

Reflectivity Report

Sydney Metro Martin Place integrated station development -
North Site

Macquarie Corporate Holdings Pty Ltd

Prepared for
Macquarie Corporate Holdings Pty Ltd

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Executive Summary

This reflectivity study has been prepared for the Sydney Metro Martin Place integrated station development – North Site at Martin Place.

This reflectivity study has been carried out to verify that the façade of the proposed project will not cause an unacceptable risk of solar reflections causing disability glare to drivers and pedestrians. Reflections to existing and future buildings have not been considered as part of this assessment.

The project has been assessed from five viewpoints from drivers and five from pedestrians to determine areas where there is a risk of a reflected image of the sun being formed. The methodology proposed by David Hassall has been used to assess where there is a risk of disability glare as calculated by the Holladay formula.

Photographs from the viewpoints have been used to complete this assessment.

Three-dimensional simulation models to assess overshadowing have been used in this assessment and screenshots have been included in Appendix B.

The analysis has been carried out based on the architectural DA drawings by JPW, as listed in Section 1.9.

All viewpoints considered have been analysed and it has been determined that the risk of rogue reflections causing disability glare to drivers and pedestrians are limited and acceptable where the normal specular reflectivity of façade materials is limited to 20% as per the design documentation by JPW.

1. Introduction

1.1 Introduction

This report supports a State Significant Development (SSD) Development Application (DA) (SSD DA) submitted to the Minister for Planning (Minister) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) on behalf of Macquarie Corporate Holdings Pty Limited (Macquarie), who is seeking to create a world class transport and employment precinct at Martin Place, Sydney.

The SSD DA seeks approval for the detailed design and construction of the North Site Over Station Development (OSD), located above and integrated with Metro Martin Place station (part of the **NSW Government's approved Sydney Metro project**). The northern entrance to Metro Martin Place station will front Hunter Street, Elizabeth Street and Castlereagh Street, with the North Site OSD situated above.

This application follows the approval granted by the Minister for a Concept Proposal (otherwise known as a Stage 1 SSD DA) for two OSD commercial towers above the northern and southern entrances of Metro Martin Place station (SSD 17_8351). The approved Concept Proposal establishes building envelopes, land uses, Gross Floor Areas (GFA) and Design Guidelines with which the detailed design (otherwise known as a Stage 2 SSD DA) must be consistent.

This application does not seek approval for elements of the Metro Martin Place Precinct (the Precinct) which relate to the Sydney Metro City and Southwest project, which is subject to a separate Critical State Significant Infrastructure (CSSI) approval. These include:

- o Demolition of buildings on the North Site and South Site;
- o Construction of rail infrastructure, including station platforms and concourse areas;
- o Ground level public domain works; and
- o Station related elements in the podium of the North Tower.

However, this application does seek approval for OSD areas in the approved Metro Martin Place station structure, above and below ground level, which are classified as SSD as they relate principally to the OSD. These components are within the Sydney Metro CSSI approved station building that will contain some OSD elements not already approved by the CSSI Approval. Those elements include the end of trip facilities, office entries, office space and retail areas, along with other office/retail plant and back of house requirements that are associated with the proposed OSD and not the rail infrastructure.

This report details the results of a reflectivity study that aims to identify the potential for adverse reflected solar glare that may affect drivers and pedestrians within the proximity of the North Site.

1.2 Context

The New South Wales (NSW) Government is implementing Sydney's Rail Future (Transport for NSW, 2012), a plan to transform and modernise Sydney's rail network so that it can grow with the city's population and meet the needs of customers in the future.

Sydney Metro is a new standalone rail network identified in Sydney's Rail Future. The Sydney Metro network consists of Sydney Metro Northwest (Stage 1) and Sydney Metro City and Southwest (Stage 2).

Stage 2 of Sydney Metro entails the construction and operation of a new metro rail line from Chatswood, under Sydney Harbour through Sydney's CBD to Sydenham and onto Bankstown through the conversion of the existing line to metro standards. The project also involves the delivery of seven (7) new metro stations, including Martin Place.

This step-change piece of public transport infrastructure once complete will have the capacity for 30 trains an hour (one every two minutes) through the CBD in each direction catering for an extra 100,000 customers per hour across the Sydney CBD rail lines.

On 9 January 2017 the Minister approved the Stage 2 (Chatswood to Sydenham) Sydney Metro application lodged by Transport for NSW (TfNSW) as a Critical State Significant Infrastructure (CSSI) project (reference SSI 15_7400). Work is well underway under this approval, including demolition of buildings at Martin Place.

The OSD development is subject to separate applications to be lodged under the relevant provisions of the EP&A Act. One approval is being sought for the North Site – this application – and one for the South Site via a separate application.

1.3 Site Description

The Metro Martin Place Precinct relates to the following properties (refer to Figure 1):

- o 50 Martin Place, 9 – 19 Elizabeth Street, 8 – 12 Castlereagh Street, 5 Elizabeth Street, 7 Elizabeth Street, and 55 Hunter Street (North Site);
- o 39 – 49 Martin Place (South Site); and
- o Martin Place (that part bound by Elizabeth Street and Castlereagh Street).

This application relates only to the North Site, which refers to the city block bounded by Hunter Street, Castlereagh Street, Elizabeth Street, and Martin Place (refer to Figure 1).

The South Site (39 – 49 Martin Place) is the subject of a separate detailed/Stage 2 SSD DA.

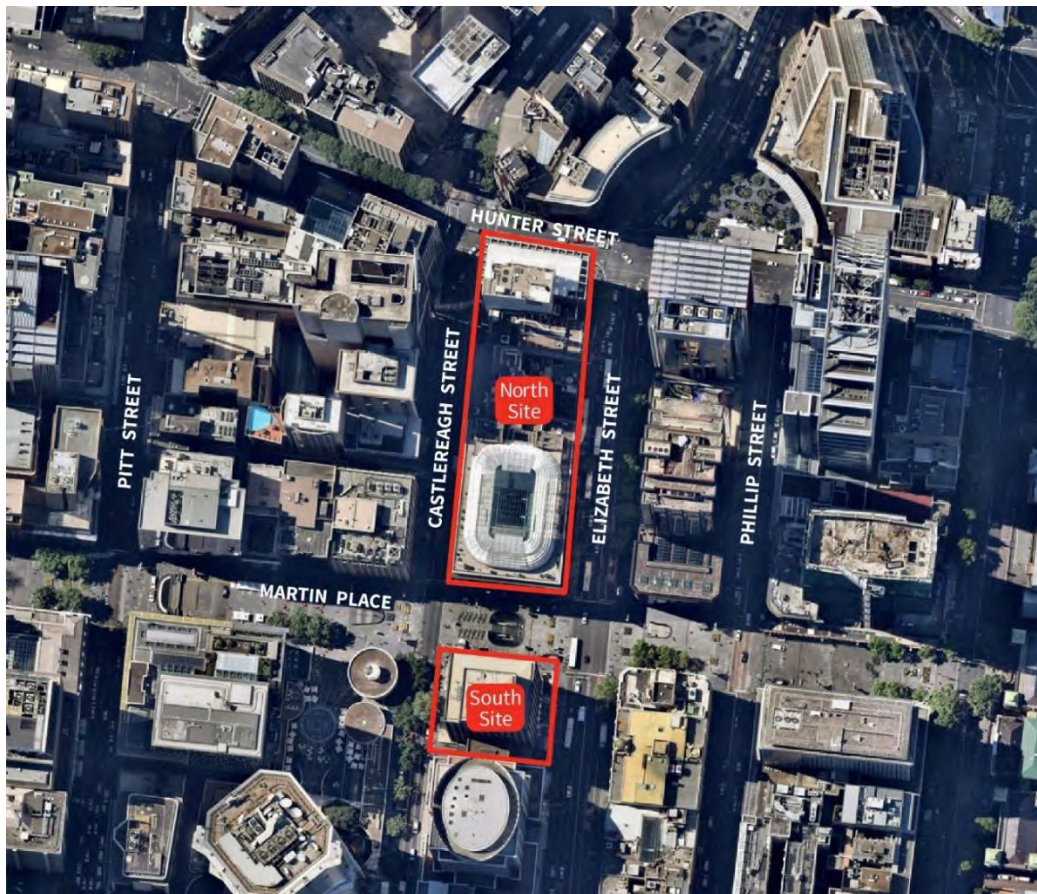


Figure 1 - Aerial Photo of the North and South Site of the Martin Place Metro Station Precinct

1.4 Background

Sydney Metro Stage 2 Approval (SSI 15_7400)

The Sydney Metro CSSI Approval approves the demolition of existing buildings at Martin Place, excavation and construction of the new station (above and below ground) along with construction of below and above ground structural and other components of the future OSD, although the fit-out and use of such areas are the subject of separate development approval processes.

On 22 March 2018, the Minister approved Modification 3 to the Sydney Metro CSSI Approval. This enabled the inclusion of Macquarie-owned land at 50 Martin Place and 9-19 Elizabeth Street within Metro Martin Place station, and other associated changes (including retention of the opening to the existing MLC pedestrian link).

Concept Proposal (SSD 17_8351) and Amending Stage 1 DA

On 22 March 2018, the Minister approved a Concept Proposal (SSD 17_8351) relating to Metro Martin Place Precinct. The Concept Proposal establishes the planning and development framework through which to assess the detailed Stage 2 SSD DAs.

Specifically, the Concept Proposal encompassed:

- Building envelopes for OSD towers on the North Site and South Site comprising:
 - 40+ storey building on the North Site (see Figure 2)
 - 28+ storey building on the South Site
 - Concept details to integrate the North Site with the existing and retained 50 Martin Place building (the former Government Savings Bank of NSW)
- Predominantly commercial land uses on both sites, comprising office, business and retail premises
- A maximum total GFA of 125,437m² across both sites
- Design Guidelines to guide the built form and design of the future development
- A framework for achieving design excellence
- Strategies for utilities and services provision, managing drainage and flooding, and achieving ecological sustainable development
- Conceptual OSD areas in the approved Martin Place Metro Station structure, above and below ground level¹

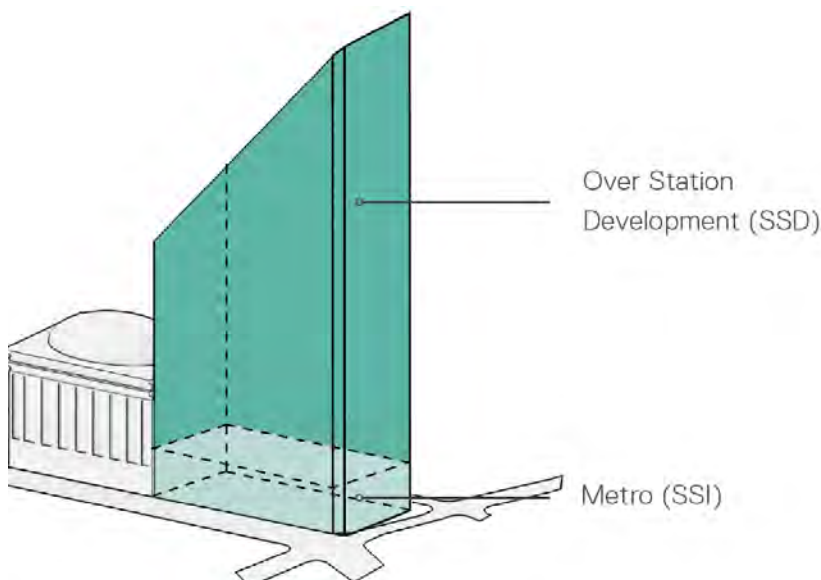


Figure 2 - North Site Approved OSD Building Envelope

¹ Refers to those components within the Metro CSSI approved station envelope that will contain some OSD elements not approved in the CSSI consent. Those elements include the end of trip facilities, office entries, office space and retail areas, along with other office/retail plant and back of house requirements that are associated with the proposed OSD and not the rail infrastructure.

Planning Proposal (PP_2017_SYDNE_007_00) - Amendment to Sydney LEP 2012

The Planning Proposal (PP_2017_SYDNE_007_00) sought to amend the development standards applying to the Metro Martin Place Precinct through the inclusion of a site-specific provision in the Sydney Local Environmental Plan (LEP) 2012. This site-specific provision reduced the portion of the South Site that was subject to a 55 metre height limit from 25 metres from the boundary to Martin Place, to 8 metres, and applies the Hyde Park North Sun Access Plane to the remainder of the South Site, forming the height limit of the tower. It also permits a revised FSR of 22:1 on the South Site and 18.5:1 on the North Site. These amendments were gazetted within Sydney LEP 2012 (Amendment No. 46) on 8 June 2018 and reflect the new planning controls applying to the Precinct.

1.5 Overview of the Proposed Development

The subject application seeks approval for the detailed design, construction and operation of the North Tower. The proposal has been designed as a fully integrated station and OSD project that intends to be built and delivered as one development, in-time for the opening of Sydney Metro City and Southwest in 2024. This application seeks consent for the following:

- o The design, construction and operation of a new 39 storey commercial OSD tower (plus rooftop plant) within the approved building envelope for the North Site, including office space and retail tenancies.
- o Physical connections between the OSD podium and the existing 50 Martin Place building, to enable the use of the North Site as one integrated building.
- o Vehicle loading areas within the basement levels.
- o Extension and augmentation of physical infrastructure / utilities as required.
- o **Detailed design and delivery of 'interface areas' within both the approved station and Concept Proposal envelope that contain OSD-exclusive elements, such as end of trip facilities, office entries, office space and retail areas not associated with the rail infrastructure.**

1.6 Planning Approvals Strategy

The State Environmental Planning Policy (State and Regional Development) 2011 (SEPP SRD) identifies development which is declared to be State Significant. Under Schedule 1 and Clause 19(2) of SEPP SRD, development within a railway corridor or associated with railway infrastructure that has a capital investment value of more than \$30 million and involves commercial premises is declared to be State Significant Development (SSD) for the purposes of the EP&A Act.

The proposed development (involving commercial development that is both located within a rail corridor and associated with rail infrastructure) is therefore SSD.

Pursuant to Section 4.22 of the EP&A Act a Concept DA may be made setting out concept proposals for the development of a site (including setting out detailed proposals for the first stage of development), and for which detailed proposals for the site are to be the subject of subsequent DAs. This SSD DA represents a detailed proposal and follows the approval of a Concept Proposal on the site under Section 4.22 of the EP&A Act.

Submitted separately to this SSD DA is a SSD DA for the South Site (Stage 2 South Site SSD DA). A Stage 1 Amending SSD DA to the Concept Proposal (Stage 1 Amending DA) has also been submitted that has the effect of aligning the approved South Site envelope with the new planning controls established for the South Site (achieved through the site specific amendment to the Sydney LEP 2012).

Figure 3 below is a diagrammatic representation of the suite of key planning applications undertaken or proposed by Macquarie and their relationship to the subject application (the subject of this report).

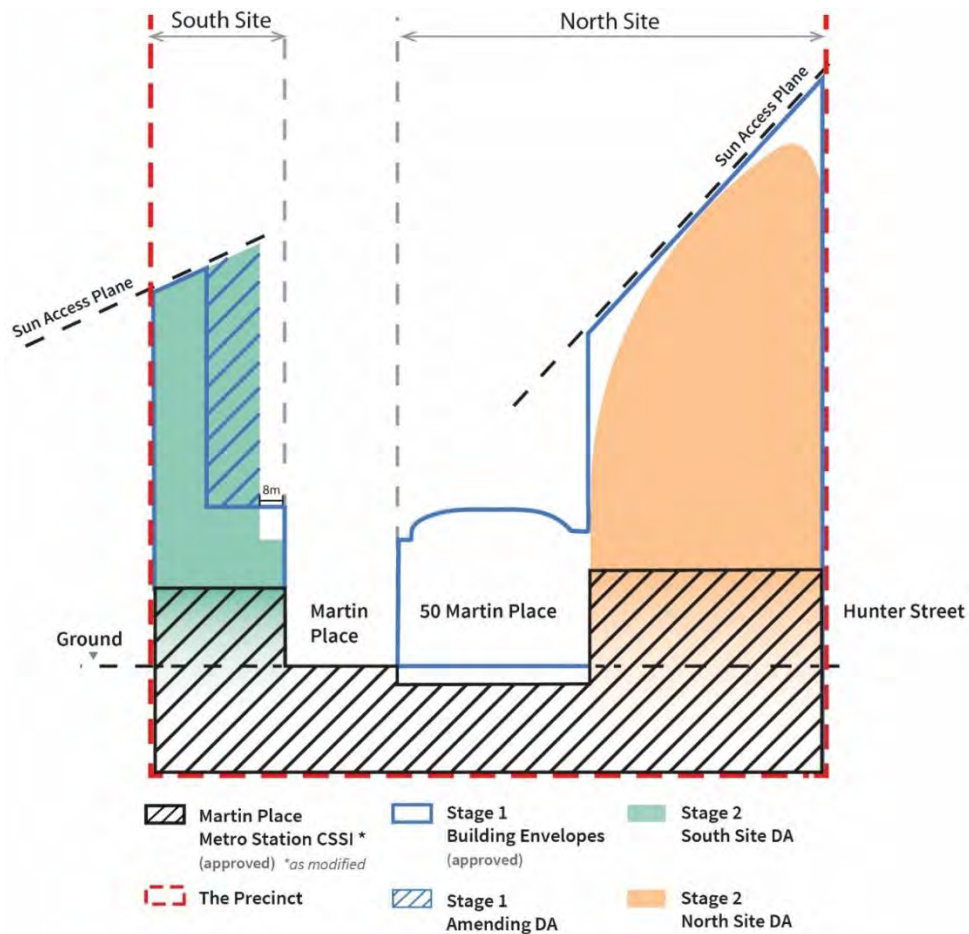


Figure 3 - Relationship of key planning applications to the Stage 2 South Site DA (this application)

The Department of Planning and Environment have provided Secretary's Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the proposed development. This report has been prepared having regard to the SEARs as follows:

- Not applicable

The only purpose of this reflectivity analysis to assess the potential disability glare conditions to users of the public domain, i.e. motorists and pedestrians. It is not common industry practice for a reflectivity analysis to assess potential impacts to occupants of neighbouring buildings. There are a number of factors and variables that influence the level of glare experienced by occupants within surrounding buildings, including the degree to which the façade of the surrounding building minimises/removes glare. Occupants of surrounding buildings, being commercial in nature, are also able to readily mitigate any potential glare through pulling down blinds, facing away from the glare etc. Importantly, there are not the same level of safety risks compared to users at ground level who are moving through and past the site. These reflections are typically considered as nuisance glare and the assessment of this is subjective.

1.7 Site Location

The site has been assessed to determine appropriate viewpoints where drivers (red), and pedestrians when they are crossing the road (blue), are able to see the building façade in their direct line of vision.

Viewpoints where a driver would be required to be travelling the wrong way down a street have not been considered in this assessment. It has been assumed that this condition will not change.

It has been assessed that the building is visible to drivers from the following locations:

- Travelling east on Hunter Street (VP1)
- Travelling south on Bligh Street (VP2)
- Travelling south on Phillip Street (VP3)
- Travelling west on Hunter Street (VP4)
- Travelling north on Elizabeth Street (VP5)

It is also directly visible to pedestrians crossing roads at pedestrian crossings at the following locations:

- Crossing east at Castlereagh Street (VPA)
- Crossing south at Hunter Street (VPB)
- Crossing south at Hunter Street (VPC)
- Crossing south at Hunter Street (VPD)
- Crossing west at Elizabeth Street (VPE)

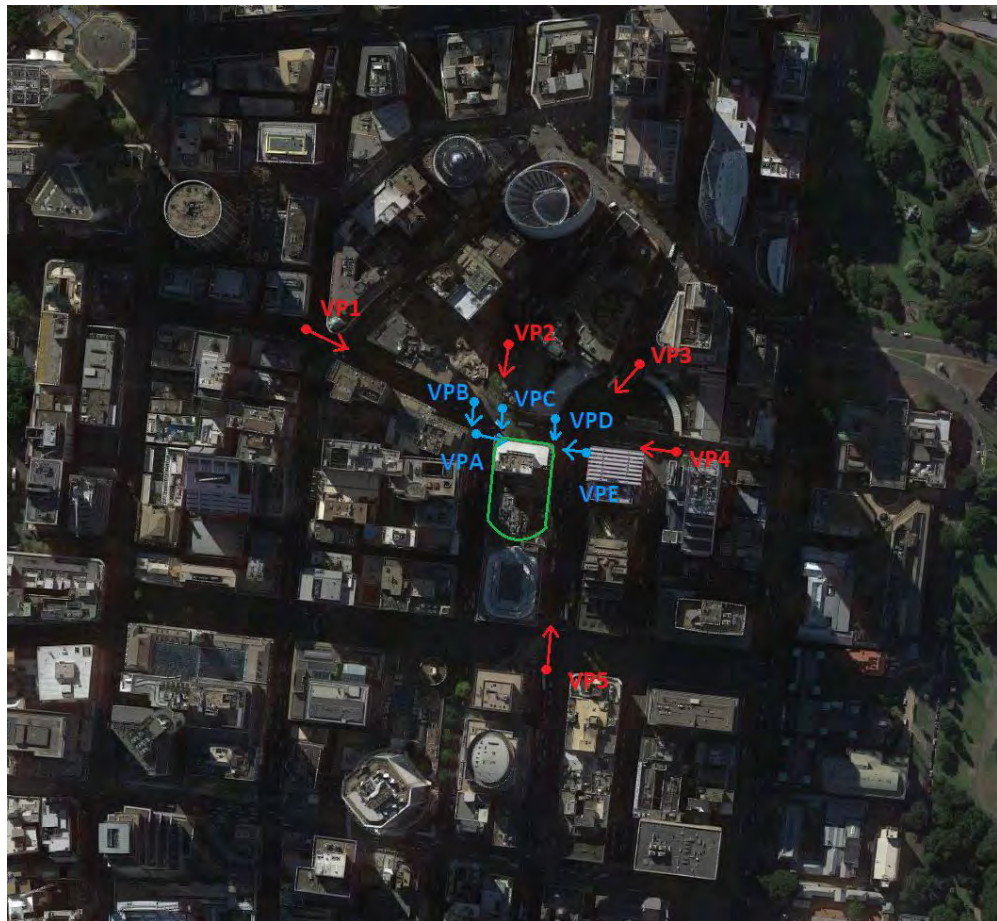


Figure 4 - Satellite Image with Viewpoints²

² Image from Google Maps

1.7.1 Site Orientation

Tower Façade Aspects that are visible (ie not immediately adjacent to another structure) are shown marked up on Figure 5 below. The tower façade, for the purpose of this report, is considered to begin from the level 3 slab (and including the panel below), the bottom of which is 13m above Elizabeth Street and 17.5 metres above Castlereagh Street (and Bligh Street).

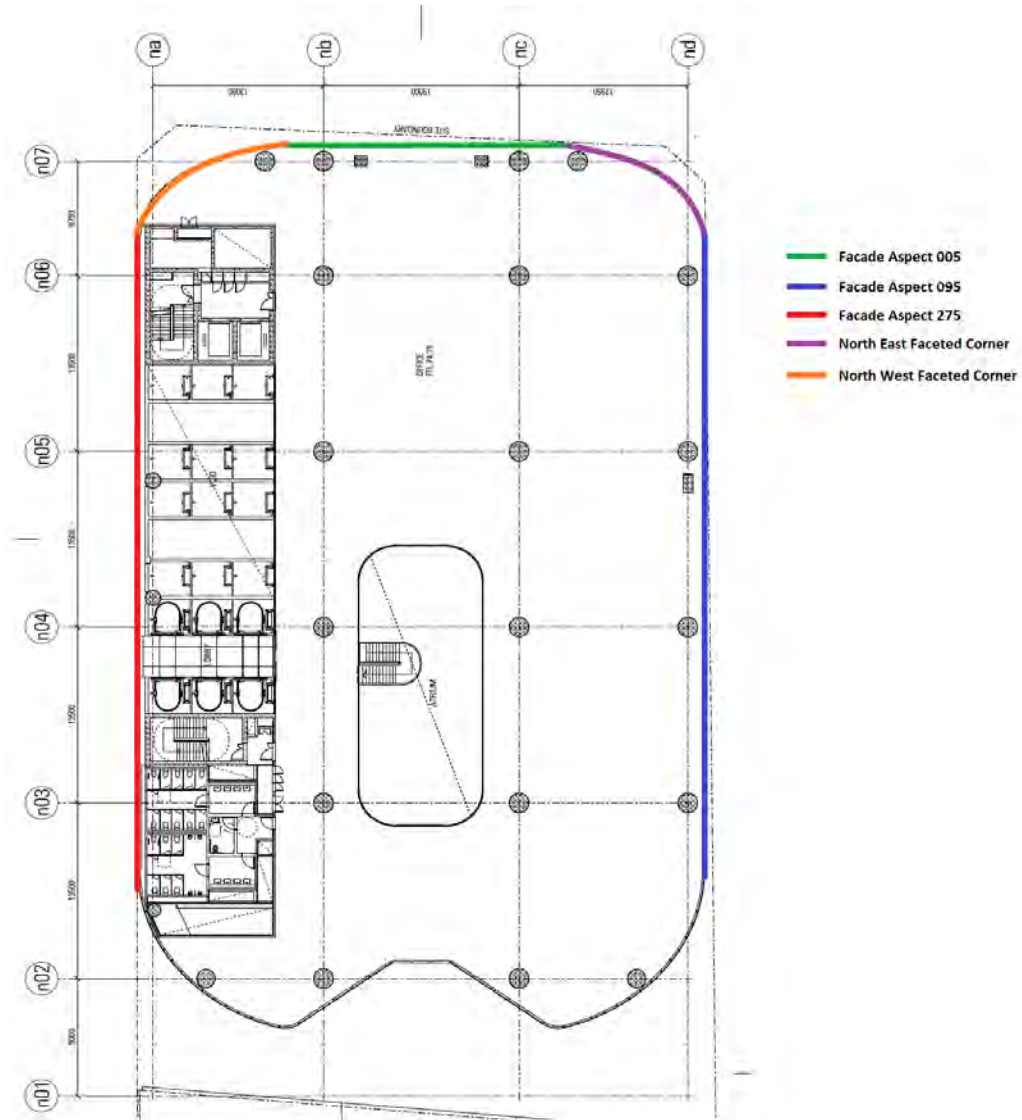


Figure 5 – Tower Building Aspects

List of façade aspects as defined in Figure 5:

- Façade Aspect 005
- Façade Aspect 095
- Façade Aspect 275

The North Site has faceted corners to all elevations of the building. For this reflectivity assessment, only the corners on the north-east and north-west can be seen from the viewpoints. These two corners have nine faceted panels in between the façade aspects described above and the angle of each faceted panel has been measured and recorded as façade aspects below.

In order to allow the assessment to be completed the assumption is that the nine faceted panels are each an equal increment of the visible portion from each viewpoint.

The façade aspects that form part of these two corners and are included in the assessment are:

North East Corner

- | | |
|---------------------|---------------------|
| ○ Façade Aspect 010 | ○ Façade Aspect 040 |
| ○ Façade Aspect 015 | ○ Façade Aspect 050 |
| ○ Façade Aspect 020 | ○ Façade Aspect 065 |
| ○ Façade Aspect 025 | ○ Façade Aspect 085 |
| ○ Façade Aspect 035 | |

North West Corner

- | | |
|---------------------|---------------------|
| ○ Façade Aspect 285 | ○ Façade Aspect 345 |
| ○ Façade Aspect 305 | ○ Façade Aspect 350 |
| ○ Façade Aspect 320 | ○ Façade Aspect 355 |
| ○ Façade Aspect 330 | ○ Façade Aspect 000 |
| ○ Façade Aspect 335 | |

The entry façade (ground floor and Level 1) has not been considered as part of this assessment.

1.8 Stereographic Sun Chart

The position of the sun in the sky throughout the year varies depending on the latitude of the location of assessment. A stereographic sun chart is a two-dimensional representation of this path of the sun for a particular line of latitude.

This chart is used in order to determine the location of a virtual reflected sun in accordance with the Hassall methodology in order to assess the potential for glare. Refer to Section 2 of this report for more detailed information on the assessment methodology

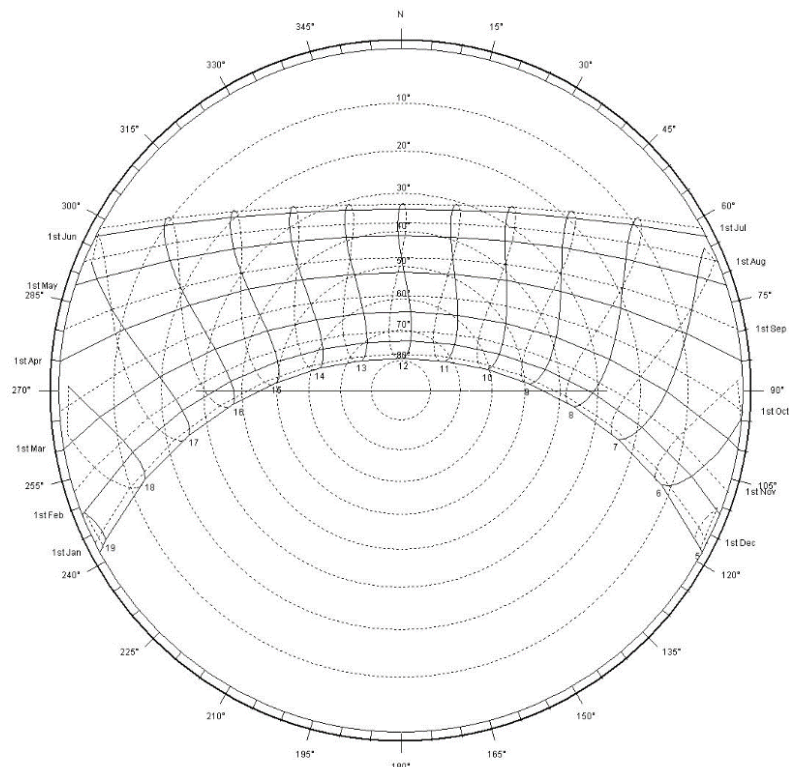


Figure 6 – Stereographic Sun Chart for Sydney (34 degree latitude)

1.9

Referenced Drawings

Drawing Number	Revision	Authoring Company	Status
CSWSMP-MAC-SMN-AT-DRG-300000	H	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300100	G	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300200	G	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300300	I	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300400	H	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300500	G	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300600	G	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300700	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300800	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-300900	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-301000	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-301100	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-301200	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-301300	F	JPW	Stage 2 DA
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CSWSMP-MAC-SMN-AT-DRG-303400	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-303500	F	JPW	Stage 2 DA

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Sydney Metro Martin Place integrated station development - North Site

Drawing Number	Revision	Authoring Company	Status
CSWSMP-MAC-SMN-AT-DRG-303600	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-303700	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-303800	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-303900	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-305000	F	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-308000	G	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-308100	B	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-308200	B	JPW	Stage 2 DA
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CSWSMP-MAC-SMN-AT-DRG-409903	F	JPW	Stage 2 DA
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CSWSMP-MAC-SMN-AT-DRG-509910	G	JPW	Stage 2 DA
CSWSMP-MAC-SMN-AT-DRG-519902	F	JPW	Stage 2 DA

2. Assessment Methodology

2.1 Analysis Philosophy

The glare assessment has been carried out as per the methodology outlined in the technical bulletin **"Reflectivity: Dealing with Rogue Solar Reflections"** written by David Hassall from the Faculty of Architecture at the University of New South Wales.

This methodology defines a glare (I_v) limit of 500 candelas/m², calculated to the Holladay formula, to which a driver can be exposed without causing disability.

Viewpoints have been defined from which it is expected that either drivers or pedestrians where they are crossing the road, are able to see the building. A stereographic sun path diagram and the building geometry are then used to determine whether a viewpoint will be subject to the reflected sun during the year.

A glare protractor, oriented in the direction of drivers or pedestrians as appropriate, is used to determine the glare based on the reflectivity of the surface and the apparent angle of viewing.

2.2 Virtual Sun Location

The virtual suns location is determined with the stereographic sun chart for the project location.

This is completed by plotting the virtual sun on the stereographic sun chart based on the orientation of the façade. The apparent reflective surface of the façade is plotted based on the bounding horizontal and vertical angles from the viewpoint.

2.3 Glare Assessment

In order to allow assessment of buildings for glare David Hassall has developed a glare protractor that provides a diagrammatic limit of 500 candelas/m² based on viewing angle and inclination and reflectivity of the viewing surface. This glare protractor is shown in Figure 8 and is used where the stereographic sun path indicates that there is glare to a particular viewpoint.

A brief description of the calculation of the glare (equivalent veiling luminance) is provided below for reference. The glare protractor has thereafter been used in this assessment.

The equivalent veiling luminance (I_v) is calculated based on the Holladay formula (1), which defines the illumination of a viewer's eye based on a calculated illuminance perpendicular to the surface (EG) and a factor based on the angle of viewing (θ).

$$I_v = 10 \times EG \div \theta^2 \quad (1)$$

The angle of viewing (θ) is based on the angle between the direct line of sight and the glare source (α) and the inclination between a viewing normal and the glare source (β). This is calculated with trigonometry based on Equation 2 below and is shown diagrammatically in Figure 7.

$$\theta = \text{ATAN} \times [\sqrt{\tan^2(\beta) + \sin^2(\alpha)}] \div \cos(\alpha) \quad (2)$$

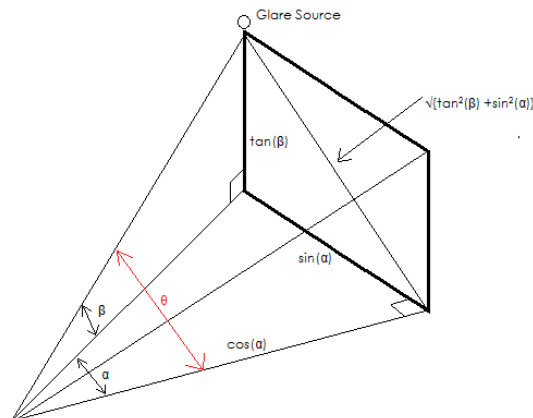


Figure 7 – Diagrammatic Angle of Viewing Calculation

The illumination of the viewer's eye normal to the light source (EG) is calculated based on the solar illumination (E), the reflectivity of the surface (R) and the angle of viewing (θ) calculated in Equation 2. The solar illumination is calculated in Equation 4 based on the solar power (W), which is dependent on the inclination of the virtual sun (β) and the luminance efficacy (I_e).

$$EG = E \times R \times \cos(\theta) \quad (3)$$

$$E = W \times I_e \quad (4)$$

The solar power is determined as 50 watts per degree up to 10 degrees and 15 watts per degree thereafter.

The luminance efficacy is 90 lumens/watt at 7.5° and 117 lumens/watt at 25° and is interpolated for other angles.

The glare protractor by Hassall joins points at incremental reflectivity (iso-glare loops) with varying α and β values in order to set a limit where the equivalent veiling luminance is limited to 500 candelas/m².

By overlaying the glare protractor on a photo or computer generated image in the direction of viewing and aligning the verticals with the building it is possible to graphically determine the maximum reflectivity to not cause disability glare.

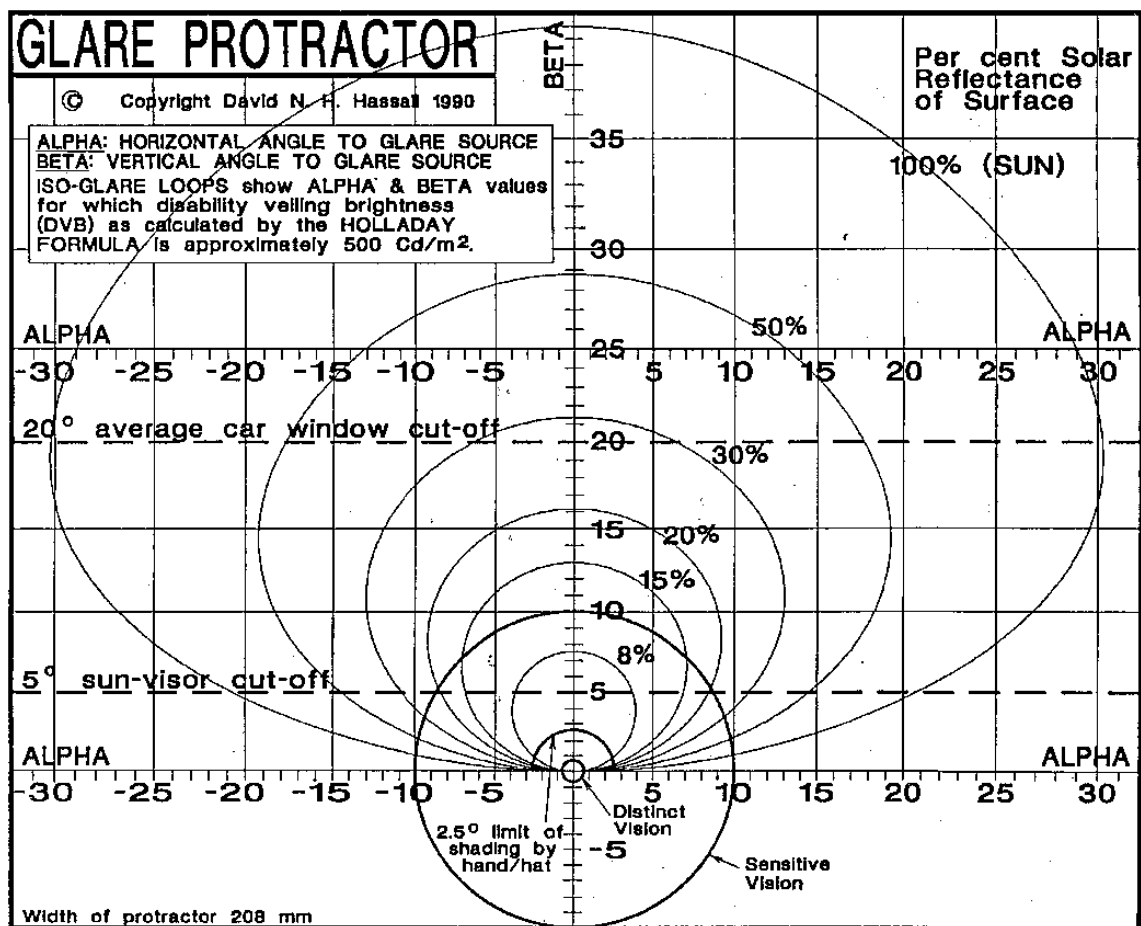


Figure 8 – Glare Protractor³

³ "Reflectivity: Dealing with Rogue Solar Reflections" – David Hassall

2.4 Maximum Normal Specular Reflectivity

The City of Sydney typically instructs as part of its DA Conditions that the normal specular reflectivity of all façade materials is limited to 20%.

As the normal specular reflectivity of all building materials is limited to 20% a limit is taken such that any area viewed with a vertical bearing angle above 16° is adequate without need for further studies. Refer to Figure 8 above.

3. Results

3.1 General

The façade has been assessed from each viewpoint identified in Section 1 of the report.

Where it is identified that there is reflected image the following actions have been taken:

1. Assessment with Ecotect software to determine if there is overshadowing of the relevant façade aspect at the time that would cause glare
2. A geometric assessment of plans to determine if reflections would reach the façade or viewpoint
3. A photo from site has been taken and the glare protractor is applied in order to determine the maximum reflectivity allowable on the façade surface to achieve a maximum equivalent veiling luminance of 500 candelas/m²

Detailed results have been included as part of Appendix A. A summary of these results is provided in this section.

3.2 Viewpoint 1

Viewpoint 1 is taken from the viewpoint of a driver travelling east on Hunter Street. The viewing angle of the driver is 116°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.3 Viewpoint 2

Viewpoint 2 is taken from the viewpoint of a driver travelling south on Bligh Street. The viewing angle of the driver is 188°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.4 Viewpoint 3

Viewpoint 3 is taken from the viewpoint of a driver travelling south-west on Phillip Street. The viewing angle of the driver is 200°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.5 Viewpoint 4

Viewpoint 4 is taken from the viewpoint of a driver travelling west on Hunter Street. The viewing angle of the driver is 188°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.6 Viewpoint 5

Viewpoint 5 is taken from the viewpoint of a driver travelling north on Elizabeth Street. The viewing angle of the driver is 3°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.7 Viewpoint A

Viewpoint A is taken from the viewpoint of a pedestrian crossing Castlereagh Street at Hunter Street. The viewing angle of the pedestrian is 102°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.8 Viewpoint B

Viewpoint B is taken from the viewpoint of a pedestrian crossing Hunter Street at Castlereagh Street. The viewing angle of the pedestrian is 187°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.9 Viewpoint C

Viewpoint C is taken from the viewpoint of a pedestrian crossing Hunter Street at Castlereagh Street. The viewing angle of the pedestrian is 187°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.10 Viewpoint D

Viewpoint D is taken from the viewpoint of a pedestrian crossing Hunter Street at Elizabeth Street. The viewing angle of the pedestrian is 181°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

3.11 Viewpoint E

Viewpoint E is taken from the viewpoint of a pedestrian crossing Elizabeth Street at Hunter Street. The viewing angle of the pedestrian is 181°.

The path of the reflected sun has been assessed from all visible façade aspects from this viewpoint. There is no risk of rogue reflections from this viewpoint and no further studies are required.

4. Conclusion

This reflectivity study has been carried out in order to address the potential for disability glare to pedestrians and drivers caused by this project.

The analysis has been completed based on the architectural drawings issued for Stage 2 DA as listed in Section 1.9.

The glare assessment has been carried out as per the methodology outlined in the technical bulletin "Reflectivity: Dealing with Rogue Solar Reflections" written by David Hassall.

A total of ten viewpoints have been selected for this study to represent possible views from drivers and pedestrians of the proposed project. Reflections to existing and future buildings have not been considered as part of this assessment.

All viewpoints considered have been analysed and it has been determined that the risk of rogue reflections causing disability glare to drivers and pedestrians are limited and acceptable where the normal specular reflectivity of façade materials is limited to 20% as per the design documentation by JPW.

Appendix A

Appendix A – Detailed Results

Viewpoint 1

Viewpoint 1 is taken from the viewpoint of a driver travelling east on Hunter Street. The viewing angle of the driver is 116°.

The distances of the viewpoint to the façade are:

- Nearest corner = 168m

The following Tower façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Façade Aspect 005
- Façade Aspect 275 (obstructed by other buildings)
- North West Faceted Corner

The following Entry façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Entry Façade Aspect 005

The bottom of the tower façade starts at 3.4° from this viewpoint.

In Figure 9 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The red arrow indicated the direction of travel and viewing.

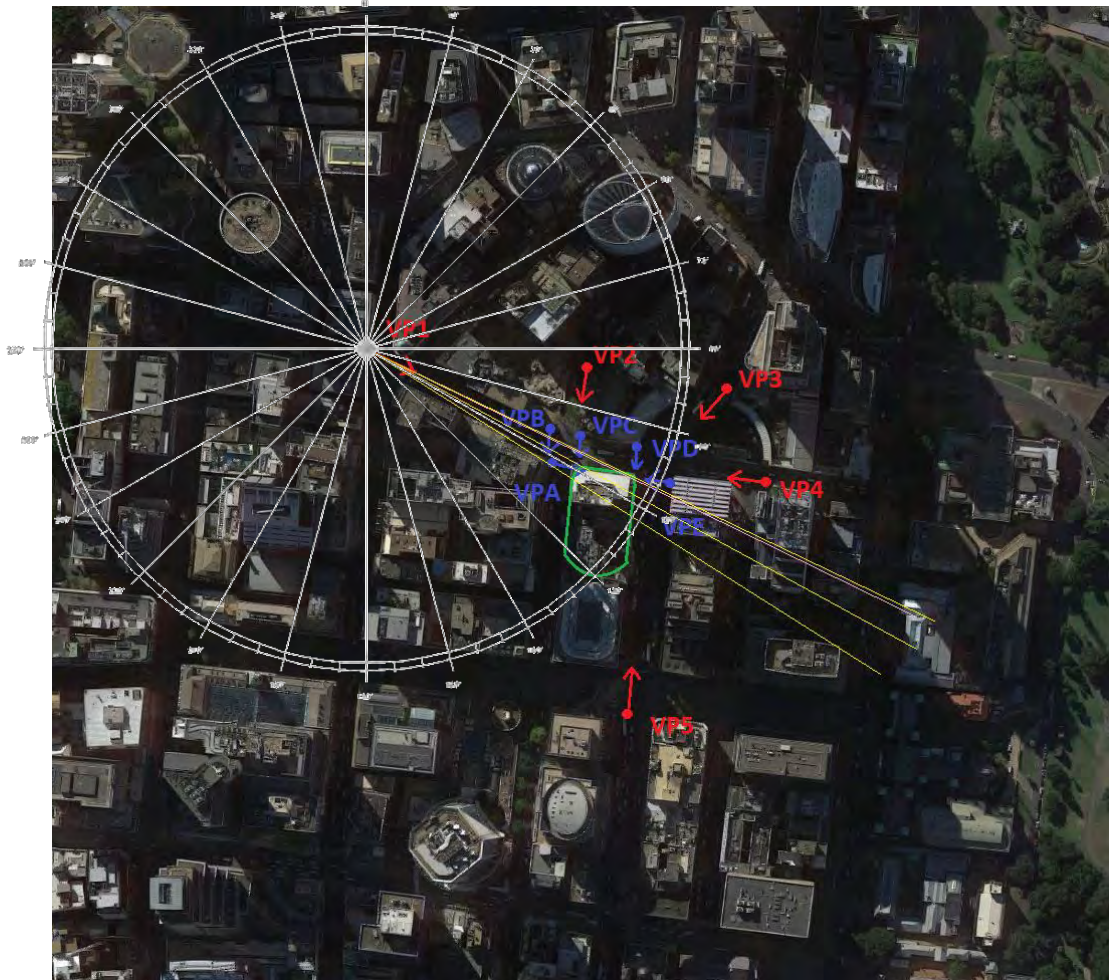


Figure 9 – Viewpoint 1 horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

Tower Facade

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 005	3.4°	16°	116°	118°
North-West Faceted Corner			118°	123°
Façade Aspect 000	3.4°	16°	122°	123°
Façade Aspect 355	3.4°	16°	122°	123°
Façade Aspect 350	3.4°	16°	121°	122°
Façade Aspect 345	3.4°	16°	121°	122°
Façade Aspect 335	3.4°	16°	120°	121°
Façade Aspect 330	3.4°	16°	119°	120°
Façade Aspect 320	3.4°	16°	119°	120°
Façade Aspect 305	3.4°	16°	118°	119°
Façade Aspect 285	3.4°	16°	118°	119°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 10 to Figure 19 below.

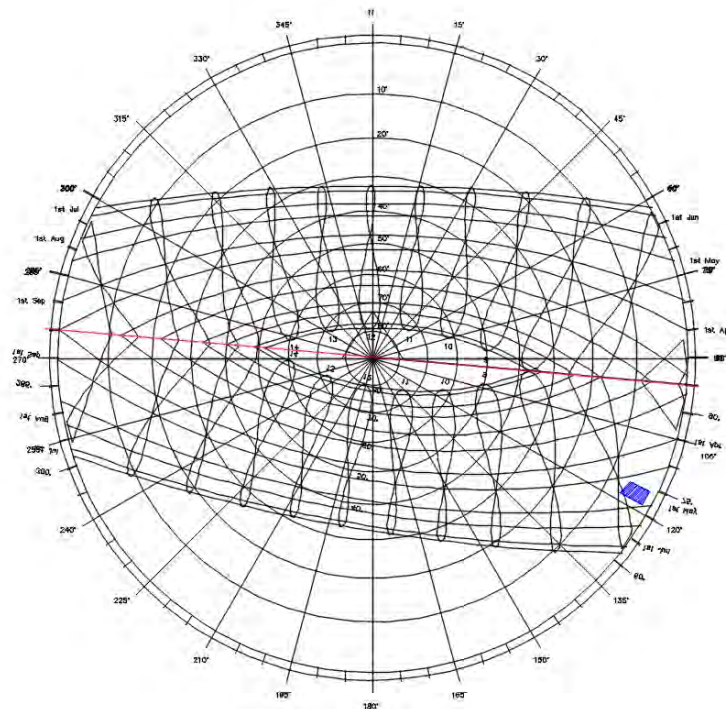


Figure 10 – Façade Aspect 005 Reflected Virtual Sun from Viewpoint 1

There is a reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 005 of the building. This reflected image occurs between 630 and 7am between April 20 and May 5 and August 25 and Sep 10 each year.

A computer model has been used to simulate the overshadowing from adjacent buildings at these times and in these date ranges. It has been determined that the sun does not strike this façade aspect. Representative images from the computer model have been included in Appendix B.

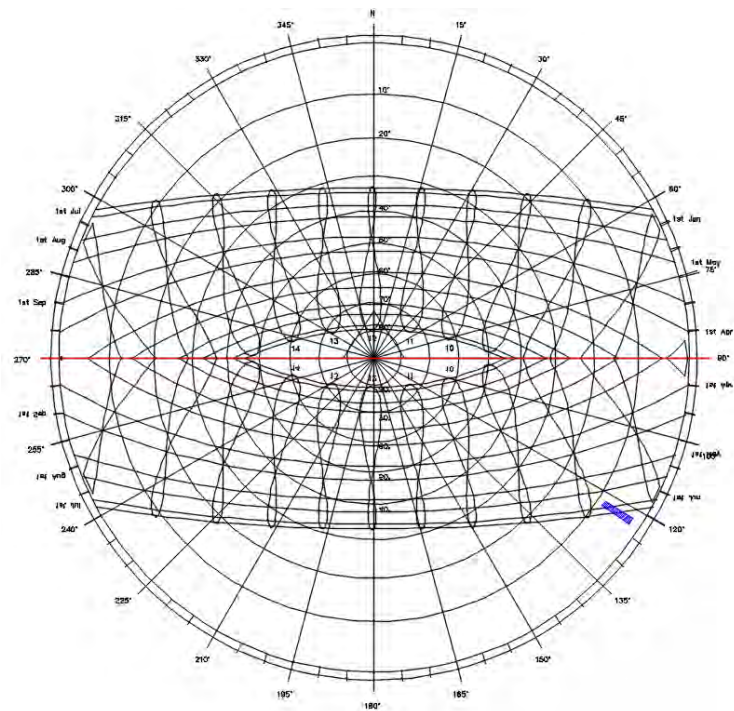


Figure 11 – Façade Aspect 000 Reflected Virtual Sun from Viewpoint 1

There is a reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 000 of the building. This reflected image occurs between 7 and 745am between May 25 and August 5 each year.

A computer model has been used to simulate the overshadowing from adjacent buildings at these times and in these date ranges. It has been determined that the sun does not strike this façade aspect. Representative images from the computer model have been included in Appendix B.

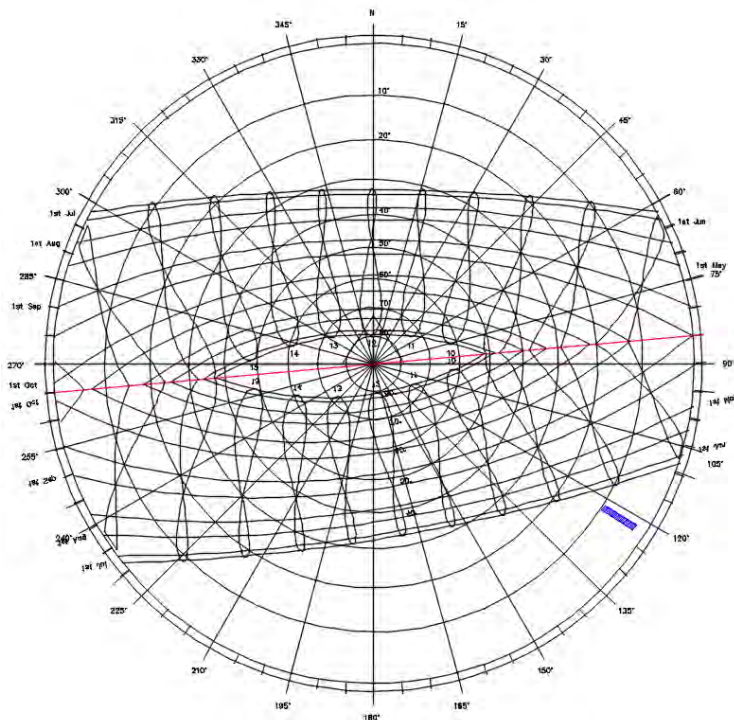


Figure 12 – Façade Aspect 355 Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 355 of the building. No further studies are required.

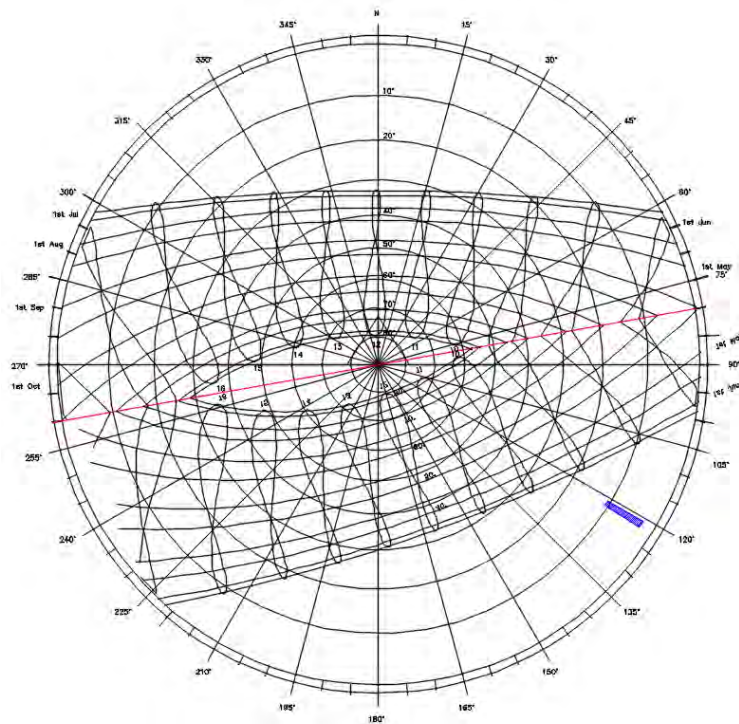


Figure 13 –Façade Aspect 350 Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 350 of the building. No further studies are required.

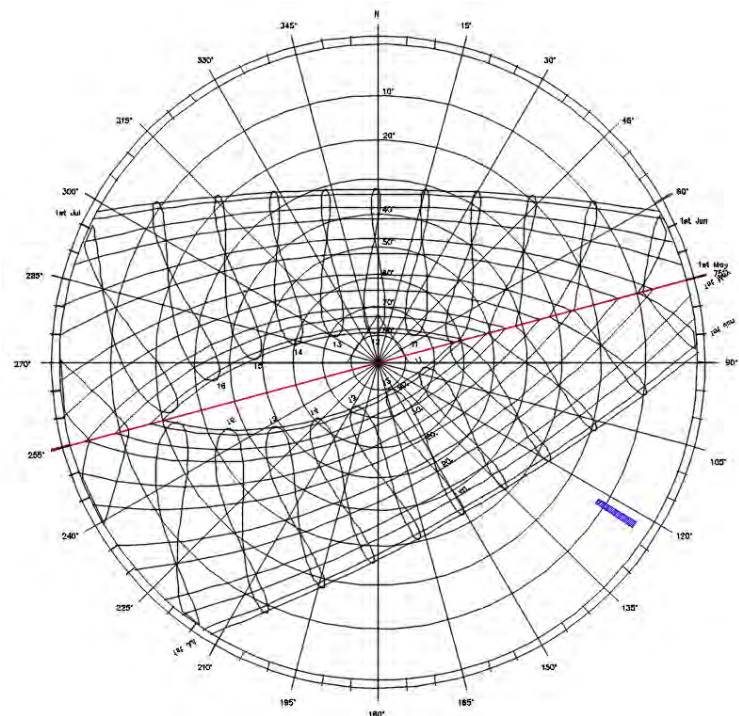


Figure 14 –Façade Aspect 345 Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 345 of the building. No further studies are required.

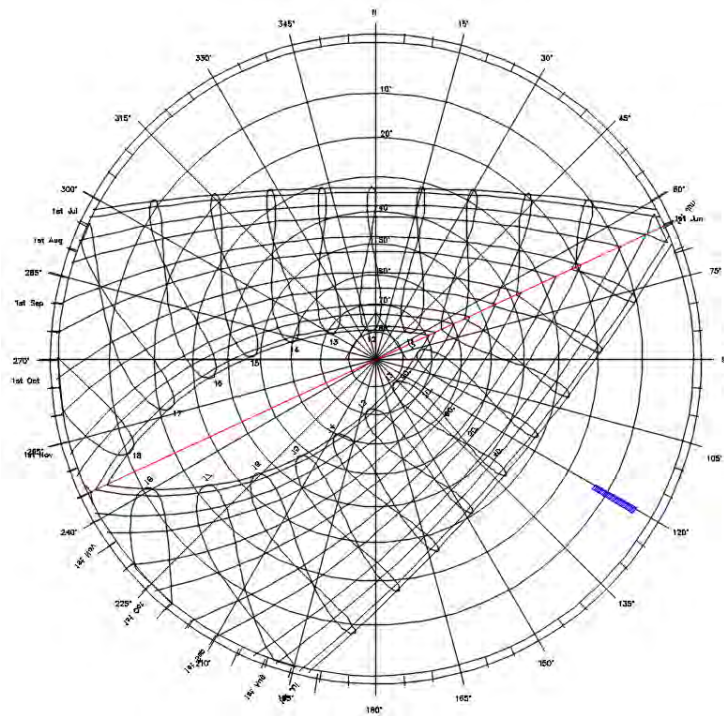


Figure 15 – Façade Aspect 335 Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 335 of the building. No further studies are required.

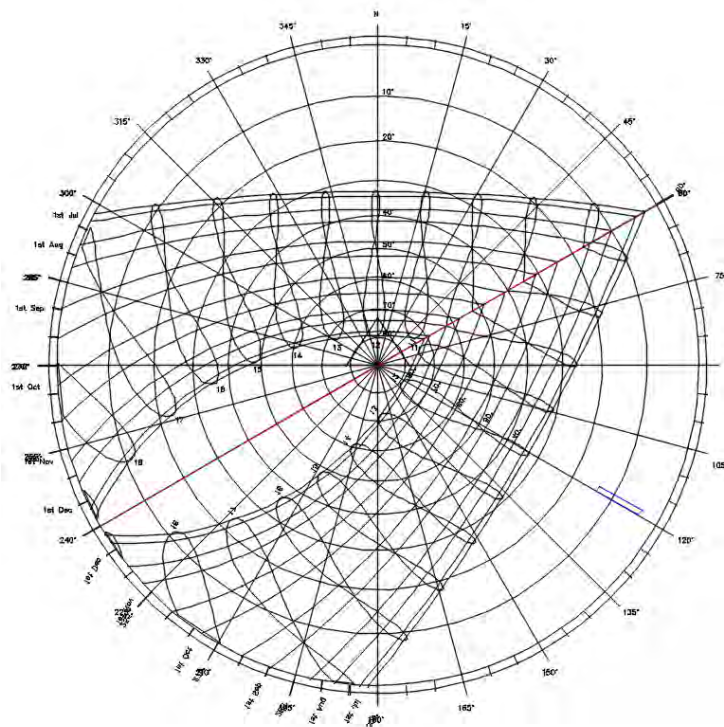


Figure 16 – Façade Aspect 330 Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 330 of the building. No further studies are required.

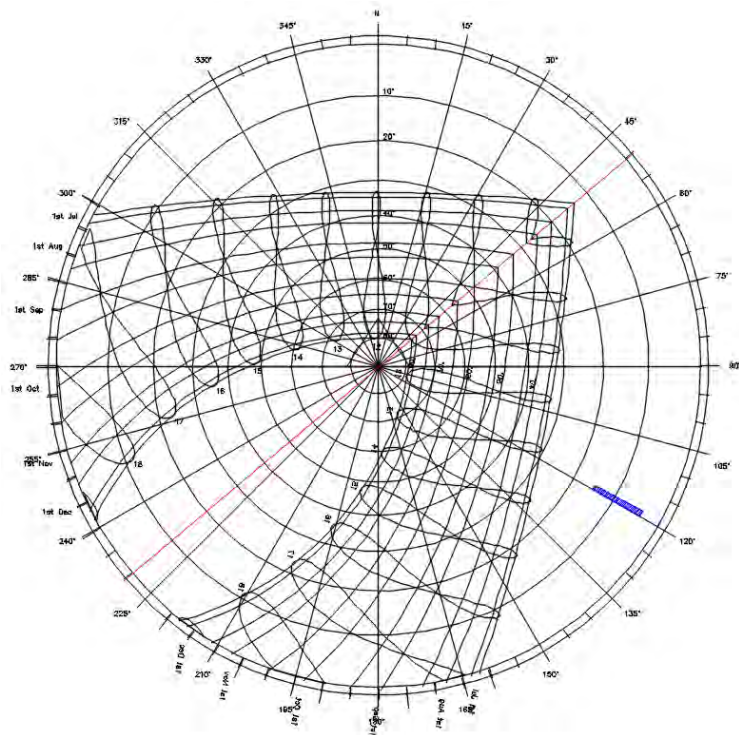


Figure 17 –Façade Aspect 320 Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 320 of the building. No further studies are required.

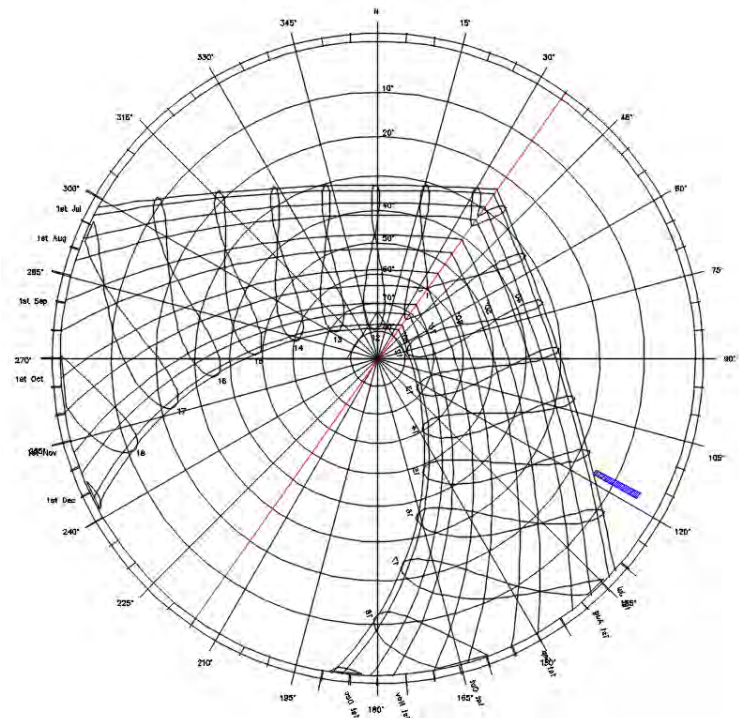


Figure 18 –Façade Aspect 305 Reflected Virtual Sun from Viewpoint 1

There is no reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 305 of the building. No further studies are required.

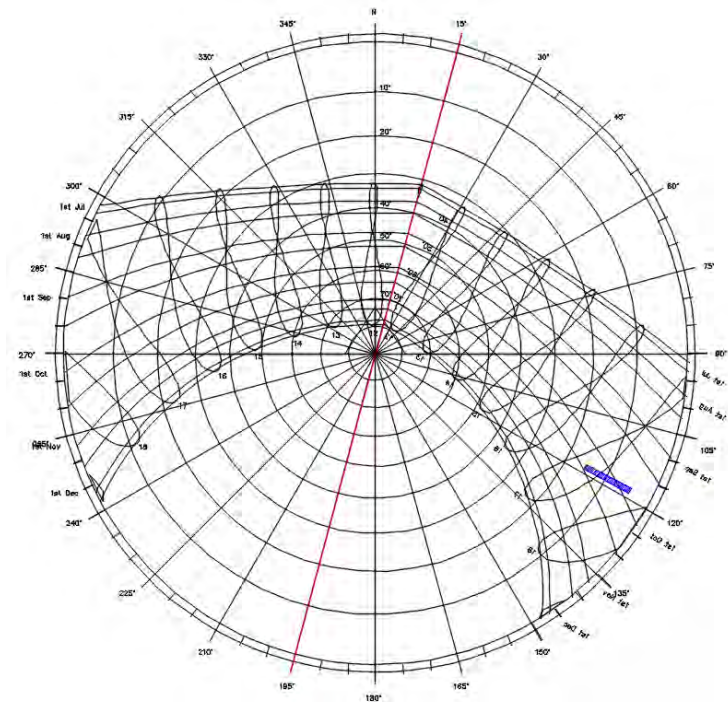


Figure 19 – Façade Aspect 285 Reflected Virtual Sun from Viewpoint 1

There is a reflected image of the sun that reaches Viewpoint 1 from Façade Aspect 285 of the building. This reflected image occurs between 5 and 6pm between March 20 and April 10 and September 20 and October 10 each year.

A computer model has been used to simulate the overshadowing from adjacent buildings at these times and in these date ranges. It has been determined that the sun does not strike this façade aspect. Representative images from the computer model have been included in Appendix B.

Viewpoint 2

Viewpoint 2 is taken from the viewpoint of a driver travelling south on Bligh Street. The viewing angle of the driver is 188°.

The distances of the viewpoint to the façade are:

- Nearest corner = 60m

The following façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Façade Aspect 005
- North West Faceted Corner

The bottom of the tower façade starts at 16° from this viewpoint and therefore none of the tower façade will cause disability reflections to this viewpoint. No further studies are required.

In Figure 20 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The red arrow indicated the direction of travel and viewing.

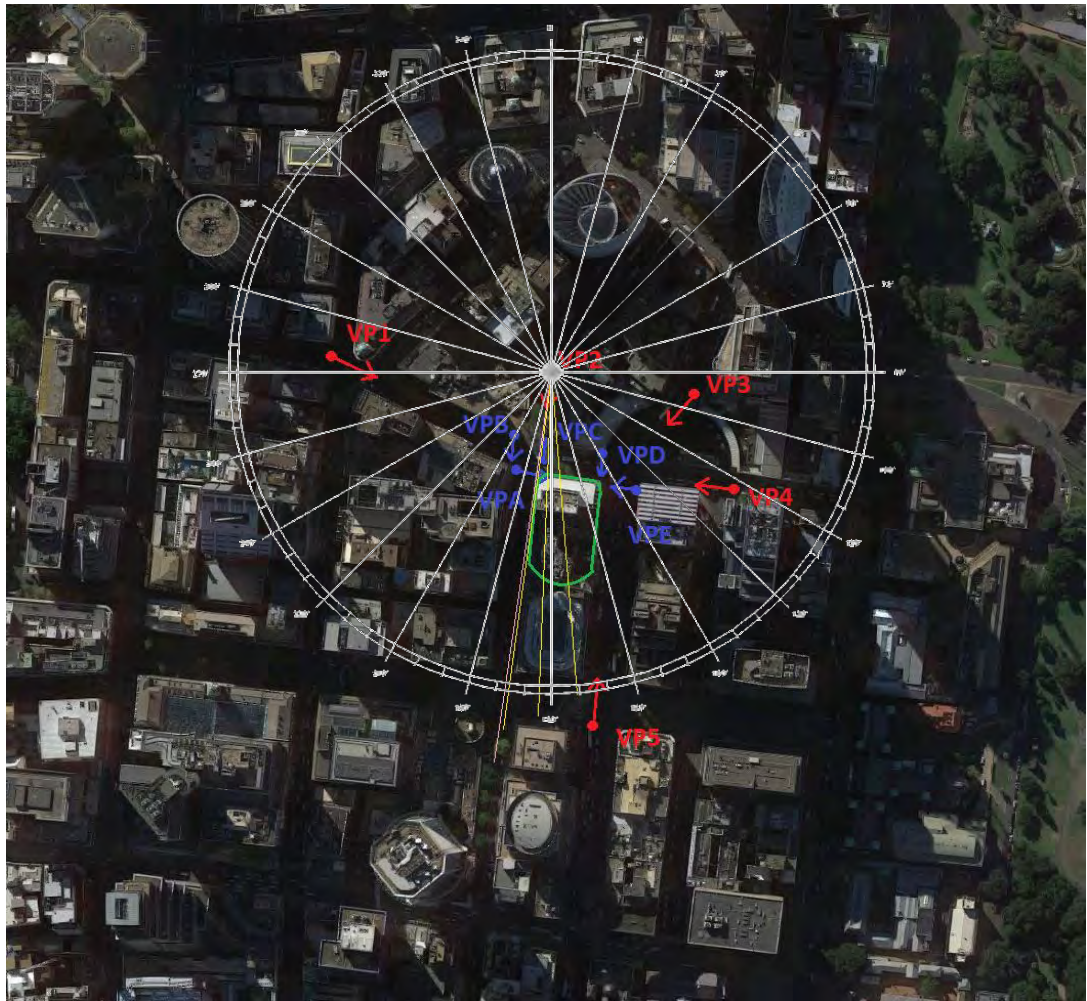


Figure 20 – Viewpoint 2 horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

Viewpoint 3

Viewpoint 3 is taken from the viewpoint of a driver travelling south-west on Phillip Street. The viewing angle of the driver is 200°.

The distances of the viewpoint to the façade are:

- Nearest corner = 80m

The following façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Façade Aspect 005
- Façade Aspect 095
- North East Faceted Corner

The bottom of the tower façade starts at 9.2° from this viewpoint.

In Figure 21 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The red arrow indicated the direction of travel and viewing.

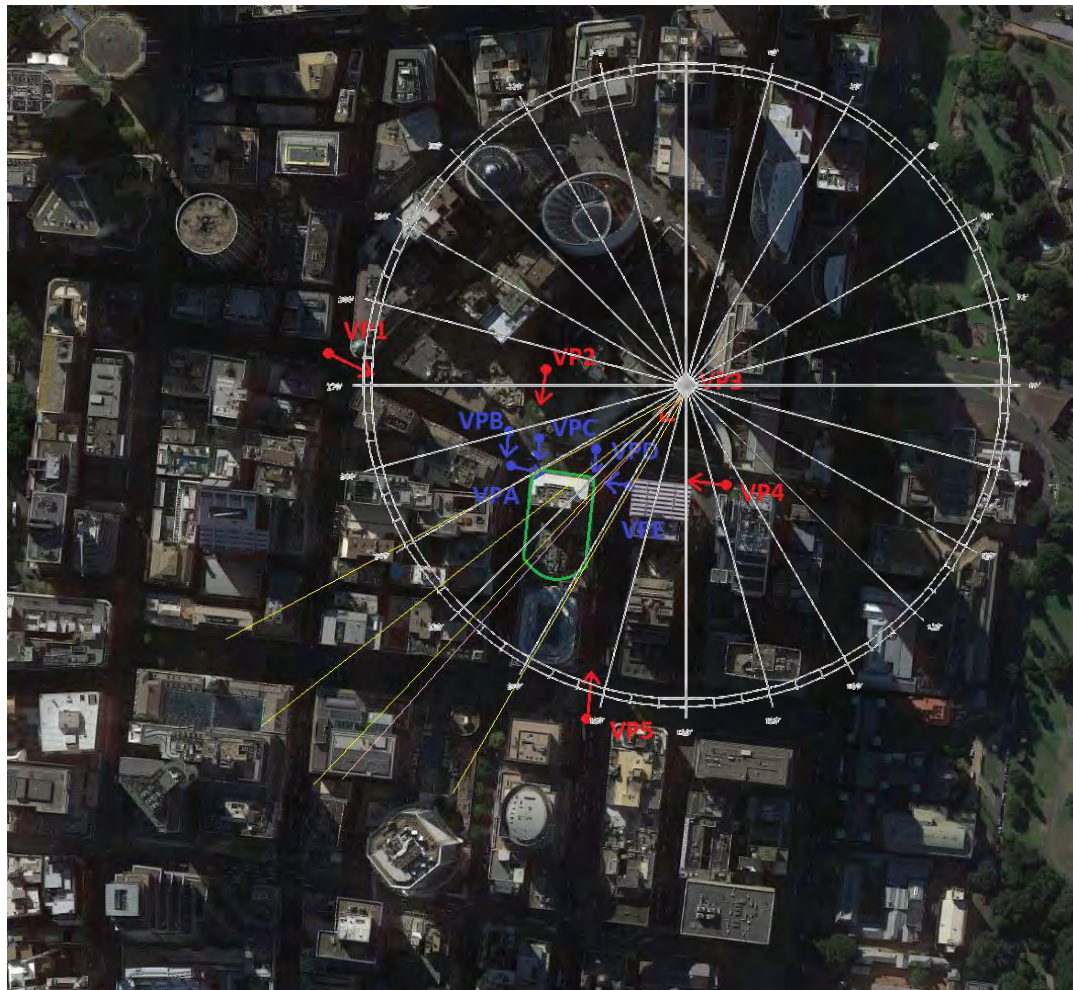


Figure 21 – Viewpoint 3 horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 005	9.2°	16°	231°	250°
Façade Aspect 095	9.2°	16°	210°	222°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 22 and Figure 23 below.

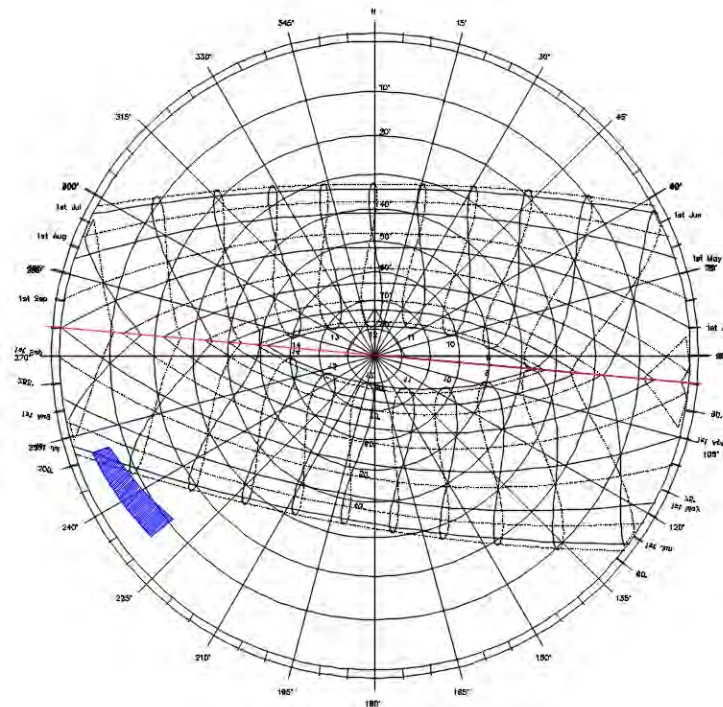


Figure 22 –Façade Aspect 005 Reflected Virtual Sun from Viewpoint 3

There is a reflected image of the sun that reaches Viewpoint 3 from Façade Aspect 005 of the building. This reflected image occurs between 4 and 445pm between June 1 and August 1 each year.

A computer model has been used to simulate the overshadowing from adjacent buildings at these times and in these date ranges. It has been determined that the sun does strike this façade aspect and further assessment is required. Representative images from the computer model have been included in Appendix B.

From Figure 22 above the reflections are caused by the Western third of the Façade Aspect 005 only. As shown in the photo below overlaid with the glare protractor, this area or the building is outside of the viewing angle for a driver at this viewpoint.



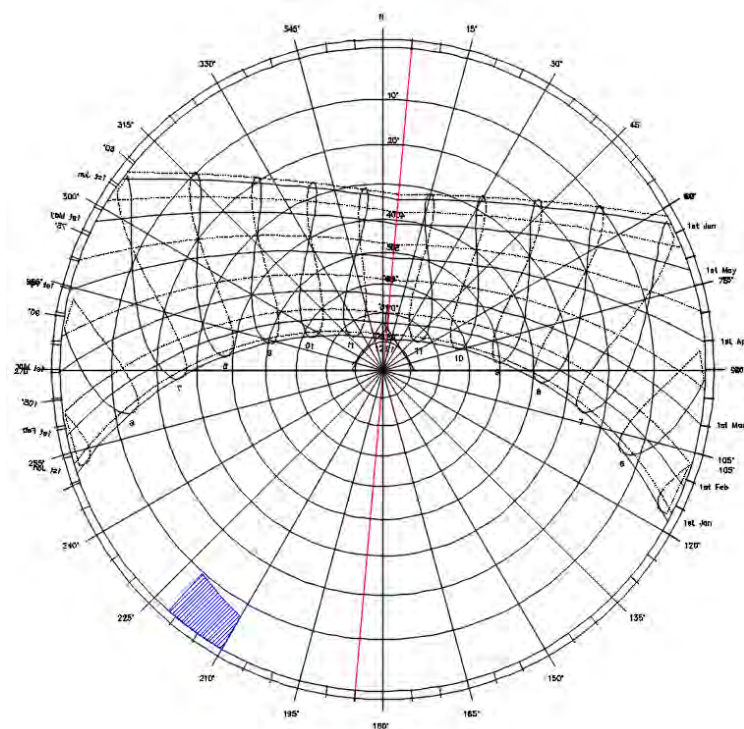


Figure 23 –Façade Aspect 095 Reflected Virtual Sun from Viewpoint 3

There is no reflected image of the sun that reaches Viewpoint 3 from Entry Façade Aspect 095 of the building. No further studies are required.

Viewpoint 4

Viewpoint 4 is taken from the viewpoint of a driver travelling west on Hunter Street. The viewing angle of the driver is 188°.

The distances of the viewpoint to the façade are:

- Nearest corner = 90m

The following façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- North East Faceted Corner

The bottom of the tower façade starts at 8.2° from this viewpoint.

In Figure 24 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The red arrow indicated the direction of travel and viewing.

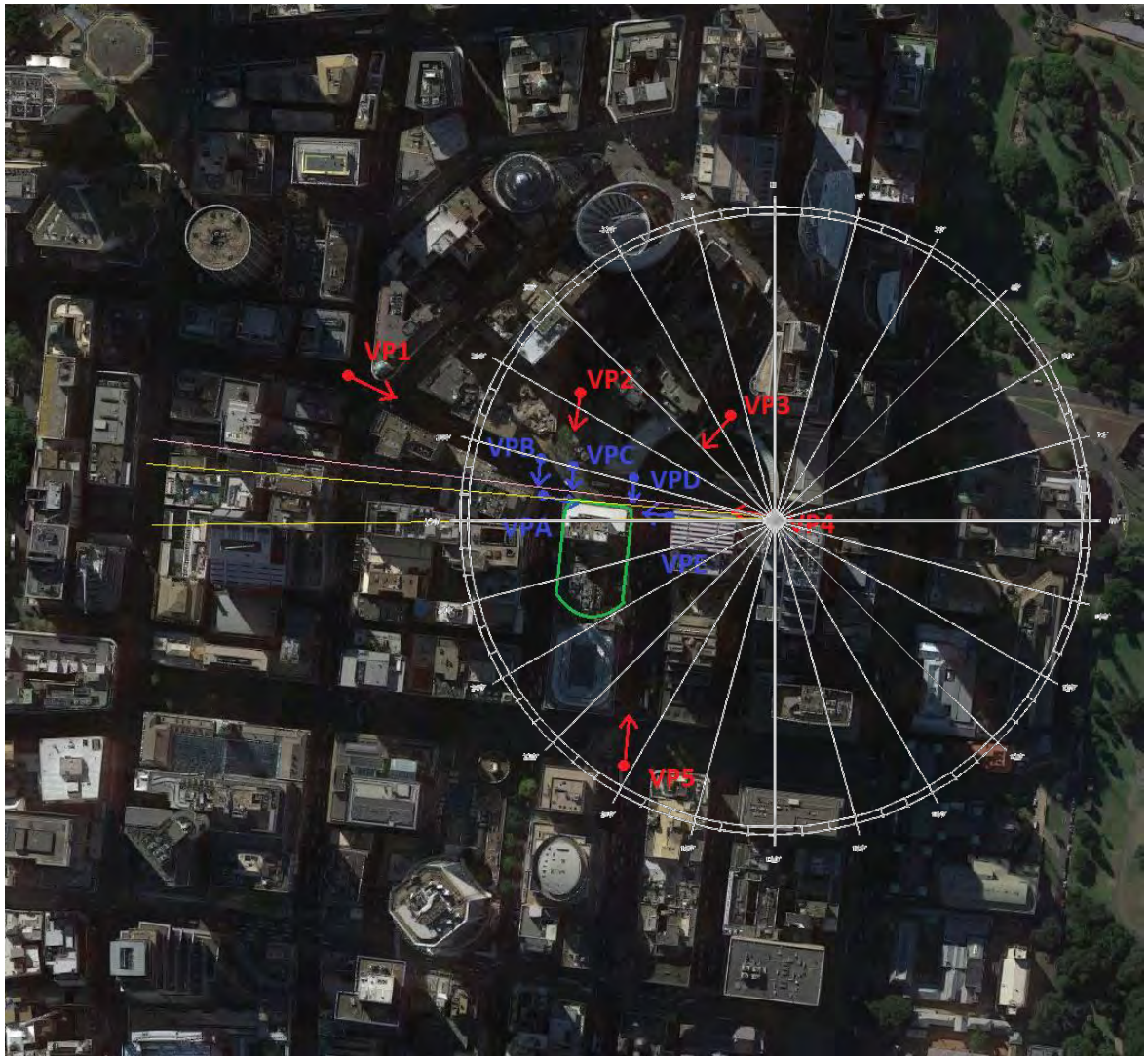


Figure 24 – Viewpoint 4 horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
North-East Faceted Corner			180°	186°
Façade Aspect 010	8.2°	16°	185°	186°
Façade Aspect 015	8.2°	16°	184°	185°
Façade Aspect 020	8.2°	16°	183°	184°
Façade Aspect 025	8.2°	16°	182°	183°
Façade Aspect 035	8.2°	16°	182°	183°
Façade Aspect 040	8.2°	16°	181°	182°
Façade Aspect 050	8.2°	16°	181°	182°
Façade Aspect 065	8.2°	16°	180°	181°
Façade Aspect 085	8.2°	16°	180°	181°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 25 and Figure 33 below.

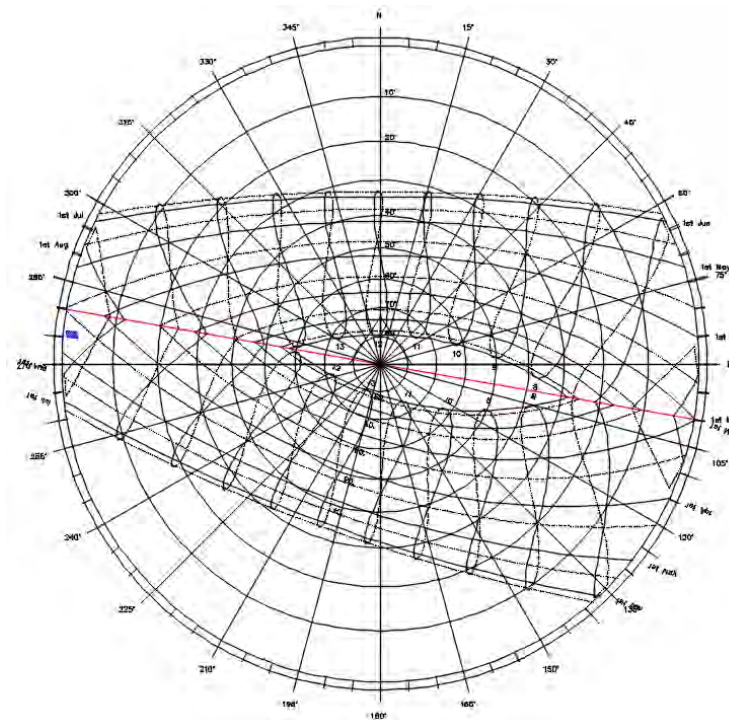


Figure 25 – Façade Aspect 010 Reflected Virtual Sun from Viewpoint 4

There is a reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 010 of the building. This reflected image occurs between 515 and 530pm between April 10 and April 20 and September 10 and September 20 each year.

A computer model has been used to simulate the overshadowing from adjacent buildings at these times and in these date ranges. It has been determined that the sun does not strike this façade aspect. Representative images from the computer model have been included in Appendix B.

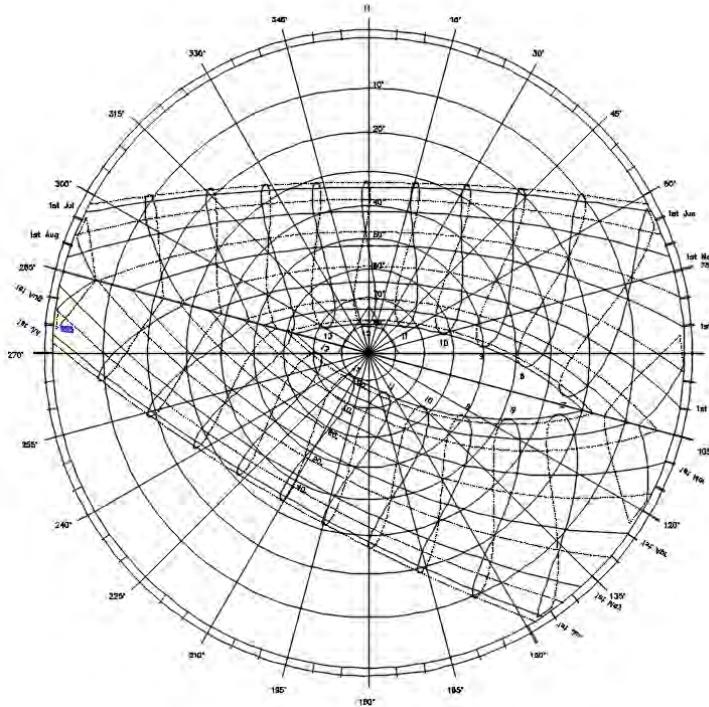


Figure 26 – Façade Aspect 015 Reflected Virtual Sun from Viewpoint 4

There is a reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 015 of the building. This reflected image occurs between 445 and 5pm between May 10 and May 20 and August 10 and August 20 each year.

A computer model has been used to simulate the overshadowing from adjacent buildings at these times and in these date ranges. It has been determined that the sun does not strike this façade aspect. Representative images from the computer model have been included in Appendix B.

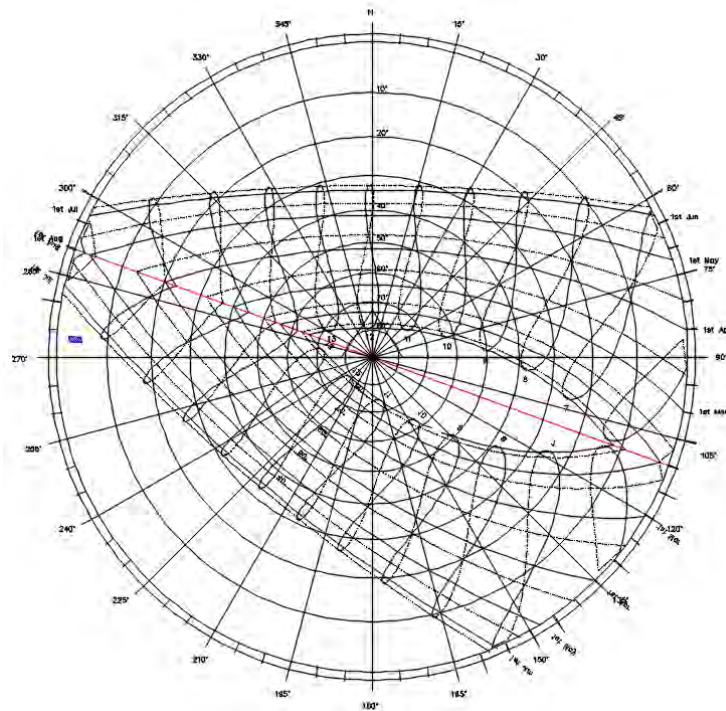


Figure 27 – Façade Aspect 020 Reflected Virtual Sun from Viewpoint 4

There is no reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 020 of the building. No further studies are required.

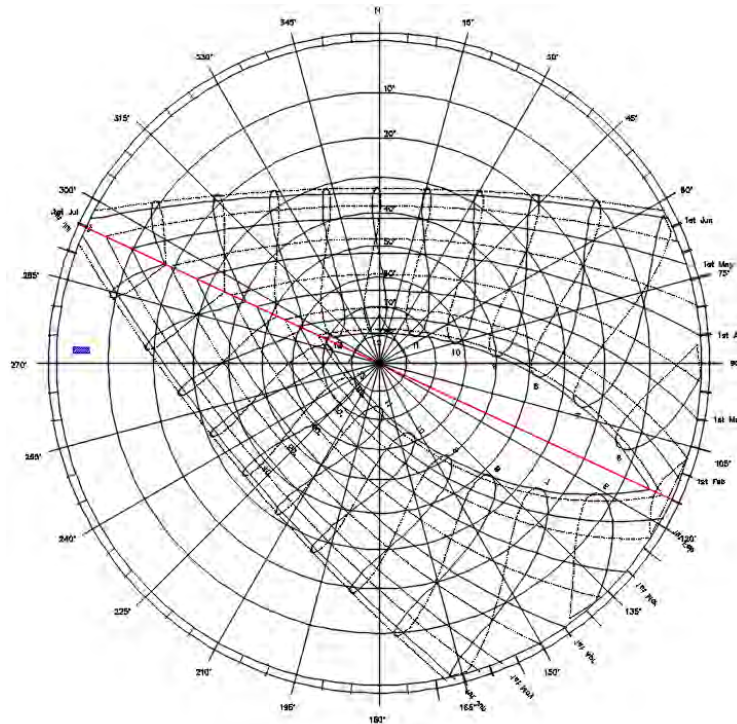


Figure 28 – Façade Aspect 025 Reflected Virtual Sun from Viewpoint 4
There is no reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 025 of the building. No further studies are required.

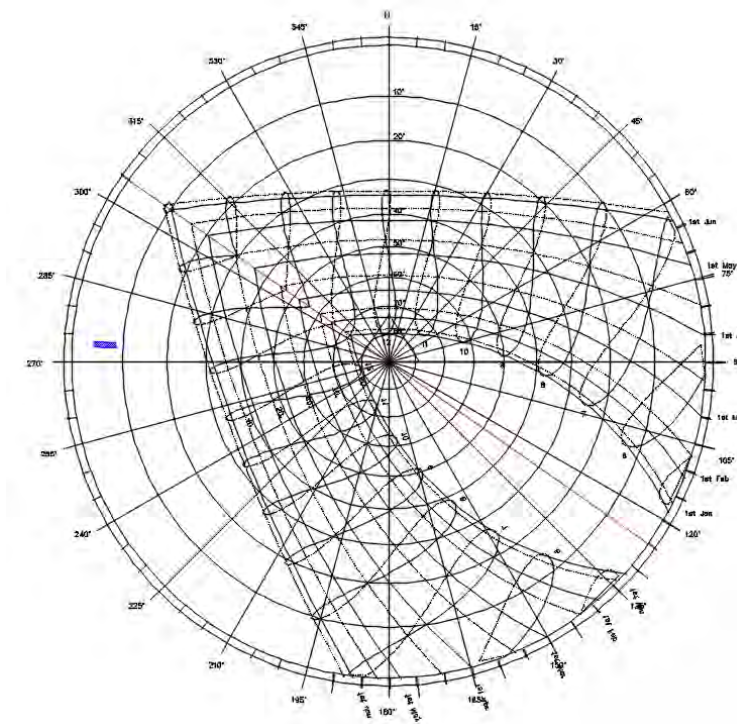


Figure 29 – Façade Aspect 035 Reflected Virtual Sun from Viewpoint 4
There is no reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 035 of the building. No further studies are required.

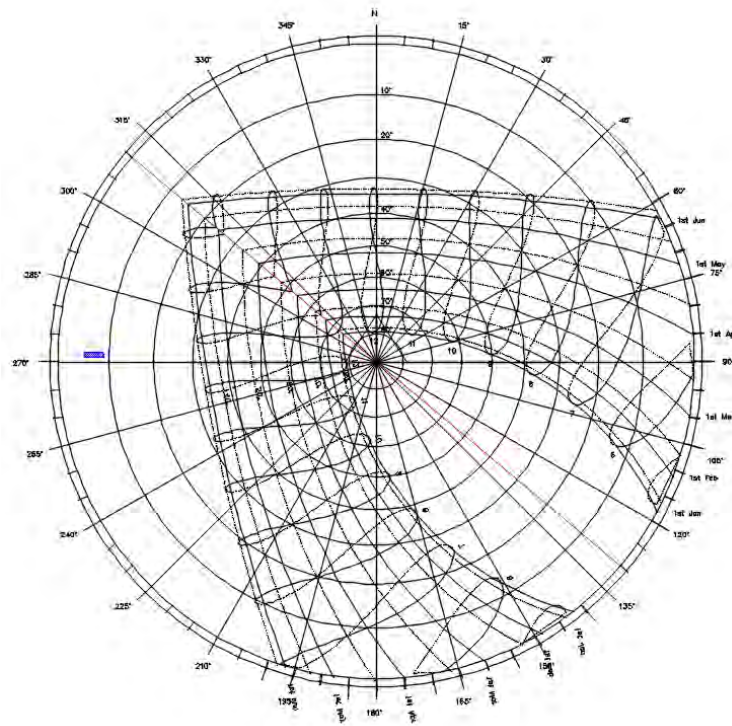


Figure 30 – Façade Aspect 040 Reflected Virtual Sun from Viewpoint 4

There is no reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 040 of the building. No further studies are required.

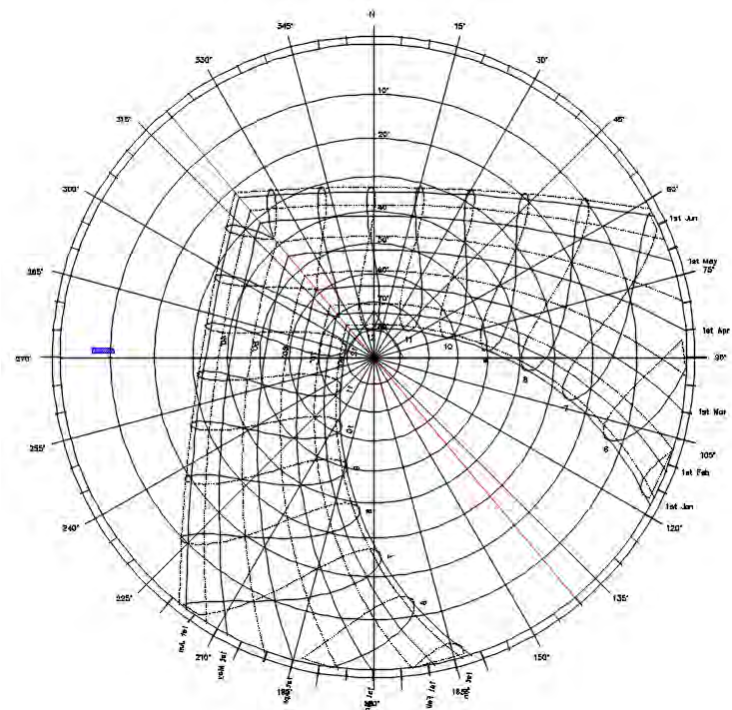


Figure 31 – Façade Aspect 050 Reflected Virtual Sun from Viewpoint 4

There is no reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 050 of the building. No further studies are required.

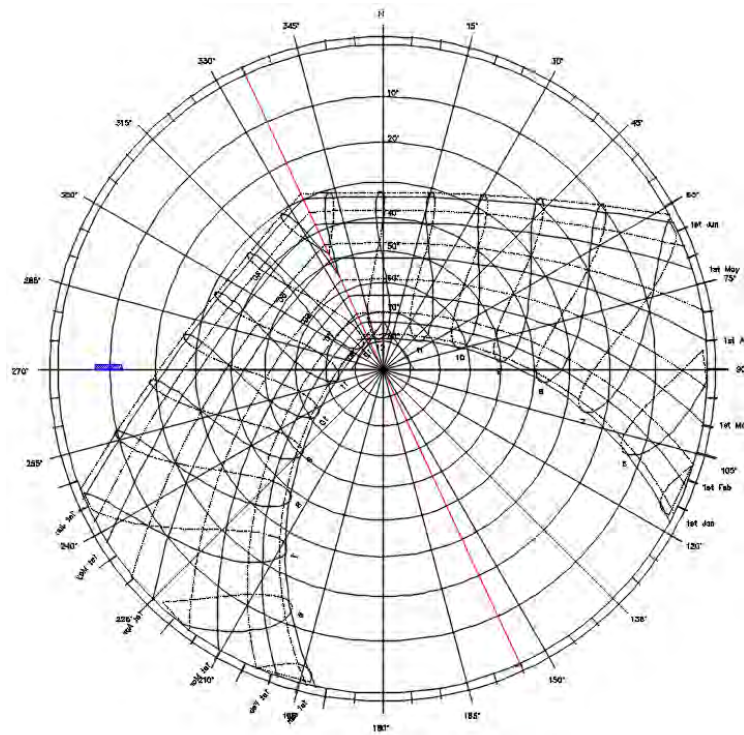


Figure 32 – Façade Aspect 065 Reflected Virtual Sun from Viewpoint 4

There is no reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 065 of the building. No further studies are required.

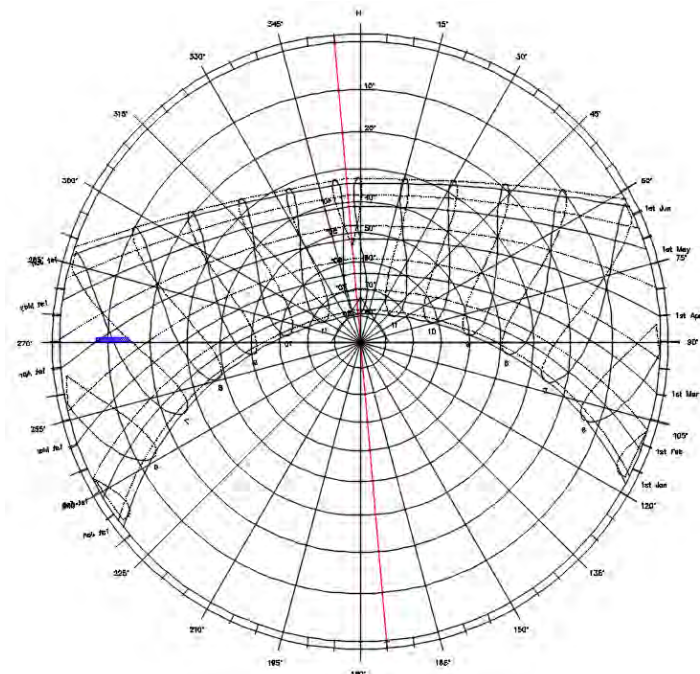


Figure 33 – Façade Aspect 085 Reflected Virtual Sun from Viewpoint 4

There is a reflected image of the sun that reaches Viewpoint 4 from Façade Aspect 085 of the building. This reflected image occurs between 630 and 7am between March 10 and April 15 and September 15 and October 15 each year.

A computer model has been used to simulate the overshadowing from adjacent buildings at these times and in these date ranges. It has been determined that the sun does not strike this façade aspect. Representative images from the computer model have been included in Appendix B.

Viewpoint 5

Viewpoint 5 is taken from the viewpoint of a driver travelling north on Elizabeth Street. The viewing angle of the driver is 3°.

The distances of the viewpoint to the façade are:

- Nearest corner = 90m

The following façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Façade Aspect 095

In Figure 34 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The red arrow indicated the direction of travel and viewing.



Figure 34 – Viewpoint 5 horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 095	0°	16°	000°	002°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 35 below.

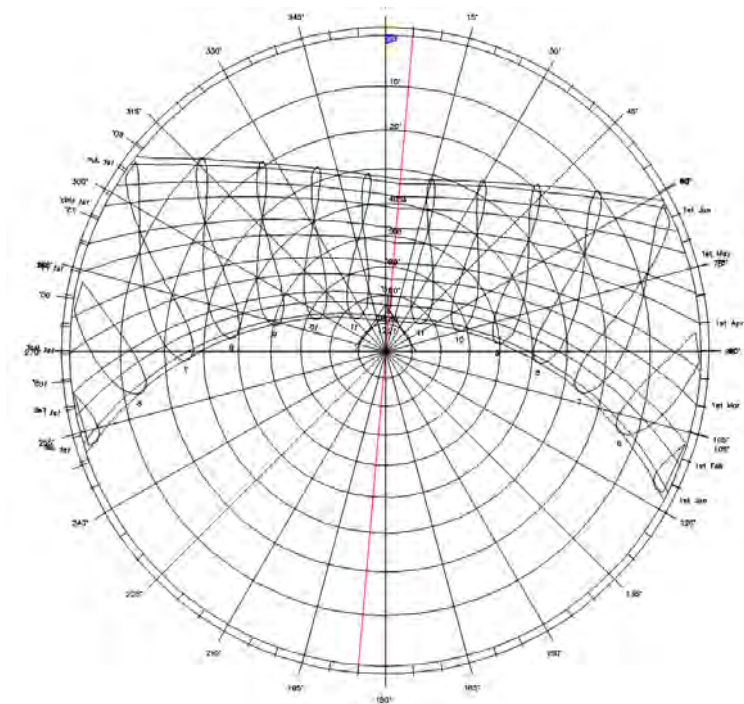


Figure 35 – Entry Façade Aspect 095 Reflected Virtual Sun from Viewpoint 5

There is no reflected image of the sun that reaches Viewpoint 5 from Entry Façade Aspect 095 of the building. No further studies are required.

Viewpoint A

Viewpoint A is taken from the viewpoint of a pedestrian crossing Castlereagh Street at Hunter Street. The viewing angle of the pedestrian is 102°.

The distances of the viewpoint to the façade are:

- Nearest corner = 20m

The following façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Façade Aspect 275

In Figure 34 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The blue arrow indicates the direction of travel and viewing.



Figure 36 – Viewpoint A horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 095	0°	16°	127°	173°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 37 below.

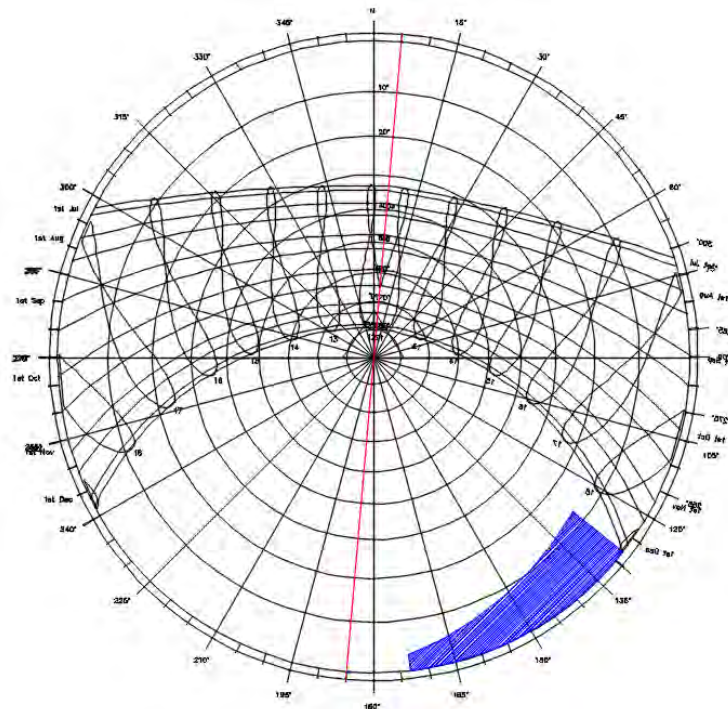


Figure 37 – Entry Façade Aspect 275 Reflected Virtual Sun from Viewpoint A

There is no reflected image of the sun that reaches Viewpoint A from Entry Façade Aspect 275 of the building. No further studies are required.

Viewpoint B

Viewpoint B is taken from the viewpoint of a pedestrian crossing Hunter Street at Castlereagh Street. The viewing angle of the pedestrian is 187°.

The distances of the viewpoint to the façade are:

- Nearest corner = 25m

The following façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Façade Aspect 275

The bottom of the tower façade starts at 27.5° from this viewpoint and therefore the north elevation and the North West faceted corner are above the 16° cut-off.

In Figure 34 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The blue arrow indicates the direction of travel and viewing.

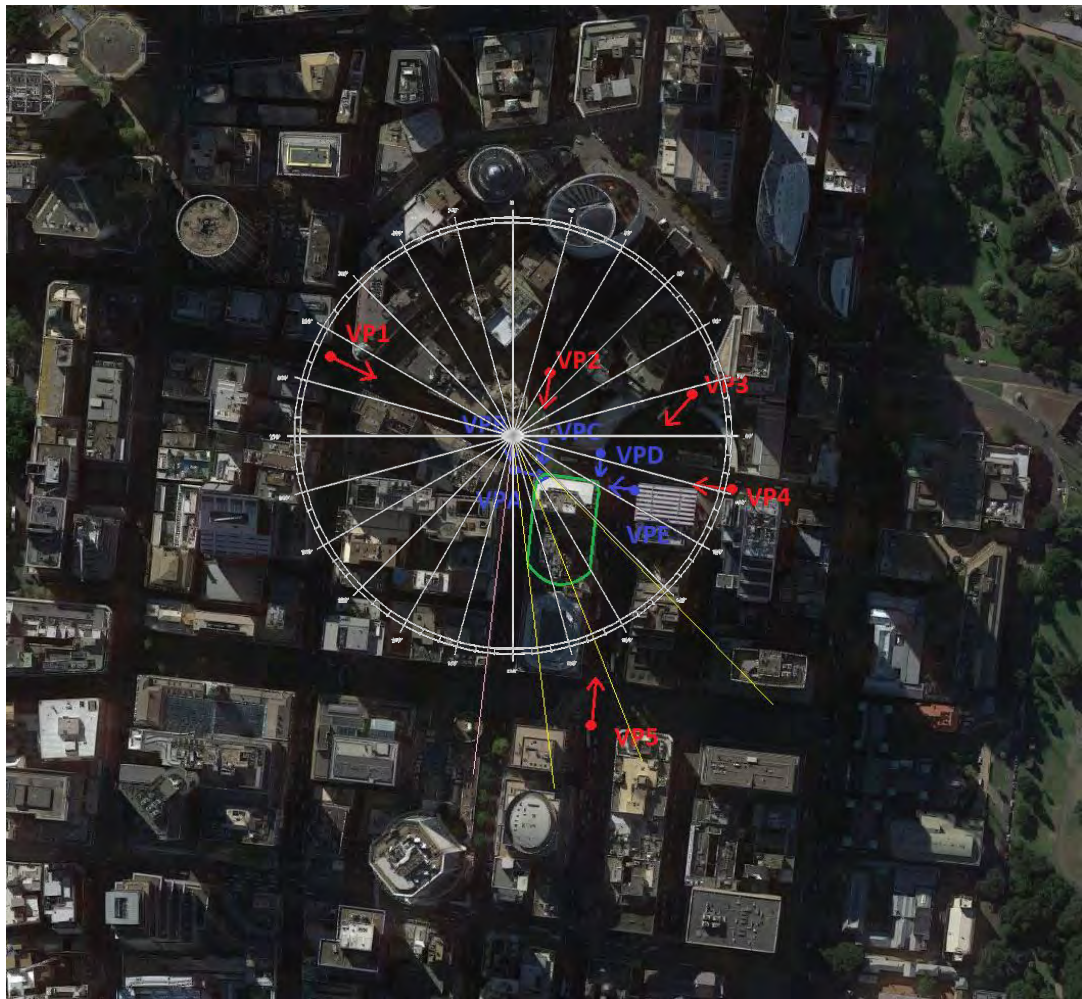


Figure 38 – Viewpoint B horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 275	0°	16°	158°	173°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 39 below.

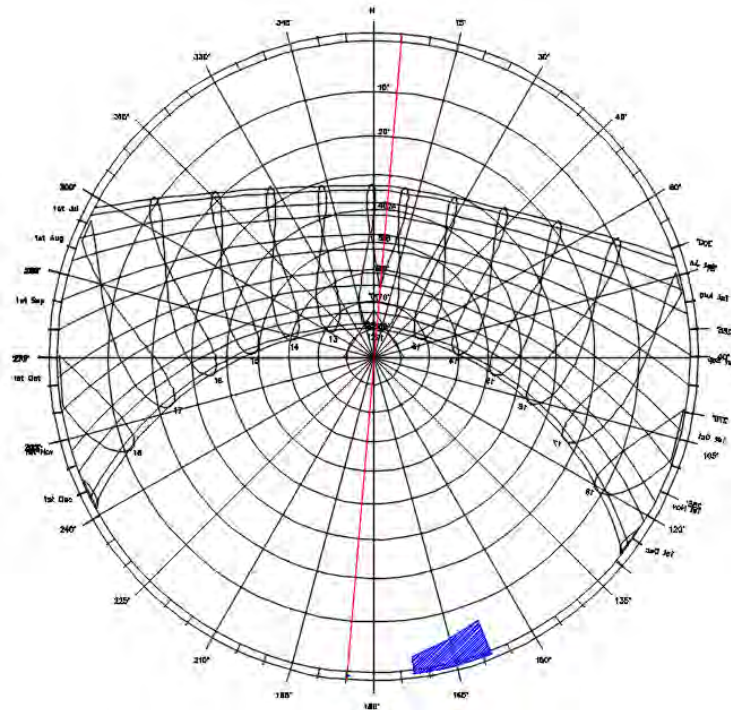


Figure 39 – Entry Façade Aspect 275 Reflected Virtual Sun from Viewpoint B

There is no reflected image of the sun that reaches Viewpoint B from Entry Façade Aspect 275 of the building. No further studies are required.

Viewpoint C

Viewpoint C is taken from the viewpoint of a pedestrian crossing Hunter Street at Castlereagh Street. The viewing angle of the pedestrian is 187°.

The distances of the viewpoint to the façade are:

- Nearest corner = 20m

The bottom of the tower façade starts at 33.1° from this viewpoint and therefore the north elevation and the North West faceted corner are above the 16° cut-off. Therefore no further studies are required.

In Figure 34 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The blue arrow indicates the direction of travel and viewing.



Figure 40 – Viewpoint C horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16°. As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

Viewpoint D

Viewpoint D is taken from the viewpoint of a pedestrian crossing Hunter Street at Elizabeth Street. The viewing angle of the pedestrian is 181° .

The distances of the viewpoint to the façade are:

- Nearest corner = 20m

The bottom of the tower façade starts at 33.1° from this viewpoint and therefore the north elevation and the North West faceted corner are above the 16° cut-off. Therefore no further studies are required.

In Figure 34 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The blue arrow indicates the direction of travel and viewing.

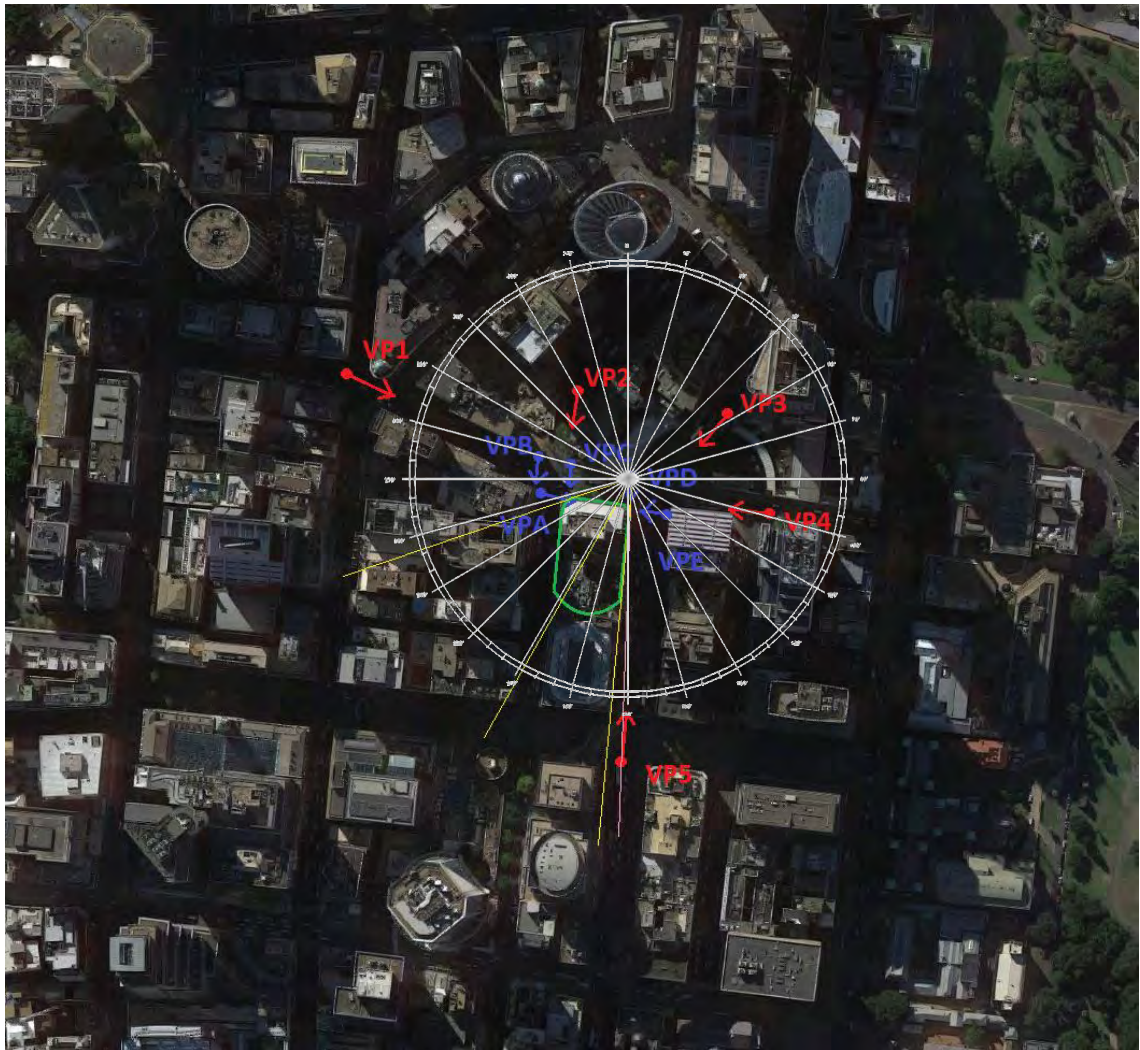


Figure 41 – Viewpoint D horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16° . As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

Viewpoint E

Viewpoint E is taken from the viewpoint of a pedestrian crossing Elizabeth Street at Hunter Street. The viewing angle of the pedestrian is 181° .

The distances of the viewpoint to the façade are:

- Nearest corner = 20m

The following façade aspects are visible from the Viewpoint in a 180° segment oriented to the direction of viewing and the distance to the corners of the aspect in brackets:

- Façade Aspect 095

In Figure 34 below yellow lines have been drawn to represent the bearing angles to the visible portions of the building. The blue arrow indicates the direction of travel and viewing.

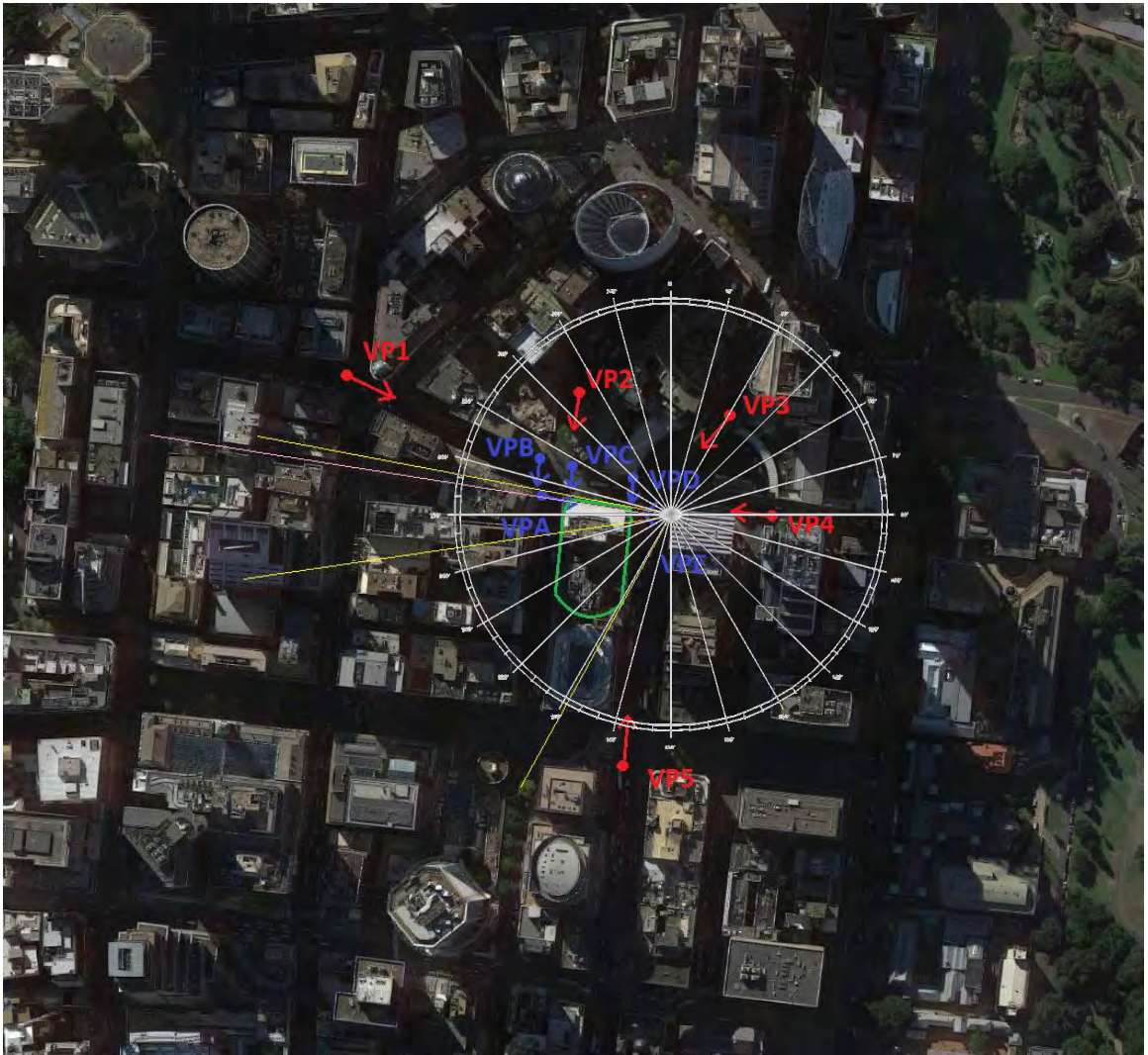


Figure 42 – Viewpoint E horizontal bearing angles

The upper limit vertical bearing angle that has been used is 16° . As set out in Section 2 of this report, any glare source above 16° will be outside of the zone of disability glare caused by materials with a specular normal reflectivity of 20%, which is the limit for buildings in Sydney.

	Vertical Bearing Angle		Horizontal Bearing Angle (0° at North)	
	Lower Bound	Upper Bound	Lower Bound	Upper Bound
Façade Aspect 095	0°	16°	208°	250°

These bearing angles have been plotted on the reflected sun path diagrams in Figure 43 below.

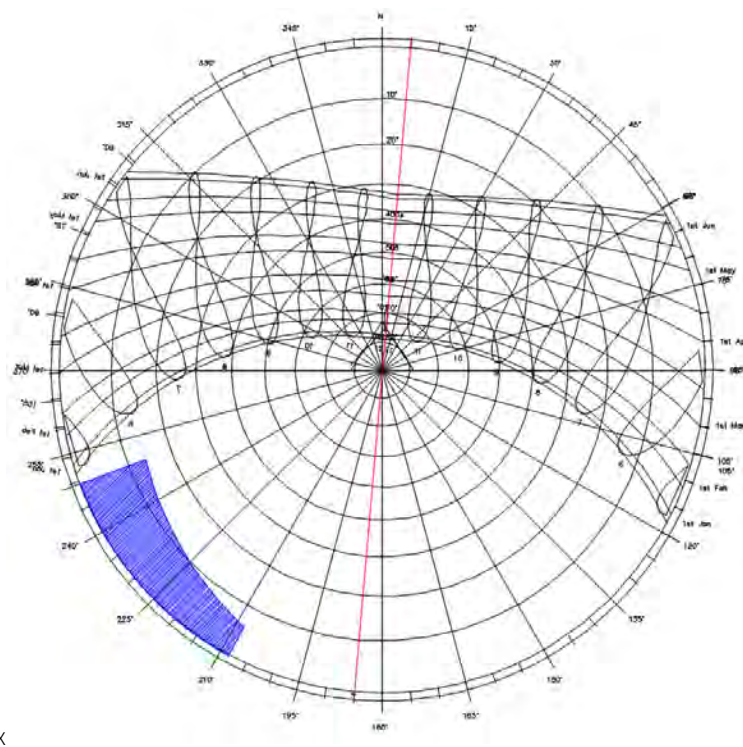
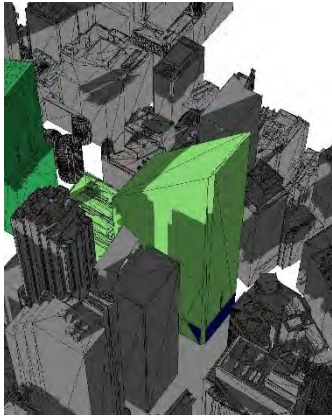
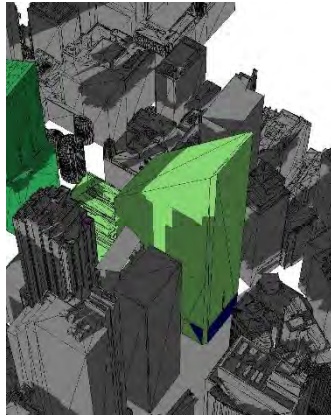
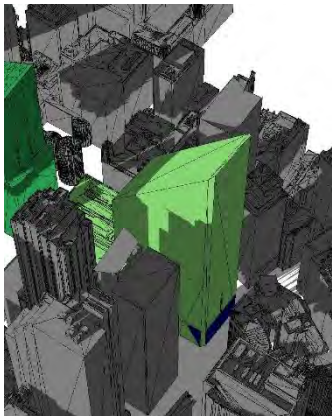
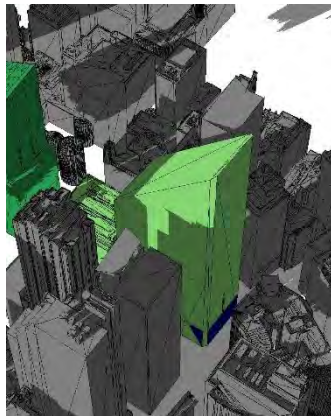
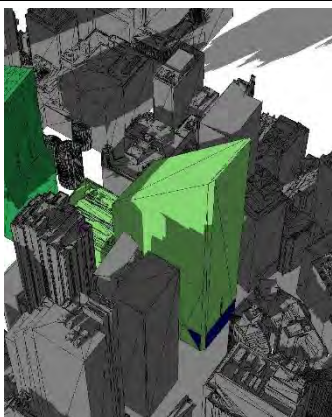
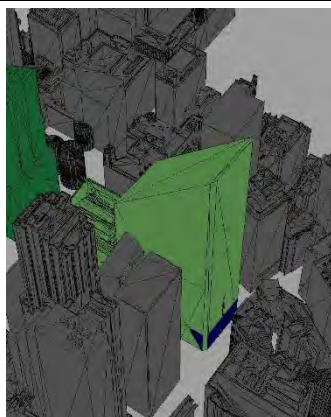


Figure 43 – Entry Façade Aspect 095 Reflected Virtual Sun from Viewpoint E

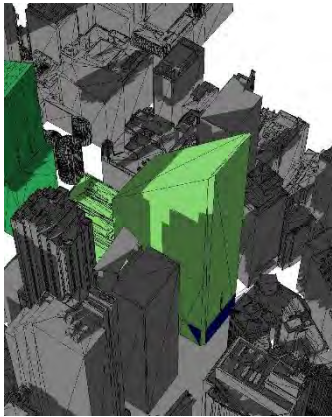
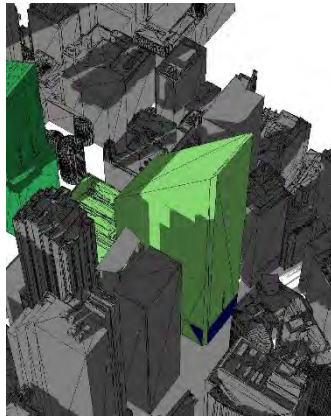
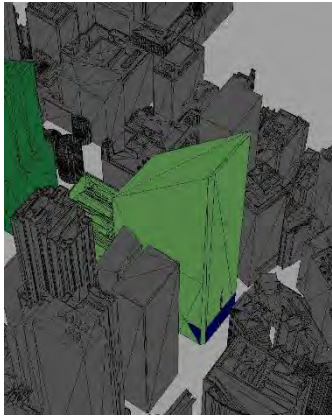
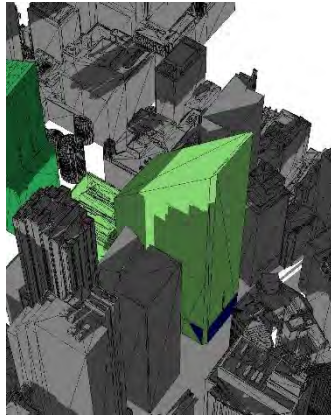
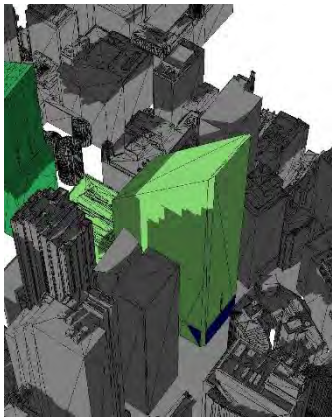
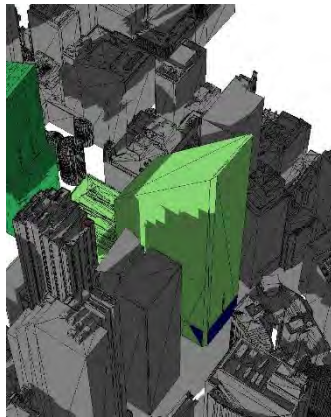
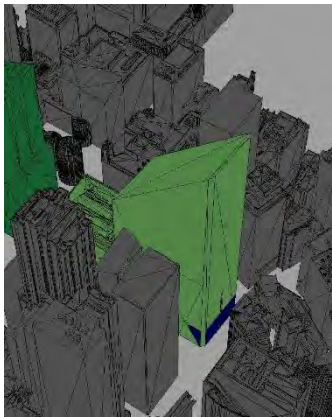
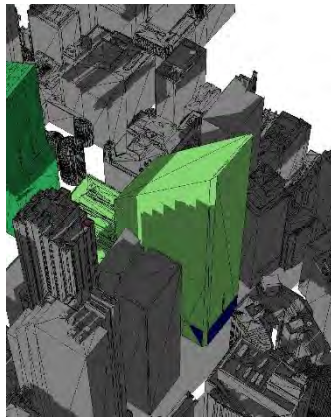
There is no reflected image of the sun that reaches Viewpoint E from Entry Façade Aspect 005 of the building. No further studies are required.

Appendix B

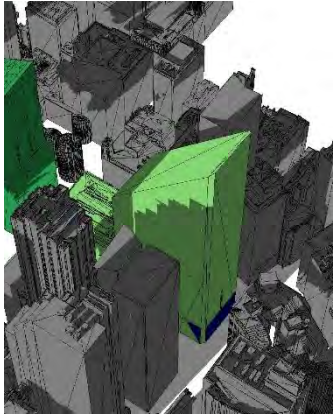
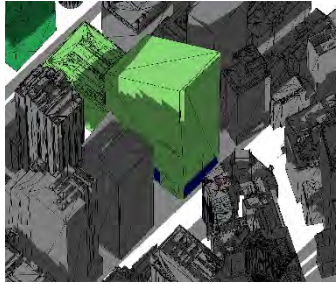
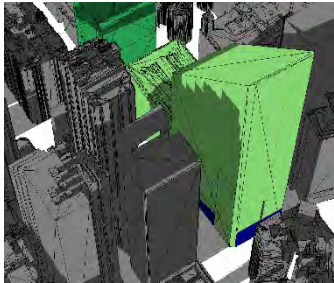
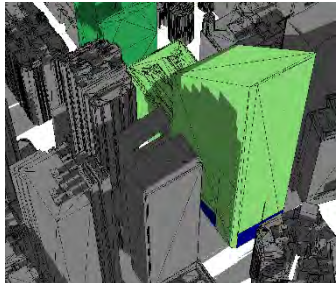
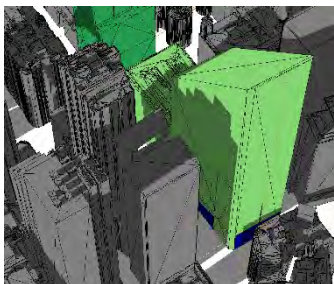
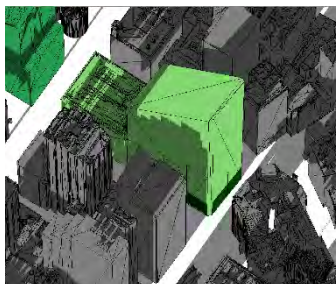
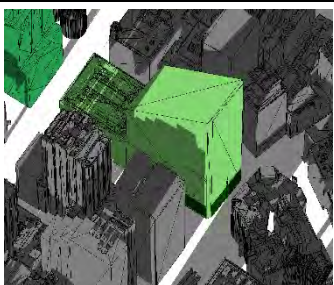
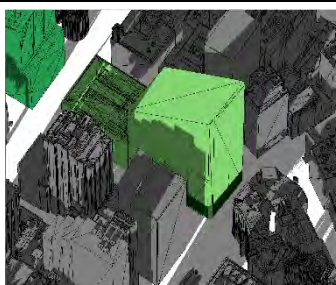
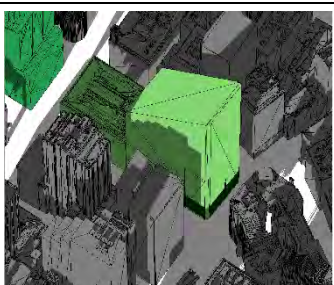
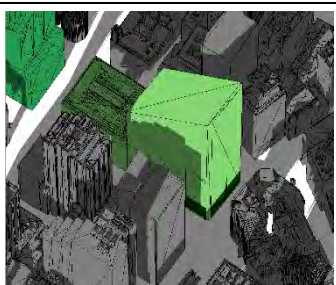
Appendix B – Overshadowing Images

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0530	01/01		0545	01/01	
0600	01/01		0600	15/01	

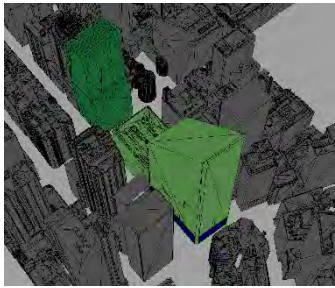
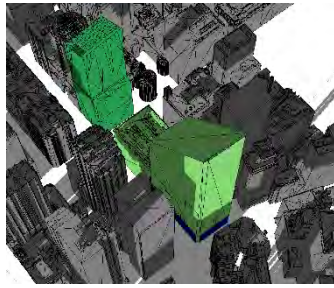
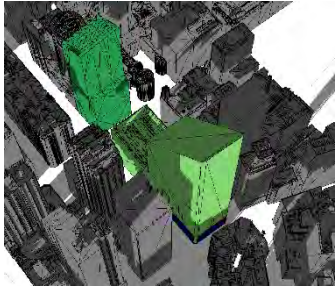
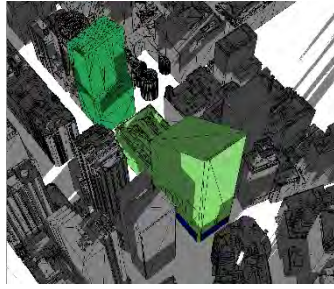
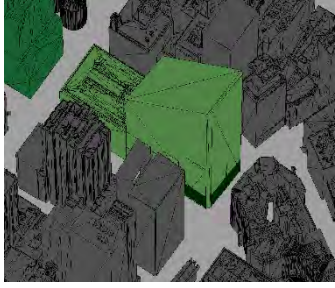
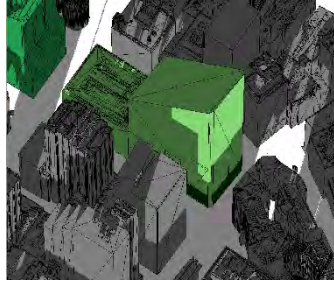
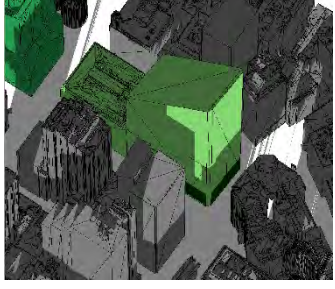
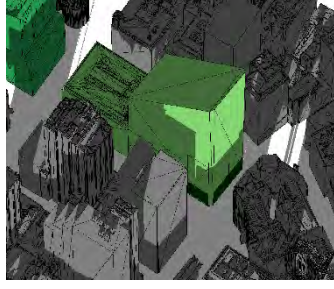
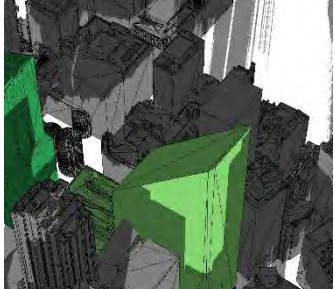
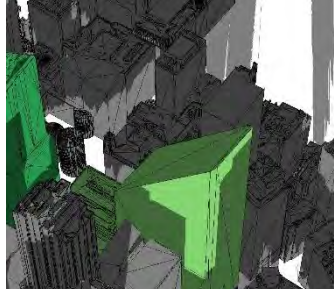
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Time	Date	Image	Time	Date	Image
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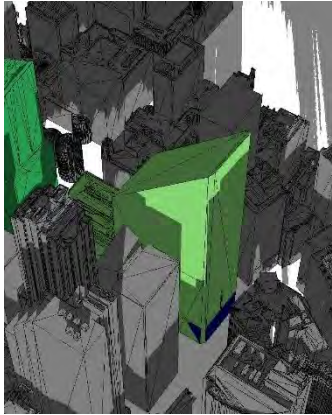
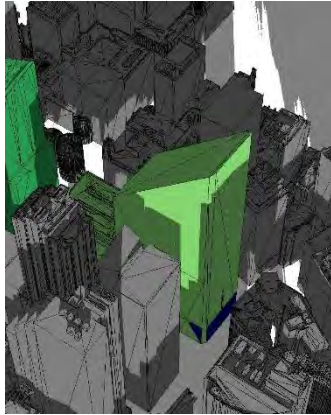
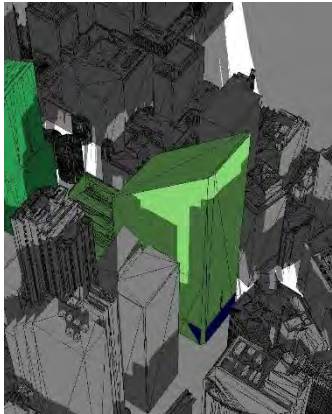
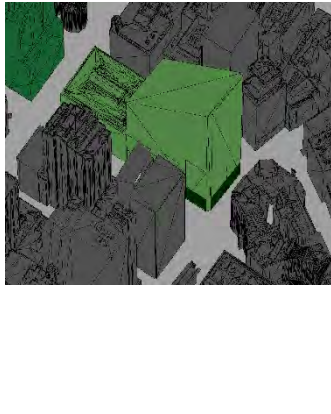

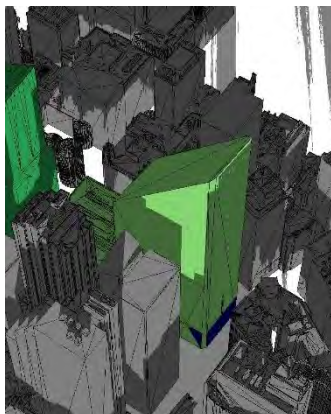
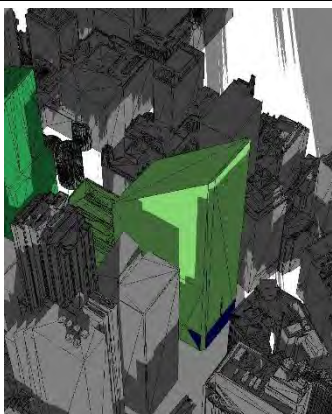
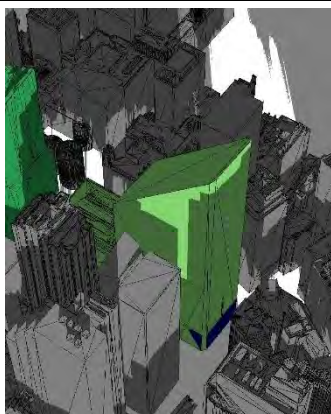
Reflectivity Report
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Time	Date	Image	Time	Date	Image
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0630	03/01		0645	03/01	
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0630	03/15		0645	03/15	

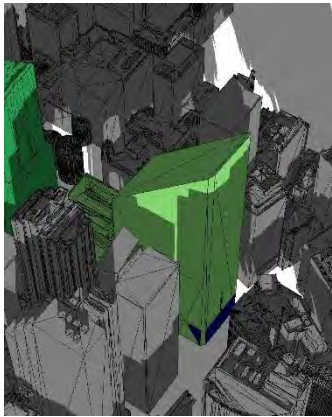
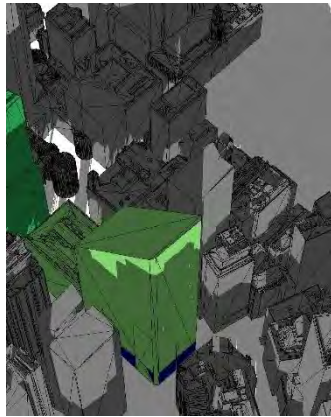
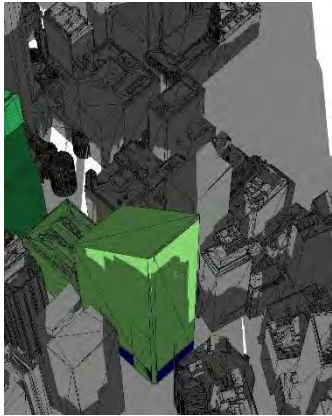
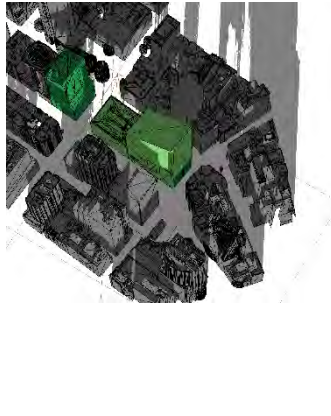
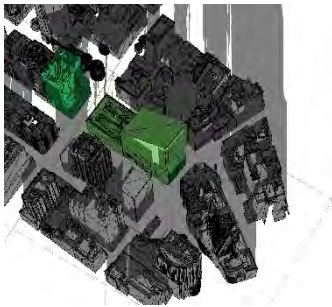
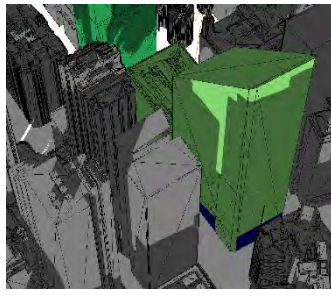
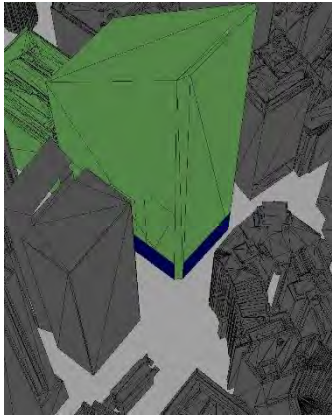

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0645	04/01		0600	04/15	
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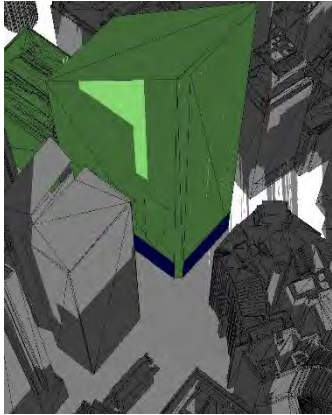
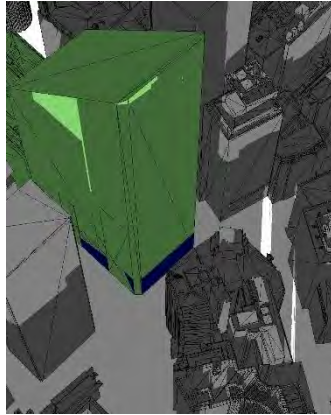
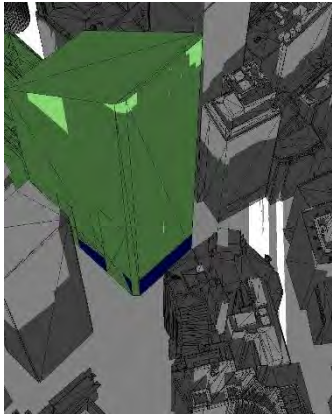
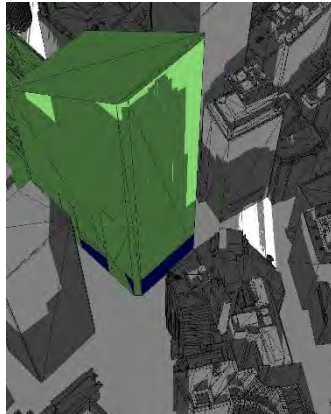
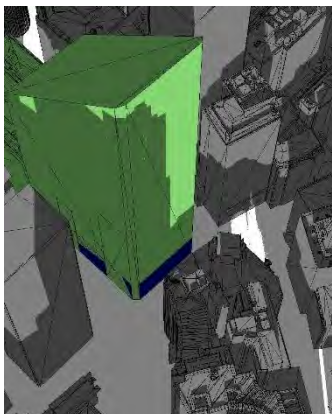
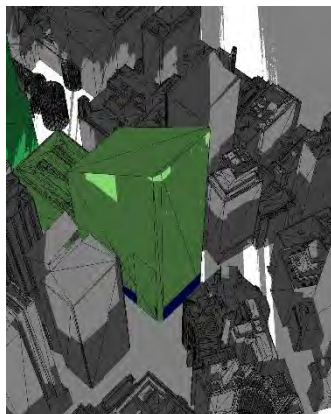
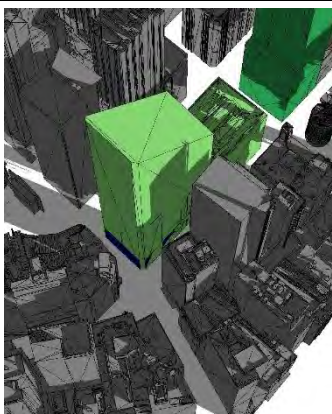
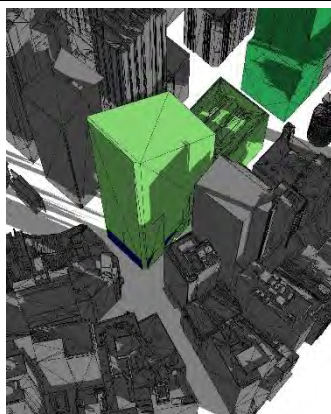
Reflectivity Report
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Time	Date	Image	Time	Date	Image
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0645	05/15		0700	05/15	
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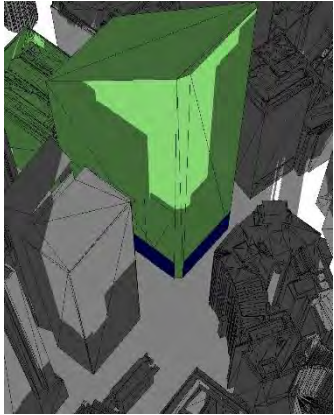
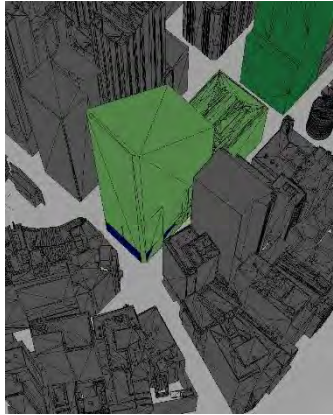
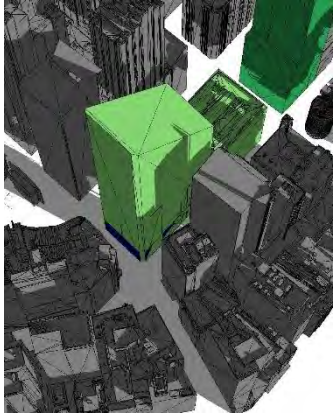
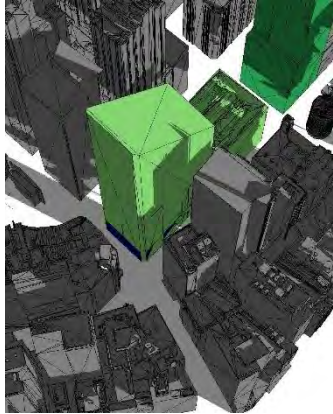
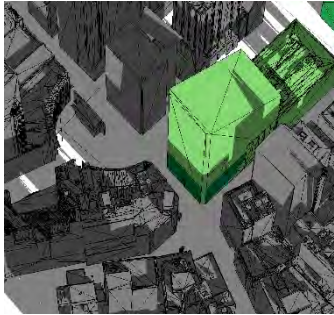
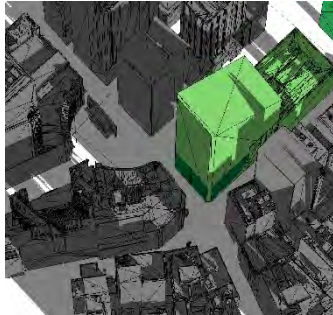
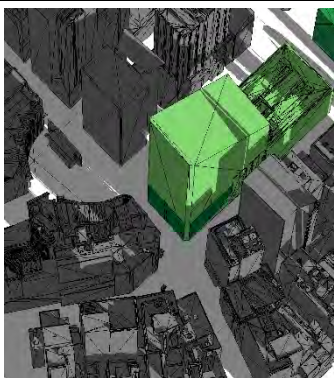
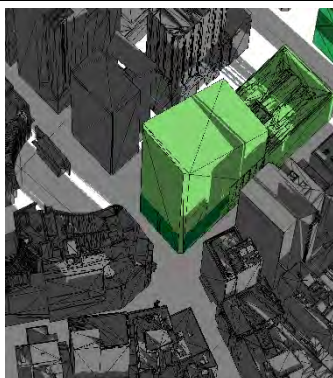
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Time	Date	Image	Time	Date	Image
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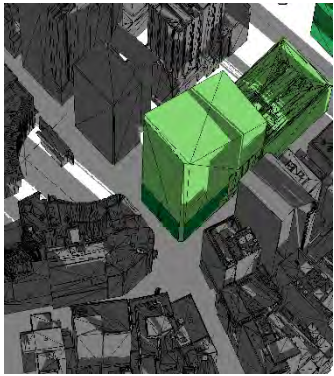
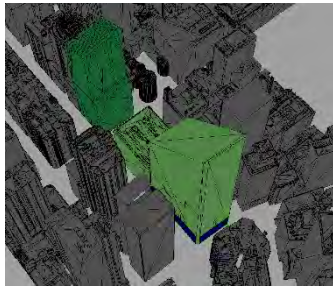
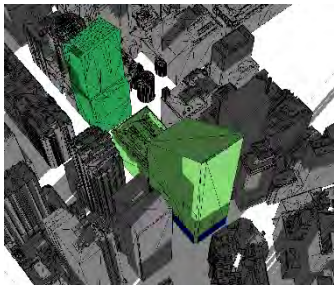
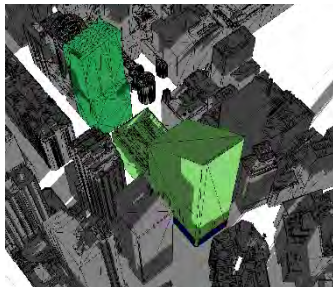
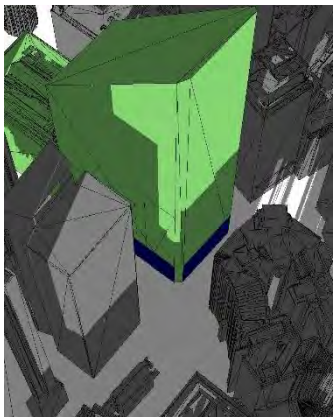
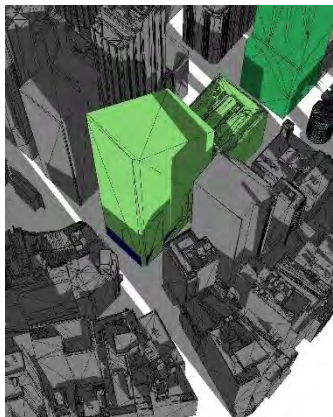
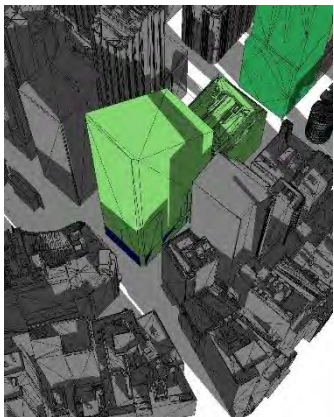
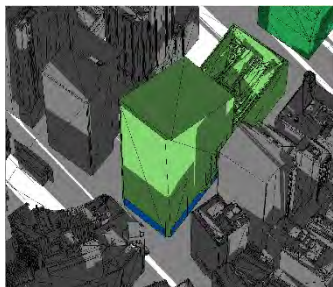
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Time	Date	Image	Time	Date	Image
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0815	06/15		0830	06/15	
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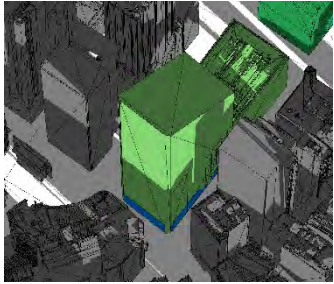
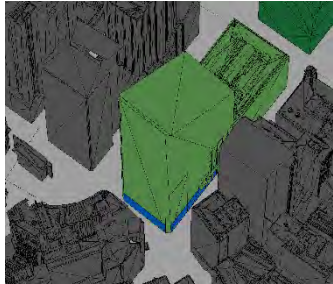
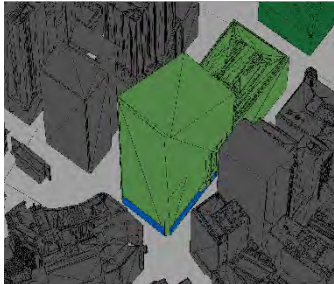
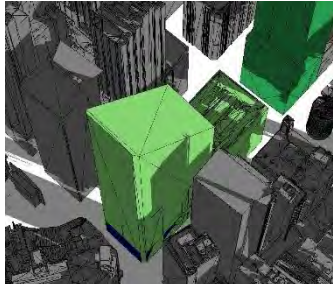
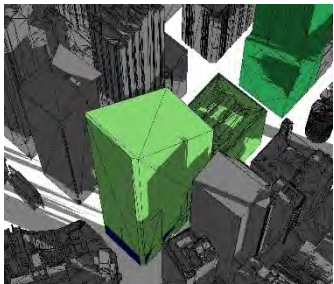
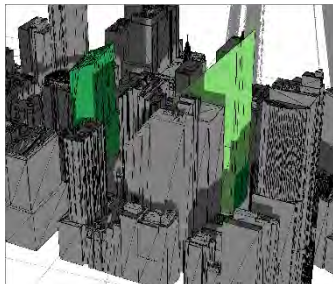
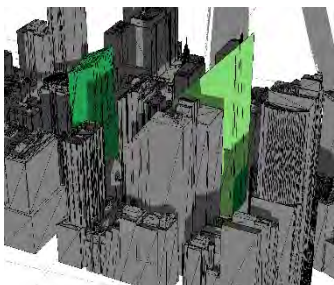
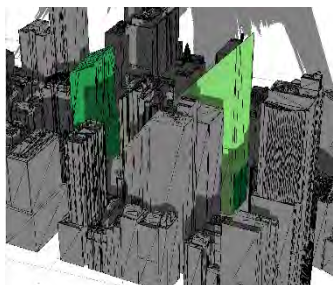
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Time	Date	Image	Time	Date	Image
0700	03/01		1730	03/01	
1800	03/01		1815	03/01	
1700	03/15		1715	03/15	
1730	03/15		1745	03/15	

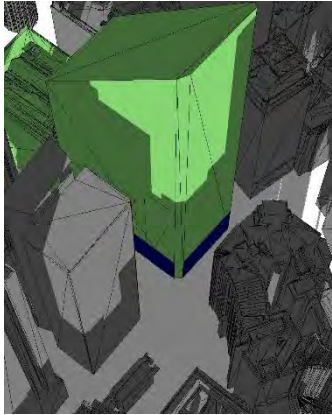
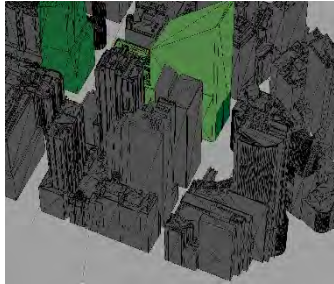
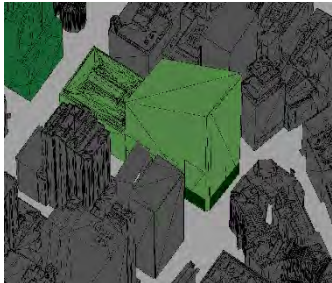
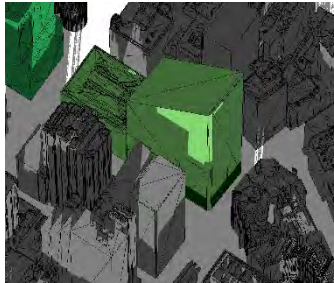
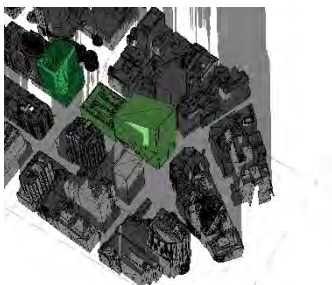
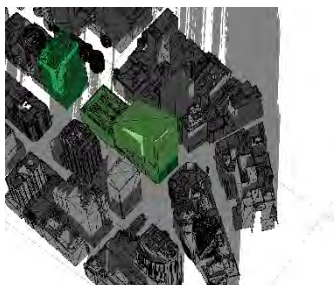
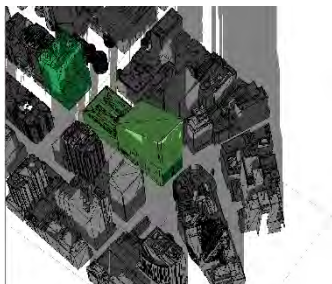
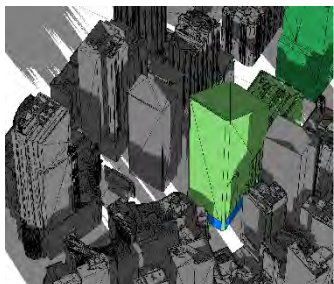
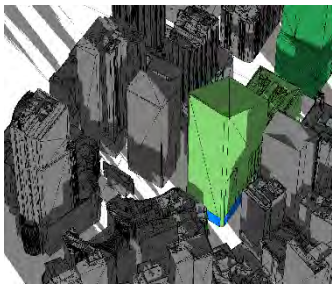
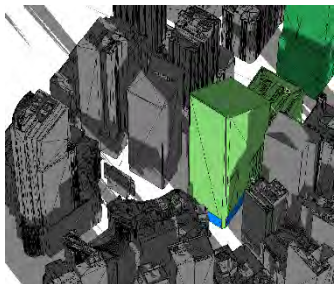
Reflectivity Report
Sydney Metro Martin Place integrated station development - North Site

Time	Date	Image	Time	Date	Image
1800	03/15		0600	04/01	
0615	04/01		0630	04/01	
0630	04/15		1630	04/15	
1645	04/15		1700	04/15	

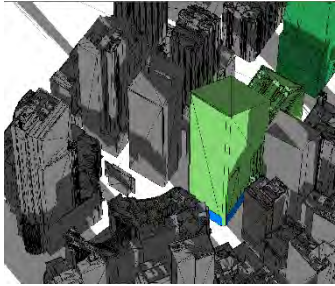
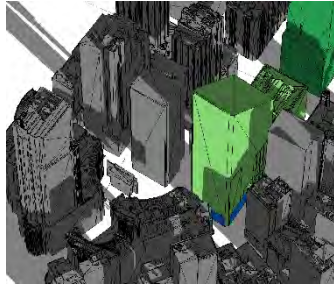
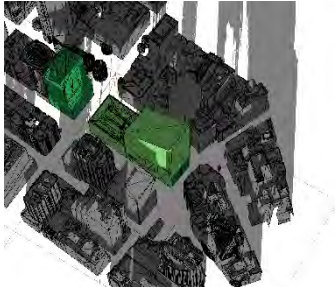
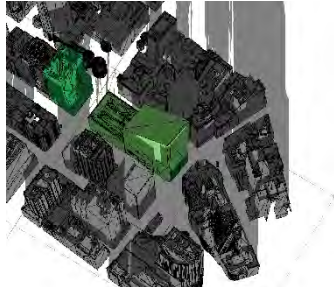
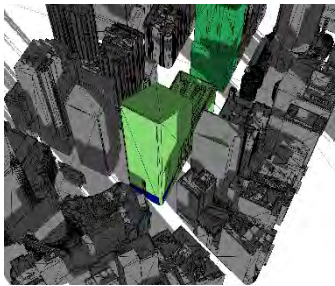
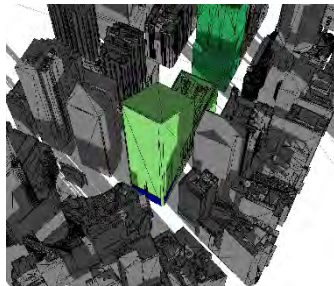
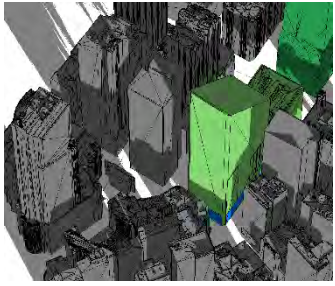
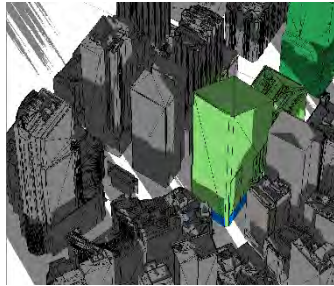
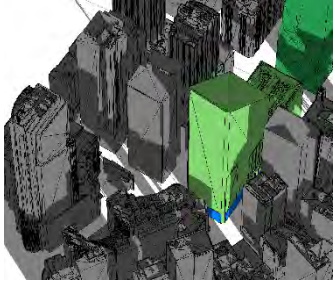
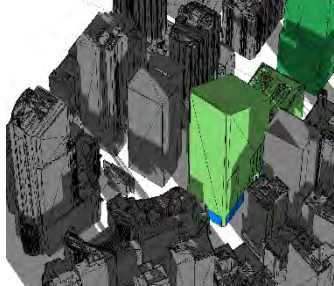
Reflectivity Report
Sydney Metro Martin Place integrated station development - North Site

Time	Date	Image	Time	Date	Image
1715	04/15		1730	04/15	
1745	04/15		1800	04/15	
1815	04/15		0630	04/15	
0645	04/15		0700	04/15	

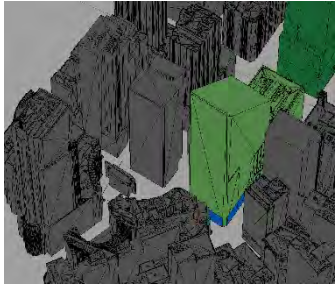
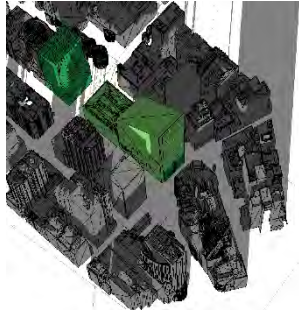
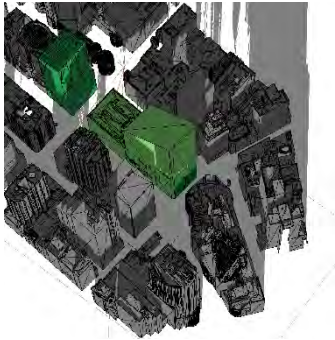
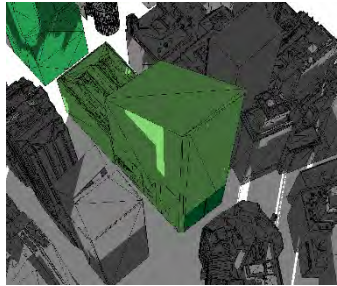
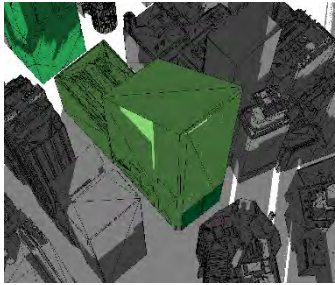
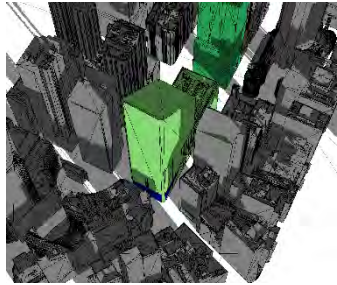
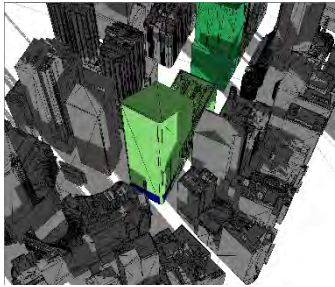
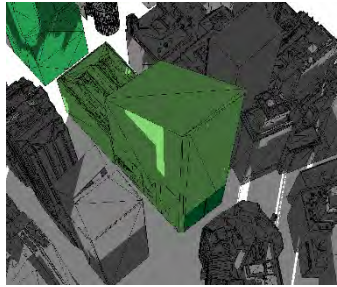
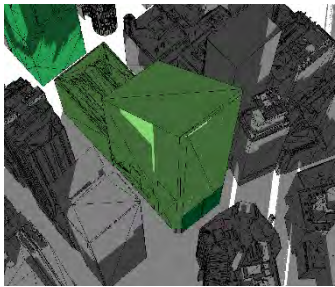
Reflectivity Report
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Time	Date	Image	Time	Date	Image
0645	05/01		0630	05/15	
0645	05/15		0700	05/15	
0730	05/15		0745	05/15	
0800	05/15		1600	05/15	
1615	05/15		1630	05/15	

Reflectivity Report
Sydney Metro Martin Place integrated station development - North Site

Time	Date	Image	Time	Date	Image
1645	05/15		1700	05/15	
0730	06/01		0745	06/01	
1630	06/01		1645	06/01	
1600	06/15		1615	06/15	
1630	06/15		1645	06/15	

Reflectivity Report
Sydney Metro Martin Place integrated station development - North Site

Time	Date	Image	Time	Date	Image
1700	06/15		0730	06/30	
0745	07/01		0730	07/01	
0745	07/01		1630	07/01	
1645	07/01		0730	07/01	
0745	07/01		1700	07/01	