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Nepean Green Project – Climate Analysis

Prepared for

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1 Introduction

1.1 Purpose of Climate Analysis

The following report has been prepared to outline the surrounding climatic conditions, their influence and recommended design solutions for the Nepean Green project, Penrith. The site is located at Station Street and Woodriff Street in Sydney's western suburbs. Penrith has a temperate climate that is subject to a moderate level of rainfall.

This report assesses the potential effects of local climate on the passive design at the site, for both indoor and outdoor spaces. This will be achieved by addressing the following key comfort factors:

- Ambient Temperatures;
- Humidity;
- Solar Exposure;
- Rainfall;
- Wind Analysis.

The Nepean Green project comprises the following mix of buildings:

- Residential apartments – approximately 570 over 5 stages;
- Tavern – 1,800sqm;
- Masters Home improvements store – 13,700sqm;
- On-grade car parking.

An aerial photograph of the site is shown below.

Figure 1: Site Map

2 Climate Analysis

The following climatic analysis is based on weather data from the Bureau of Meteorology weather station at Penrith and surrounding suburbs.

2.1 Ambient Temperatures

Figure 2 outlines the annual average ambient temperatures from 1995 to present (best available weather data). It is important that long-term temperature trends are considered for the site.

Daily mean maximum temperatures are within comfort levels for most of the year, while mean minimum temperatures are below typical comfort levels between mid-March and late November.

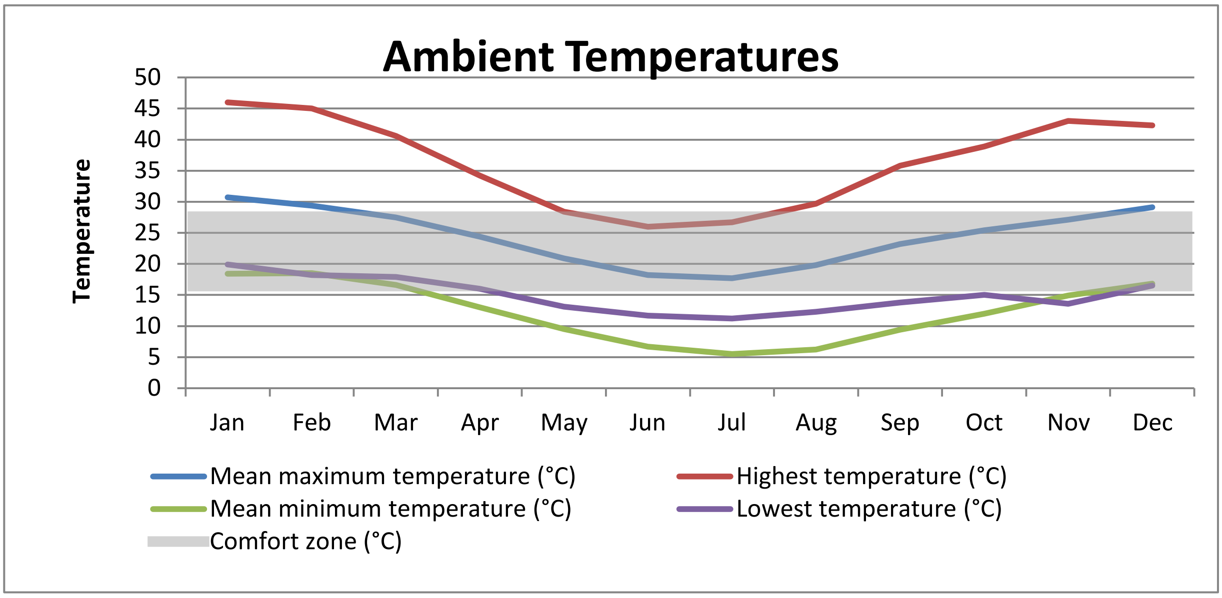


Figure 2: Ambient temperatures

For the purpose of this analysis an outdoor comfort level band of 18-26°C has been set. Figure 3 below shows that on a 24-hour basis over 12 months, ambient temperatures are within comfortable levels for approximately 48% of the time, below 18°C for approximately 51% of hours, while above 26°C for around 10% of the time. Night-time hours are the major contributor to hours <18°C.

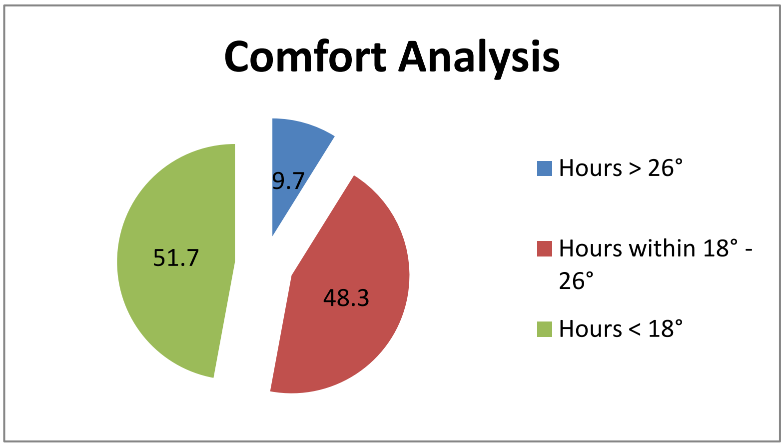


Figure 3: Comfort Analysis

In assessing the viability of the local climatic conditions it is important to consider the long-term temperature trends.

Climate change analysis work by the CSIRO indicates a long term average increase in mean temperatures over the next 10 to 50 years. The image below shows the increasing average annual temperatures over the next 20, 40 and 50 years against different emission levels.

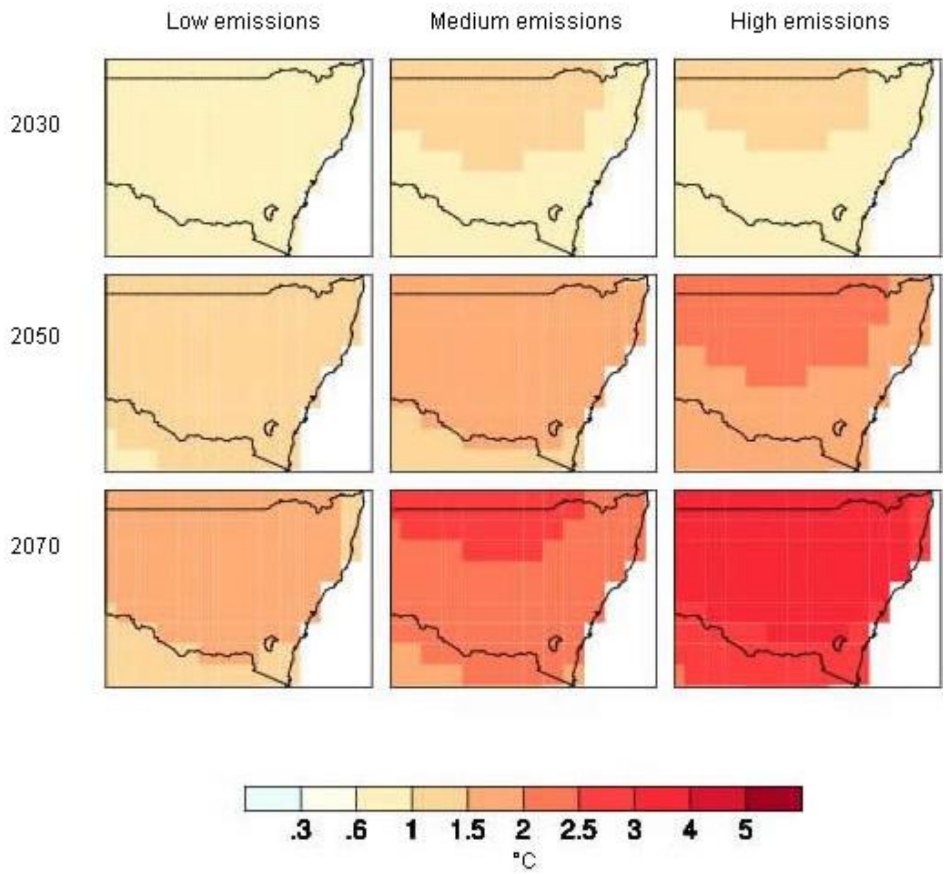


Figure 4: Climate Change Analysis

Using the information outlined above it will be assumed that mean temperatures will continue to rise over the next 10 to 40 years. This information will be taken into account when assessing climatic conditions and design solutions.

2.2 Humidity

Afternoon humidity remains within accepted comfort levels throughout the year whilst morning humidity exceeds the maximum comfort levels between January and August. This is a result of cooler temperatures in the morning; cool air contains less water vapour than warm air causing humidity to rise.

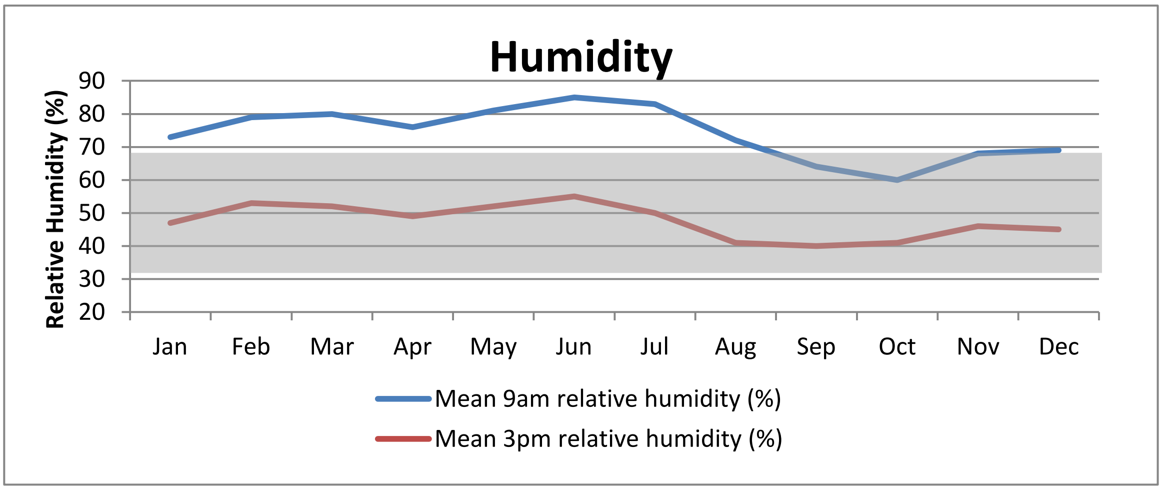


Figure 5: Relative humidity

2.3 Solar Exposure

Figure 6, 7 and 8 below outline the number of cloudy days, percentage of cloud cover (okta's) and solar exposure respectively. The Penrith climate has a mix of clear and cloudy days all year round.

Cloud cover is measured visually by estimating the fraction (in eighths or oktas) of the dome of sky cover by cloud. A completely clear sky is recorded as zero okta, while a totally overcast sky is 8 oktas. For the purpose of solar exposure, it has been deemed that between 1-5 oktas provides good solar exposure.

In addition, Penrith is subject to a reasonable number of daylight hours and solar availability in the summer months. Using the data from Figures 6, 7 & 8 Penrith should have good solar exposure throughout most of the year, with the optimum occurring from June to September.

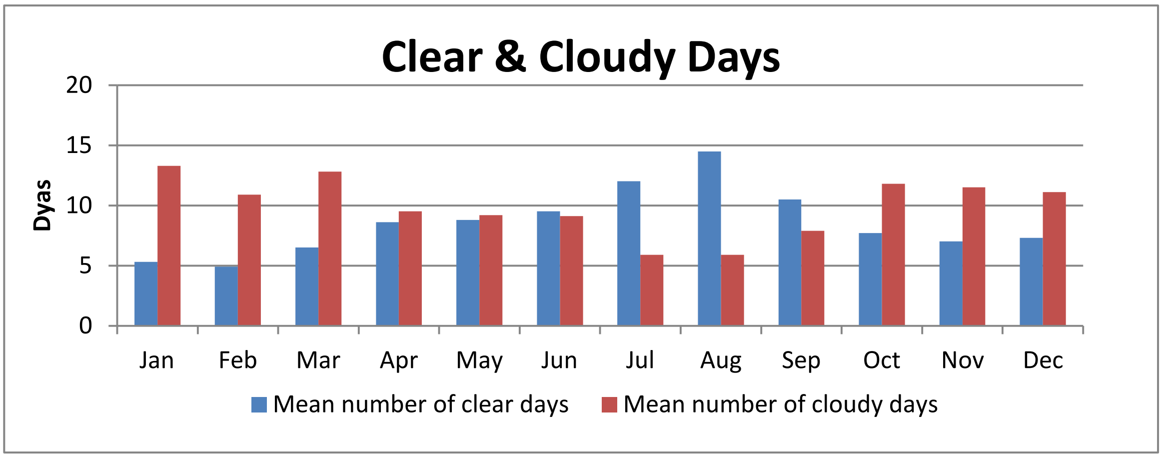


Figure 6: Clear & Cloudy days

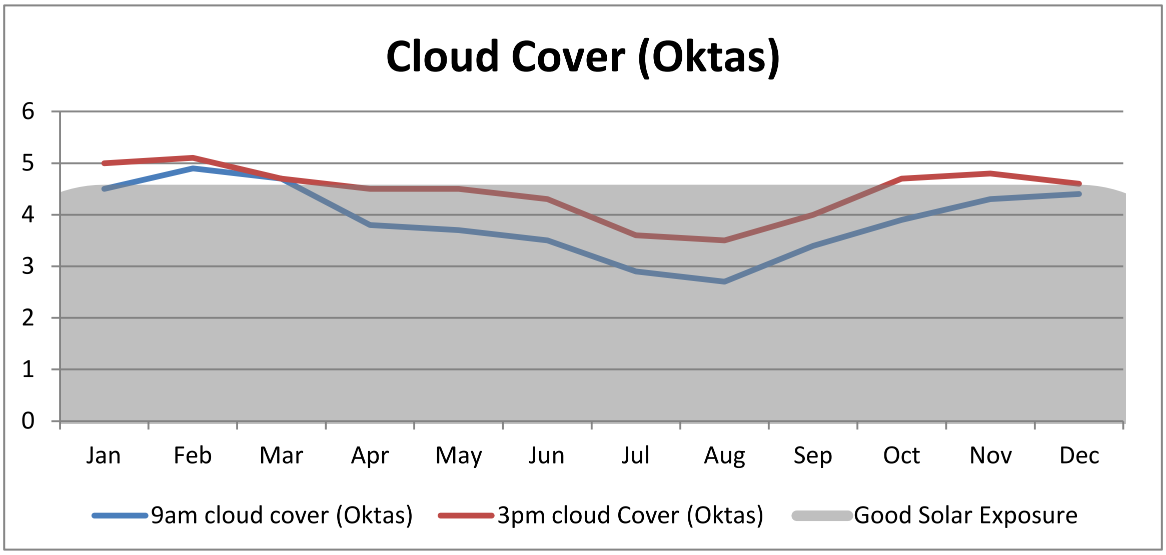


Figure 7: Cloud Cover (Oktas)

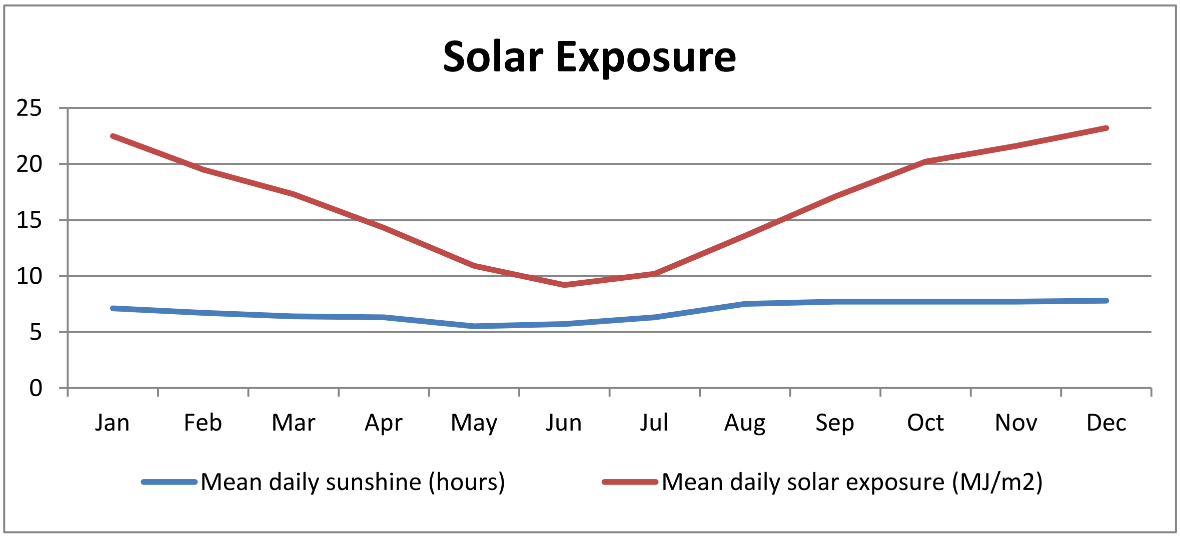


Figure 8: Solar Exposure

2.4 Rainfall

As outlined in Figure 9, Penrith is subject to a moderate level of year round rainfall, raining on average 134 days a year. Historically February receives the most rain with average of 137mm. The moderate level and frequency of annual rainfall represents an opportunity for rainwater harvesting; rainwater collection systems should be sized in relation to climate, annual rainfall and capture/roof area.

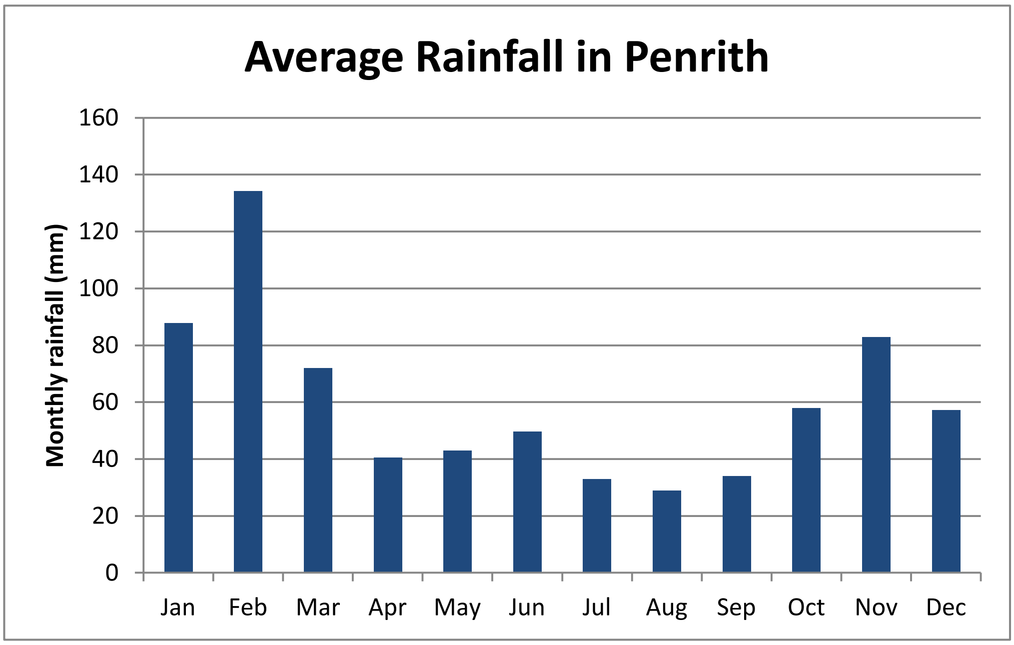


Figure 9: Average Rainfall

With an average annual rainfall of 720.5mm the site has potential to reduce the use of potable water through rainwater harvesting. Rainwater ranks may also reduce stormwater detention requirements, depending on Council requirements.

2.5 Wind Analysis

Wind roses are provided for each season to demonstrate the frequency of wind conditions experienced at various times throughout the year. The longest point represents the wind direction with the greatest frequency. In addition, there are three roses that illustrate the respective wind speeds for different temperatures during a typical year.

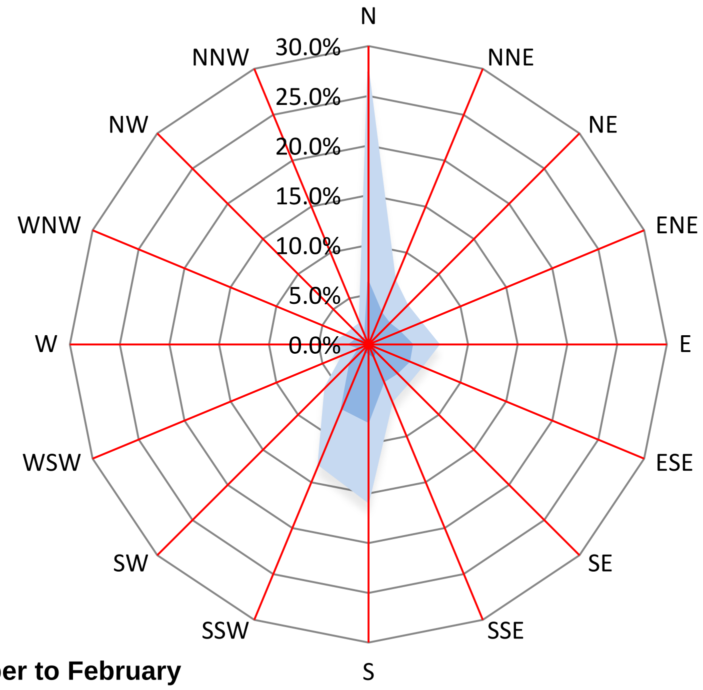
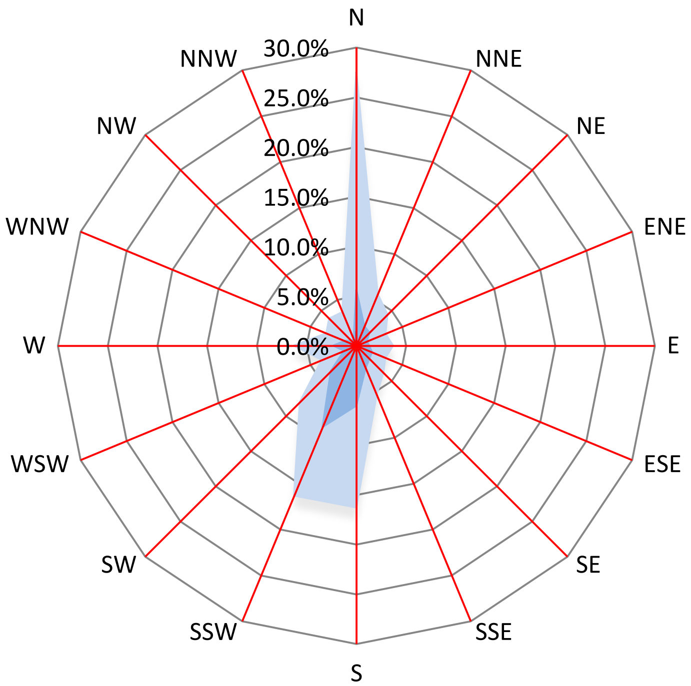


Figure 10: December to February



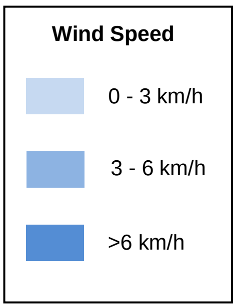


Figure 11: March - May

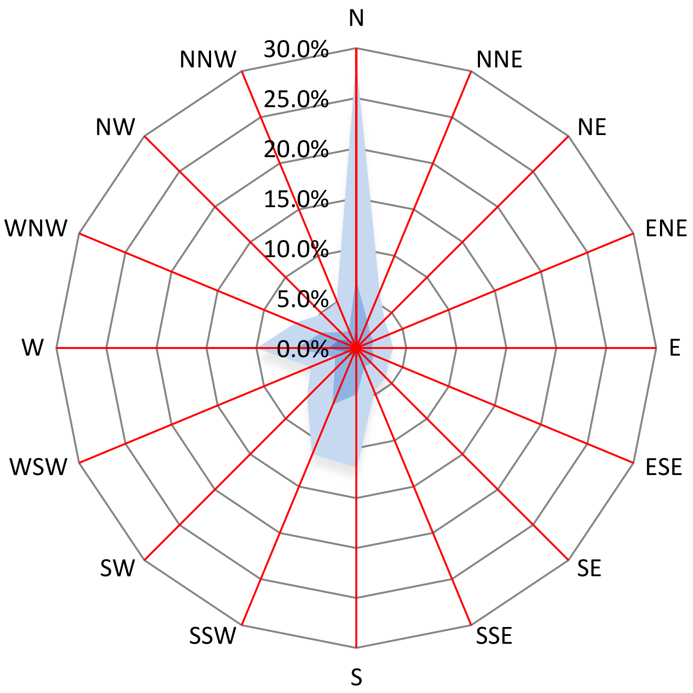


Figure 12: June to August

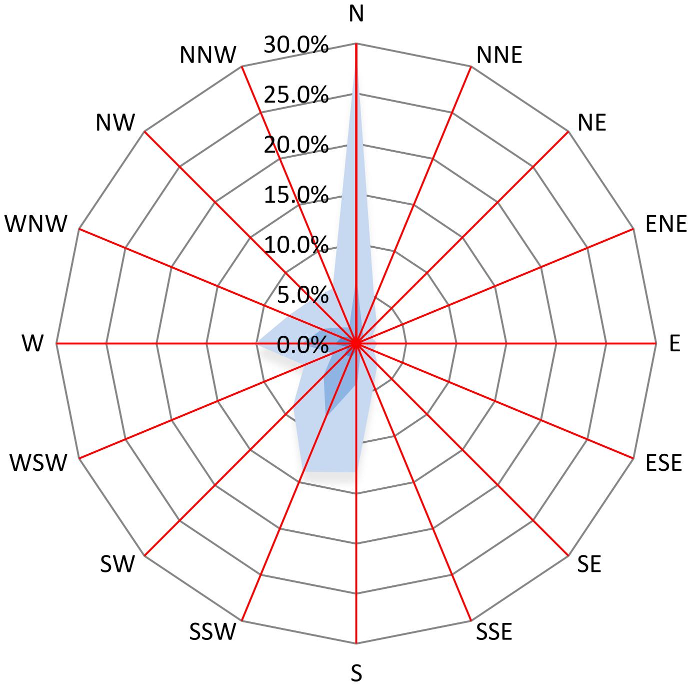


Figure 13: September to November

Wind Speed

- 0 - 3 km/h
- 3 - 6 km/h
- >6 km/h

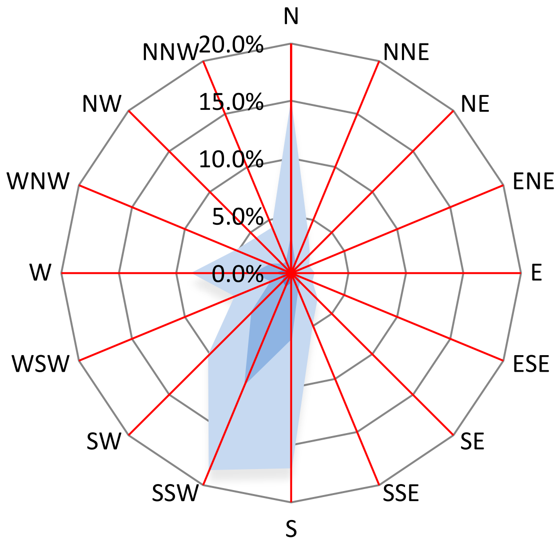


Figure 14: Wind speeds less than 18°C (typical year)

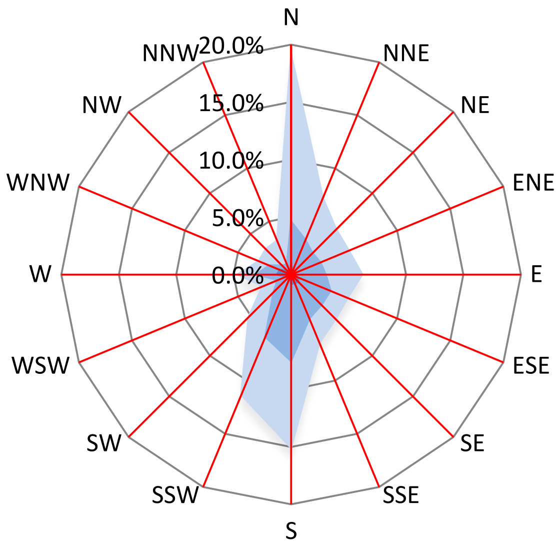
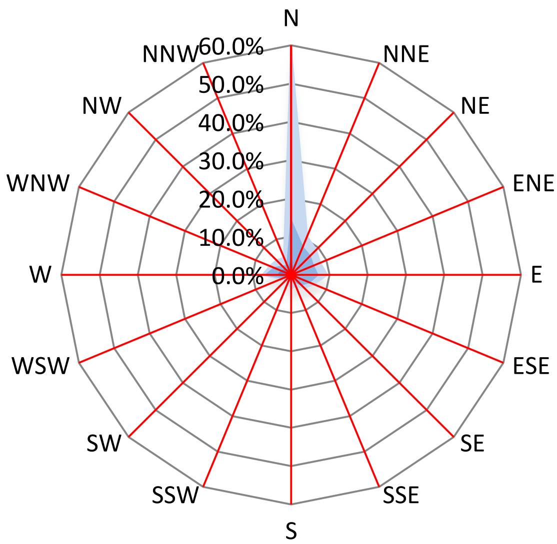


Figure 15: Wind speeds between 18°C - 26°C (typical year)



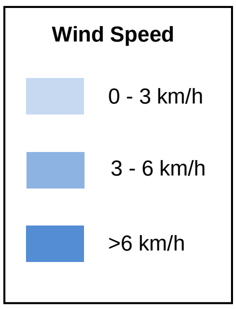


Figure 16: Wind speeds greater than 26°C (typical year)

3 Climatic ESD Opportunities

3.1 Passive Design Opportunities

The following recommendations are made for internal and external comfort based on the localised climatic conditions.

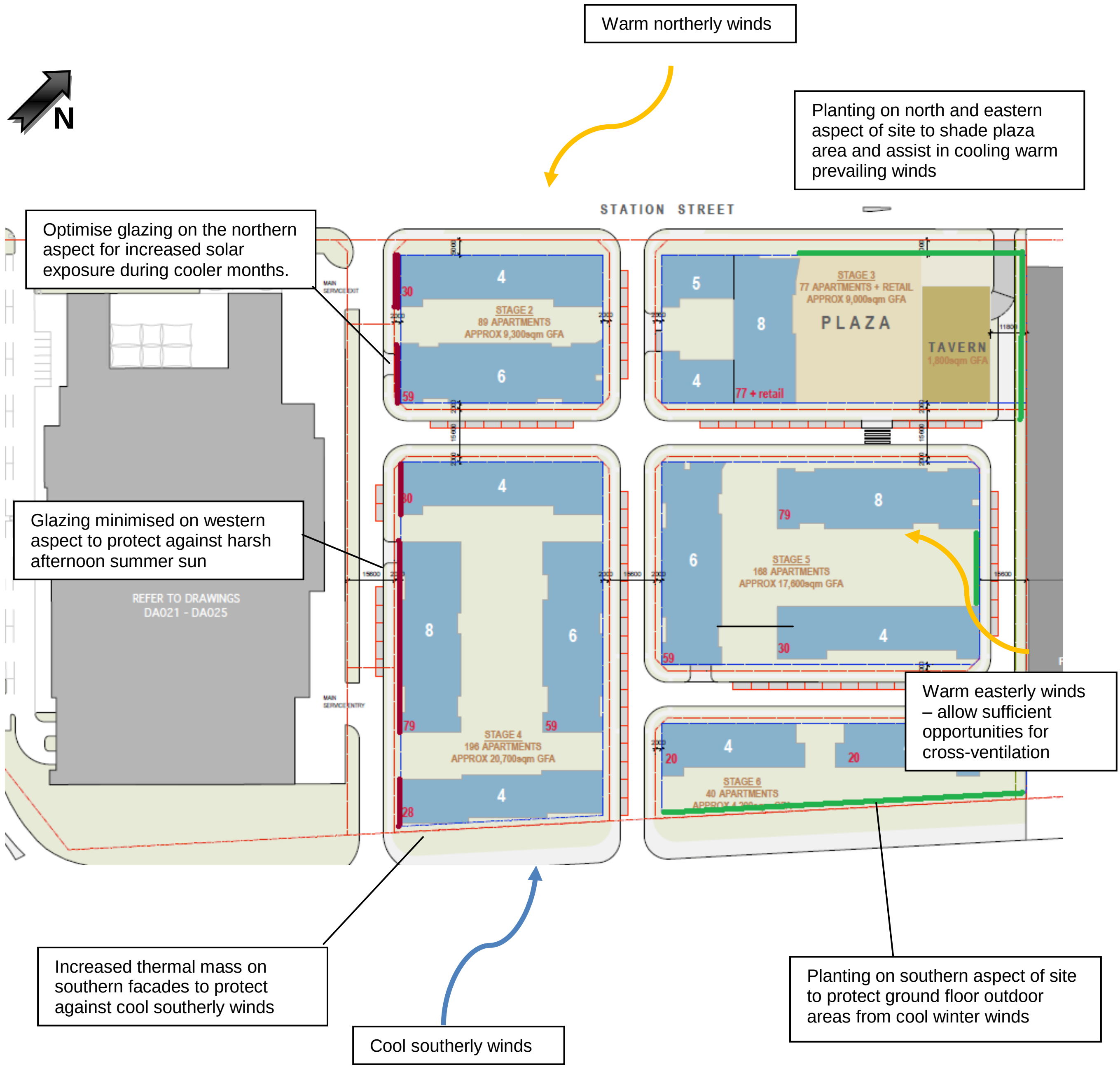
Internal Comfort

- Use of louvres and window openings on northern and southern facades to optimise cross-ventilation during temperatures of 18° - 26°C (Figure 15);
- Increased thermal mass on southern and western aspect of the site to protect buildings from cooler winter winds (Figure 13 & 14);
- Regularly occupied spaces, such as living rooms should be orientated north to north-east with a internal layout that will maximise morning winter sun exposure whilst minimising exposure to the harsh afternoon summer sun;
- Typically unoccupied spaces, such as services rooms, store rooms and bathrooms, should face west or south where possible as they require a lower degree of comfort control. These areas can also assist in providing thermal barriers for the regularly occupied spaces, such as the living areas;
- Larger glazed windows should be concentrated to the north to maximise potential morning sun light capture;
- Windows and openings on the west heat bearing walls should be minimised to reduce solar heat load. However small openings such as air vents can be used to provide natural ventilation on these facades;
- Effective shading (such as external louvers) and heavy insulation should be used on the on the western and northern heat bearing walls to minimise solar heat gain and maximise indoor thermal comfort;
- Smaller apartment blocks should be located on the northern perimeter of the site to prevent overshadowing from the larger scale buildings.

External Comfort

- Shading should be used to protect the outdoor areas from harsh summer sun, whilst allowing winter solar access;
- Shading and planting used to shade the footpath networks and northern plaza area;
- External surfaces should generally be light-coloured to minimise heat absorption and reduce the heat-island effect, which can raise urban temperatures by several degrees.
- Use of planting on northern and eastern aspect of site to assist in cooling warmer winds experienced during summer months (Figure 10 & 16).
- Use of planting or architectural screening on southern aspect of site to protect outdoor areas parallel to Woodriff St from cool southerly winds (Figure 12 & 14).

A summary of climatic opportunities is shown in the following image.



3.2 Other Climatic Opportunities

Orientation - Strategic passive solar orientation of buildings and floor plan layouts;

Photovoltaic Cells – Good annual solar exposure provides the potential for the efficient implementation of photovoltaic cells;

Air Exchange – Maximise the use of natural ventilation through operable windows and north-east facing floor plates to promote air exchange throughout each floor;

Rainwater – Average annual rainfall of 720.5mm provides opportunities for the use of rainwater harvesting;

Night Purging – Given that around 50% of the time the ambient temperatures are below comfort levels there is a possibility of night purging.