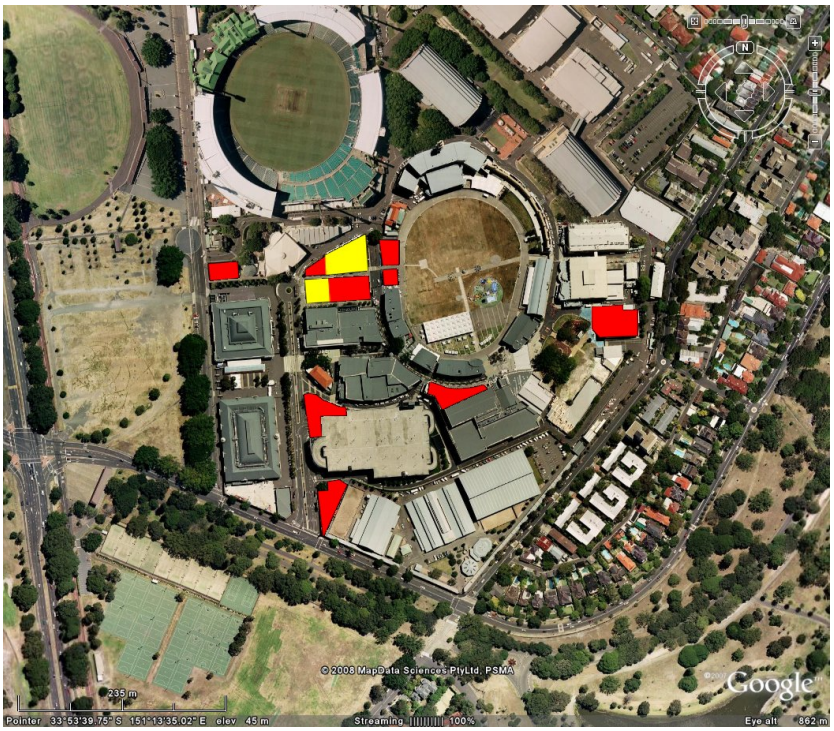
BBC Consulting Planners

Entertainment Quarter, Desktop Wind Effects Study



Report No. 30B-09-0004-TNT-428850-1

Vipac Engineers & Scientists Ltd

Melbourne VIC

10th February 2009

DOCUMENT CONTROL

Entertainment Quarter, Desktop Wind Effects Study

REPORT NO:
30B-09-0004-TNT-428850-1

LIBRARY CODE:

PREPARED FOR:
BBC Consulting Planners
Level 2, 55 Mountain Street
Broadway
NSW 2007
Contact: Robert Chambers
Phone: +61 2 92114099
Fax : +61 2 92112740

PREPARED BY:
Vipac Engineers & Scientists Ltd
Private Bag 16
Port Melbourne VIC 3207
AUSTRALIA
Email: melbourne@vipac.com.au
Phone: 61 3 9647 9700
Fax : 61 3 9646 4370

AUTHOR:

Gokul Krishnan Rajamani — Date: 10.02.2009
Project Engineer

REVIEWED BY:

Dr. Seifu Bekele — Date: 10.02.2009
Principal Wind Engineer

REVISION HISTORY:

Revision No.	Date Issued	Reason/Comments
00	29th January 2009	Initial Issue
01	10th February 2009	Final Issue

DISTRIBUTION:

Copy No._____		Location
1		Project
2	**Uncontrolled Copy**	Client (PDF Format)

KEYWORDS: Entertainment Quarter, Wind Effects Statement

NOTE: This is a controlled document within the document control system. If revised, it must be marked SUPERSEDED and returned to the Vipac QA Representative.

EXECUTIVE SUMMARY

BBC Consulting Planners commissioned Vipac Engineers and Scientists Ltd to prepare a statement of wind effects for the proposed new Buildings within the Entertainment Quarter in Sydney. This appraisal is based on Vipac's experience as a wind-engineering consultancy.

The findings of this study are summarised as follows,

1. In Vipac's opinion, that at most locations, the proposed new Buildings will not cause any significant change to the existing wind conditions in the Entertainment Quarter region.
2. The winds approaching from the western direction could result in wind conditions close to the walking comfort criterion in some pedestrian footpath areas. (However, it is to be noted that the assessment is based on concept design)
3. General recommendations have been made based on similar experience in Sydney and around the world.

It is to be noted that all of the above assessments are made based on concept design. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing may be in error

TABLE OF CONTENTS

1. INTRODUCTION

Vipac Engineers & Scientists Ltd was commissioned by BBC Consulting Planners to carry out an appraisal in estimating the overall wind effects of 9 proposed new buildings at pedestrian levels, in the Entertainment Quarter, Moore Park, Sydney.

The Entertainment Quarter at Moore Park is located at approximately 2.5 km to the south east of Sydney's CBD.

The proposed Development comprises of 9 new buildings (see Figure 1) at various locations within the Entertainment Quarter. The height of these 9 buildings varies from 8.2m (Building H) to 22.9m (Building F). The proposed new buildings are surrounded by a number of existing buildings of the Entertainment Quarter as shown in Figure 2.

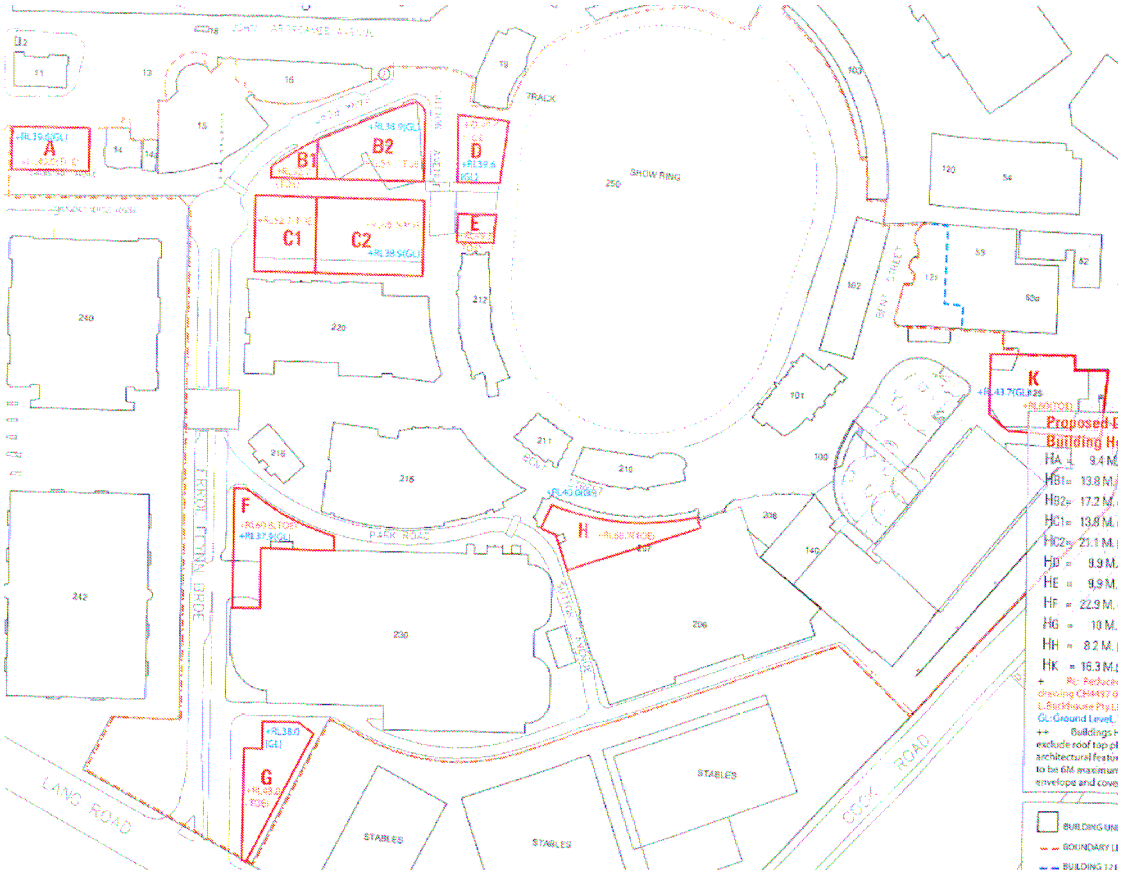


Figure 1- Proposed new buildings at the Entertainment Quarters, Moore Park, Sydney, NSW.

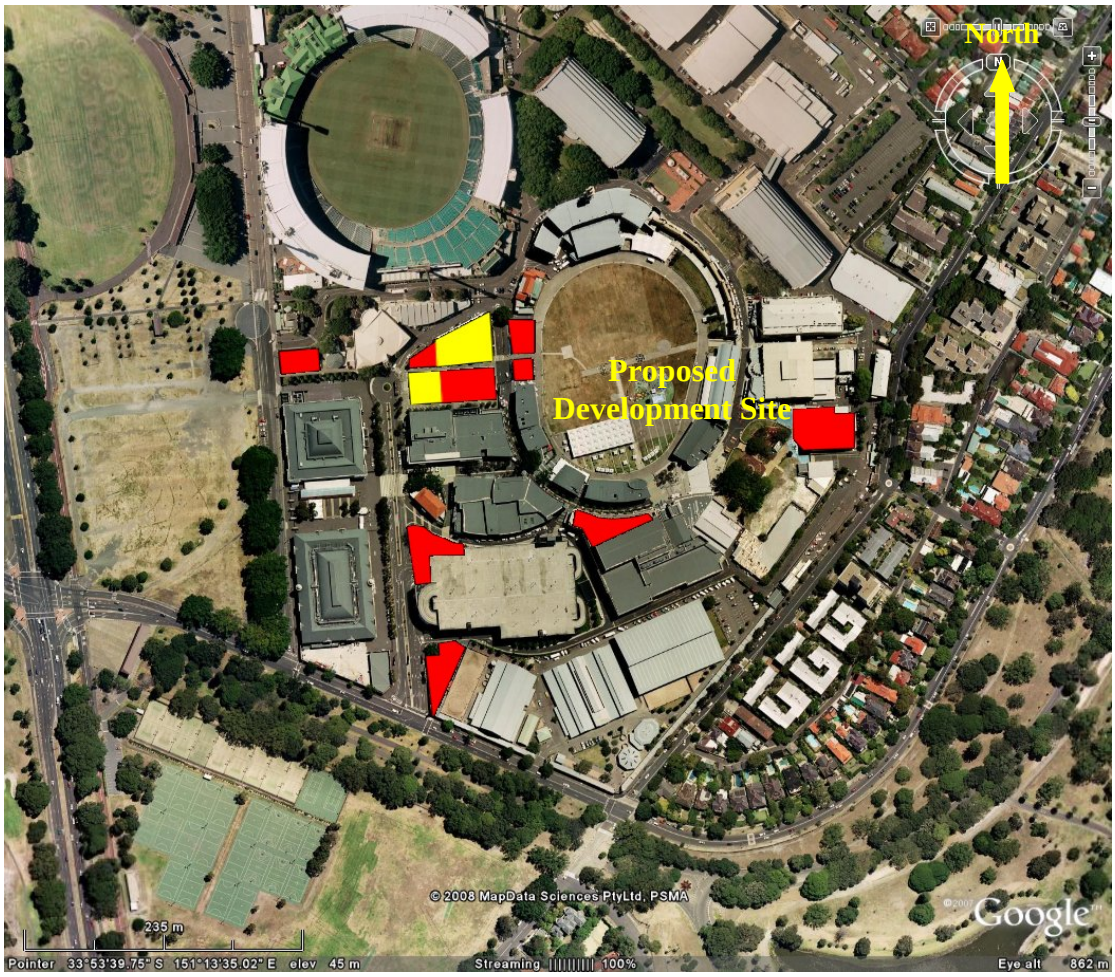


Figure 2 - Satellite image of site locations for the proposed new buildings at the Entertainment Quarter, Sydney, NSW.

This report details the opinion of VIPAC as an experienced wind consultancy regarding the wind effects in ground level public areas and access-ways in and adjacent to the proposed buildings. No wind tunnel testing has been carried out at this stage. Wind tunnel testing where required is more appropriately undertaken when the architectural design of buildings is resolved.

Drawings of the proposed Development were supplied to Vipac by BBC Consulting Planners dated January 2009.

2. SITE EXPOSURE

The site of the proposed Development is located 2.5km to the south east of Sydney's CBD. Within a 5km radius of the site of the proposed Development there is a mixture of low, medium and high-rise developments. The site of the proposed Development is located on terrain that rises to the east.

Considering the immediate surroundings and terrain, the site of the proposed Development is assumed to be within a terrain Category 3 for all wind directions.

2.2 REGIONAL WIND CLIMATE

The mean and gust wind speeds have been recorded in the Sydney area for over 30 years. This data has been analysed and the directional probability distribution of wind speeds have been determined. The directional distribution of hourly mean wind speed at the gradient height (≈500m), with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 3. The wind data at this free stream height is common to all Sydney city sites and may be used as a reference to assess ground level wind conditions at the Site.

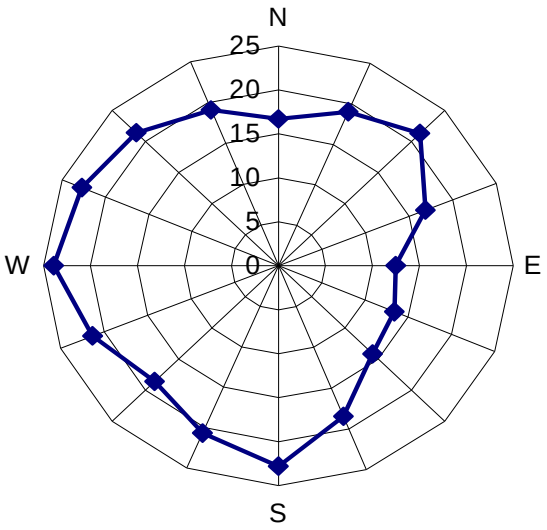


Figure 3 - Directional Distribution of Annual Return Period Mean Hourly Wind Velocities (ms^{-1}) at Gradient Height of 500m for Sydney.

2.3 ASSESSMENT CRITERIA

With some consensus of international opinion, pedestrian wind comfort is rated according to the suitability of certain activities at a site in relation to the expected annual peak 3-second gust velocity at that location for each wind direction. Each of the major areas (public pedestrian walkways, building entrances, outside sitting area) around the site are characterised by the annual maximum gust wind speeds. Most patrons would consider a site generally unacceptable for its intended use if it were probable that during one annual wind event, a peak 3-second gust occurs which exceeds the established comfort threshold velocity. If that threshold is exceeded once per year then it is also likely that during moderate winds, noticeably unpleasant wind conditions would result, and the windiness of the location would be voted as unacceptable.

The threshold gust velocity criteria are:

Annual Maximum Gust Speed	Result on Perceived Pedestrian Comfort
>23m/s	Unsafe (frail pedestrians knocked over)
<16m/s	Acceptable for Walking (steady steps for most pedestrians)
<13m/s	Acceptable for Standing (window shopping, vehicle drop off, queuing)
<10m/s	Acceptable for Sitting (outdoor cafés, pool areas, gardens)

Table 1 – Recommended Wind Comfort and Safety Gust Criteria

In a similar manner, a set of hourly mean velocity criteria with a 1% probability of occurrence are also applicable to ground level areas in and adjacent to the proposed Development. An area should be within both the relevant mean and gust limits in order to satisfy the particular human comfort and safety criteria in question.

The threshold mean velocity criteria are:

Annual Maximum Mean Speed	Result on Perceived Pedestrian Comfort
>15m/s	Unsafe (frail pedestrians knocked over)
<10m/s	Acceptable for Walking (steady steps for most pedestrians)
<7m/s	Acceptable for Standing (window shopping, vehicle drop off, queuing)
<5m/s	Acceptable for Sitting (outdoor cafés, pool areas, gardens)

Table 2 – Recommended Wind Comfort and Safety Mean Criteria

Recommended Criteria

The following table lists the specific areas adjacent to the Development and the corresponding recommended criteria.

Area	Recommended Criteria
Public Footpaths	Acceptable for Walking
Building Entrances	Acceptable for Standing
Outdoor cafés, gardens	Acceptable for Sitting

Table 3 – Recommended application of criteria

3. PREDICTED AERODYNAMIC INTERACTIONS AND PEDESTRIAN LEVEL WIND CONDITIONS

North easterly and north westerly winds

The north easterly and north westerly winds, though relatively strong in magnitude are not expected to cause any adverse conditions in the ground level areas. This is mainly because of the relative orientation of the proposed new building to these approaching wind directions.

Westerly winds:

The westerly winds considered to be the strongest of all wind directions (Sydney's wind climate), could approach wind conditions close to the walking comfort criteria near some pedestrian footpath areas.

The effects of these westerly winds could be mainly expected near the footpath areas between buildings B and C and also near the footpath areas on Errol Flynn Brde (adjacent to Building F). The adverse conditions at ground level areas between Buildings B and C are mainly due to channelling flows caused as a result of the relative orientation of these Buildings to the approaching wind direction. The later effects on the footpath area adjacent to Building F on Errol Flynn Brde are mainly caused by downwash flows, which in turn are caused by the relatively flat western façade of Building F.

For other directions either the surrounding developments are expected to significantly shelter the proposed Development or the form of the proposed Development is considered unlikely to produce adverse ground level wind effects or the wind climate for those directions is weak. Furthermore, the proposed new buildings are not expected to cause any significant changes to the existing wind conditions at ground level areas within the Entertainment Quarter.

It is to be noted that the current assessment is not made based on a detailed design. All of the above assessments are based on building envelopes only.

4. GENERAL RECOMMENDATIONS

Recommendations regarding the various wind ameliorating devices for future development proposals are described below.

4.1.1. Building Orientation/ Massing

- It is recommended that main entrances shall not be located near building corners.
- Curved edges to the buildings would help reduce corner accelerating flows and improve pedestrian comfort conditions at ground level areas.

4.1.2. Use of Canopies/ Awnings

- Canopies around the base of each of the buildings would be a distinct advantage, since they assist to mitigate down wash flows.
- Canopies in combination with trees would provide both vertical and horizontal elements of protection especially for ameliorating channelling flows between Buildings B and C.
- With regards to the downwash flows from buildings, set backs, such as podium canopies, are effective in wind amelioration.

4.1.3. Use of Trees as Wind breaks

- Choose an evergreen species with medium to heavy leaf density; this shall apply for all trees considered in the landscape plan.
- Foliage density should be maintained close to the outer periphery of the crown and extend as close to ground level as possible.
- Solid barriers produce a significant localised wind reduction but tend to displace the wind problem.
- Small flow accelerations should be expected around the trees or between gaps in a row of trees and hence spacing should be as close as possible.
- The height of the tree should be approximately twice the height of the area to be protected (e.g. twice pedestrian height).
- Height to width ratio should be around 2:1 or 3:1. Cylindrical shaped crowns are just as effective in absorbing wind energy as a square faced hedge.
- Many other considerations exist in choosing tree species such as water, light, salt levels in the air, use of planter boxes, soil, drainage, weather conditions and town planning regulations.

5. CONCLUSIONS

An appraisal of the likely wind conditions caused by the proposed new Developments with the Entertainment Quarter in Sydney has been conducted.

The proposed new Development consists of 9 buildings located at various locations within the Entertainment Quarter, which is approximately 2.5km to the south east of Sydney's CBD.

Vipac have carefully considered the form and exposure of the proposed Development, nominated criteria for various ground level areas and referred to past experience to produce our opinion of likely ground level wind conditions adjacent to the proposed Development.

In Vipac's opinion, that at most locations, the proposed new Buildings will not cause any significant changes to the existing wind conditions within the Entertainment Quarter region. Based on the assessments made on the provided concept drawings, the proposed buildings are not expected to exceed the criteria for safety at any locations. Furthermore, detailed analysis will be more appropriately undertaken when the architectural design of buildings is resolved.

General recommendations have been made based on experience of similar situations in Sydney and around the world. As with any opinion, it is possible that an assessment of wind effects based on experience and without wind tunnel model testing may be in error.

This Report has been Prepared

For

BBC Consulting Planners

By

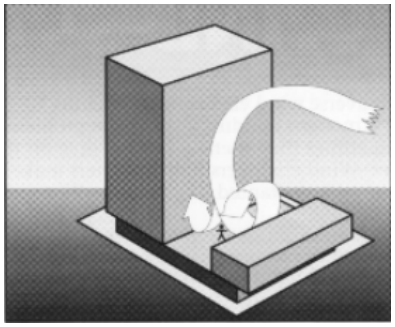
VIPAC ENGINEERS & SCIENTISTS LTD.

APPENDIX A - ENVIRONMENTAL WIND EFFECTS

Atmospheric Boundary Layer

As wind flows over the earth it encounters various roughness elements and terrain such as water, forests, houses and buildings. To varying degrees, these elements reduce the mean wind speed at low elevations and increase air turbulence. The wind above these obstructions travels with unattenuated velocity, driven by atmospheric pressure gradients. The resultant increase in wind speed with height above ground is known as a wind velocity profile. When this wind profile encounters a tall building, some of the fast moving wind at upper elevations is diverted down to ground level resulting in local adverse wind effects.

The terminology used to describe the wind flow patterns around the proposed Development is based on the aerodynamic mechanism, direction and nature of the wind flow.



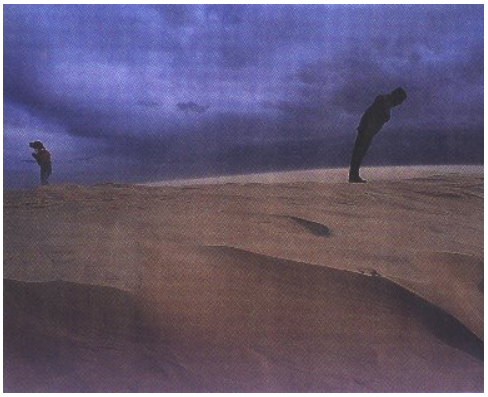
Downwash – refers to a flow of air down the exposed face of a tower. A tall tower can deflect a fast moving wind at higher elevations downwards.

Corner Accelerations – when wind flows around the corner of a building it tends to accelerate in a similar manner to airflow over the top of an aeroplane wing.

Flow separation – when wind flowing along a surface suddenly detaches from that surface and the resultant energy dissipation produces increased turbulence in the flow. Flow separation at a building corner or at a solid screen can result in gusty conditions.

Flow channelling – the well-known “street canyon” effect occurs when a large volume of air is funnelled through a constricted pathway. To maintain flow continuity the wind must speed up as it passes through the constriction. Examples of this might occur between two towers, in a narrowing street or under a bridge.

Direct Exposure – a location with little upstream shielding for a wind direction of interest. The location will be exposed to the unabated mean wind and gust velocity. Piers and open water frontage may have such exposure.



APPENDIX B - REFERENCES

[1] *Structural Design Actions, Part 2: Wind Actions*, Australian/New Zealand Standard 1170.2:2002

[2] *Wind Effects on Structures* E. Simiu, R Scanlan, Publisher: Wiley-Interscience

[3] *Architectural Aerodynamics* R. Aynsley, W. Melbourne, B. Vickery, Publisher: Applied Science Publishers

APPENDIX C – DRAWING LIST

Name	Size	Type	Date Modified
a3 drawings.pdf	4,422 KB	Adobe Acrobat Doc...	20/01/2009 9:27 AM