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Katz Architecture Pty Ltd

1-5 Bogong Avenue, Glen Waverly - Multi Deck Carpark

Wind Impact Assessment

30N-22-0259-TNT-39001-0

29 July 2022

Job Title:	1-5 Bogong Avenue, Glen Waverly - Multi Deck Carpark
Report Title:	Wind Impact Assessment
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Executive Summary

Katz Architecture 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 **1-5 Bogong Avenue, Glen Waverly - Multi Deck Carpark.** This appraisal is based on Vipac's experience as a wind-engineering consultancy.

Drawings of the proposed development were provided by Katz Architecture in July 2022.

The findings of this study can be summarized as follows:

With proposed design:

- Wind conditions in the ground level footpath areas and access ways would be expected to be within the **walking** comfort criterion or similar to the existing conditions;
- the entrance to the lobby lift would be expected to be within the **standing** comfort criterion or similar to the existing conditions.
- The proposed development would not expected to generate unacceptable impact on surrounding land.

The assessments provided in this report have been made based on experience of similar situations in Melbourne 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.

Vipac believes that no wind tunnel testing is necessary for this appraisal.

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1 Introduction

Vipac Engineers and Scientists has been commissioned by **Katz Architecture Pty Ltd** to carry out an appraisal of the pedestrian wind effects at the ground level of the proposed development at **1-5 Bogong Avenue, Glen** Waverly **- Multi Deck Carpark.**

Strong winds in pedestrian areas are frequently encountered in central business districts of cities around the world; including Sydney, Melbourne and Brisbane. Wind characteristics such as the mean speed, turbulence and ambient temperature determine the extent of disturbance to users of pedestrian areas. These disturbances can cause both comfort and safety problems and require careful consideration to mitigate successfully.

The proposed development is an additional four level extension on top of an existing three storey carpark. The site is bounded by Bogong Ave to the south, and existing developments with excess laneways to the other directions. A satellite image of the proposed development site and the north and west elevations of the building are shown in Figure 1 and Figure 2, respectively.

This report details the opinion of Vipac as an experienced wind engineering consultancy regarding the wind effects in ground level footpath areas 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. Empirical data for typical buildings in boundary layer flows has also been used to estimate the likely wind conditions on the ground level areas of the proposed development [2] & [3].

Drawings of the proposed development were supplied to Vipac by Katz Architecture in July 2022. A list of drawings supplied is provided in Appendix C of this report.

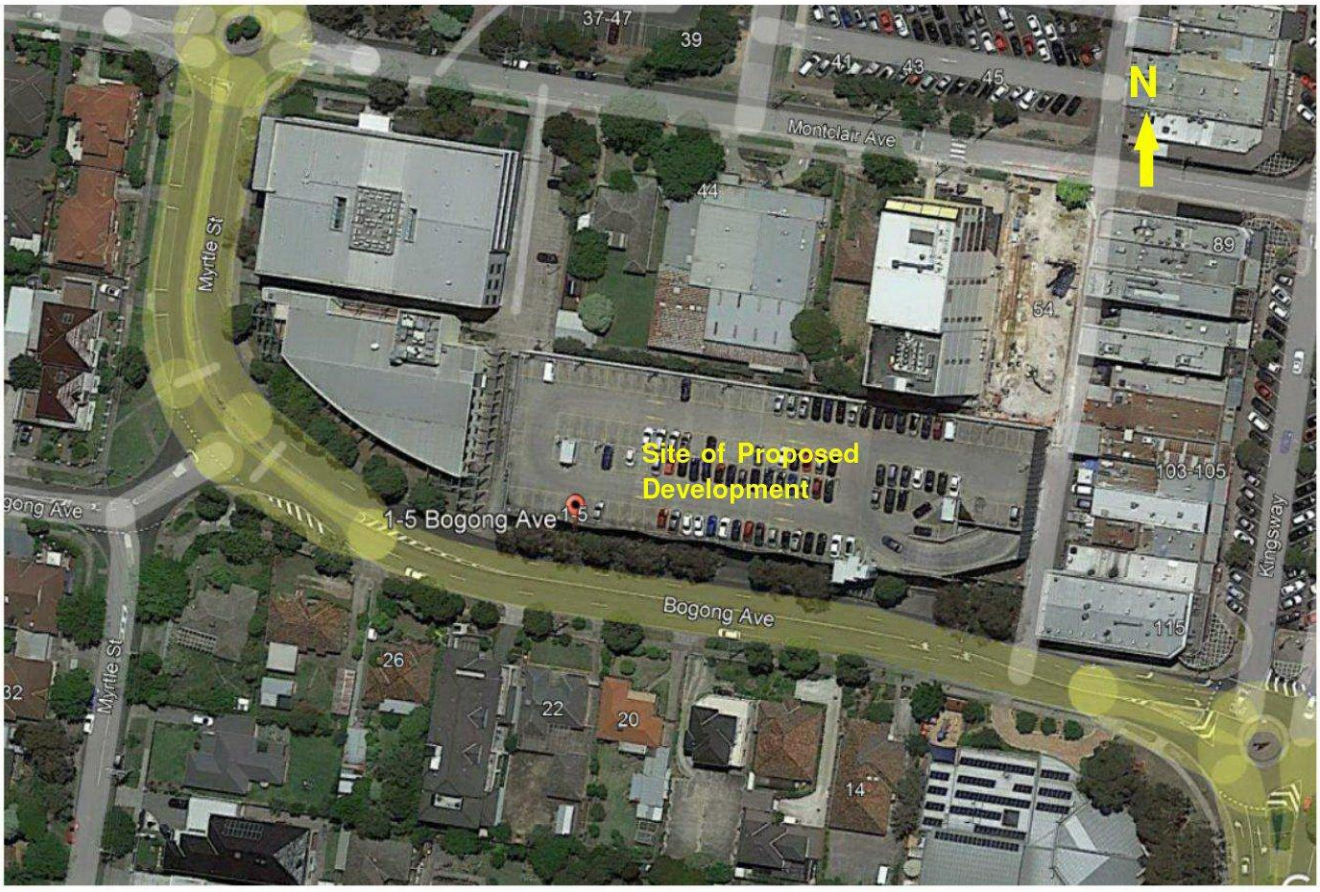


Figure 1: Aerial view of the proposed development site.

Figure 2: North and West Elevations of the proposed development.

2 Analysis Approach

In assessing whether a proposed development is likely to generate adverse wind conditions in ground level footpath areas, Vipac has considered the following 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; and
- The assessment criteria determined by the intended use of the areas affected by wind flows generated or augmented by the proposed development.

The pedestrian wind comfort at specific locations of ground level footpath areas may be assessed by predicting the gust and mean wind speeds with a probability of 0.1% and 20% expected at that location. The location may be deemed generally acceptable for its intended use while gust and mean wind speeds are within the threshold values noted in Section 2.5. Where Vipac predicts that a location would not meet its appropriate comfort criterion, the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating may be recommended. 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 a relatively flat terrain. The site is surrounded within an approximately 1.4 km radius predominately by low rise developments with some mid-rise buildings to the northeast; A satellite image showing these site surroundings is shown in Figure 3.

Considering the immediate surroundings and terrain, for the purposes of this study, the site of the proposed development is assumed to be within Terrain Category 3 for all wind directions (Figure 3).

Figure 3: Assumed terrain categories for wind speed estimation.

2.2 Regional Wind Climate

The mean and gust wind speeds have been recorded in the Melbourne area for over 30 years. This data has been analysed and the directional probability distribution of wind speeds has been determined. The directional distribution of hourly mean wind speed at the gradient height, with a probability of 0.1% of time and 20% of time exceeded are shown in Figure 4. The wind data at this free stream height is common to all Melbourne city sites and may be used as a reference to assess ground level wind conditions at the site.

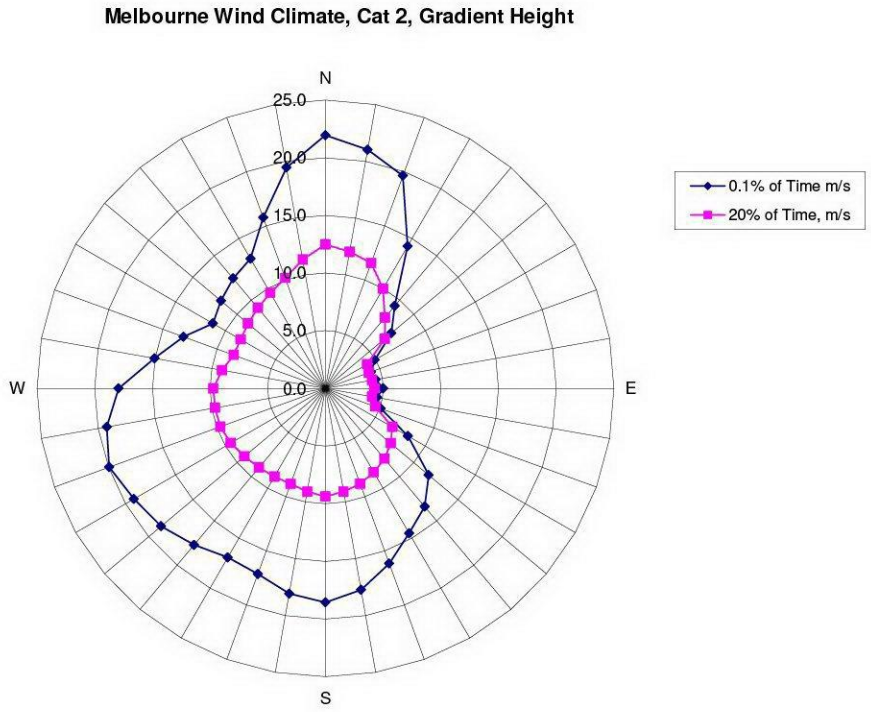


Figure 4: Directional Distribution of Mean Hourly Wind Velocities (m/s) for 0.1% and 20% exceeded at Gradient Height for Melbourne.

2.3 Building Geometry and Orientation

The proposed development is an additional four level extension on top of an existing three storey carpark. The overall plan-form dimensions are approximately 35 m x 115 m as shown in Figure 5. The main vehicle entrances are located on Bogong Ave. The development incorporates porous facades for all directions.

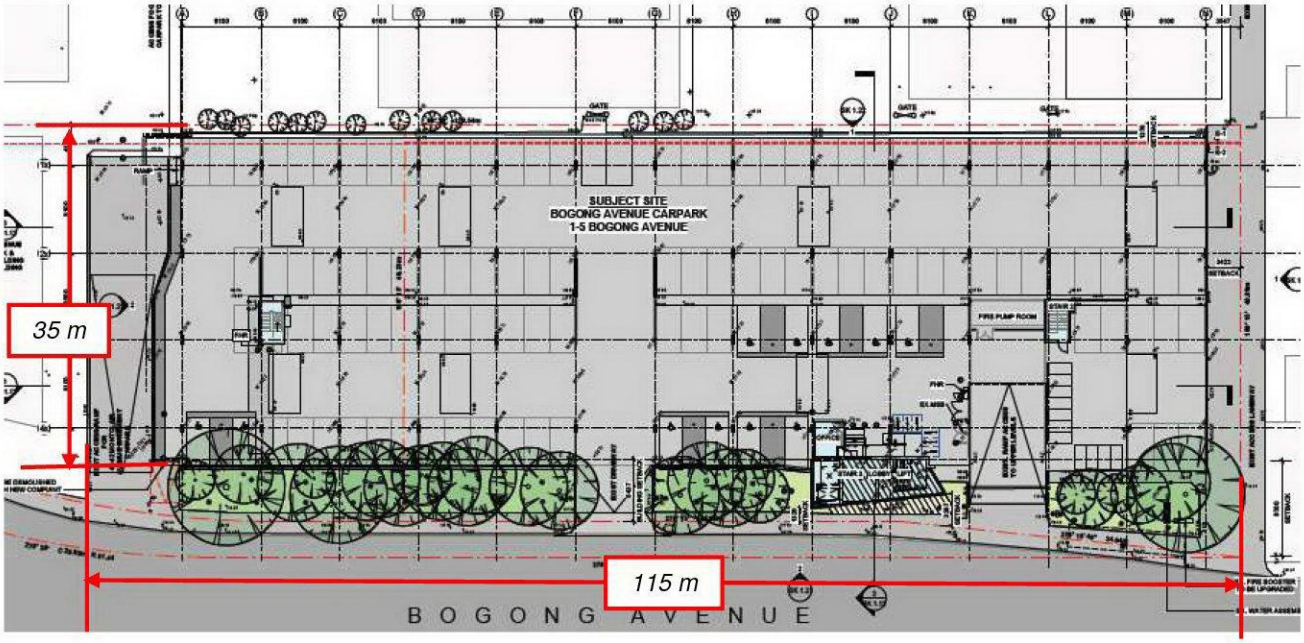


Figure 5: Ground floor plans with the plan-form dimensions overlaid.

2.4 Flow interactions with Adjacent Developments

The immediately adjacent developments are shown in Figure 6. The site is exposed to direct winds from the southerly and westerly directions channelling along Bogong Ave; and uninterrupted northerly winds from the carpark lots to the north. The development is taller than the surrounding buildings and so is exposed to winds from all directions at the upper levels. Vipac notes that there is an approved 11-storey development immediately north of the proposed carpark development.

Figure 6: Immediately adjacent surroundings and their approximate number of floors (F).

2.5 Assessment Criteria

The following wind comfort criteria detailed in Table 1 were applied in this study.

Table 1: Wind Comfort Criteria applied in this study

Unsafe	Comfortable
Annual maximum 3 second gust wind speed exceeding **20m/sec** with a probability of exceedance of 0.1% considering at least 16 wind directions.	Hourly mean wind speed or gust equivalent mean speed from all wind directions combined with probability of exceedance less than 20% of the time, equal to or less than: **3m/sec** for sitting areas (outdoor cafés) **4m/sec** for standing areas (window shopping, queuing) **5m/sec** for walking areas (steady steps for most pedestrians)

This criterion specifically calls for the safety criterion to be used to assess infrequent winds (e.g. peak event of ≤ 0.1% of the time); and the perceived pedestrian comfort to be assessed based on frequently occurring winds (e.g. winds that occurs 80% of the time).

In Table 1, the mean wind velocity is defined as the maximum of hourly mean or gust equivalent mean (Gust/1.85)

This criteria specifies that safe and comfortable wind conditions must be achieved in publicly accessible areas within a distance equal to half the longest width of the building measured from all facades or half the overall height of the building, whichever is greater, as shown in Figure 7.

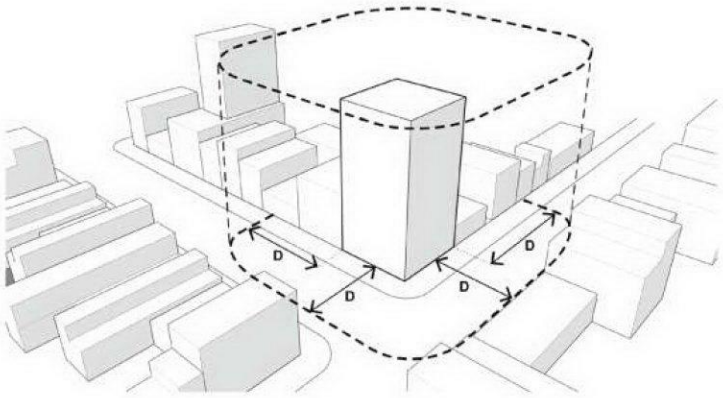


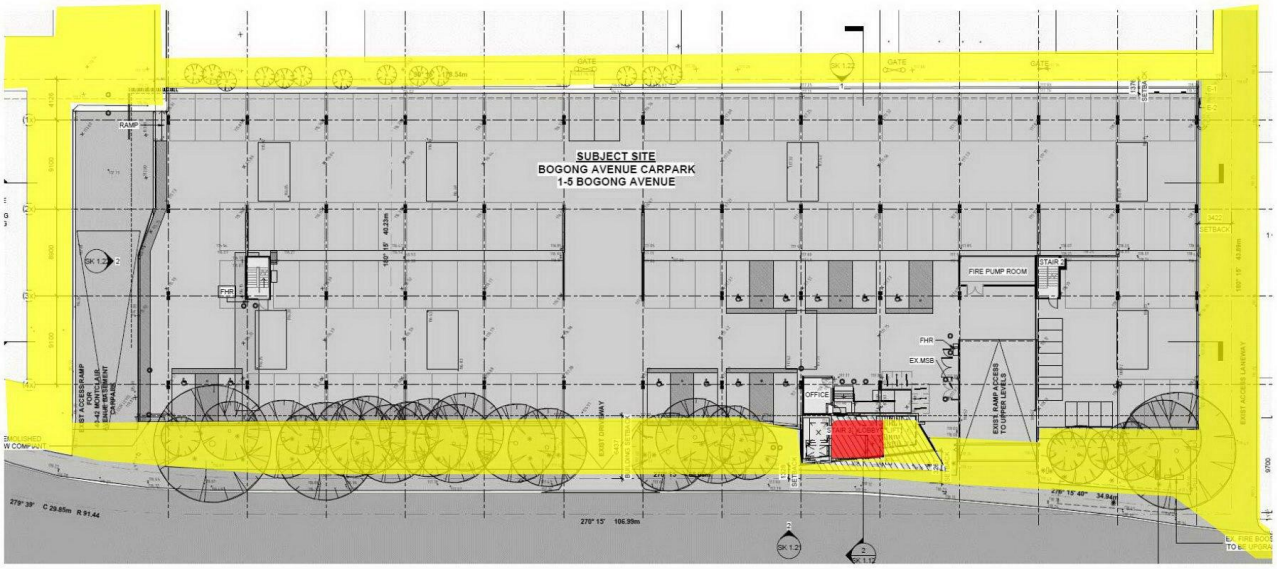
Figure 7: Assessment distance.

2.5.1 Use of Adjacent Pedestrian Occupied Areas & Recommended Comfort Criteria

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

Table 2: Recommended application of criteria

Area	Specific location	Recommended Criteria
Public Footpaths, Access ways	Along Bogong Ave and access laneways	Walking
Entrance to lobby lift	Along Bogong Ave	Standing



Recommended to fulfil Walking *Recommended to fulfil Standing*

Figure 8: Ground floor with recommended wind criteria overlaid.

3 Pedestrian Level Wind Effects

3.1 Existing Wind Conditions

The subject site is particularly exposed to adverse winds from all directions. Low rise residential development lay to the south and west are not expected to provide significant shielding value. Additionally, high winds are expected to run uninterruptedly through expansive carpark and train line to the north.

In the immediate vicinity of the subject site, there are two midrise developments of 7 and 11 storeys (approved) tall. These two developments are expected to catch the high winds and cause adverse wind conditions to the surrounding area. Northerly winds are expected to create adverse wind conditions along Montclair Ave, the adjacent laneway to the east and the corner of Kings Way and Montclair Ave. High southerly and westerly winds are expected to cause adverse winds at the Montclair Ave Car Park, Bogong Ave, the laneway to the east, and the corner of Bogong Ave and Kings Way. The predicted wind flow paths are presented in Figure 9 below; the areas highlighted in red are predicted high wind areas.

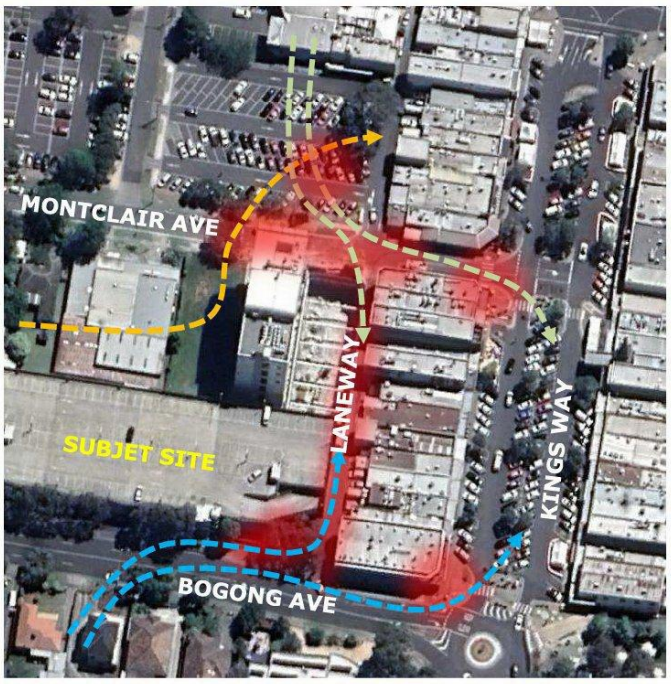


Figure 9: Predicted wind flow paths of Northerly, Westerly and Southerly winds

3.2 Effect of Proposed Development

The proposed development is an additional four level extension on top of an existing three storey carpark. At a total height of 7 storey it is expected catch high uninterrupted winds from all directions. However, these adverse winds are expected to be relieved through the porous nature of the carpark instead of being redirected to the street level. Such that the proposed increase in height is not expected to increase existing wind conditions.

High Southerly, South Westerly and Westerly winds are expected to channel along Bogon Ave and accelerate at the eastern laneway and at the Kings Way Corner. However, these winds are not expected to be in excess of the recommended walking comfort criterion or is expected to be similar to existing wind conditions. The proposed landscaping along this southern edge is also expected to provide further wind mitigation to relief channelling wind flows.

The entry to the lobby lift located along Bogong Ave is recommended to meet the standing comfort criterion. With the angle of the façade and proposed canopy above, this entrance is expected to meet the recommended standing comfort criterion. The proposed extension would not be expected increase downwash values in this area as the porous carpark is expected to assist in relieving these adverse winds. As such, this area would be expected to fulfil standing or be similar to the existing conditions.

Vipac recommends that the porosity of the cladding to be maintained at 40% as a minimum. This would ensure that the adverse winds be adequately relieves through the structure.

In Vipac's professional opinion and experience in wind tunnel testing carpark developments of similar size and scale, there is no necessity to carry out a wind tunnel testing of environmental wind conditions for the proposed development.

4 Conclusions

An appraisal of the likely wind conditions at the pedestrian ground level of the proposed development at **1-5 Bogong Avenue, Glen Waverly - Multi Deck Carpark** 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.

The findings of this study can be summarised as follows:

With proposed design:

- Wind conditions in the ground level footpath areas and access ways would be expected to be within the **walking** comfort criterion or similar to the existing conditions;
- The entrance to the lobby lift would be expected to be within the **standing** comfort criterion or similar to the existing conditions.
- The proposed development would not expected to generate unacceptable impact on surrounding land.

The assessments provided in this report have been made based on experience of similar situations in Melbourne 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.

Vipac believes that no wind tunnel testing is necessary for this appraisal.

This Report has been Prepared

For

Katz Architecture Pty Ltd

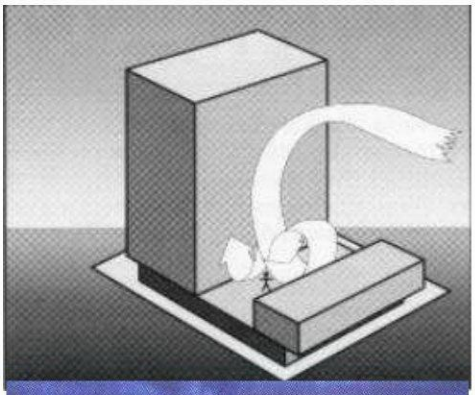
By

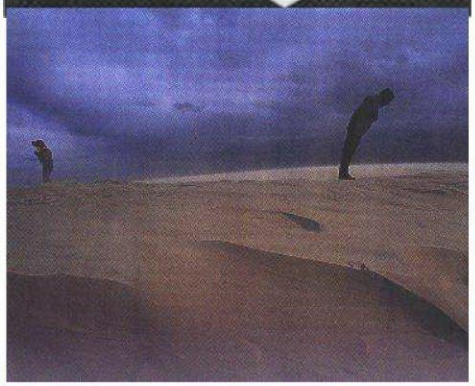
VIPAC ENGINEERS & SCIENTISTS PTY LTD.

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 un-attenuated 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 Drawings List

Drawings Received: July 2022

SK. 0.00 – Cover

SK 0.05 – Site Plan

SK 0.11 - Existing Ground Floor Plan

SK 0.12 - Existing First Floor Plan

SK 0.13 - Existing Second Floor Plan

SK 0.14 - Existing Roof Deck Plan Floor Plan

SK 0.21 - Existing Elevations

SK 1.01 - Proposed Level Ground

SK 1.02 - Proposed Level One

SK 1.03 - Proposed Level Two

SK 1.04 - Proposed Level Three

SK 1.05 - Proposed Level Four

SK 1.06 - Proposed Level Five

SK 1.07 - Proposed Level Six

SK 1.08 – Proposed Level 7 0- Roof Deck

SK 1.12 – Proposed Sections

SK 1.21 – Proposed Elevations – Sheets 1

SK 1.22 – Proposed Elevations – Sheets 2