Defined Developments

Top Ryde City Development

Reflectivity Assessment – Stage 2 DA
Commercial Buildings A & B

Report No. 20C-08-0195-TRP-251313-2

Vipac Engineers & Scientists Ltd

Sydney, NSW

9th March 2009

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REPORT NO:	**LIBRARY CODE:**
20C-08-0195-TRP-251313-2	
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REVISION HISTORY:

Revision No.	Date Issued	Reason/Comments
0	11th November 2008	Initial Issue
1	4th March 2009	Minor adjustments
2	9th March 2009	Final Issue

DISTRIBUTION:

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KEYWORDS: Top Ryde City Development, Reflectivity

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EXECUTIVE SUMMARY

VIPAC Engineers & Scientists Ltd. has been commissioned by Defined Developments to assess the interaction of the proposed Top Ryde City Development with the local environment in terms of Reflectivity.

The site is located on a block bounded by Pope Street to the north, Tucker Street to the east and Blaxland Road to the south. The towers sit above a four level carpark already approved in a separate DA submission. An existing building (Ryde Civic Centre) located to the west on Devlin Street of the site & proposed developments.

The glazing elements of the proposed building facades have been investigated in this report as a potential source of road traffic disability discomfort glare.

The analysis has identified no instances in which reflections from the proposed buildings could cause a *persistent* disability glare to motorists & pedestrians. VIPAC assumed all façades to have a visible light reflectivity coefficient of 20%.

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1. INTRODUCTION

VIPAC Engineers & Scientists Ltd. has been commissioned by Defined Developments to assess the interaction of the proposed Top Ryde City Development with the local environment in terms of Reflectivity.

This study uses the results of a simulation that models the solar movements in relation to the proposed building development. Reflection conditions were modelled for all daylight hours throughout the year.

When analysing effects of building reflections the first consideration is the geometry of the possible incoming solar rays relative to the building. Below in Figure 1 shows the geometry of solar rays striking a flat surface.

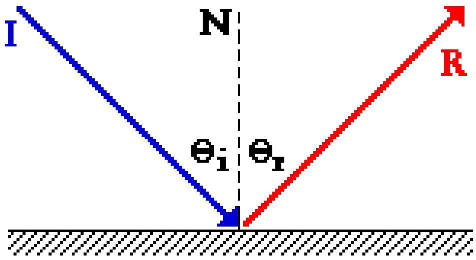

Figure 1: Reflection Geometry

Angle of incidence (θ_i) is the angle the incoming solar rays make with the surface normal. Angle of reflection (θ_r) is the angle the reflected solar rays make with the surface normal.

Figure 2 shows the percentage of reflected light as a function of angle of incidence. As shown, as the angle of incidence increases the percentage of reflected light increases. Hence the higher the angle of incidence, the more glare occurrences may be experienced.

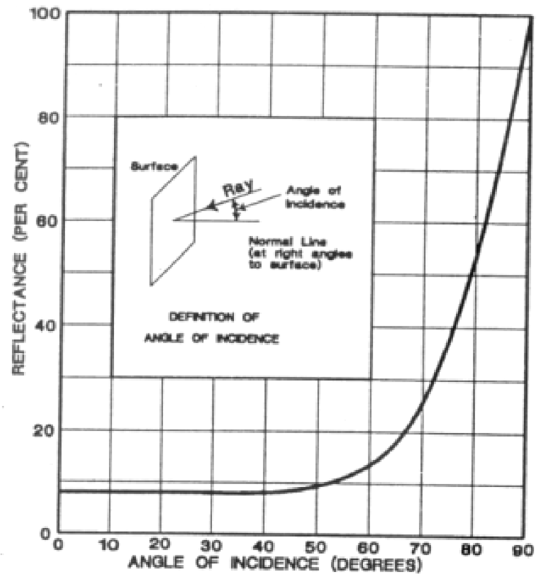

Figure 2: Graph showing change of reflection factor with change of incidence[1]

The level of glare discomfort and visual disability is evaluated using a calculated parameter called the Threshold Increment* (TI). TI is based on the perception of an object, which is dependant on the luminance of that object relative to the illumination of the background. For example, if the target and the background have the same colour and the same level of illumination, then it will be impossible to distinguish the target from the background.

**A description of the TI concept is given in "Occasional Paper No.11 – Building Reflectivity: Quantitative Assessment of Solar Glare from Vertical Glazed Curtain Walls. Vipac Engineers and Scientists".*

The approach VIPAC applies uses the maximum recommended TI of 20[2]. The maximum TI used in each analysis varies with respect to the class type of the road and traffic activity that surrounds the development. All roads are classified as 'Important rural or urban roads with heavy traffic & moderate speed" with a criteria value of TI=20.

These and other considerations affecting glare potential are discussed further in Appendix A of this report. The methodology used by VIPAC to calculate and assess potential rogue building reflections is outlined in Appendix A.

Following is a listing of factors by which reflections can be limited or eliminated from consideration.

A. Incident angles of solar rays relative to cladding

Mullions on facades will tend to intersect (block) incident and/or reflected solar rays with high incident angles. The specific incident angle is a function of mullion depth and spacing.

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[1] Hassall, D.N.H., *Reflectivity: Dealing with rouge solar reflections* pg 1, 1991

[2] Australian Standard ® AS1158.1.1-1997: Road Lighting Part 1.1:- Vehicular traffic (Category V) lighting – Performance and installation design requirements, page 10.

B. Lateral Vision

Reflections to a receiver occurring outside of 45° to the direction of travel will not cause any disability to the receiver.

C. Solar Altitude

Reflected rays will be intersected by vehicle windscreen line and/or windscreen sun-visor when the sun is above a certain altitude. The sun angle at this cut-off altitude is called the visual cut-off angle and is taken to be 20°.

D. Façade surfaces have diffuse reflective properties.

E. Direction of travel relative to the reflection direction

The degree to which the direction of the reflection coincides with the direction of travel and/or the required line of vision, thereby creating the potential for a persistent reflection.

F. Shading from surrounding structures

Surrounding buildings that block:

- Incident solar rays from reaching the buildings
- Reflections from reaching the plane of the road.

G. Threshold Increment Value (TI)

Reflections that reach observers on the plane of the road are assessed for the level of discomfort and visual disability using a measure based on the TI value that fall below the critical level.

2. DESCRIPTION OF FACADE

Figure 3 shows an overall plan view of the development, outlining its location with respect to the surrounding roadways and buildings. The building reaches a height of approximately 23 metres.

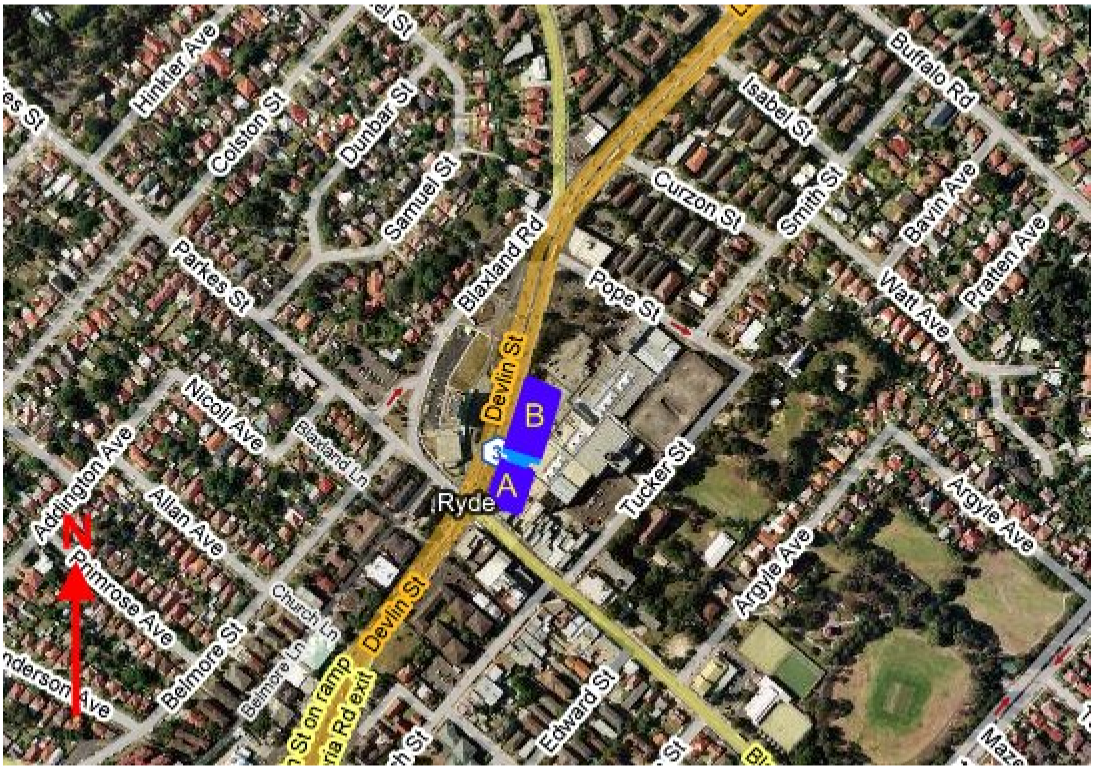

Figure 3 – Outline of Proposed Building Site[3] (marked blue). Not to scale.

The following features comprise of the facades exposed to motorists and pedestrians. Estimates of proportions of façade details are obtained from the drawings provided and are approximate.

- ***North façade***
  - 90% glass curtain wall with horizontal louvered blades.
  - 10% precast concrete
- ***Southwest façade***
  - 95% glass curtain wall with vertical fixed blades spaced approximately 1800mm and 900mm depth
  - 5% precast concrete
- ***South façade***
  - 90% glass curtain wall

[3] Compiled from Google maps ©2008

- 10% precast concrete

- ***East & West façade***

  - 90% glass curtain wall with vertical fixed blades spaced approximately 1800mm and 900mm depth

  - 10% precast concrete

In the analysis, the external glazing on all façade faces are assumed to have a visible light reflectivity coefficient of 20%. The shading effect of articulated facades are also taken into account when determining the reflections off any façade in the assessment.

Local Traffic Environment ...

Pope Street is located to the north of the site, along with Tucker Street to the east with low traffic flow. Blaxland Road to the south & Devlin Street to the west of the site have medium to high traffic flow. All traffic areas exposed to the facades of the development were examined for disability and discomfort glare.

Local Built-Up Environment ...

Medium-rise apartment buildings are located to the north and low & medium-rise developments to the east and existing to the south of the site. The existing Ryde Civic Centre is located to the west of the site.

3. OBSERVER LOCATIONS

Some of the "observer" locations monitored for reflected glare located on surrounding roadways and pedestrian areas are indicated in Figure 4, specified by numerical, "1","2", etc.

1-19. North/Southbound on Devlin St

20-29. East/Westbound on Blaxland Rd

30-34. East/Westbound on Parkes St

35-37. North/Southbound on Blaxland Rd

38-43. Eastbound on Pope St (one way)

43-48. North/Southbound on Tucker St

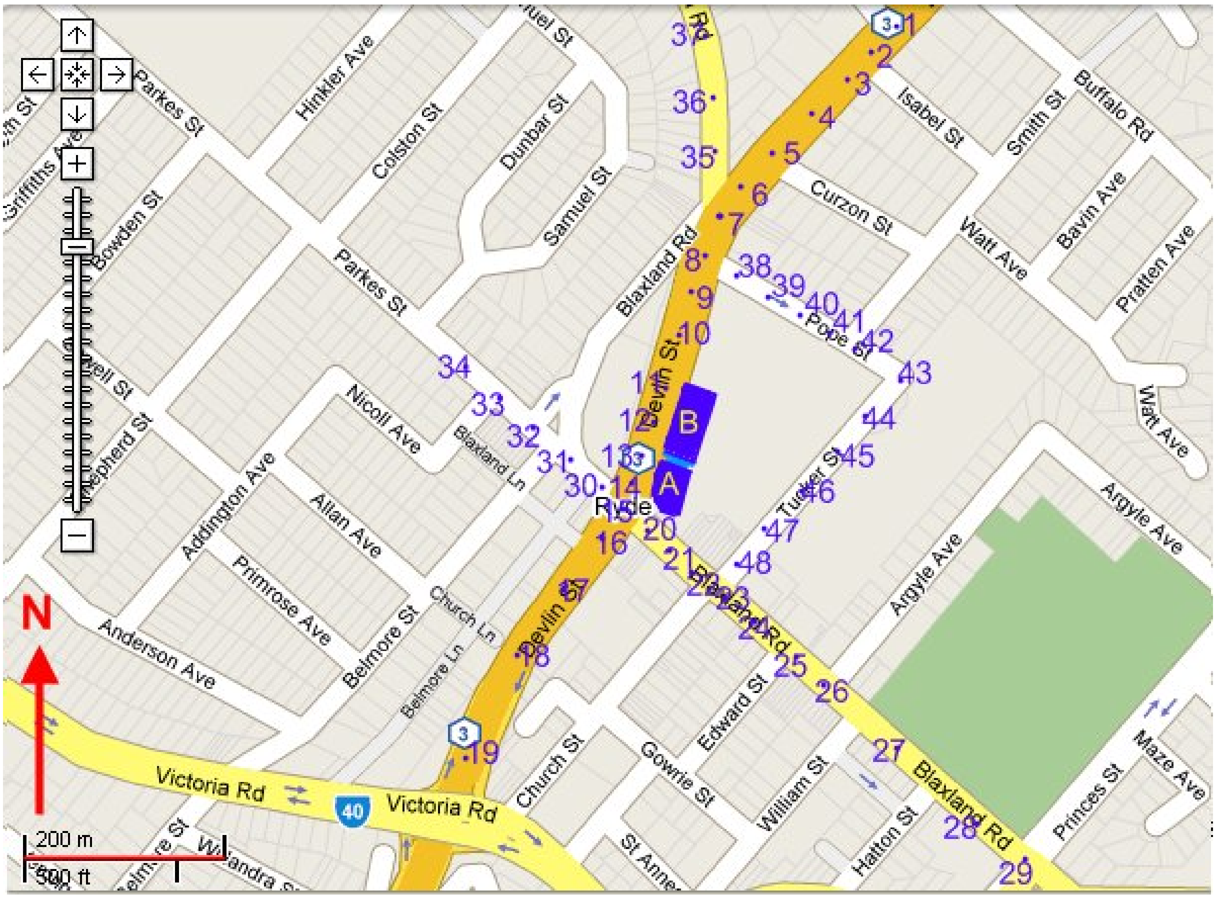

Figure 4 - Location of Drivers & Pedestrians Relative to the Development.

The area bounded in blue denotes the proposed building site[4]. Not to scale.

[4] Compiled from Google maps ©2008

4. SOLAR ANALYSIS RESULTS

This analysis determines the possibility of adverse glare effects on drivers and pedestrians from facades of the development that may cause visual impairment. This is assessed on all positions along adjacent roads (refer to Figure 4).

4.1. NORTH FAÇADE FACING POPE STREET

There are no potential high adverse glare events that occur along Pope Street and Devlin Street to impact drivers and pedestrians.

4.2. EAST FAÇADES FACING TUCKER STREET

The potential for high adverse glare events to impact drivers and pedestrians on Blaxland Road reaches a peak due to the relative geometric positions of sun, façade and position and direction of travel of the motorist & pedestrian:

- ❖ During early morning (2 – 3 hours after sunrise) between March to September.

At these times of day the driver/pedestrian does not experience predicted discomfort glare exceeding the acceptable criteria (TI >20) due to the following factors:

- ➢ Self-shading of the façade shape and articulation due to vertical blades reduce glare effects.
- ➢ Significant solar blockage from Retail/Cinema building directly north of building.
- ➢ The pedestrians have the ability to adjust their line of sight.

It should be noted that the vertical blades are to be specified on the façade as **not** buffed or polished.

Accordingly with all the conditions outlined above, these reflections are unlikely to cause adverse glare conditions for pedestrians and motorists.

4.3. SOUTH FAÇADE FACING BLAXLAND ROAD

The potential for high adverse glare events to impact drivers and pedestrians on Blaxland Road reaches a peak due to the relative geometric positions of sun, façade and position and direction of travel of the motorist & pedestrian:

- ❖ During late afternoon (1 – 2 hours before sunset) between October to February.

At these times of day the driver/pedestrian does not experience predicted discomfort glare exceeding the acceptable criteria (TI >20) due to the following factors:

- ➢ Significant solar blockage from surrounding buildings

- The pedestrians have the ability to adjust their line of sight.

Accordingly with all the conditions outlined above, these reflections are unlikely to cause adverse glare conditions for pedestrians and motorists.

4.4. SOUTHWEST FAÇADE FACING CORNER OF BLAXLAND ROAD & DEVLIN STREET

The potential for high adverse glare events to impact drivers and pedestrians on Devlin Street reaches a peak due to the relative geometric positions of sun, façade and position and direction of travel of the motorist & pedestrian:

- During late afternoon (1 – 2 hours before sunset) between November to January.

At these times of day the driver/pedestrian may experience a marginal exceedence of the predicted discomfort glare acceptable criteria (TI >20). However, the likelihood of the glare occurrence are reduced due to the following factors:

- Self-shading of the façade shape and articulation due to vertical blades reduce glare effects.
- The pedestrians have the ability to adjust their line of sight.

It should be noted that the vertical blades are to be specified on the façade as **not** buffed or polished.

Accordingly with all the conditions outlined above, these reflections are unlikely to cause adverse glare conditions for pedestrians and motorists.

4.5. WEST FAÇADES FACING DEVLIN STREET

The potential for high adverse glare events to impact drivers and pedestrians on Devlin Street reaches a peak due to the relative geometric positions of sun, façade and position and direction of travel of the motorist & pedestrian:

- During late morning (1-2 hours before midday) all year round
- During mid afternoon (midday to an hour after midday) all year round.

At these times of day the driver/pedestrian does not experience predicted discomfort glare exceeding the acceptable criteria (TI >20) due to the following factors:

- Self-shading of the façade shape and articulation due to vertical blades reduce glare effects.
- The pedestrians have the ability to adjust their line of sight.

It should be noted that the vertical blades are to be specified on the façade as **not** buffed or polished.

Accordingly with all the conditions outlined above, these reflections are unlikely to cause adverse glare conditions for pedestrians and motorists.

5. SUMMARY

The analysis has identified no instances in which reflections from the proposed buildings could cause a *persistent* disability glare to motorists & pedestrians. VIPAC assumed all façades to have a visible light reflectivity coefficient of 20%.

In summary, through a combination on choice of cladding, façade orientation and design, and special façade treatments, no facades of the proposed development will produce reflections causing either disability glare for passing motorist or unacceptable discomfort glare for passing pedestrians.

6. ARCHITECTURAL DRAWINGS

The environmental assessment carried out in this report was based on the following architectural drawings supplied by Turner + Associates.

DA00	Cover Page, Location Plan & Drawing Schedule	NTS	revision K
DA01	Site Analysis Plan	1:1000 @ A1	revision J
DA02	Site Plan	1:500 @ A1	revision K
DA20	Ground Level_Devlin Street [Lobby Fitout Only]	1:200 @ A1	revision L
DA21	Level 3 Plan (Parking)	1:200 @ A1	revision N
DA22	Level 4 Plan (Parking)	1:200 @ A1	revision N
DA23	Level 5 - 8 (Commercial Office, Typical)	1:200 @ A1	revision J
DA24	Roof Plan (Plant)	1:200 @ A1	revision K
DA40	Context Elevations_Devlin Street & Strada	1:500 @ A1	revision H
DA41	West Elevation (Devlin Street)	1:200 @ A1	revision K
DA42	South Elevation (Blaxland Street)	1:200 @ A1	revision G
DA43	East Elevation (Strada)	1:200 @ A1	revision H
DA44	North Elevation (Building A + B)	1:200 @ A1	revision G
DA45	Internal South Elevation (Building B)	1:200 @ A1	revision G
DA46	Section AA (Typical)	1:200 @ A1	revision F
DA47	Section BB (Typical)	1:200 @ A1	revision G
DA50	Building Envelope Analysis	1:500 @ A1	revision H
DA61	Area Schedule Diagrams	1:500 @ A1	revision J
DA70	Shadow Diagrams_June 21st (Part 1 of 2)	1:500 @ A1	revision H
DA71	Shadow Diagrams_June 21st (Part 2 of 2)	1:500 @ A1	revision H

This Report Has Been Prepared

For

DEFINED DEVELOPMENTS

by

VIPAC ENGINEERS & SCIENTISTS Ltd

APPENDIX A

Considerations Affecting Glare Potential & General Procedure

Several factors must be borne in mind in considering the potential for rogue building reflections, particularly in the case of traffic disability glare.

- The glass chosen for this project will have a reflectivity value of described as a % of the intensity of the solar ray striking the glass. This reflectivity % would be taken at "incident angles" less than 70^o. The incident angle is defined as 0^o for a solar ray striking perpendicular to the plane of the glass.

- Thus, for reflections to occur which have the capacity to induce disability or discomfort glare, the oncoming solar rays would have to impact on the building at relatively high incident angles, greater than 70^o, ie. close to parallel to the plane of the glazing.

- Studies on the visual cut-off angle of windscreens show that the sun altitude angle must be less than 25^o to produce a disability glare event. In fact, on a practical level, solar altitudes greater than 20^o are intersected and obstructed by a typical windscreen roofline.

- A further requirement regarding the sun position is that the full solar disc must be above the horizon. Since the solar disc subtends a finite angle of 1.5^o, glare events will only occur when the solar altitude is greater than about 3^o.

- Finally, the class of road (ie. freeway, trunk road, local street etc.) influences the acceptability level of building reflections. For example, some level of solar reflection may be acceptable for local traffic where the limiting speed is low but be unacceptable for freeway conditions with heavy, high-speed traffic.

Thus, the range of sun positions for which reflections off a vertical glazing element have the potential to produce a disability glare event can be greatly reduced.

In practice, the time of the day that a vertical glazing element can produce a disability glare event for motorists is typically early morning and late afternoon and when the incident radiation is close to parallel to the glazing element of interest and also has a low altitude angle. This restricts the incoming angles of solar radiation which can produce rogue reflections depending upon the time of the year.

Pedestrian discomfort glare can occur at other times of the day when the sun altitude is greater than 20^o above the horizon. However, in assessing the potential for glare in these cases, it should be borne in mind that a pedestrian has the ability (in most instances) to adjust his/her line of sight to a more horizontal view away from the glare source.

From the range of sun positions on days of interest throughout the year and the position and orientation of the glazing element of interest in a building, the resultant reflection envelope on the ground can be calculated using simple trigonometry.

Given a set of reflections, the issue of most significance is the effect of these reflections on the ability of a driver or pedestrian to perceive an object in their vision field. The perception of an object depends on the luminance of that object relative to the illumination of the background. For example, if the target and the background have the same colour and the same level of illumination, then it will be impossible to distinguish the target from the background.

VIPAC's glare recognition methodology uses target recognition procedures originally developed by NASA and also used by NATO.