BAPTISTCARE MACQUARIE PARK CONCEPT MASTER PLAN

Appendix U - Wind Impact Assessment

State Significant
Development Application (SSDA)

Prepared for BaptistCare

31/10/2022

TABLE OF CONTENTS

1. INTRODUCTION 3
2. THE SITE 3
3. BACKGROUND AND APPROACH 4
4. METEOROLOGICAL DATA 5
5. RWDI PEDESTRIAN WIND CRITERIA 6
4.1 SAFETY CRITERION 6
4.2 PEDESTRIAN COMFORT CRITERIA 6
6. RESULTS AND DISCUSSION 7
6.1 GENERAL WIND FLOW AROUND BUILDINGS 7
6.2 EXISTING SITE CONDITIONS 7
6.3.1 Site Exposure 8
6.3.2 Wind Interactions and Expected Activity 8
6.3.3 Design Advice 11
7. SUMMARY 14
8. APPLICABILITY OF ASSESSMENT 15

DOCUMENT CONTROL

Version	Status	Date	Prepared By	Reviewed By
A	Draft	20 September 2022	Aman Choudhry	Joseph Gallace
B	Draft	31 October 2022	Aman Choudhry	Joseph Gallace
C	DA for Issue	31 October 2022	Aman Choudhry	Joseph Gallace

1. INTRODUCTION

This report has been prepared to accompany a State Significant Development Application (SSDA) for a Concept Master Plan for the site located at 157 Balaclava Road, Macquarie Park.

Specifically, consent is sought for the following in this Concept SSDA:

- A mixed use development comprising a maximum GFA of 190,000m^2 dedicated to a range of land uses including:
  - Student Housing;
  - Seniors Housing;
  - Build to Rent;
  - Retail;
  - Residential;
  - Mixed uses including commercial and allied health; and
  - A school.
- Maximum building heights and GFA for each development block;
- Public domain landscape concept, including parks, streets and pedestrian connections;
- Vehicular and intersection upgrades.

2. THE SITE

The site is located at 157 Balaclava Road, Macquarie Park and is legally identified as Lot 60 in DP 1107965. The site is located near the corner of Herring Road and Epping Road within the City of Ryde Local Government Area (LGA). It is directly south of Macquarie University and in close proximity to Macquarie Shopping Centre. The surrounding area is characterised by a mix of commercial and education uses, as well as student accommodation and residential dwellings.

The site comprises a significant land holding with street frontages to Balaclava Road and Epping Road. It currently accommodates several low-medium density buildings that are connected via internal footpaths and lower order road networks. The total site area of the BaptistCare landholding is 63,871m^2.

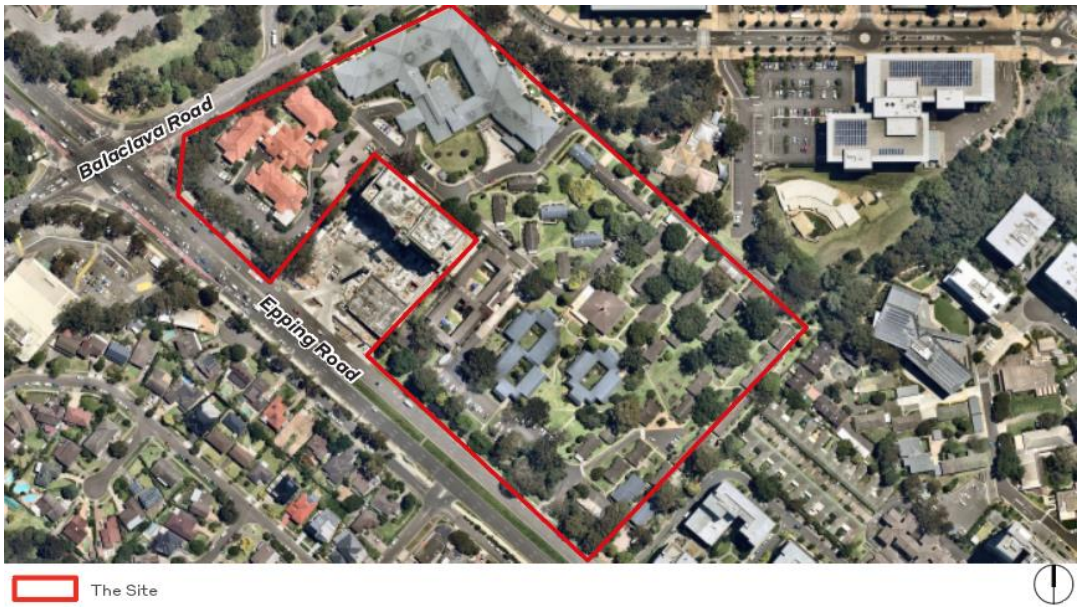

Figure 1: – Location Plan

This report has been prepared in response to the Secretary's Environmental Assessment Requirements (SEARS) dated 17 August 2022 for SSD-46561712. Specifically, this report has been prepared to respond to those SEARS summarised in Table 1.

Table 1 – SEARs requirements

Item	Description of Requirement	Section Reference (this report)
5. Environment Amenity	Assess amenity impacts on the surrounding locality, including solar access, visual privacy, visual amenity, overshadowing, wind impacts and acoustic impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.	6

3. BACKGROUND AND APPROACH

Predicting wind speeds and occurrence frequencies around a building is a complex process and involves the combined assessment of building geometry, orientation, position and height of surrounding buildings, upstream terrain and the local wind climate. Over the years, RWDI has conducted thousands of wind-tunnel model studies and CFD assessments on pedestrian wind conditions around buildings, yielding a broad knowledge base of potential flow behaviour. In some situations, this knowledge and experience, together with literature, allows for a reliable, consistent, and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing.

The qualitative approach used for this assessment provides a screening-level estimation of potential wind conditions. Conceptual wind control measures to improve wind comfort are recommended where necessary to aid in the design process. During this early stage where the design of the precinct can change rapidly, it is highly recommended to incorporate CFD simulations to guide the design process from a wind and thermal comfort perspective. Once the design has matured, the predicted conditions can be quantified, and conceptual wind control measures can be refined further through physical scale model tests in a boundary-layer wind tunnel. Wind tunnel testing will be undertaken during the Detailed Design stage of the project.

RWDI's assessment is based on the following:

- A review of the regional long-term meteorological data.
- Information and precinct models of the development site received by RWDI in August 2022 (BAPTIST CARE MACQUARIE PARK CONCEPT MASTERPLAN, APPENDIX E – BVN VA – 26/08/2022).
- Use of RWDI's proprietary software (*WindEstimator*) for providing a screening-level numerical estimation of potential wind conditions around generalised building forms.
- Wind-tunnel studies and desktop assessments undertaken by the team for projects in the region.
- Our engineering judgement, experience, and expert knowledge of wind flows around buildings.
- RWDI Criteria for pedestrian wind comfort and safety.

Note that other microclimate issues such as those relating to cladding and structural wind loads, door operability, building air quality, noise, vibration, etc. are not part of the scope of this assessment.

4. METEOROLOGICAL DATA

Meteorological data recorded at Sydney International Airport from 1999 to 2019 were used as a reference for wind conditions in the area. Figure 2 graphically depicts the directional distributions of wind frequencies and speeds recorded at the station during the summer (Nov-Apr) and winter (May-Oct) seasons. The records indicate that winds from the northeast and the southern sectors are predominant during the summer season. Wind from the west and northwest directions are predominant in the winter season and can have an impact on the perceived outdoor thermal comfort of a space.

Long-term metrological data recorded at Bankstown Airport (also indicated in Figure 3) were also examined to establish the local wind directionality. The analysis confirms the prevalence of northeasterly sector winds during the summers and the westerly / northwesterly winds during the winters. The southerly winds during the summers are noted to be more spread-out from the south half of the compass. Wind statistics recorded at Bankstown Airport station are generally calmer than those measured at Sydney International Airport. This is expected since the observation site is located further away from the coast and, therefore, wind speeds are typically lower due to the sheltering provided by the upwind terrain. This is also expected for the subject development site.

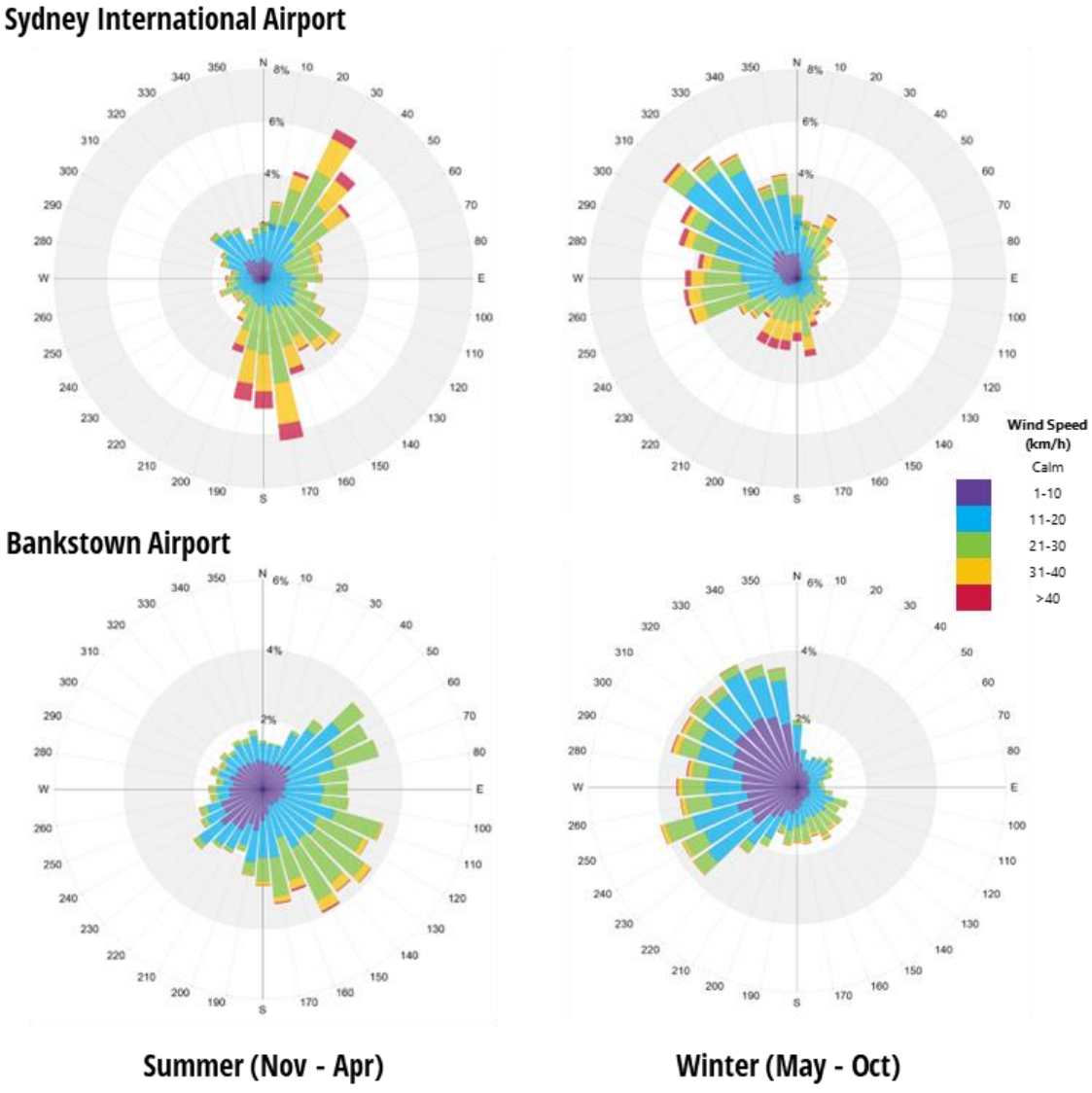

Figure 2: Directional Distribution of Winds Approaching Sydney and Bankstown Airports - Recorded from 1999-2019

5. RWDI PEDESTRIAN WIND CRITERIA

5.1 Safety Criterion

Pedestrian safety is associated with excessive gusts that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (83 km/h) occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe. These generally coincide with areas of high wind activity noted in the report and have been assessed qualitatively.

5.2 Pedestrian Comfort Criteria

The RWDI pedestrian wind comfort criteria, depicted in Figure 3, are used in the current study. These criteria have been developed by RWDI through research and consulting practice since 1974 and have also been widely accepted by municipal authorities, building designers and the city planning community worldwide. These are categorised based on typical / intended pedestrian activities. Note that wind conditions are assessed at a typical pedestrian chest height and are considered suitable for the intended use of the space if the associated mean winds are expected for at least 80% of the time. Wind control measures are typically required at locations where winds are rated as uncomfortable, or they exceed the wind safety criterion.

Furthermore, note that these criteria for wind forces represent average wind tolerance. These are sometimes subjective with regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. also affecting people's perception of the wind climate.

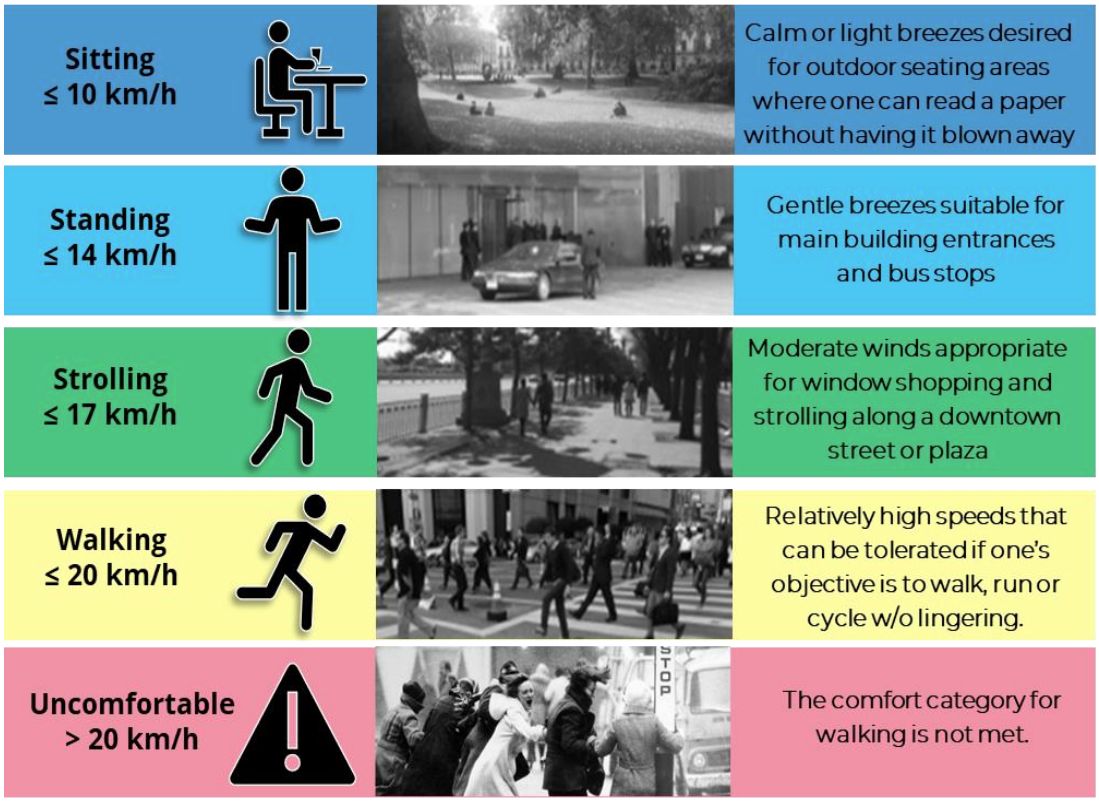

Figure 3: RWDI Pedestrian Wind Comfort Criteria

6. RESULTS AND DISCUSSION

6.1 General Wind Flow around Buildings

In our discussion of wind conditions on and around the proposed development, reference may be made to the following generalised wind flows (see Figure 4). If these building / wind combinations occur for prevailing winds, there is a greater potential for increased wind activity and uncomfortable or potentially unsafe conditions.

Design details such as setting back a tower from the edges of a podium, deep canopies close to ground level, wind screens / tall trees with dense landscaping, etc. (Figure 4) can help reduce high wind activity. The choice and effectiveness of these measures would depend on the exposure and orientation of the site with respect to the prevailing wind directions and the size and massing of the proposed buildings.

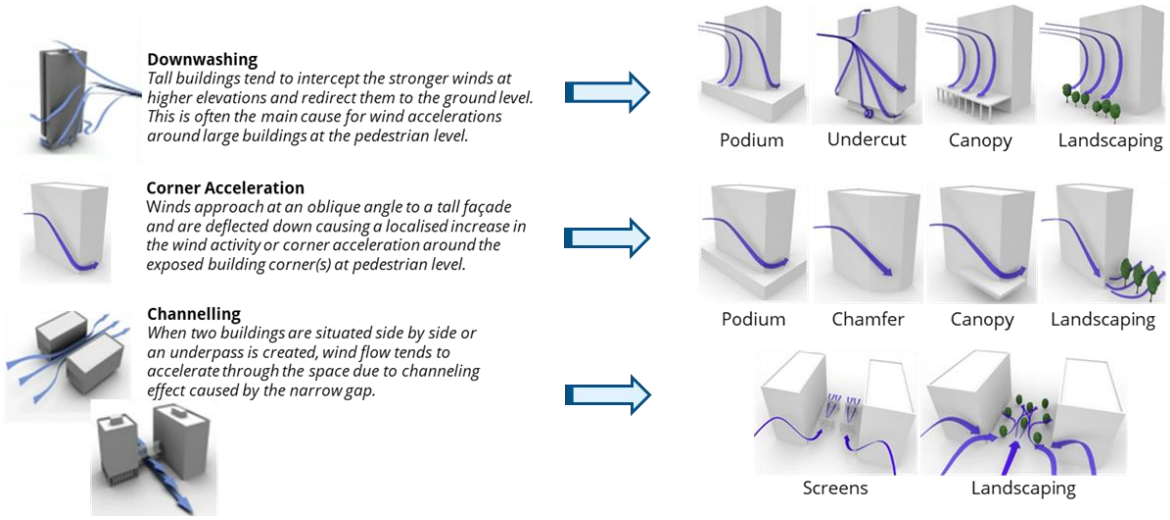

Figure 4: General Wind Flow Patterns Around Buildings and Common Mitigation Strategies

6.2 Existing Site Conditions

The existing site is currently occupied by low-rise buildings. Immediately surrounding the site are generally low-rise residential buildings and mid-rise buildings of Macquarie University to the north. High-rise buildings are located along Epping Road to the south of the site.

The existing site is generally shielded from the prevailing winds due to the neighbouring buildings and dense vegetation. However, the alignment of the currently under-construction Parkside Building along Epping Road with the prevailing northeasterly winds can lead to downwash effect. Other wind interactions with regional prevailing winds are also likely that can cause localised high wind activity at the corners of the building. These can also have some impact on the surrounding existing sites particularly along the existing Eucalyptus Street. However, noting the inland location of the site, it is generally expected that wind conditions would be suitable for active use along the street front with most other areas around the existing site suitable for passive use throughout the year. The dense vegetation within and around the existing precinct is also expected to reduce the overall exposure to the prevailing winds.

6.3 Proposed Site Conditions

6.3.1 Site Exposure

The proposed masterplan consists of buildings that are generally taller in height than the immediate neighbouring buildings in most of the prevailing wind directions for the region. These are, therefore, expected to intercept the regional prevailing winds and impact the local wind microclimate.
The exposure of the site to the prevailing winds is indicated in Figure 5. The site is generally shielded from the prevailing northeasterly sector winds due to the Macquarie University Campus that offer some buffer to the winds from this direction. However, with little upstream shielding, winds from the south and west to northwest can impact the local wind conditions around the precinct. Noting the inland location of the site and the dense vegetation around the precinct, the approaching winds are likely to be less severe than those shown in the Figure. Similarly, the scale of the masterplan implies that areas within the precinct will be shielded from most wind interactions with critical zones generally relegated to the street fronts. The currently under construction Parkside Building is also likely to provide some shelter to the area. However, the orientation and height of the proposed buildings can create high wind regions that can impact the comfort or safety of users. These are assessed individually in the following sections.

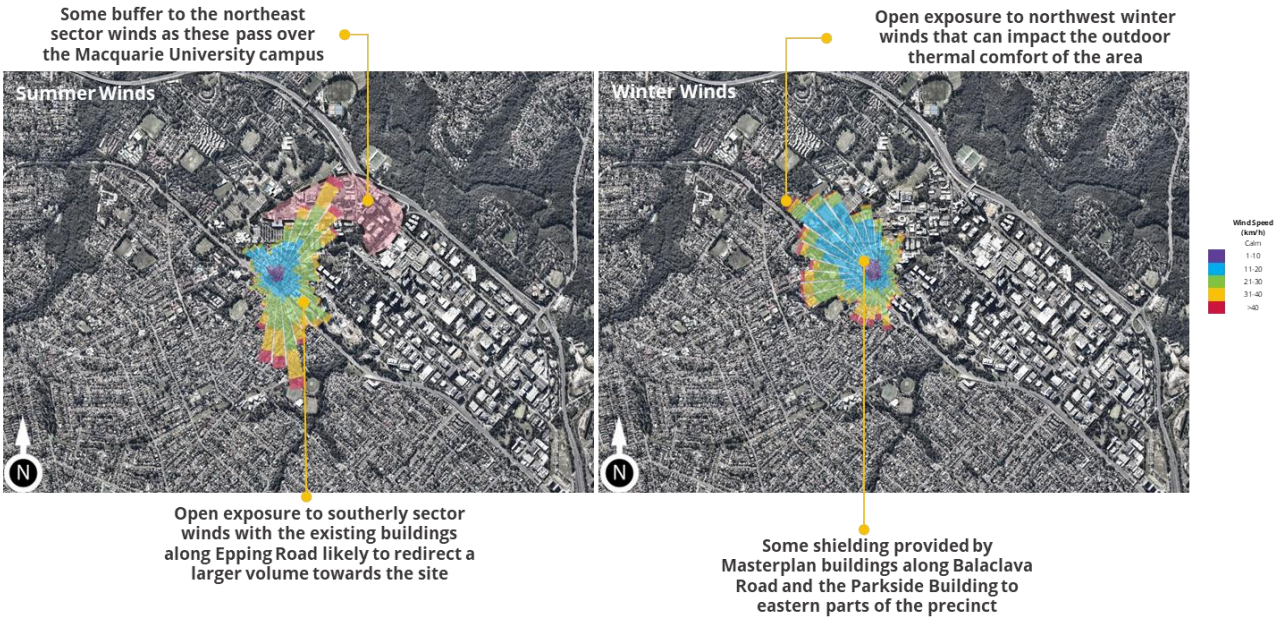

Figure 5: Exposure of Site to Regional Prevailing Winds

6.3.2 Wind Interactions and Expected Activity

The interaction of the region prevailing winds with the proposed massing of the precinct is indicated in Figures 6-9. Key interactions are noted below with expected wind conditions shown in Figure 10:

- The southerly winds that are prevalent throughout the year can interact with the proposed buildings along Epping Street front of the precinct. These winds are generally misaligned with the proposed buildings and will likely not impact the amenity of the internal spaces. The winds can, however, be redirected by the proposed massing of the buildings within the masterplan and channel through open spaces, as shown in Figure 6. Due to the misalignment, the winds from upper levels can be directed towards the ground plane and will likely accelerate around the southwest corners of the buildings along Epping Street. This can create localised regions of high wind activity as indicated in Figure 10.
- As noted earlier, the northeasterly winds will generally present at the site with reduced intensity. These winds are also prevalent during the summers and are generally welcomed in outdoor spaces due to their added cooling benefit. However, the alignment of these winds with the northern block of masterplan can lead to downwash. The downwashed winds can then wrap around the corners of the buildings and channel

through the internal corridors.

- The westerly winds are prevalent during the winters and can impact the outdoor thermal comfort of areas. These winds are also generally misaligned with the proposed massing of the towers. However, the winds can rapidly accelerate around the exposed corners of the buildings along Balaclava Road and Epping Road fronts of the precinct creating regions of high wind activity during winters. The winds can also channel through the internal corridors of the precinct and impact the amenity of outdoor space planned here as noted in Figure 10.
- The northwesterly sector winds are also prevalent during the winters and are well-aligned with the proposed massing along Balaclava Road. This can lead to downwash and rapid wind accelerations around the corners of the buildings. These winds are also aligned with the internal streets and corridors. Therefore, channelling effect is also expected that can impact the amenity of these outdoor spaces.

As noted in Figure 10, most internal areas are generally shielded from the high winds. However, winds from the south and northwest can create high wind activity within the precinct particularly along Epping Road and Balaclava Road fronts of the masterplan. Localised high wind speeds that can create unsafe environments is generally expected at the exposed corners. Channelling can also cause moderate wind activity in most internal corridors. However, these are generally suitable for active use throughout the year.

Figure 6: Expected Wind Flow Patterns within the Proposed Masterplan due to Southerly Sector Winds

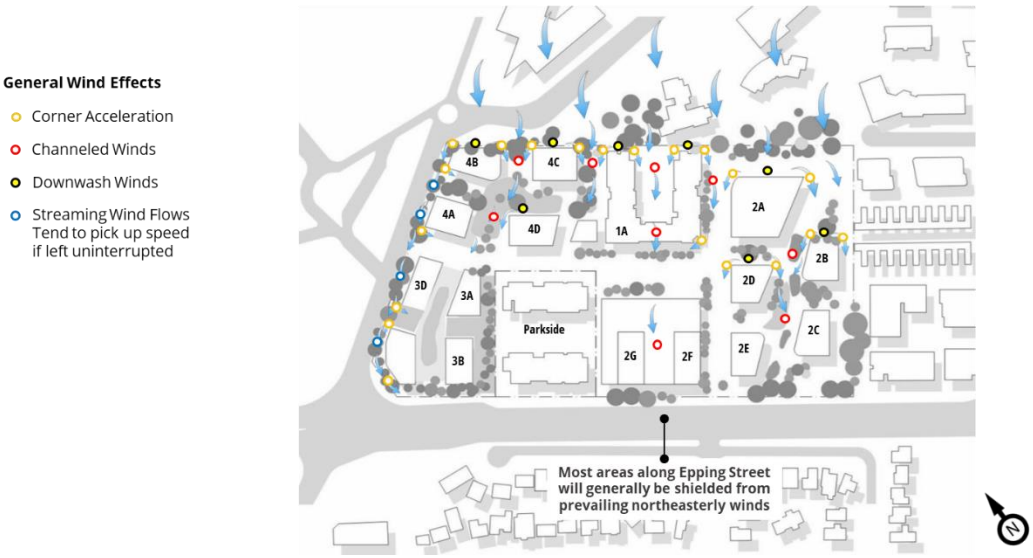

Figure 7: Expected Wind Flow Patterns within the Proposed Masterplan due to Northeasterly Sector Winds

Figure 8: Expected Wind Flow Patterns within the Proposed Masterplan due to Westerly Sector Winds

Figure 9: Expected Wind Flow Patterns within the Proposed Masterplan due to Northwesterly Sector Winds

Figure 10: Expected Wind Conditions within the Proposed Masterplan

6.3.3 Design Advice

Based on the discussions provided, the following design advice can be used to create comfortable wind amenity is achieved around the site (examples shown in Figures 12 and 13):

- The tower plan form should avoid the use of sharp corners which can increase downwash and acceleration effects. Examples of suitable corner profiles may include rounded, stepped, or chamfered corners of the tower planform similar to Buildings 2C, 2E and 3C.
- Podium setbacks can reduce the intensity of downwashed winds on the ground and public domain. For instance, towers 2G and 2F should be situated more centrally atop the podium to reduce the impact of southerly winds. However, in the instances that such setbacks are not possible, provisions for awnings

aligning with the aspect exposed to downwash effect in Figures 8-11 should be made. This is particularly important for the southern and western aspects of the buildings along Balaclava Road and Epping Road.

- Any outdoor seating areas should correspond to favourable wind locations such as the internal courtyard to the south of Building 1A. Locating the seating areas away from corners is also recommended. Inclusion of localised measures such as planting and screening (north-south aligned) around seating areas is also recommended.
- Horizontal façade elements can be used to reduce downwash with vertical articulation in the form of recess or protrusions in the tower and podium form, use of vertical screening elements at corners, or vegetation can reduce the impact of side-streaming winds. However, any such elements / features should not create a high risk of wind-induced noise.
- Inclusion of porous façade for any podium carpark levels along the northern and southern aspects can allow for additional flow paths for the wind and improve wind conditions around the ground level. However, the porous screening can create a high risk of wind-induced noise that should be assessed.
- Additional elements such as canopies / trellises can be situated centrally within any planned podium terraces to reduce the impact of channelling winds. Screening along the perimeter can reduce winds spilling on to the street fronts.
- Any balconies should be located away from the corners of the towers or include end screening to ensure comfort for patrons. Inclusion of screening for upper-level terraces need to be included as part of the design scheme due to direct wind exposure. Rooftop terraces might also be exposed to winds upwashing off the tower form and reattaching within the terraces. Provisions for localised canopies should be made.
- It is understood that the development site will be landscaped with numerous trees and shrubs (concept landscape render indicated in Figure 11). Plantings with large crowns and dense foliage, complemented with underplanting to prevent wind flows from accelerating under the crowns, will help reduce wind activity immediately around them. Dense clusters located at the corners of the precinct should also be retained.

Figure 11: Indicative Landscape Render for the Masterplan

Figure 12: Examples of Wind Control Measures for Ground Level and Public Domain Spaces

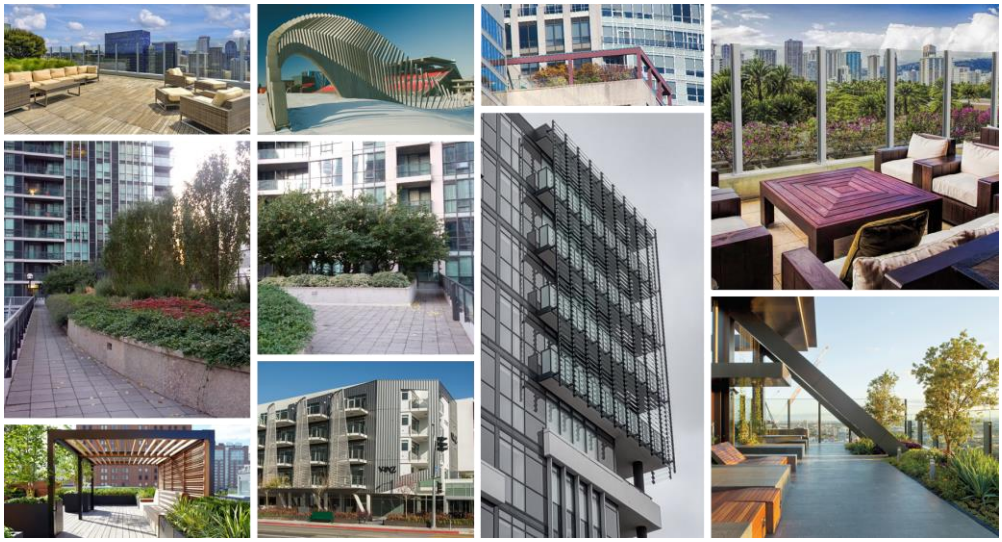

Figure 13: Examples of Wind Control Measures for Balconies and Upper-Level Amenities

7. SUMMARY

Wind conditions on and around proposed Masterplan located in Macquarie Park, NSW are discussed in this report. The qualitative assessment is based on the review of local wind climate and the current design of the proposed precinct. The impact of the surrounding buildings and landscaping has also been considered. The assessment is based on our experience with wind tunnel testing and CFD analysis of similar masterplans within the region.

Conceptual wind flows around the proposed precinct are discussed in the report for the prevailing wind directions to identify key wind sensitive areas. The design of the masterplan allows areas within the precinct that are sheltered from prevailing wind impacts. Landscaping has also been informed by the wind analysis where applicable to improve the wind amenity further. Design advice in the form of conceptual mitigation measures and built-form response are also presented for areas where higher wind activity is likely. It is to be noted that the mitigation options discussed in this report are based on the assumptions and flow activity noted here. Detailed wind assessment can be undertaken with subsequent built form development applications.

Note that the assessed wind forces only represent the average wind tolerance of occupants and considers the impact of the precinct as a whole. In addition, this is only one metric to understand human comfort. Wind comfort is sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, exposure to sunlight and shading etc. can also affect person's perception of the wind climate.

Therefore, given the scale of the precinct and the staging involved, a thermal comfort assessment could be carried out for a holistic understanding of comfort around the precinct in subsequent built form development applications. Undertaking such an assessment can provide an exceptional level of insight into the combination of unique factors that impact a person's comfort, including temperature, humidity, wind, solar radiation, and how the space will be used. The information gained can be used to better plan the usage of outdoor spaces and can also provide additional insights into the site conditions as the staging progresses further. RWDI can assist the design team with this study if needed.

8. APPLICABILITY OF ASSESSMENT

The assessment discussed in this report pertains to the proposed development in accordance with the drawings and information received in July 2022. In the event of any significant changes to the design, construction or operation of the building or addition of surroundings in the future, RWDI could provide an assessment of their impact on the wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.

Statement of Limitations

This report entitled Pedestrian Wind Assessment, dated October 31, 2022 was prepared by RWDI Australia Pty Ltd ("RWDI"). The findings and conclusions presented in this report have been prepared for the Client and are specific to the project described herein ("Project"). The conclusions and recommendations contained in this report are based on the information available to RWDI when this report was prepared. Because the contents of this report may not reflect the final design of the Project or subsequent changes made after the date of this report, RWDI recommends that it be retained by Client during the final stages of the project to verify that the results and recommendations provided in this report have been correctly interpreted in the final design of the Project.

The conclusions and recommendations contained in this report have also been made for the specific purpose(s) set out herein. Should the Client or any other third party utilize the report and/or implement the conclusions and recommendations contained therein for any other purpose or project without the involvement of RWDI, the Client or such third party assumes any and all risk of any and all consequences arising from such use and RWDI accepts no responsibility for any liability, loss, or damage of any kind suffered by Client or any other third party arising therefrom.

Finally, it is imperative that the Client and/or any party relying on the conclusions and recommendations in this report carefully review the stated assumptions contained herein and to understand the different factors which may impact the conclusions and recommendations provided.