



PEDESTRIAN WIND ENVIRONMENT STATEMENT
GOSFORD HOSPITAL REDEVELOPMENT AND HEALTH &
WELLBEING PRECINCT PHASE 1

WC351-01F02(REV4)- WS REPORT
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Prepared for:

Health Infrastructure

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EXECUTIVE SUMMARY

This report is in relation to the proposed development known as the Gosford Hospital Redevelopment and Health and Well Being Precinct Stage 1, 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 principal wind directions for the Gosford region; namely north-easterly to northerly, southerly to south-easterly and westerly to north-westerly winds. The analysis of the wind effects relating to the proposal 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 Fitzpatrick and Partners, and Jacobs, received March 2015. No wind tunnel tests have 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 tolerable wind conditions are expected to be achieved along the majority of the ground level outdoor trafficable areas within and around the site due to the shielding provided by the subject and surrounding developments, and the existing densely foliating trees around the site. These include the pedestrian footpaths along the Holden Street frontage of the Health and Well Being Precinct, the outdoor trafficable areas adjacent to the emergency and main entry foyers into the building extension of the main hospital.

There are however outdoor trafficable areas that are potentially exposed to adverse wind conditions due to a number of factors such as existing site conditions due to the alignment of the streets to the prevailing wind directions, accelerating flows around the corner of the development, exposure to direct winds and down-wash effects off the building façade. These areas include the pedestrian footpath along the Showground Road frontage and Level 6 Plaza of the Health and Well Being Precinct, and the various outdoor terraces and courtyards on Levels 1 and 2 of the building extension of the main hospital. To ensure adequate wind conditions are achieved for all trafficable outdoor areas within and around the site, various of treatments have been recommended and are described in this report.

With the inclusion of the recommended treatments within the final design of the development, it is expected the wind conditions for all outdoor trafficable areas within and around the subject development will be tolerable for its intended uses.

1 DESCRIPTION OF THE DEVELOPMENT AND SURROUNDINGS

The proposed building extension of the main Hospital is bounded by Hospital Road to the north and south, Beane Street West to the south-west and Racecourse Road to the north-west. Surrounding the site is the existing low to mid-rise developments of Gosford Hospital, including a multi-storey carpark to the north, mental health building to the east and the main hospital to the south.

The Health and Well Being Precinct development site is bounded by Showground Road to the east, Beane Street West to the south and Holden Street to the west. Surrounding the site are low-rise private residential developments to the north and south, with the Gosford Hospital located directly west and the Gosford railway line running along the eastern boundary.

Further away from the site are a mixture of parkland and low-rise residential/commercial developments, such as the Gosford CBD to the east and Gosford Golf Course to the north-west. Primary landmarks around the site include the Bluetongue Football Stadium and waterway of Fagans Bay. There are significant topographic effects around the site, rising steeply towards the west of the site. An aerial image of the sites and the surroundings is shown in Figure 1.

The proposed Health and Well Being Precinct development consists of two office buildings; the western office building five storeys high and the eastern office building four storeys high, above the Holden Street (Level 6) ground level atop of a common car-park podium approximately six storeys high above the lower Showground Road ground level. Car-parking is accommodated within the aforementioned podium with vehicular access provided off Showground Road and Holden Street.

The critical trafficable outdoor areas associated with the proposed development, which are the focus for pedestrian wind effects in this assessment, are detailed as follows:

- The pedestrian footpath adjacent to car-park entry/drop off area along the Showground Road frontage of the site.
- The pedestrian footpath along the Holden Street frontage of the site.
- The pedestrian footpaths and communal outdoor areas within and around the Level 6 Plaza.
- The Level 11 communal rooftop garden.

The proposed extension of the main Hospital consists of an eleven storey high building abutting the main hospital along the northern aspect. The critical trafficable outdoor areas associated with the proposed redevelopment, which are the focus for pedestrian wind effects in this assessment, are detailed as follows:

- The Level 1 outdoor courtyard and terrace areas located along the southern and western aspects of the building extension.

- The Level 2 outdoor terrace along the southern aspect of the building extension.
- The pedestrian footpath along the Level 3 Emergency Main Entry Foyer.
- The pedestrian footpath and outdoor courtyard area associated with the Level 4 Main Entry Foyer.
- The pedestrian link between the Hospital redevelopment and the Health and Well Being Precinct Stage 1.
- The Level 6 communal outdoor terrace.
- The Level 11 rooftop garden.



Figure 1: Aerial Image of the Site Location

2 WIND CLIMATE OF THE GOSFORD REGION

An analysis of the regional wind climate of Gosford has been undertaken using measured mean wind speed and wind rose data from the local meteorological station at Norah Head AWS. The meteorological station Norah Head AWS was chosen as the wind climate data analysed are typically acquired from airports. However, there are no airports in or near Gosford and the closest meteorological station which contains similar conditions to an airport was the Norah Head AWS. We have cross-checked the results of our analysis of the data obtained from Norah Head AWS with the Sydney Airport and Newcastle Airport meteorological stations. The results of our analysis are consistent between the three stations. The Gosford region is governed by three principle wind directions; north to north-east, south to south-east and west to north-west directions, and these can potentially affect the subject development. A summary of the principal time of occurrence of these winds throughout the year is presented in Table 1 below. The wind roses are attached in the appendix of this report.

Table 1: Principle Time of Occurrence of Winds for Gosford

Month	Wind Direction		
	Notherly to North-Easterly	Southerly to South-Easterly	Westerly to North-Westerly
December through February	X	X	
March through May	X	X	
June through August			X
September through November	X	X	

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	Gust 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 OBSERVATION AND RECOMMENDATION

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 site for Gosford Hospital Redevelopment and Health and Well Being Precinct Stage 1 respectively, for each of the three predominant wind directions for the Gosford region. The interaction between the wind and the building morphology in the area was considered, and important features taken into account include the distances between the proposed building form, their overall heights and bulk, as well as the landform. Note that only the potentially critical wind effects are discussed in this report.

4.1 Building Extension of the Gosford Hospital

4.1.1 Level 1 Outdoor Courtyard and Terraces

The wind conditions on the southern courtyard are expected to be acceptable for its intended uses due to the shielding provided by the building extension and the existing large densely foliating trees surrounding the courtyard. The wind conditions can be further enhanced with the inclusion of an impermeable balustrade along the perimeter of the courtyard.

The outdoor terrace located along the western aspect of the building benefits from the shielding provided by the building extension to the prevailing southerly to south-easterly winds. However it is potentially exposed to the direct westerly and north-easterly winds travelling over the Golf Course and between the existing services/car-park respectively.

Recommendations

It is expected the inclusion of a row of densely foliating trees along the northern perimeter of the terrace as indicated in Figure 2 will be effective in mitigating the potential adverse wind conditions along the terrace. Note that the densely foliating trees should be capable of growing to a height of 4m with a 4m wide canopy and should be of an evergreen species to ensure their effectiveness in wind mitigation throughout the year.

4.1.2 Level 2 Outdoor Terrace

The outdoor terrace located at the south-western corner of the building benefits from the shielding provided by the building extension to the prevailing southerly and north-easterly winds. It is however, potentially exposed to the direct westerly winds and accelerating flows around the corner of the development.

Recommendations

Hence it is recommended a full-height impermeable screen is included along the western perimeter of the terrace as indicated in Figure 3, to mitigate these potential adverse wind effects.

4.1.3 Trafficable outdoor areas around the Level 3 Emergency Main Entry Foyer

The wind conditions along the pedestrian footpath adjacent to the Emergency Main Entry Foyer is expected to be acceptable for its intended uses due to the shielding provided by the building extension and the existing multi-storey carpark and mental health building located along the northern boundary.

Recommendations

Note the wind conditions can be further enhanced with the inclusion of densely foliating vegetation such as trees or shrubs around the drop-off area.

4.1.4 Trafficable outdoor areas around the Level 4 Main Entry Foyer

The wind conditions along the pedestrian footpath and courtyard areas adjacent to the Main Entry Foyer is expected to be acceptable for its intended uses due to the shielding provided by the building extension, the existing mental health building and main hospital from the prevailing winds.

Recommendations

The inclusion of the proposed densely foliating vegetation along the walkways and courtyard areas as indicated in the architectural drawings and Figure 4 are expected to further enhance the wind conditions within these areas, hence they are recommended to be retained.

4.1.5 Pedestrian Link between the Hospital Redevelopment and the HWP Stage 1

The wind conditions along the proposed pedestrian footpath linking the building extension to the Health and Well Being Precinct is expected to be acceptable for its intended uses due to the shielding provided by the abovementioned proposed developments, the existing mental health building, and main hospital from the prevailing winds.

Recommendations

The inclusion of the proposed densely foliating vegetation, along pedestrian footpath as indicated in the architectural drawings and in Figure 4 is expected to further enhance the wind conditions along the footpath, hence they are recommended to be retained. Furthermore, it is recommended the proposed densely foliating vegetation along the Holden Street frontage are to be densely foliating trees capable of growing to a height of 4m with a 4m wide canopy.

4.1.6 Level 6 Outdoor Terrace

The wind conditions on the outdoor terrace located along the southern aspect of the building is expected to be acceptable for its intended uses due to the shielding provided by the building extension and its setback location away from the building edge.

Recommendations

The inclusion of an impermeable balustrade or blade walls along the perimeter of the terrace as indicated in Figure 5 is expected to further enhance the local wind conditions.

4.2 Health and Well Being Precinct (Stage 1)

4.2.1 Pedestrian Footpaths along Showground Road

The pedestrian footpath along Showground Road benefits from the shielding provided by the subject development to the prevailing westerly to northerly winds. Furthermore, the subject development is not expected to further exacerbate the south-easterly to north-easterly winds due to the large setback of the development from the road frontage. The existing large densely foliating tree at the south-eastern corner and proposed trees along the Showground Road median strip are expected to be effective in further enhancing the wind conditions along the pedestrian footpath.

The pedestrian footpath adjacent to the car-park entry/drop off area however is exposed to the easterly to south-easterly winds down-washing off the eastern car-park podium façade.

Recommendations

To mitigate the potential adverse wind conditions along the pedestrian footpath, it is recommended the following treatments as indicated in Figure 6 and described below are included within the final design of the development:

- The inclusion of a recommended ground level impermeable awning along the eastern car-park podium facade.
- The inclusion of recommended densely foliating trees within and around the car-park entry /drop off area.

Hence with the inclusion of the abovementioned recommendations, the wind conditions along the various pedestrian footpaths on the ground level are expected to be acceptable for its intended uses. Note that the densely foliating trees should be capable of growing to a height of 4m with a 4m wide canopy.

4.2.2 Pedestrian Footpath along Holden Street (Level 6)

The pedestrian footpath along Holden Street benefits from the shielding provided by the surrounding developments and existing large densely foliating trees from the prevailing easterly and westerly winds. The footpath however is exposed to northerly and southerly winds due to the alignment of Holden Street to these wind directions.

Recommendations

It should be noted this is an existing wind condition for the site, and the inclusion of the proposed densely foliating trees along Holden Street is expected to be effective in further enhance along the pedestrian footpath, hence it is recommended to be retained in the final design of the development.

4.2.3 Trafficable outdoor areas within and around the Level 6 Plaza

The pedestrian footpaths and communal outdoor areas located within and around the Plaza; located along the southern half of the site, benefits from the shielding provided by the surrounding developments and the existing densely foliating trees along the southern boundary.

Recommendations

The proposed densely foliating trees and impermeable pergolas as indicated within the architectural drawings are expected to be effective in further enhancing the localised wind conditions, hence they are recommended to be retained.

The trafficable areas along the eastern boundary however are potentially exposed to the direct easterly winds due to the lack of shielding provided by the upstream low-rise developments.

Recommendations

It is expected the inclusion of the proposed 1.8m high screen along eastern perimeter, impermeable pergolas and densely foliating trees; particularly along the south-eastern corner adjacent to the stair/lift core, as indicated in Figure 7, the wind conditions within along the plaza are expected to be acceptable for its intended uses.

The pedestrian footpath along the upper plaza between the office buildings are potentially exposed to the direct north-easterly to north-westerly winds and funnelling effects between the office buildings.

Recommendations

It is recommended a 1.8m high impermeable screen is included along the northern and eastern perimeter of the upper plaza as indicated in Figure 8 to ameliorate the potential adverse wind conditions along the footpath.

Hence with the inclusion of the abovementioned recommendations, the wind conditions along the outdoor trafficable areas of the Level 6 Plaza are expected to be acceptable for its intended uses. Note that the densely foliating trees should be capable of growing to a height of 4m with a 4m wide canopy and should be of an evergreen species to ensure their effectiveness in wind mitigation throughout the year. The inclusion of additional densely foliating vegetation such as shrubs or hedge planting within and around the plaza is expected to be effective in enhancing the localised wind conditions.

4.2.4 Level 11 Rooftop Garden

The outdoor trafficable areas within the rooftop garden are exposed to the prevailing north-easterly to southerly winds due to the lack of shielding provided by the upstream developments.

Recommendations

It is expected the inclusion of a 1.8m high impermeable screen along the perimeter of the rooftop garden as indicated in Figure 9 to be effective in mitigating these direct adverse wind effects. Hence it is recommended to be included in the final design of the development. Note the inclusion of additional densely foliating vegetation such as shrubs and hedge planting within and around the rooftop garden is expected to further enhance the localised wind conditions.

- Legend**
- Recommended densely foliating trees capable of growing to a height of 4m, with a 4m wide canopy.
 - The inclusion of impermeable screens or balustrades along the perimeter of the courtyard/terrace is expected to further enhance the local wind conditions.

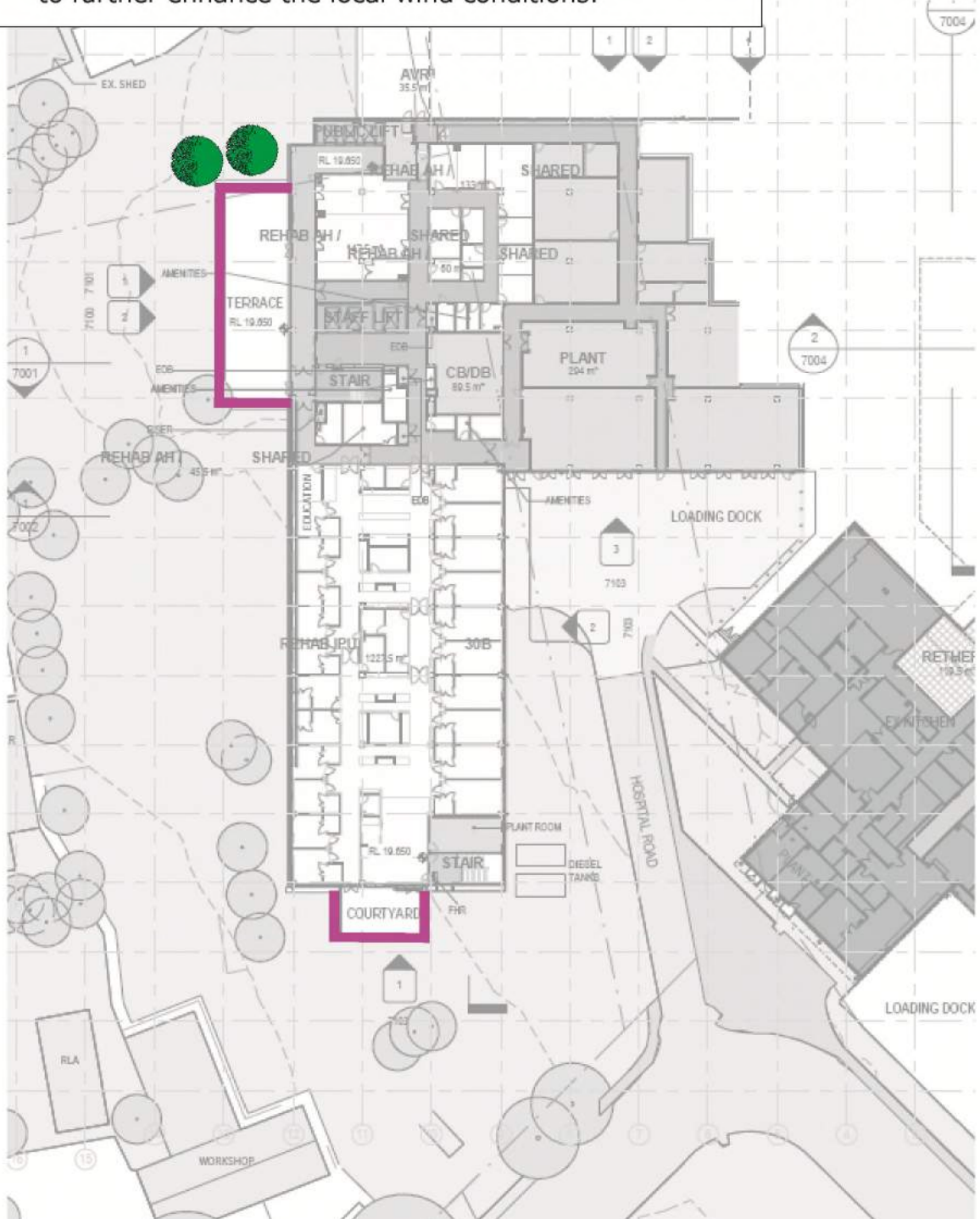


Figure 2: Recommended Treatments – Building Extension of the Main Hospital Level 1

Legend

- Recommended full-height impermeable screen.
- The inclusion of impermeable screens or balustrades along the perimeter of the courtyard/terrace is expected to further enhance the local wind conditions.



Figure 3: Recommended Treatments – Building Extension of the Main Hospital Level 2

Legend

- Recommended densely foliating trees capable of growing to a height of 4m, with a 4m wide canopy.
- Recommended inclusion of the proposed densely foliating vegetation as indicated in the architectural drawings.

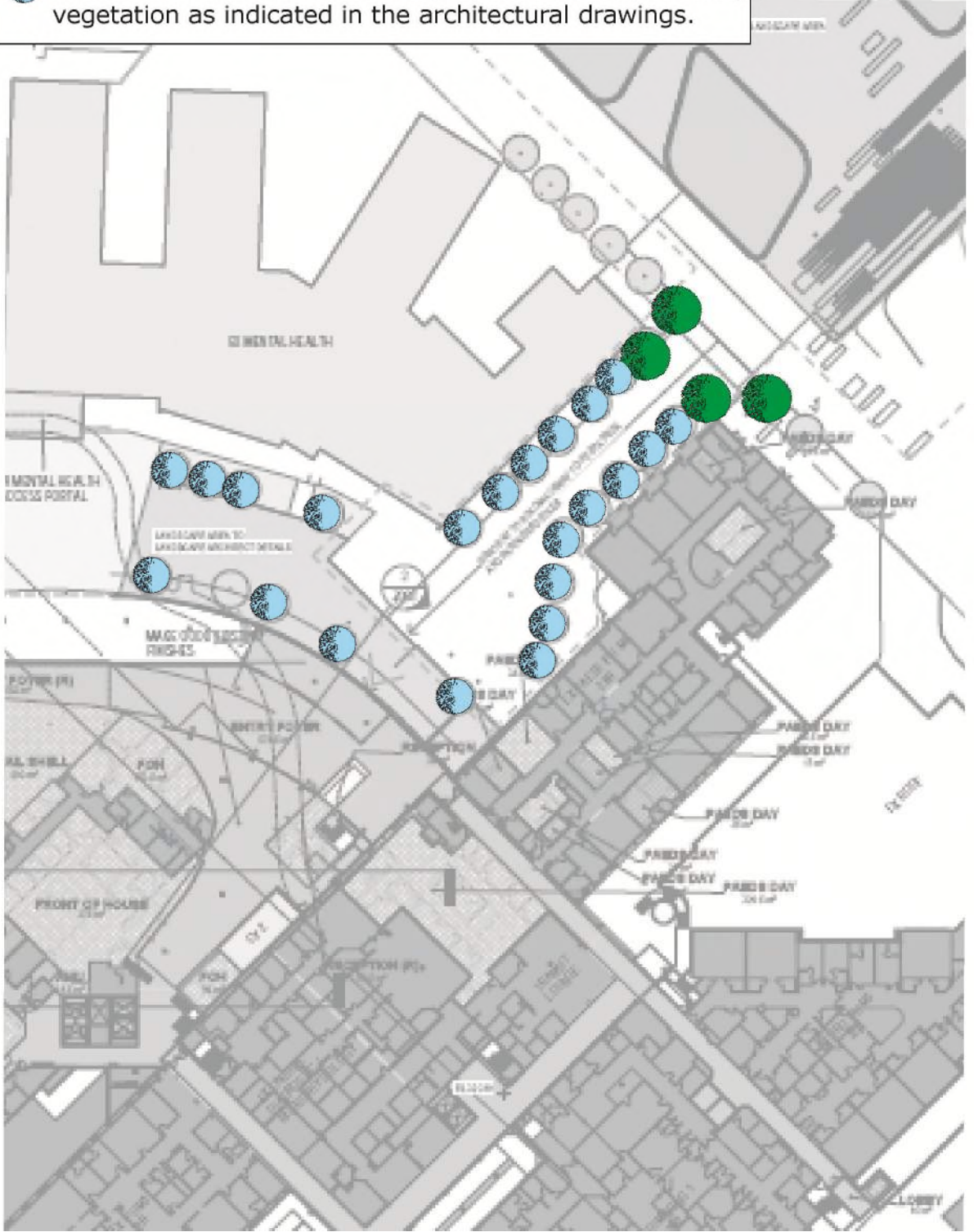
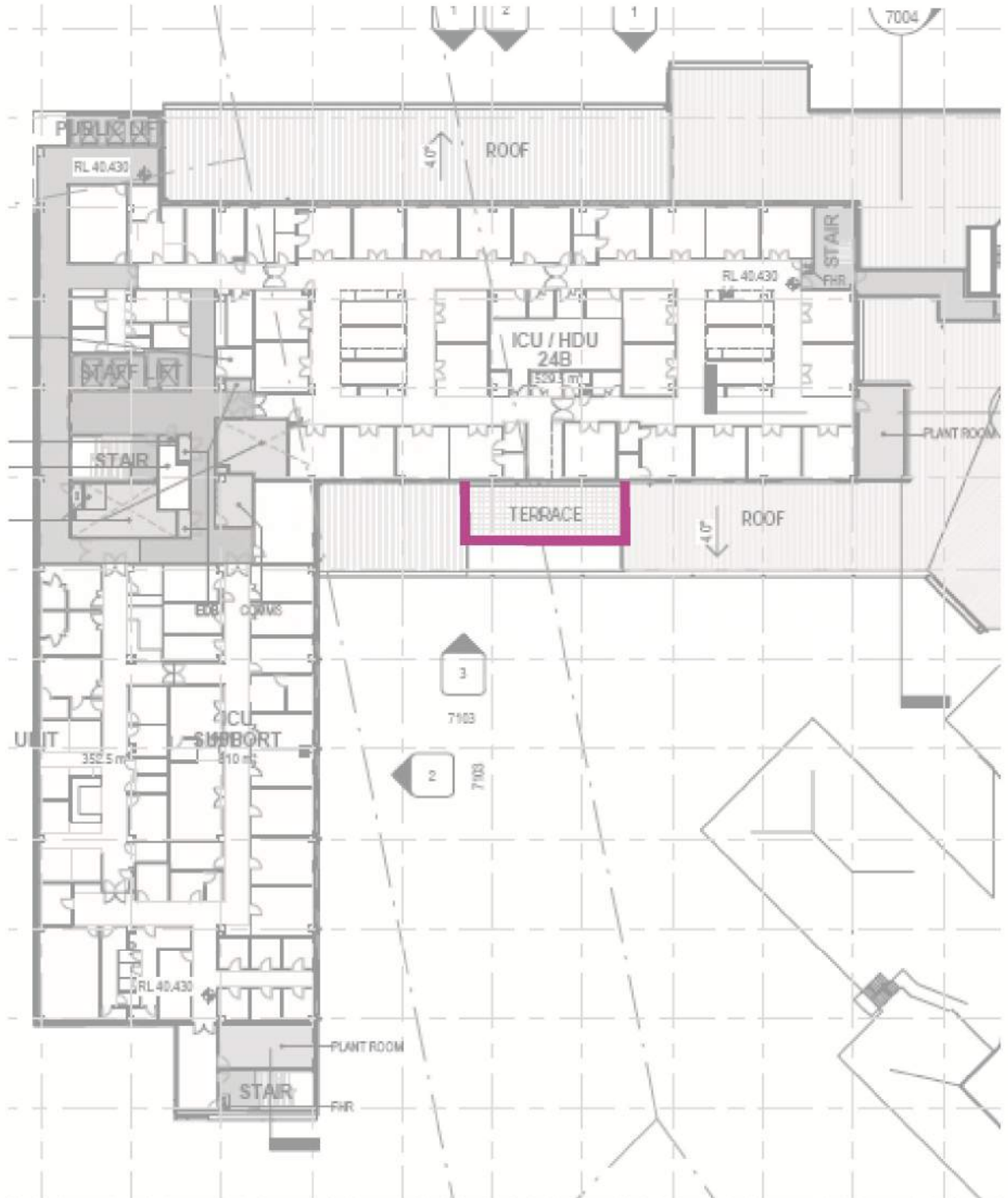


Figure 4: Recommended Treatments – Building Extension of the Main Hospital Level 4

Legend

- The inclusion of impermeable screens or balustrades along the perimeter of the courtyard/terrace is expected to further enhance the local wind conditions.



**Figure 5: Recommended Treatments – Building Extension of the Main Hospital
Level 6**

Legend

- Recommended impermeable awning
- Recommended densely foliageating trees capable of growing to a height of 4m, with a 4m wide canopy.

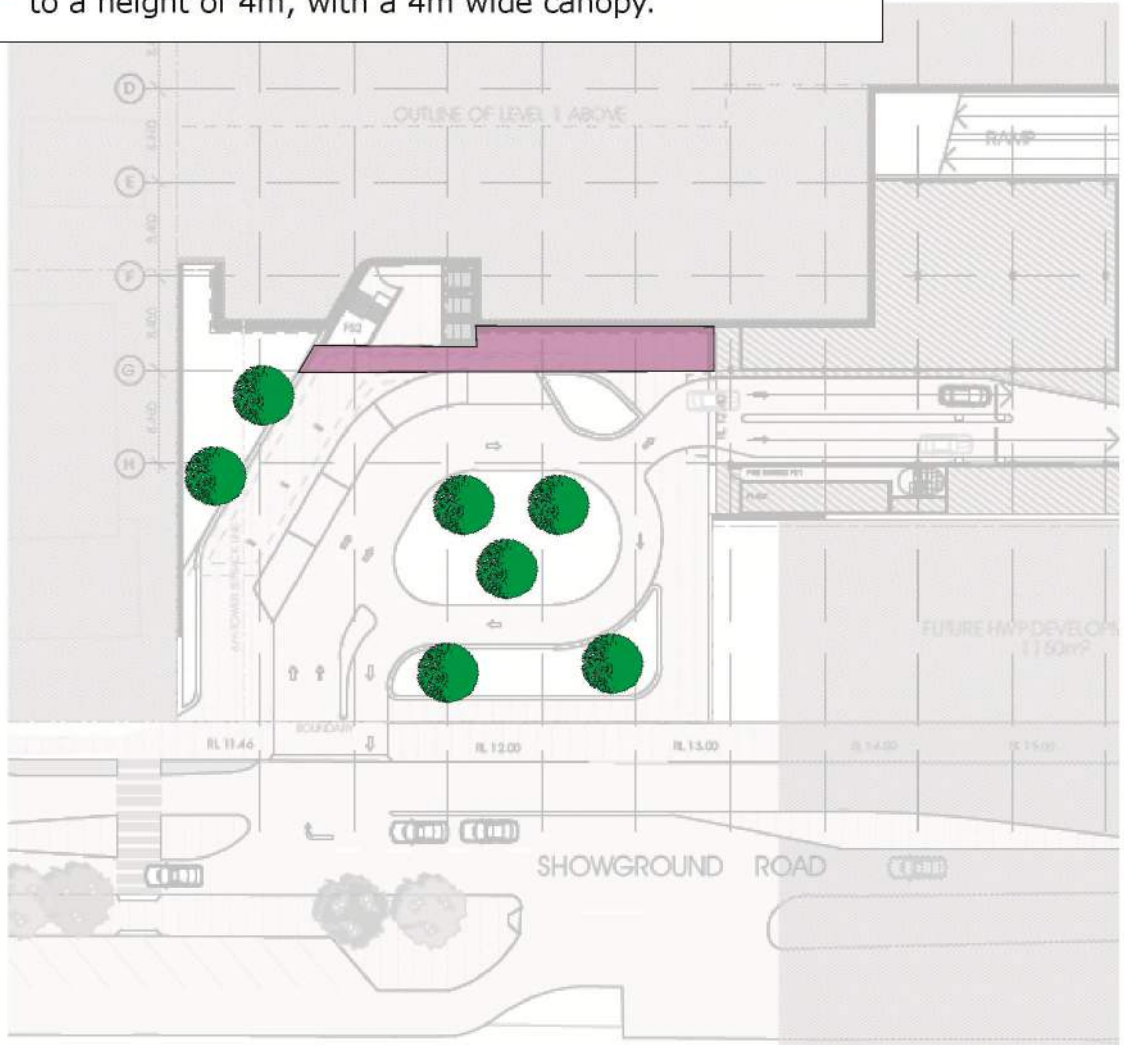
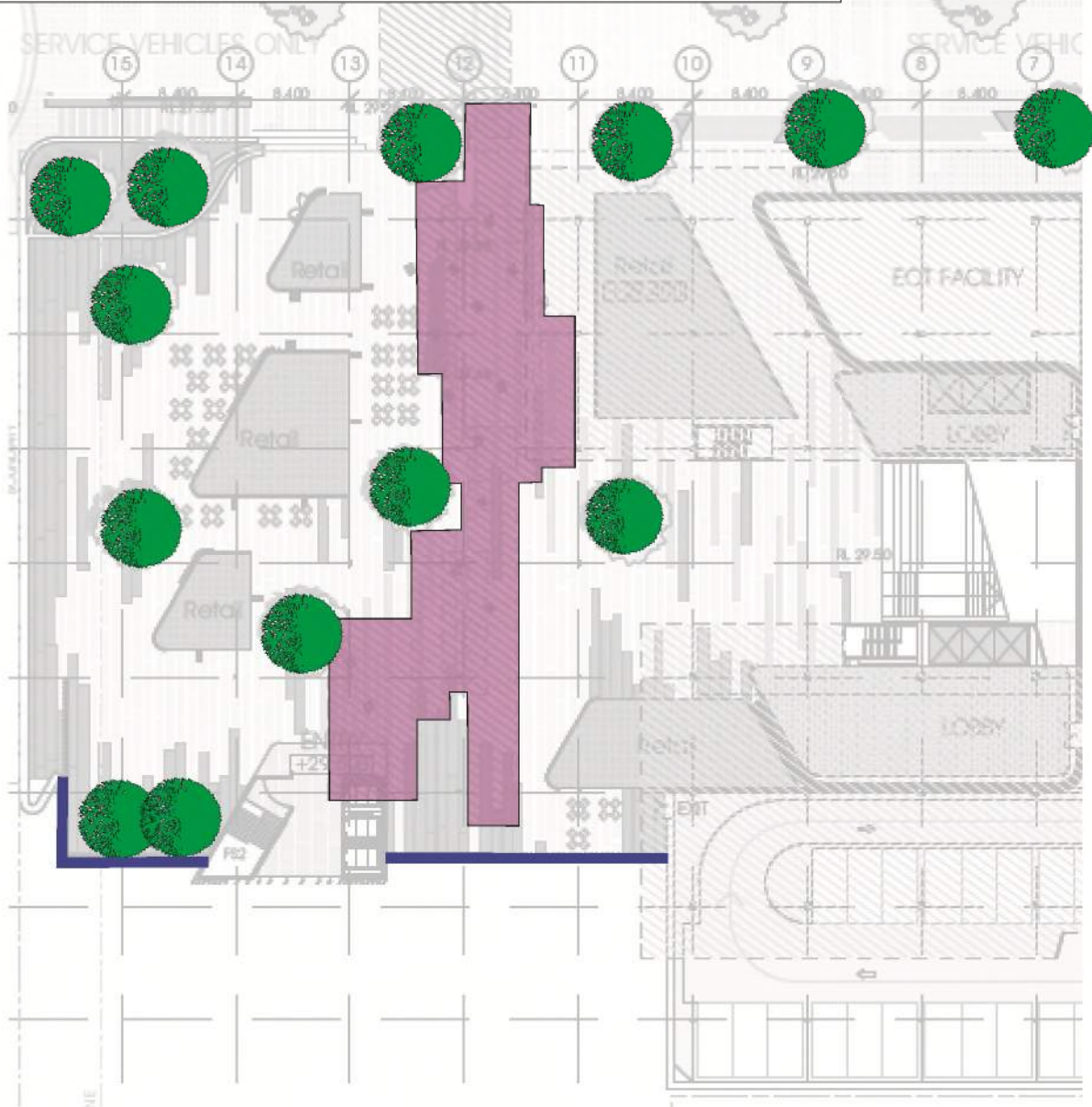


Figure 6: Recommended Treatments – Health and Well Being Precinct Ground Level

Legend

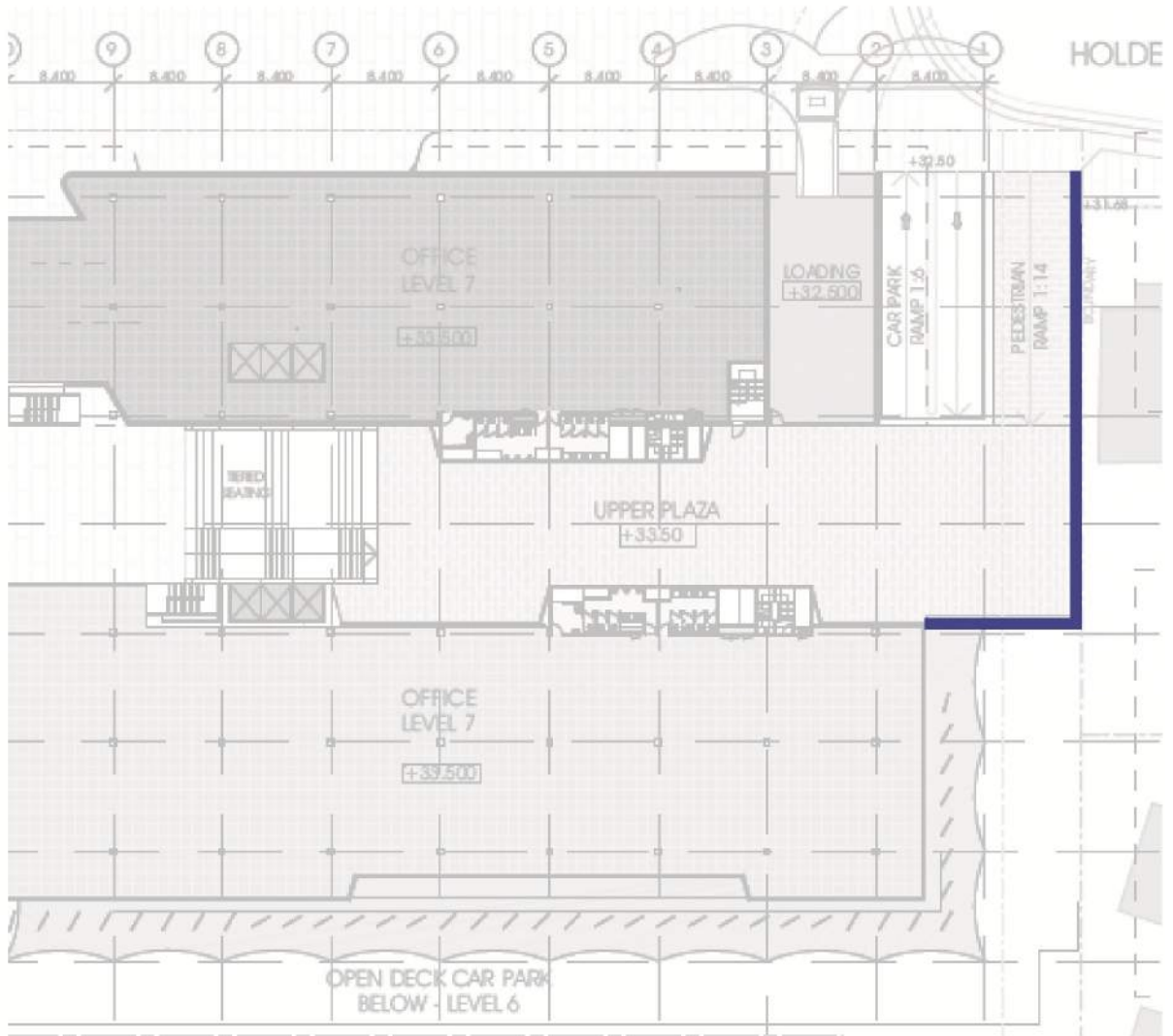
- Proposed impermeable awning recommended to be retained
- Recommended densely foliageing evergreen trees capable of growing to a height of 4m, with a 4m wide canopy.
- Proposed 1.8m high screen recommended to be retained.



**Figure 7: Recommended Treatments – Health and Well Being Precinct
Level 6 Plaza**

Legend

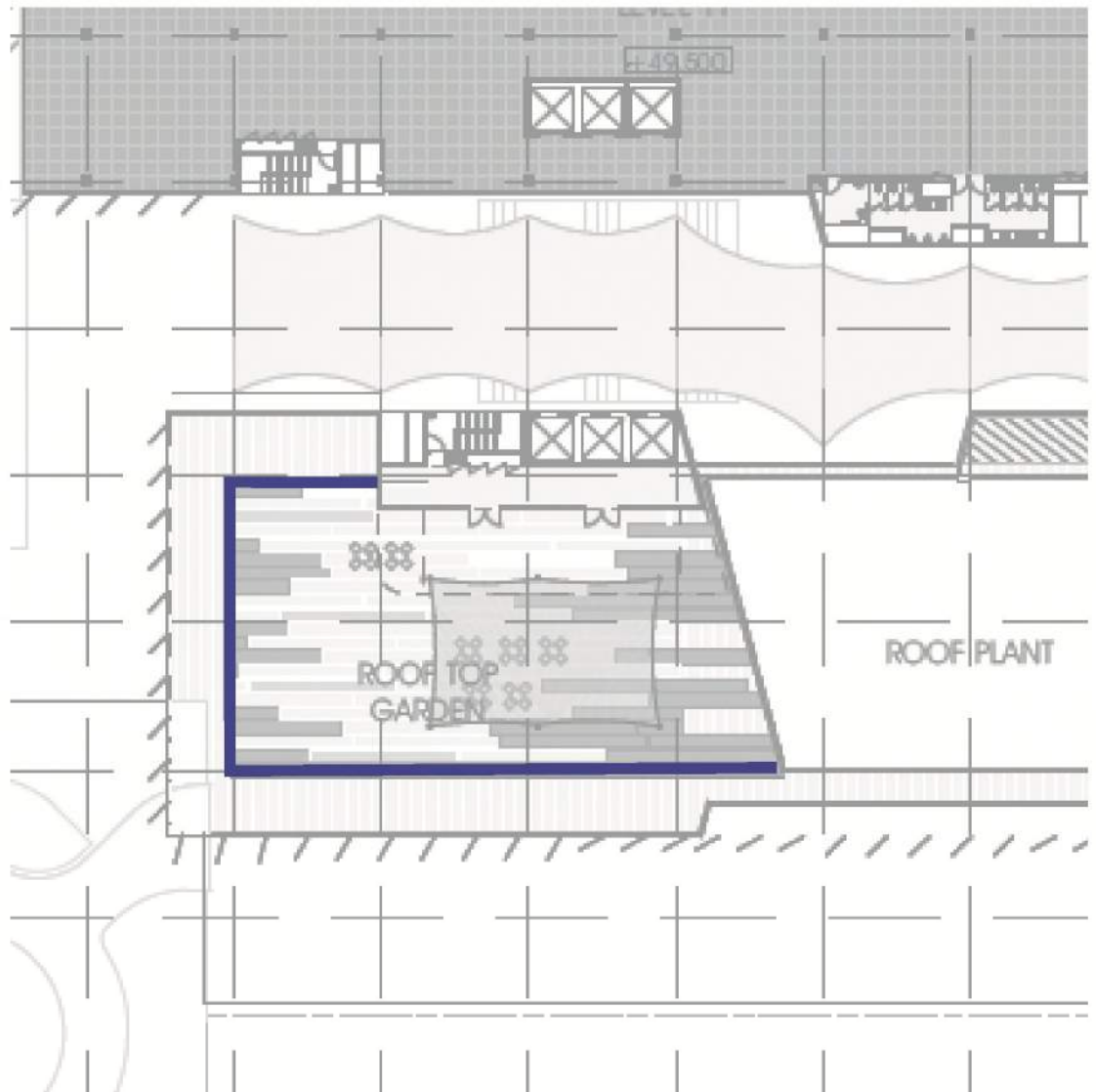
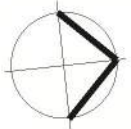
— Recommended 1.8m high screen.



**Figure 8: Recommended Treatments – Health and Well Being Precinct
Level 6 Upper Plaza**

Legend

■ Recommended 1.8m high screen.



**Figure 9: Recommended Treatments – Health and Well Being Precinct
Level 11 Rooftop Garden**

5 CONCLUSION

An analysis of the wind environment impact with respect to the principal wind directions for the Gosford region has been completed for the proposed development known as the Gosford Hospital Redevelopment and Health and Well Being Precinct Stage 1. 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 Fitzpatrick and Partners, and Jacobs received March 2015. No wind tunnel tests have 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 tolerable wind conditions are expected to be achieved along the majority of the ground level outdoor trafficable areas within and around the site due to the shielding provided by the subject and surrounding developments, and the existing densely foliating trees around the site. These include the pedestrian footpaths along the Holden Street frontage of the Health and Well Being Precinct, the outdoor trafficable areas adjacent to the emergency and main entry foyers into the building extension of the main hospital.

There are however outdoor trafficable areas that are potentially exposed to adverse wind conditions due to a number of factors such as existing site conditions due to the alignment of the streets to the prevailing wind directions, accelerating flows around the corner of the development, exposure to direct winds and down-wash effects off the building façade. These areas include the pedestrian footpath along the Showground Road frontage and Level 6 Plaza of the Health and Well Being Precinct, and the various outdoor terraces and courtyards on Levels 1 and 2 of the building extension of the main hospital.

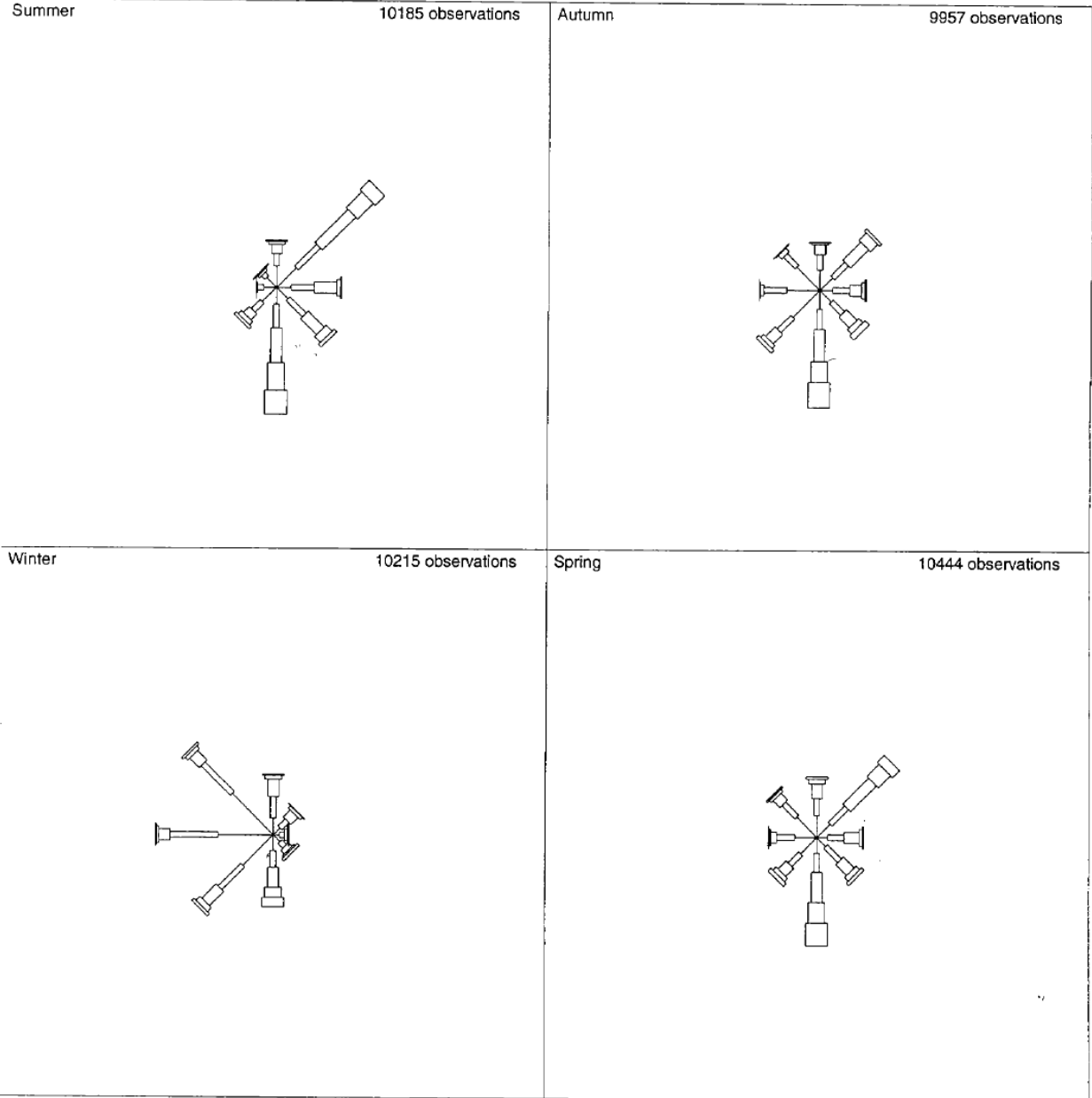
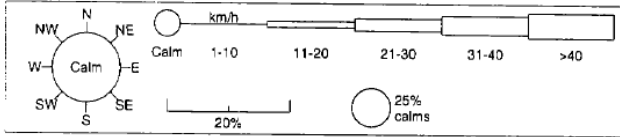
With the inclusion of the recommended treatments within the final design of the development, we expect the wind conditions for all outdoor trafficable areas within and around the subject development will be tolerable for its intended uses. The densely foliating trees are to be capable of growing to a height of 4m with a 4m wide canopy, and the trees along the Holden Street frontage and within the Level 6 Plaza of the Health and Well Being Precinct, and along the western boundary of the building extension of main hospital are to be of an evergreen species to ensure their effectiveness in wind mitigation throughout the year.

Localised wind conditions can be further enhanced with the inclusion of additional densely foliating vegetation within and around the subject development site; particularly within Level 6 Plaza, Level 11 rooftop garden and along the drop-off area of the Level 3 emergency main foyer.

6 APPENDIX – GOSFORD WIND ROSES

Wind Roses using available data between 1969 and 1999 for Norah Head Lighthouse

Site Number 061273 • Locality: Norah Head • Opened Jan 1969 • Still Open • Latitude 33°16'58"S • Longitude 151°34'30"E • Elevation 27m



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Figure A1: Annual Observation Wind Roses