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Mr. Andrew Golden
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4 November 2021

Waterloo Estate (South) – wind assessment report

Dear Mr. Golden,

Further to our recent correspondence, please find herein a brief comparative report detailing the impact of the changes to the Waterloo Estate (South) envelope Masterplan on the expected wind conditions in and around the site. This report follows on from the Arup environmental wind assessment report dated 28 January 2021, and a review of the Hassell Waterloo Estate South, Urban Design review Envelope Approach document dated 21 October 2021.

Pedestrian safety and comfort are both important for the success of any project. At this stage of the design, ensuring that the building massing does not exceed safety concerns is paramount. This is the reason why non-permanent landscaping or building ancillaries are not included during the initial wind-tunnel tests. From a pedestrian comfort perspective, the primary usage of areas around the site (e.g. dining, sitting, to transient usage) should be informed by the wind-tunnel test results with appropriate mitigation employed as necessary to meet the intended use of the space. Any wind mitigation would assist with safety.

Wind assessment criteria

The current draft Central Sydney Planning Strategy 2016-2036 wind controls are considered appropriate for a large development, and were used in the initial wind assessment report. An expansion of these based on the original research is presented in Table 1. The comfort criterion are based on a 5% of the time exceedance during daylight hours (6 am to 10 pm). The safety criterion is based on the maximum 0.5 s gust wind speed in an hour of 24 m/s occurring once per annum during daylight hours.

Table 1 Pedestrian comfort criteria for various activities

Comfort (max. of mean or GEM wind speed for 5% of daylight hours)	
≤2 m/s	Dining
>2-≤4 m/s	Sitting
>4-≤6 m/s	Standing
>6-≤8 m/s	Walking
>8-≤10 m/s	Fast walking or cycling
>10 m/s	Uncomfortable
Safety (max. 0.5 s gust wind speed occurring in an hour, for 0.0172% of daylight hours)	
≤24 m/s	Pass
>24 m/s	Fail

Previous results

From the previous wind-tunnel testing on a base scheme, the wind conditions on the ground plane at all locations around the site met the safety criterion. Test locations around the outer corners of the entire development, particularly close to the southern towers were close to the safety limit, and caused by the proposed development. The results for comfort classification are reproduced in Figure 1. Locations classified as suitable for walking (orange), or fast walking (pink) approached the safety criterion. The poor wind conditions to the north of Wellington Street were not caused by the Waterloo Estate (South) buildings.

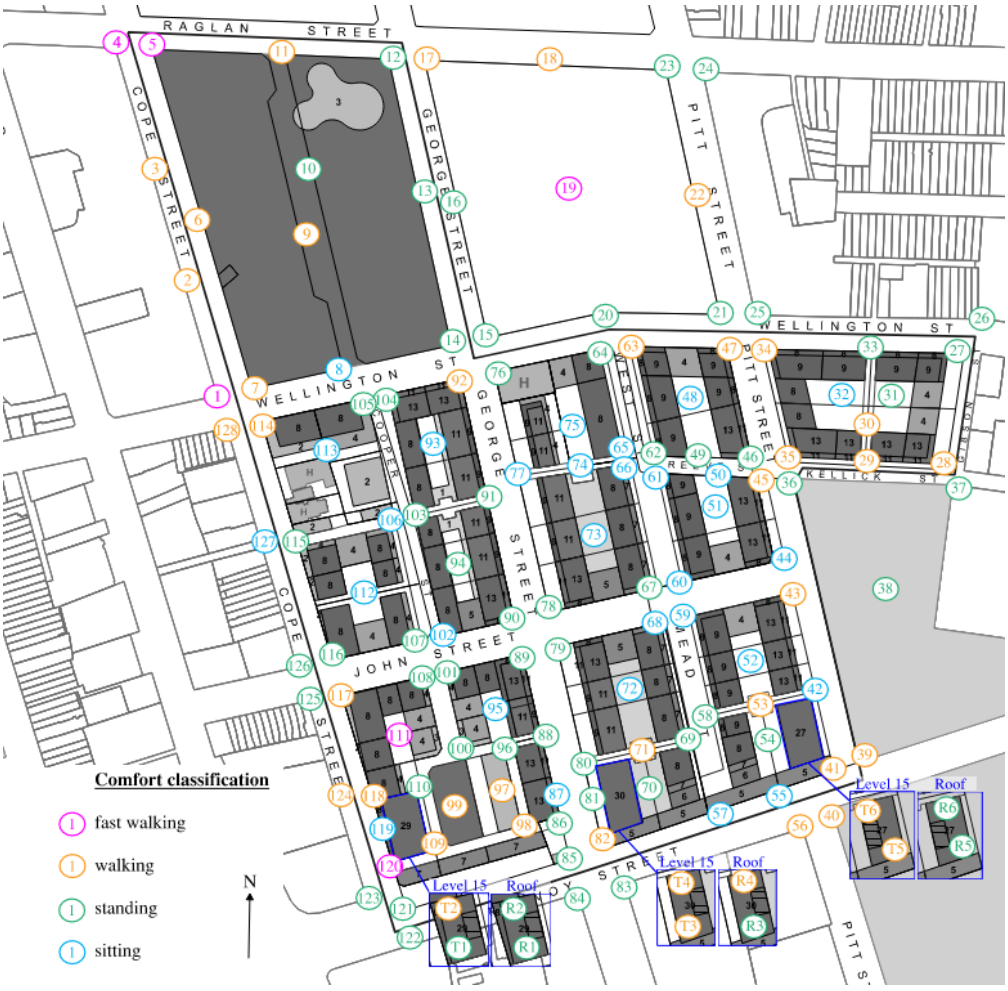


Figure 1: Summary of test locations and comfort classification

Building changes

Comparative drawings between the building heights used for the wind-tunnel testing and the current configuration are presented in Figure 2. The tower heights tested in the original wind-tunnel study were lower than the maximum envelope height of RL126.4 m, which are retained in the current scheme. In Figure 2, the primary changes are annotated on the proposed scheme and colour coded with benefit from a wind perspective. It is evident the general orientation, layout, and massing of the development precinct has not changed. The main changes from a wind safety perspective, in order of importance, are:

1. the additional tall tower in the north-east corner,
2. enclosing the laneway from Cope Street in the south-west corner,
3. increase in height of the three southern towers,
4. proposed removal of the mid-height building slots, Figure 3, and
5. the opening of the southern podium along McEvoy Street.

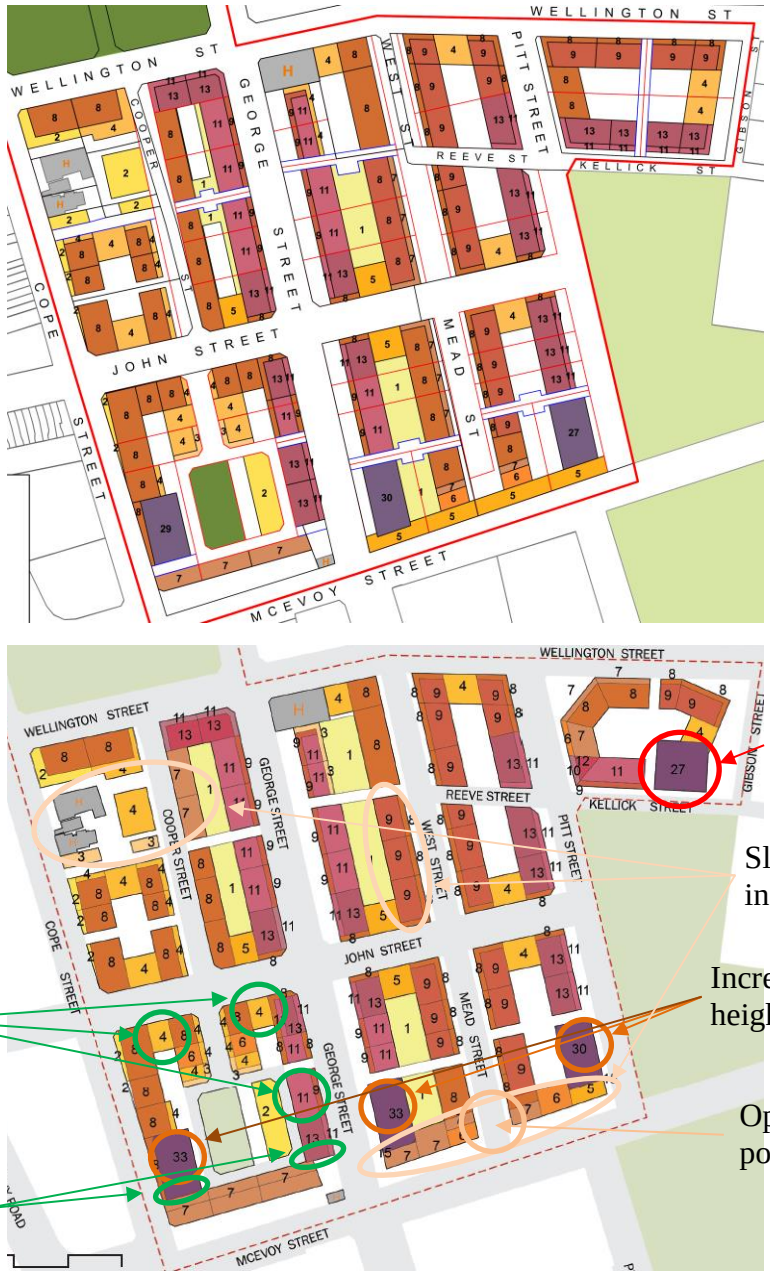


Figure 2: Building height in storeys: as tested (T), preferred proposed (B)

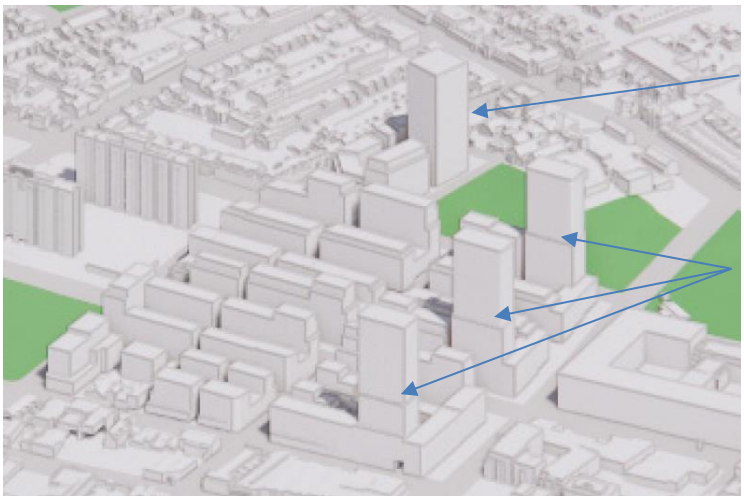
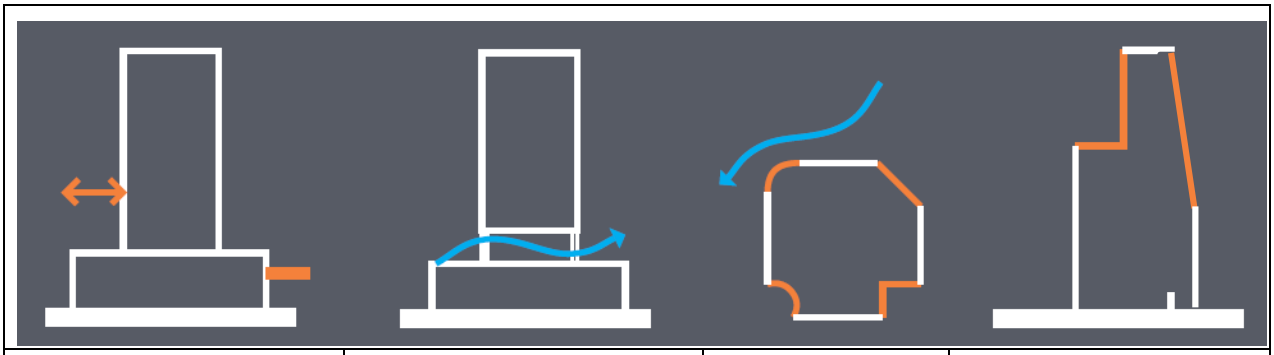


Figure 3: Aerial view looking east of preferred scheme

Discussion

From the previous testing, locations approaching the safety criterion and poor comfort conditions were located close to the taller towers along McEvoy Street on the outer corners of the development massing. The minor changes in height to the low- and medium-rise buildings and the opening on the southern podium to McEvoy Street would be expected to have minimal impact on the measured safety conditions around the site, having a greater impact on pedestrian comfort.

The removal of the mid-height slots and 3-4 storey increase in height to the three southern towers, and the enclosing of the Laneway from Cope Street, would all be expected to increase the wind conditions around the corner of McEvoy and Cope Streets. Without the mature trees in the vicinity of the corner, the wind conditions would be expected to exceed the safety criterion. It is understood that the current design is an envelope, and the final tower volume would be smaller by 10-15%. With appropriate sculpting of the Envelope tower form, it is considered that the safety wind conditions could be achieved, as per the previous testing. The safety wind conditions could be ameliorated with altering the building massing for example by rounding the south-west corner, increasing the tower setback from the podium edge to the west, reducing the height of the tower, introducing appropriate place articulation, and incorporating an awning structure around the corner. Some generic information to improve the wind conditions around an isolated tall building is provided in Figure 4.



Keep taller buildings to centre of block, and/or include a podium with min. 6 m offset to the tower from the podium edge, or at minimum include awnings around the corners.	Raise the tower above the podium to allow the flow to dissipate through this open level; best with a tower setback from the podium edge and minimum 3 storey gap.	Round or chamfer tower corners to encourage horizontal flow.	Provide setbacks or taper in the tower with height to reduce the windward area.

Figure 4: Methods to improve pedestrian level wind conditions

The preferred location of the additional tower on Kellick Street to the north-east of the site, Figure 2, is not ideally located from a wind perspective. A tall building in this elevated location is exposed to all prevailing strong wind directions. The wind conditions at Location 28, on the corner of Kellick and Gibson Streets, Figure 1, approached the safety criterion. With the significant increase in building massing, this and nearby locations along Gibson and Kellick Streets, and Waterloo Park would be expected to exceed the safety criterion. The ground level wind conditions would improve significantly if the tower were moved to the west away from the corners of the block. The tower location allows the retention of three mature trees on the corner of Kellick and Gibson Streets, which will improve the wind conditions around this corner, but as not permanent should not be relied on to mitigate safety conditions. If this is not possible to move the tower for other design

requirements, the amelioration techniques through shaping of the tower, as discussed above and in Figure 4, should be used to improve the wind conditions. The wind conditions around this isolated tall tower will require significant consideration of the building geometry to improve the wind conditions to a safe level

Summary

The proposed changes to the development, in particular the additional tower, and the increase in height of the three existing towers would be expected to be detrimental to the local wind conditions around the site. The current envelope design without any landscaping would be expected to exceed the safety criterion around the corners of Cope and McEvoy Street, and Kellick and Gibson Streets. As the volume of the Envelope design would be about 10-15% than the final building massing, it is considered that with appropriate building sculpting as outlined in Figure 4 and/or relocating the towers away from the corners a safe wind environment could be achieved from the design excellence competition. The impact of wind would have to be paramount in the consideration of the competition jury.

The wind conditions in and around the final designs would require wind-tunnel testing.

I hope this is of assistance, please do not hesitate to contact me on (02) 9320 9921, if you have any questions regarding any aspect of this report.

Yours sincerely,

Graeme Wood
Associate Principal