

DEFINED DEVELOPMENTS

TOP RYDE CITY– PROPOSED COMMERCIAL BUILDINGS A & B

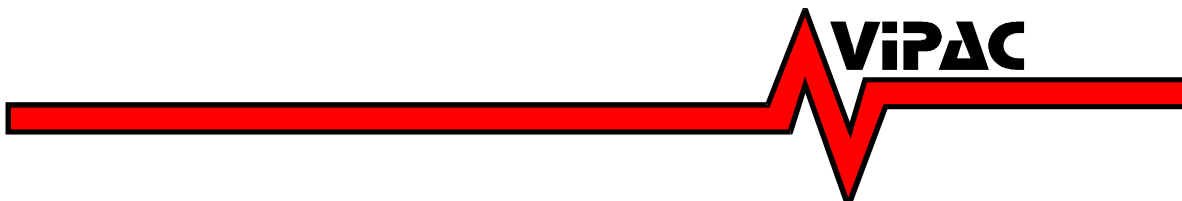
WIND EFFECTS STATEMENT

Report No. 30B-08-0350-TNT-427331-2-

VIPAC Engineers & Scientists Ltd

Sydney, NSW



March 2009





Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 2 of 15

DOCUMENT CONTROL

TOP RYDE CITY – PROPOSED COMMERCIAL BUILDINGS A & B		
Wind Effects Statement		
REPORT NO: 30B-08-0350-TNT-427331-2 PREPARED FOR: Defined Developments Contact: Tim Campbell Phone: Fax:	LIBRARY CODE: PREPARED BY: VIPAC Engineers & Scientists Ltd 2 Sirius Road LANE COVE NSW 2066 AUSTRALIA Email: sydney@vipac.com.au Phone: (02) 9422 4222 Fax : (02) 9420 5911	
AUTHOR:	 ----- Harry Fricke Consulting Wind Engineer	Date: 17 th March 2009
REVIEWED BY:	 ----- Dr Seifu Bekele Principal Wind Engineer	Date: 17 th March 2009
APPROVED BY:	-----	
REVISION HISTORY:		
Revision No.	Date Issued	Reason/Comments
0	13/11/08	Initial Issue
1	16/3/09	Revised drawings
2	17/3/09	Updated commentary
DISTRIBUTION:		
Copy No. <u> 2 </u>		Location
1		Project
2	Uncontrolled Copy	Client (PDF Format)
KEYWORDS:		
Wind Effects, Defined Developments, Top Ryde Shopping Centre		

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 If revised, it must be marked SUPERSEDED and returned to the Vipac QA Representative.



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 3 of 15

EXECUTIVE SUMMARY

Defined Developments commissioned Vipac Engineers and Scientists to prepare a statement of pedestrian wind effects for the Top Ryde City Proposed Commercial Buildings A & B Levels 5 to 8 (referred to hereafter as “the proposed Redevelopment”). This appraisal is based on VIPAC’s experience as a wind-engineering consultancy and previous model scale wind tunnel tests of an aerodynamically similar configuration of the proposed Redevelopment (refer to Vipac Report no. 30B-06-0084-TRP-235022-1 [4]).

VIPAC predicts wind conditions in the outdoor building corner terrace areas of the Redevelopment as proposed would meet the relevant criteria.

The findings of this study can be summarised as follows:

- The outdoor areas in consideration are east-facing terraces at the building corners (levels 5 to 8) of the proposed Redevelopment.
- Vipac predicts wind conditions in the Terraces would meet the minimum recommended criterion for such areas, the criterion for safety.

The recommendations and assessments provided in this report have been made based on some wind tunnel test results of adjacent areas for similar configurations of the Redevelopment and 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 can be in error.



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 4 of 15

TABLE OF CONTENTS

TABLE OF CONTENTS	4
1.0 INTRODUCTION	5
1.1 ENVIRONMENTAL WIND EFFECTS.....	7
2.0 ASSESSMENT CRITERIA	8
3.0 THE SITE WIND ENVIRONMENT	9
3.1 SITE DESCRIPTION.....	9
3.2 SYDNEY APPROACH WINDS	9
4.0 PEDESTRIAN LEVEL WIND EFFECTS AND RECOMMENDATIONS	10
4.1 ANALYSIS APPROACH.....	10
4.2 RECOMMENDED CRITERIA.....	11
4.3 PREDICTED WIND EFFECTS	12
4.4 RECOMMENDATIONS.....	12
5.0 CONCLUSIONS	13
6.0 REFERENCES	14
ARCHITECTURAL DRAWINGS	15

LIST OF FIGURES

FIGURE 1: SCHEMATIC PLAN VIEW OF THE PROPOSED REDEVELOPMENT, RYDE	5
FIGURE 2: DIRECTIONAL DISTRIBUTION OF ANNUAL RETURN PERIOD MAXIMUM MEAN HOURLY WIND VELOCITIES (MS-1) AT GRADIENT HEIGHT OF 500M FOR SYDNEY.....	9
TABLE 1: INTERNATIONALLY ADOPTED WIND COMFORT CRITERIA	8
TABLE 2: RECOMMENDED CRITERIA FOR OUTDOOR AREAS.....	11

1.0 INTRODUCTION

Vipac Engineers & Scientists Ltd was commissioned by **Defined Developments** to carry out an appraisal of the pedestrian wind effects for the Top Ryde City Proposed Commercial Buildings A & B Levels 5 to 8 (referred to hereafter as the “proposed Redevelopment”).

The site is located on a block in Ryde bounded by Pope Street to the north, Tucker Street to the east, Blaxland Road to the south and Devlin Street to the west as shown in the DA documentation to be submitted to the City of Ryde.

The proposed Redevelopment consists of 2 medium rise tower structures on a low-rise retail building in a mixed low, medium and high-rise commercial/residential area approximately 10km to the northwest of the Sydney central business district.

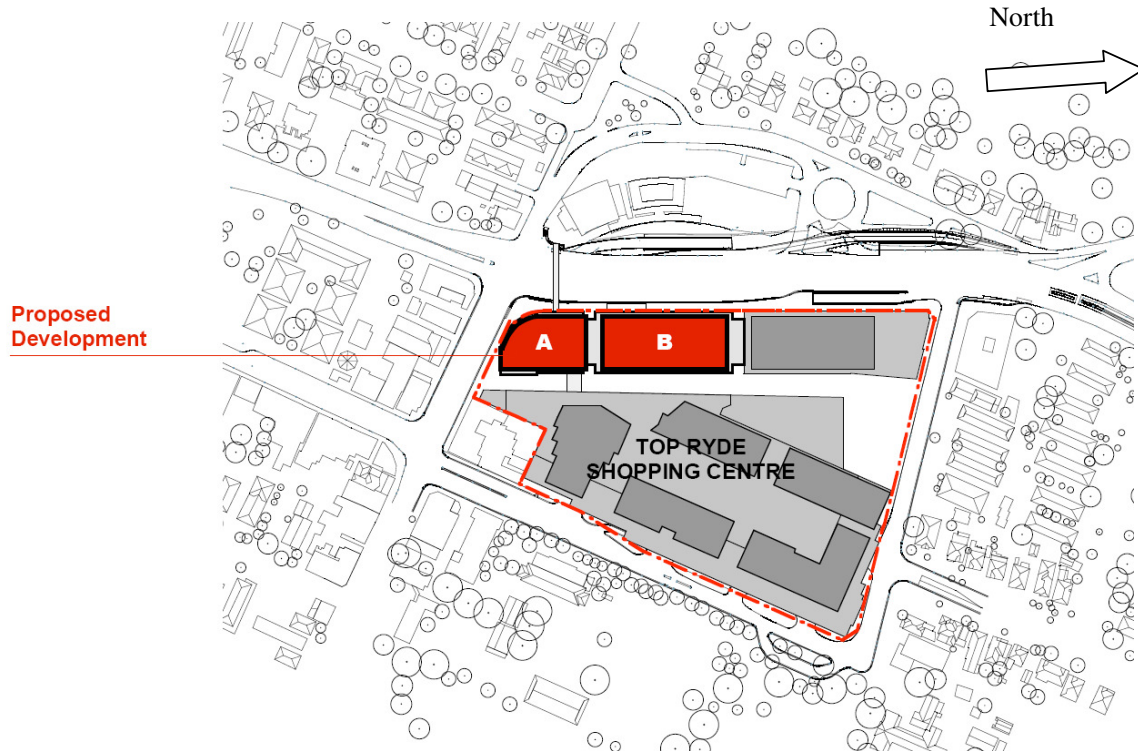


Figure 1: Schematic plan view of the proposed Redevelopment, Ryde.

This report details the opinion of VIPAC as an experienced wind consultancy regarding the wind effects in outdoor areas in and adjacent to the Redevelopment as proposed. Wind tunnel testing has not been carried out for this specific configuration of the proposed Redevelopment. VIPAC has carried out wind tunnel studies on other configurations of this Redevelopment and on a large number of developments of similar shape and having similar exposure to that of the



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 6 of 15

proposed Redevelopment. These serve as a valid reference for the prediction of wind effects for the proposed Redevelopment.

This assessment is based on the drawings supplied to VIPAC by Defined Developments dated February 2009. A list of the drawings supplied are provided in Appendix A.

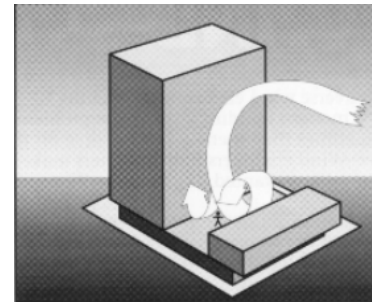
1.1 ENVIRONMENTAL WIND EFFECTS

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 Redevelopment is based on the aerodynamic mechanism, direction and nature of the wind flow.

Downwash – refers to the rush of air down the exposed face of a tower. A tall tower can catch the fast moving wind at higher elevations and deflect it down to its base.



Corner Accelerations – when wind is forced to bend around the corner of a building it tends to accelerate in a similar manner to that of flow over the top of an aeroplane wing.

Flow separation – when wind flowing along a surface suddenly detaches from that surface, 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 and forced to travel within a constricted pathway. To maintain flow continuity the wind must speed up as it passes between two towers or a narrowing street or under a bridge for example.

Direct Exposure – a location with little upstream shielding, which would experience the mean and gust velocity of the unabated wind flow during a key prevailing wind direction. Locations such as a pier, or open water frontage may have such exposure.





2.0 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 around the site are characterised by the annual maximum gust expected there. 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 (unsteady steps for some pedestrians)
<13m/s	Acceptable for Standing (window shopping, vehicle drop off, queuing)
<10m/s	Acceptable for Sitting (outdoor café's, pool area, gardens)

Table 1: Internationally Adopted Wind Comfort Criteria

It is suggested that for the proposed Redevelopment the applicable criteria would be:

- ⇒ Wind gusts within the safe condition (i.e., under 23m/s annual gust) for all public and residential areas adjacent to and within the proposed Redevelopment.
- ⇒ Wind conditions meeting the “Acceptable for Walking” criterion for all access-ways within the proposed Redevelopment, adjacent roadways and properties
- ⇒ Wind conditions meeting the “Acceptable for Standing Comfort” criterion at major building entrances and retail window display areas.
- ⇒ Wind conditions meeting the “Acceptable for Sitting Comfort” in outdoor retail areas within the proposed Redevelopment.
- ⇒ In the event that existing wind conditions in adjacent private properties are deemed acceptable, the proposed Redevelopment should not substantially change these conditions.

For cases where Vipac predicts that a location would not meet its appropriate comfort criterion we may recommend the use of wind control devices and/or local building geometry modifications to achieve the desired comfort rating. For complex flow scenarios or where predicted flow conditions are well in excess of the recommended criteria, Vipac recommend scale model wind tunnel testing to determine the type and scope of the wind control measures required to achieve acceptable wind conditions.

3.0 THE SITE WIND ENVIRONMENT

3.1 SITE DESCRIPTION

The site is located on a block in Ryde bounded by Pope Street to the north, Tucker Street to the east, Blaxland Road and an existing development to the south and Devlin Street to the west.

There are existing low and medium-rise residential and commercial developments on undulating terrain in all directions within a 2-kilometre radius of the proposed Redevelopment. The site of the proposed Redevelopment is therefore considered to be within a Terrain Category 3 for all wind directions [Reference 1].

3.2 SYDNEY APPROACH WINDS

The mean and gust wind speeds have been recorded in the Sydney area for 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 ($\approx 500\text{m}$), with a probability of occurring once per year (i.e. 1 year return period) is shown in Figure 2. The wind data at this freestream 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 2 indicates that the stronger winds can be expected from the northeasterly, southerly and westerly directions.

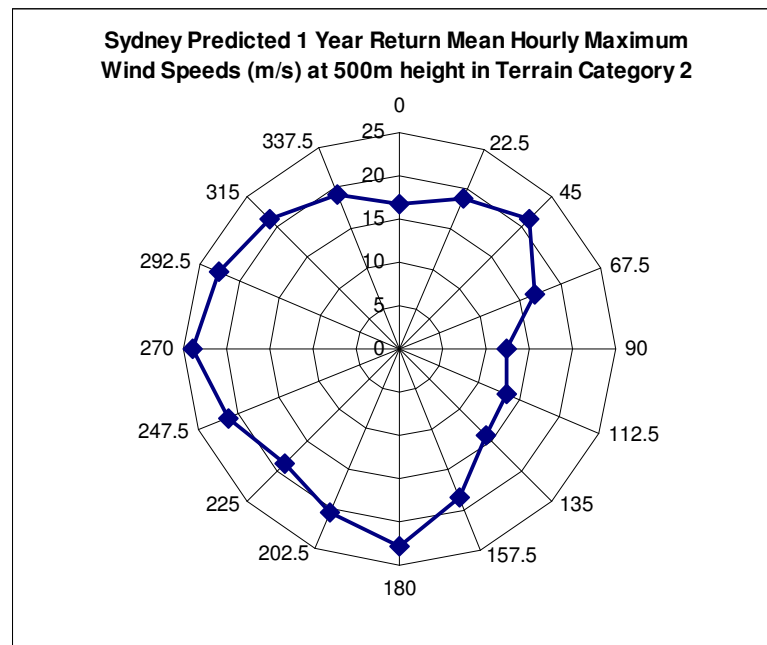


Figure 2: Directional Distribution of Annual Return Period Maximum Mean Hourly Wind Velocities (ms-1) at gradient height of 500m for Sydney.



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 10 of 15

4.0 PEDESTRIAN LEVEL WIND EFFECTS AND RECOMMENDATIONS

4.1 ANALYSIS APPROACH

When considering whether a proposed development is likely to generate adverse wind conditions in adjacent ground level areas, VIPAC considers five main points:

- The exposure of the proposed development to wind
- The regional wind climate
- The geometry and orientation of the proposed development
- The interaction of flows with adjacent developments
- The intended use of the public areas and access-ways affected by wind flows generated or augmented by the proposed development.

Exposure of the proposed Redevelopment

The proposed Redevelopment is considered to be significantly exposed to wind flows, being approximately 2 to 4 times taller than the majority of adjacent developments.

These predictions are reflected in the wind tunnel test results for similar configurations of the proposed Redevelopment.

The Regional Wind Climate

As discussed in Section 3.2, the Sydney wind climate generally experiences stronger winds from the northeasterly, southerly and westerly directions.

Geometry and Orientation of the proposed Redevelopment

The proposed Redevelopment has medium-rise, wide, flat facades in some cases approximately continuous to ground level facing the strong north-westerly and westerly winds of the Sydney region. There are a large number of closely spaced vertical screens on the facades of the proposed Redevelopment.

Flow interactions with adjacent developments

With the exception of the residential towers of the Top Ryde Shopping Centre to the east, the adjacent developments are considered too small or too far away to generate any significant direct flow interactions with the proposed Redevelopment.

The residential towers on the eastern side of Top Ryde Shopping Centre site are expected to provide some shelter for the proposed Redevelopment for easterly wind directions.



Intended use of Level 5 to 8 Terrace areas

The Level 5 to 8 Terraces on the eastern building corners are outdoor recreation areas to be used, when conditions permit, for building occupants for lunch breaks etc.

4.2 RECOMMENDED CRITERIA

Area	Recommended Criteria
Level 5 to 8 Terraces	Safety (refer to notes below)

Table 2: Recommended Criteria for Outdoor Areas.

Elevated Terrace Areas Recommended Criterion Discussion

Vipac recommend as a minimum the Terrace areas meet the criterion for safety since,

- these areas are not public spaces,
- the use of these areas is optional,
- it is likely to be difficult to achieve wind conditions meeting a more stringent criterion than the safety criterion on the Terrace areas of the proposed Development due to their exposure,
- many similar developments in Sydney and other Australian capital cities experience wind conditions on balconies and rooftop areas in the vicinity of the criterion for safety.

However, Vipac wish to clearly state that meeting the safety criterion in recreation areas will be no guarantee that occupants will find wind conditions in these areas acceptable.

It is Vipac's experience that outdoor recreation areas should be close to the criterion for sitting comfort in order that the majority of reasonable people consider such areas acceptable for their intended use from a wind point-of-view. Wind conditions over this criterion will tend to result in a perceived reduction in amenity of the area.

This perception may be due to:

- the cooling effect of the wind on the human body,
- the removal of lightweight items such as towels, serviettes, newspapers, lightweight furniture (eg. plastic lounges),
- difficulty hearing others speak



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 12 of 15

Wind conditions meeting the criterion for safety may still result in the following adverse effects whilst the Terrace areas are unoccupied:

- the removal of furniture during storms.

4.3 PREDICTED WIND EFFECTS

The proposed Redevelopment is significantly taller than the adjacent developments in all directions and is therefore exposed to wind flows moving above the surrounding developments. The proposed Redevelopment has some large, aerodynamically continuous façades which are exposed to the stronger north-easterly, north-westerly and westerly winds of the Sydney region.

Due consideration has been taken of the exposure of the proposed Redevelopment to the Sydney region wind climate, the geometry of the proposed Redevelopment and adjacent developments and the intended use of the upper level outdoor areas likely to be affected by wind flows generated by the proposed Redevelopment. Previous test results have also been used to estimate whether areas experiencing adverse wind conditions are likely (the reader is referred to VIPAC's wind tunnel study, VIPAC Report no. 30B-06-0084-TRP-235022-1 [4]).

VIPAC concludes that, as currently proposed, wind conditions on the proposed Terraces would meet the recommended criterion for safety. Wind conditions on the rooftop areas of the proposed Redevelopment are likely to be close to, and possibly in excess of, the safety criterion, particularly in areas nearer the building corners. Adjacent developments are not expected to be adversely affected by the proposed Redevelopment.

4.4 RECOMMENDATIONS

Vipac predicts the Level 5 to 8 Terraces should experience satisfactory wind conditions. However, based on Vipac's experience of such areas, Vipac recommends that the building management should monitor these areas to ensure lightweight items such as chairs etc. are stowed when not in use. There are many cases of such items being removed from terrace areas during storms and presenting a public hazard.



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 13 of 15

5.0 CONCLUSIONS

An appraisal of the wind conditions expected in and adjacent to the Top Ryde City Proposed Commercial Buildings A & B has been made.

The proposed Redevelopment consists of a medium-rise development on a site approximately 10km northwest of the Sydney Central Business District.

The geometry, orientation, surrounding developments, Terrace usage and the Sydney regional wind climate have been considered in this assessment of the likely wind conditions on the proposed Redevelopment. Vipac concludes that wind conditions in the Terraces of the proposed Redevelopment would be acceptable.

The recommendations and assessments provided in this report have been made based on wind tunnel test results of similar configurations of the proposed Redevelopment as tested by VIPAC and 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 can be in error. For this reason, if further study of the wind effects is required, we recommend a wind tunnel based assessment to develop the assessment of this report and to finalise the building design.

This Report has been Prepared

For

Defined Developments

By

VIPAC ENGINEERS & SCIENTISTS LTD.



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 14 of 15

6.0 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
- [4] *Assessment of Wind Effects, Top Ryde Shopping Centre Redevelopment, Ryde* Vipac Engineers and Scientists Ltd, Report no. 30B-06-0084-TRP-235022-1-



Report No. 30B-08-0350-TNT-427331-2-		
Defined Developments		
Top Ryde city- Proposed Commercial Buildings A & B		Page 15 of 15

ARCHITECTURAL DRAWINGS

Drawings supplied by Defined Developments to Vipac for this study:

Drawing Number	Revision	Date
DA00	K	27/2/09
DA01	J	27/2/09
DA02	K	27/2/09
DA20	L	27/2/09
DA21	N	27/2/09
DA22	N	27/2/09
DA23	J	27/2/09
DA24	K	27/2/09
DA40	H	27/2/09
DA41	K	27/2/09
DA42	G	27/2/09
DA43	H	27/2/09
DA44	G	27/2/09
DA45	G	27/2/09
DA46	F	27/2/09
DA47	G	27/2/09
DA50	H	27/2/09
DA61	J	27/2/09

This Report Has Been Prepared
For
DEFINED DEVELOPMENTS
by
VIPAC ENGINEERS & SCIENTISTS Ltd