

# 2 Bowen Crescent Residential Development, Melbourne Desktop Pedestrian Level Wind Report



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Development, Melbourne



## 2 Bowen Crescent, Melbourne Pedestrian Level Wind Report

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## EXECUTIVE SUMMARY

GWTS has been commissioned by **Wuzhong International** to perform an assessment of pedestrian level winds for the proposed residential development of **2 Bowen Crescent, Melbourne**.

This study was conducted by GWTS as a study to help in achieving a greater understanding of the wind conditions and environment of the proposed development. GWTS investigated the wind environment around the proposed building by considering the form and exposure of the proposed development, the nearby existing developments, the local wind climate and the proposed use of ground level areas in and adjacent to the proposed development. Utilizing observations made from the simulations and experience, the wind speeds around the buildings were examined and compared with widely used and accepted criteria for pedestrian comfort and safety.

This study concludes that some localized increases in ground level wind conditions due to the proposed development are likely and consequently, wind speeds are expected to marginally exceed the criteria for comfort. It is recommended to use foliage, hand railing and canopies as wind reducing mechanisms to reduce wind speeds on the adjacent Bowen Crescent and Bowen Lane.

Please note that this is an opinion statement solely based on empirical data and experience, and is not based on a wind tunnel test. If a high level of confidence is required a comparative wind tunnel test is recommended.

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## 1. INTRODUCTION

The proposed **2 Bowen Crescent, Melbourne** development (“the proposed development”) is a 18-storey residential building. The site is bounded by Bowen Crescent to the southeast, Bowen lane to the northwest and existing developments to the North East and southwest. A close-up aerial view of the site is shown in **Figure 1**. A satellite view of the proposed development with the surroundings of an approximately 2 km radius is shown in **Figure 2**.

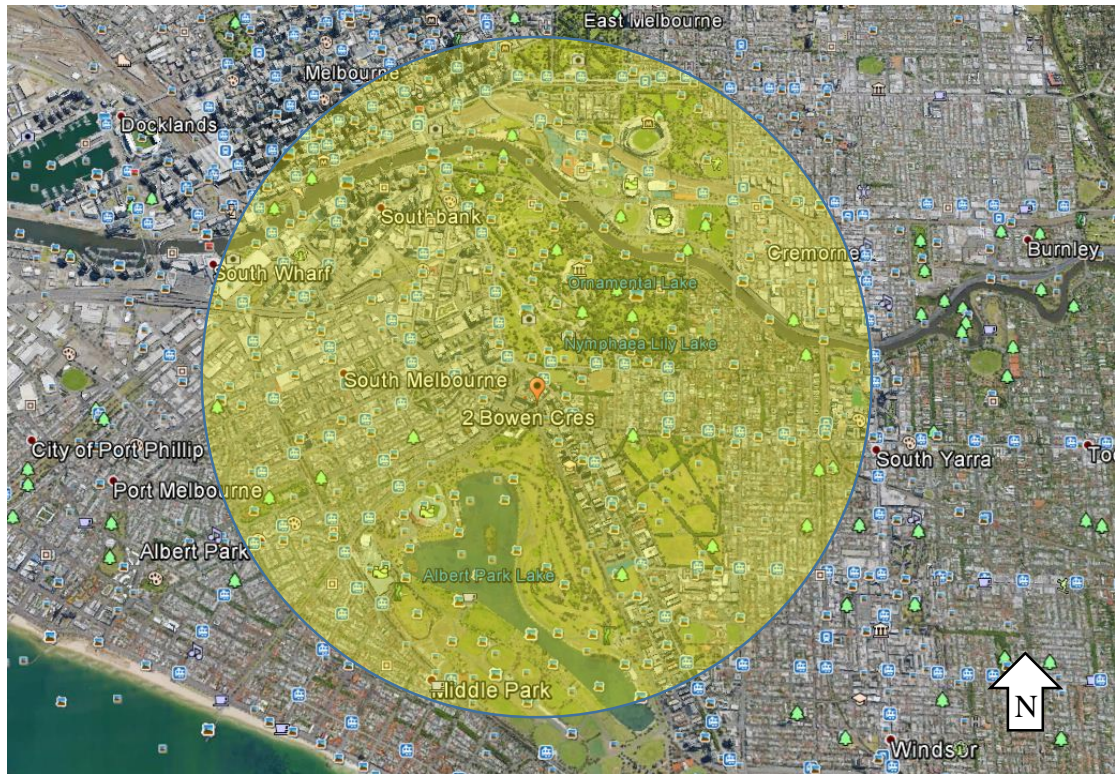
The objective of the study was to consider the likely wind conditions in ground level outdoor areas adjacent to the proposed development in relation to criteria for human comfort and safety. The pedestrian wind environment study of the development was based on experience, empirical data, architectural drawings supplied to GWTS by Plus Architecture (**Appendix A**) and the site wind climate.

This report is an opinion statement, and is not based on wind tunnel testing. Thus, the findings of this study are based on a wind climate assessment of the site of the proposed development as well as the authors’ experience of scale model wind tunnel testing and full scale assessments of other similar developments.



**Figure 1: Location of the proposed Development – 2 Bowen Crescent, Melbourne.**

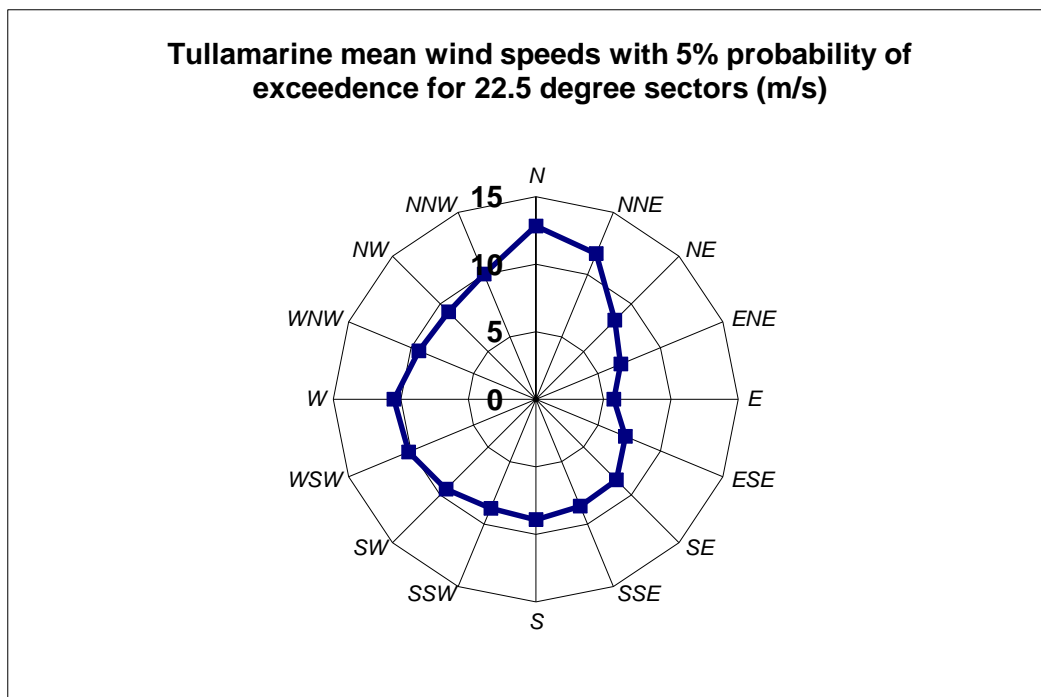




**Figure 2: Satellite image of the site of the proposed development on 2 Bowen Crescent, Melbourne and surrounding terrains.**

## 2. WIND CLIMATE

Weather records from Melbourne Airport meteorological station (1970-2010) have been obtained from the Australian Bureau of Meteorology [4] and statistically analysed to produce the directional distribution of mean (averaged over 1 hour) wind speed thresholds at a reference height of 10m, with a probability of exceedance of 0.05% (Figure 3). The 0.05% probability of exceedance for the directional wind speeds is approximately equivalent to a combined probability of exceedance for winds from all directions of 0.1%, as required by the criteria in Table 2 [5].



**Figure 3: Directional distribution of annual maximum 10 minute mean wind speeds (m/s) at 10m height at Melbourne Airport.**

The stronger winds of the Melbourne region originate from the Northerly and Westerly directions, with the highest predicted wind speeds coming from the north.

## 2.1 WIND EXPOSURE

The surrounding terrain within a 2km radius of the site consists of low and medium-rise developments, Albert Park Lake and parklands to the south, the Royal Botanical Gardens to the north and northeast with some high-rise developments to north. The surrounding topography within 2km of the site in all directions is predominantly low rise. Therefore, the site of the proposed Development is considered to have a Terrain Category 3 in the East and West directions and a Terrain Category 2.5 in the North and South directions, as defined in the Australian Standard for Wind Actions [4], with no significant topographic effects in any direction. Satellite photographs of the Project site and surrounding terrain are shown in Figure 2.

## 3. ASSESSMENT CRITERIA

GWTS's assessment criteria for pedestrian wind comfort are based on 3-second gust criteria. A set of annual maximum peak 3-second gust velocities is derived from meteorological data for the geographical location under consideration, for all wind direction to be assessed. For all of these possible wind directions and speeds, the regions where each of the wind speed criteria may be exceeded are then considered.

Most people will consider a site unacceptable for a given activity if the mean and/or gust velocities in that area during the annual maximum wind event exceed the annual maximum wind speed criterion for that activity. The site would also be likely to be considered excessively windy for that activity during more moderate winds.

The threshold gust velocity criteria are:

**Table 1 –Wind Comfort and Safety Gust Criteria for Melbourne Area**

<b>Annual Maximum 3 second Gust Speed</b>	<b>Result on Perceived Pedestrian Comfort</b>
>23m/s	Unsafe (frail pedestrians knocked over)
<16 m/s	Acceptable for walking (steady steps for most pedestrians)
<13 m/s	Acceptable for short standing (window shopping, vehicle drop off, queuing)
<10 m/s	Acceptable for long standing, sitting (outdoor cafés, pool area, gardens)



## Recommended Criteria

Table 2 lists the specific areas adjacent to the development and the corresponding recommended criteria. The assessment areas are also shown in Figure 4 to Figure 7 with the recommended criteria overlaid.

**Table 2 – Recommended application of criteria**

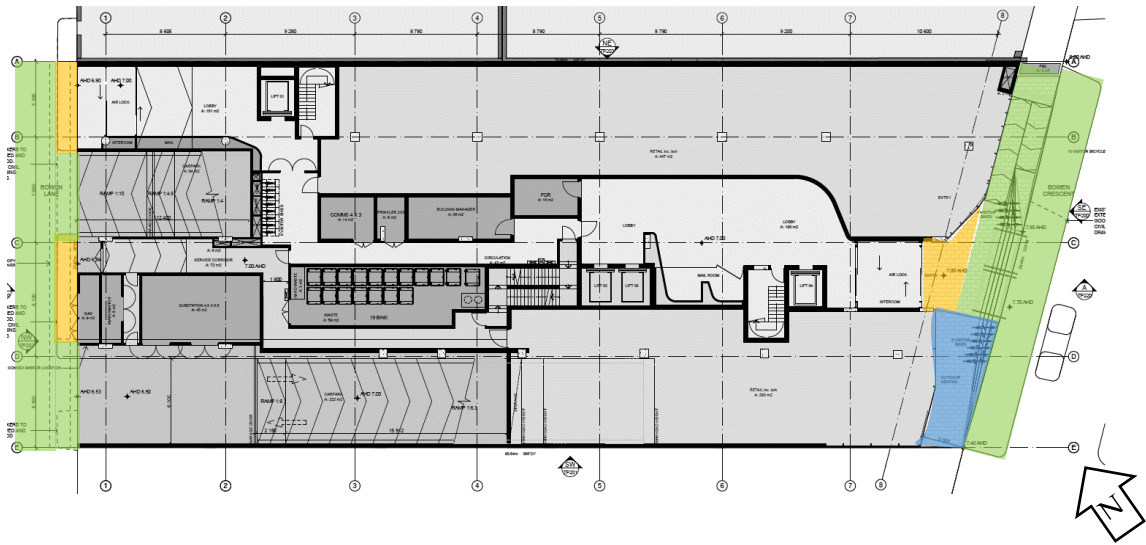
Area	Recommended Criteria
Public Footpaths	Recommended to meet the criterion for walking
Building Entrances	Recommended to meet the criterion for standing
Balconies, Podium rooftop, External deck	Recommended to meet the criterion for walking
Cafes, outdoor seating areas	Recommended to meet the criterion for sitting

## Intended Use of Adjacent Ground Level Areas

There are public footpaths adjacent or in close proximity to the proposed Development on Bowen Crescent and Bowen Lane. These areas are highlighted in green on **Figure 4a**. It is recommended that the walking criterion be satisfied for these pedestrian walkway areas.

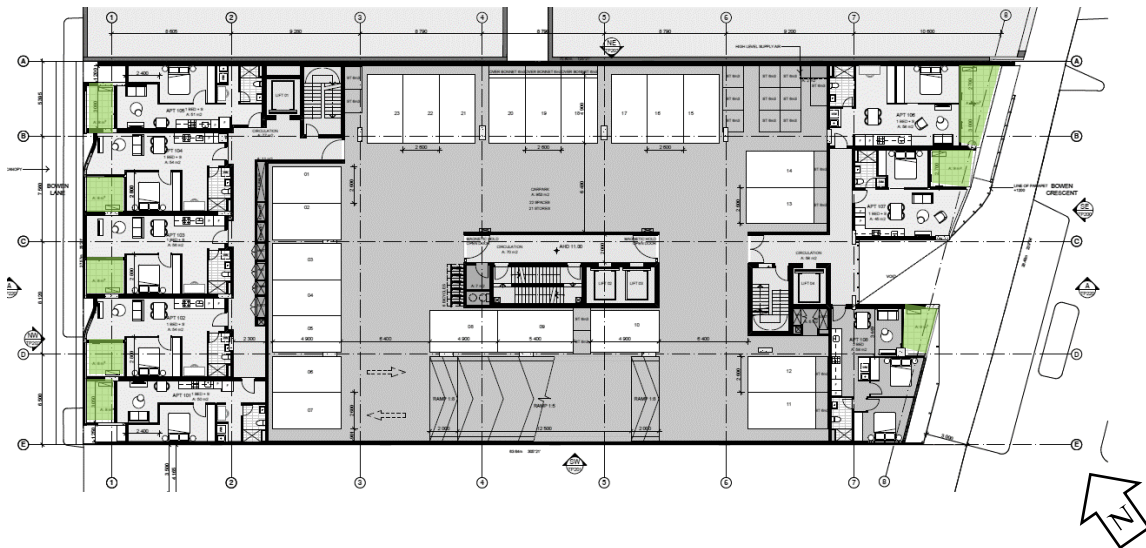
The building entrances of the development and outdoor seating areas, on Bowen Crescent and Bowen Lane, are highlighted in orange and blue, respectively, in **Figure 4a**. It is recommended that the standing criterion be satisfied for entrances and outdoor seating areas.

The balconies located along Bowen Lane, Bowen Crescent, the south west and the north east facades of the development are highlighted in green in **Figures 4b-4f**. It is recommended that the walking criterion be satisfied for such areas.



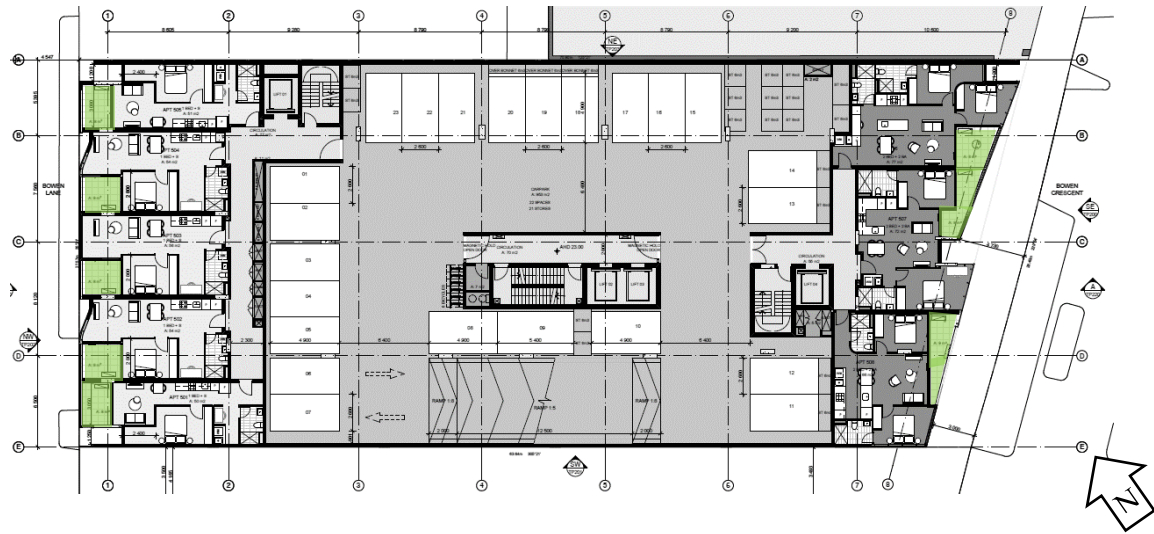
- Recommended to meet criterion for sitting
- Recommended to meet criterion for walking
- Recommended to meet criterion for standing

**Figure 4a: Schematic plan view of proposed development with recommended wind criteria overlaid on adjacent ground level.**



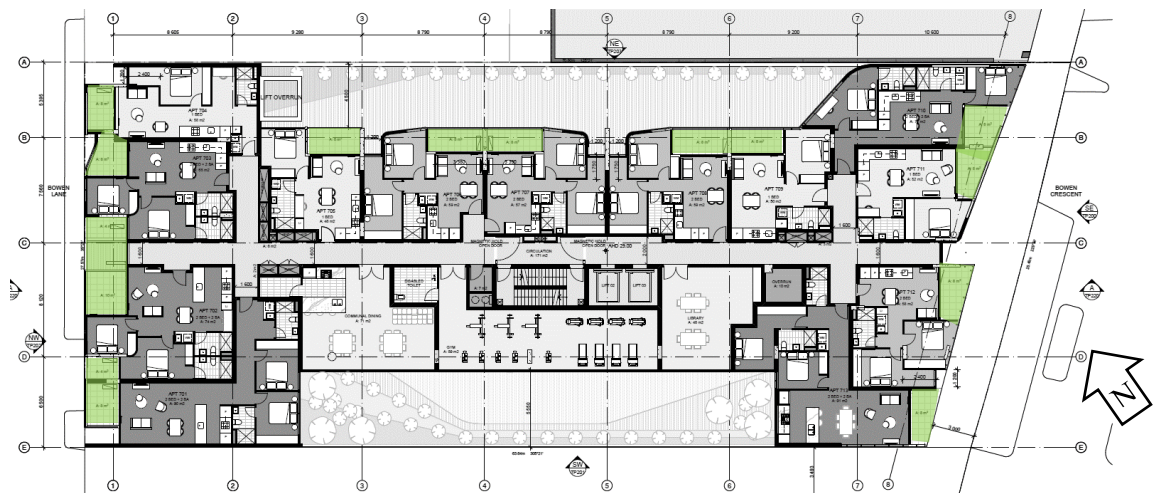
- Recommended to meet criterion for walking

**Figure 4b: Schematic plan view of proposed development with recommended wind criteria overlaid on level 1.**



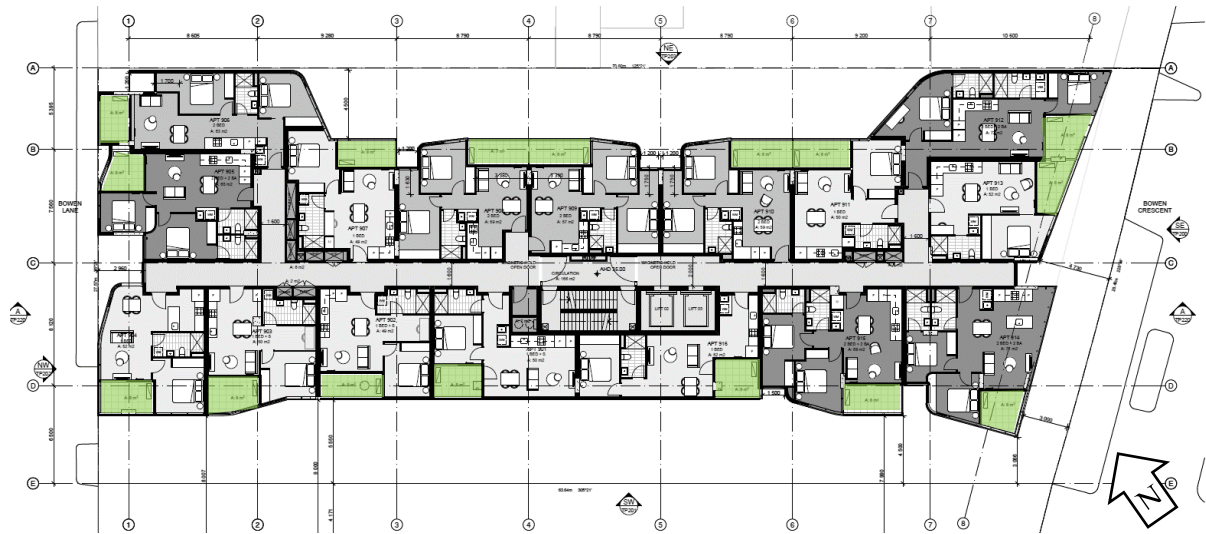
Recommended to meet criterion for walking

**Figure 4c: Schematic plan view of proposed development with recommended wind criteria overlaid on levels 2-6.**



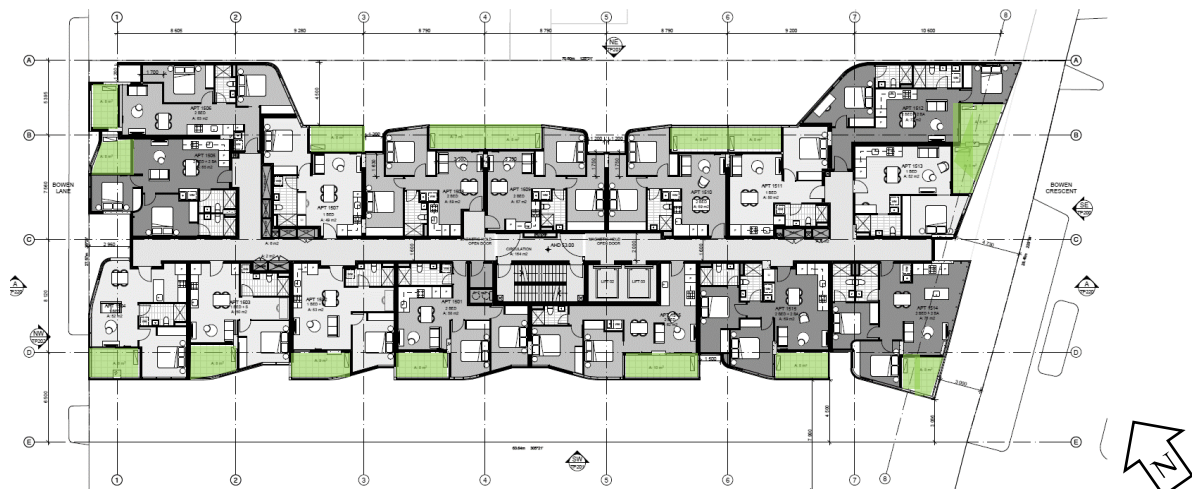
Recommended to meet criterion for walking

**Figure 4d: Schematic plan view of proposed development with recommended wind criteria overlaid on level 7.**



Recommended to meet criterion for walking

**Figure 4e: Schematic plan view of proposed development with recommended wind criteria overlaid on levels 8-13.**



Recommended to meet criterion for walking

**Figure 4f: Schematic plan view of proposed development with recommended wind criteria overlaid on levels 14-18.**



## 4. WIND ENVIRONMENT ANALYSIS

The wind profile of the site can be factored for height above ground, estimated local terrain roughness, local turbulence and the influence of buildings to produce estimated annual average maximum 3-second moving average gust wind speeds adjacent to the proposed development. These estimates can then be compared with the applicable criteria to determine whether they would be acceptable or not.

Estimates of ground level wind speeds have been made based on the Melbourne region wind climate data, empirical aerodynamics data and upstream exposure. Wind conditions in all ground level areas adjacent to the proposed development are predicted to meet or marginally exceed the criterion for safety. Estimates suggest westerly and south-westerly wind directions could potentially result in some localized wind speed increases at ground level.

### **Winds from the North (north eastern wall)**

A northerly wind is the strongest wind direction experienced in Melbourne and is expected to create a downwash upon interaction with the north-eastern façade of the building. However, shielding from common stronger winds by neighbouring upwind structures of heights ranging between 80-90 metres will prevent the widest face of the proposed development from exceeding the comfort criteria due to downwash. The effect of downwash caused from the north eastern wall will have negligible effect on pedestrian comfort as the neighbouring buildings are not intended for outdoor recreational use. The north-eastern facing balconies incorporated in the design will also assist in retarding the downwash upon contact and is not expected to exceed the walking criteria for comfort.

### **Wind from the East (south eastern wall)**

On the south eastern façade is the main entrance of the proposed development from Bowen Crescent. The ground floor is forecasted for retail use, outdoor seating, visitor bicycle parking and landscaping, demanding the criteria for sitting and standing to be met.

Although south easterly winds are some of the weakest winds produced in Melbourne, wind and light breezes from this direction are apparent and are felt more frequently along Bowen Crescent. The ease of flow over the Albert Park Lake and parklands provide an unobstructed pathway for winds to channel through Queens Road and Bowen Crescent, which account for the southerly breezes felt along the entrance to the proposed development. Simple discomforts due to this exposure are likely to be felt such as wind raising loose paper, the disturbance of hair, slight cooling of the body and the flapping of light clothing. Considering the exposure to the outdoor seating along Bowen Crescent, the comfort criteria for sitting is expected to be marginally exceeded and wind ameliorating mechanisms are recommended.

Drawings provided by Plus Architecture indicate that an entrance alcove behind the building line has been utilised at the mid-section of the building, which will generally produce a calmer entrance area [9]. The use of an alcove will eliminate the need for canopies and help to alleviate the adverse effects of downwash, such as difficulty opening doors.

### **Wind from the South (south western wall)**

The southwestern wall is considerably sheltered by Building 4 (TABCORP) on Bowen Crescent. As the height of TABCORP has significantly approached the height of the proposed development, it will, in effect, provide a substantial degree of sheltering and any increase in wind speed due to downwash will thus be low. The proposed development will therefore no longer be subjected to the full dynamic pressure of the wind over its entire face. Downwash generated on the portion of the building that is exposed is likely to be deflected by the podium at level 7. Thus, considering the degree of shielding, the building podium and the relative strength of the wind from the south, the wind environment along the south-eastern wall of the development would meet the criterion as recommended.

### **Winds from the West (north western wall)**

The north western wall of the proposed development, along Bowen Lane, is exposed to the second strongest directional wind speed in Melbourne. As illustrated in the velocity vector plot in **Figure 5**, wind from the west will hit the north western façade and is expected to create a downwash, marginally increasing wind speeds along Bowen Lane and in the neighbouring car park of the Albert Road Clinic. Estimates suggest that this may result in a minor adverse effect on the amenity of the footpath as a pedestrian thoroughfare, resulting in the marginal exceedance of the recommended walking criteria on Bowen Lane.

As also illustrated plot in **Figure 5**, it is likely that accelerations away from the base of the building will occur and architectural features are likely necessary to ameliorate the effects of downwash. As this wall is highly exposed and consists of prominent openings (two car park entrances and two building entrances), care must be taken to ensure the safety and comfort of pedestrians upon entry and exit of the building. Openings at building corners are particularly prone to undergoing accelerated wind speeds due to separation of wind flow at the base of the building. As illustrated in drawings provided by Plus Architecture, the north eastern lobby entrance will be sheltered by the use of canopies, however, careful selection in canopy sizing must be taken to avoid the exceedance of the comfort criteria and recommendations are provided in **Section 5**. The car park entrance illustrated in **Figure 7**, however, may be effected by corner streams. Although the opening is sheltered by a roller door, the infrequent event of accessing the substation room while the roller door is open may result in simply unpleasant conditions and frequent difficulty to open doors.

A channel flow effect is expected to occur between 3 Bowen Crescent and the proposed development, as illustrated in the velocity vector plot in **Figure 6**. It is expected that wind speed will marginally increase due to the proposed development although the wind environment between the two buildings is not expected to exceed the criteria as recommended.

Similar to wind felt on the Bowen Crescent entrance, however, south westerly winds generated from the open terrain effects of Albert Park Lake and Parklands are most often felt at the proposed building site along Bowen Lane. Considering the strength of the wind from the south direction, the wind environment created by the southerly winds is expected to be within the recommended criteria.



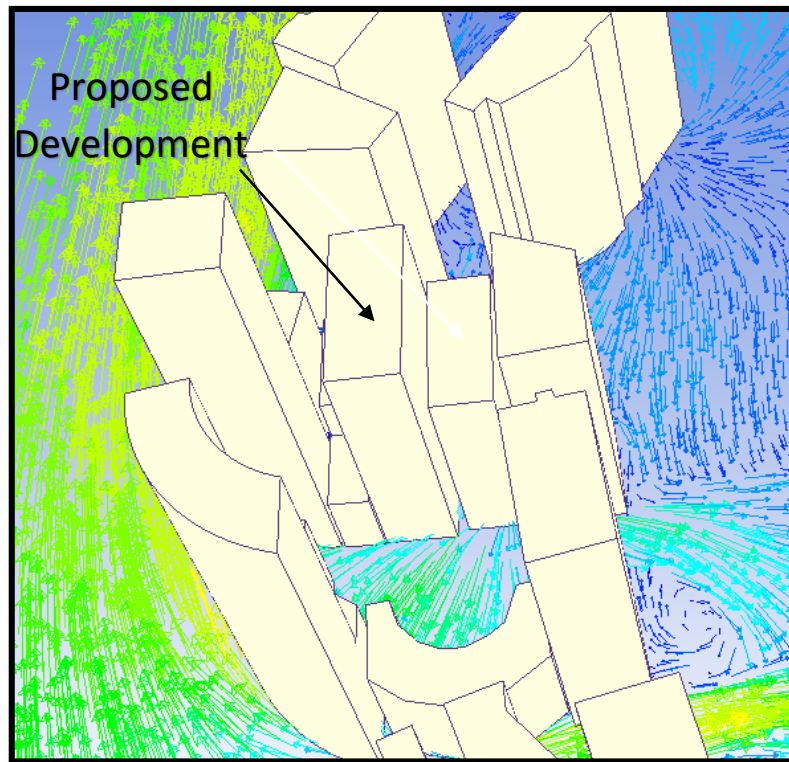


Figure 5: Flow of westerly wind on the north-western wall

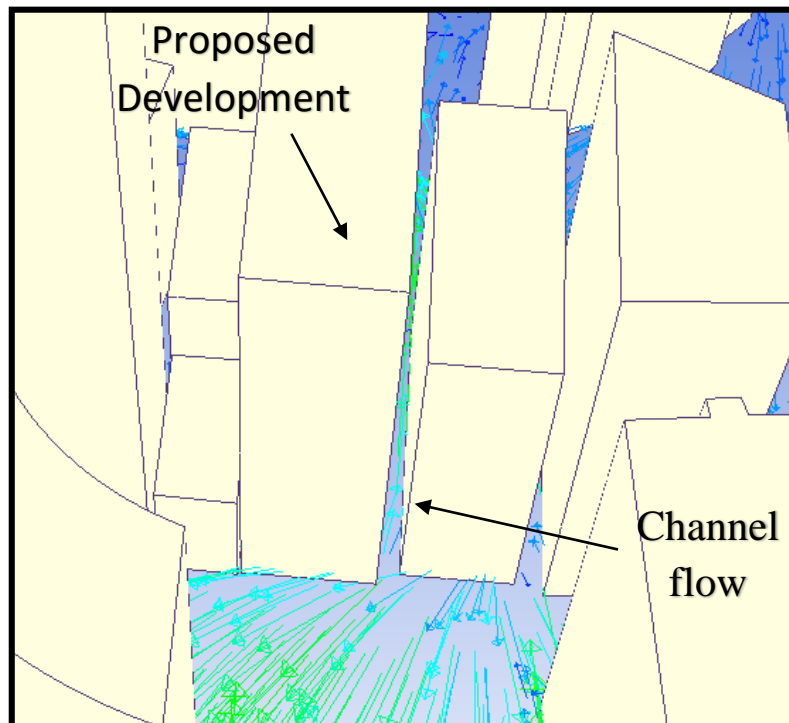


Figure 6: Channel flow between the proposed development and 3 Bowen Crescent

## **Balconies**

Although the proposed apartment balconies will often be acceptable for outdoor recreation, conditions may occasionally exceed the criteria for human comfort during moderate to strong winds. Balcony and terrace areas located at the mid-section of a broad face are usually a lot calmer when compared to areas located at the ends and corners of the building. Accelerated corner flows, standing vortices and high exposure to corner balconies often attract a windy environment that may impede the overall use of the recreational area. Owners of corner apartments may therefore resort to using their balcony less frequently or limiting the area of recreational use to zones that are more protected.

The phenomenon of elevated wind conditions producing slight discomfort to pedestrians on corner balconies and terrace areas is a common occurrence for similar developments in Melbourne and the apartment balconies are expected to be within the recommended walking criteria.

## 5. RECOMMENDATIONS

The placement of foliage, hand railing and canopies as wind reducing mechanisms is recommended to reduce wind speeds on the adjacent Bowen Lane.

- **Canopies**  
As illustrated in **Figure 7**, proposed canopies have been positioned above the northwest facing entrances to provide comfort and safety to pedestrians upon entry and exit of the building. It is recommended that canopies along Bowen Lane have a minimum width of 2 m from the face of the proposed development to ameliorate the effects of downwash.
- **Pedestrian comfort at Bowen Crescent entrance**  
The placement of artwork, foliage, screens or planter boxes with foliage is recommended across the building entrance along Bowen Crescent, as illustrated in **Figure 8**, in order to reduce the impact of wind flow from the nearby open terrain of Albert Park Lake. Wind tunnel testing is recommended for the selection of an appropriate height and porosity of screening to effectively decrease the localised wind in this area.
- **Foliage**  
In the unlikely event of discomfort to pedestrians in the car park of the Albert Road Clinic, the placement of denser evergreen foliage over the existing greenery, illustrated in **Figure 9**, may offer a higher degree of sheltering to the effects of downwash from the proposed development.
- **Railing outside the substation**  
As illustrated in yellow in **Figure 7**, hand railing may be used to provide safety to workmen requiring access to the substation room and to prevent any equipment from obstructing the driveway to vehicles. **Figure 10** illustrates the use of hand railing outside the substation of 3 Bowen Crescent (adjacent to the proposed development) which may be used for guidance.
- **Balconies**  
During high wind events, the balconies, external deck and the roof of the building are at potential risk of the removal of lightweight items from these areas of the proposed development. It is recommended that safety and precaution is taken by the building occupants to securely fix lightweight items on balconies.

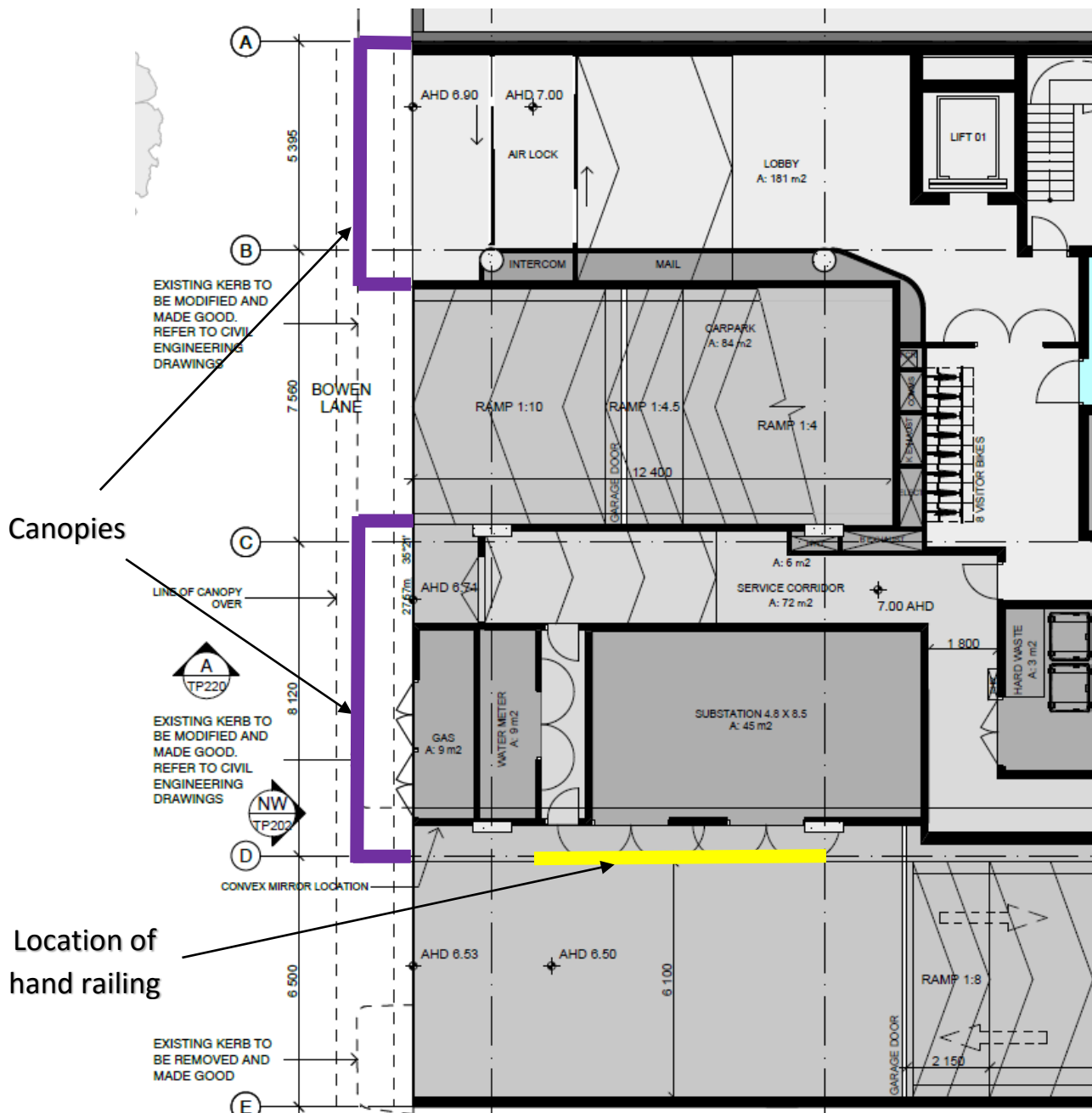
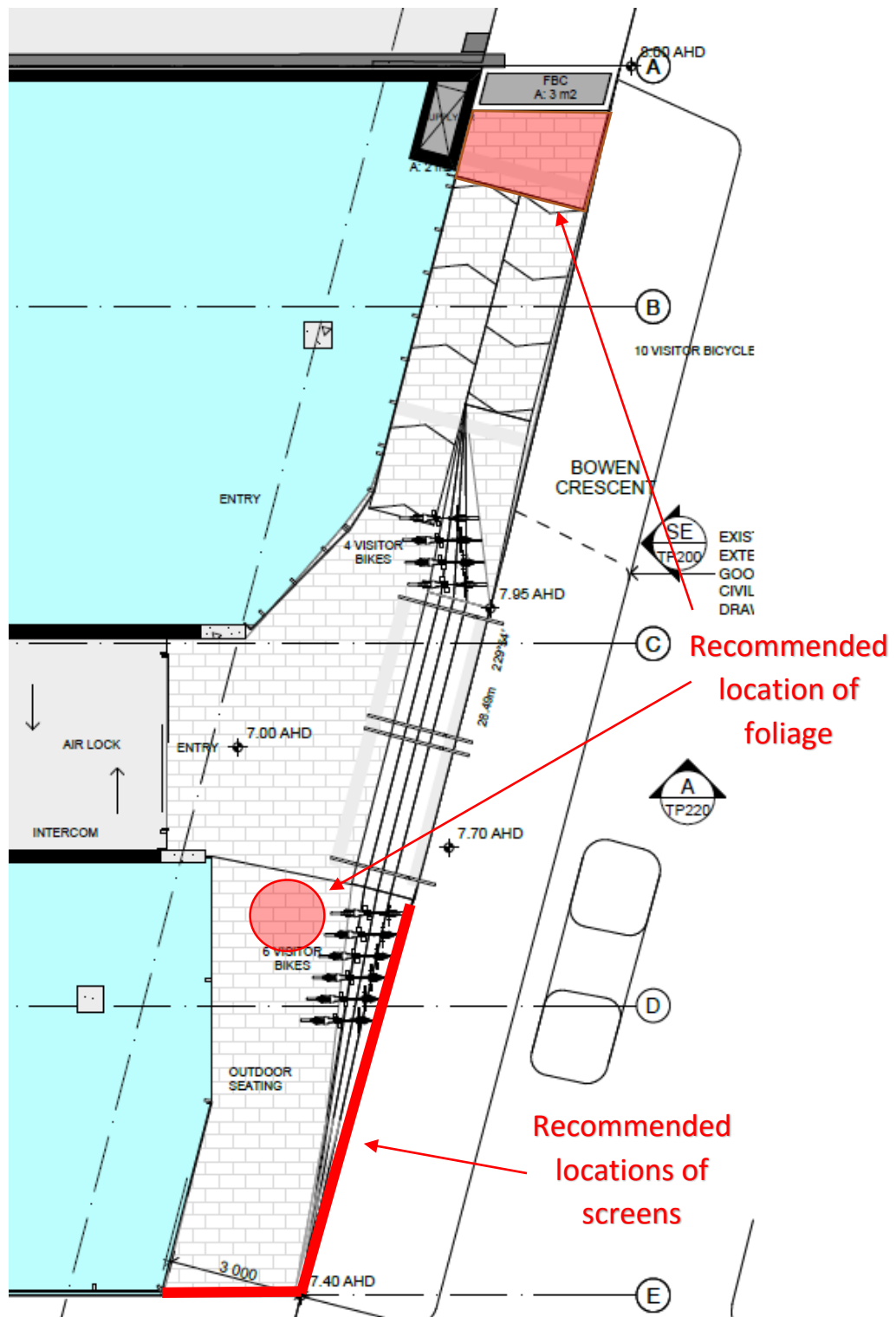


Figure 7: Location of canopies and of hand railing





**Figure 9:**

**Recommended placement of foliage**



**Figure 10: Use of hand railing  
at 3 Bowen Crescent**



## 6. CONCLUSIONS

GWTS has carefully evaluated the wind environment around the proposed building by considering the form and exposure of the proposed development, the nearby existing developments, the local wind climate and the proposed use of ground level areas in and adjacent to the proposed development. Based on our experience and empirical relations for wind speed at a ground level and the above consideration, expected wind speeds around the proposed building are predicted and then compared in relation to widely used and accepted criteria for comfort and safety.

This study concludes that some localized increases in ground level wind conditions due to the proposed development might occur. Consequently, exceedances of the recommended criteria are likely and some recommendations are made. The exact specifications of each recommendation would need to be determined from wind tunnel testing.

**Please note that this is an opinion statement and is not based on wind tunnel test. If a high level of confidence is required a wind tunnel test is recommended.**

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## 7.0 REFERENCES

- 1) Australian Standard 1170.2:1989, Wind actions
- 2) Melbourne, W. H., "Criteria for Environmental Wind Conditions", Jour. Industrial Aerodynamics, Vol. 3, 241-249, 1978
- 3) Australian Wind Engineering Society, "Cladding Pressure and Environmental Wind Studies" Quality Assurance Manual, 1994
- 4) AS/NZS 1170.2 Supplement 1: 2011
- 5) *Adelaide City Development Plan (current)*, Adelaide City Council, <http://www.adelaidecitycouncil.com/planning-development/cityplanning/development-plan/>
- 6) Aynsley R, Melbourne W, Viclery B, *Architectural Aerodynamics*, Applied Science Publishers
- 7) Australasian Wind Engineering Society, *Guidelines for Pedestrian Wind Effects Criteria*, <http://www.awes.org/archives/news/pedestrian-wind-effects-criteria/>
- 8) Simiu, E., Scanlan, R.H., *Wind Effects on Structures, Fundamentals and Applications to Design*, Third Edition, John Wiley & Sons Inc. 1996
- 9) Cochran, L, *Design Features to Change and/or Ameliorate Pedestrian Wind Conditions*, Structures , 1-8, 2004.

## APPENDIX A - DRAWING LIST

### Drawing List

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