FINAL REPORT

37 GRAHAM ROAD, HIGHETT

MELBOURNE, VIC

WIND ENVIRONMENT DESKTOP ASSESSMENT

RWDI PROJECT #2000966
JULY 29, 2021

SUBMITTED TO

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1. INTRODUCTION

RWDI Anemos Ltd. (RWDI) was retained by Gallagher Jeffs, on behalf of Wolf International Group (Sunkin Wolf Development Pty Ltd.) to assess the pedestrian wind environment for the proposed development at 37 Graham Road in Highett, Victoria (**Image 1a**).

The proposed masterplan consists of 14 apartment buildings ranging in heights from four to seven storeys, four blocks of townhouses, open spaces, parkland and three hectares of conservation area (**Image 1b**).

Most of the immediate surroundings consist of single-family homes or multi-family residential buildings. There are taller (four storey) commercial buildings just beyond the east end of the site and other taller buildings dispersed to the west and south. Moorabbin Airport is approximately 5 km to the southeast.

The current wind assessment discusses wind conditions for the final overall built form configuration of the master plan. The wind assessment of individual buildings is to be carried out at planning permit stage when the building design has been progressed.

Image 1a: Aerial View of the Existing Site and Surroundings (Credit: Google™ Earth)

Image 1b: Proposed Redevelopment (Credit: ClarkeHopkinsClarke)

2. METHODOLOGY

Predicting wind speeds and occurrence frequencies is complex process. It involves a 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 on pedestrian wind conditions around buildings, yielding a broad knowledgebase. In some situations, this knowledge and experience, together with literature, allow for a reliable, consistent and efficient desktop estimation of pedestrian wind conditions without wind-tunnel testing. This approach provides a screening-level estimation of potential wind conditions and offers conceptual wind control measures for improved wind comfort, where necessary.

In order to quantify the predicted conditions or refine any of the suggested conceptual wind control measures, physical scale model tests in a boundary-layer wind tunnel would be required.

RWDI's wind assessment is based on the following:

- Design drawings dated October 8, 2020 received on October 27, 2020 and updated drawings received on April 20, 2021.
- Use of RWDI's proprietary software (*WindEstimator*[1]) for providing a screening-level numerical estimation of potential wind conditions around generalized building forms;
- A review of the regional long-term meteorological data from Moorabbin Airport;
- RWDI wind comfort criteria and AWES' safety criterion;
- Wind-tunnel studies and desktop assessments undertaken by RWDI for projects located in Melbourne and around the world; and,
- RWDI's engineering judgement and knowledge of wind flows around buildings[2, 3].

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.

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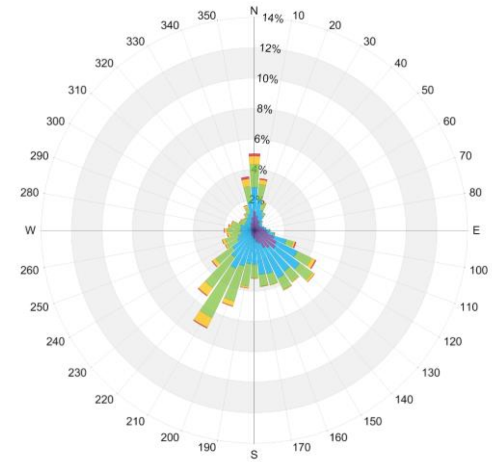
1. H. Wu, C. J. Williams, H.A. Baker and W.F. Waechter (2004), "Knowledge-based Desk-Top Analysis of Pedestrian Wind Conditions", *ASCE Structure Congress 2004,* Nashville, Tennessee.
2. H. Wu and F. Kriksic (2012). "Designing for Pedestrian Comfort in Response to Local Climate", *Journal of Wind Engineering and Industrial Aerodynamics*, vol.104-106, pp.397-407.
3. C. J. Williams, H. Wu, W. F. Waechter and H.A. Baker (1999), "Experience with Remedial Solutions to Control Pedestrian Wind Problems", *10th International Conference on Wind Engineering*, Copenhagen, Denmark.

3. METEOROLOGICAL DATA

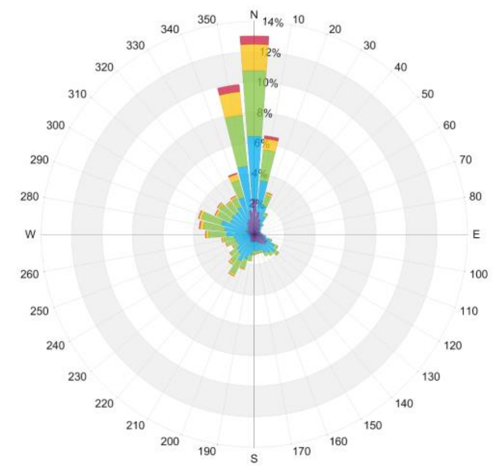
Meteorological data recorded at Moorabbin Airport for the period from 1992 to 2018 were used as a reference for wind conditions in the study area. The distributions of wind frequency and directionality for the summer (November through April) and winter (May through October) seasons are shown in **Image 2**. When all wind data is considered, winds are most frequent from the north. Wind from the southwest and southeast are common in the summer, while winds from the northeast also occur, but less frequently.

Strong winds of a mean speed greater than 10 m/s (36 km/h) measured at the airport (at an anemometer height of 10 m, yellow and red bands in **Image 2**) occur more frequently in the winter (8.3%) than summer (6.4%). They are generally from the north and southwest in summer and north and northwest in winter.

The north winds are considered to be the source of potentially uncomfortable wind conditions, depending upon the site exposure and development design. However, the current analysis method has accounted for all wind directions.



Summer (November - April)



Winter (May - October)

	Wind Speed (km/h)	Probability (%) Summer	Winter
	Calm	4.8	5.9
	1-10	23.3	24.0
	11-20	37.3	35.9
	21-30	28.2	25.9
	31-40	5.5	6.7
	>40	0.9	1.6

Image 2: Directional Distribution of Winds Approaching Moorabbin Airport (1992-2018)

4. PEDESTRIAN WIND CRITERIA

Consideration for the wind comfort conditions for the development have been based on the RWDI pedestrian wind criteria. These criteria have been developed by RWDI through research and consulting practice since 1974. They have also been widely accepted by municipal authorities and by the building design and city planning community. The Australiasian Wind Engineering Society (AWES)'s wind safety criterion is also used for the safety assessment.

4.1 Pedestrian Safety

Pedestrian safety is associated with excessive gust wind speeds that can adversely affect a pedestrian's balance and footing. If strong winds that can affect a person's balance (according to AWES, **23 m/s or 83 km/h**) occur more than 0.1% of the time or 9 hours per year, the wind conditions are considered severe.

4.2 Pedestrian Comfort

Wind comfort levels are categorised by typical pedestrian activities:

- **Sitting (≤ 10 km/h)**: Calm or light breezes desired for outdoor seating areas where one can read a paper without having it blown away.
- **Standing (≤ 14 km/h)**: Gentle breezes suitable for main building entrances and bus stops.
- **Strolling (≤ 17 km/h)**: Moderate winds that would be appropriate for window shopping and strolling along a downtown street, plaza or park.
- **Walking (≤ 20 km/h)**: Relatively high speeds that can be tolerated if one's objective is to walk, run or cycle without lingering.
- **Uncomfortable**: None of the comfort categories are met.

Wind conditions are considered suitable for sitting, standing, strolling or walking if the associated wind speeds are expected for at least four out of five days (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.

These criteria for wind forces represent average wind tolerance. They are sometimes subjective and regional differences in wind climate and thermal conditions as well as variations in age, health, clothing, etc. can also affect people's perception of the wind climate.

For the current development, wind speeds comfortable for walking or strolling are appropriate for footpaths and walkways, and lower wind speeds comfortable for standing are required for building entrances where pedestrians may linger. Wind speeds comfortable for sitting are appropriate for outdoor terraces, especially during the summer when these areas are used more often.

5. PEDESTRIAN WIND CONDITIONS

5.1 Existing Wind Conditions

The existing buildings on this site are relatively low. These images show the summer and winter wind roses superimposed on an aerial photo of the site and surroundings (see **Image 3**).

The north end of the site will somewhat sheltered by the existing commercial buildings along Highett Road, however that benefit rapidly diminishes as one progresses to the south across this site. Most winds will reach the site virtually uninterrupted.

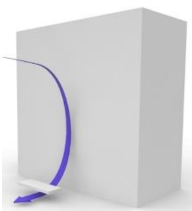
Appropriate wind conditions likely exist throughout the current site, including public footpaths and walkways (walking or strolling) and building entrances (standing or sitting). No exceedances of the wind safety criteria are likely to exist.

These existing wind conditions will be altered by the proposed development, as per the following discussion.

Image 3: Site Wind Exposure in the Summer (left) and Winter (right)

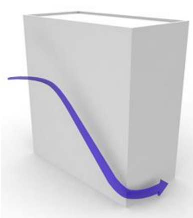
5.2 Wind Flow Around Buildings

In our discussion of wind conditions on and around the proposed project, reference may be made to the following generalised wind flows (see **Image 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.



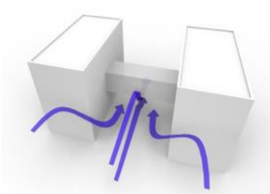
Downwashing

Tall buildings tend to intercept the stronger winds at higher elevations and redirect them to the ground level. This is often the main cause for wind accelerations around large buildings at the pedestrian level.



Corner Acceleration

Winds approach at an oblique angle to a tall façade and are deflected down causing a localised increase in the wind activity or corner acceleration around the exposed building corner(s) at pedestrian level.



Channeling

When two buildings are situated side by side or an underpass is created, wind flow tends to accelerate through the space due to channeling effect caused by the narrow gap.

Image 4: Generalised Wind Flows

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. (**Image 5**) can help reduce wind speeds. 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.

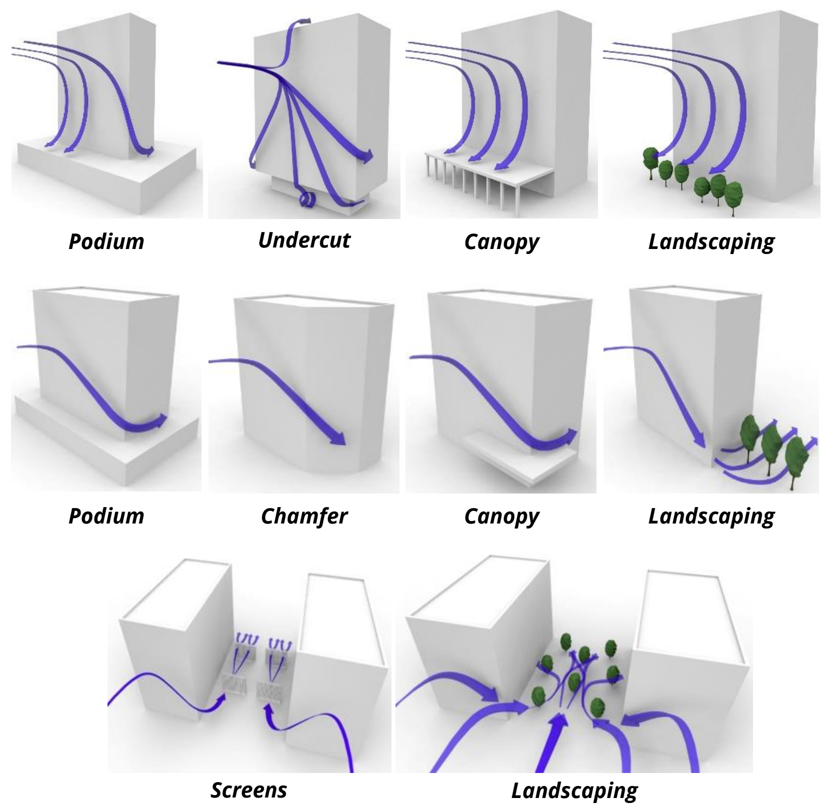


Image 5: Examples of Common Wind Control Measures

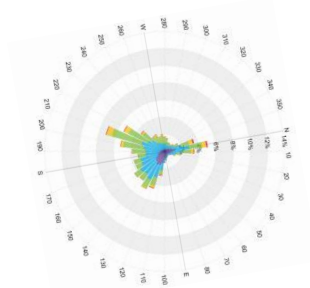
5.3 Pedestrian Level Wind Conditions

The predicted annual wind conditions associated with the masterplan are presented in **Image 6** for the final complete development scenario. Due to the seasonal climate, the winter wind speeds are expected to be slightly higher than those in the summer. No wind safety exceedances are predicted to occur.

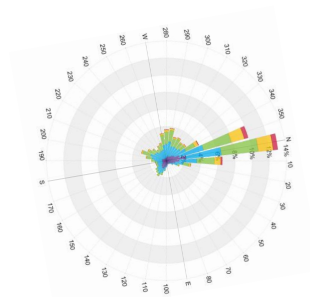
Annual
Wind Comfort Conditions

- Sitting / Standing
- Strolling / Walking
- Uncomfortable

Image 6: Predicted *Annual* Wind Comfort Conditions at Pedestrian Level



Summer Winds



Winter Winds

5. PEDESTRIAN WIND CONDITIONS

Building Entrances

Entrances to buildings where strolling / walking conditions are predicted in **Image 6** would be considered less than ideal. Good design practice would be to encourage recessing these entrances into the façade and/or providing landscaping / wind screens to the north of entrances to provide suitable conditions. **Image 7** offers some examples of wind control strategies for entrances.

Footpaths and Walkways

All footpaths and walkways are expected to have appropriate wind conditions (i.e., comfortable for strolling, walking or better).

Ground Level Amenities

Outdoor ground level amenity areas where more passive pedestrian uses are planned (e.g., sitting, dining, café, etc.) where strolling / walking conditions are predicted (as per **Image 6**) will require supplementary wind control. For protection from horizontal wind flows the most effect wind control strategies are in the form of landscaping and/or wind screens. These should be installed as per the guidelines in **Image 8**. Landscaping will behave similarly to a porous windscreen shown on the left side of this image. In cases where there is a tall façade above an amenity area on the north or west sides, overhead protection in the form of canopies or trellises is beneficial to reduce the impacts of downwashing winds (see **Image 5**). Photographic examples are provided in **Images 9 and 10**.

Image 7: Wind Control Examples for Entrances

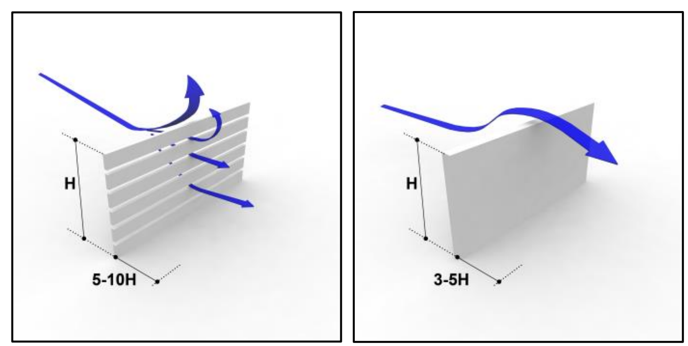


Image 8: Design Guidelines for Windscreens

5. PEDESTRIAN WIND CONDITIONS

Elevated Terraces

Outdoor terraces situated on the podium or roof level of buildings are subject to stronger winds which naturally increase with height above the ground. In this case, the buildings are not very tall hence the winds are not expected to be severe. However, there could be situations where terraces will be windier than desired for passive use (i.e., comfortable for walking). Typical wind control strategies call for tall perimeter wind screens and/or intermediate partitions to protect from horizontal wind flows installed as per **Image 7**. **Images 9 and 10** offer some examples.

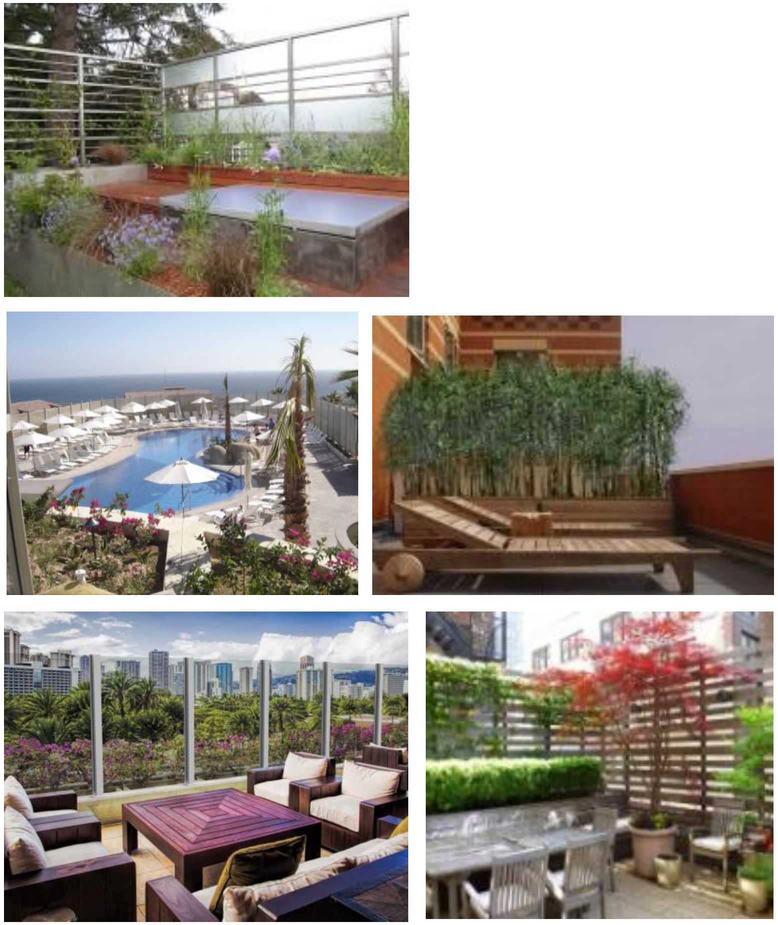


Image 9: Wind Screens for Outdoor Amenity Spaces

5. PEDESTRIAN WIND CONDITIONS

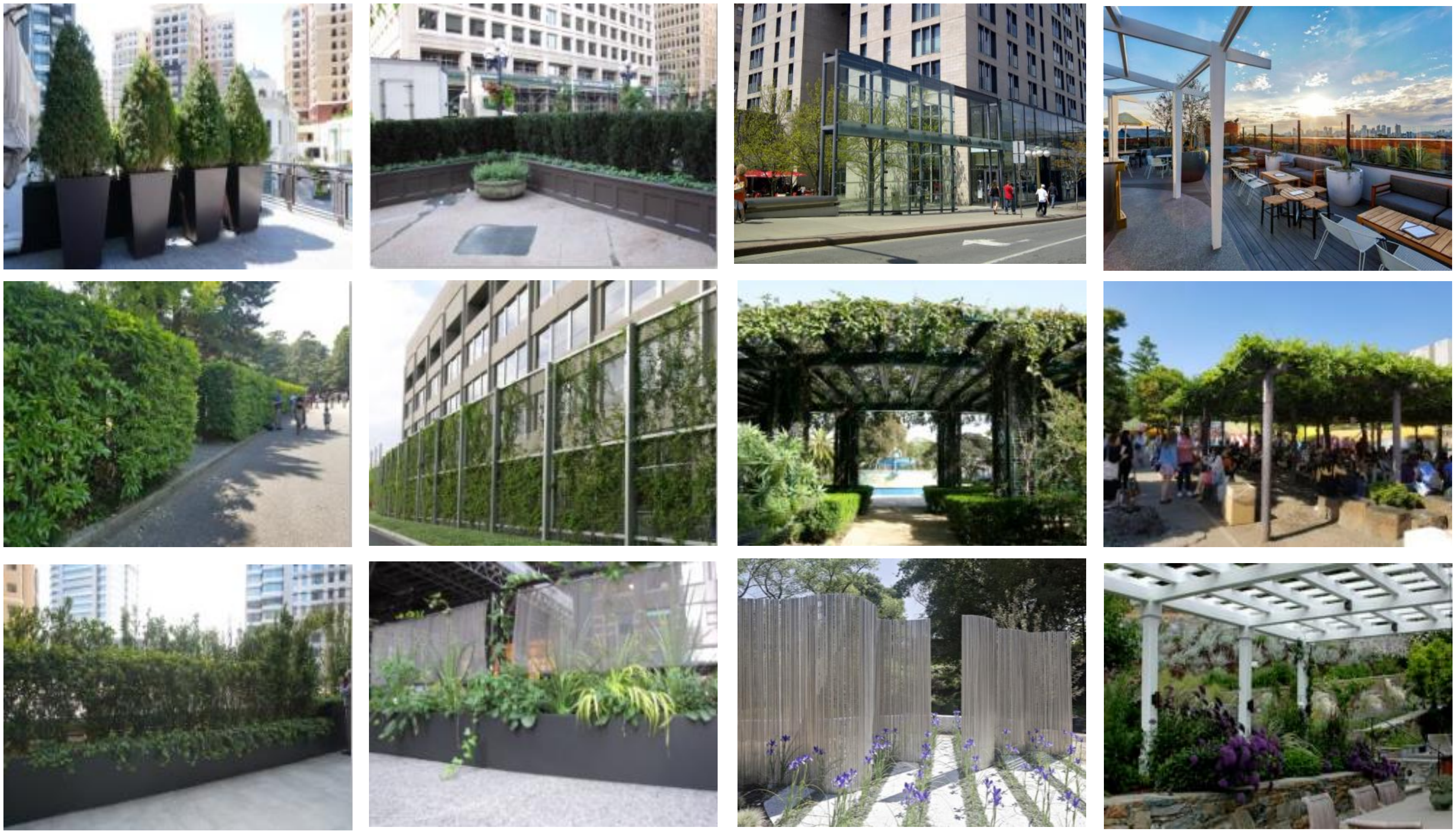


Image 10: Additional Wind Control Measures for Outdoor Amenity Areas

6. SUMMARY

Wind conditions on and around the proposed 37 Graham Road master planned development in Highett, Victoria, are discussed in this report. Our qualitative assessment was based on the local wind climate, the current design of the proposed master plan, existing surrounding buildings and our experience with wind tunnel testing of similar buildings.

The taller buildings will be exposed to the prevailing winds. Based on the local climate, the wind safety criterion is predicted to be met at all locations on and around the project. Suitable wind conditions are also expected at all footpaths, walkways and many building entrances.

Some building entrances are predicted to have less than ideal wind conditions and design strategies have been provided.

Ground level amenities and elevated terraces where passive use is planned would require supplementary wind control.

Wind control concepts are discussed and examples provided in the report for windy areas. The wind assessment of individual buildings is to be carried out at planning permit stage when the building design has been progressed.

Simulations can be undertaken to provide further clarity on the wind conditions throughout the precinct and guide the design. This can include either Computational Fluid Dynamics (CFD) or wind tunnel modelling.

7. APPLICABILITY OF RESULTS

The assessment presented in this report is for the proposed 37 Graham Road development based on the information received by RWDI on October 27, 2020 and April 20, 2021 listed in the table below. 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 pedestrian wind conditions discussed in this report. It is the responsibility of others to contact RWDI to initiate this process.

File Name	File Type	Date Received (dd/mm/yyyy)
Park Village Highett_S173(rev14)_2020.10.08.pdf	pdf	27/10/2020
190081_Highett_Stage 1_RECUT_2021.04.16_v4	pdf	20/04/2021