion.

Level 1 Pool Deck

Wind conditions in the outdoor pool areas on L1N are expected to exceed the recommended criterion for walking, due to the downwash from the prevailing east sector winds. We recommend incorporating a canopy or similar feature to reduce the downwash winds to the pool deck to improve the wind conditions in the area.

Outdoor Terraces

The open terraces are private and have folding glass doors, sliding privacy wind screens as well as landscaping proposed. These features are expected to mitigate adverse winds, and therefore these areas are expected to be within the recommended walking criterion. Most of these areas would achieve the more stringent standing to sitting criteria.

Whilst wind conditions on the proposed open terraces will frequently be acceptable for outdoor recreation, during moderate to strong winds, conditions in these areas may exceed human comfort criteria. Balcony/terrace areas on similar developments in many major Australian capital cities typically experience similar elevated wind conditions.

3.2 RECOMMENDATIONS

After careful consideration of the areas at the base of the proposed development, Vipac predicts that the proposed development will present some changes to existing wind conditions in adjacent ground level areas. Vipac does not predict any exceedance of the recommended criteria at the ground level, and various high level terraces.

Due to the exposure and sheer façade design, the pool deck at Level 1N would be expected to high wind conditions. We recommend incorporating a canopy attached to the top of Level 1N to reduce the adverse downwash winds to within the recommended comfort criterion (Figure 12). The canopy could be designed as adjustable, and used only in windy days.

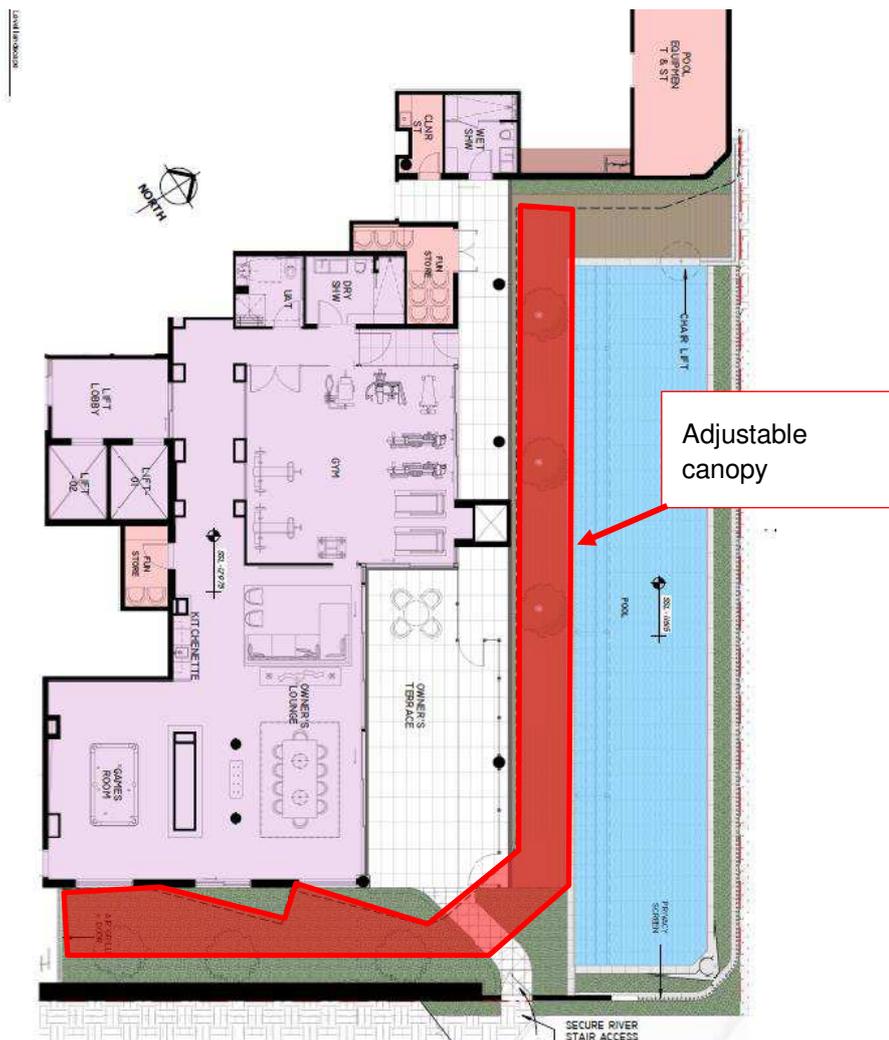


Figure 12: Plan view of Level 1 Lower basement with the recommended wind control measures overlaid.

As a general statement, educating residents about wind conditions at high-level balconies and terraces areas during high-wind events is also recommended.

It should be noted that this study is based on experience only and has not utilised any experimental data for the analysis. Considering the dimension and exposure of the proposed development, Vipac recommends a scaled wind tunnel study in the detail design stage to verify the predictions and determine the optimal wind controls.

4. CONCLUSIONS

An assessment of the likely wind conditions at pedestrian level of the proposed development at **8 Parker Street, South Perth** has been made.

Vipac has carefully considered the form and exposure of the proposed development, nominated criteria for various public areas according to their function and referred to past experience to produce our opinion of likely wind conditions. Based on this assessment, the following conclusions are drawn:

- With the proposed design, the adjacent footpaths would be expected to have wind levels within the walking comfort criterion.
- With the proposed design, all building entrances would be expected to have wind levels within the recommended comfort criteria of standing.
- With the proposed design, the featured seating areas would be expected to have wind conditions within the recommended comfort criterion of sitting.
- With the proposed design, terraces on various levels are expected to have wind conditions within the walking comfort criterion. Most of these areas could achieve the more stringent criteria of standing to sitting comfort.
- With the proposed design **and recommendations**, the Level 1N pool deck is expected to have wind conditions within the recommended comfort criterion for walking.

As a general statement, educating occupants about wind conditions at open terrace/balcony areas during high-wind events and fixing loose, lightweight furniture on the terrace are highly recommended.

The assessments provided in this report have been made based on experience of similar situations in Perth and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without experimental validation may not account for all complex flow scenarios in the vicinity. Considering the dimensions and exposure of the proposed development, Vipac recommends a scaled wind tunnel study in the detail design stage to verify the predictions and determine the optimal wind controls.

This Report has been Prepared

For

8 Parkers Street Pty Ltd

By

VIPAC ENGINEERS & SCIENTISTS LTD.

Appendix A: ENVIRONMENTAL WIND EFFECTS

Atmospheric Boundary Layer

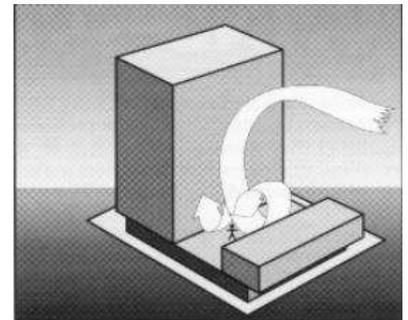
As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a wind velocity profile. When this wind profile encounters a tall building, some of the fast moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.

Downwash – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast moving wind at higher elevations downwards.

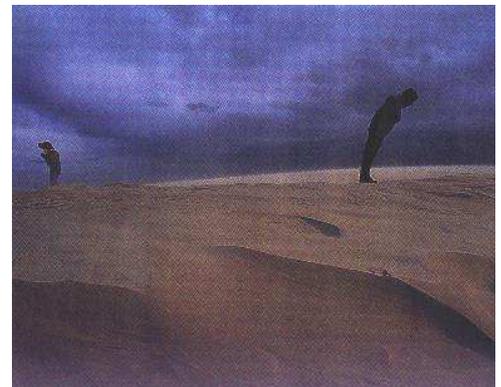
Corner Accelerations – when wind flows around the corner of a building it tends to accelerate in a similar manner to airflow over the top of an aeroplane wing.

Flow separation – when wind flowing along a surface suddenly detaches from that surface and the resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.



Flow channelling – the well-known “street canyon” effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Piers and open water frontage may have such exposure.



Appendix B: REFERENCES

- [1] *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2011
- [2] *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience
- [3] *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

Appendix C: DRAWING LIST

Received September 2020:

DA DRAWING LIST	
Sheet No	Sheet Name
*A000	Cover Page
*A100	Survey Plan (Prior to Demolition Work)
*A101	Survey Drawing (After Demolition Work)
*A114	Architectural and Surveyor Contours Interpolated Drawing
*A120	Demolition Plan
*A200	Proposed Site Plan
*A201	L1 Lower Basement Level plan and Amenities Deck
*A201A	L1-Lower Basement Level Landscape Reference
*A202	L2 Basement Plan
*A203	L3 Ground Floor Plan - Entry Level
*A204	North Building - L4N Plan
*A205	North Building - L5N Plan
*A206	North Building - L6N Plan
*A207	North Building - L7N Plan
*A208	North Building - L8N Plan
*A209	North Building - L9N Plan
*A210	North Building - L10N Plan
*A211	North Building - L11N Plan
*A212	North Building - L12N Plan
*A213	North Building - L13N Plan
*A214	North Building - L14N Penthouse Plan
*A215	North Building - L15 Roof Terrace Plan
*A220	South Building - L4S
*A221	South Building L5S & L6S
*A230	Roof Plan
*A301	Contextual North Elevation
*A302	Contextual East Elevation
*A303	South Building - South and North Contextual Elevation
*A304	Contextual West Elevation
*A305	North Building - Contextual South Elevation
*A321	Fence Elevation - North and East
*A322	Fence Elevation - South and West
*A402	Cross Section - North to South