WIND ENGINEERING CONSULTANTS

QUALITATIVE WIND ASSESSMENT
CPP PROJECT 21132
11 SEPTEMBER 2025

Next DC S5
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Executive Summary

A qualitative assessment of the proposed 11 SEPTEMBER 2025

Next DC S5 development was conducted to provide an initial assessment of the impact on the surrounding pedestrian wind environment. The assessment was based on the local wind climate, CPP's experience in the region and on comparable projects, and the characteristics of the proposed development.

For most locations around the site, wind conditions are expected to remain similar to the existing wind conditions with some areas getting windier and others calmer depending on the incident wind direction. Qualitatively, integrating the expected directional wind conditions around the site with the wind climate, it is considered that with respect to the City of Ryde wind criteria that the wind conditions would be generally classified as suitable for 'Main retail centres', increasing to 'Footpaths and other pedestrian accessways' around the exposed corners of the development. These pedestrian comfort levels are considered acceptable for the intended use of the space and suitable for public accessways. All locations would be expected to satisfy the safety/distress limiting annual maximum gust criterion.

This report is a high level qualitative assessment based on basic features of the local wind climate and proposed built environment. To quantify the qualitative advice provided in this report, numerical or physical modelling of the development would be required, which would be recommended for a development of this size and prominent location close to the Macquarie Park station.

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1. Introduction

CPP have been engaged to provide an experienced-based wind impact assessment report for the proposed 11 SEPTEMBER 2025

Next DC S5 development in Macquarie Park. This report outlines the assessment and subsequent recommendations for wind engineering services related to pedestrian wind comfort and safety on the ground level.

2. Wind Assessment

WIND CLIMATE

The proposed development lies approximately 7 km to the north-east of the Sydney Olympic Park Bureau of Meteorology anemometer, which provides the best source of historical wind data for the project. The wind rose for Sydney Olympic Park is shown in Figure 1 along with Bankstown Airport anemometer located a further 13 km to the south-west from the site for comparison. In Figure 1, the arms point in the direction from where the wind is blowing, the width and colour of the arm represent the wind speed, and the length of the arm indicates the percent of the time that the wind blows for that combination of speed and direction. It is evident from Figure 1 that prevailing winds come from the south-east, and north-west. This wind assessment is structured around these prevailing wind directions.

The difference between the two wind roses in Figure 1 is primarily due to the immediate surroundings to the anemometer. The directional difference is primarily due to the local topography, and the speed difference due to larger surrounding obstructions at Sydney Olympic Park.

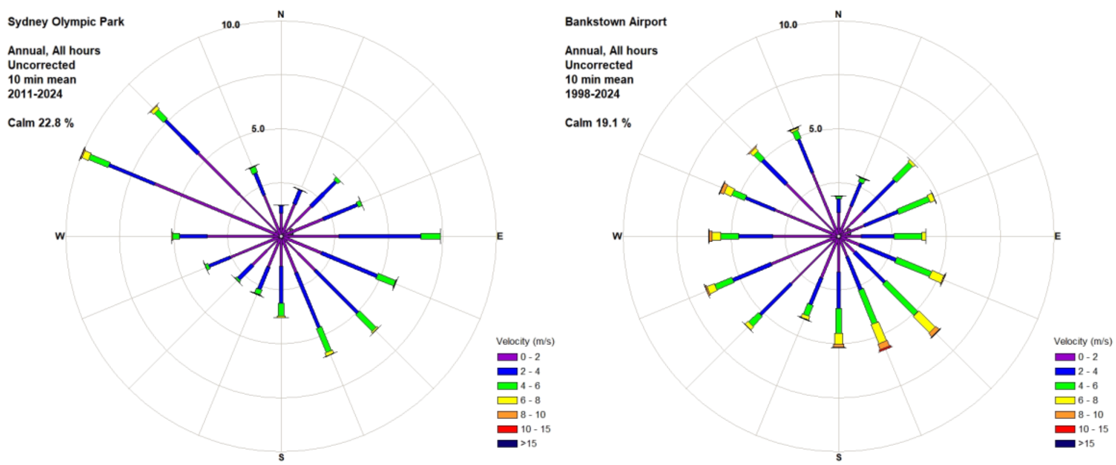

Figure 1: Wind rose for Sydney Olympic Park, Archery Centre (L), Bankstown Airport (R)

WIND ASSESSMENT CRITERIA

A number of researchers have suggested quantitative methods for assessing wind comfort and safety based on estimated wind speeds and local climate statistics. These criteria provide a means of evaluating the wind amenity of a location based on the frequency of threshold wind speeds, noting that pedestrians will tolerate higher wind speeds for a shorter time period than lower speeds. The comfort criteria allows planners to assess the usability, with respect to the wind environment, of different locations for various purposes. A discussion on various criteria is presented in Appendix B.

There are no specific wind controls for the SSDA, however City of Ryde (2014) has specific wind comfort and safety criteria, reproduced in Figure 2. The criteria do not accurately define the probability of exceedance: weekly could be all hours, daylight hours, or operational hours. It is evident from Figure 18 that the City of Ryde criteria for mean wind speed are conservative compared with other published data. The limiting annual maximum gust criterion is considered to be based on the work of Melbourne (1978), Figure 19, where a probability of 0.05-0.1% of the time is used, and the peak 3 s gust wind speed occurs in a typical temperate storm lasting about 4 hours.

AREA CLASSIFICATION	LIMITING WEEKLY MAXIMUM GUST-EQUIVALENT MEAN	LIMITING ANNUAL MAXIMUM GUST
Outdoor dining areas, amphitheatres etc	3.5 m/s	10 to 13 m/s
Main retail centres and retail streets, parks, communal recreational areas	5.5 m/s	13 m/s
Footpaths and other pedestrian accessways	7.5 m/s	16 m/s
Infrequently used laneways, easements, private balconies	10 m/s	23 m/s

Figure 2: City of Ryde (2021) wind assessment criteria

SITE DESCRIPTION

The site is located is located on the block bounded by Lane Cove, Waterloo, Wicks, and Epping Roads in Macquarie Park, Figure 3. The Macquarie Park area is developing rapidly, with existing medium- to high-rise buildings to the north-west of the site, and proposed medium- to high-rise buildings along both sides of Waterloo Road. The Macquarie Park area is elevated, however remains relatively flat from a wind perspective.

Winds in such surrounds tend to experience less channelling than areas with many tall structures, with local effects instead being dictated by exposed buildings and their relation to prevailing strong wind directions. Several wind flow mechanisms such as downwash and channelling flow are described in Appendix A, as well as the effectiveness of some common wind mitigation measures.

The proposed development is a prismatic building of rectangular floor plan approximately 65 by 170 m, rising to a maximum height of about 65 m above local ground level, Figure 4. As the proposed building massing is large and taller than surrounding buildings, it is expected to have some impact on the local wind conditions, and the extents are discussed in this report.

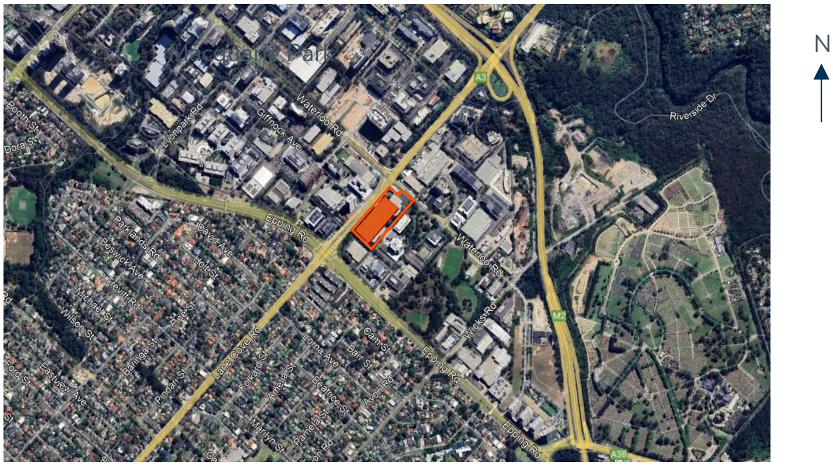

Figure 3: Site location (Google Earth, 2024)

Figure 4: Ground floor plan (T), section looking north-west (C), east elevation (BL), view from north (BR)

WINDS FROM THE SOUTH-EAST

The site is relatively exposed to winds from the south-east quadrant approaching over low-rise suburbia and open land. The aspect ratio of the building would reduce the amount of downwash generated and direct a large portion of the flow over the roof, with horizontal flow accelerating around the south and east corners of the building, Figure 5. The change in building height to the west is of benefit as more flow would be directed in this direction. The colonnade around the eastern corner would attract more flow at ground level and the wind conditions around the corner would be windy. The footpath to the south-east is about 10 m from the building façade, Figure 6, which is considered sufficient to dissipate the accelerated flow around the corners before the accessible areas. Patrons to any outdoor areas around the east corner would avoid the corner during winds from this direction. Once mature, the proposed landscaping along the south-east façade would further improve the wind conditions at this location.

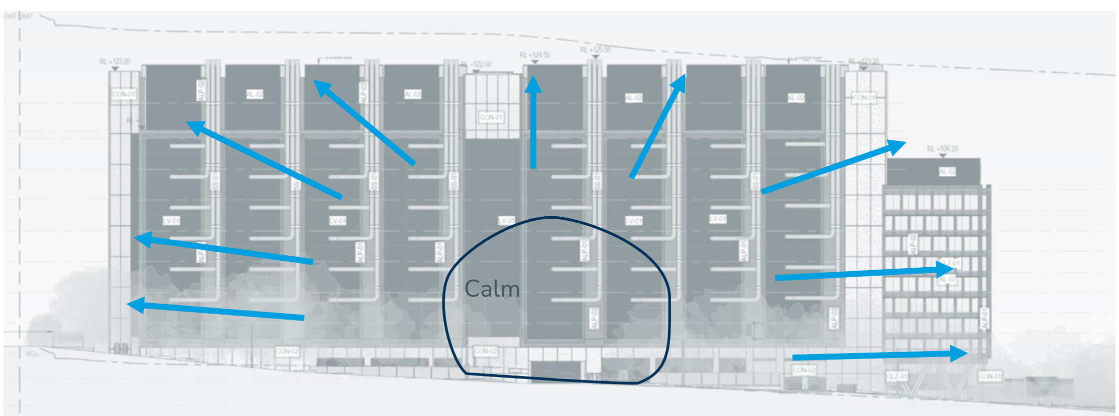

Figure 5: Flow patterns for winds from the south-east

Wind with a direction more from the east or south would impinge on the corner of the building rather than orthogonal to the face. This would tend to induce more horizontal flow, hence would be expected to provide similar or better wind conditions around these corners compared with that described above. Any landscaping between the footpath and south-east façade would improve the local wind conditions, particularly dense hedges close to the corners if the windy zones noted in Figure 6 are accessible.

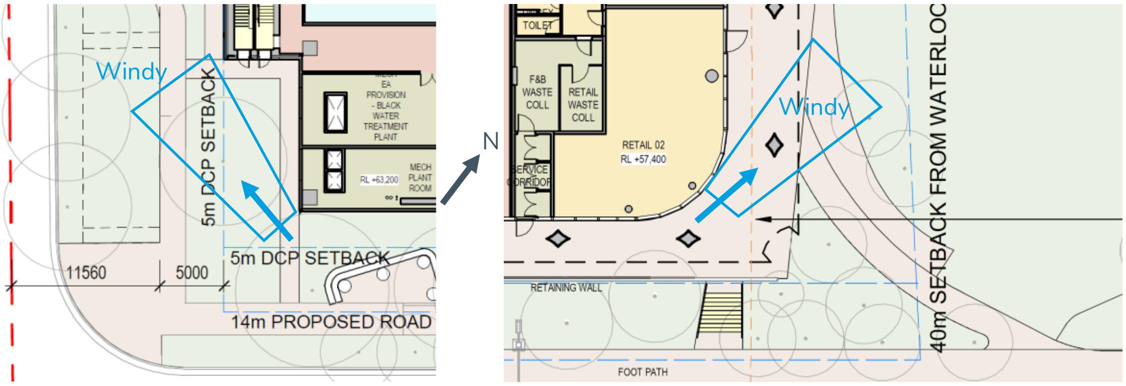

Figure 6: Ground floor plan of the south(L) and east (R) corners for winds from the south-east

WINDS FROM THE NORTH-WEST

Winds from the north-west are slightly more shielded by the upstream taller buildings, which would channel some of the flow along Waterloo Road and Giffnock Avenue. The incident flow would impinge on the north-west façade inducing a similar flow pattern to winds from the south-east, Figure 5. The pedestrian footpath on this side of the building passes closer to the building, Figure 7, hence would be exposed to stronger wind conditions. With the prevalence of winter winds from this direction, it would be recommended to redirect the path to avoid the windy area around the northern corner.

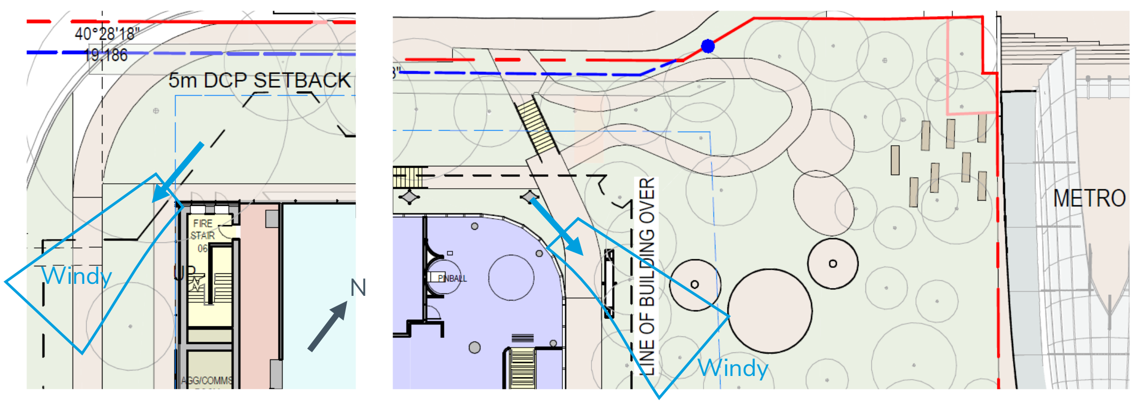

Figure 7: Ground floor plan of the west (L) and north (R) corners for winds from the north-west

The landscaped area between the proposed building and the Metro Station, will be impacted by the accelerated flow. The landscaped area would provide local amelioration, Figure 8, and users would naturally use areas that suited their environmental requirements.

Figure 8: Render of landscaped area

DISCUSSION – PUBLIC DOMAIN

The height of the proposed development is taller than the surrounding buildings and therefore would be expected to have an impact on the local wind environment. For most locations around the site, wind conditions are expected to remain similar to the existing wind conditions with some areas getting windier and others calmer depending on the incident wind direction. Qualitatively, integrating the expected directional wind conditions around the site as discussed above with the wind climate, it is considered that wind conditions would be generally classified as suitable for 'Main retail centres', increasing to 'Footpaths and other pedestrian accessways' around the exposed corners of the development. These pedestrian comfort levels are considered acceptable for the intended use of the space and suitable for public accessways. All locations would be expected to satisfy the safety/distress limiting annual maximum gust criterion.

The main entrances to the building are well located in the middle of the building face and remote from the high wind speed zones around the corners.

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Appendix A – Wind Flow Mechanisms

An urban environment generates a complex wind flow pattern around closely spaced structures, hence it is exceptionally difficult to generalise the flow mechanisms and impact of specific buildings as the flow is generated by the entire surrounds. However, it is best to start with an understanding of the basic flow mechanisms around an isolated structure.

ISOLATED BUILDING

When the wind hits an isolated building, the wind is decelerated on the windward face generating an area of high pressure, Figure 9, with the highest pressure at the stagnation point at about two thirds of the height of the building. The higher pressure bubble extends a distance from the building face of about half the building height or width, whichever is lower. The flow is then accelerated down and around the windward corners to areas of lower pressure, Figure 9. This flow mechanism is called **downwash** and causes the windiest conditions at ground level on the windward corners and along the sides of the building.

Rounding the building corners or chamfering the edges reduces downwash by encouraging the flow to go around the building at higher levels. However, concave curving of the windward face can increase the amount of downwash. Depending on the orientation and isolation of the building, uncomfortable downwash can be experienced on buildings of greater than about 6 storeys.

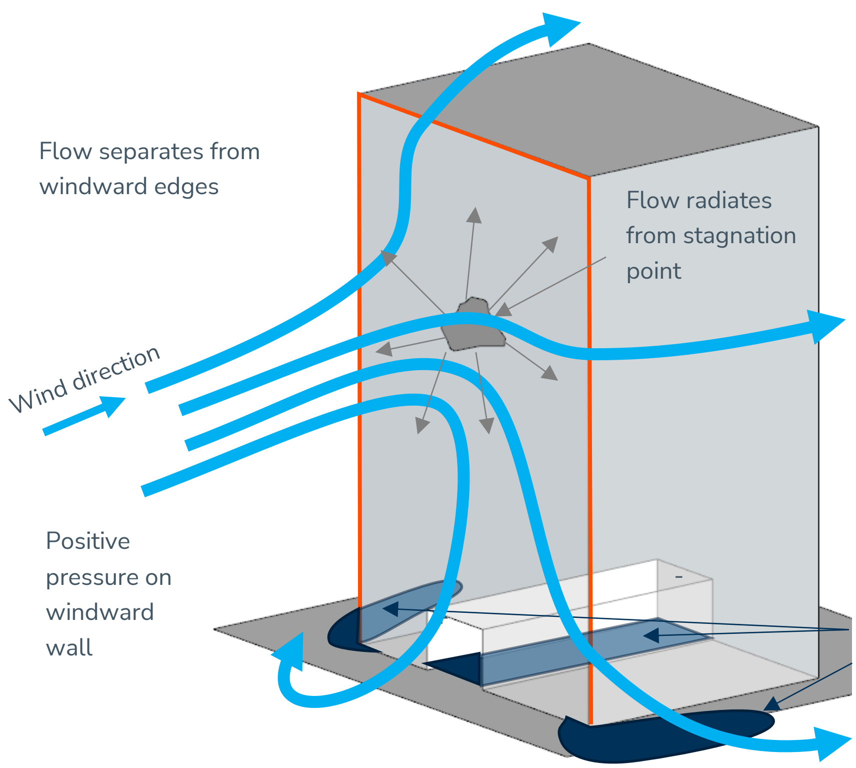

Figure 9: Schematic wind flow around tall isolated building

Techniques to mitigate the effects of downwash winds at ground level include the provision of horizontal elements, the most effective being a podium to divert the downward flow away from pavements and building entrances, but this will generate windy conditions on the podium roof, Figure 10. Generally, the lower the podium roof and deeper the setback from the podium edge to the tower improves the ground level wind conditions. The provision of an 8 m setback on an isolated building is generally sufficient to improve ground level conditions, but is highly dependent on the building isolation, orientation to prevailing wind directions, shape and width of the building, and any plan form changes at higher level.

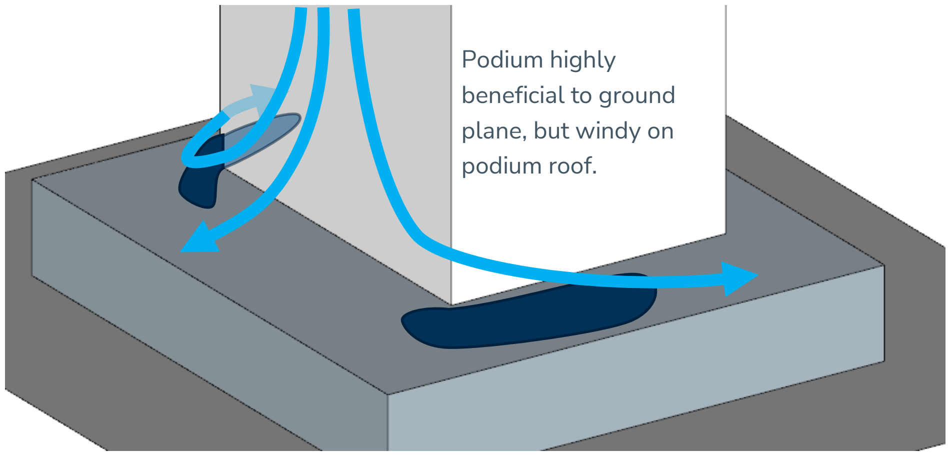

Figure 10: Schematic flow pattern around building with podium

Awnings along street frontages perform a similar function as a podium, and generally the larger the horizontal projection from the façade, the more effective it will be in diverting downwash flow, Figure 11. Awnings become less effective if they are not continuous along the entire façade, or on wide buildings as the positive pressure bubble extends beyond the awning resulting in horizontal flow under the awning.

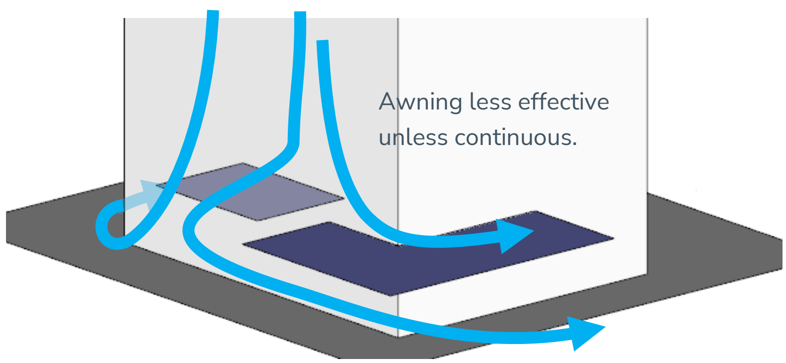

Figure 11: Schematic flow pattern around building with awnings

It should be noted that colonnades at the base of a building with no podium generally create augmented windy conditions at the corners due to an increase in the pressure differential, Figure 12. Similarly, open through-site links through a building cause wind issues as the pressure tries to equilibrate between the entrances to the link causing strong flow, Figure 9. If the link is blocked, wind conditions will be relatively calm, Figure 13. This area is in a region of high pressure and therefore there is the potential for internal flow issues. A ground level recessed corner has a similar effect as an undercroft, resulting in windier conditions, Figure 13.

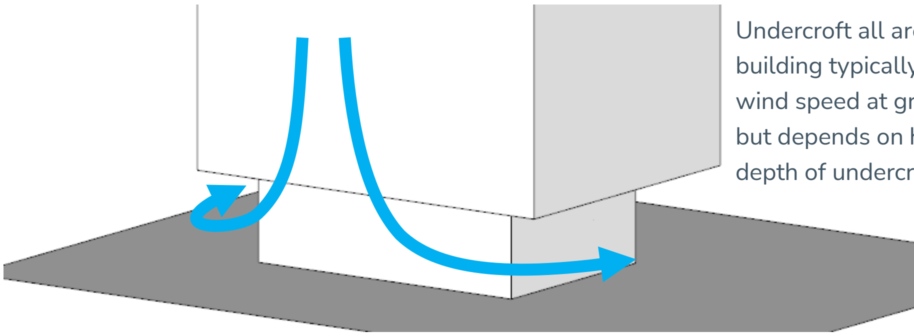

Figure 12: Schematic of flow patterns around isolated building with undercroft

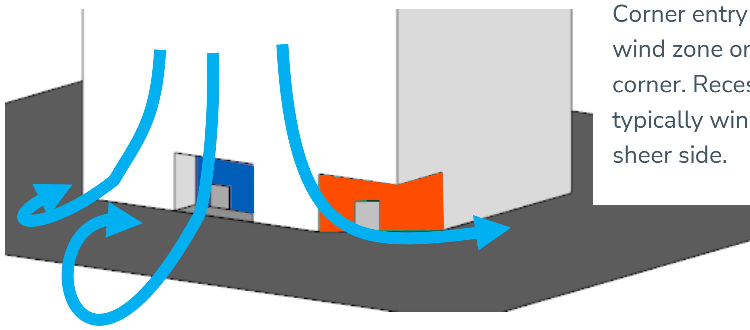

Figure 13: Schematic of flow patterns around isolated building with ground articulation

MULTIPLE BUILDINGS

When a building is located in a city environment, depending on upwind buildings, the interference effects may be positive or negative, Figure 14. If the building is taller, more of the wind impacting on the exposed section of the building is likely to be drawn to ground level by the increase in height of the stagnation point, and the additional negative pressure induced at the base by the surrounding buildings. If the upwind buildings are of similar height then the pressure around the building will be more uniform hence downwash is typically reduced with the flow passing over the buildings.

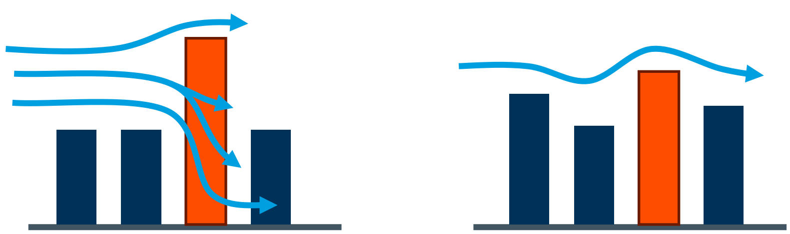

Figure 14: Schematic of flow pattern interference from surrounding buildings

The above discussion becomes more complex when three-dimensional effects are considered, both with orientation and staggering of buildings, and incident wind direction, Figure 15.

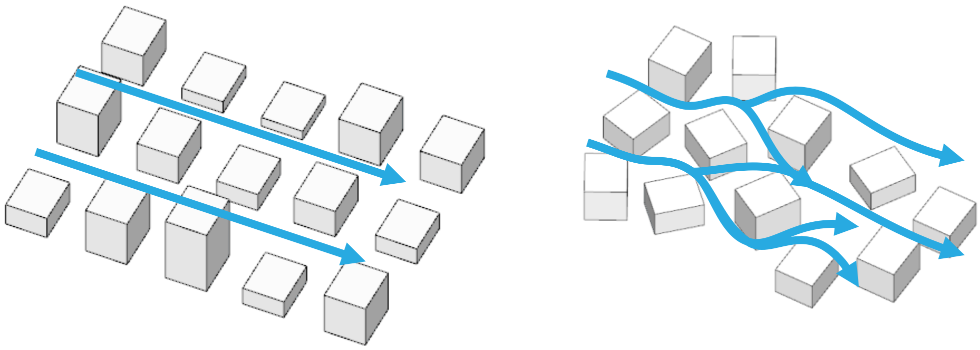

Figure 15 Schematic of flow patterns through a grid and random street layout

On the fringe of a city, the compound shape of neighbouring buildings instigates the flow pattern through the city. The overall massing causes an obstruction to the flow causing a slowing of the incident flow and increasing the windward pressure. Pressure driven flow is produced between the buildings, Figure 16. The vertical component in pressure driven flow is lower than downwash flow.

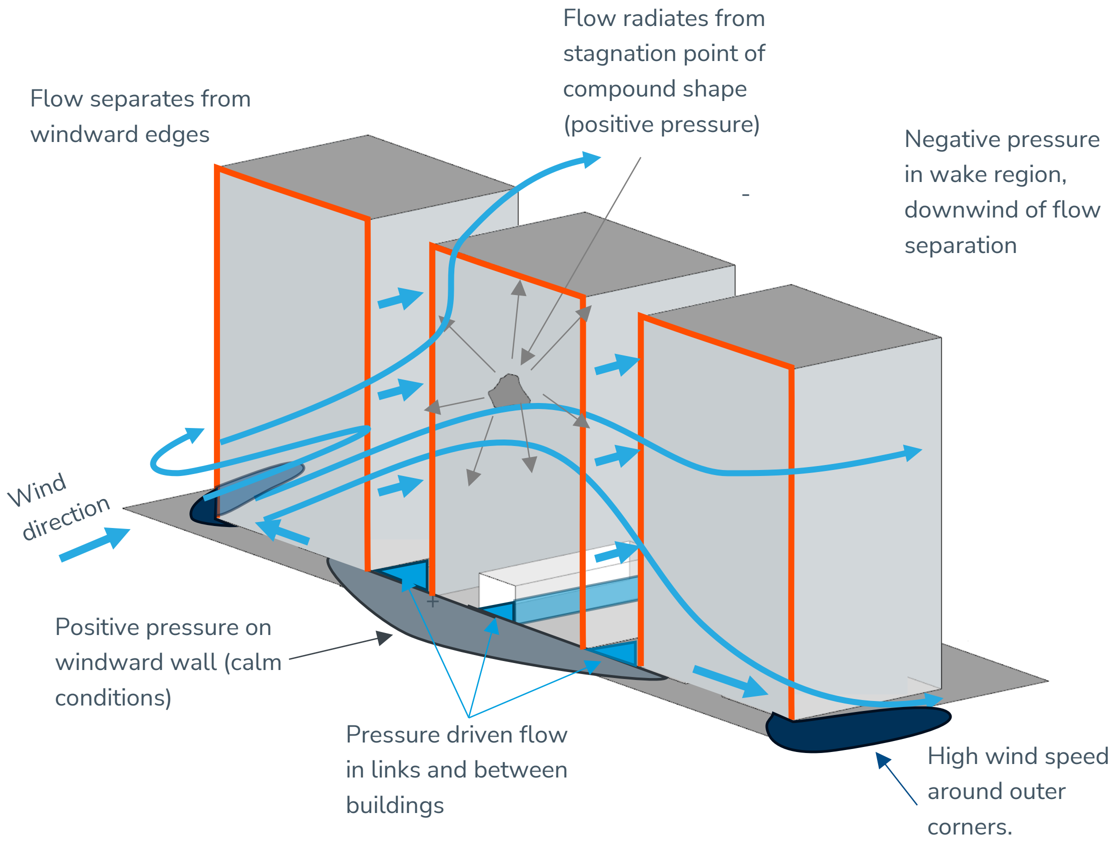

Figure 16: General flow pattern around multiple buildings

Channelling is instigated when pressure driven flow accelerates between two buildings, and continues along straight streets with buildings on either side, Figure 15(L). This occurs on the edge of large built-up areas where the approaching flow is diverted around the overall massing and channelled along the fringe by a relatively continuous wall of building facades. This is generally the primary mechanism producing strong wind conditions on the perimeter of a built-up area, particularly on corners, which can be exposed to multiple prevailing wind directions. The perimeter edge zone in a built-up area is typically about two blocks deep. Downwash is the more important flow mechanism for the edge zone of a built-up area with buildings of similar height.

As the city expands, the central section of the city typically becomes calmer, particularly if the grid pattern of the streets is discontinued, Figure 15(R). When buildings are located on the corner of a central city block, the geometry becomes slightly more important with respect to the local wind environment.

BARRIERS AND SCREENS

The wind flow pattern over a vertical barrier is illustrated in Figure 17, showing there will be recirculation zones near the windward wall and in the immediate lee of the barrier. The typical extent of these recirculation zones relative to the height of the barrier, *h*, is illustrated in Figure 17. These regions are not fixed but fluctuate in time. The mean wind speed in the wake areas drops significantly compared with the incident flow. With increasing distance from the barrier, the flow pattern will resort to the undisturbed state. Typically, the mean velocity and turbulence intensity at barrier height would be expected to be within 10% of the free stream conditions at 10 times the height of the structure downwind from the barrier.

Multiple barriers offer improved wind conditions between the barriers by preventing the flow from reattaching to the surface.

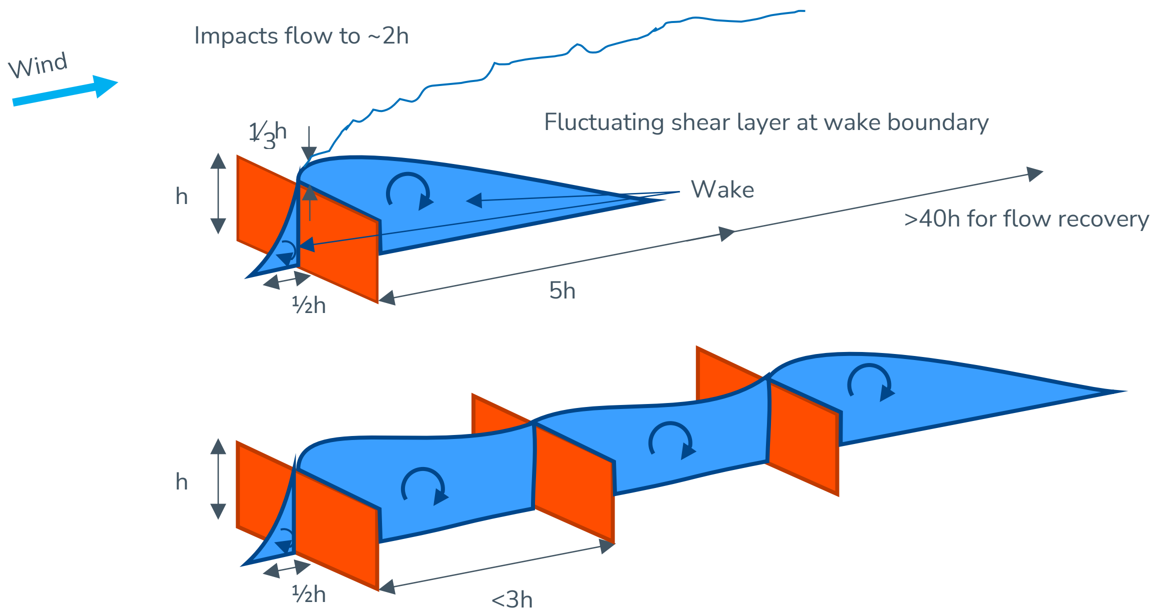

Figure 17: Sketch of the flow pattern over vertical elements

Appendix B – Wind Speed Criteria

GENERAL DISCUSSION

Primary controls that are used in the assessment of how wind affects pedestrians are the wind speed, and rate of change of wind speed. A description of the effect of a specific wind speed on pedestrians is provided in Table 1. It should be noted that the turbulence, or rate of change of wind speed, will affect human response to wind and the descriptions are more associated with response to mean wind speed.

Table 1: Summary of wind effects on pedestrians

Description	Speed (m/s)	Effects
Calm, light air	0–2	Human perception to wind speed at about 0.2 m/s. Napkins blown away and newspapers flutter at about 1 m/s.

Light breeze	2–3	Wind felt on face. Light clothing disturbed. Cappuccino froth blown off at about 2.5 m/s.
Gentle breeze	3–5	Wind extends light flag. Hair is disturbed. Clothing flaps.
Moderate breeze	5–8	Raises dust, dry soil. Hair disarranged. Sand on beach saltates at about 5 m/s. Full paper coffee cup blown over at about 5.5 m/s.
Fresh breeze	8–11	Force felt on body. Limit of agreeable wind on land. Umbrellas used with difficulty. Wind sock fully extended at about 8 m/s.
Strong breeze	11–14	Hair blown straight. Difficult to walk steadily. Wind noise on ears unpleasant. Windborne snow above head height (blizzard).
Near gale	14–17	Inconvenience felt when walking.
Gale	17–21	Generally impedes progress. Difficulty with balance in gusts.
Strong gale	21–24	People blown over by gusts.

Local wind effects can be assessed with respect to a number of environmental wind speed criteria established by various researchers. These have all generally been developed around a peak 3 s gust in an hour, or 1 hour mean wind speed. During strong events, a pedestrian would react to a significantly shorter duration gust than a 3 s, and historic weather data is normally presented as a 10 minute mean.

Despite the apparent differences in numerical values and assumptions made in their development, it has been found that when these are compared on a probabilistic basis, there is some agreement between the various criteria. However, a number of studies have shown less agreement over a wider range of flow conditions. The downside of these criteria is that they have seldom been benchmarked, or confirmed through long-term measurements in the field, particularly for comfort conditions. The wind criteria were all developed in temperate climates and are unfortunately not the only environmental factor that affects pedestrian comfort.

For assessing the effects of wind on pedestrians, neither the random peak gust wind speed (3 s or otherwise), nor the mean wind speed in isolation are adequate. The gust wind speed gives a measure of the extreme nature of the wind, but the mean wind speed indicates the longer duration impact on pedestrians. The extreme gust wind speed is considered to be suitable for safety considerations, but not necessarily for serviceability comfort issues such as outdoor dining. This is because the instantaneous gust wind speed does not always correlate well with mean wind speed, and is not necessarily representative of the parent distribution. Hence, the perceived ‘windiness’ of a location can either be dictated by strong steady flows, or gusty turbulent flow with a smaller mean wind speed.

To measure the effect of turbulent wind conditions on pedestrians, a statistical procedure is required to combine the effects of both mean and gust. This has been conducted by various researchers to develop an equivalent mean wind speed to represent the perceived effect of a gust event. This is called the ‘gust equivalent mean' or 'effective wind speed' and the relationship between the mean and 3 s gust wind speed is defined within the criteria, but two typical conversions are:

$$U_{GEM} = \frac{(U_{1\ hour\ mean} + 3 \cdot \sigma_u)}{1.85} \text{ and } U_{GEM} = \frac{1.3 \cdot (U_{1\ hour\ mean} + 2 \cdot \sigma_u)}{1.85}$$

It is evident that a standard description of the relationship between the mean and impact of the gust would vary considerably depending on the approach turbulence, and use of the space.

A comparison between the mean and 3 s gust wind speed criteria from a probabilistic basis are presented in Figure 18 and Figure 19. The grey lines are typical results from modelling and show how the various criteria would classify a single location. City of Auckland has control mechanisms for accessing usability of spaces from a wind perspective as illustrated in Figure 18 with definitions of the intended use of the space categories included in this Figure.

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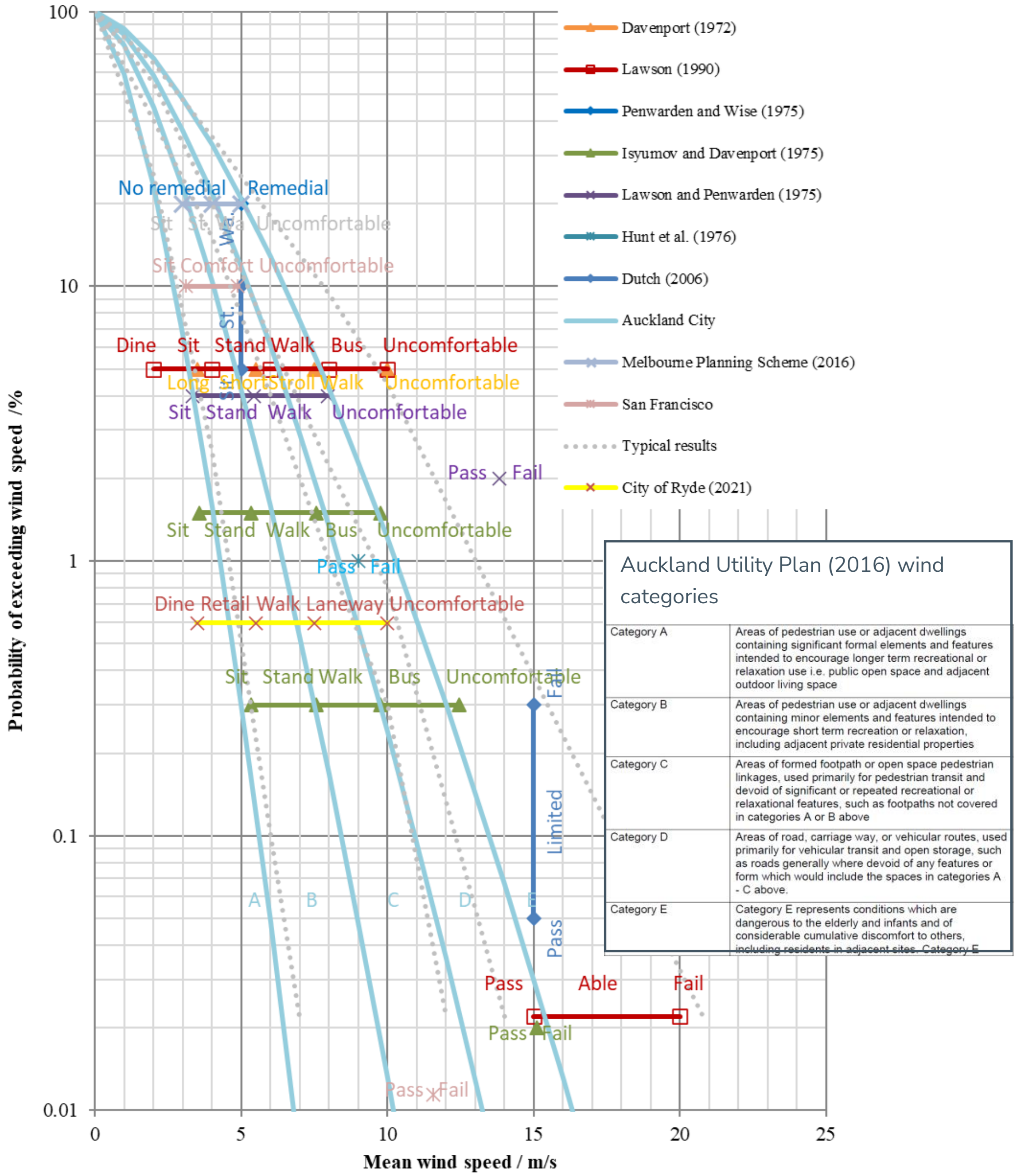

Figure 18: Probabilistic comparison between wind criteria based on mean wind speed

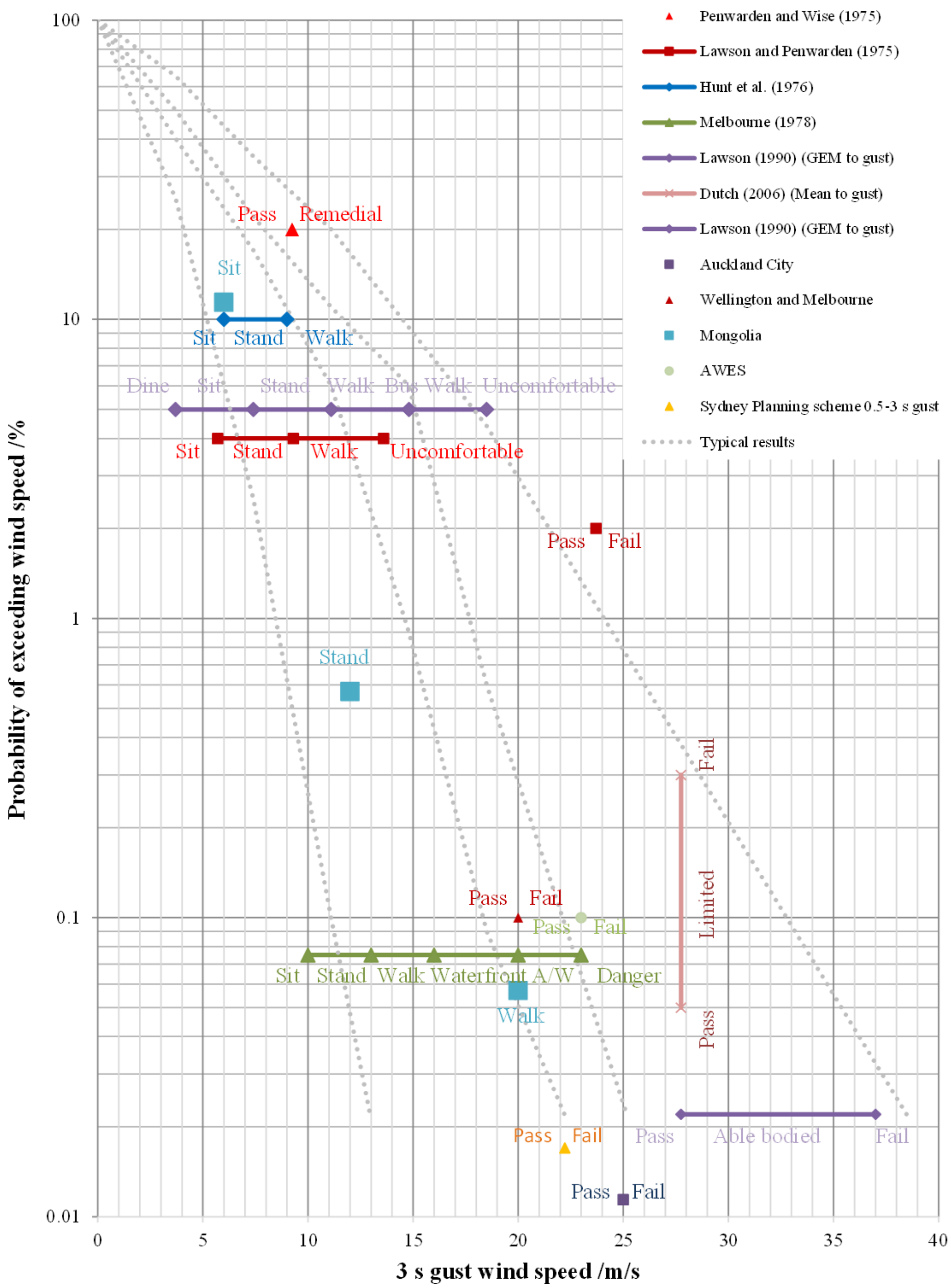

Figure 19: Probabilistic comparison between wind criteria based on 3 s gust wind speed