104-116 REGENT STREET, REDFERN

Environmental Glare and Reflectivity Assessment

Prepared for:

The Trust Company (Australia) Limited ATF WH Redfern Trust
c/- Antoniades Architects Pty Ltd
19a Boundary Street
DARLINGHURST NSW 2010

SLR Ref: 610.30265-R02
Version No: -v1.0
December 2021

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd (SLR) with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with The Trust Company (Australia) Limited ATF WH Redfern Trust (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.30265-R02-v1.0	6 December 2021	James Cleary	Dr Neihad Al-Khalidy	Dr Neihad Al-Khalidy

EXECUTIVE SUMMARY

SLR Consulting Australia Pty Ltd (SLR) has been engaged by The Trust Company (Australia) Limited ATF WH Redfern Trust to provide an assessment of the reflectivity and glare caused by a proposed 18-storey development located at 104-116 Regent Street, Redfern.

The proposed development was assumed to have glazing with a reflectivity value no greater than 20%.

In the Stage 1 preliminary screening analysis, several potential glare conditions were excluded, including:

- North bound Regent Street traffic;
- South bound Gibbons Street traffic, etc.

In the Stage 2 initial TI Value analysis, SLR identified areas that may be affected by potential adverse glare. The following points were noted:

- TI values were not recorded to the Railway, Margaret Street, Rosehill Street, Gibbons Street and Albert Street.
- TI values were recorded to Regent Street, Carpark, Cope Street, Phillip Street and William Lane.
- The potential for exceedance of the TI criterion was not recorded to any of the surrounding streets.
- The luminous intensity will not exceed 500 Cd/m^2 for any of the surrounding streets.

In the Stage 3 detailed assessment, development features which will further improve glare conditions were outlined (refer **Section 3.4**), such as:

- Existing landscaping and vegetation around the site obstructing low level glare conditions;
- Surrounding development obstructing incoming or reflected solar rays; and
- Façade mitigating elements including glazing setbacks and mullion protrusions, which reduce possible glare conditions.

As no adverse glare conditions were recorded, no further mitigating features were required within the scope of the Stage 4 detailed analysis.

Recommendations to be implemented or retained to the proposed design are summarised as follows:

- SLR has proposed that glazing with a reflectivity coefficient of less than 20% be applied to all facades.
- Existing and proposed landscaping is recommended to be retained to the surrounds of the proposed development.
- Façade elements including setbacks and mullion protrusions are to be retained as specified unless otherwise stated within the body of this report.
- The development should retain current proportions and orientation of glazing.

The TI Value analysis shows that the development did have some potential for pedestrian discomfort glare, however mitigating measures highlighted when assessing glare to motorists has removed the potential for these reflections.

EXECUTIVE SUMMARY

On the basis of the above, the detailed reflectivity analysis undertaken in this study shows that the proposed development will cause neither traffic disability glare nor pedestrian discomfort glare on surrounding public areas.

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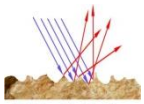
Abbreviations and Definitions

Terms relevant to Daytime Reflective Glare	
Glare	Glare refers to the reflections of the sun off any reflective surface, experienced as a source of excessive brightness relative to the surrounding diffused lighting. Glare covers reflections experienced by both stationary and moving observers (the latter sometimes referred to as "glint") and reflections which are either specular or diffuse.
Specular	A reflection which is essentially mirror-like – there is virtually no loss of intensity or angle dispersion between the incoming solar ray and outgoing reflection  Specular Reflection
Diffuse	A reflection in which the outgoing reflected rays are dispersed over a wide ("diffuse") range of angle compared to the incoming (parallel) solar rays, typical of "rougher" surfaces  Diffuse Reflection
KVP	Key View Points (KVPs) are offsite locations where receivers of interest have the potential to experience adverse reflective glare
Luminous intensity	The concentration of luminous flux emitted in a specific direction. Unit: candela (Cd).
Luminance **AS 1158.2:2005**	This is the physical quantity corresponding to the brightness of a surface (e.g. a lamp, luminaire or reflecting material such as façade glazing) when viewed from a specified direction. Unit: Cd/m^2
Illuminance **AS 1158.2:2005**	This is the physical measure of illumination. It is the luminous flux arriving at a surface divided by the area of the illuminated surface – the unit is lux (lx) … 1 lx = 1 lm/m^2 The term covers both "Horizontal Illuminance" (the value of illuminance on a designated horizontal plane at ground level) and "Vertical Illuminance" (the value of illuminance on a designated vertical plane at a height of 1.5m above ground level).
Glare Criteria **AS 1158.2:2005**	Condition of vision in which there is a discomfort or a reduction in the ability to see, or both, caused by an unsuitable distribution or range of luminance, or to extreme contrast in the field of vision. Glare can include: (a) Disability Glare – glare that impairs the visibility of objects without necessarily causing discomfort. (b) Discomfort Glare – glare that causes discomfort without necessarily impairing the visibility of objects.
Threshold Increment (TI) **AS 4282-1997**	TI is the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Higher TI values correspond to greater disability glare.

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by The Trust Company (Australia) Limited ATF WH Redfern Trust to provide an assessment of the reflectivity and glare caused by a proposed 18-storey development located at 104-116 Regent Street, Redfern.

The study examines the impact on areas surrounding the development using SLR's reflectivity calculator and our previous experience in many reflectivity assessments for buildings of this size.

The report will form part of the development application to the City of Sydney

1.1 Location of Development Site

The proposed development is bounded by Regent Street to the east, Margaret Street to the south, and similar height future developments to the west and to the north. - refer **Figure 1**.

Figure 1 Satellite Image of the Proposed Development Site

1.2 The Surrounding Built Environment

In terms of surrounding buildings:

- Buildings surrounding site are generally low and mid-rise, comprising a mix of commercial, retail and residential buildings (several of similar height to the proposed development).
- Gibbons Street Reserve lies to the west with Redfern train station to the north-northwest.
- There are a number of planned and approved future developments of similar height located immediately to the north and west of the proposed development, running between Gibbons Street and Regent Street.
- Sydney's CBD area lies further to the north.

The terrain is undulating in the surrounding built environment, with no particularly significant topographical variations (ie hills, escarpments, etc) influencing local wind speeds.

These aspects are shown in representative views in **Photo 1**.

Photo 1 Representative Project Surrounds (Views towards Site, East and West of Site)

1.3 Development Description

The proposal comprises the redevelopment of the site as summarised below:

- Construction of an 18-storey building comprising a total of 9,562m² gross floor area with a mix of land use activities including:
  - Level 1: 72 m² of retail floorspace, 490m² of communal area for the student accommodation, 102 bicycle parking spaces, loading and waste management facilities and ancillary services and facilities.
  - Upper levels: student accommodation providing a total of 411 beds, including ensuite rooms, studios and two-bedroom configurations, with indoor and outdoor communal spaces on Levels 2, 4 and 16 and additional indoor communal areas on Levels 2 and 4.
- Hard and soft landscaping within the outdoor communal terraces on the roof-top of the podium level and Levels 4 and 16.
- Public domain improvements including provision of a landscaped through-site link connecting William Lane to Margaret Street and associated improvements to the Regent Street and Margaret Street frontages, including awnings and footpath upgrades.

Figure 2 Representative Views of the Proposed Development

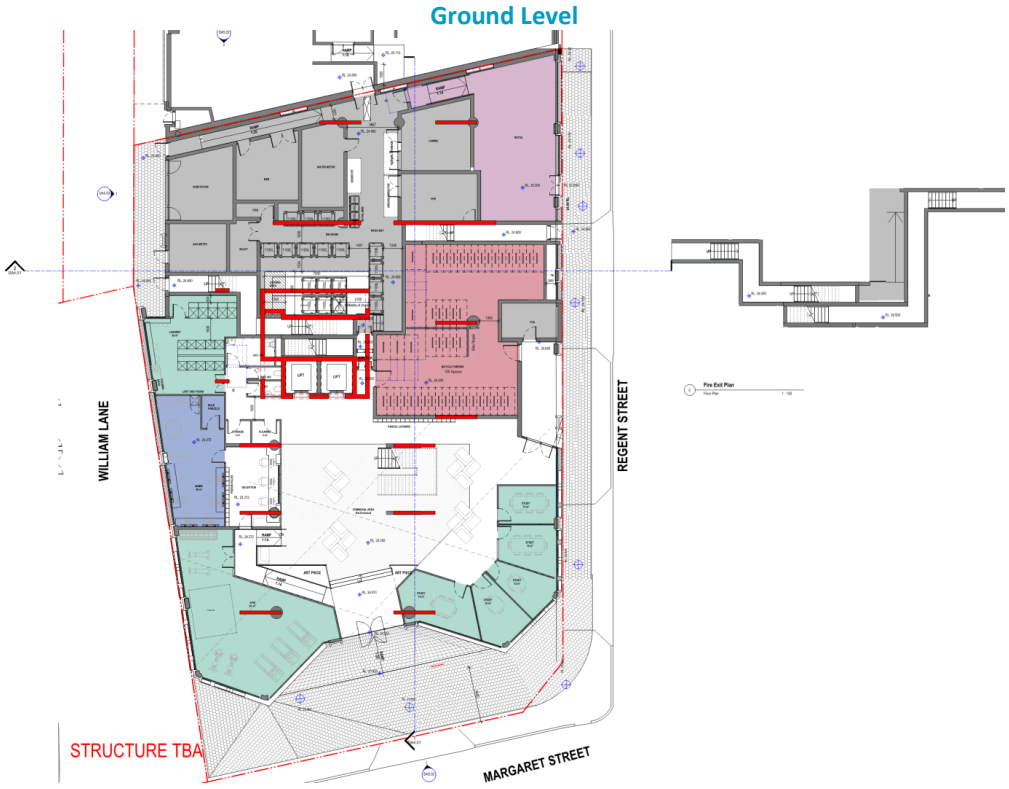


Fig 3. Continued

Level 2

Fig 3. Continued

Level 03

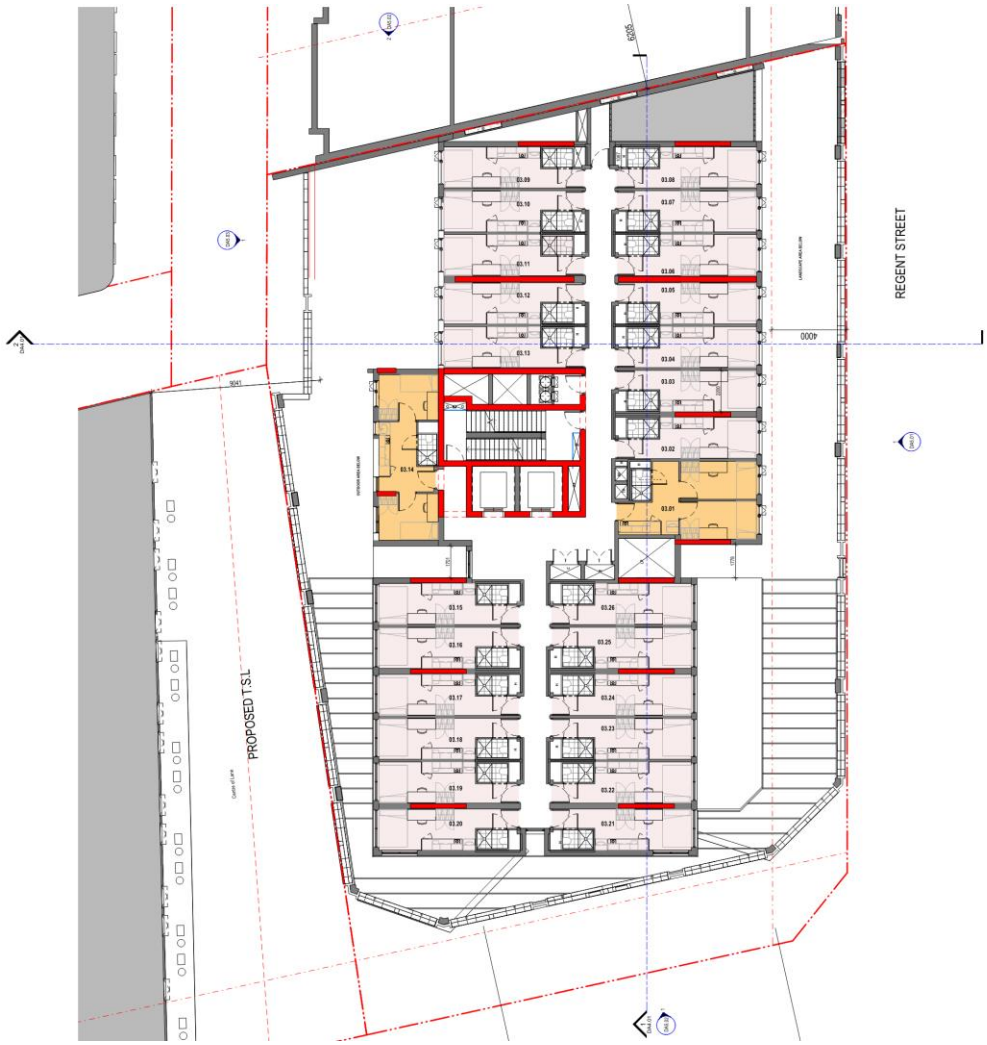


Fig 3. Continued

Fig 3. Continued

2 Reflectivity Impact Methodology and Criteria

2.1 Glare Characteristics

With respect to the reflectivity impact of the proposed development, the following issues are relevant:

- At large incident angles (typically greater than 70°), the reflectivity of all glazing types *increases dramatically*. Thus, regardless of the glazing type, the potential for glare increases significantly when incoming solar rays can impact on a building close to parallel to the plane of the glazing.
- On a practical level, incoming solar rays with an altitude angle greater than 20° are intersected and obstructed by a typical windscreen roof-line. In this Report, it is assumed that the sun altitude angle must be less than 25° to have the potential to produce a traffic disability glare event.
- Pedestrian discomfort glare can occur when the sun altitude is greater than 25°. However, in most such instances, a pedestrian has the ability to adjust their line of sight to a more horizontal view away from the glare source.
- It is assumed that glare events can only occur when the solar altitude is greater than about 3°, enabling the entire solar disc to be visible.

2.2 Glare Acceptability Assessment

The criteria used within this report to assess the acceptability or otherwise of glare events are the limiting values of the so-called *"Threshold Increment Value"*, or *TI Value,* of the reflection condition, as shown in **Table 1**.

Table 1 Threshold Increment (TI) Criteria

Glare Category	Classification	TI Acceptable Limit
Disability Glare (for motorists)	Major Roads	10
	Minor Roads	20
Discomfort Glare (for pedestrians)	Pedestrian Crossings	2
	Other Footpath Locations	3

For further information regarding the TI Calculation methodology please refer:

- AS 4282:2019, *"Control of the obtrusive effects of outdoor lighting"*
- AS 1158.2:2005, *"Lighting for roads and public spaces Part 2: Computer procedures for the calculation of light technical parameters for Category V and Category P lighting"*

2.3 Threshold Increment Calculations

TI values are calculated in accordance with AS/NZS 4282-2019 and are the measure of disability glare expressed as the percentage increase in contrast required between an object and its background for it to be seen equally well with a source of glare present. Note: Higher values of TI correspond to greater disability glare. The calculation process involves the following:

- Set the source Point Spacing

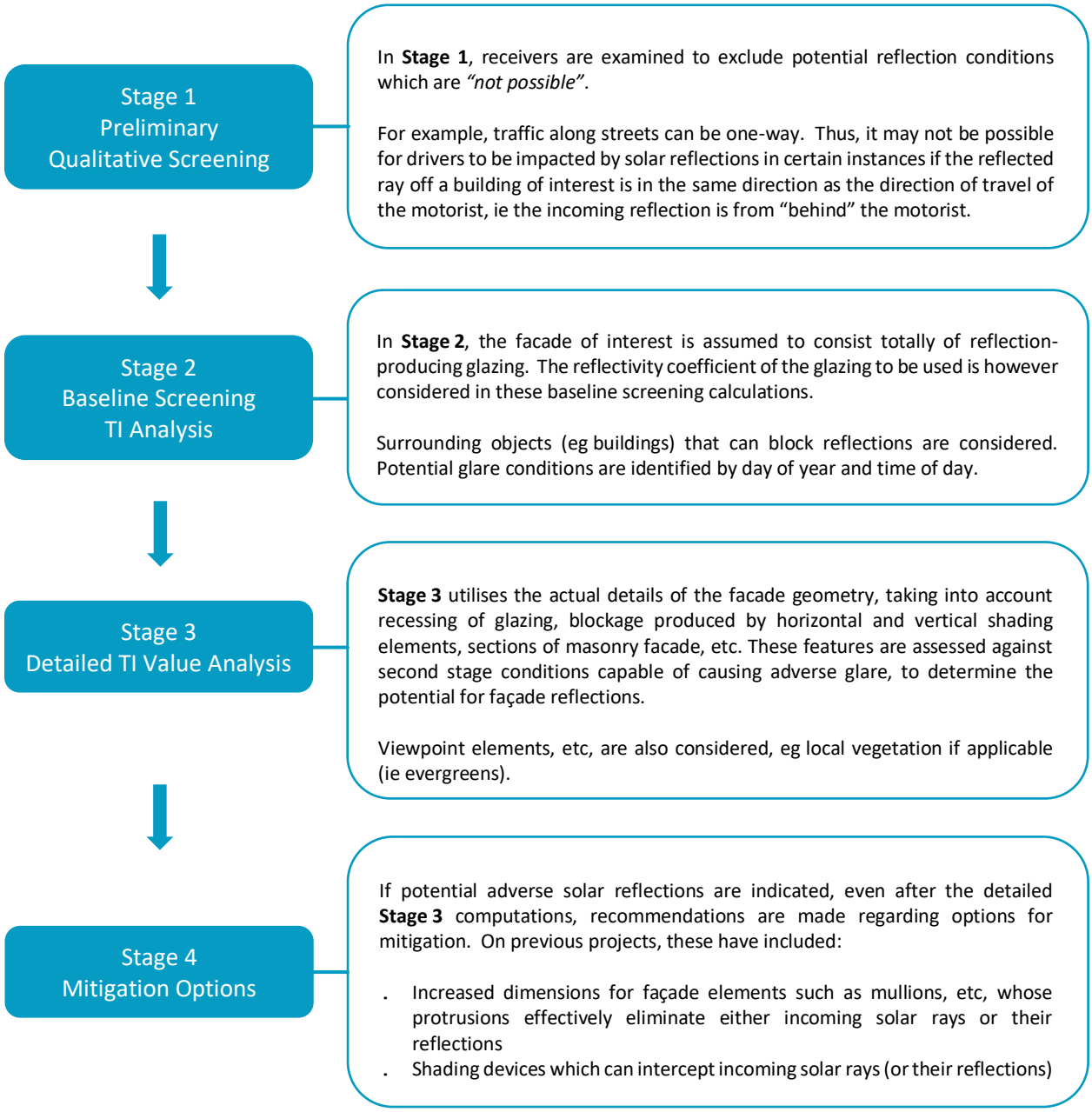
- Set the Observer Height
- Set the Viewing Direction of the Observer
- Set the Windshield (windscreen) cutoff angle according to the requirement in the standard (20° for AS/NZS 4282:2019)
- Select the appropriate Adaptation Luminance in accordance with AS/NZS 4282:2019.
- Calculate the TI Value in accordance with AS/NZ 4282:2019 formulae.

SLR assessed TI Values at the identified assessment points in 5-minute intervals throughout the entire calendar year.

2.4 Reflectivity Methodology

SLR Consulting carries out reflectivity TI calculations using a staged, screening process and our in-house software as outlined in **Figure 3**.

Figure 3 SLR's TI Value Analysis Methodology



2.5 Sydney Solar Angles – Annual Variations

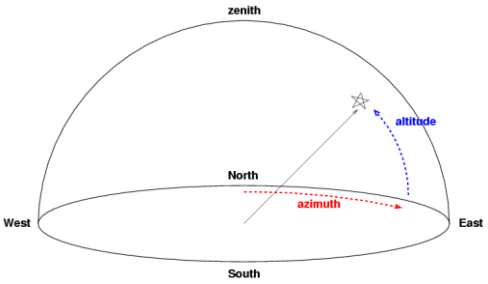
To assist in the screening process and initial TI computations, it is useful to be aware of the potential range of incoming solar angles at the site – refer **Table 2** and **Figure 4**. These are relevant to the daytime solar ray / reflection angles shown in **Figure 5** to **Figure 7**.

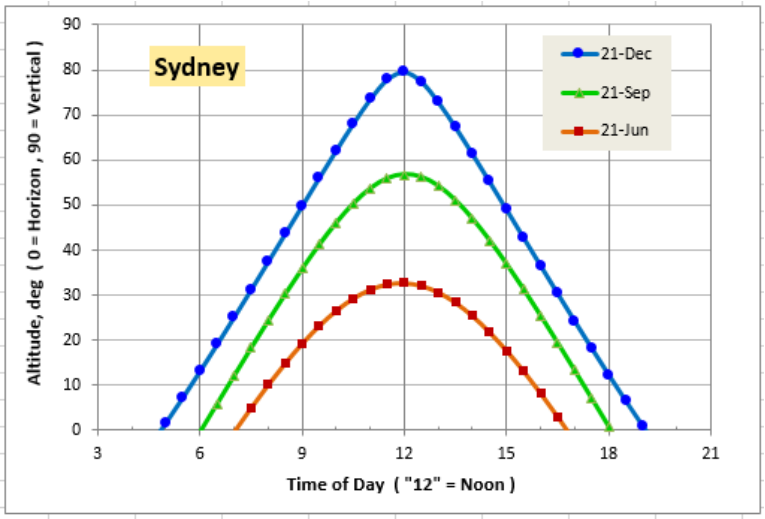
Table 2 Key Annual Solar Angle Characteristics for Sydney

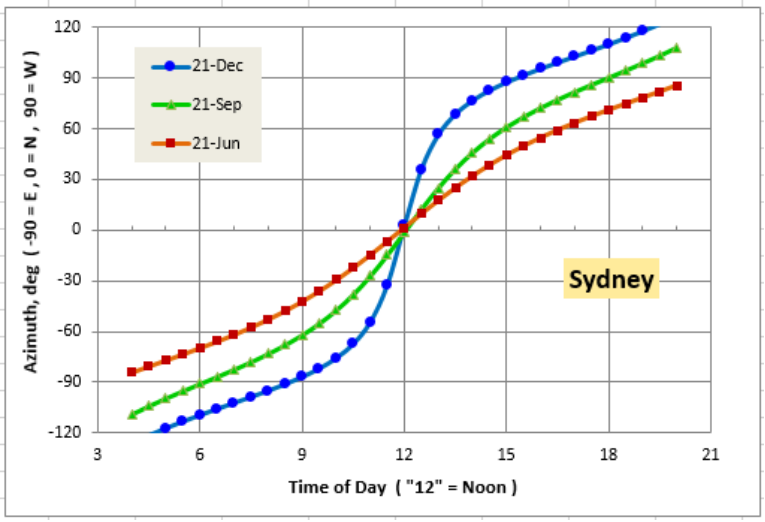
Day of Year	Sunrise	Sunset	Azimuth Range	Highest Altitude
Summer Solstice	5:49 am [1]	8:05 pm [1]	119° E of North to 119° W of North	80°
Equinox	6:01 am	6:04 pm	91° due east to 91° DUE WEST	57°
Winter Solstice	7:01 am	4:46 pm	61° E of North to 61° W of North	33°

Note 1: Time takes into account Eastern Daylight Savings Time

Figure 4 Sydney Incoming Solar Angle Variations







3 Glare Impact Analysis

3.1 Assumptions

The proposed development has façade predominantly fronting Regent Street and Margaret Street, there is also frontage to William Lane. Surrounding buildings that may provide shielding at certain times have only been considered in the **Stage 3** assessments.

For the purposes of this analysis, the following has been assumed:

- The development's glazing will have a reflectivity coefficient of *less than 20%*;
- All surrounding streets are Category V roads which have a TI limit of 20% according to Table 2.2 of AS/NZS 1158.1.1:2005.
- Reflected solar glare to drivers should not exceed 500 Cd/m^2. A candela is the base unit for measuring the intensity of luminance under the International System of Units (SI).

3.2 Stage 1 - Preliminary Qualitative Screening Analysis

Potential solar ray combinations (incoming/reflecting) are shown in **Figure 5** to **Figure 7**.

Figure 5 Current Possible Reflected Rays – Ground Level

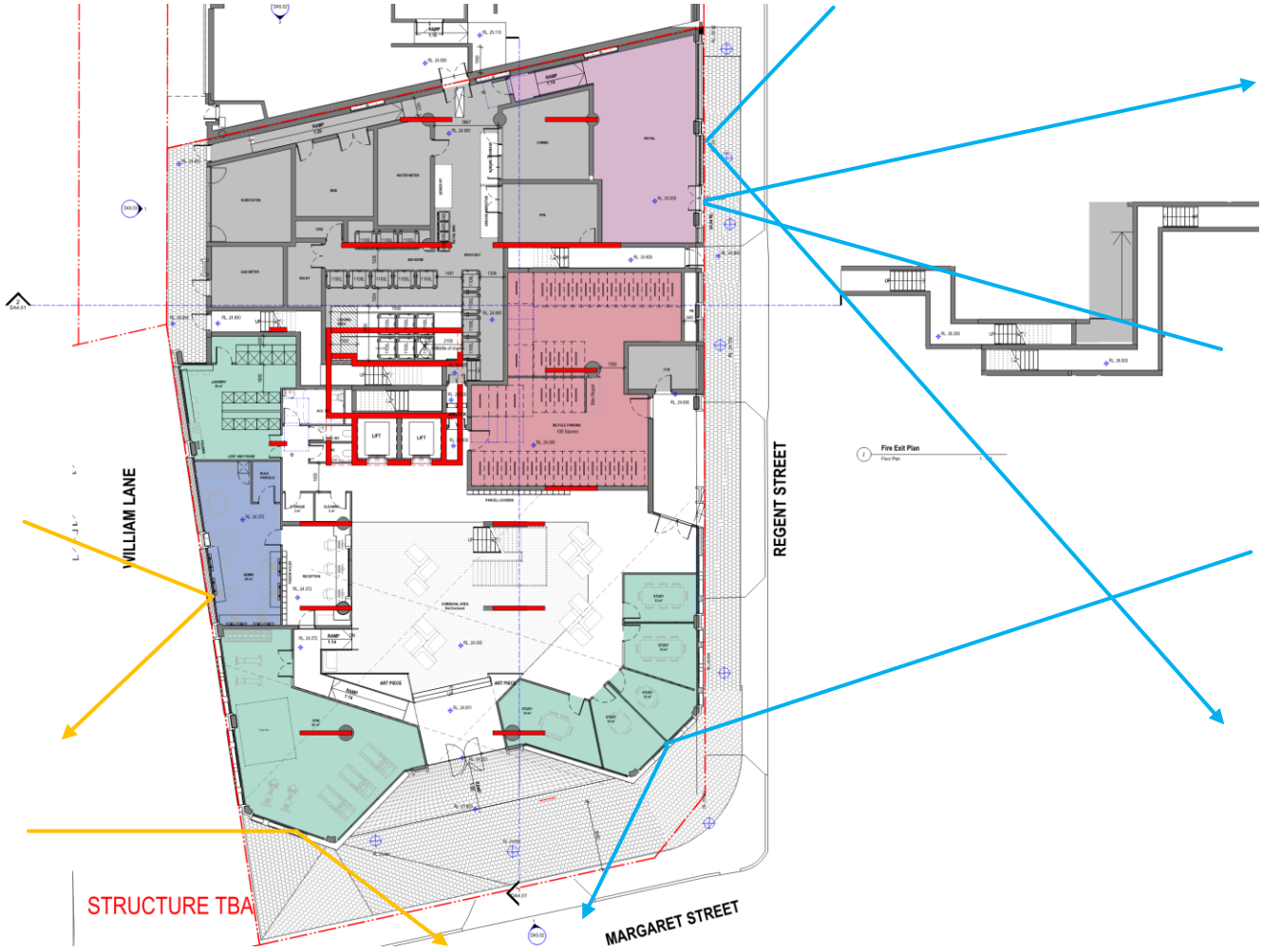


Figure 6 Current Possible Reflected Rays – Tower Levels

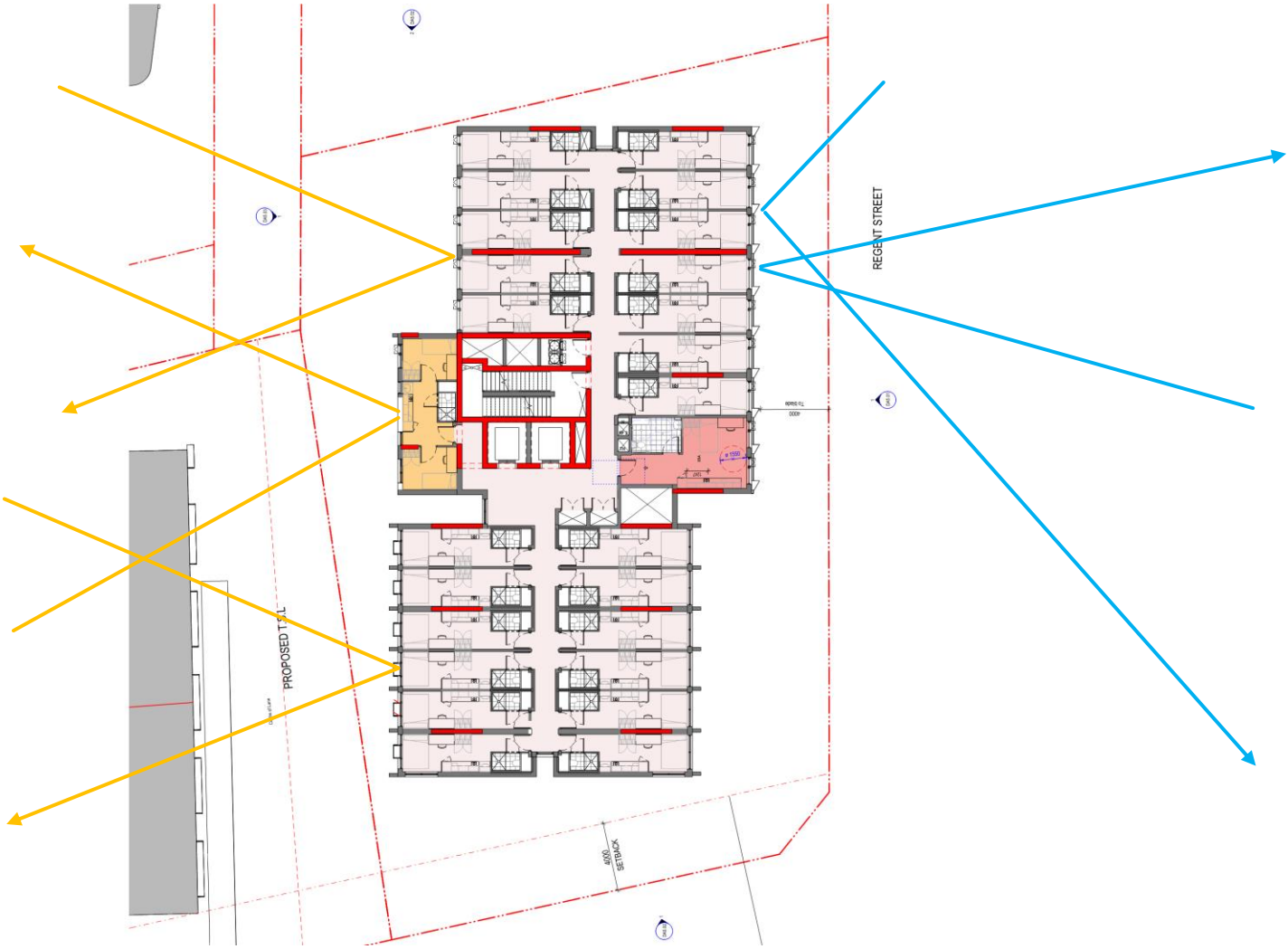
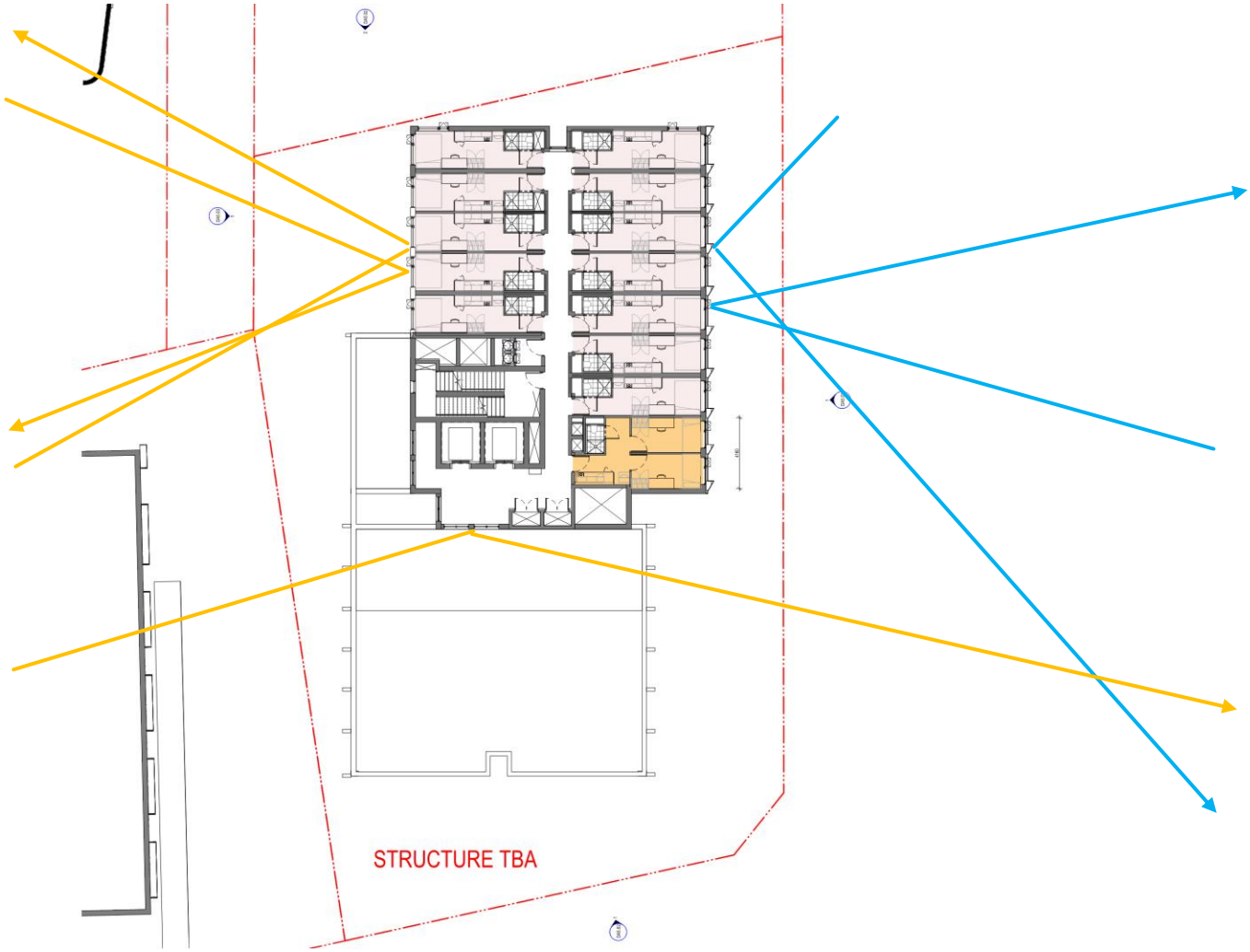


Figure 7 Current Possible Reflected Rays – Upper Levels



The preliminary, qualitative screening analysis, combined with the information shown in **Section 2.4**, yields the potential reflection conditions summarised in **Table 3**.

Table 3 Potential Reflectivity Conditions

Street	Traffic Direction	Time	Relevant Facade
Railway	East bound	Afternoon rays	West
Margaret Street	East bound	Afternoon rays	West
Rosehill Street	North bound	Afternoon rays	West
Gibbons Street	North bound	Afternoon rays	West
Regent Street	South bound	Morning rays	East
Carpark	West bound	Morning rays	East
Cope Street	North bound	Morning rays Afternoon rays	South East

Street	Traffic Direction	Time	Relevant Facade
Albert Street	West bound	Morning rays	East
Phillip Street	West bound	Morning rays Afternoon rays	South East
William Lane	North bound South bound	Afternoon rays	West

3.3 Stage 2 – Baseline TI Calculations

On the basis of the potential reflection conditions described in **Table 3**, SLR chose representative locations in the surrounds to calculate TI values – refer **Figure 8**.

Figure 8 Stage 2 TI Value Calculation Positions

A summary of the Stage 2 Baseline TI Calculations is shown in **Table 4**. Note that the Stage 2 calculations assume uninterrupted glazing flush with the building façade and NO blockage effects from surrounding façade protrusions, etc.

Table 4 Stage 2 Bassline TI Calculation Results (Assuming Uninterrupted Glazing)

Street / Locations	TI Value Criterion	Max Traffic TI Value Calculation		Candelas/m^2 (Cd/m^2)
Railway #1, #2, #3	20	W Façade	nil	NA
Margaret Street #4, #5, #6	20	W Façade	nil	NA

Street / Locations	TI Value Criterion	Max Traffic TI Value Calculation			Candelas/m² (Cd/m²)
Rosehill Street #7, #8	20	W Façade	nil		NA
Gibbons Street #9, #10, #11	20	W Façade	nil		NA
Regent Street #12, #13	20	E Façade	TI_{max} = 0.4	(21 December, 6:20am)	1
Carpark #16	20	E Façade	TI_{max} = 7.4	(17 December, 8:15am)	21
Cope Street #14, #15	20	S Façade E Façade	nil TI_{max} = 6.1	 (20 July, 12:05pm)	NA 17
Albert Street #17, #18	20	E Façade	nil		NA
Phillip Street #19, #20	20	S Façade E Façade	nil TI_{max} = 2.3	 (10 October, 10:00am)	NA 6
William Lane #21, #22, #23, #24, #25, #26	20	W Façade	TI_{max} = 13.5	(11 June, 1:45pm)	42

A summary of the Stage 2 Baseline TI Calculations is:

- TI values were not recorded to the Railway, Margaret Street, Rosehill Street, Gibbons Street and Albert Street.
- TI values were recorded to Regent Street, Carpark, Cope Street, Phillip Street and William Lane.
- The potential for exceedance of the TI criterion was not recorded to any of the surrounding streets.
- The luminous intensity will not exceed 500 Cd/m^2 for any of the surrounding streets.

Note that the above calculations do NOT consider façade details, façade protrusions, etc.

The façade / roadways of interest combinations noted above were examined further in the following section, ie the Stage 3 Detailed Assessments.

3.4 Stage 3 Detailed TI Value Analysis with Façade Details

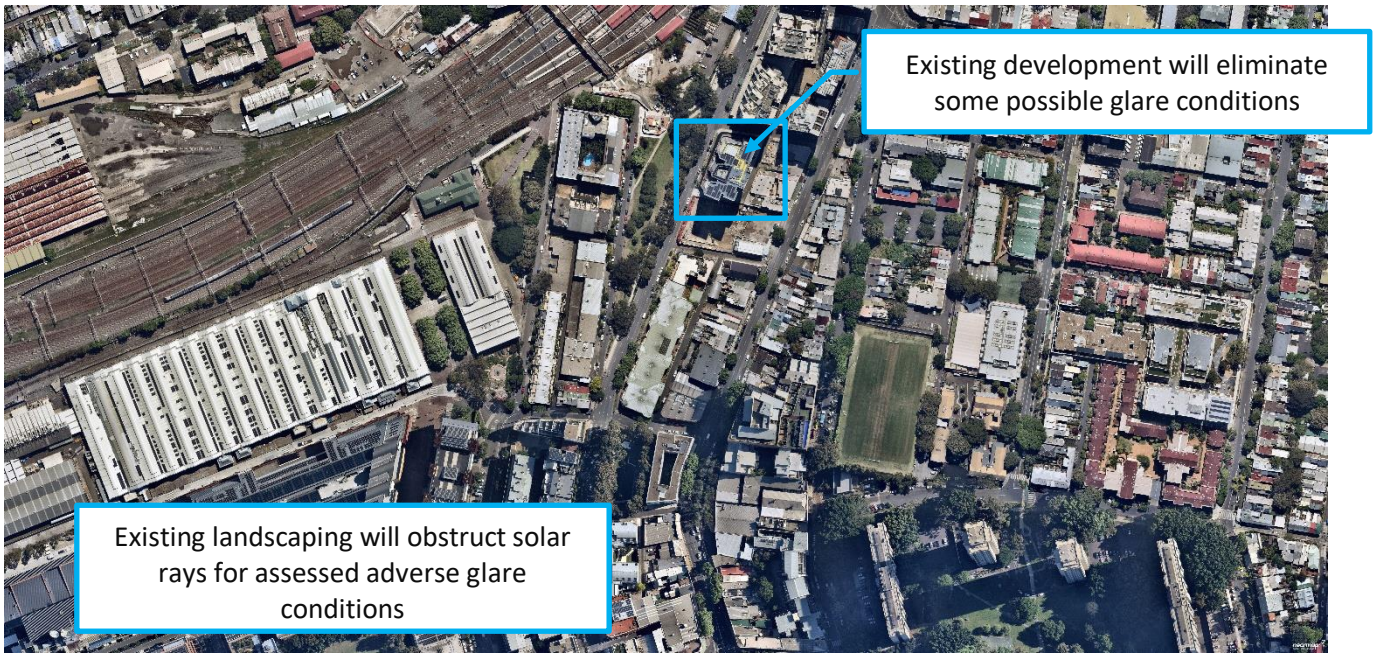
Having considered areas of the façade assessed as having a potential for adverse glare conditions in the initial stages, SLR undertook detailed assessment against recorded glare conditions noting angle of incidence, azimuth angle and facade position. These results are then examined against the existing façade geometry and features to consider if glare conditions are possible, given mitigating façade features such as façade mullion protrusions, screens, façade wing walls, blades, etc.

Upon completing the calculations, SLR found that whilst glare conditions were possible from the development facades, none proved to classify as being potential adverse to motorists in the vicinity of the site. Features which will further reduce glare conditions have been highlighted in further throughout **Section 3.4**.

3.4.1 Landscaping and Surrounds Obstruction of Adverse Glare Conditions

Observing glare to the proposed development, SLR has noted the existing landscaping and surrounding built environment. Given the height and angles of incidence associated with glare conditions, SLR has determined that the landscaping and surrounds will be sufficient in addressing possible glare conditions.

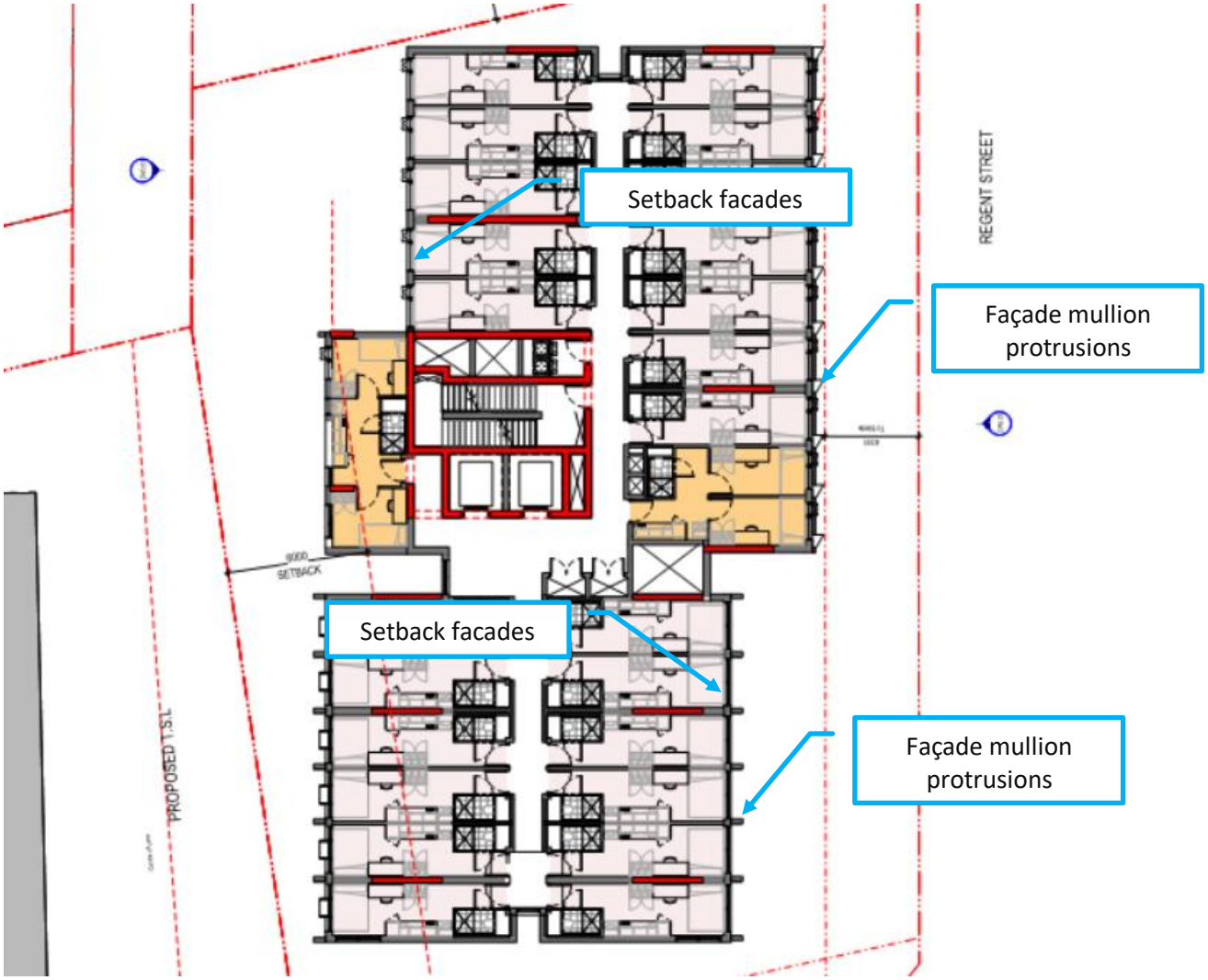
Figure 9 Obstruction to Adverse Glare Conditions via Surrounding Proposed Landscaping



3.4.2 Façade Mullion and Protrusion Obstruction of Adverse Glare Conditions

The proposed development has several features which will reduce the potential for glare conditions, including glazing setbacks and mullion protrusions. Mitigating features have been highlighted in **Figure 10**.

Figure 10 Mitigating Development Features



3.5 Stage 4 Mitigation of Potential Adverse Glare Conditions

Upon concluding the assessment of the proposed development SLR found no instances where recorded glare would prove harmful to motorists travelling with the existing environment surrounding the site. Further, development features have been outlined which will decrease glare conditions from the conservative assessments within SLR calculations. Given this, no further mitigating features have been deemed necessary for the proposed site.

3.6 Pedestrian Discomfort Glare

The initial calculations show that there will be some glare for pedestrians around the proposed development. The values calculated were in some cases above the allowable limits of 3 and 2 for footpaths and pedestrian crossings. Recommendations:

Following initial calculations and mitigations outlined in **Section 3.4,** pedestrian discomfort glare has been reduced to acceptable levels.

Further, although initial calculations are nominally in excess of the pedestrian TI criteria provided in **Table 1**, pedestrians are also able to adjust their line of sight to reduce the effects of discomfort glare.

4 Conclusion

SLR Consulting Australia Pty Ltd (SLR) has been engaged by The Trust Company (Australia) Limited ATF WH Redfern Trust to provide an assessment of the reflectivity and glare caused by a proposed 18-storey development located at 104-116 Regent Street, Redfern. The report will form part of the development application to the City of Sydney

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On the basis of the above, the detailed reflectivity analysis undertaken in this study shows that the proposed development will cause neither traffic disability glare nor pedestrian discomfort glare on surrounding public areas.

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