PEDESTRIAN WIND ENVIRONMENT STATEMENT

WOOLOOWARE BAY TOWN CENTRE - STAGE 4

RESIDENTIAL/HOTEL

WB597-06F02(REV1)- WS REPORT

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Prepared for:

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report is in relation to the proposed development known as the Stage 4 Residential/Hotel, as part of the Woolooware Bay Town Centre project, and presents an opinion on the likely impact of the proposed design 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 architectural drawings which have been prepared by the project architect Turner, received October 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.

The results of this assessment indicate that the development is quite exposed to the prevailing winds of the Sydney region, due to the low-lying areas surrounding the development in all directions. Wind conditions within the site are expected to benefit from the inclusion of wind mitigating design features in the proposed design, such as extensive landscaping, setting back residential towers A and B from the southern edge of the podium and the inclusion of inter-tenancy screening between the various residential balconies. The site is also expected to benefit from proposed landscaping to the north of the development, subject to a separate development application. Some areas across the development are potentially exposed to adverse wind conditions. With the inclusion of the following treatment recommendations, it is expected that suitable wind conditions across the entire development can be achieved:

- Retention of proposed tree planting at Levels 1, 3 and 7 in the final design.
- Additional tree planting, dense landscaping and shrub planting at strategic locations across Levels 1, 3 and 7.
- Strategic placement of impermeable screens and louvres across Levels 1, 3 and 7 of the development.
- Retention of the proposed awning at the southern end of the Podium Level 3 walkway in the final design.
- Strategic placement of impermeable screens/inter-tenancy screens at the various outdoor terraces and private balconies across the entire development.

Note that tree planting should be evergreen, densely foliating and capable of growing to a height of 4m tall with a 4m wide canopy, interlocking with other trees where possible. Tree planting is recommended to be effective in achieving wind comfort criteria.

With the inclusion of the recommended in-principal treatments within this report, it is expected that wind conditions throughout the subject site will be suitable intended uses of the various trafficable areas. Wind tunnel testing is being undertaken for the proposed development to accurately understand the wind conditions within and around the site. The extent and requirement for the abovementioned recommended in-principle treatments will be verified during this study.

1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The development site is located on Captain Cook Drive, directly to the east of Southern Cross Stadium. To the north of the subject development site is an area of dense mangrove forest extending along the shore of Woolooware Bay. A petrol station and three-storey commercial building are directly to the east. Across Captain Cook Drive to the south is Woolooware Golf Club, along with low-rise suburban areas. To the west of Southern Cross Stadium is a construction site for Stage 1, Stage 2 and Stage 3 of the Woolooware Bay Town Centre development. The water of Woolooware Bay extends further to the north, while to the east is Cronulla Golf Club and mixed suburban residential and bushland extended to the coastline. Low-rise residential areas extend to the south and west, while there is a large industrial area to the north-west along the Woolooware Bay coastline. A survey of the local land topography indicates that the land across the site is relatively flat. An aerial image of the subject site and the local surroundings is shown in Figure 1.

The proposed development consists of four mixed height residential apartment lots with residential facilities, a tourism/sports facilities building and commercial podium levels surrounding the existing club which adjoins the stadium grandstand. The tourism/sporting facilities building, Building E sits stop a two level podium, with an access road running north-south along the podium roof. The western side of the proposed development consists of a taller, six level podium with four residential towers and communal outdoor areas atop the podium.

The critical trafficable areas associated with the proposed development, which are the focus of this assessment with regards to wind effects, are detailed as follows:

- The ground level pedestrian footpaths along all frontages of the site.
- The ground level stadium entrance and retail entrance at the southern aspect of the proposed development.
- All outdoor pedestrian areas on Level 3.
- All outdoor areas on the Level 7 podium.
- The Level 4 outdoor terrace at the north-western corner of Building E
- The Level 8 roof terrace on the central residential communal facilities building.
- The rooftop terrace areas on Level 11 of Buildings B and C.
- Various private balconies/terraces throughout the development.

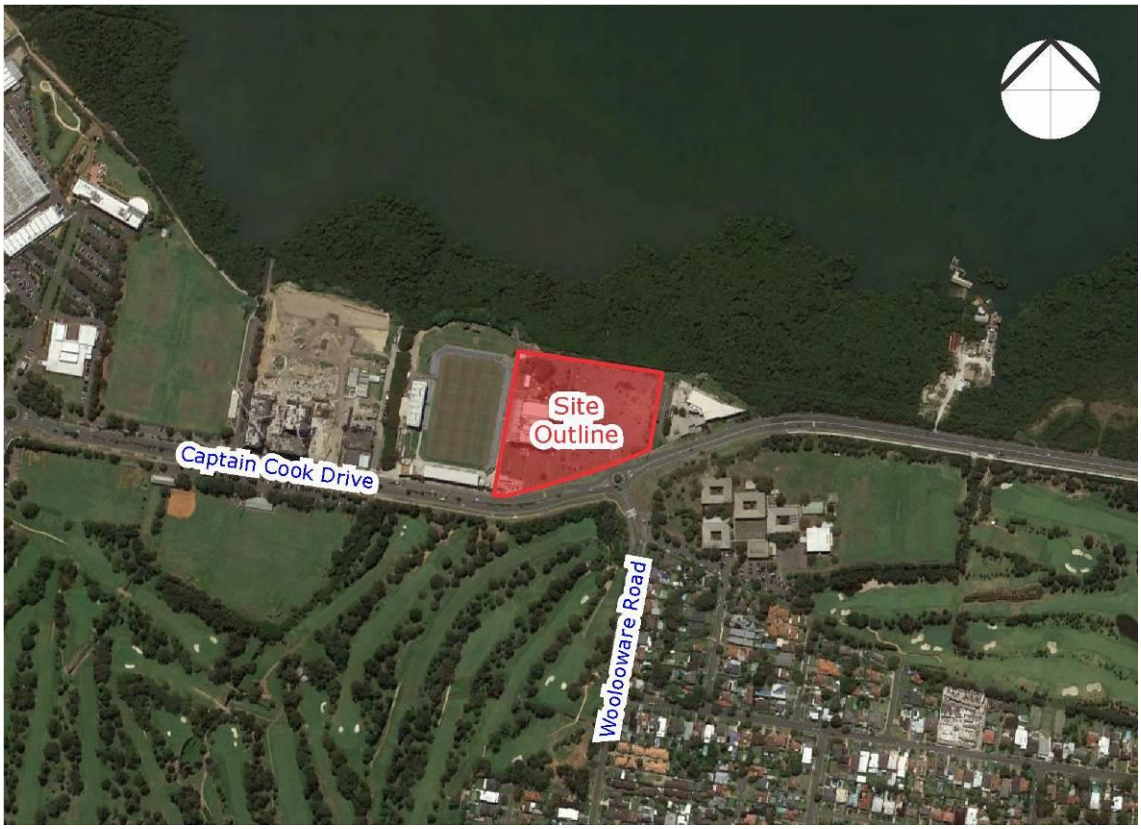

Figure 1: Aerial Image of the Site Location

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	

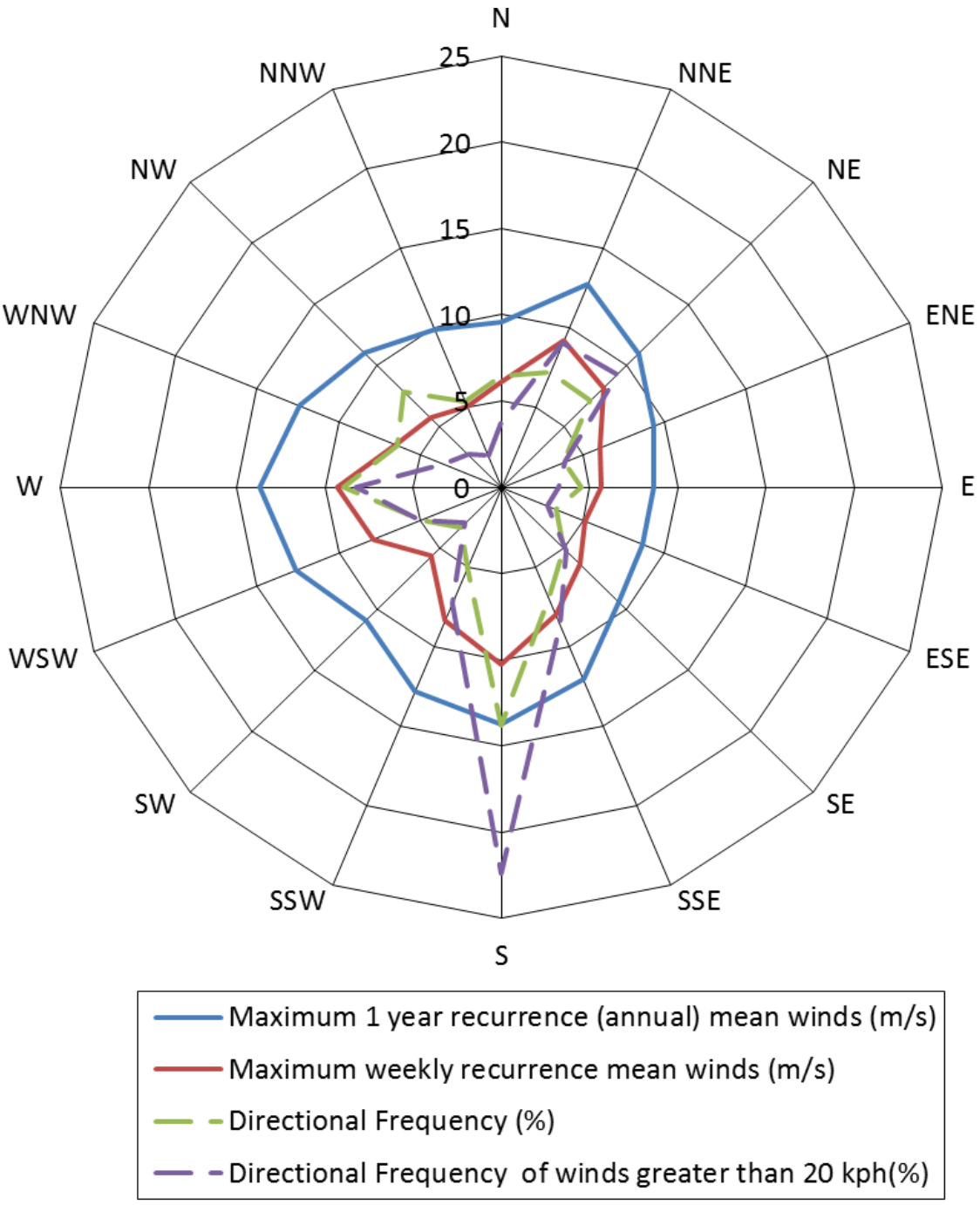

Figure 2: Annual and Weekly Recurrence Mean Wind Speeds, and Frequencies of Occurrence, for the Sydney Region (based on 10-minute mean observations from Kingsford Smith Airport from 1939 to 2008, corrected to open terrain at 10m)

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

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.

4.1 Ground Level Pedestrian Accessible Areas

The ground level pedestrian accessible areas are potentially exposed to the prevailing winds of the Sydney region, due to the exposure of the site created by its proximity to Woolooware bay to the north and low level residential housing to the south. Areas along the southern aspect of the development are expected to benefit from the setback of residential towers A and B from the southern edge of the podium, preventing winds being downwashed onto the ground level.

It is expected that suitable wind conditions can be achieved at the ground level areas throughout the site with the inclusion of the following treatment recommendations, also shown in Figure 3:

- Include tree planting as proposed along the Captain Cook Drive frontage of the development. Trees should be densely foliating, evergreen and capable of growing to a height of at least 4m with 4m wide canopies.
- Include trees as proposed at the main entrance on the southern aspect of the development. Trees should be densely foliating, evergreen and capable of growing to a height of at least 4m with 4m wide canopies.
- At the south-western corner of the development site, adjacent to the stadium entrance, include trees as proposed and retain the proposed impermeable screen/wall.
- Provision for additional dense landscaping along the western aspect adjacent to the switch chamber and sub chamber.

Proposed landscaping to the north of the site, as subject to a separate development application, is expected to aid in the mitigation of any potential adverse wind conditions within the ground level areas at the northern end of the subject site.

4.2 Central Roadway Level 3

Prevailing winds from the south could potentially side-stream around buildings A and E and result in adverse wind conditions through the central walkway of the development. Similarly, the north-east winds could potentially side-stream around Building D and be funnelled through the central area of the development. The following recommendations are made to help mitigate these potential wind effects, and are also shown in Figure 4:

- Retain the proposed awning over the southern walkway in the final design.
- Include densely foliating, evergreen trees along the western edge of the triangular landscaped area to the east of the walkway. Trees should be capable of growing to a height of 4m with 4m canopies, interlocking with each other where possible.
- Include a 2m high impermeable screen along the southern edge of the podium level.
- Retain tree planting as proposed along the central walkways within the site. Trees should be densely foliating, evergreen and capable of growing to a height of at least 4m with 4m wide canopies.
- Additional tree planting at the northern end of the central walkway/access road. Trees should be densely foliating, evergreen and capable of growing to a height of at least 4m with 4m wide canopies.
- Include full height louvres/porous screening along the southern aspect of the meeting room terrace at the southern end of the development.

4.3 Building E Level 4 Terrace

Due to the potential exposure of the Level 4 outdoor terrace on Building E to north-easterly and westerly winds, it is recommended that a 2m tall impermeable screen be included along the edges of the terrace area. This recommendation is shown in Figure 5.

4.4 Level 7 Podium

The outdoor areas on Level 7 are expected to benefit from the inclusion of proposed tree planting. Some areas may be still be exposed to adverse wind conditions. It is expected that acceptable wind conditions for all outdoor areas on Level 7 will be achieved through the inclusion of the following treatment recommendations, also shown in Figures 6a and 6b:

- Retain proposed tree planting in the final design. Trees should be densely foliating, evergreen and capable of growing to a height of 3m with a 3m wide canopy, interlocking with adjacent trees where possible.
- Additional tree planting to the north of the western skylight and to the south of Building B. Trees should be densely foliating, evergreen and capable of growing to a height of 3m with a 3m wide canopy, interlocking with adjacent trees where possible.
- Include 2m tall impermeable screening at the following locations:

- Along the western edge of the podium between Building D and the residential facilities building.
- Around the western skylight.
- Along the northern edge of the podium between Buildings C and D.
- Along either the northern or western aspect of the north-western corner balcony on Building E.
- Along the western edge of the north-western corner terrace of Building C.

4.5 Private Balconies

It is expected that the wind conditions in most private balconies and terraces across the residential towers in the proposed development will experience acceptable wind conditions. This is due to the implementation of effective wind mitigation techniques such as recessing the balconies into the building form. For some of the more exposed corner balconies, it is recommended that full-height impermeable screening be included along their critical aspects, as indicated in Figure 7.

4.6 Rooftop Terraces

Buildings B and C have rooftop terrace areas located on Level 11 of the proposed development, and there is also a rooftop terrace on top of the residential facilities building. Since these areas are potentially exposed to adverse wind conditions, it is recommended to include a number of the following design features:

- Full-height impermeable screening.
- 3m tall impermeable screens.
- Impermeable inter-tenancy screening.

The extent of the above recommended treatments are indicated in Figures 7 and 8.

Figure 3: Recommended Treatments – Ground/Level 1

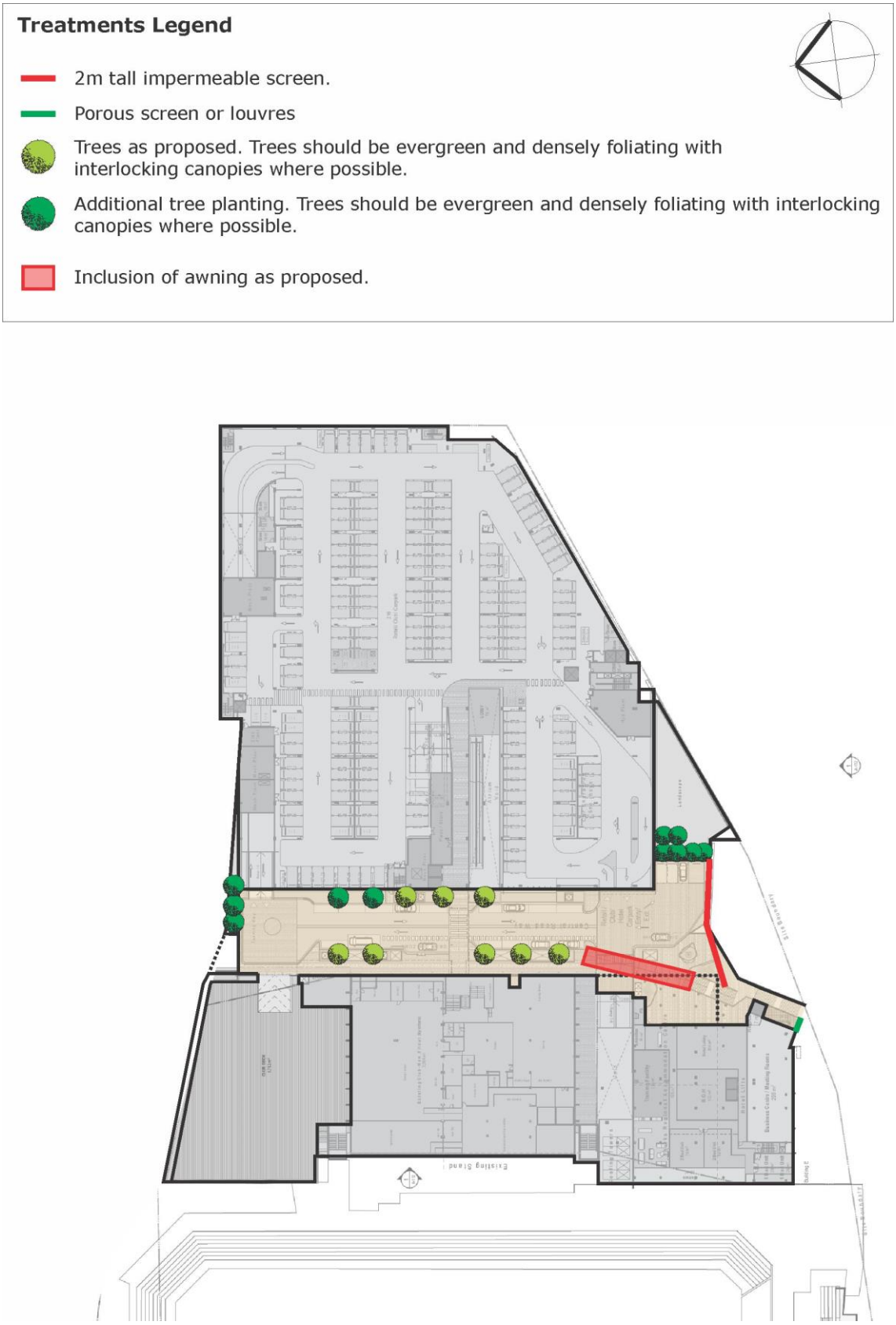

Figure 4: Recommended Treatments – Level 3

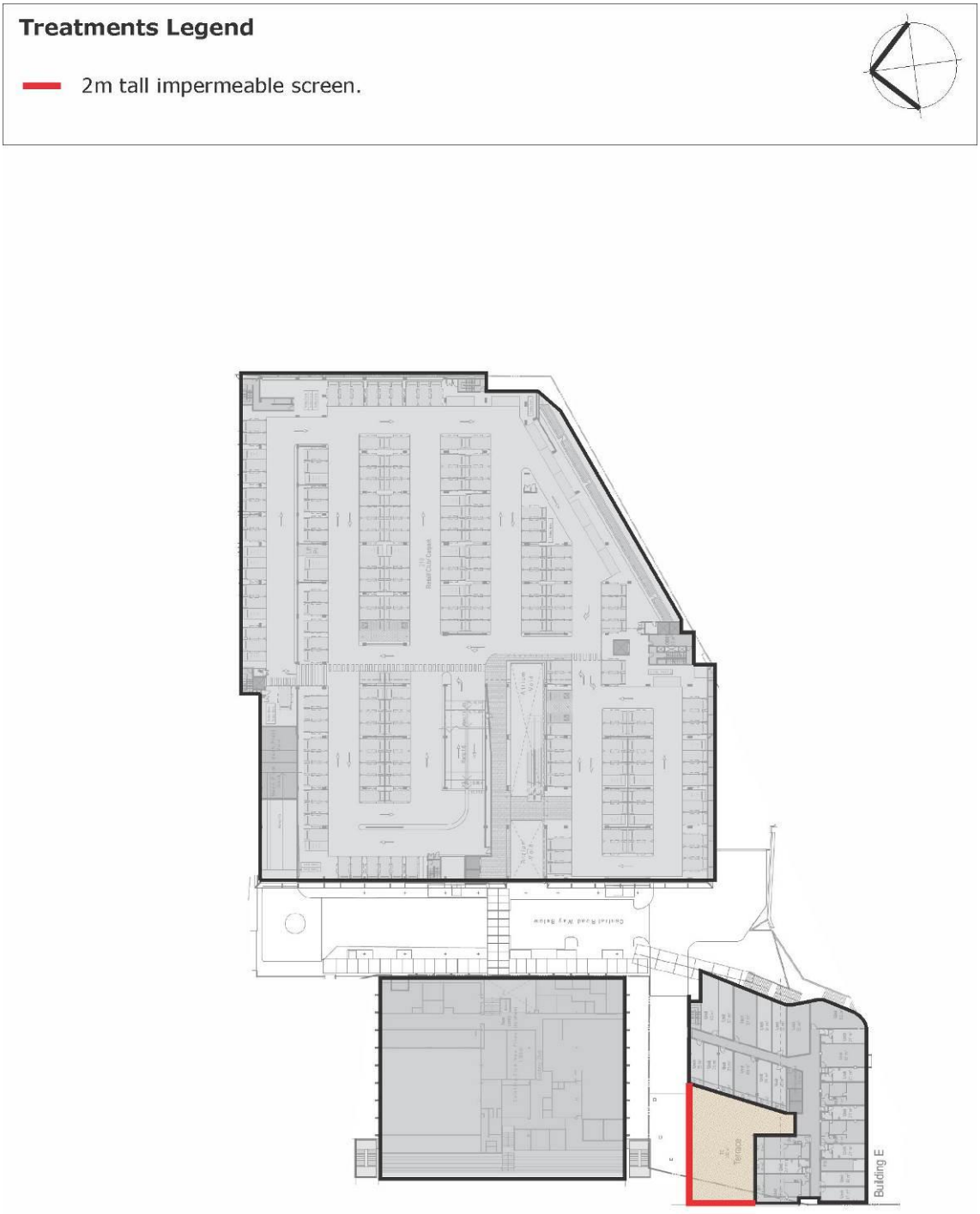

Figure 5: Recommended Treatments – Level 4

Figure 6: Recommended Treatments – Level 7

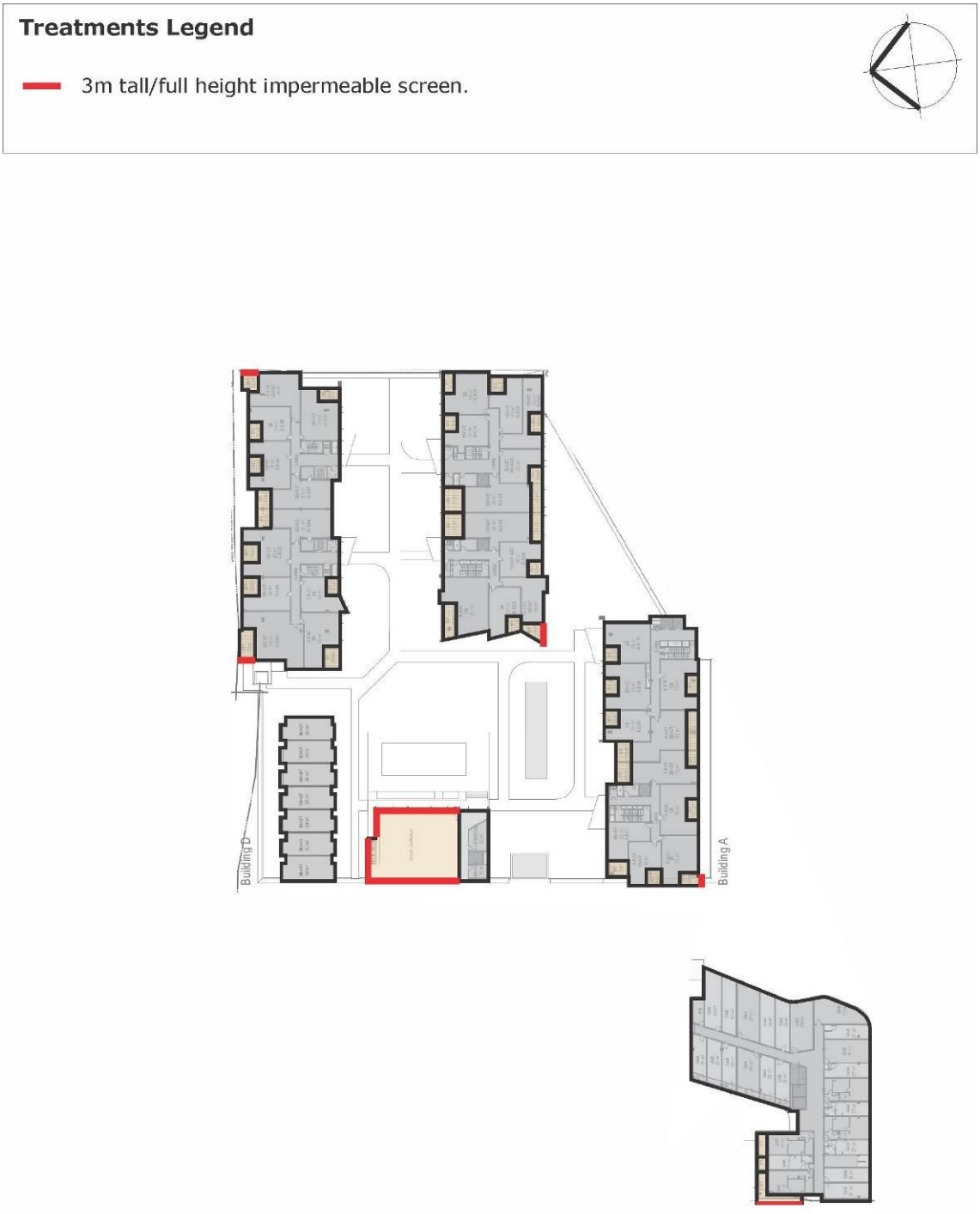

Figure 7: Recommended Treatments – Level 8

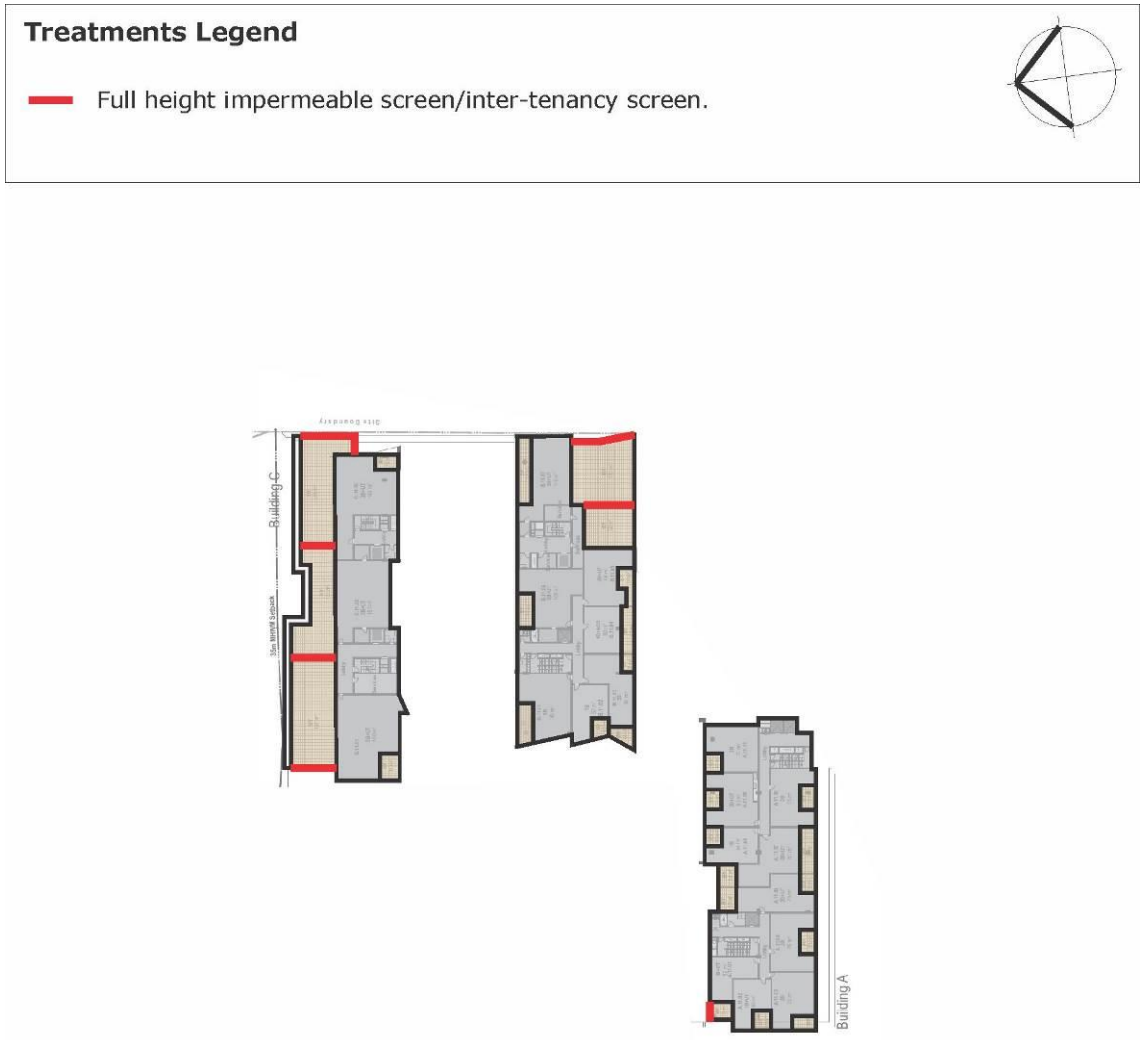

Figure 8: Recommended Treatments – Level 11