



# PEDESTRIAN WIND ENVIRONMENT STATEMENT

## CHANNEL 9, WILLOUGHBY

WD189-01F02(REV2)- WS REPORT

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Prepared for:

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## DOCUMENT CONTROL

Date	Revision History	Non-Issued Revision	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
July 05, 2016	Initial	-	0	BU	TR	TR/BU
July 06, 2016	Updated figures and comments.	-	1	BU	TR	BU
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## EXECUTIVE SUMMARY

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This report is in relation to the Channel 9 development, located in Willoughby, and presents an opinion on the likely impact of the “proposed” design scheme on the local wind environment to the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; namely the north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposed development was carried out in the context of the local wind climate, building morphology and land topography.

The conclusions of this report are drawn from our extensive experience in this field and are based on an examination of the Appendix 1 Architectural Drawings prepared by Chrofi, and the Approved Master Plan Drawings prepared by SJB architects, received June 27, 2016. No wind tunnel testing has been undertaken for the subject development, and hence this report addresses only the general wind effects and any localised effects that are identifiable by visual inspection. Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects. It is noted that the provided drawings are concept design drawings with further architectural detail to be designed at a later stage.

The results of this assessment indicate that suitable wind conditions can be expected for the pedestrian footpath areas along Artarmon Road and Richmond Avenue for the “proposed” design scheme. The central streetscape areas of the subject development may be exposed to strong winds. Notwithstanding, the proposed landscape plan shown in Figure 3 of this report is expected to ameliorate these impacts appropriately.

The “proposed” design scheme is expected to provide additional shielding from the prevailing winds due to the alignment of the buildings situated along the perimeter of the development site. It is expected that the central buildings in the “approved” design scheme will not benefit as heavily from these shielding effects due to the absence of the buildings along the perimeter.

Wind conditions within the balcony areas on the low-rise buildings around the perimeter of the development site (Buildings A, B, C, G, H and J) for the “proposed” design scheme are expected to be suitable for their intended use.

However, the upper corner balcony areas on Buildings D, E and F may be exposed to the prevailing winds. To mitigate the potential adverse wind effects at these upper corner balconies, the following in-principal treatments are recommended:

- Building D:
  - The inclusion of full-height impermeable screening along the western aspect of the north-western and south-western corner balconies.

- The inclusion of full-height impermeable screening along the eastern aspect of the south-eastern corner balconies.
- Building E:
  - The inclusion of full-height impermeable screening along the southern aspect of the south-eastern corner balconies.
  - The inclusion of full-height impermeable screening along the northern aspect of the north-western corner balconies.
  - The inclusion of full-height impermeable screening along the eastern aspect of the south-western corner balconies.
- Building F:
  - The inclusion of full-height impermeable screening along the western aspect of the south-western corner balconies.
  - The inclusion of full-height impermeable screening along the southern aspect of the south-eastern corner balconies of the northern wing.

With the inclusion of the abovementioned recommendations, it is expected that wind conditions for all outdoor trafficable areas within and around the subject development will be suitable for their intended uses. Accordingly, it is recommended that future Development Applications for these buildings are accompanied by a further wind assessment once the detailed design is determined.

# **1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS**

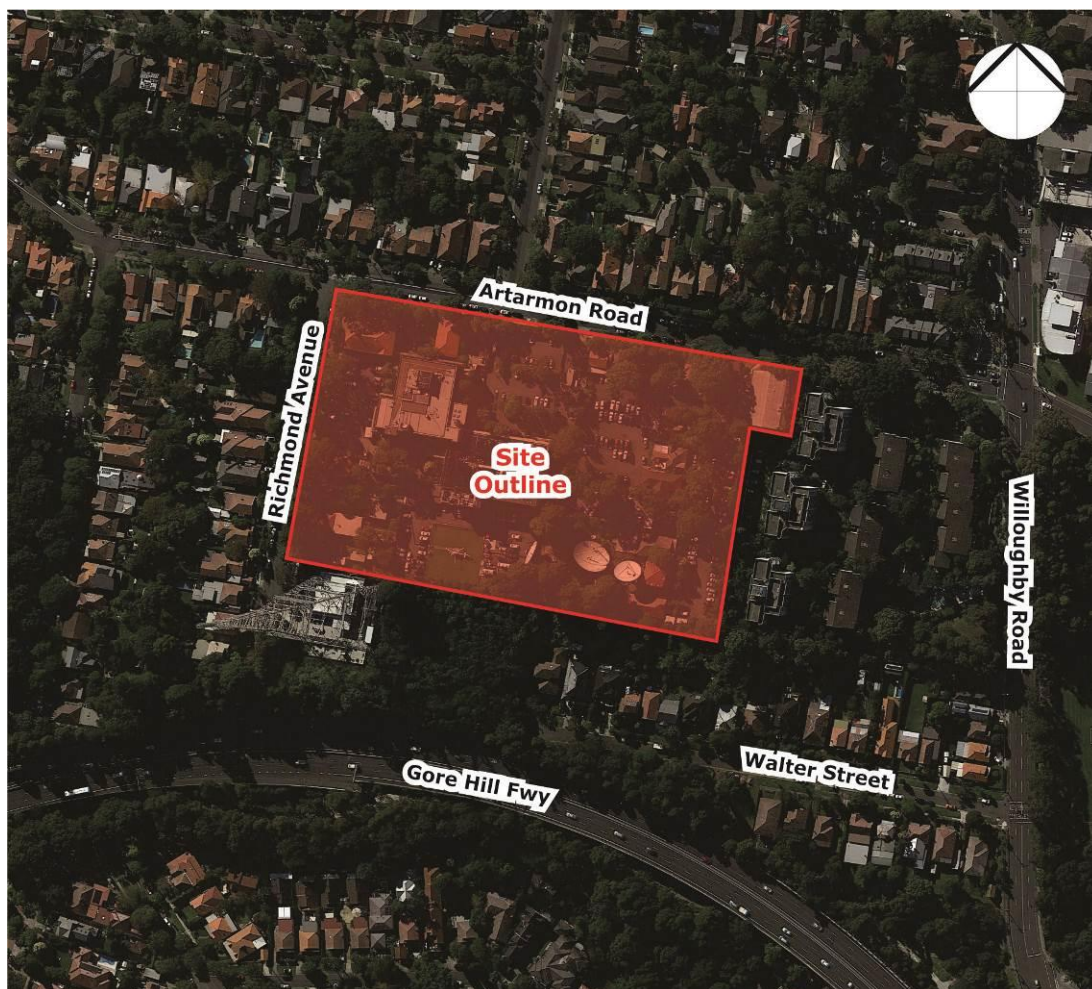
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The development site is bound by Artarmon Road to the north, Richmond Avenue to the west, Willoughby Road to the east and Gore Hill Freeway to the south. Neighbouring the site to the east is the Bicentennial Reserve, with the Flat Rock Gully Reserve located further beyond to the east. Artarmon Reserve is located to the west of the site. A telecommunications tower is located directly to the south-west of the site, with various mid-rise buildings located further beyond to the south-west. An aerial image of the subject site and the local surroundings is shown in Figure 1a.

The “proposed” design scheme of the development consists of various low to mid-rise buildings (Buildings A-H and Building J) and “The Loft” located at the north-eastern corner of the site. The critical trafficable areas associated with the “proposed” design scheme of the development, which are the focus of this assessment with regards to wind effects, are detailed as follows:

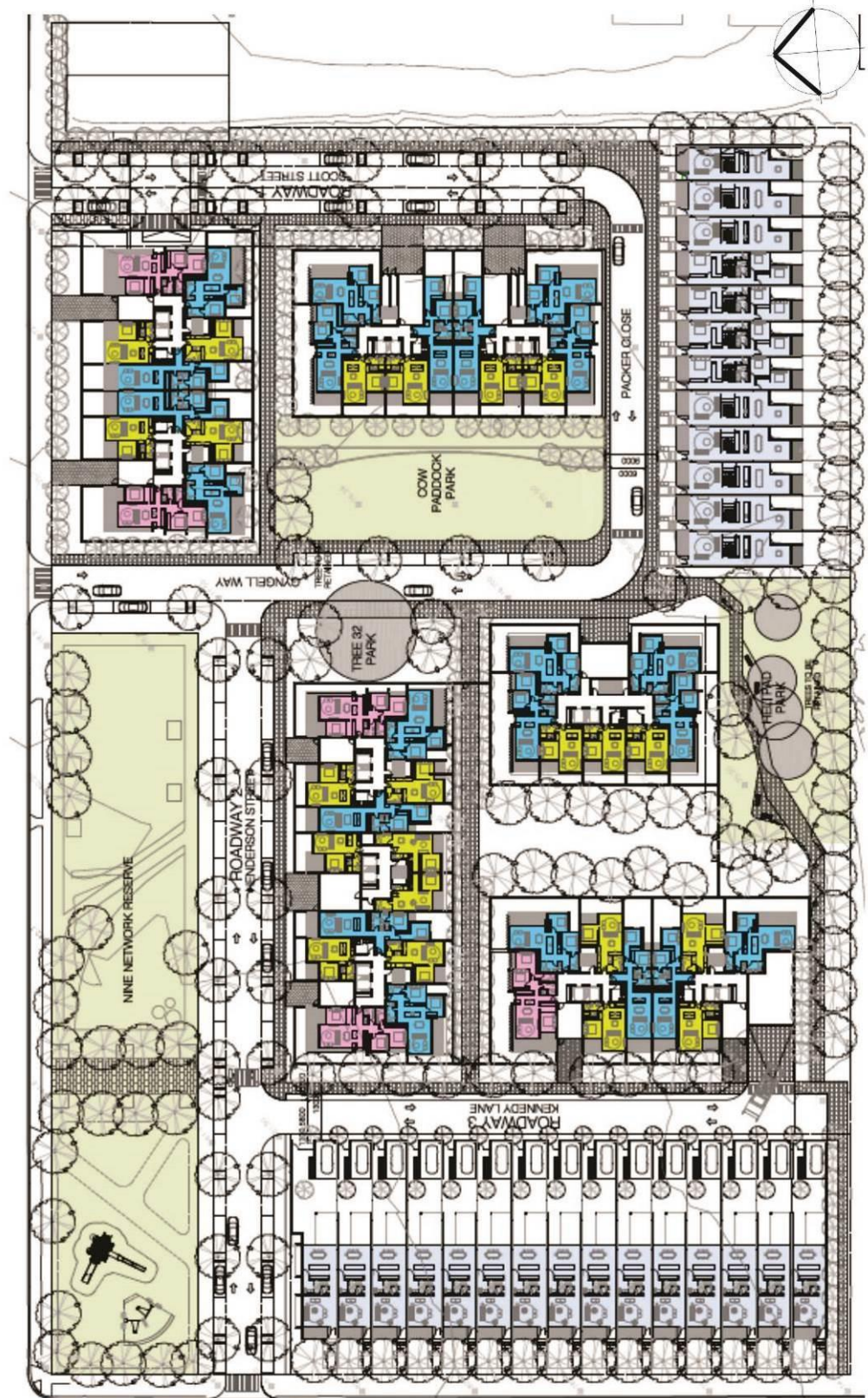
- The pedestrian footpaths along the frontages of the various buildings throughout the development site.
- Private balconies of the various buildings throughout the development.

Comparison is also made with the “approved” design scheme of the development where required, which is shown in Figure 1b.



**Figure 1a: Aerial Image of the Site Location**





**Figure 1b: "Approved" Design Scheme**

## 2 WIND CLIMATE OF THE SYDNEY REGION

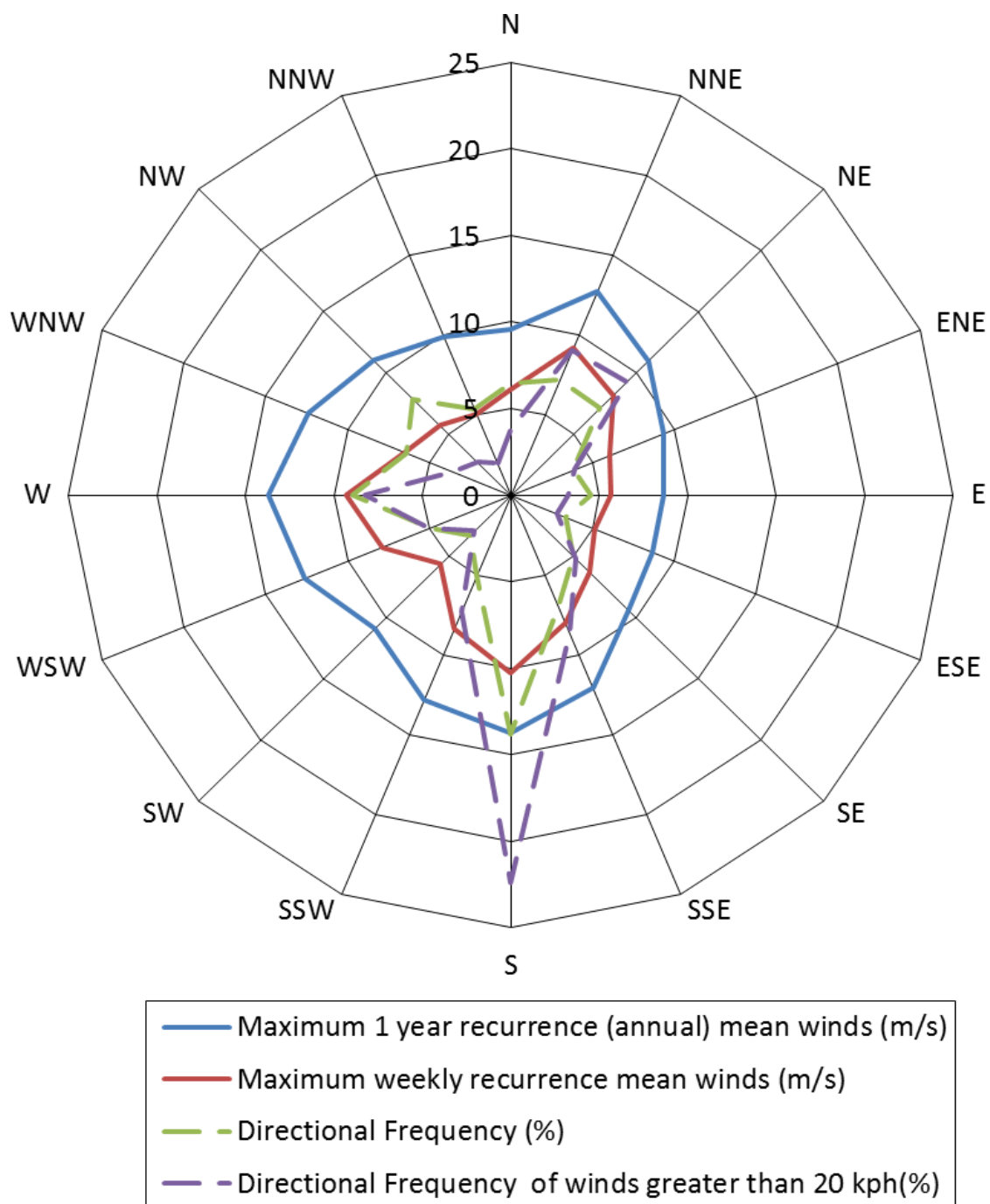
The Sydney region is governed by three principle wind directions, and these can potentially affect the subject development. These winds prevail from the north-east, south and west. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. This summary is based on a detailed analysis undertaken by Windtech Consultants of recorded directional wind speeds obtained at the meteorological station located at Kingsford Smith Airport by the Bureau of Meteorology (recorded from 1939 to 2008). From this analysis, a directional plot of the annual and weekly recurrence winds for the Sydney region is also determined, as shown in Figure 2. The frequency of occurrence of these winds is also shown in Figure 2.

As shown in Figure 2, the southerly winds are by far the most frequent wind for the Sydney region, and are also the strongest. The westerly winds occur most frequently during the winter season for the Sydney region, and although they are typically not as strong as the southerly winds, they are usually a cold wind since they occur during the winter and hence can be a cause for discomfort for outdoor areas. North-easterly winds occur most frequently during the warmer months of the year for the Sydney region, and hence are usually welcomed within outdoor areas since they are typically not as strong as the southerly or westerly winds.

**Table 1: Principle Time of Occurrence of Winds for Sydney**

Month	Wind Direction		
	North-Easterly	Southerly	Westerly
January	X	X	
February	X	X	
March	X	X	
April		X	X
May			X
June			X
July			X
August			X
September		X	X
October	X	X	
November	X	X	
December	X	X	





**Figure 2: Annual and Weekly Recurrence Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (based on 10-minute mean observations from Kingsford Smith Airport from 1939 to 2008, corrected to open terrain at 10m)**

### 3 WIND EFFECTS ON PEOPLE

The acceptability of wind in any area is dependent upon its use. For example, people walking or window-shopping will tolerate higher wind speeds than those seated at an outdoor restaurant. Various other researchers, such as Davenport, Lawson, Melbourne, Penwarden, etc, have published criteria for pedestrian comfort for pedestrians in outdoor spaces for various types of activities. Some Councils and Local Government Authorities have adopted elements of some of these into their planning control requirements in Australia.

The following table is an example, which was developed by Penwarden in 1975, and describes the effects of various wind intensities on people. Note that the applicability column relates to the indicated wind conditions occurring frequently (exceeded approximately once per week on average). Higher ranges of wind speeds can be tolerated for rarer events.

**Table 2: Summary of Wind Effects on People (Penwarden, 1975)**

Type of Winds	Mean Wind Speed (m/s)	Effects	Applicability
Calm, light air	0 - 1.5	Calm, no noticeable wind.	Generally acceptable for Stationary, long exposure activities such as in outdoor restaurants, landscaped gardens and open air theatres.
Light breeze	1.6 - 3.3	Wind felt on face.	
Gentle breeze	3.4 - 5.4	Hair is disturbed, Clothing flaps.	
Moderate breeze	5.5 - 7.9	Raises dust, dry soil and loose paper. Hair disarranged.	Generally acceptable for walking & stationary, short exposure activities such as window shopping, standing or sitting in plazas.
Fresh breeze	8.0 - 10.7	Force of wind felt on body.	Acceptable as a main pedestrian thoroughfare
Strong breeze	10.8 - 13.8	Umbrellas used with difficulty, Hair blown straight, Difficult to walk steadily, Wind noise on ears unpleasant.	Acceptable for areas where there is little pedestrian activity or for fast walking.
Near gale	13.9 - 17.1	Inconvenience felt when walking.	
Gale	17.2 - 20.7	Generally impedes progress, Great difficulty with balance.	Unacceptable as a public accessway.
Strong gale	20.8 - 24.4	People blown over by gusts.	Completely unacceptable.

It should be noted that wind speeds can only be accurately quantified with a wind tunnel study. This assessment addresses only the general wind effects and any localised effects that are identifiable by visual inspection and the acceptability of the conditions for outdoor areas are determined based on their intended use (rather than referencing specific wind speeds). Any recommendations in this report are made only in-principle and are based on our extensive experience in the study of wind environment effects.

## 4 RESULTS AND DISCUSSION

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The expected wind conditions are discussed in the following sub-sections of this report for the various outdoor areas within and around the subject development for each of the three predominant wind directions for the Sydney region. The interaction between the wind and the building morphology in the area is considered and important features taken into account including the distances between the surrounding buildings and the proposed building form, their overall heights and bulk, as well as the surrounding landform. Note that only the potentially critical wind effects are discussed in this report.

The recommended treatment strategies discussed below are for the “proposed” design scheme. Reference is also made to the “approved” design scheme where required.

### 4.1 Pedestrian Footpaths Surrounding and Within the Site

The wind conditions experienced at the pedestrian footpath areas along Artarmon Road and Richmond Avenue are expected to be suitable for their intended use for the “proposed” design scheme. Winds down-washing onto these pedestrian footpath areas are not expected due to the relatively low height of these buildings around the perimeter of the site.

The west-east and south-north alignment of the streetscape in between the buildings within the development site is such that these areas are exposed to the prevailing westerly and southerly winds for the “proposed” design scheme. These prevailing winds are likely to funnel through the central streetscape between these buildings. Potentially adverse wind conditions may also be experienced at these areas due to winds being down-washed from the taller central buildings (Buildings D, E and F) and side streamed around the corner sections of the buildings. The landscape design outlined in the Appendix 1 Architectural Drawings should be retained for the “proposed” design scheme to address these impacts appropriately. The planting that is expected to assist in the wind mitigation of these areas are indicated in Figure 3. With the incorporation of this landscaping, and subject to further assessment of the detailed building and landscape design, it is expected that these mitigation measures will ensure that this is suitable for its intended pedestrian uses.

The “proposed” design scheme is expected to provide additional shielding from the prevailing winds due to the alignment of the buildings situated along the perimeter of the development site. It is expected that the central buildings in the “approved” design scheme will not benefit as heavily from these shielding effects due to the absence of the buildings along the perimeter.

### 4.2 Upper Private Balconies

Wind conditions within the balcony areas on the low-rise buildings around the perimeter of the development site (Buildings A, B, C, G, H and J) for the “proposed” design scheme are expected to be suitable for their intended use.

It is expected that the wind conditions within the upper corner balcony areas on Buildings D, E and F will not be suitable for their intended use due to the exposure of these areas to the prevailing winds. These buildings are also located in the central area of the development and as such the upper balconies are not as shielded from the prevailing wind directions as the low-rise buildings situated around the perimeter of the development. To mitigate the potential adverse wind effects at these upper corner balconies, the following in-principal treatments are recommended:

- Building D:
  - The inclusion of full-height impermeable screening along the western aspect of the north-western and south-western corner balconies, as indicated in Figure 4.
  - The inclusion of full-height impermeable screening along the eastern aspect of the south-eastern corner balconies, as indicated in Figure 4.
- Building E:
  - The inclusion of full-height impermeable screening along the southern aspect of the south-eastern corner balconies, as indicated in Figure 4.
  - The inclusion of full-height impermeable screening along the northern aspect of the north-western corner balconies, as indicated in Figure 4.
  - The inclusion of full-height impermeable screening along the eastern aspect of the south-western corner balconies, as indicated in Figure 4.
- Building F:
  - The inclusion of full-height impermeable screening along the western aspect of the south-western corner balconies, as indicated in Figure 4.
  - The inclusion of full-height impermeable screening along the southern aspect of the south-eastern corner balconies of the northern wing, as indicated in Figure 4.

It is noted that our assessment is based off the Chrofi reference design that has informed the Concept Plan Application. These recommendations may change as a result of the detailed design of these buildings, and we recommend that a further assessment be undertaken prior to the submission of a Development Application for these three buildings.

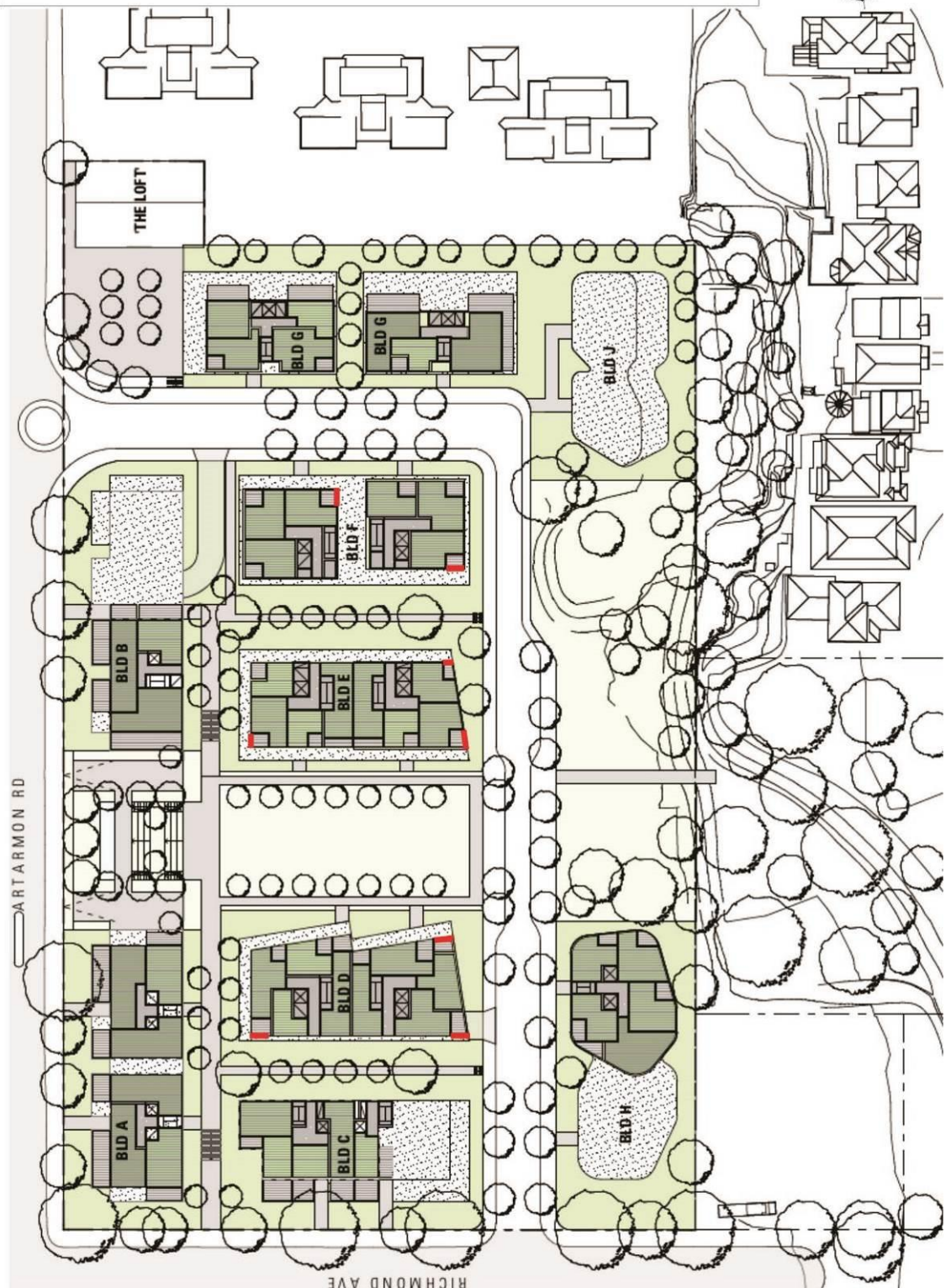


**Figure 3: Recommended Treatments – Ground Level (“Proposed” Design Scheme)**



### Recommended Treatments

■ Full height impermeable screen.



**Figure 4: Recommended Treatments – Upper Balcony Areas (“Proposed” Design Scheme)**



## 5 CONCLUSION

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This report has presented an opinion on the likely impact of the Channel 9 development, located in Willoughby, and presents an opinion on the likely impact of the “proposed” design scheme on the local wind environment to the critical outdoor areas within and around the subject development. The effect of wind activity is examined for the three predominant wind directions for the Sydney region; namely the north-easterly, southerly and westerly winds. The analysis of the wind effects relating to the proposed development was carried out in the context of the local wind climate, building morphology and land topography.

The results of this assessment indicate that suitable wind conditions in the “proposed” design scheme can be expected for the pedestrian footpath areas along Artarmon Road and Richmond Avenue. The central streetscape areas of the subject development will have suitable landscape treatment to ameliorate the strong winds. The landscape design outlined in the Appendix 1 Architectural Drawings should be retained for the “proposed” design scheme to address these impacts appropriately, as shown in Figure 3 of this report.

The “proposed” design scheme is expected to provide additional shielding from the prevailing winds due to the alignment of the buildings situated along the perimeter of the development site. With the incorporation of these mitigation measures, and subject to further assessment of detailed building and landscape design, it is expected that these areas will be suitable for their intended pedestrian uses.

Wind conditions within the balcony areas on the low-rise buildings around the perimeter of the development site (Buildings A, B, C, G, H and J) for the “proposed” design scheme are expected to be suitable for their intended use.

However, the upper corner balcony areas on Buildings D, E and F may be exposed to the prevailing winds. To mitigate the potential adverse wind effects at these upper corner balconies, the following in-principal treatments are recommended:

- Building D:
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With the inclusion of the abovementioned recommendations, it is expected that wind conditions for all outdoor trafficable areas within and around the subject development will be suitable for their intended uses.