Kavlyn Pty Ltd

Elsie, George and Victoria Streets, Burwood

Reflectivity Assessment

Report No. 20C-06-0038-TRP-247472-2

Vipac Engineers & Scientists Ltd

Sydney, NSW

8th December 2008

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Reflectivity Assessment

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EXECUTIVE SUMMARY

Vipac Engineers & Scientists Ltd. has been commissioned by Kavlyn Pty Ltd to assess the interaction of the proposed Elsie, George and Victoria Streets, Burwood with the local environment in terms of Reflectivity.

The site is located on a block bounded by existing developments adjoining the site. George Street runs on the southern of the site. The proposed development will comprise of 3 buildings (Block A, B & C) above a podium, which contains 3 levels of existing commercial spaces. Block A contains 14 levels of residential apartments, Block B contains 12 levels of residential apartments, Block C contains 9 levels of residential apartments.

The Reflectivity Study of this development has investigated the potential for traffic disability glare and pedestrian discomfort glare from the building's glazing elements.

It has been concluded that no glazing elements of the development as proposed will cause adverse traffic disability glare at surrounding locations because of:

- The orientation of façade cladding elements and the assistance from shielding by upstream buildings.
- The choice of the development's cladding, which is recommended to comprise of glass with a visible light reflectivity coefficient of 10% or less.
- Pedestrians' ability to adjust their line of sight to avoid any glare.

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

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1. BACKGROUND

Several factors must be considered when assessing the potential for rogue building reflections. Criteria to be considered include:

- Reflectivity coefficients of glazing and other specular type cladding surfaces.
- Incident angles of solar rays relative to cladding.
- Altitude angles of the sun.
- The class of roadways surrounding the development.
- Pedestrians' access surrounding the site.

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.

2. SOLAR REFLECTIONS FROM THE PROPOSED BUILDING

An overall plan view of the development identifying its location with respect to neighbouring roadways and buildings is shown in Figure 1. Each building comprises of cavity brick walls with single glazing with the following features:

Podium:

- ***North & East Façades***
  - Single glazing approximately 80% of the façade.
  - Concrete mullions.
  - Louvres on the commercial glazing.
  - Glazing on the ground level are setback
- ***South Façade***
  - Single glazing comprises of approximately 40% of the façade.
  - Masonry wall and roller doors.
  - Glazing on the ground level are setback
- ***West Façade***
  - Single glazing approximately 30% of each wall façade.
  - Masonry wall on ground level.

❖ 30% of façade has louvres fitted

Building A:

➢ ***East Façade***

❖ Single glazing (including balustrades and glazing setback under balconies) approximately 70% of the façade.

❖ Concrete mullions.

❖ 20% of façade has sliding louvres fitted on the balustrades for residential balconies.

➢ ***South Façade***

❖ Single glazing (including balustrades) that comprises approximately 80% of the façade.

❖ Masonry walls for each level including the lift shaft

❖ Mullions are concrete.

➢ ***West Façade***

❖ Single glazing (including balustrades and glazing setback under balconies) approximately 60% of the façade.

❖ Concrete mullions.

❖ 30% of façade has sliding louvres fitted on the balustrades.

Building B:

➢ ***East Façade***

❖ Single glazing (including balustrades and glazing setback under balconies) approximately 60% of the façade.

❖ Masonry balconies and concrete mullions.

❖ 15% of façade has sliding louvres fitted and approximately 20& of façade has architectural louvres fitted.

➢ ***West Façade***

❖ Single glazing (including balustrades and glazing setback under balconies) approximately 70% of the façade.

❖ Concrete mullions.

❖ 20% of façade has sliding louvres fitted on the balustrades

❖ **Building C:**

➢ ***North Façade***

- Single glazing (including balustrades and glazing setback under balconies) approximately 70% of the façade.
- Masonry balconies for each level and concrete mullions.
- 20% of façade has architectural louvers fitted.

- ***East Façade***

  - Single glazing (including balustrades and glazing setback under balconies) approximately 70% of the façade.
  - Masonry balconies and walls for each level and concrete mullions.
  - 10% of façade has architectural louvers fitted.

- ***West Façade***

  - Single glazing (including balustrades and glazing setback under balconies) approximately 60% of the façade.
  - Masonry balconies for each level and concrete mullions.
  - 15% of the façade has sliding louvres fitted on the balustrades and
  - 15% of the façade has architectural louvers fitted.

In the analysis, over the external glazing on all façade faces are assumed to have a visible light reflectivity coefficient of 10% or less (at normal incidence). Remaining façade areas comprise of cavity brick (having a less 'specular' and more 'diffuse' reflection properties compared to that of glass).

The shading effect of balconies, shading devices and any building protrusions is taken into account when determining the reflections off any façade in the assessment.

Local Traffic Environment ...

All surrounding traffic areas in the vicinity of the development were examined for disability and discomfort glare.

Local Built-Up Environment ...

The local built-up environment is a mix of 5-6 storey office buildings to the South & East, and 2, 3, 4 & 8 storey residential houses to the North and West.

3. REFLECTION PROJECTIONS

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

1. Junction between George Street & Elsie Street.
2. North & Southbound on Elsie Street
3. North & Southbound on Elsie Street
4. Junction between Elsie Street & Victoria Street.
5. Westbound on Victoria Street.
6. West & Eastbound on Victoria Street.
7. West & Eastbound on Victoria Street.
8. Junction between Victoria Street & Gloucester Avenue.
9. North & Southbound on Gloucester Avenue
10. North & Southbound on Gloucester Avenue
11. Junction between Gloucester Avenue & George Street
12. Eastbound on George Street
13. West & Eastbound on George Street
14. West & Eastbound on George Street.

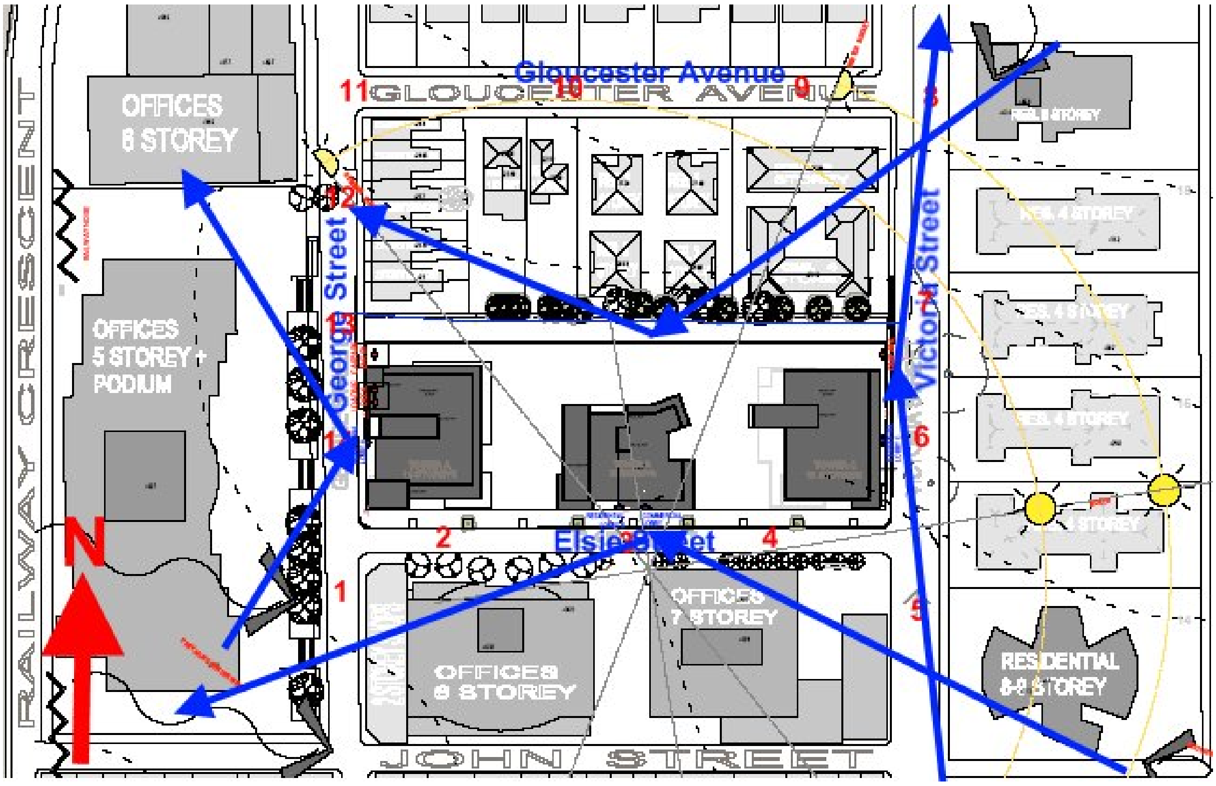

Figure 1: Overall Site Plan of the Development and Surrounding Road Carriageways

4. SOLAR ANALYSIS RESULTS

4.1. TRAFFIC AND PEDESTRIAN DISABILITY GLARE

North Façade (façade facing Victoria Street):

Reflections off the building's north façade can occur as follows:

- From mid-afternoon all year round, solar rays can strike the north façade with reflections impacting onto westbound traffic on Victoria Street.
- Early to mid-morning all year round, can strike the north façade with reflections impacting on eastbound traffic on Victoria Street.

For the first reflection, the solar rays can strike the façade with a high incidence angle (nearly parallel to the façade) during the mid-afternoons. At this time of the day, the incoming solar rays will be at higher incidence angles, producing reflections that might have the potential to impact onto westbound motorists and pedestrians on Victoria Street. The points at which these solar arrays hit the glazing and cause high reflections are at low height levels (i.e. from 9 – 10 metres from the ground). The sunrays that reaches these areas will be blocked by the buildings to the west hence reduce the probability of any of these reflections causing an adverse glare condition for motorists.

For the second reflection, the point at which these solar arrays hit the glazing and cause high reflections are at low height levels (i.e. from 7 – 14 metres from the ground). The sunrays that reaches these areas will be blocked by the buildings to the east hence reduce the probability of any of these reflections causing an adverse glare condition for pedestrians. Victoria Street is noted on the site plan provided by Architex as a one-way street travelling westbound hence glare effects would only affect pedestrians.

It is also noted that some of the façade areas comprises of non-glazed material, which have a less ‘specular’ and more ‘diffuse’ reflection properties compared to that of glass, and some of the glazing will have architectural shading devices. It is recommended that architectural shading devices on this façade are to have matte finish.

It is recommended that the glazing on this façade is to have a visible light reflectivity coefficient of 10% or less to ensure that there will be minimal reflection conditions from this façade.

Given this, and a pedestrian’s ability to adjust their line of sight, it is unlikely that these reflections will cause adverse glare conditions for motorists.

East Façades (façades facing Elsie Street):

Reflections off the east façades can occur as follows:

- Mid to late morning solar rays can strike the façade with reflections impacting pedestrians on Elsie Street in mid autumn to winter.

For mid to late morning reflection conditions, the highest reflections (i.e. producing the highest glare values) occur during the morning from 10am to 11am between the end of autumn to the end of winter when the solar altitude angle is low. However, while the altitude of the sun is low at this time of year, the sun is higher than the visual cut-off angle of a motorist. Therefore it is unlikely that these reflections would cause an adverse glare condition for motorists.

It is also noted that most of the façades areas comprise of glazed material, which have higher reflective properties compared to that of the building surface. Residential tower glazing will be set back behind architectural shading devices or balconies as shown on the plans. It is recommended that the architectural shading devices on this façade are to have matte finish. Again it is recommended that the glazing on this façade is to have a visible light reflectivity coefficient of 10%or less to ensure there will be minimal reflective conditions for this façade.

Given this, and a pedestrian’s ability to adjust their line of sight, it is unlikely that these reflections will cause adverse glare conditions for motorists or pedestrians.

South Façade (façades facing George Street):

Reflections off the south façades can occur as follows:

- Mid-afternoon solar rays can strike the façade with reflections impacting westbound motorists and pedestrians in summer and end of spring on George Street.

- Early morning solar rays can strike the façade with reflections impacting eastbound motorists and pedestrians from end of spring to the beginning of autumn on George Street.

For the first reflection, the mid-late afternoon reflection conditions that give the highest reflections (i.e. producing the highest glare values) occur during the afternoon about 3-5pm, in summer and end of spring when the solar altitude angle is low. The points at which these solar arrays hit the glazing and cause high reflections are at low height levels (i.e. from 1 – 10 metres from the ground). The sunrays that reaches these areas will be blocked by the buildings to the west hence reduce the probability of any of these reflections causing an adverse glare condition for motorists.

For the second reflection, the early morning reflection conditions that give the highest reflections (i.e. producing the highest glare values) occur during the morning about 5-6am in end of spring to the beginning of autumn when the solar altitude angle is low. However, while the altitude of the sun is low at this time of year, the adjacent buildings to the east will assist in blocking the reflections that could cause adverse glare effects for both pedestrians and motorists.

It is also noted that most of the façades areas comprise of glazed material, which have higher reflective properties compared to that of the building surface. Residential tower glazing will be set back behind architectural shading devices or balconies as shown on the plans. It is recommended that the architectural shading devices on this façade are to have matte finish. Again it is recommended that the glazing on this façade is to have a visible light reflectivity coefficient of 10%or less to ensure there will be minimal reflective conditions for this façade.

Given this, and a pedestrian's ability to adjust their line of sight, it is unlikely that these reflections will cause adverse glare conditions for motorists or pedestrians.

West Façade (façade facing Gloucester Avenue):

- Midday to late afternoon solar rays can strike the façade with reflections impacting motorists and pedestrians throughout the year on George Street.

The early afternoon reflection conditions that give the highest reflections (i.e. producing the highest glare values) occur from midday to early afternoon about 12-3pm during the year. At the time solar altitude angle is high in the sky the visual cut-off angle for motorists applies. Given the visual cut-off angle of the motorist from these reflections and a pedestrians ability to adjust their line of sight, it is unlikely that these reflections will cause adverse glare conditions for pedestrians

In late afternoon glare conditions, the altitude of the sun is low hence adjacent building to the north; south and east will assist in blocking the reflections that could cause adverse glare effects for both pedestrians and motorists.

It is also noted that most of the façades areas comprise of glazed material, which have higher reflective properties compared to that of the building surface. Residential tower glazing will be set back behind architectural shading devices or balconies as shown on the plans. It is recommended that the architectural shading devices on this façade are to have matte finish. Again it is recommended that the glazing on this façade is to have a visible light reflectivity coefficient of 10%or less to ensure there will be minimal reflective condition for this façade.

Given this, and a pedestrian's ability to adjust their line of sight, it is unlikely that these reflections will cause adverse glare conditions for motorists or pedestrians.

5. SUMMARY

The Reflectivity Study of this development has investigated the potential for traffic disability glare and pedestrian discomfort glare from the building's glazing elements.

It has been concluded that no glazing elements of the development as proposed will cause adverse traffic disability glare at surrounding locations because of:

- The orientation of façade cladding elements.
- The choice of the development's cladding, which is recommended to comprise of glass with a visible light reflectivity coefficient of 10% or less.
- Blockage to both incoming solar rays and outgoing reflections provided by upstream buildings and the architectural shading devices.
- Pedestrians' ability to adjust their line of sight to avoid any glare.

In summary, through a combination of 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.

DWG/SPEC TITLE:	SCALE	No.	REVISION No.			
DA DRAWINGS						
Cover						
Site/roof Plan	1:500 @ A1	DA10	G	H	I	I
Level 3	1:200 @ A1	DA11	G	I	I	I
Level 4-7	1:200 @ A1	DA12	G	I	I	I
Level 8	1:200 @ A1	DA13	G	H	H	H
Level 9-10	1:200 @ A1	DA14	F	G	G	G
Level 11	1:200 @ A1	DA15	G	I	I	I
Level 12	1:200 @ A1	DA16	F	G	G	G
Level 13-14	1:200 @ A1	DA17	G	H	H	H
Level 15-16	1:200 @ A1	DA18	F	H	H	H
Level 17	1:200 @ A1	DA19	G	H	H	H
Tower C north & south elevations	1:200 @ A1	DA20	E	F	F	F
East elevations	1:200 @ A1	DA21	E	G	G	G
Tower A north & south elevations	1:200 @ A1	DA22	E	F	F	F
West elevations	1:200 @ A1	DA23	E	F	F	F
Tower B north & south elevations	1:200 @ A1	DA24	E	F	F	F
Section AA	1:200 @ A1	DA30	A	B	B	B
Section BB Tower A	1:200 @ A1	DA31	A	B	B	B
Section CC Tower B	1:200 @ A1	DA32	A	B	B	B
Section DD Tower C	1:200 @ A1	DA33	A	B	B	B

APPENDIX A - CONSIDERATIONS AFFECTING GLARE POTENTIAL & GENERAL PROCEDURE

Considerations Affecting Glare Potential

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 no greater than 10% 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.