



global environmental solutions

230-232 and 234-238 Sussex Street, Sydney
Environmental Wind Assessment

Report Number 610.14201-R1R3

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Meriton Apartments Pty Ltd
Level 11, 528 Kent Street
SYDNEY NSW 2000

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230-232 and 234-238 Sussex Street, Sydney

Environmental Wind Assessment

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DOCUMENT CONTROL

| Reference | Status | Date | Prepared | Checked | Authorised |
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| 610.14201-R1R3 | Revision 3 | 07 April 2015 | Horatio Cai | Neihad Al-Khalidy | Neihad Al-Khalidy |
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SLR has been engaged by Meriton to assess the environmental impact of an indicative scheme at 230-232 and 234-238 Sussex Street in the Sydney CBD with respect to the wind environment in and around the site.

The site is located at the western side of the CBD on the north east corner of Sussex Street and Druitt Place.

Prevailing wind directions of interest in Sydney are from northeast, south, southeast and west quadrants. Their seasonal variation is described in Section 2 of this report.

Existing Winds

Existing street level wind conditions in the vicinity of the site are likely to be close to the 16 m/s “walking comfort” criterion for the south prevailing wind directions given the channelling along Sussex Street.

Future Winds Environment

In terms of the *future* wind environment, the following features of the indicative scheme are noted as being of most significance:

- Sussex Street footpath will continue to be exposed to strong southerly wind conditions channelling along Sussex Street.
- The footpaths and entrances are protected from downwash winds by the setback of the tower above and the setback of the entrances from the main façade.
- Recommendations to mitigate adverse winds are shown in Figure 7.

The above analysis has been made on the basis of our best engineering judgment and on the experience gained from scale model wind tunnel testing or computational fluid dynamics analysis of a range of developments. The conclusions of SLR report can be quantified using wind tunnel testing or computational fluid dynamics analysis.

| | | |
|-----|--|----|
| 1 | INTRODUCTION | 6 |
| 1.1 | Development Site | 6 |
| 1.2 | Surrounds | 6 |
| 1.3 | Proposed Development Description | 6 |
| 2 | SYDNEY'S WIND CLIMATE | 8 |
| 2.1 | Seasonal Winds | 8 |
| 2.2 | Wind Exposure at the Site – the “Local” Wind Environment | 8 |
| 3 | WIND ACCEPTABILITY CRITERIA | 9 |
| 3.1 | Standard Local Government Criteria | 9 |
| 3.2 | Application of Standard Council Wind Criteria | 9 |
| 4 | BUILDING-WIND INTERACTION – SOME GENERAL OBSERVATIONS | 10 |
| 5 | WIND IMPACT OF THE PROPOSED DEVELOPMENT | 12 |
| 5.1 | Existing Winds – Wind Impact and Effects | 12 |
| 5.2 | Future Winds – Predicted Wind flow Patterns | 12 |
| 5.3 | North East Winds | 14 |
| 5.4 | South and South East Winds | 14 |
| 5.5 | Westerly Winds | 15 |
| 6 | WIND AMELIORATION RECOMMENDATIONS | 16 |
| 7 | CONCLUSION | 19 |

TABLES

| | | |
|---------|---|----|
| Table 1 | Standard Local Government Wind Acceptability Criteria | 9 |
| Table 2 | Recommended Wind Mitigation | 16 |

FIGURES

| | | |
|----------|--|----|
| Figure 1 | Site Location | 6 |
| Figure 2 | 3D Model of development | 7 |
| Figure 3 | Annual Sydney Wind Rose for years 2005-2009 | 8 |
| Figure 4 | Wind flow Patterns Past Regular Shaped Buildings | 10 |
| Figure 5 | Undercroft Wind | 11 |
| Figure 6 | Areas of Interest (Ground Level) | 13 |
| Figure 7 | Mitigation Recommendations (Ground Level) | 17 |
| Figure 8 | Mitigation Recommendations (Residential Levels) | 17 |

APPENDICES

Appendix A Sydney Wind Roses

1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Meriton Apartments Pty Ltd (Meriton) to assess the environmental impact of a indicative scheme at 230-232 and 234-238 Sussex Street in the Sydney CBD with respect to the wind environment in and around the site.

1.1 Development Site

The site is located at the western side of the CBD on the north east corner of Sussex Street and DrUITt Place.

Figure 1 Site Location

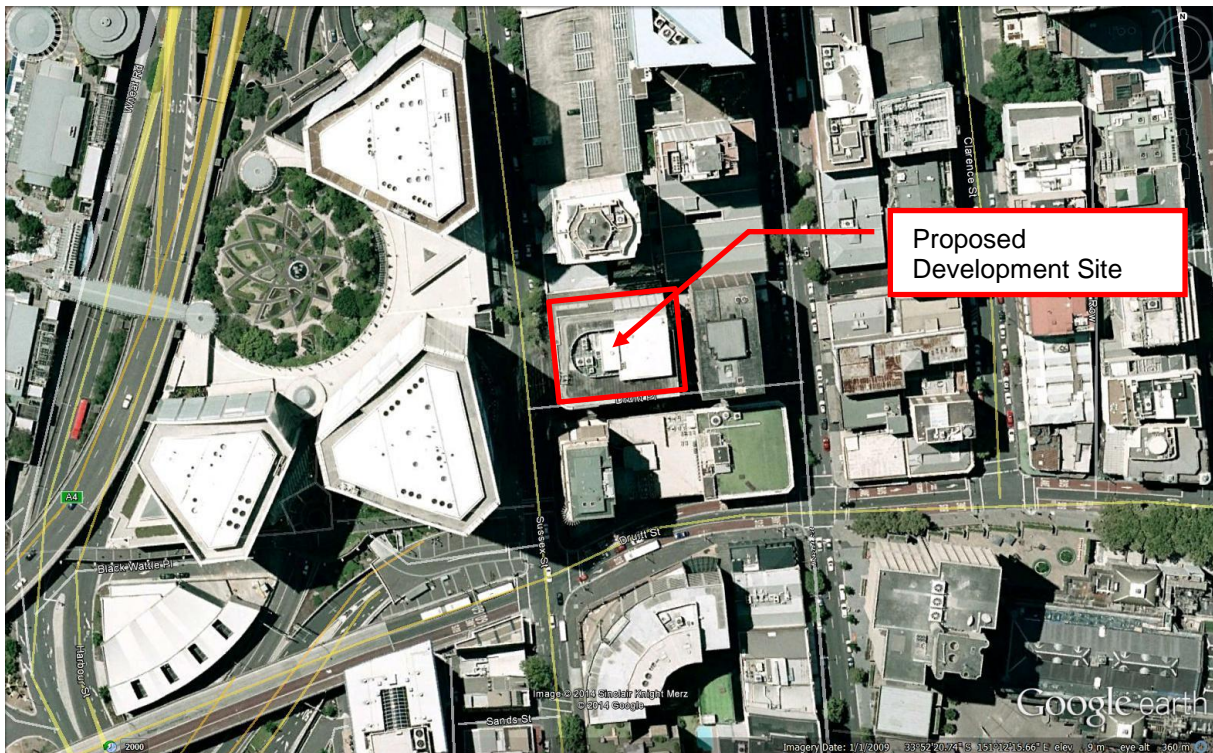


Image: Google

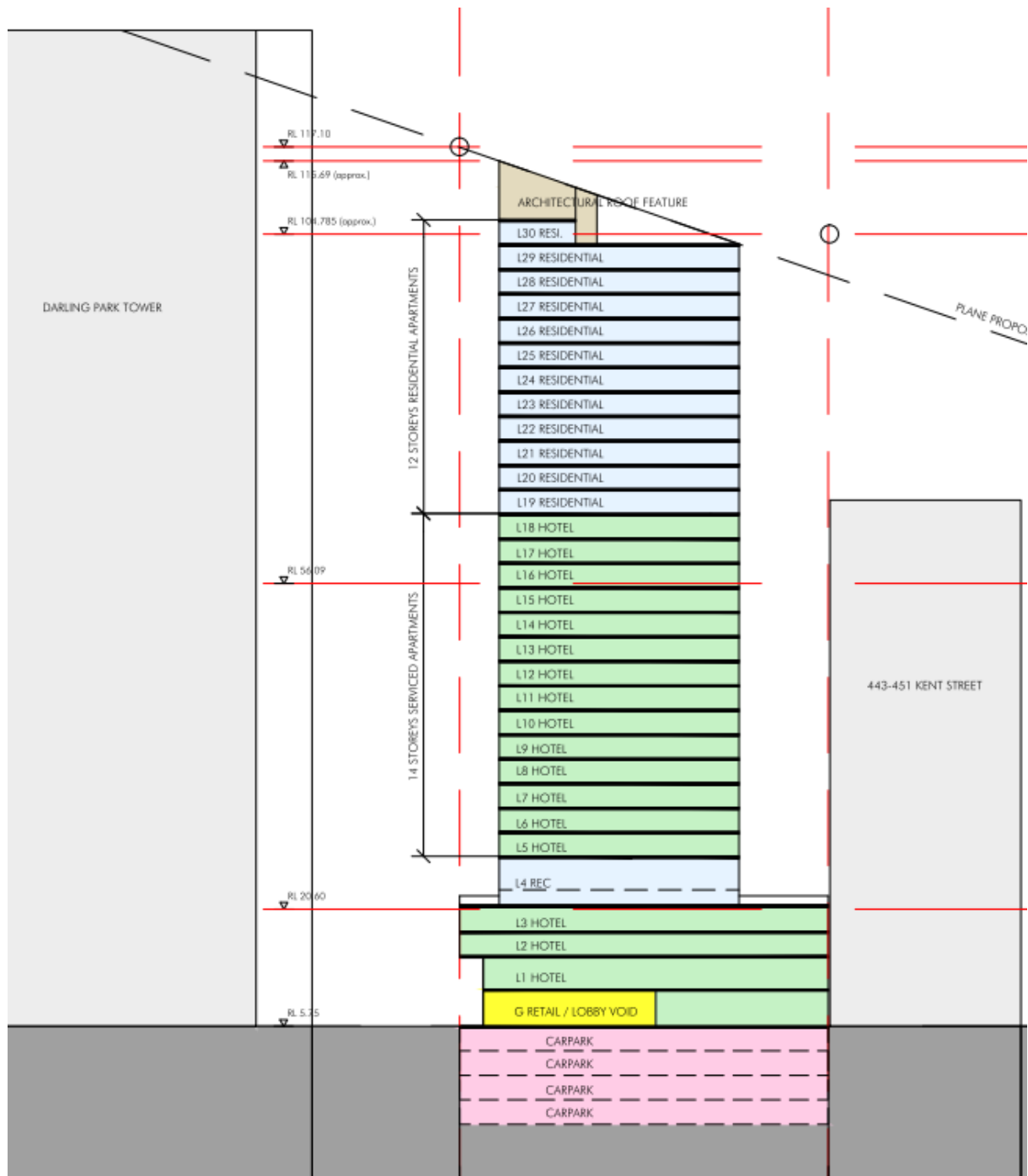
1.2 Surrounds

The area surrounding the site contains a number of high-rise buildings as is typical of the Sydney CBD. Between these there are generally medium-rise buildings with little space between them. The site is somewhat more open to the west as there is only one row of buildings between the site and Cockle Bay.

1.3 Indicative Scheme Description

The site will be redeveloped to consist of a four level basement carpark, a hotel with serviced apartments from ground level to level 18 and residential apartments from level 19 to 30. Figure 2 shows the vertical layout of the proposed development.

Figure 2 Vertical layout of development



2 SYDNEY'S WIND CLIMATE

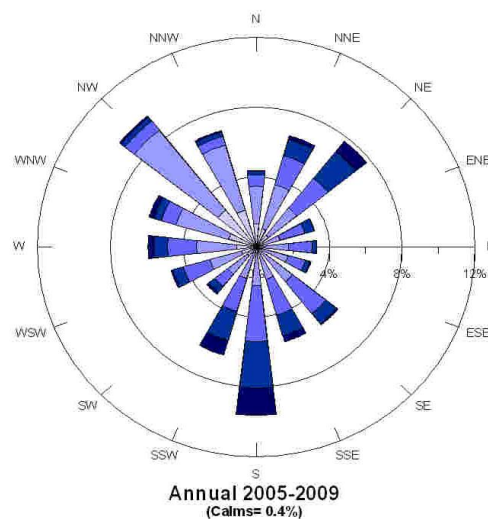
The data of interest in this study are the annual extreme, mean hourly wind speeds and largest gusts experienced throughout the year, how these winds vary with azimuth, and the seasonal break-up of winds into the primary Sydney wind seasons.

2.1 Seasonal Winds

In relation to key characteristics of the Sydney Region Wind Climate (refer to wind roses provided in **Appendix A**) relevant to the wind impact assessment of the proposed development, we note that Sydney is affected by two primary wind seasons:

- Summer winds occur mainly from the northeast, southeast and south.
 - While northeast winds are the more common prevailing wind direction (occurring typically as offshore land-sea breezes), southeast and south winds generally provide the strongest gusts during summer.
- Winter/Early Spring winds occur mainly from the west and the south.
 - West quadrant winds (southwest to northwest) provide the strongest winds during winter and in fact for the whole year.

Figure 3 Annual Sydney Wind Rose for years 2005-2009



2.2 Wind Exposure at the Site – the “Local” Wind Environment

Close to the ground, the “regional” wind patterns described above are affected by the local terrain and topography.

- The site currently receives shielding from buildings surrounding the site from all directions.

3 WIND ACCEPTABILITY CRITERIA

3.1 Standard Local Government Criteria

The choice of suitable criteria for evaluating the acceptability of particular ground level conditions has been the subject of relatively recent research. The acceptability criteria that have been developed from this research and currently referenced by most Australian Local Government Development Control Plans have been summarised below in Table 1.

Table 1 Standard Local Government Wind Acceptability Criteria

| Type of Criteria | Limiting Gust Wind Speed Occurring Once Per Year | Activity Concerned |
|------------------|--|------------------------------------|
| Safety | 24 m/s | Knockdown in Isolated Areas |
| | 23 m/s | Knockdown in Public Access Areas |
| Comfort | 16 m/s | Comfortable Walking |
| | 13 m/s | Standing, Waiting, Window Shopping |
| | 10 m/s | Dining in Outdoor Restaurant |

The primary objectives relating to the above wind impact criteria are as follows:

- The general objective is for annual 3-second gust wind speeds to remain at or below the so-called 16 m/sec “Walking Comfort” criterion. Whilst this magnitude may appear somewhat arbitrary, its value represents a level of wind intensity which the majority of the population would find unacceptable for comfortable walking on a regular basis at any particular location.
- In many urban locations, either because of exposure to open water conditions or because of street “canyon” effects, etc., the 16 m/sec “Walking Comfort” level may already be currently exceeded. In such instances a new development should ideally not exacerbate existing adverse wind conditions and, wherever feasible and reasonable, ameliorate such conditions.
- It can be seen in **Table 1** that the recommended limiting wind speeds for spaces designed for activities such as seating, outdoor dining, etc., are lower than for “walking comfort”.

3.2 Application of Standard Council Wind Criteria

The criteria provided in Table 1 should not be viewed as “hard” numbers as the limiting values were generally derived from subjective assessments of wind acceptability. Such assessments have been found to vary with the height, strength, age, etc., of the pedestrian concerned.

A further factor for consideration is the extent of windy conditions, and some relaxation of the above criteria may be acceptable for small areas under investigation provided the general site satisfies the relevant criteria.

Finally, it is noted that the limiting wind speed criteria in **Table 1** are based on the maximum wind gust occurring (on average) once per year. Winds at all other times, i.e. monthly winds, weekly winds, etc., would be of lesser magnitude. So for example, a location with a maximum annual gust of 10 m/sec would experience winds throughout the year of a generally very mild nature, conducive to stationary activities (seating, dining, etc.).

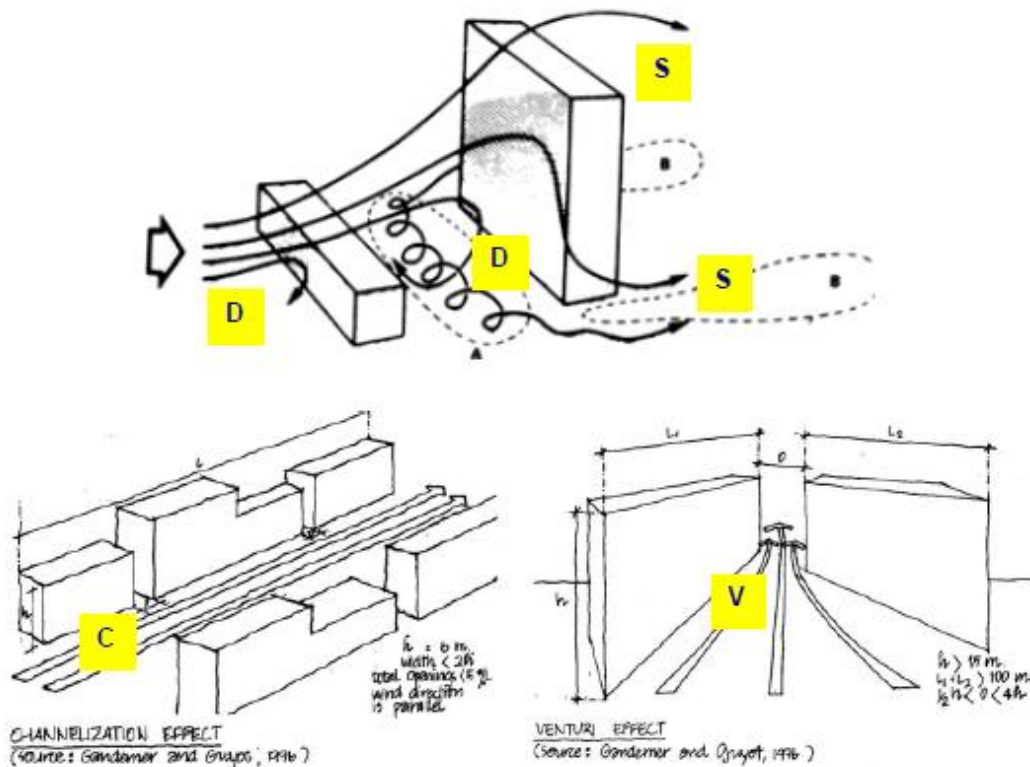
4 BUILDING-WIND INTERACTION – SOME GENERAL OBSERVATIONS

The impact of wind flowing past buildings has well known general impacts at ground level – refer Figure 4:

- **Downwash winds “D”** are the winds which impact on the windward face of a building and are then deflected downwards to ground level in a vertical direction
- Accelerating **Shearflow winds “S”** are the winds which experience an acceleration as they pass by the building edges and roof as the wind flow moves around and past the building

In general, the taller the building, the more pronounced the impact on ground level winds. Local building details can also influence winds in the immediate vicinity; e.g. building undercrofts are often associated with local acceleration of winds.

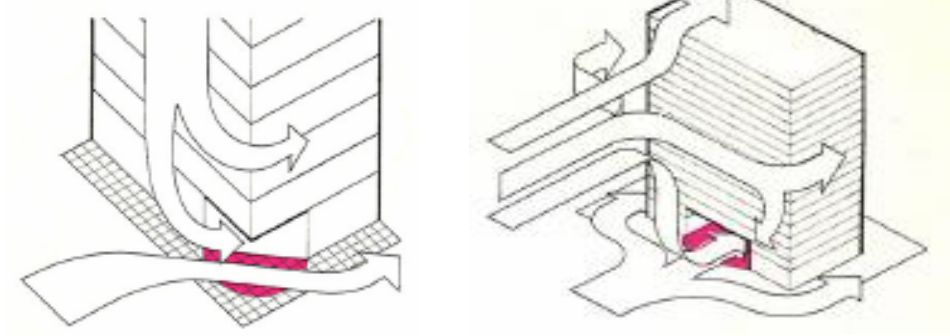
Figure 4 Wind flow Patterns Past Regular Shaped Buildings



The grouping of buildings can also have an impact on resulting pedestrian winds – refer Figure 4:

- **Canyon Effect winds “C”** result when there are rows of parallel buildings (especially taller ones) where the gaps in between line up with prevailing wind directions.
- **Venturi Effect winds “V”** result when wind flow is forced to pass between two converging buildings or groups of buildings with a resulting increase in flow.
- **“Undercroft”** effect is a well-known adverse building-wind characteristic as depicted in the generic building wind effect diagrams shown in Figure 5. The winds are induced towards the negative pressure area within the undercroft, creating concentrated adverse wind flow through undercrofts.

Figure 5 Undercroft Wind



Building Undercrofts (left) and Building Cross-Façade Openings (right) can induce concentrated adverse wind flow past and through a building.

5 WIND IMPACT OF THE INDICATIVE SCHEME

5.1 Existing Winds – Wind Impact and Effects

Existing street level wind conditions in the vicinity of the site are likely to be close to the 16 m/s “*walking comfort*” criterion for the southerly winds given the alignment of Sussex Street with this wind direction.

Northeast Winds

The site has significant shielded at ground levels from CBD buildings to the northeast of the site.

Southerly Winds

There is potential for stronger wind conditions to approach and even exceed the 16 m/sec criterion from the south. Southerly winds may have the tendency to channel along Sussex Street.

Westerly Winds

The site is shielded at ground level from the strong westerly winds by the triangular buildings and podium directly to the west of the site.

Upper Level Winds

Existing upper level wind conditions at the site are likely to exceed the 16 m/sec “*walking comfort*” criterion for stronger prevailing wind directions (eg south and west) given there are fewer surrounding buildings of significant height in these directions. There may also be venturi effect winds caused by the triangular buildings to the west

5.2 Future Winds – Predicted Wind flow Patterns

The following sections analyse the expected impacts of the indicative scheme on the pedestrian wind environment in the adjacent streetscape.

The wind impact of the indicative scheme is described by examining the impact of prevailing wind conditions on all public access areas of interest within and external to the site.

Areas of interest (i.e. surrounding footpaths, primary entry points, seating and dining areas, etc.) are identified in Figure 6.

5.3 North East Winds

| Location | Wind Impact |
|--|--|
| Pedestrian Footpath along Sussex Street | Potential impact here should be less than 16 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. • Shielding from the development itself. • Shielding from existing vegetation. |
| Pedestrian Footpath along Druitt Place | Potential impact here should be less than 16 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. • Shielding from the development itself. |
| Hotel Lobby Entrance, Outdoor Dinning Area and Retail Entrance | Potential impact here should be less than 10 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. • Shielding from the development itself. • Shielding from existing vegetation. |
| Residential Lobby Entrance | Potential impact here should be less than 16 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. • Shielding from the development itself. |
| Retail Entrance & Outdoor Dinning area | Potential impact here should be less than 10 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. • Shielding from the development itself. |
| Upper Balconies | Potential impact here could be close to 10 m/s , affected by: <ul style="list-style-type: none"> • Stronger upper level winds. • Some balconies will be shielded by the development itself |

5.4 South and South East Winds

| Location | Wind Impact |
|--|---|
| Pedestrian Footpath along Sussex Street | Potential impact here could be close to 16 m/s , affected by: <ul style="list-style-type: none"> • Channelling along Sussex Street. • Shielding from existing vegetation. |
| Pedestrian Footpath along Druitt Place | Potential impact here should be less than 16 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. |
| Hotel Lobby Entrance, Outdoor Dinning Area and Retail Entrance | Potential impact here should be less than 10 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. • Shielding from the development itself. |
| Residential Lobby Entrance | Potential impact here should be less than 16 m/s , affected by: <ul style="list-style-type: none"> • Shielding from the development itself. |
| Retail Entrance & Outdoor Dinning area | Potential impact here should be less than 10 m/s , affected by: <ul style="list-style-type: none"> • Shielding from upstream buildings. • Shielding from the development itself. |
| Upper Balconies | Potential impact here could be close to 10 m/s , affected by: <ul style="list-style-type: none"> • Stronger upper level winds. • Some balconies will be shielded by the development itself |

5.5 Westerly Winds

| Location | Wind Impact |
|--|--|
| Pedestrian Footpath along Sussex Street | Potential impact here should be less than 16 m/s , affected by: <ul style="list-style-type: none">• Shielding from upstream buildings. |
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6 WIND AMELIORATION RECOMMENDATIONS

On the basis of the expected wind impacts outlined in previous four sections, recommendations for wind break features are made in areas where winds are expected to

- Approach or exceed 10 m/s or 16 m/s depending on the designed use for that area

These wind mitigation recommendations are summarised in **Table 2**.

Table 2 Recommended Wind Mitigation

| Location of Interest | Wind Impact Potential | Windbreak Treatment/Recommendation |
|--|--|--|
| Pedestrian Footpath along Sussex Street | Moderate Winds could be above 16 m/s for southerly winds <i>This is an existing condition</i> | No Mitigation Required |
| Pedestrian Footpath along Druitt Place | Low Winds should be below 16 m/s for wind directions | No Mitigation Required |
| Hotel Lobby Entrance, Outdoor Dinning Area and Retail Entrance | Low Winds should be below 10 m/s for wind directions | No Mitigation Required |
| Residential Lobby Entrance | Low Winds should be below 16 m/s for wind directions | No Mitigation Required |
| Retail Entrance & Outdoor Dinning area | Low Winds should be below 10 m/s for wind directions | No Mitigation Required |
| Upper Balconies | High Winds could be above 10 m/s for all wind directions | Mitigation Required Sliding or pull down shutters could improve the balconies wind performance |

Figure 7 Mitigation Recommendations (Indicative Scheme – Typical Residential Plan)

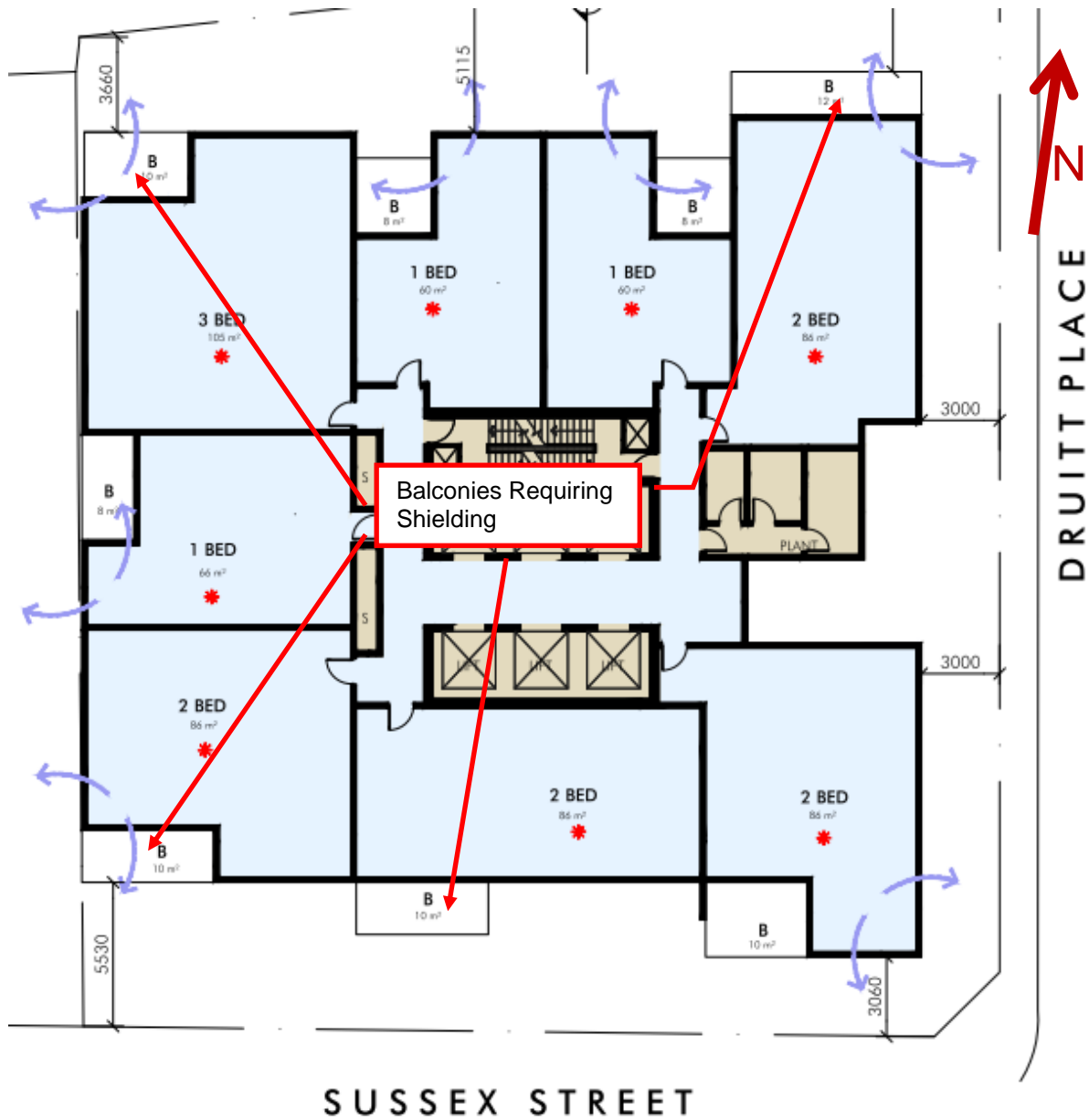
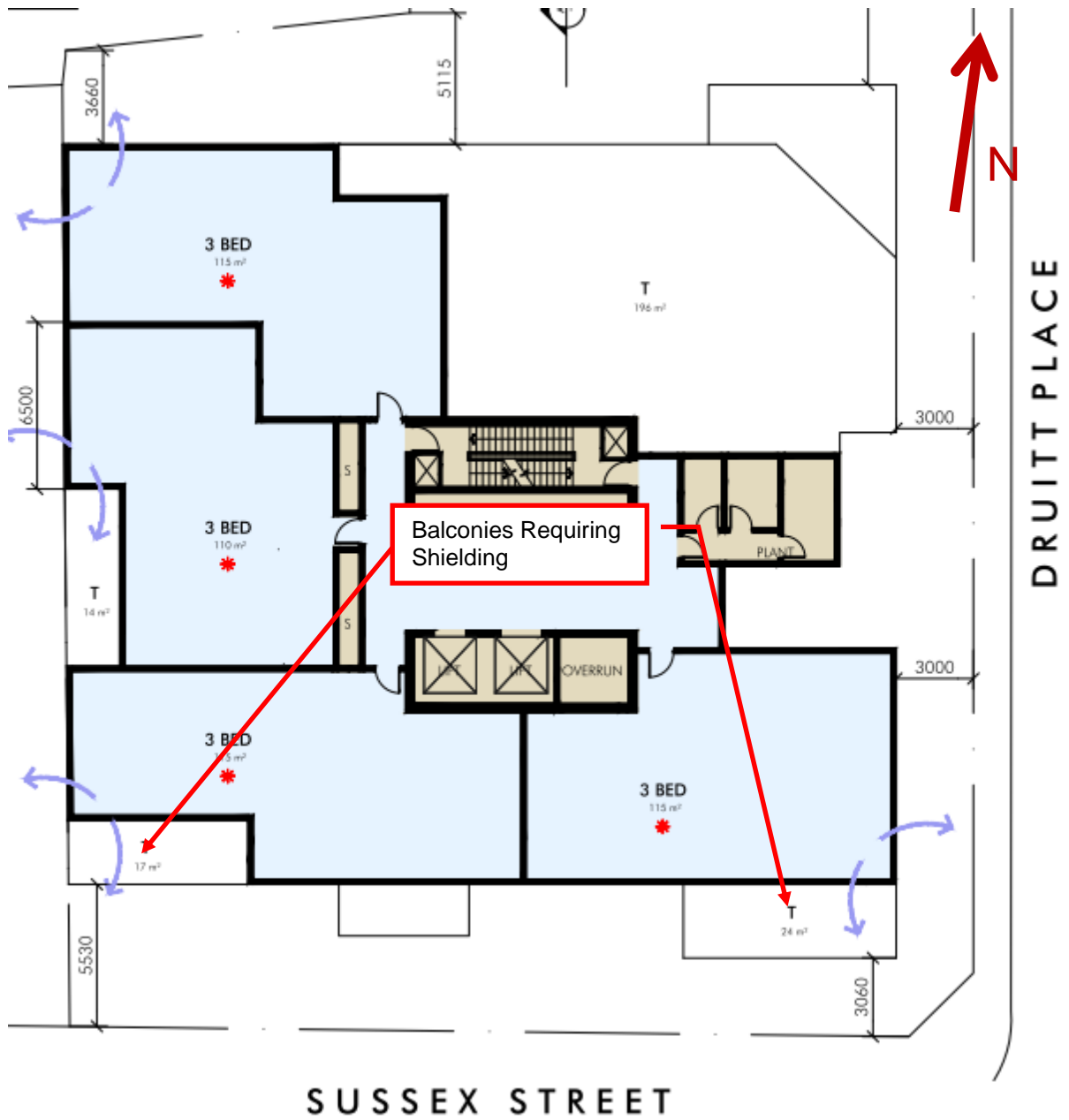


Figure 8 Mitigation Recommendations (Indicative Scheme –Top Residential Plan)



7 CONCLUSION

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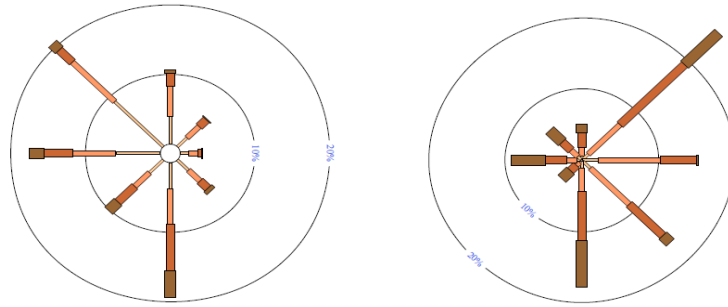
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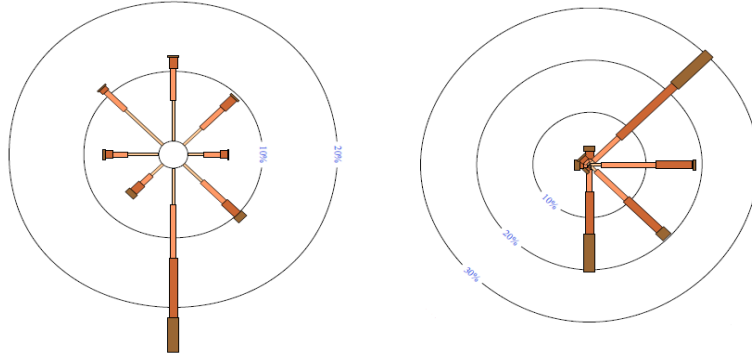
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SYDNEY WIND ROSES

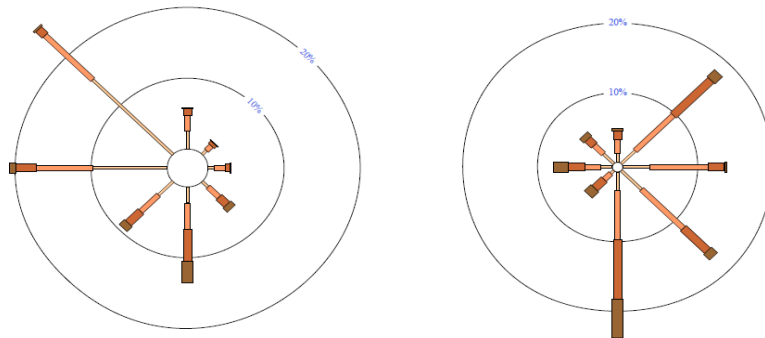
Spring



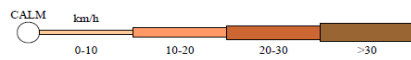
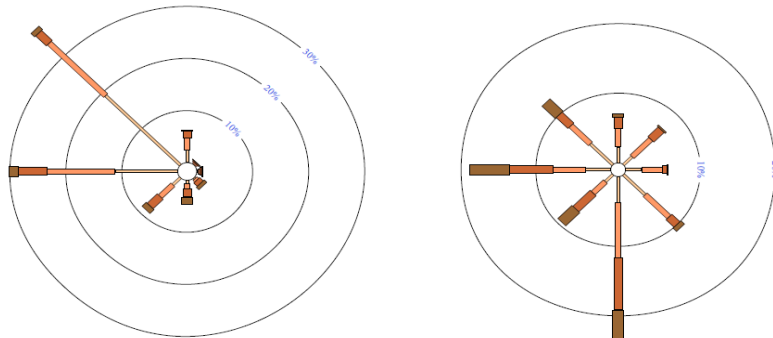
Summer



Autumn



Winter



Scale factor = 30.0%