SOLAR LIGHT REFLECTIVITY ANALYSIS

161 SUSSEX STREET REDEVELOPMENT, SYDNEY

WB327-02F02(REV1)- SR REPORT

27 FEBRUARY 2013

Prepared for:

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DOCUMENT CONTROL

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EXECUTIVE SUMMARY

This report presents the results of a detailed study for the effect of potential solar glare from the proposed 161 Sussex Street redevelopment, Sydney. The redevelopment is located within the Darling Harbour precinct and has been identified as a State Significant Development. The analysis has been undertaken based on architectural drawings prepared by the project architect Cox Richardson, received on February 15, 2013.

This assessment has been undertaken with consideration of the Director General's Environmental Assessment Requirements, Schedule 2, Key Issue 5 Ecologically Sustainable Development (ESD). This report investigates the Solar Light Reflectivity on the surrounding areas as a result of the proposed redevelopment.

This study addresses the following planning control requirements of Section 3.2.7 of the City of Sydney Development Control Plan 2012, which are summarised as follows:

- Minimise the reflection of sunlight from buildings to surrounding areas and buildings.
- Ensure that building materials do not lead to hazardous, undesirable or uncomfortable glare to pedestrians, motorists or occupants of surrounding buildings
- Generally, light reflectivity from building materials used on facades must not exceed 20%.
- For buildings in the vicinity of arterial roads/major roads and Sydney Airport, proof of light reflectivity is required and is to demonstrate that light reflectivity does not exceed 20%.

The proposed redevelopment includes the addition of a tower which extends from the southern aspect of the existing hotel building, and an extension of the podium component of the hotel which is to extend over the Western Distributor roadway. Some parts of the eastern aspect façade of the existing podium will also be redeveloped, and will include the addition of some glass awnings. Note that this analysis only assesses the potential for solar glare from the façade of the redevelopment.

A site survey has been undertaken to obtain photographs of the critical sightlines of drivers on the surrounding streets. These photographs are calibrated and are able to be overlaid with a glare meter, which allows us to determine the extent, if any, of potential solar glare reflections from the subject redevelopment.

The results of the analysis indicate that reflections from the façade of the redevelopment are effectively broken-up by the many external façade features on the podium expansion and the tower component, which include external vertical fins and the pitched metal roofs which drape over the western aspect of the podium expansion, and the extensive use of external sunshade louvres on the external façade of the tower component. There are no continuous large, flat and

glazed portions of the external façade of the redevelopment. Nonetheless, to avoid any adverse glare to drivers and pedestrians on the surrounding streets, to pedestrians within the Darling Harbour precinct, and to occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following is recommended:

- All glazing used for the external façade of the redevelopment should have a maximum normal specular reflectivity of visible light of 20%.
- Three 40cm high solid screens to be added on top of the glazed roof portion of the western podium expansion. The screens should have a north/south alignment and be located along the front, middle and back of the glazed roof.

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. The proposed louvres on most aspects of the redevelopment are expected to be metal with a painted finish, and the maximum specular reflectance for these types of façade elements is in the range of 1% to 5%, which is well within the abovementioned recommended limits. Similarly, the metal roofs of the podium expansion are expected to have a painted finish and hence the maximum normal reflectance of visible light will be well within the City of Sydney DCP limit of 20%. Furthermore, it is noted that the metal roofs will have a corrugated profile, which will further assist in diffusing reflected glare.

Hence, with the incorporation of the abovementioned recommendations, the subject redevelopment will not cause adverse solar glare to pedestrians or motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the City of Sydney Development Control Plan 2012.

CONTENTS

1 DESCRIPTION OF THE PROPOSED REDEVELOPMENT AND SURROUNDS

The proposed redevelopment includes the addition of a tower which extends from the southern aspect of the existing hotel building, and an extension of the podium component of the hotel which is to extend over the Western Distributor roadway. Metal roofing is proposed for the podium. Some parts of the eastern aspect façade of the existing podium will also be redeveloped, and will include the addition of some glass awnings.

The podium extension over the Western Distributor extends from the existing terrace slab which covers part of the Western Distributor, and will include function and meeting rooms. A metal roof is proposed for the podium extension, and it will feature a series of small pitched roofs aligned perpendicular to the overall orientation of the site. A portion of the podium extension roof will feature a glazed roof section. The proposed new tower will be approximately 30m taller than the main bulk of the existing southern wing of the existing hotel building. The façade of the tower and the podium extension over the Western Distributor are to be mostly covered by small vertical louvres, positioned perpendicular or slightly angled to the face of the redevelopment.

The topography varies across the site since the landform falls away towards Darling Harbour. The Sussex Street ground level is approximately one storey higher than the Western Distributor ground level. To the east of the site, the landform continues to rise until George Street, where it generally levels off. An aerial perspective of the existing site area is shown in Figure 1, and a marked-up site plan of the redevelopment is shown in Figure 2.

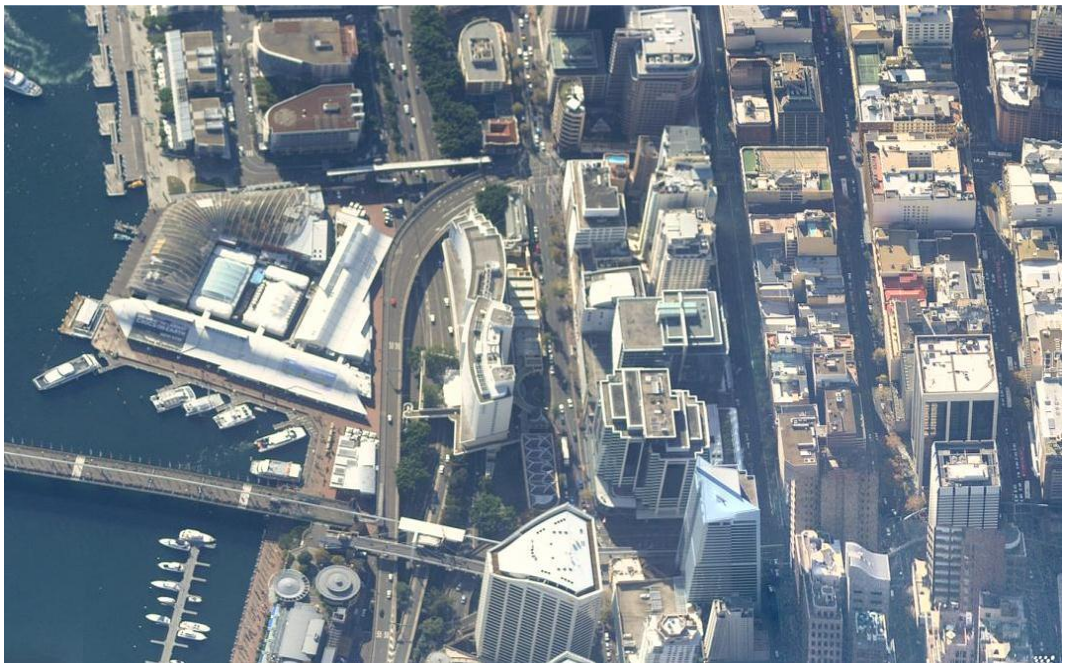

Figure 1: Aerial Perspective of the Existing Site
(view from the south, facing north)

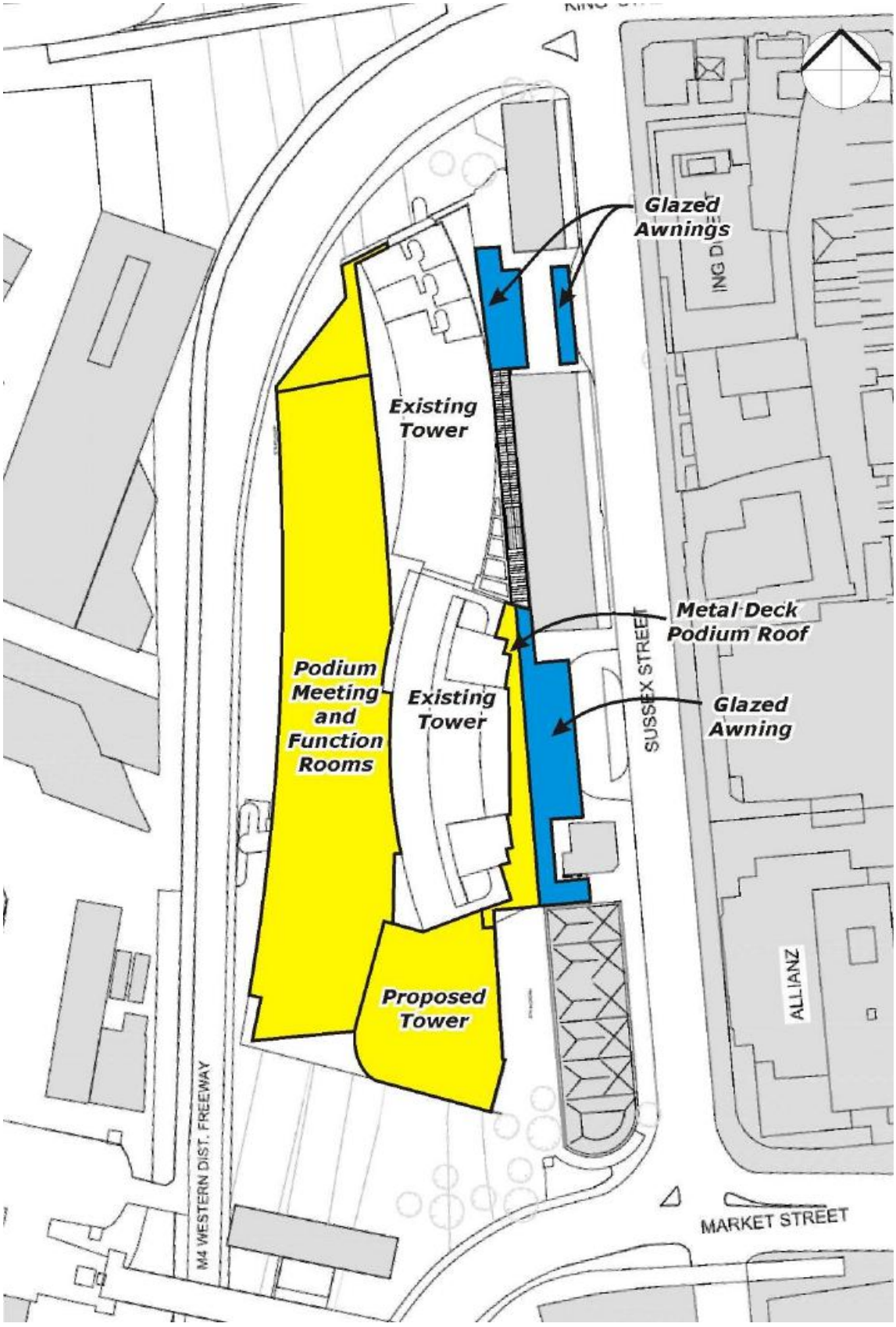

Figure 2: Site Plan

2 METHODOLOGY

The reflectivity analysis of the subject redevelopment has been carried out using the technique published by Mr David N. H. Hassall (1991)[1]. The limiting veiling luminance of 500 candelas per square metre for the comfort of vehicle drivers, as suggested in Hassall (1991), has been adopted as a basis of assessing the glare impact from the subject redevelopment. In meeting this criterion for vehicle drivers, conditions will also be satisfactory for pedestrians. The glare impact onto occupants of neighbouring buildings is also discussed in this assessment.

The various critical aspects were determined for the redevelopment and are shown in Figure 3. Solar charts for each of these critical aspects is presented in Appendix B, and these are used to derive the check zones which are shown in Figures 4a and 4b. The check zones highlight the zones that are potentially affected by solar reflections from each critical aspect. It should be noted that the check zones shown in Figures 4a and 4b do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in Section 3 of this report.

Study point locations are selected within the check zone areas where motorists are facing the general direction of the subject redevelopment. These are shown in Figure 5. For each of the study point locations, photographs have been taken from the viewpoint of drivers and pedestrians using a calibrated camera. Views from the study point locations are presented in Appendix A of this report. A scaled glare protractor has been superimposed over each photograph.

The glare protractor is used to assess the amount of glare likely to be caused and to provide a direct comparison with the criterion of 500 candelas per square metre. Alternatively, the glare protractor can be used to determine the maximum acceptable reflectivity index for the glare to be within the criterion of 500 candelas/m^2.

If it is found that a section of the subject redevelopment will be within the zone of sensitive vision of a motorist at a selected study point location (the central area of the glare protractor), the glare protractor is used to determine what the maximum normal specular reflectance of visible light should be for the glazing or any other reflective material used on that section of the façade of the redevelopment to ensure that solar glare will not cause discomfort or threaten the safety of motorists or pedestrians, and hence to allow the subject redevelopment to comply with the relevant planning control requirements.

[1] D.N. Hassall, 1991, Reflectivity, Dealing with Rogue Solar Reflections (published by author)

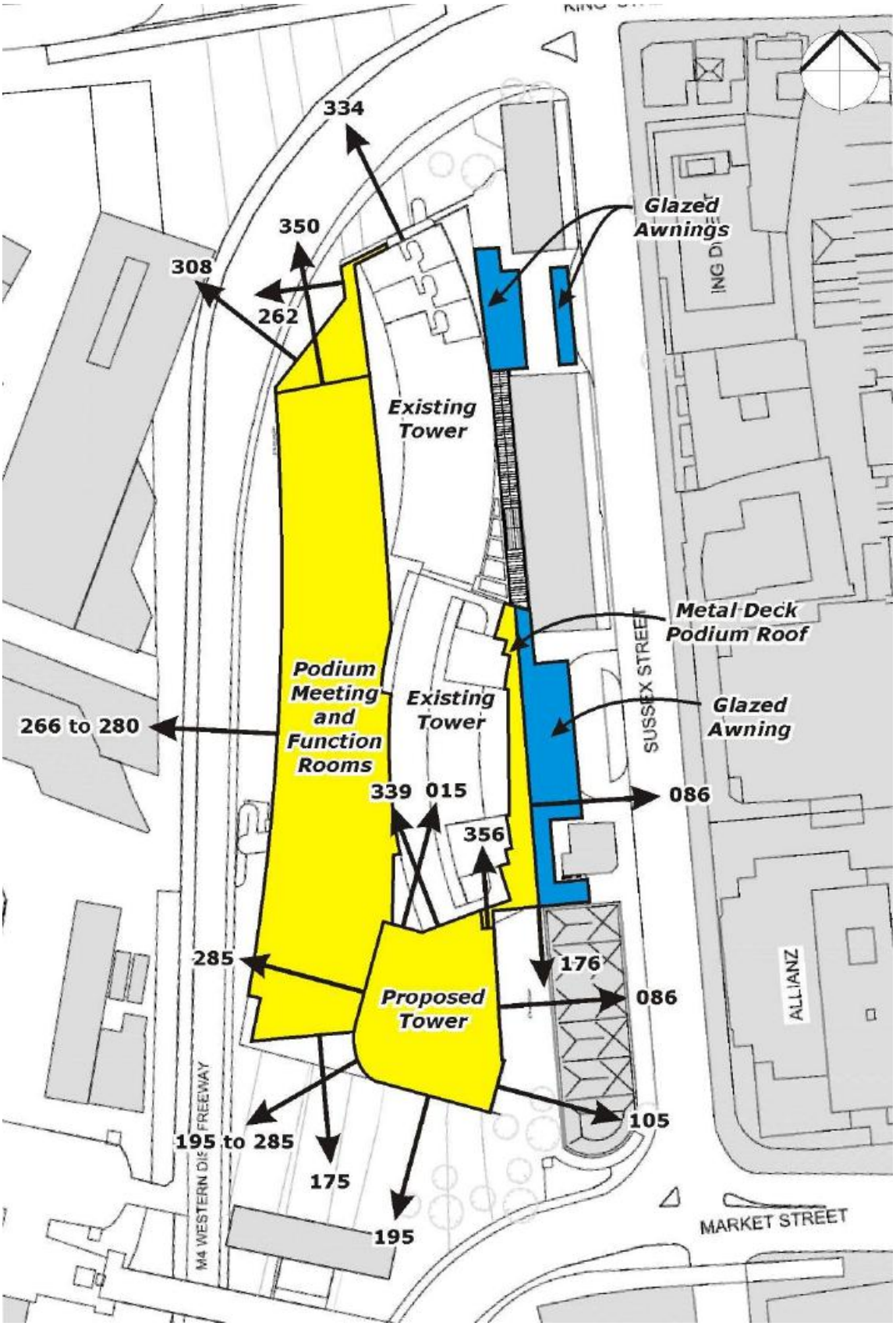

Figure 3: Critical Aspects of the Redevelopment

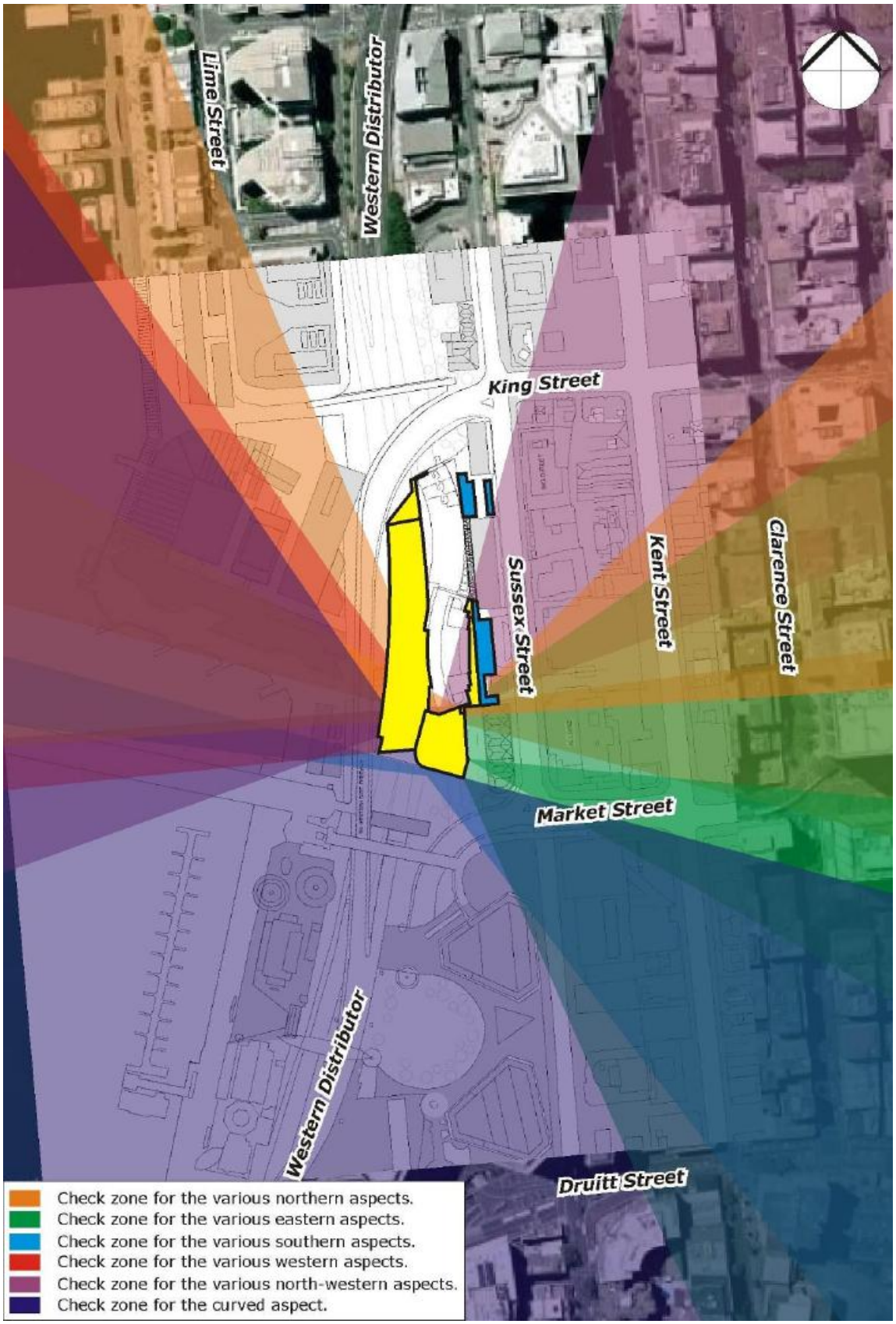

Figure 4a: Check Zones (these are the areas where glare can potentially be observed from the tower component of the redevelopment)

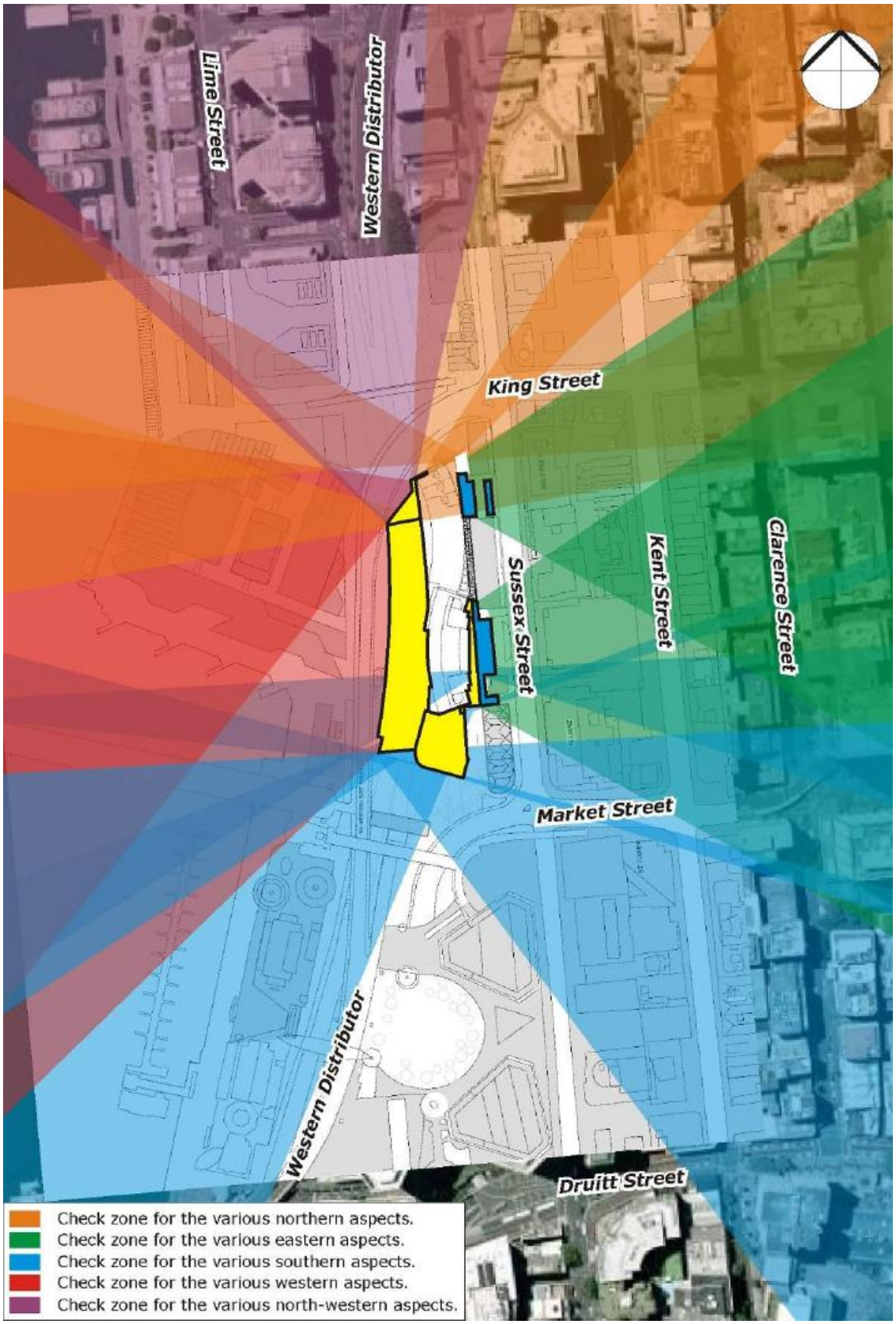

Figure 4b: Check Zones (these are the areas where glare can potentially be observed from the podium component of the redevelopment)

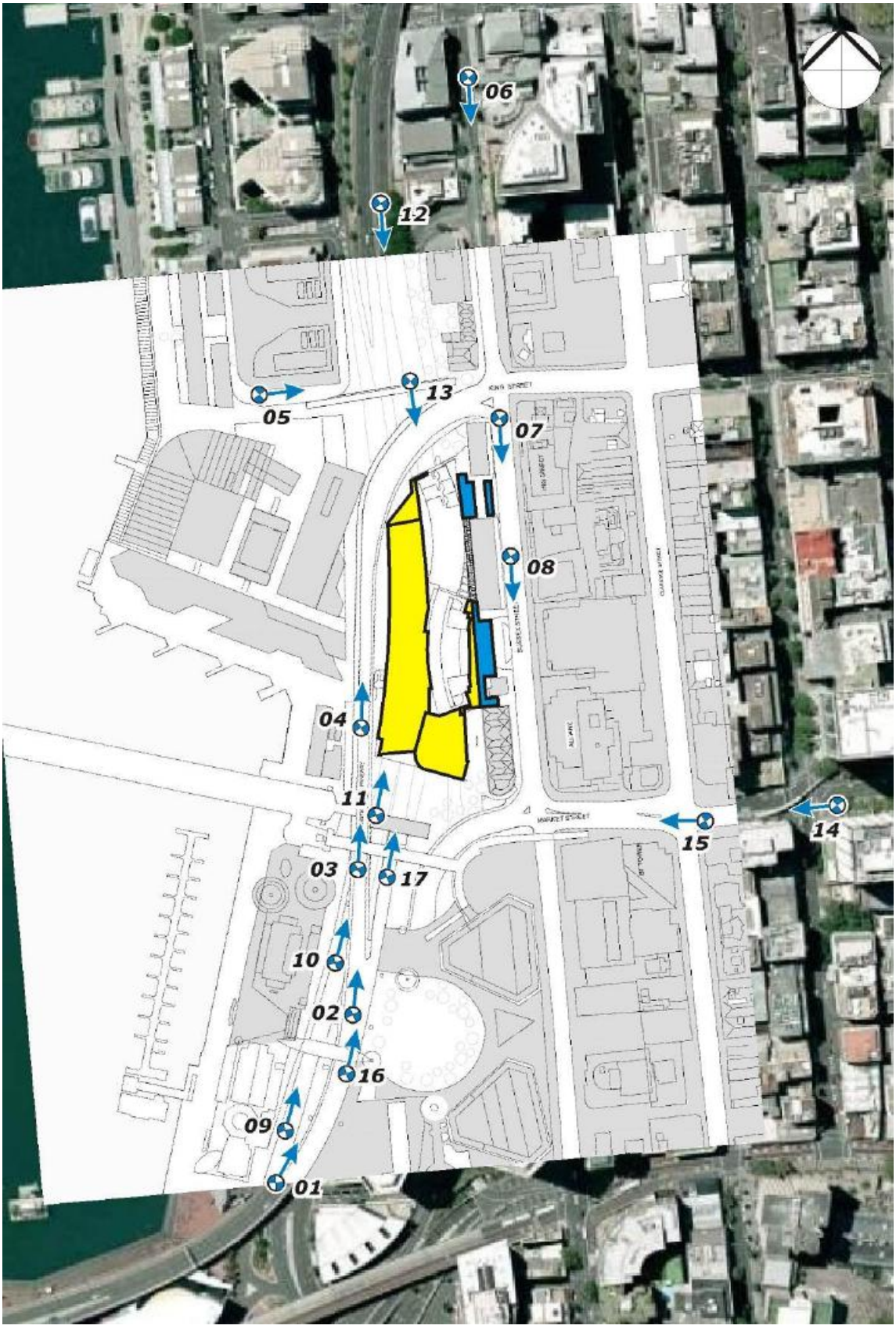

Figure 5: Check Zones and Layout of Study Points

3 ANALYSIS

3.1 Impact onto Drivers and Pedestrians

From the study of the check zones shown in Figures 4a and 4b, a total of 17 street level locations have been identified for detailed analysis. These locations are indicated in Figure 5. A summary of the location of each study point, and the aspects of the subject redevelopment could potentially reflect solar glare to each study point location, is shown in Table 1 below. Note that, as mentioned in Section 2, the check zones shown in Figures 4a and 4b do not take into account the effect of overshadowing by neighbouring buildings or the shielding effect of any existing trees or other obstructions. These effects are examined in the detailed analysis described in the following sub-sections.

Table 1: Aspects of the proposed Redevelopment that could reflect solar glare to each Study Point

Study Point	Location and Viewpoint	Aspect(s) of the Redevelopment
1	Western Distributor, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: None
2	King Street exit from the Western Distributor, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: None
3	King Street exit from the Western Distributor, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: Southern aspect of the eastern podium component
4	King Street exit from the Western Distributor, heading north.	New Tower: Curved, western and north-western aspects Podium Expansion/Renovation: Western aspect of the podium expansion, and the southern aspect of the eastern podium component
5	King Street, heading east.	New Tower: Northern aspect Podium Expansion/Renovation: Western, north-western and northern aspects
6	Sussex Street, heading south.	New Tower: None Podium Expansion/Renovation: North-western and northern aspects
7	Sussex Street, heading south.	New Tower: None Podium Expansion/Renovation: Northern aspects
8	Sussex Street, heading south.	New Tower: North-western aspect Podium Expansion/Renovation: None
9	Harbour Street, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: Southern aspect of the eastern podium component
10	Harbour Street, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: Southern aspect of the eastern podium component

Study Point	Location and Viewpoint	Aspect(s) of the Redevelopment
11	Harbour Street, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: Southern aspect of the eastern podium component
12	Western Distributor, heading south.	New Tower: None Podium Expansion/Renovation: North-western aspect
13	Western Distributor, heading south.	New Tower: None Podium Expansion/Renovation: North-western aspect
14	Market Street, heading west.	New Tower: Northern and eastern aspects Podium Expansion/Renovation: Eastern aspect, and the 175° portion of the southern aspect
15	Market Street, heading west.	New Tower: Eastern aspects Podium Expansion/Renovation: Eastern aspect, and the 175° portion of the southern aspect
16	Western Distributor, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: None
17	Western Distributor, heading north.	New Tower: Curved aspect Podium Expansion/Renovation: Southern aspect of the eastern podium component

3.1.1 Drivers heading north along the Western Distributor

Points 1, 16 and 17 are located along the Western Distributor, to the south of the redevelopment site. These points represent the critical sightlines of drivers heading north along the Western Distributor at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figures A1, A16 and A17 of Appendix A. The view of the proposed redevelopment is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoint at Point 1 indicates that the view of the redevelopment is not within the zone of sensitive vision of drivers at this location. Hence there will be no adverse solar glare reflected from the redevelopment to drivers heading north along the Western Distributor at Point 1.

An analysis of the glare meter overlaid onto the viewpoint at Point 16 indicates that the view of the lower levels of the curved aspect of the tower is in the centre of the zone of sensitive vision of drivers at this location. The lower levels will be visible underneath the pedestrian bridge over the Western Distributor. The other visible areas of the tower (the higher two-thirds of the tower) will be outside the zone of sensitive vision. Since Point 16 is located within the check-zone for the curved aspect of the tower, adverse solar glare could potentially be observed at Point 16 from the lower levels of the curved aspect of the tower. However, it should be noted that reflected glare from a curved surface is quite diffuse, so the intensity of the glare is reduced. Furthermore, the many vertical louvres proposed on that section of the façade of the tower will be effective in further breaking up areas of reflected glare. Hence, as long as the materials used on the façade of the redevelopment have a maximum normal specular

reflectivity of visible light of 20% (as required by the City of Sydney DCP), it is not expected that there will be adverse solar glare reflected from the redevelopment to drivers heading north along the Western Distributor at Point 16.

An analysis of the glare meter overlaid onto the viewpoint at Point 17 indicates that only the southern aspect of the podium extension over the Western Distributor will be within the zone of sensitive vision of drivers at this location. Since Point 17 is not located within the check zone for that aspect of the redevelopment, there will be no adverse solar glare reflected from the redevelopment to drivers heading north along the Western Distributor at Point 17.

3.1.2 Drivers heading north along Harbour Street

Points 9, 10 and 11 are located along Harbour Street and represent the critical sightlines of drivers heading north at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading north along Harbour Street at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figures A9, A10 and A11 of Appendix A. The view of the proposed redevelopment is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoint at Point 9 indicates that the view of the lower levels of the curved aspect of the tower is within the zone of sensitive vision of drivers at this location. The lower levels will be visible underneath the pedestrian bridge over Harbour Street. Since Point 9 is located within the check-zone for the curved aspect of the tower, adverse solar glare could potentially be observed at Point 9 from the lower levels of the curved aspect of the tower. However, it should be noted that reflected glare from a curved surface is quite diffuse, so the intensity of the glare is reduced. Furthermore, the many vertical louvres proposed on that section of the façade of the tower will be effective in further breaking up areas of reflected glare. Hence, as long as the materials used on the façade of the redevelopment have a maximum normal specular reflectivity of visible light of 20% (as required by the City of Sydney DCP), it is not expected that there will be adverse solar glare reflected from the redevelopment to drivers heading north along Harbour Street at Point 9.

An analysis of the glare meter overlaid onto the viewpoints at Point 10 and 11 indicates that the view of the redevelopment is not within the zone of sensitive vision of drivers at these locations. Hence there will be no adverse solar glare reflected from the redevelopment to drivers heading north along Harbour Street at Points 10 or 11.

3.1.3 Drivers heading north along the King Street Exit from the Western Distributor

Points 2, 3 and 4 are located along the King Street Exit from the Western Distributor and represent the critical sightline of drivers heading north at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading north

along the King Street Exit from the Western Distributor at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figures A2, A3 and A4 of Appendix A. The view of the proposed redevelopment is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoint at Point 2 indicates that the view of the lower levels of the curved aspect of the tower is within the zone of sensitive vision of drivers at this location. Since Point 2 is located within the check-zone for the curved aspect of the tower, adverse solar glare could potentially be observed at Point 2 from the lower levels of the curved aspect of the tower. However, it should be noted that reflected glare from a curved surface is quite diffuse, so the intensity of the glare is reduced. Furthermore, the many vertical louvres proposed on that section of the façade of the tower will be effective in further breaking up areas of reflected glare. Hence, as long as the materials used on the façade of the redevelopment have a maximum normal specular reflectivity of visible light of 20% (as required by the City of Sydney DCP), it is not expected that there will be adverse solar glare reflected from the redevelopment to drivers heading north along the King Street Exit from the Western Distributor at Point 2.

An analysis of the glare meter overlaid onto the viewpoint at Point 3 indicates that the view of the redevelopment is not within the zone of sensitive vision of drivers at this location. Hence there will be no adverse solar glare reflected from the redevelopment to drivers heading north along the King Street Exit from the Western Distributor at Point 3.

An analysis of the glare meter overlaid onto the viewpoint at Point 4 indicates that the view of the northern end of the western aspect of the podium expansion of the redevelopment is within the zone of sensitive vision of drivers at this location. However, it should be noted that there are a series of external vertical fins in front of the glazing on the western aspect of the podium expansion. Furthermore, the series of pitched metal roofs of the podium expansion will drape over the western aspect. These will obstruct the view of the glazed portions of the western aspect of the podium expansion when viewed from Point 4, and hence there will be no adverse solar glare reflected from the redevelopment to drivers heading north along the King Street Exit from the Western Distributor at Point 4.

3.1.4 Drivers heading south along the Western Distributor

Points 12 and 13 are located along the Western Distributor and represent the critical sightlines of drivers heading south at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading south along the Western Distributor at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figures A12 and A13 of Appendix A. The view of the proposed redevelopment is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoints at Points 12 and 13 indicates that the view of the redevelopment is not within the zone of sensitive vision of drivers at these locations. Hence there will be no adverse solar glare reflected from the redevelopment to drivers heading south along the Western Distributor at Points 12 or 13.

3.1.5 Drivers heading east along King Street (near King Street Wharf)

Point 5 is located on King Street (the section of King Street near King Street Wharf) and represents the critical sightline of drivers heading east at this location. A site survey of this location has been undertaken, and a photograph showing the viewpoint of drivers heading east along this section of King Street was obtained using a calibrated camera. The photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figure A5 of Appendix A. The view of the proposed redevelopment is also overlaid onto this image.

An analysis of the glare meter overlaid onto the viewpoint at Point 5 indicates that the view of the redevelopment is not within the zone of sensitive vision of drivers at this location. Hence there will be no adverse solar glare reflected from the redevelopment to drivers heading east along King Street (the section of King Street near King Street Wharf) at Point 5.

3.1.6 Drivers heading south along Sussex Street

Points 6, 7 and 8 are located along Sussex Street and represent the critical sightlines of drivers heading south at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading south along Sussex Street at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figures A6, A7 and A8 of Appendix A. The view of the proposed redevelopment is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoints at Points 6, 7 and 8 indicates that the view of the redevelopment is not within the zone of sensitive vision of drivers at these locations. Hence there will be no adverse solar glare reflected from the redevelopment to drivers heading south along Sussex Street at Points 6, 7 or 8.

3.1.7 Drivers heading west along Market Street

Points 14 and 15 are located along Market Street and represent the critical sightlines of drivers heading west at these locations. A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading west along Market Street at these locations were obtained using a calibrated camera. Each photograph has been scaled to enable the glare meter to be overlaid onto the image, as shown in Figures A14 and A15 of Appendix A. The view of the proposed redevelopment is also overlaid onto these images.

An analysis of the glare meter overlaid onto the viewpoint at Point 14 indicates that only a very slim view of the southern aspect of the tower will be within the zone of sensitive vision of drivers at this location. However, it should be noted that Point 14 is not located within the check zone for the southern aspect of the tower, and hence there will be no adverse solar glare reflected from the redevelopment to drivers heading west along Market Street at Point 14.

An analysis of the glare meter overlaid onto the viewpoint at Point 15 indicates that the view of the redevelopment is not within the zone of sensitive vision of drivers at this location. Hence there will be no adverse solar glare reflected from the redevelopment to drivers heading west along Market Street at Point 15.

3.2 Pedestrians within the Darling Harbour Precinct to the West of the Site

Reflections from the façade of the redevelopment are effectively broken-up by the many external façade features on the podium expansion and the tower component, which include external vertical fins and the pitched metal roofs which drape over the western aspect of the podium expansion, and the extensive use of external sunshade louvres on the external façade of the tower component. There are no continuous large, flat and glazed portions of the external façade of the redevelopment. Nonetheless, to ensure that no adverse solar glare is observed when viewed by pedestrians within the outdoor areas associated with the Darling Harbour precinct, it is recommended that the maximum normal specular reflectance of visible light of the selected glazing for the development should be 20%. Note that the 20% limit for the reflectance of the external façade is already a requirement of the City of Sydney DCP.

3.3 Potential for Glare from the Glazed Roof of the Podium Extension

It is noted that a section of the roof of the podium expansion will feature a glazed roof. The roof, which is pitched by 3°, has the potential to cause adverse glare to the occupants of the adjacent existing hotel rooms (namely rooms 212, 214, 220 and 222). This will occur late in the afternoon, when the sun is low on the western horizon. Note also that this will occur regardless of the reflectance properties of the selected glazing for the roof, since the reflectance from glass for high angles-of-incidence will be well over 20% regardless of the normal spectral reflectance value, and in this case when the sun is low on the western horizon the angle of incidence of the reflected glare will be close to 90°. Hence to avoid causing adverse glare to the occupants of the adjacent hotel rooms, it is recommended to add three 40cm high solid screens with a north/south alignment at the front, middle and back of the glazed roof. The recommended locations are also shown in Figure 6 (in marked-up section and plan drawings) on the following page. With the inclusion of these screens, reflected glare that could have otherwise have been observed from the occupants of the adjacent hotel rooms will be blocked.

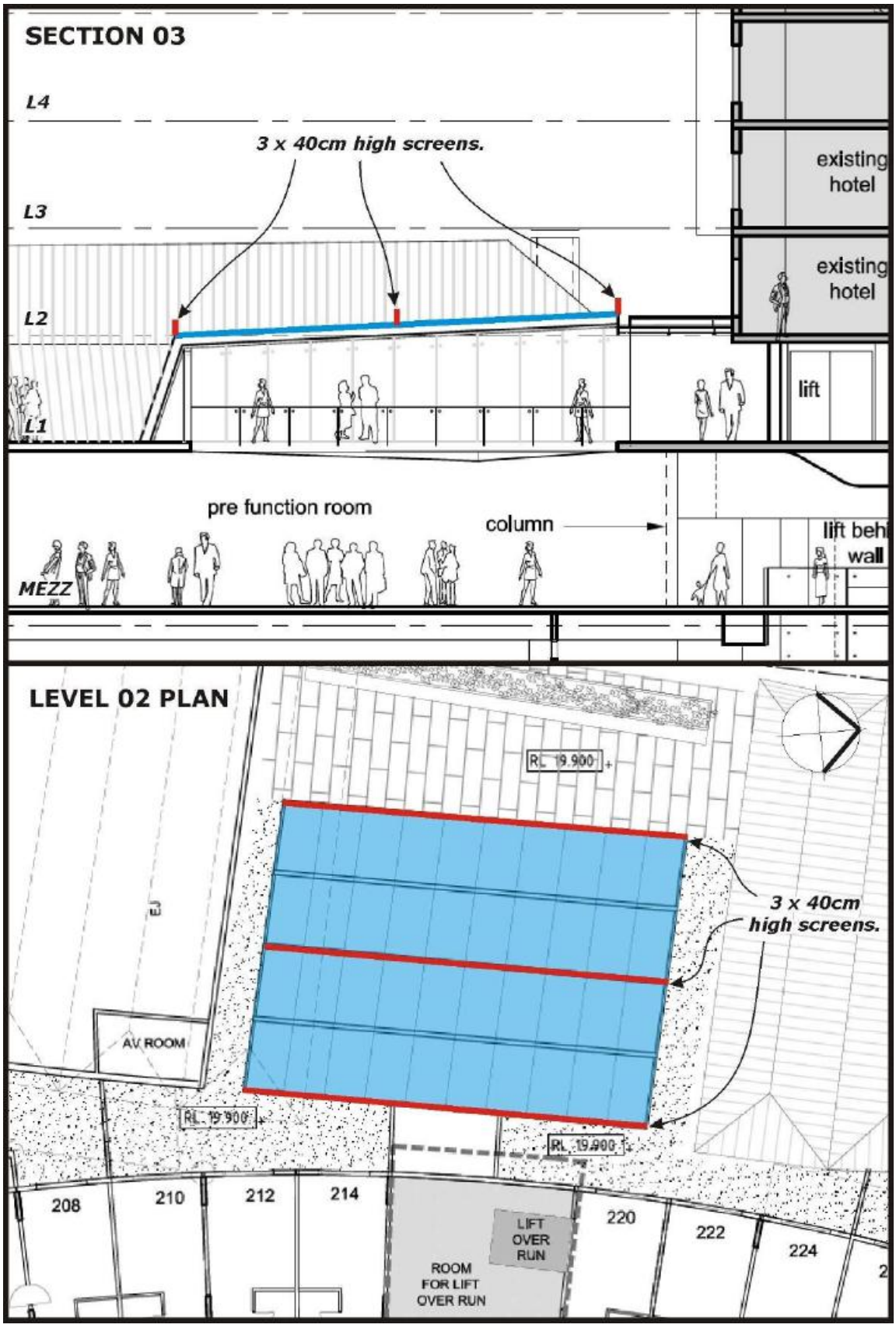

Figure 6: Recommended Screens to be added to the Glazed Roof of the Podium Extension

3.4 Occupants of Neighbouring Buildings

Our past experience involving more than 200 projects, and also research by Rofail and Dowdle (2004)[2], tends to indicate that buildings which cause a nuisance to occupants of neighbouring buildings are those that have a normal specular reflectivity of visible light greater than 20%. This seems to justify the suggested limit of 20% reflectivity by many local government authorities and state planning bodies (including the City of Sydney DCP).

Hence, a general recommendation is made that all glazing and other reflective materials used on the façade of the subject redevelopment have a maximum normal specular reflectivity of visible light of 20% to avoid adverse solar glare to occupants of neighbouring buildings.

3.5 Potential for Glare from the Sunshade Louvres and Metal Roofs

It is noted that there are many vertical louvres proposed on the façade of the redevelopment. These will likely be metal with a painted finish. These louvres will be effective in providing shading, or blocking glare, that may have otherwise been visible from that glazing of the façade of the redevelopment. Metal roofs are also proposed for the podium expansion, and it is expected that these will also have a painted finish. It is not expected that adverse glare will be observed from the painted surfaces of the louvres themselves, or from the metal roofs, for the following reasons:

- The sunshade louvres are spaced relatively closely to one another, and most of the time they will cast shadows, or block glare from being visible, from the other nearby louvres.
- The maximum specular reflectance of visible light of metallic façade materials with a painted finish range from 1% to 5%, which is well within the 20% maximum limit specified by the City of Sydney DCP.
- It is noted that the metal roofs will have a corrugated profile. This will assist in diffusing reflected glare from those surfaces.

[2] A.W. Rofail and B. Dowdle, 2004, "Reflectivity Impact on Occupants of Neighbouring Properties" International Conf. on Building Envelope Systems & Technologies, Sydney.

4 CONCLUSION

An analysis has been undertaken to assess the potential for solar glare from the proposed 161 Sussex Street redevelopment within the Sydney city CBD. The analysis has been undertaken based on architectural drawings prepared by the project architect Cox Richardson, received on February 15, 2013. The redevelopment is located within the Darling Harbour precinct and has been identified as a State Significant Development.

This assessment has been undertaken with consideration of the Director General's Environmental Assessment Requirements, Schedule 2, Key Issue 5 Ecologically Sustainable Development (ESD). This report investigates the Solar Light Reflectivity on the surrounding areas as a result of the proposed redevelopment.

This study addresses the following planning control requirements of Section 3.2.7 of the City of Sydney Development Control Plan 2012, which are summarised as follows:

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- Ensure that building materials do not lead to hazardous, undesirable or uncomfortable glare to pedestrians, motorists or occupants of surrounding buildings
- Generally, light reflectivity from building materials used on facades must not exceed 20%.
- For buildings in the vicinity of arterial roads/major roads and Sydney Airport, proof of light reflectivity is required and is to demonstrate that light reflectivity does not exceed 20%.

The proposed redevelopment includes the addition of a tower which extends from the southern aspect of the existing hotel building, and an extension of the podium component of the hotel which is to extend over the Western Distributor roadway. Some parts of the eastern aspect façade of the existing podium will also be redeveloped, and will include the addition of some glass awnings. Note that this analysis only assesses the potential for solar glare from the façade of the redevelopment.

A site survey has been undertaken to obtain photographs of the critical sightlines of drivers on the surrounding streets. These photographs are calibrated and are able to be overlaid with a glare meter, which allows us to determine the extent, if any, of potential solar glare reflections from the subject redevelopment.

The results of the analysis indicate that reflections from the façade of the redevelopment are effectively broken-up by the many external façade features on the podium expansion and the tower component, which include external vertical fins and the pitched metal roofs which drape over the western aspect of the podium expansion, and the extensive use of external sunshade louvres on the external façade of the tower component. There are no continuous large, flat and

glazed portions of the external façade of the redevelopment. Nonetheless, to avoid any adverse glare to drivers and pedestrians on the surrounding streets, to pedestrians within the Darling Harbour precinct, and to occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following is recommended:

- All glazing used for the external façade of the redevelopment should have a maximum normal specular reflectivity of visible light of 20%.
- Three 40cm high solid screens to be added on top of the glazed roof portion of the western podium expansion. The screens should have a north/south alignment and be located along the front, middle and back of the glazed roof.

It should be noted that the most reflective surface on the façade of a building is the glazing. Reflected solar glare from concrete, brickwork, timber, etc, is negligible (ie: less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. The proposed louvres on most aspects of the redevelopment are expected to be metal with a painted finish, and the maximum specular reflectance for these types of façade elements is in the range of 1% to 5%, which is well within the abovementioned recommended limits. Similarly, the metal roofs of the podium expansion are expected to have a painted finish and hence the maximum normal reflectance of visible light will be well within the City of Sydney DCP limit of 20%. Furthermore, it is noted that the metal roofs will have a corrugated profile, which will further assist in diffusing reflected glare.

Hence, with the incorporation of the abovementioned recommendations, the subject redevelopment will not cause adverse solar glare to pedestrians or motorists in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity for the City of Sydney Development Control Plan 2012.

APPENDIX A - GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

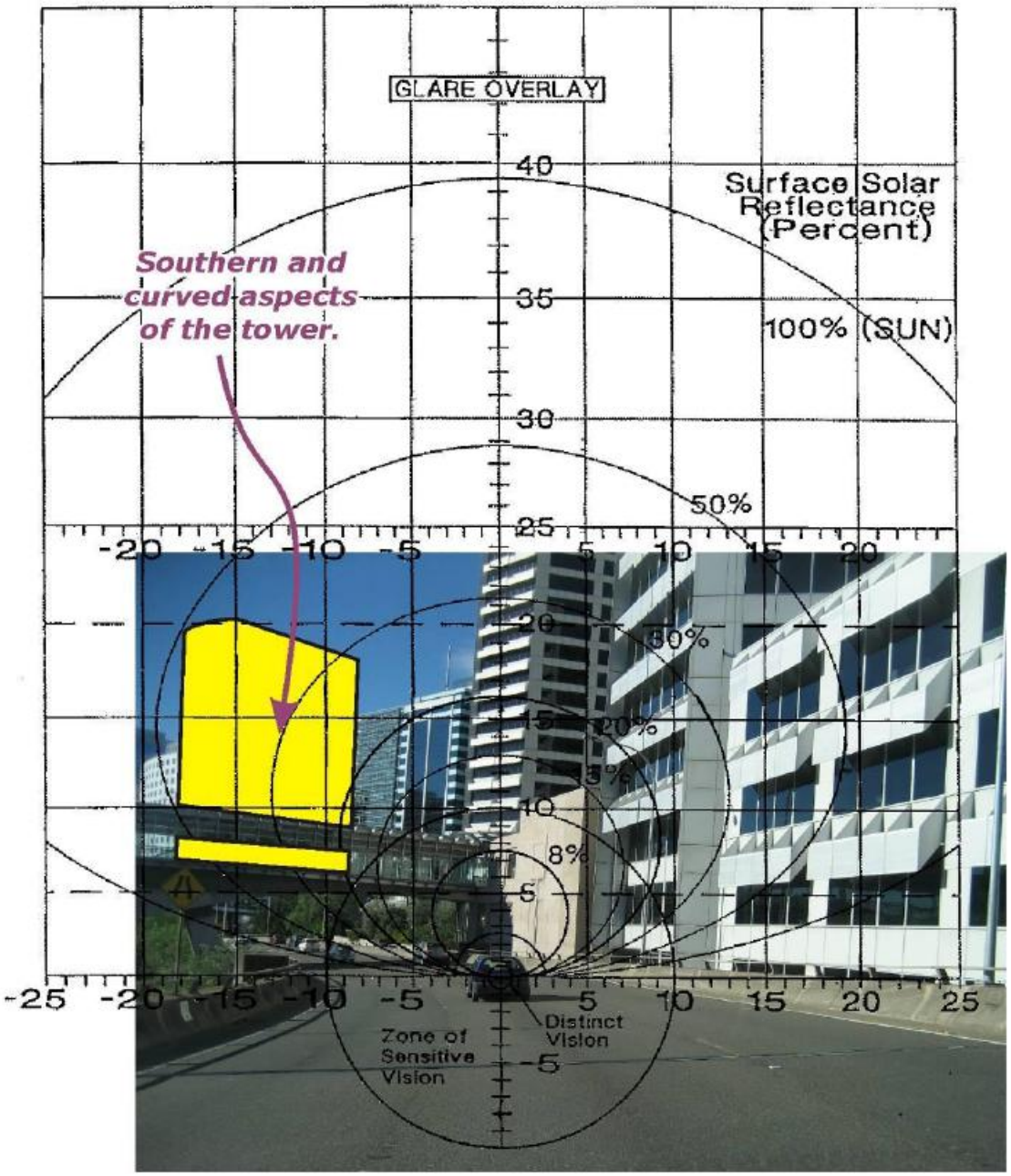

Figure A1: Glare Overlay for Point 1

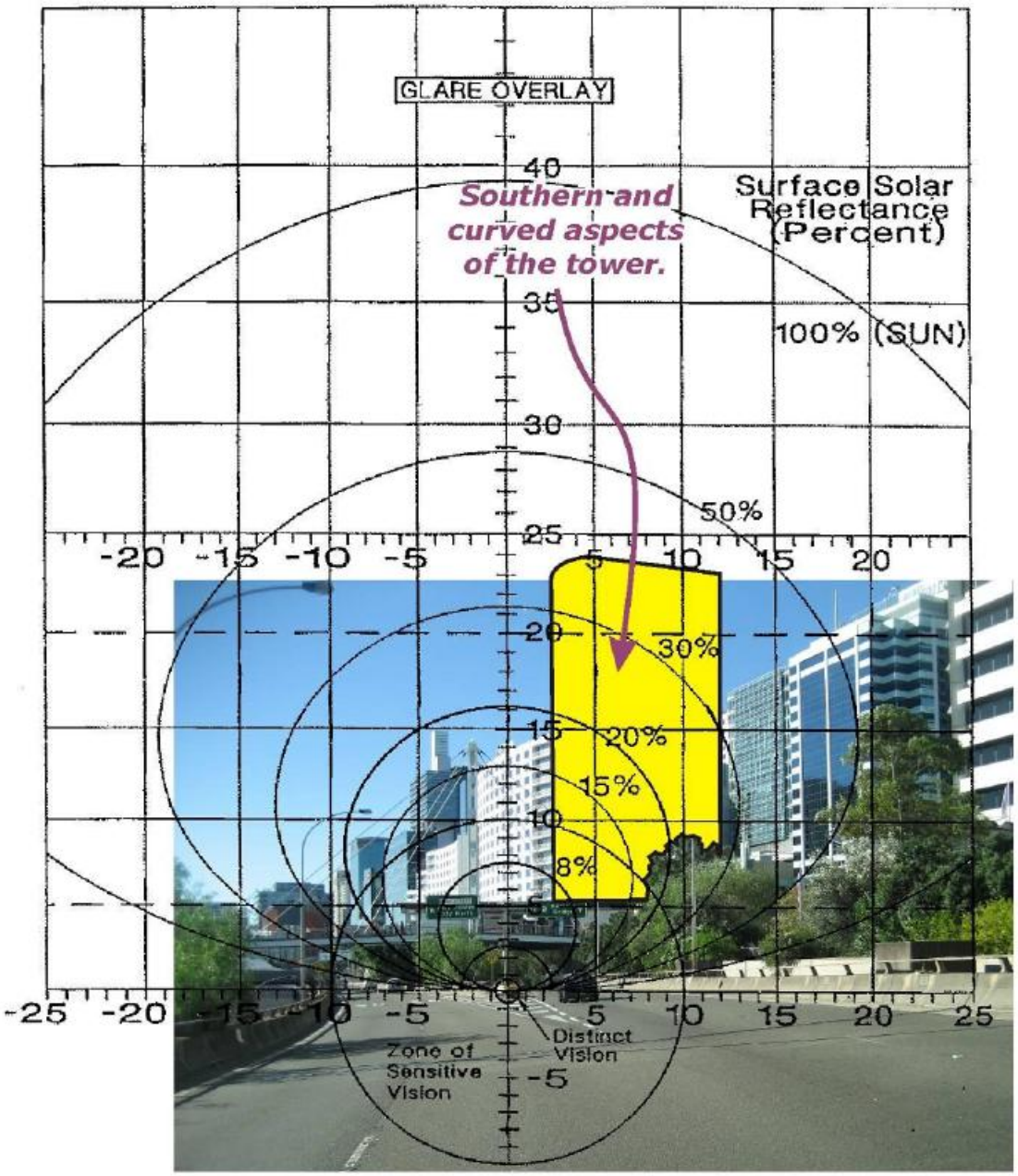

Figure A2: Glare Overlay for Point 2

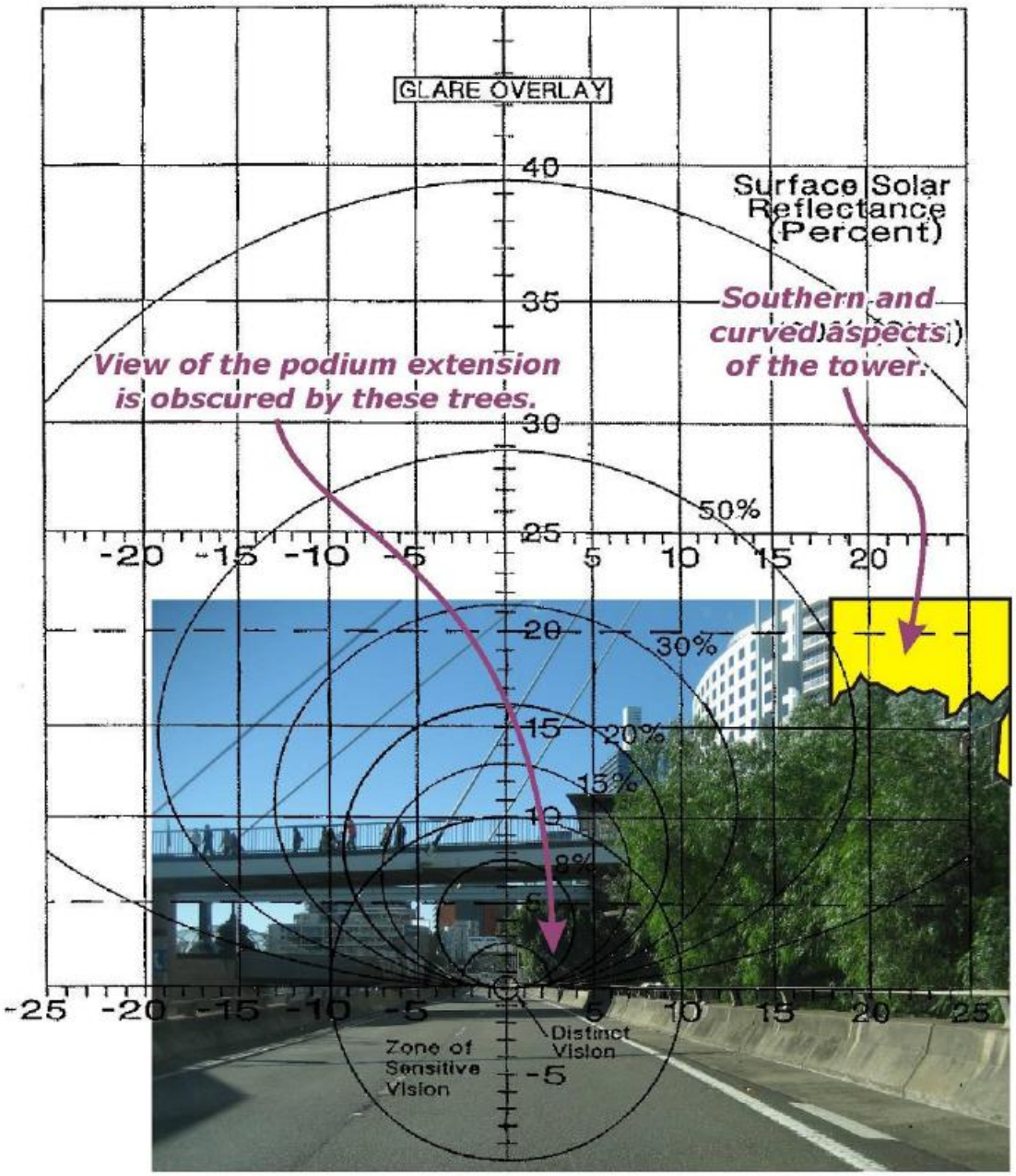

Figure A3: Glare Overlay for Point 3

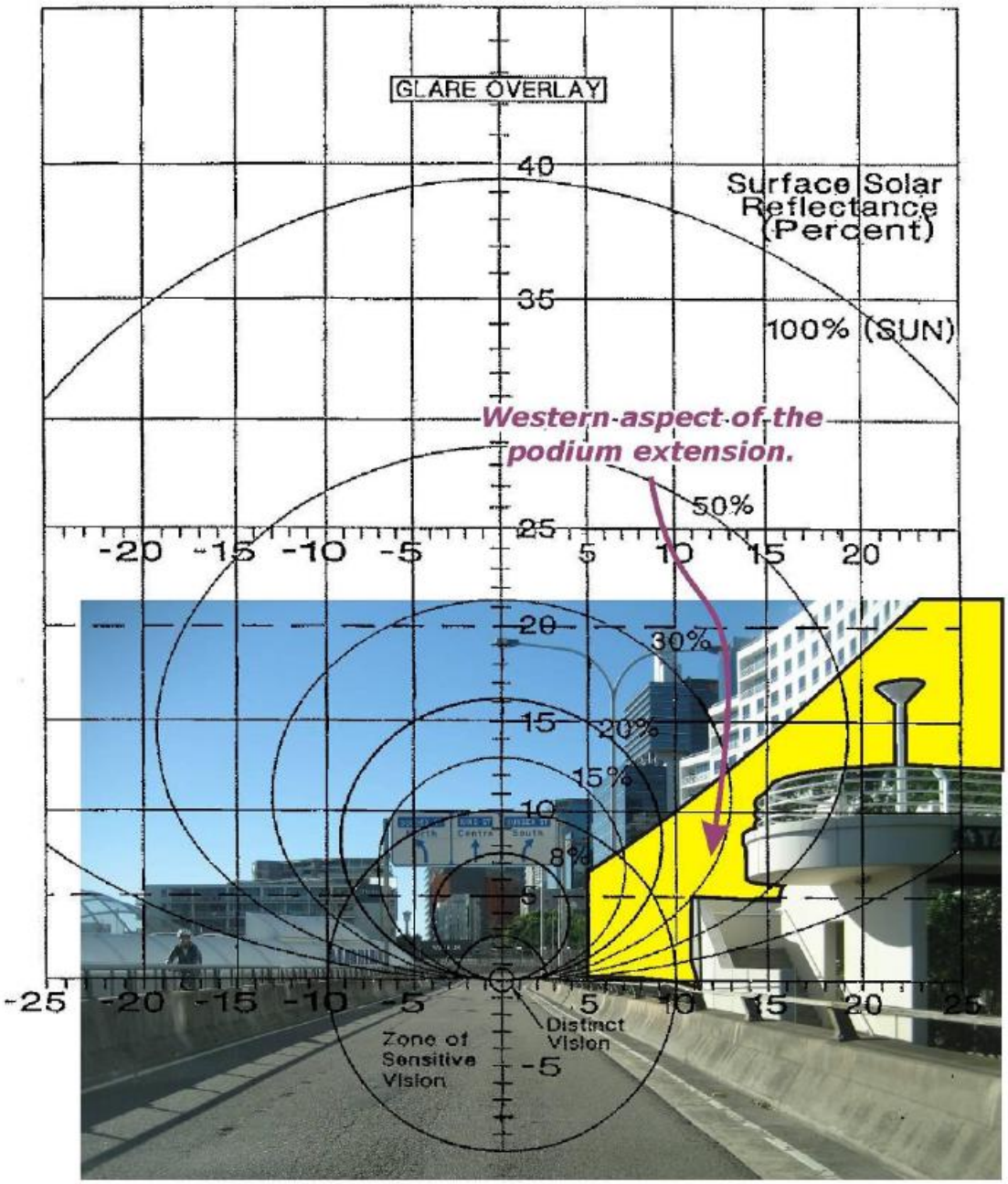

Figure A4: Glare Overlay for Point 4

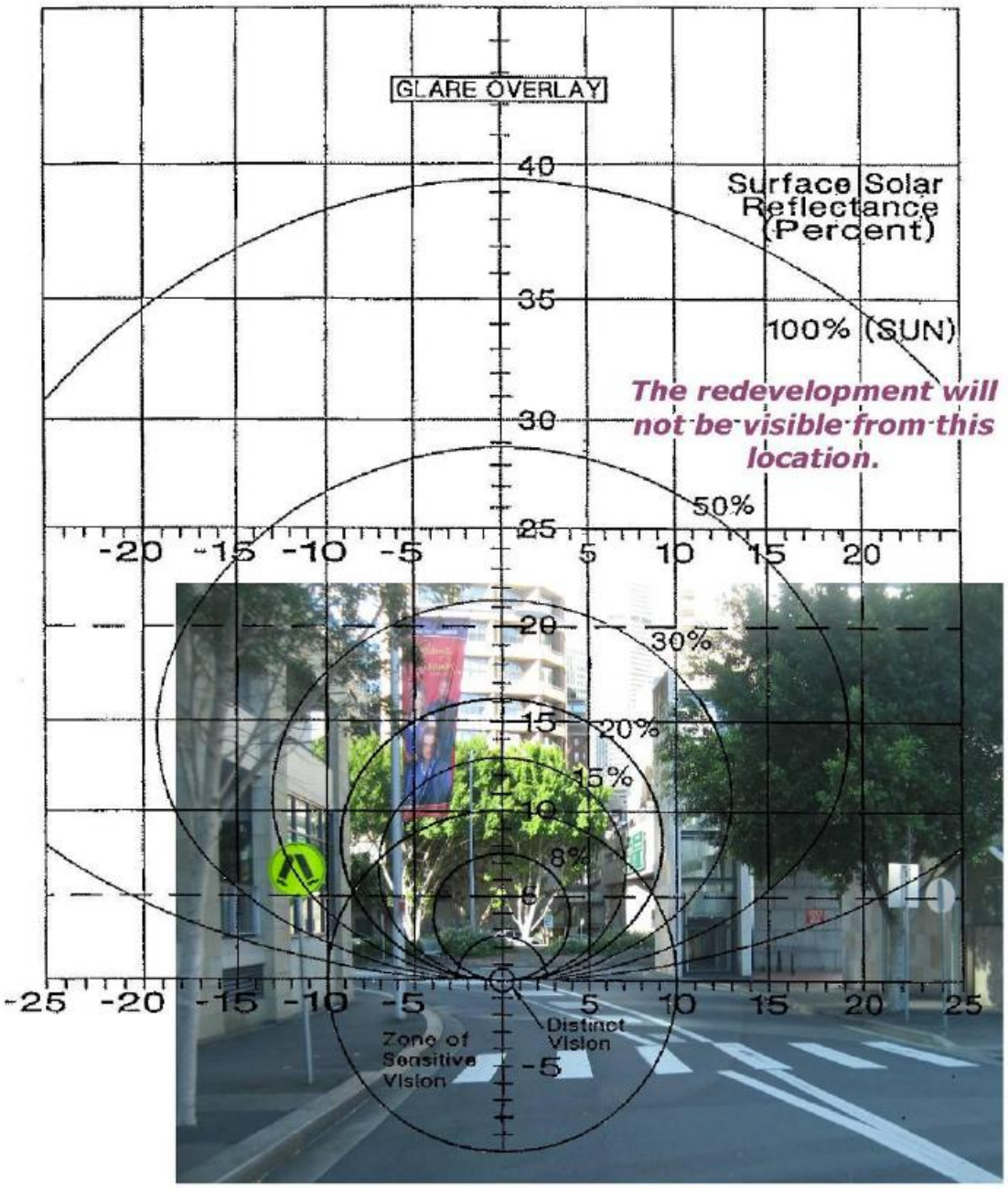

Figure A5: Glare Overlay for Point 5

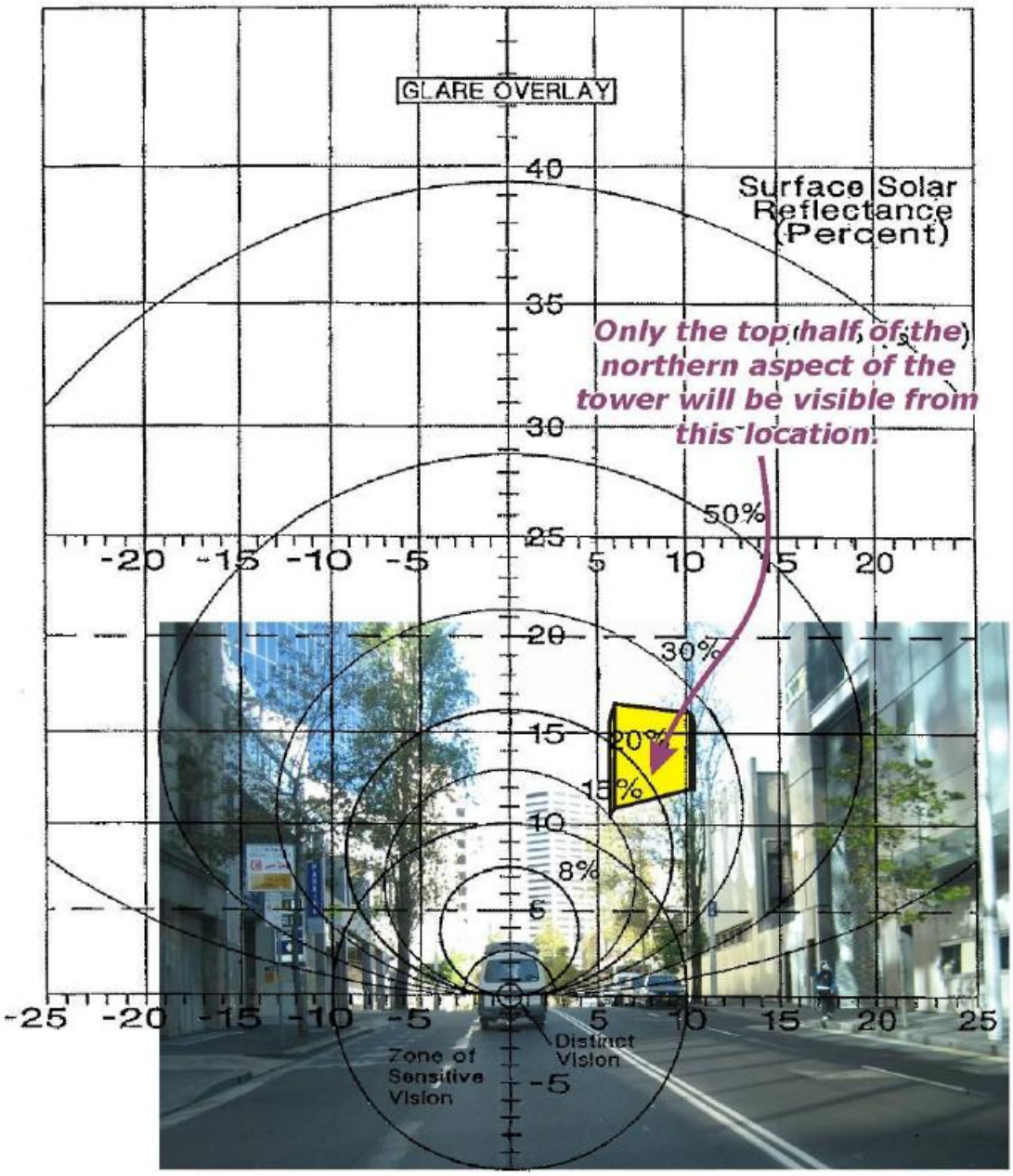

Figure A6: Glare Overlay for Point 6

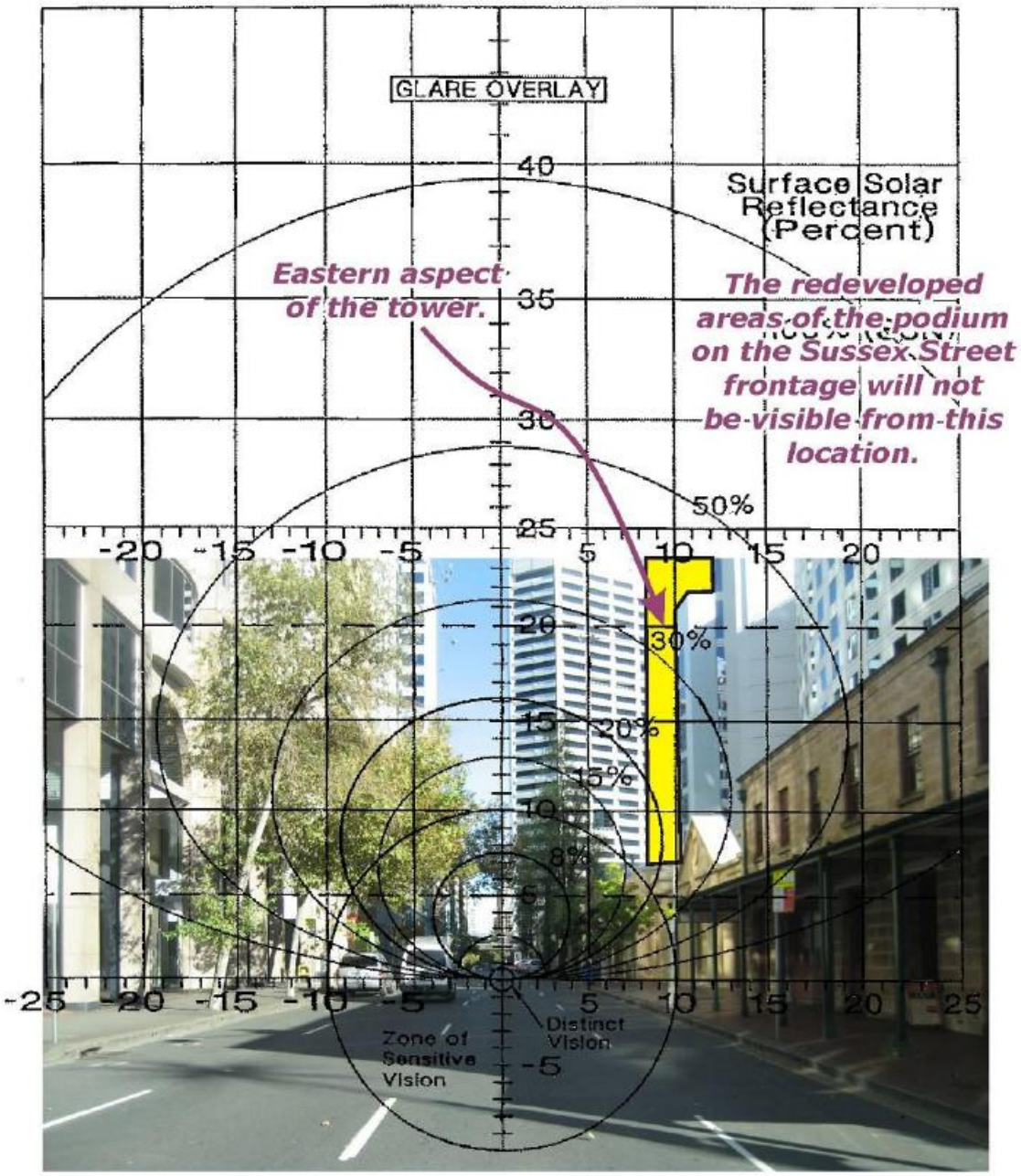

Figure A7: Glare Overlay for Point 7

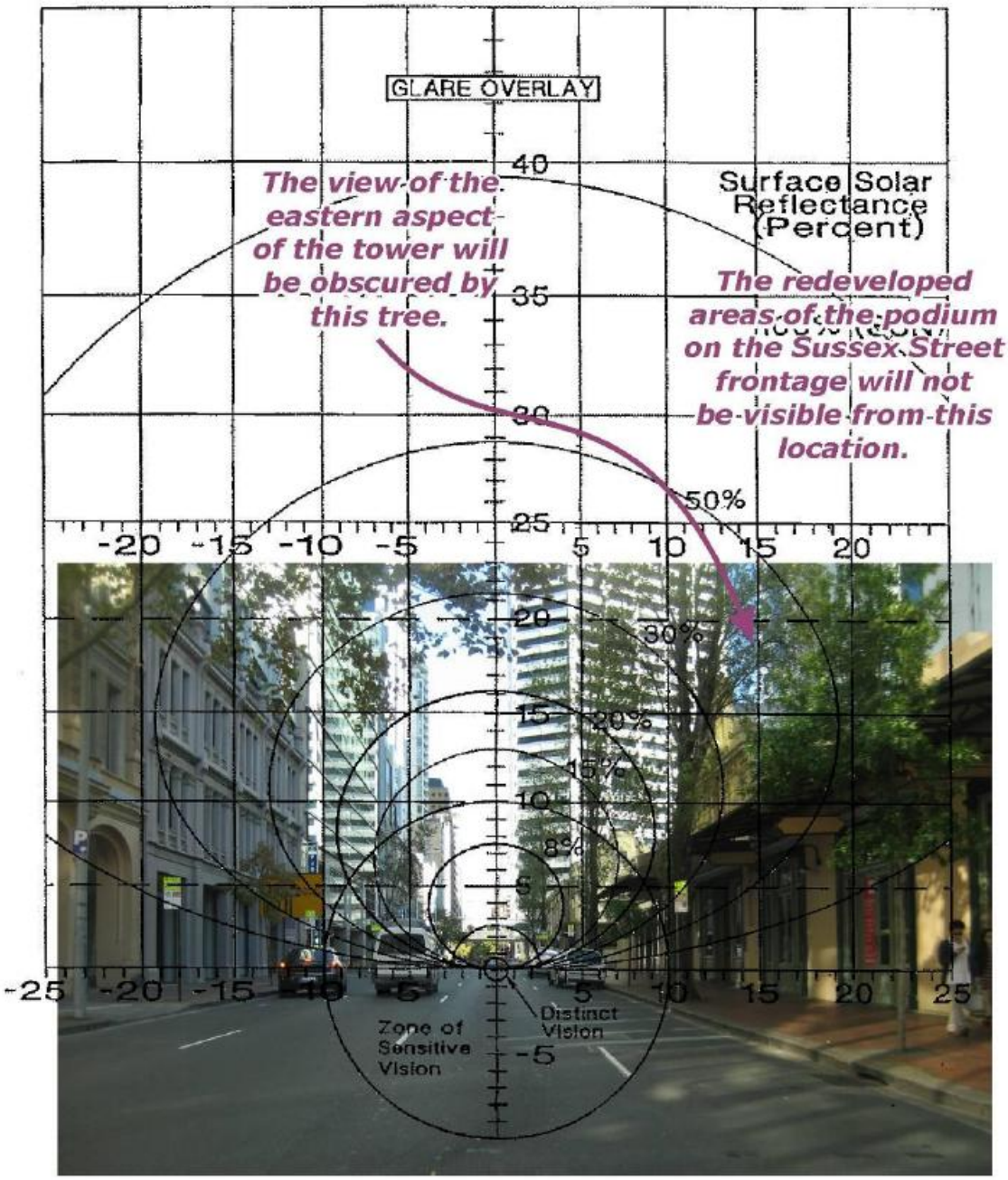

Figure A8: Glare Overlay for Point 8

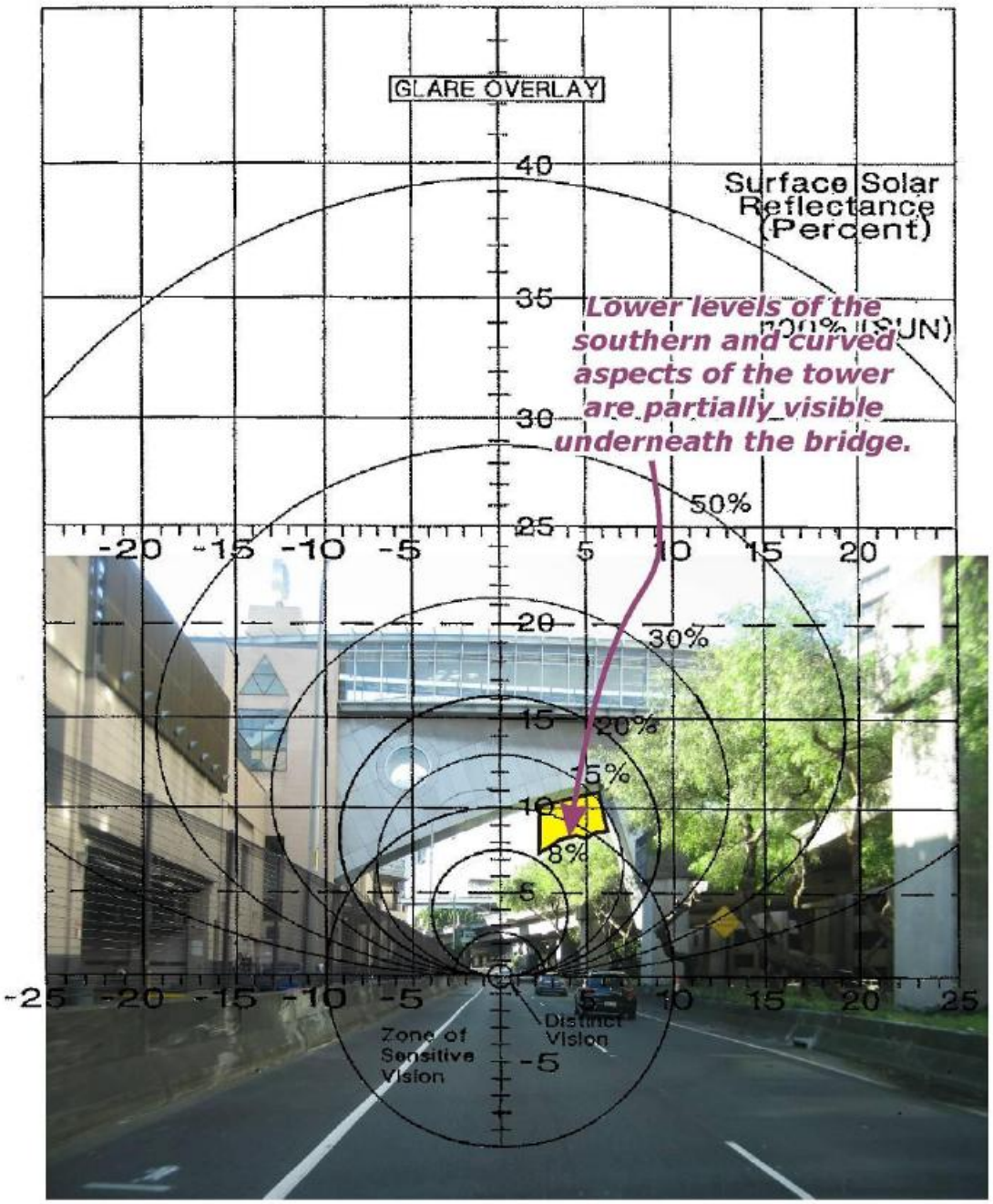

Figure A9: Glare Overlay for Point 9

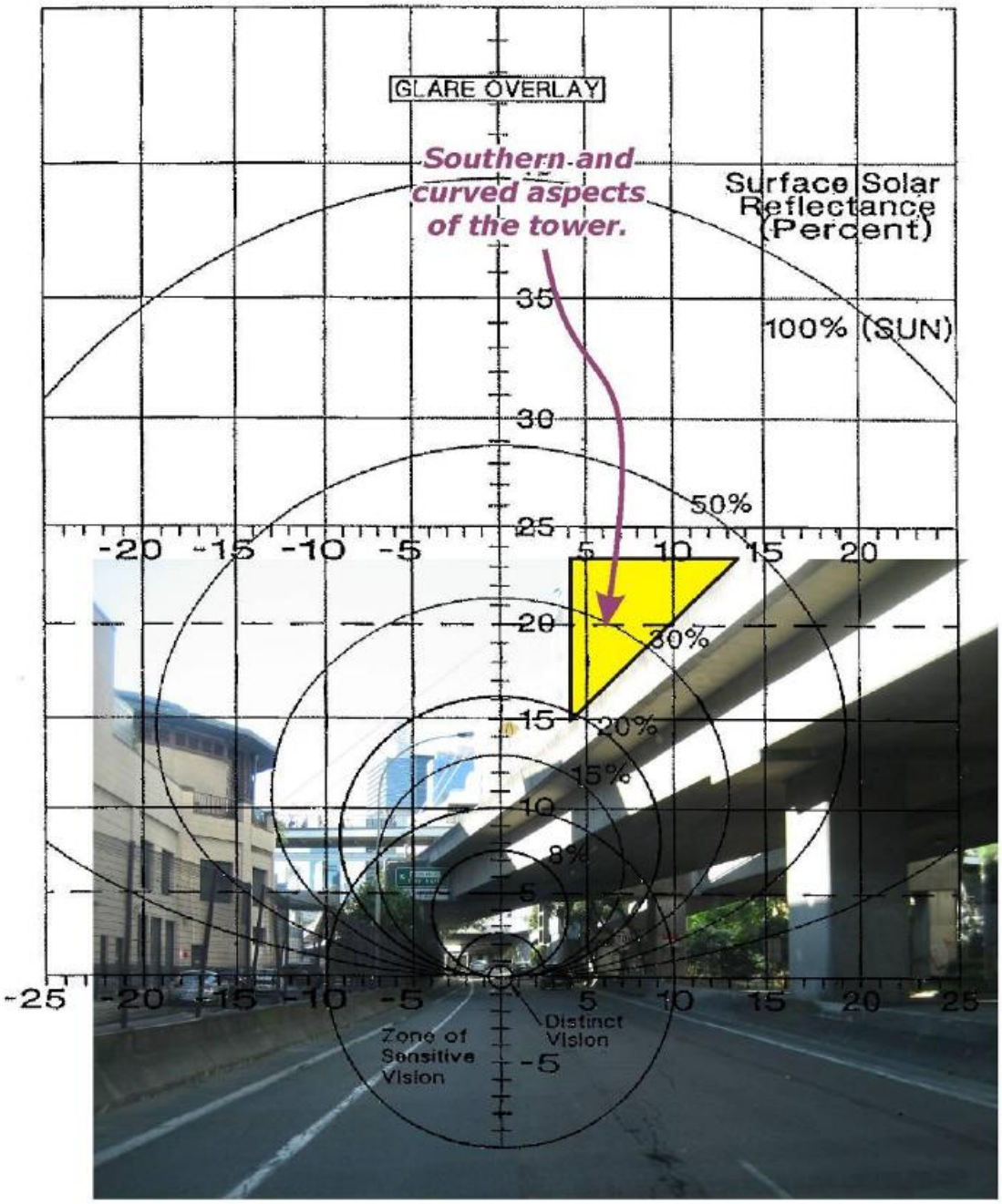

Figure A10: Glare Overlay for Point 10

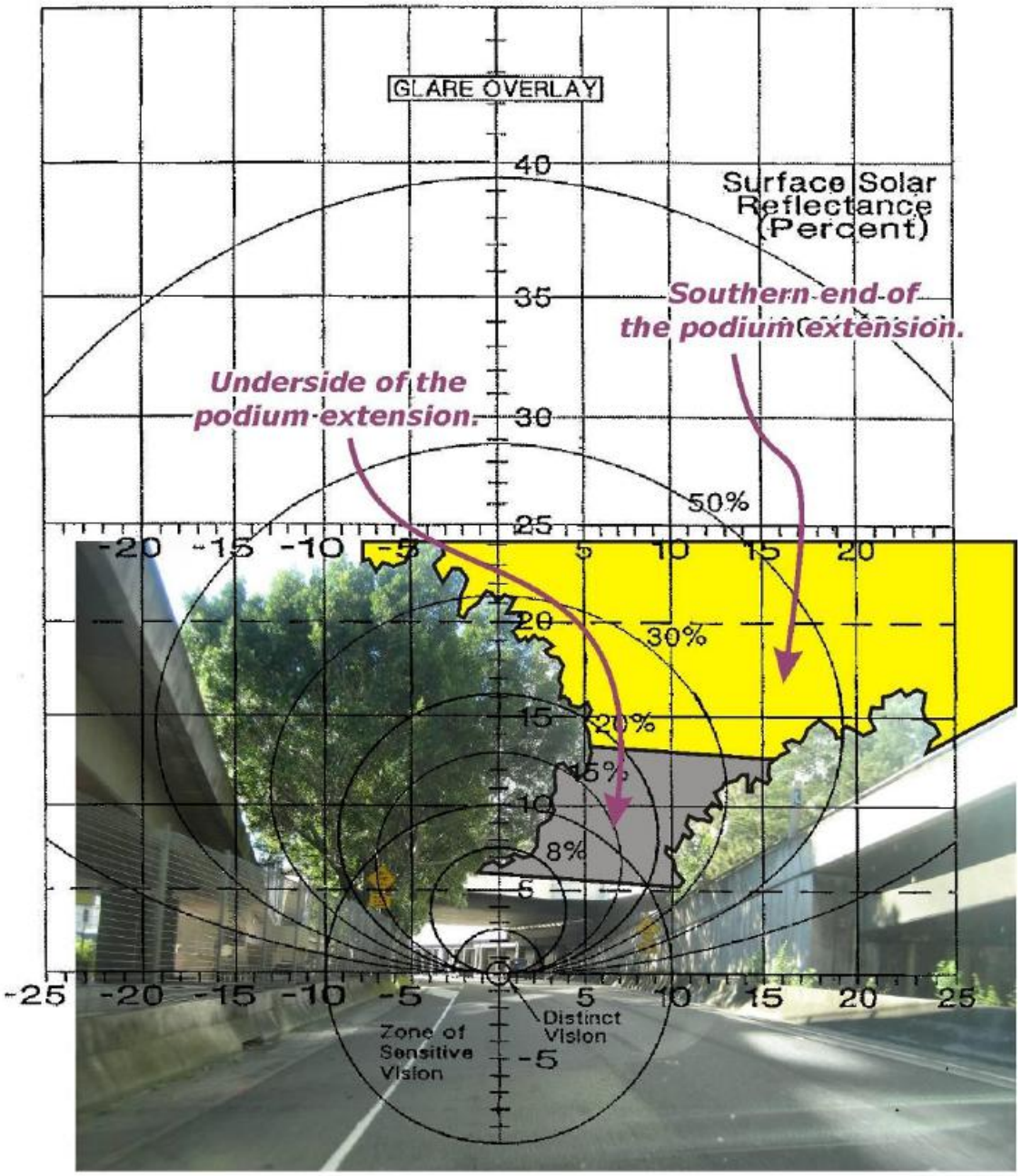

Figure A11: Glare Overlay for Point 11

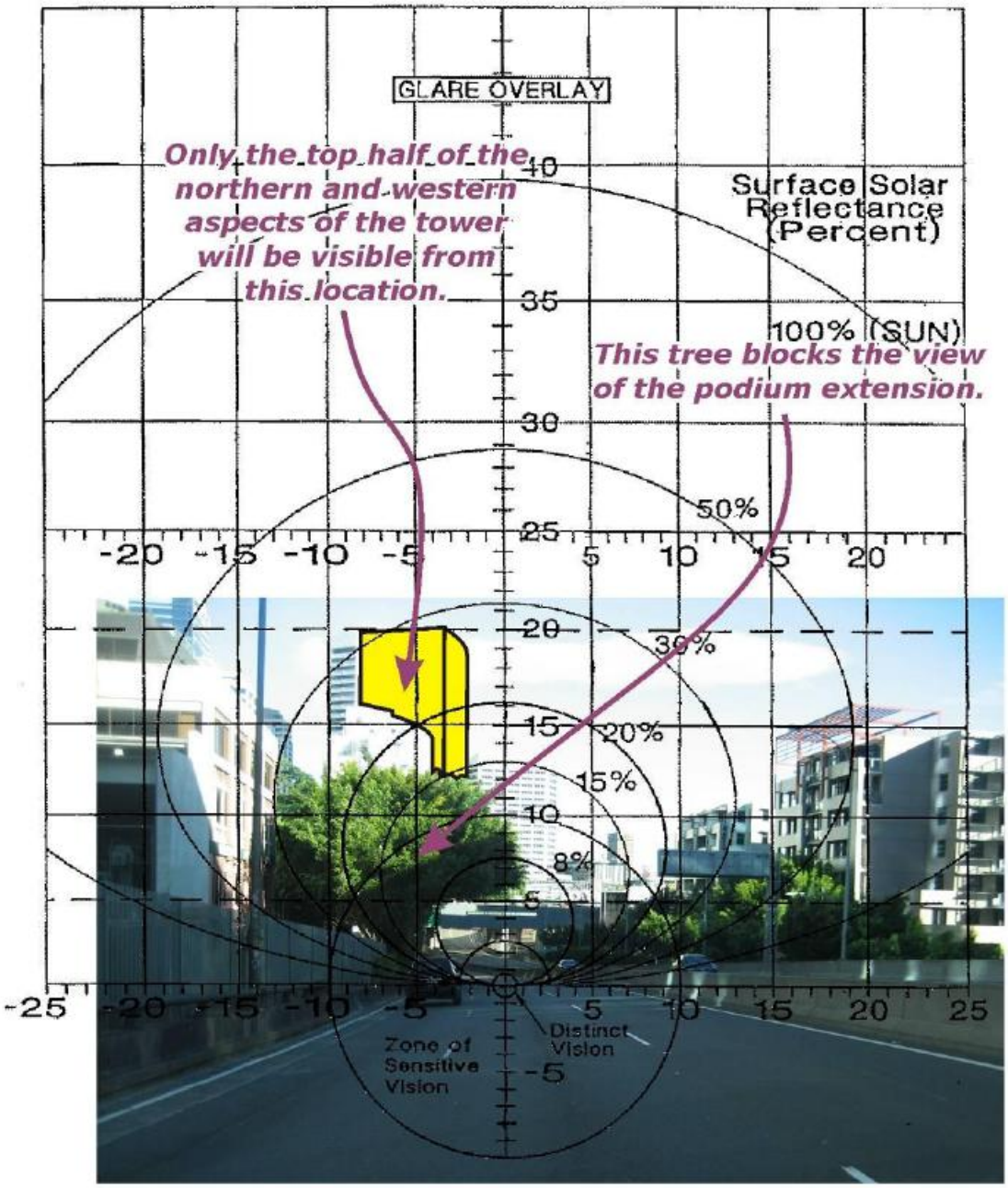

Figure A12: Glare Overlay for Point 12

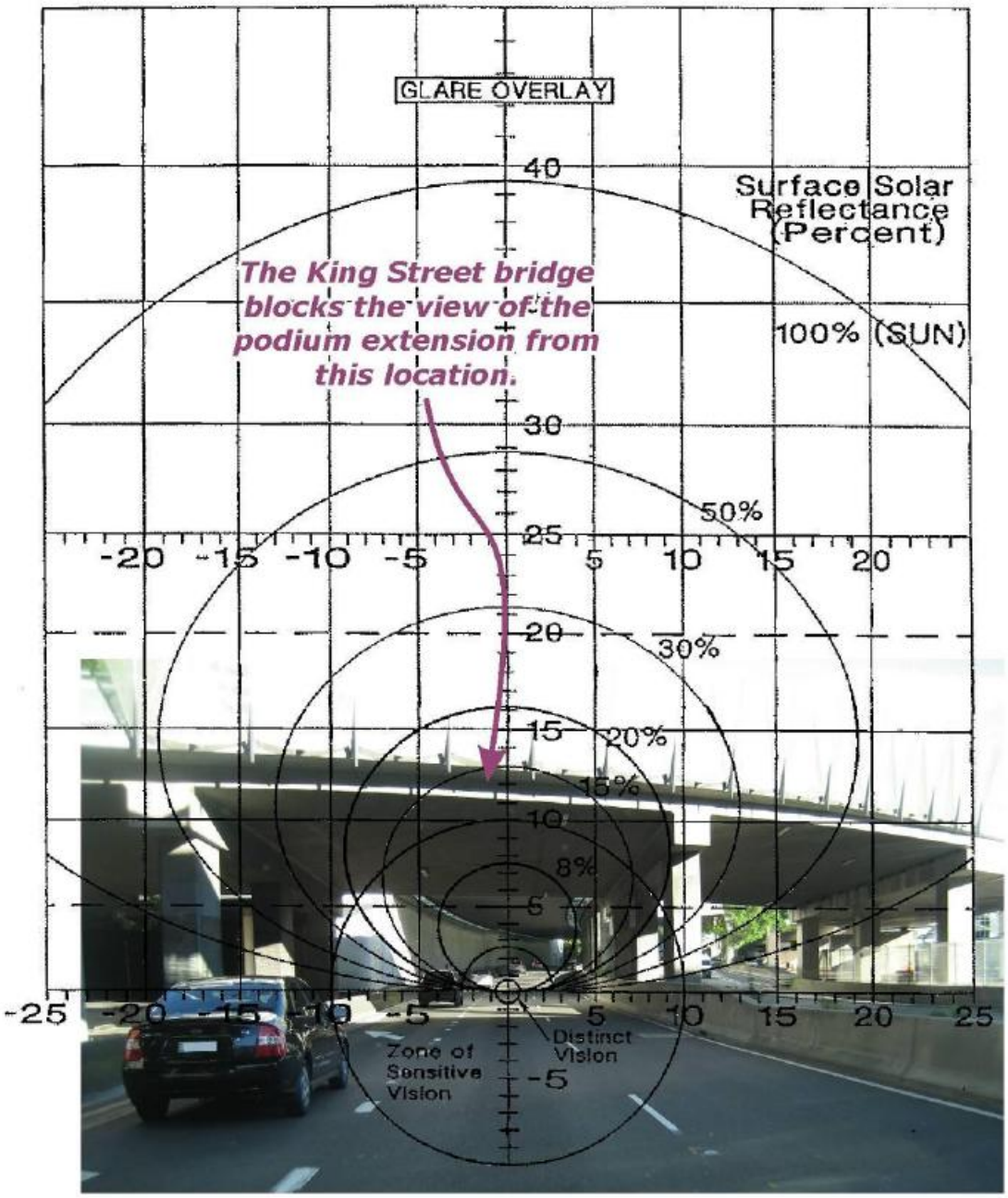

Figure A13: Glare Overlay for Point 13

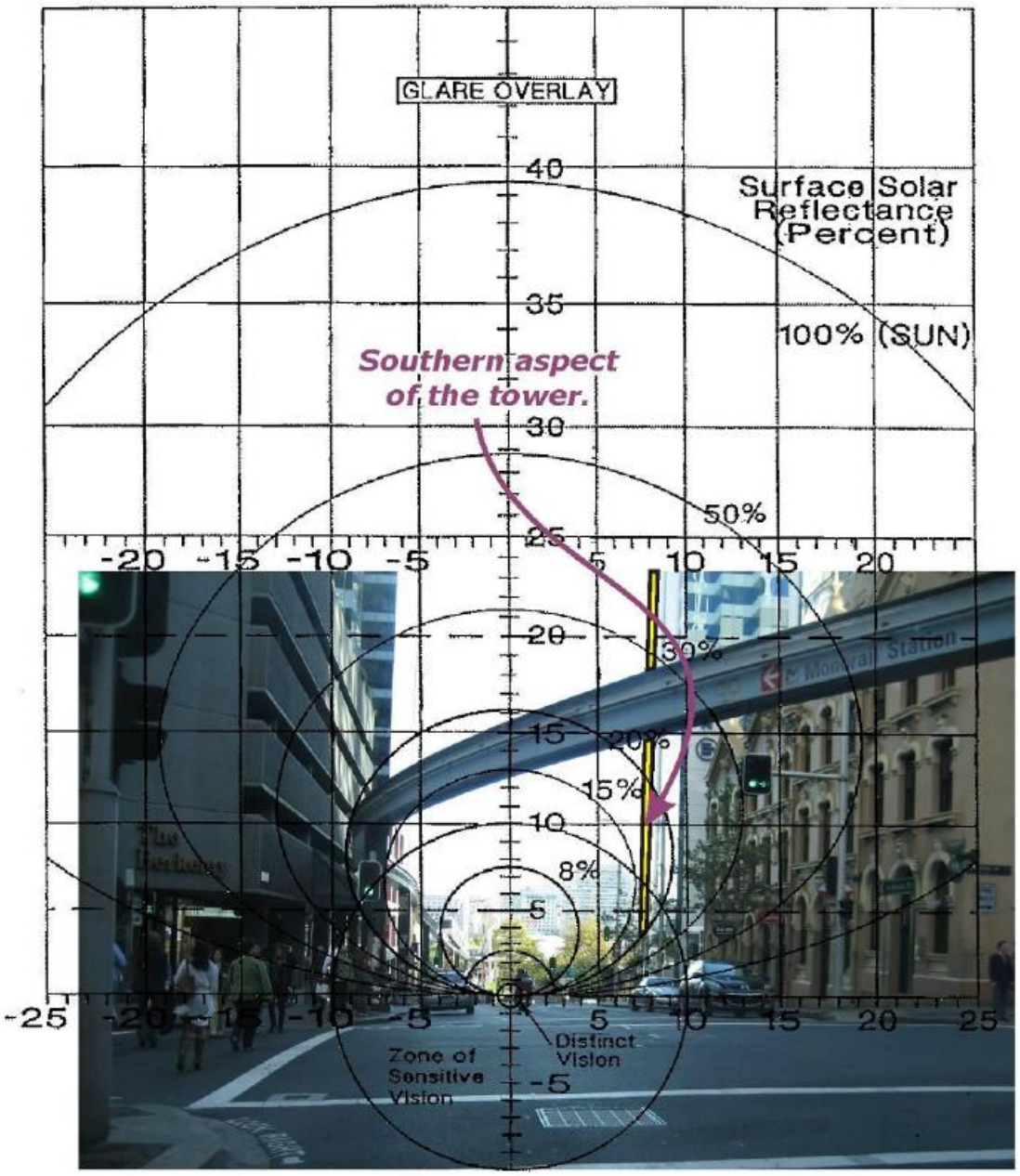

Figure A14: Glare Overlay for Point 14

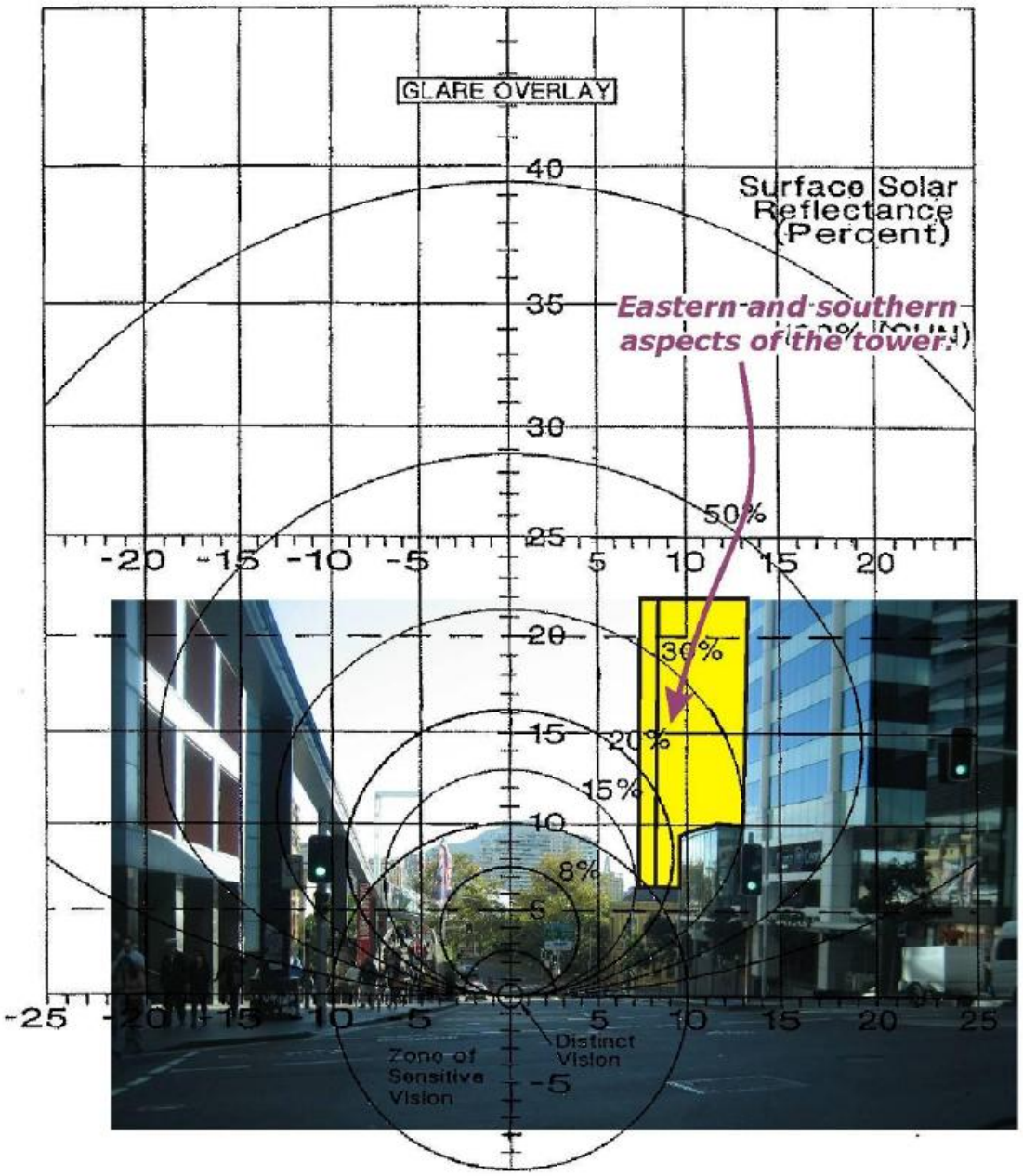

Figure A15: Glare Overlay for Point 15

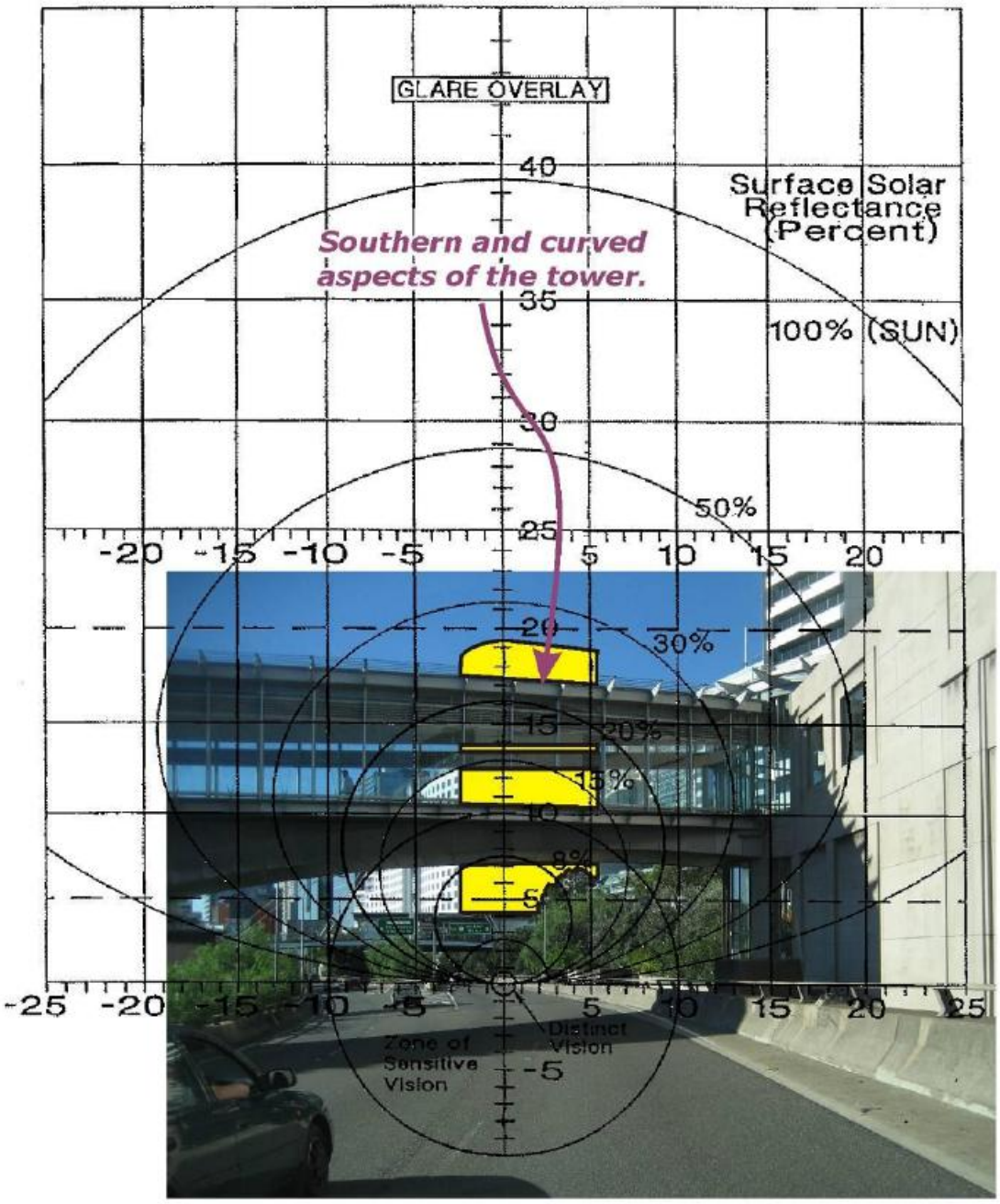

Figure A16: Glare Overlay for Point 16

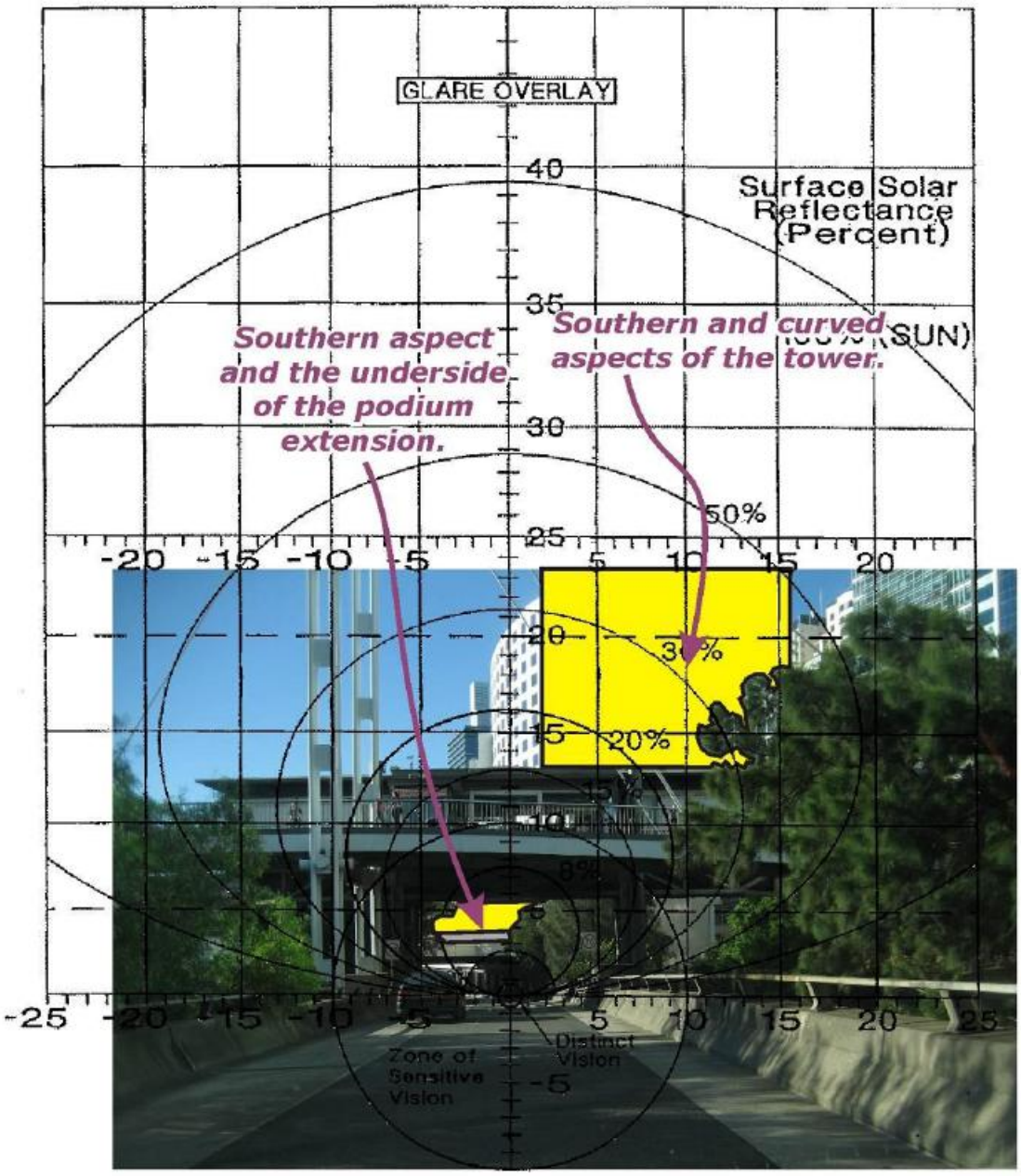

Figure A17: Glare Overlay for Point 17

APPENDIX B - SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

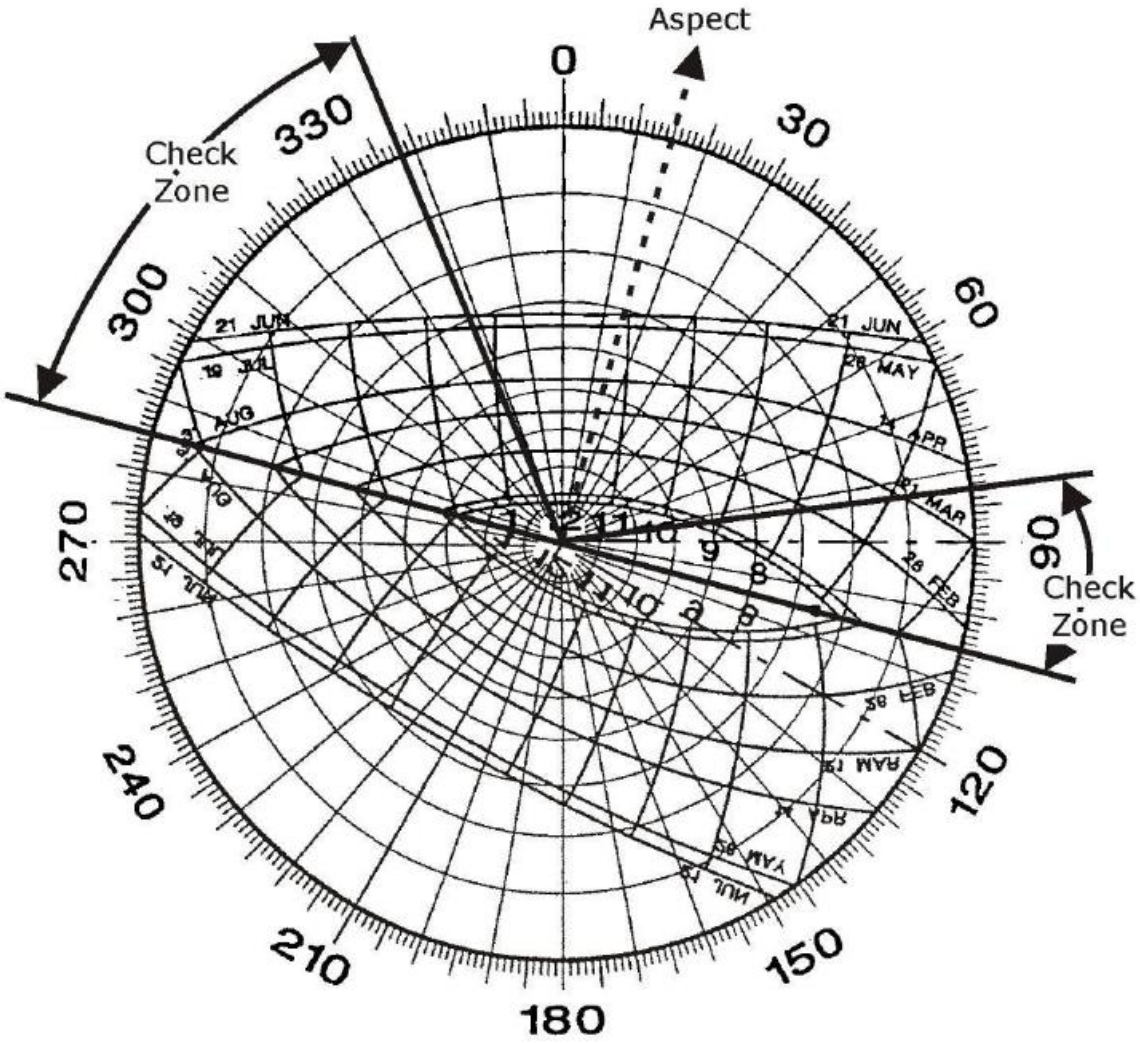

Figure B1: Sun Chart for Aspect 015°

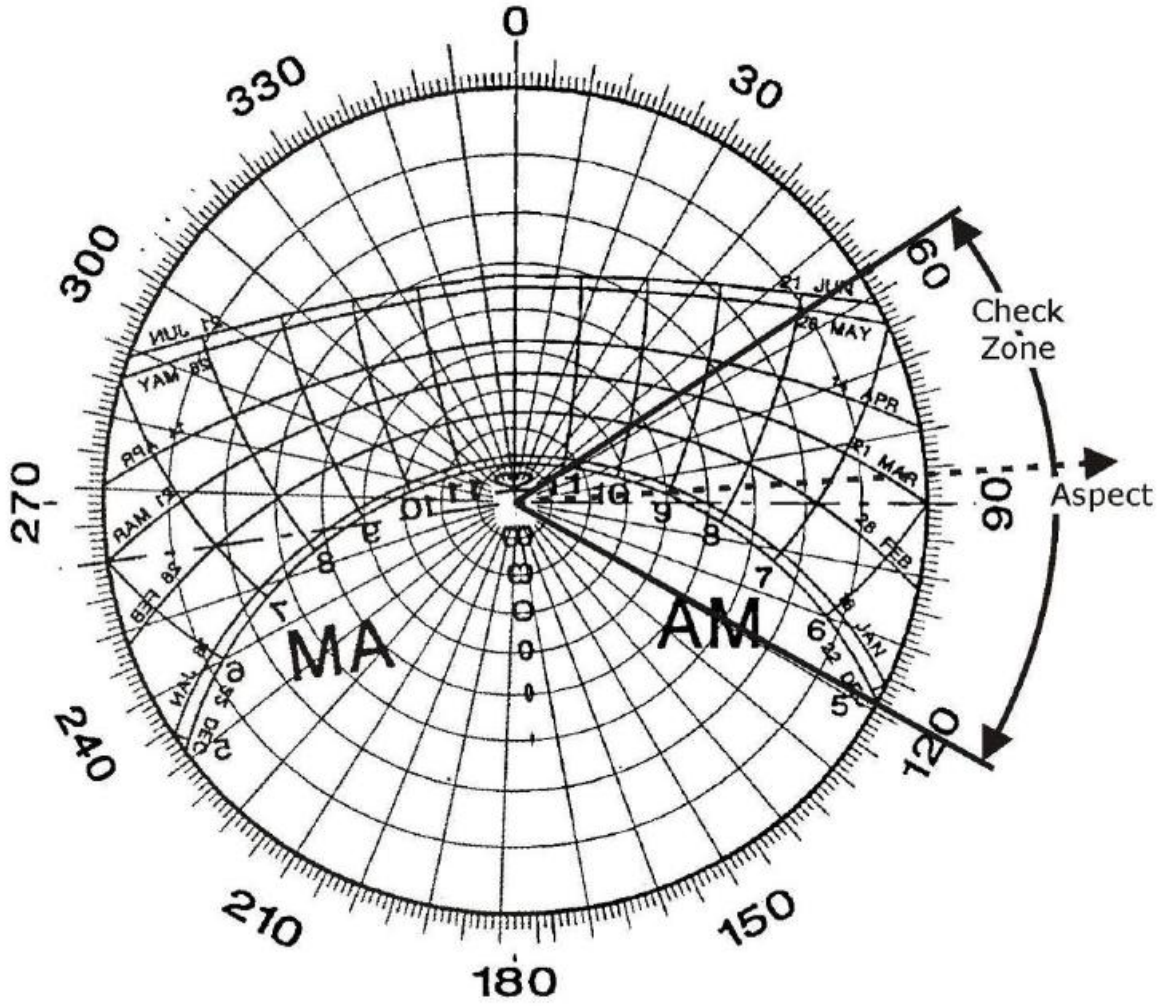

Figure B2: Sun Chart for Aspect 086°

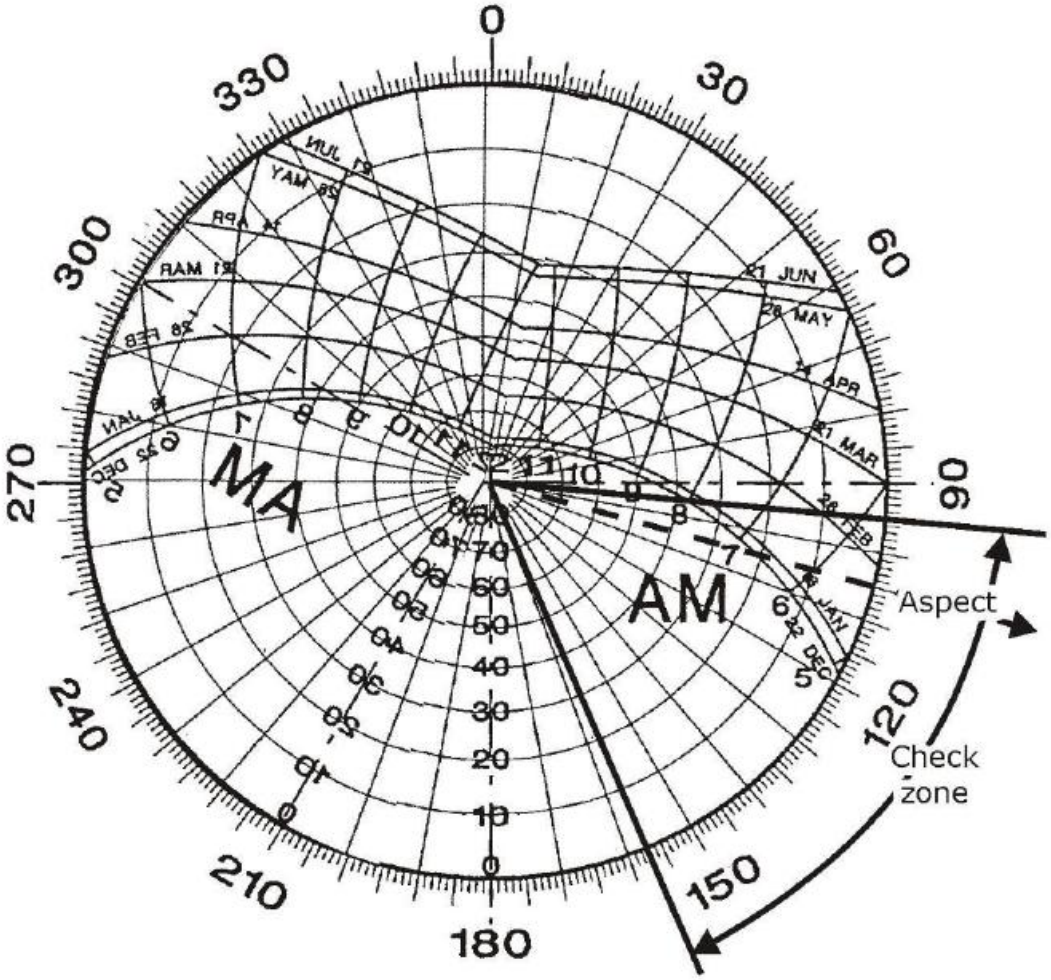

Figure B3: Sun Chart for Aspect 105°

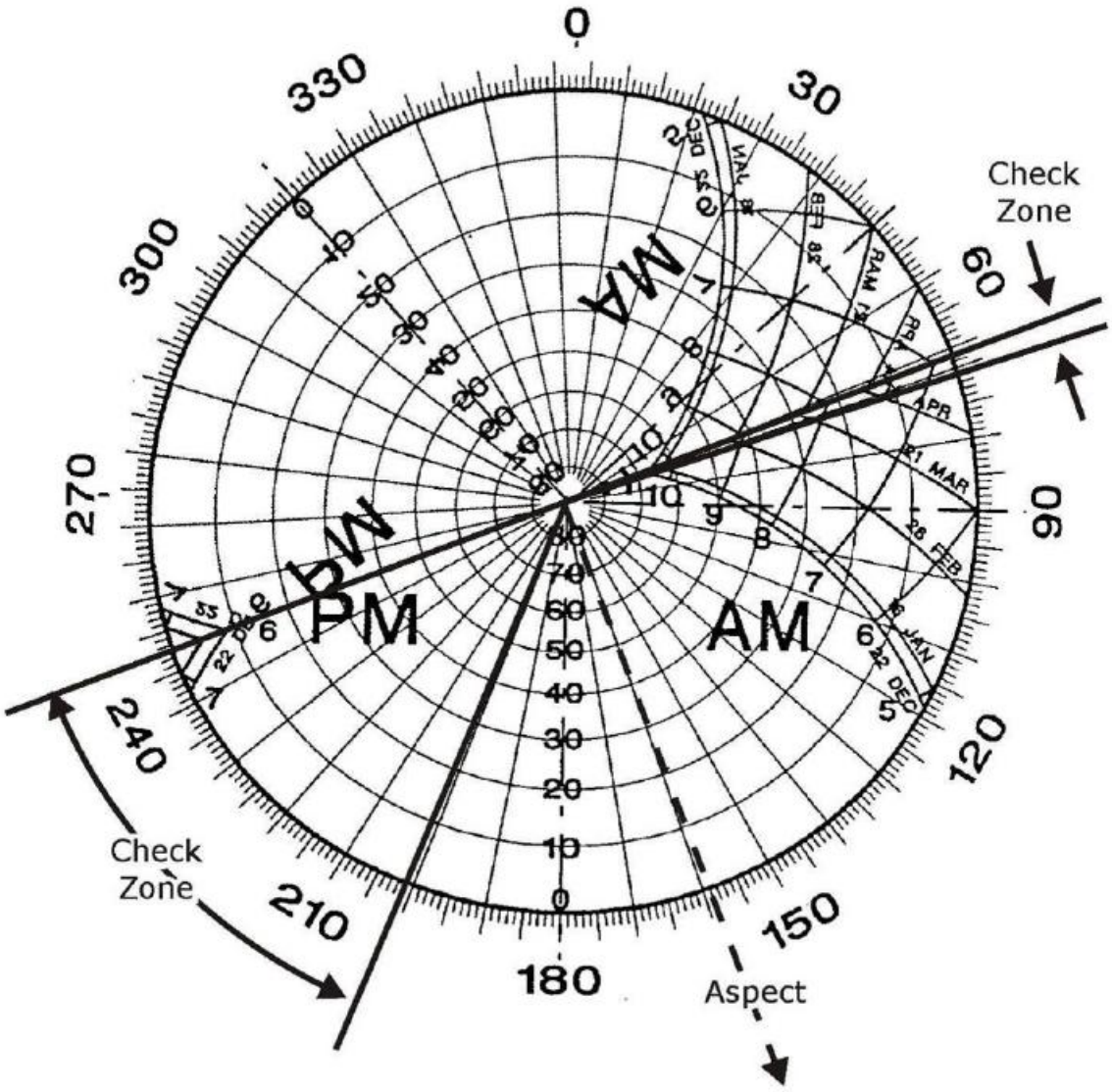

Figure B4: Sun Chart for Aspect 159°

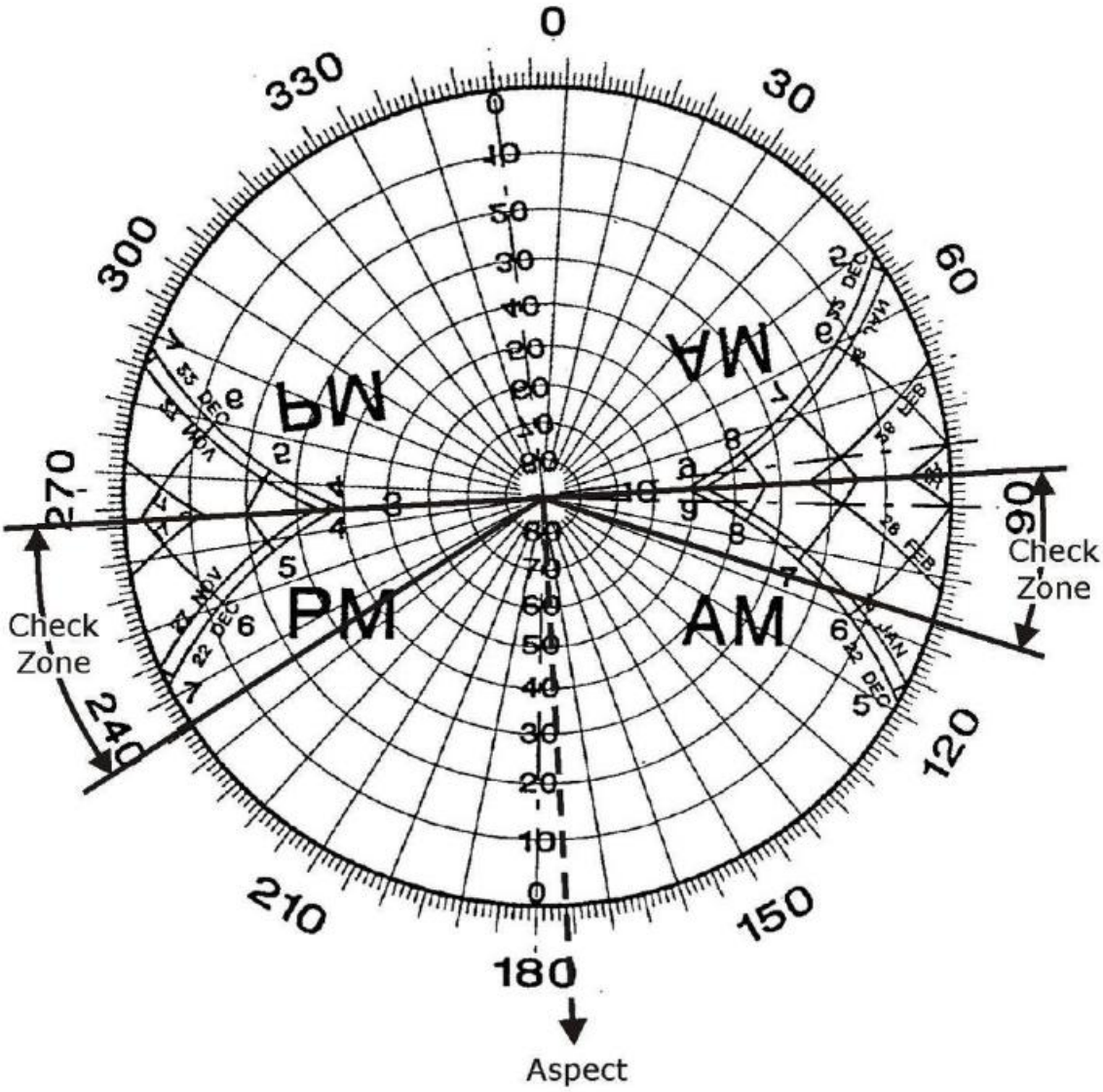

Figure B5: Sun Chart for Aspect 176°

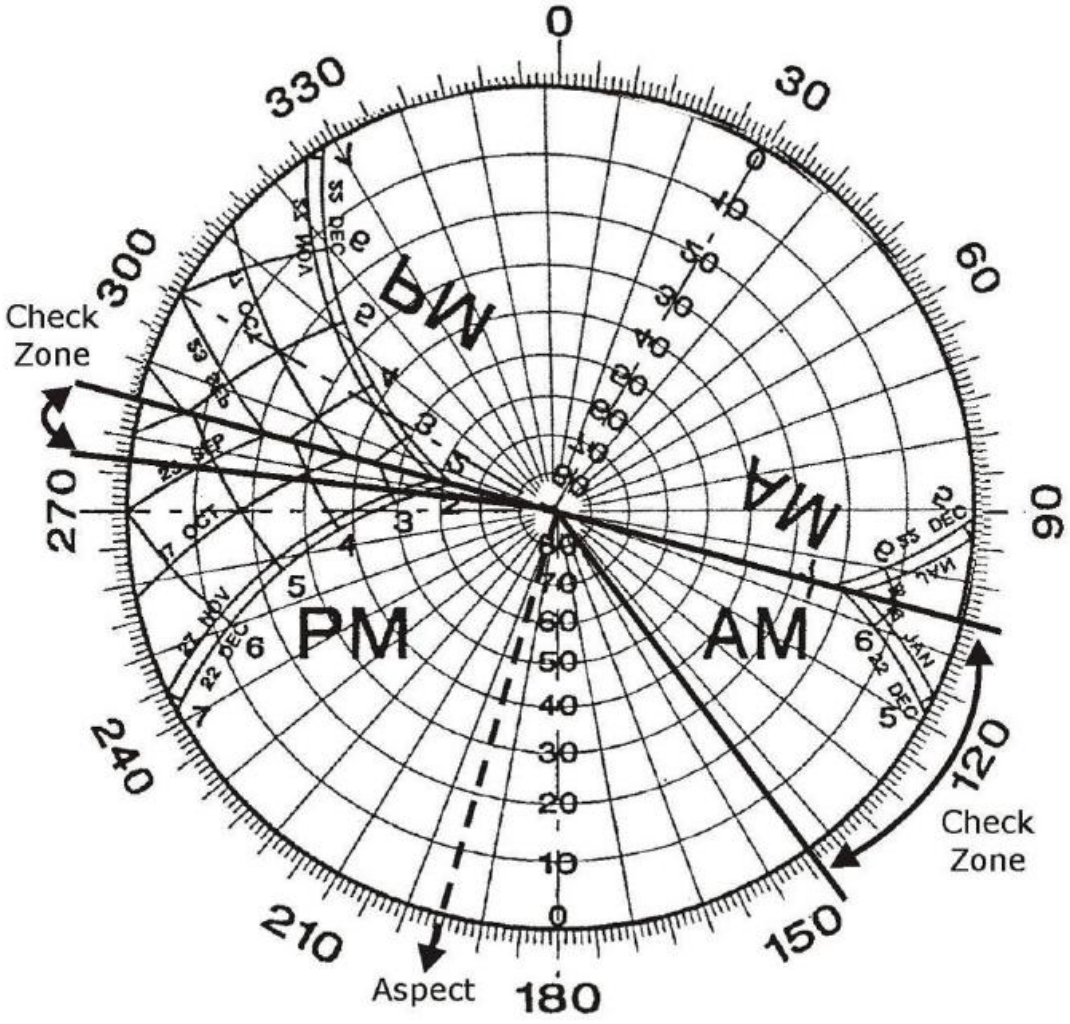

Figure B6: Sun Chart for Aspect 195°

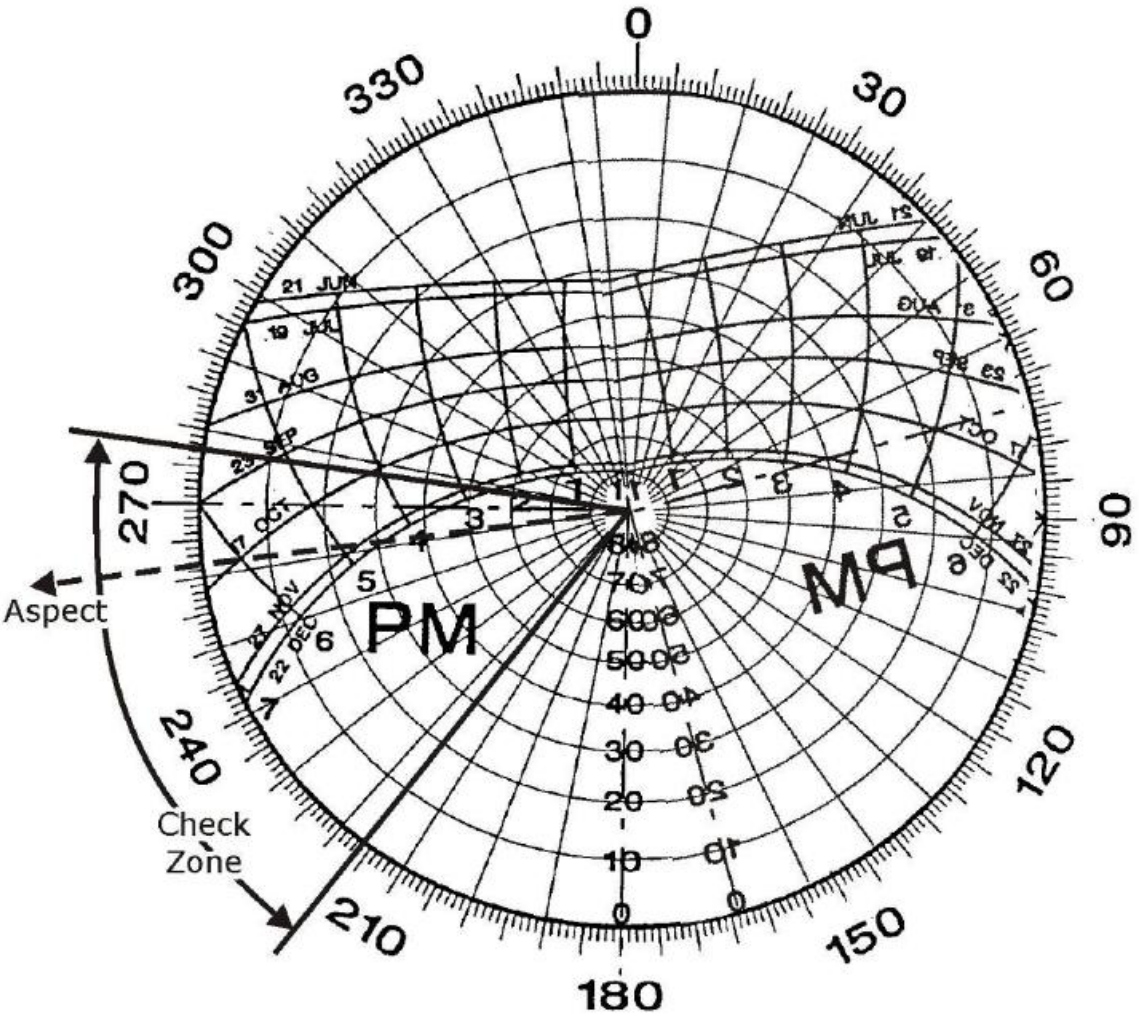

Figure B7: Sun Chart for Aspect 262°

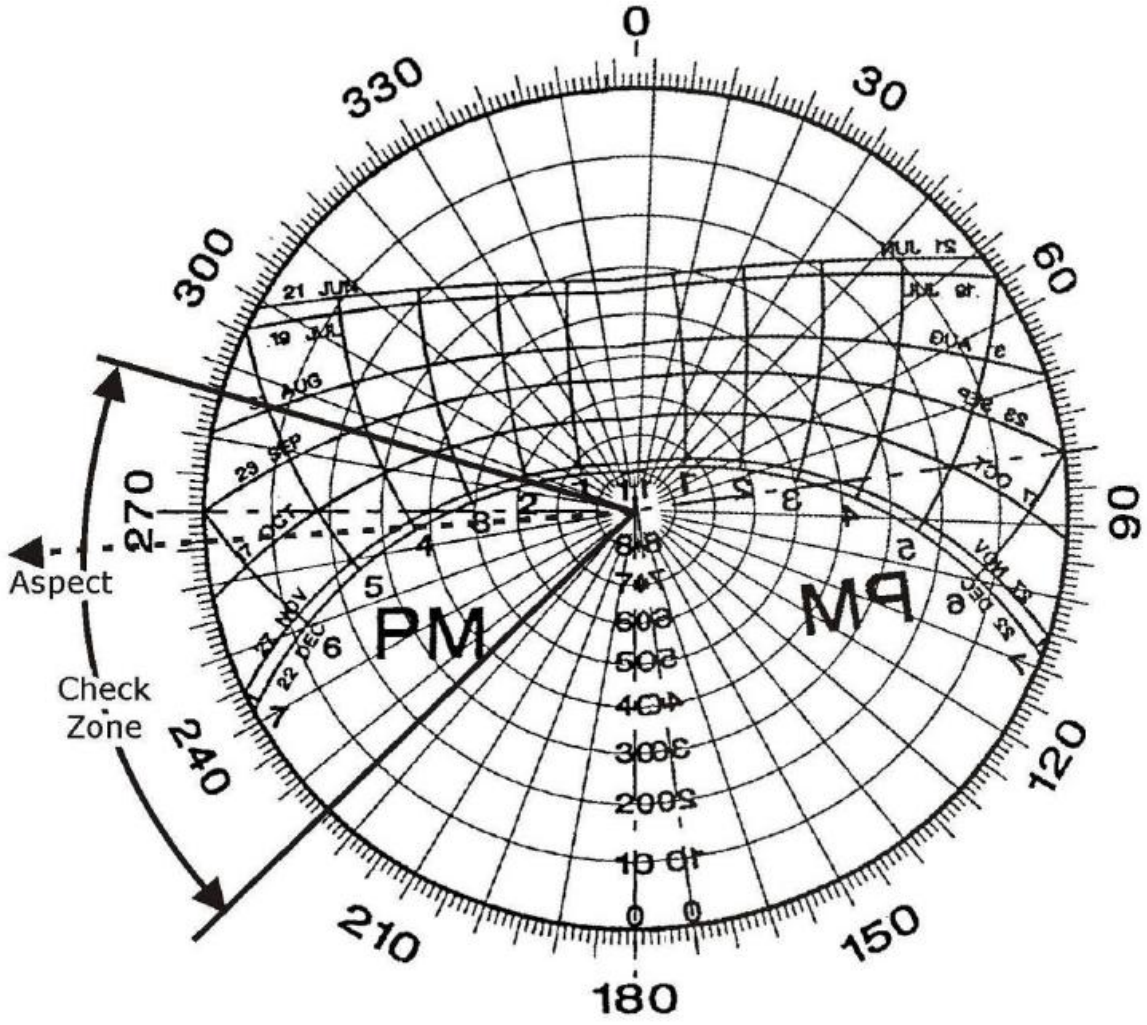

Figure B8: Sun Chart for Aspect 266°

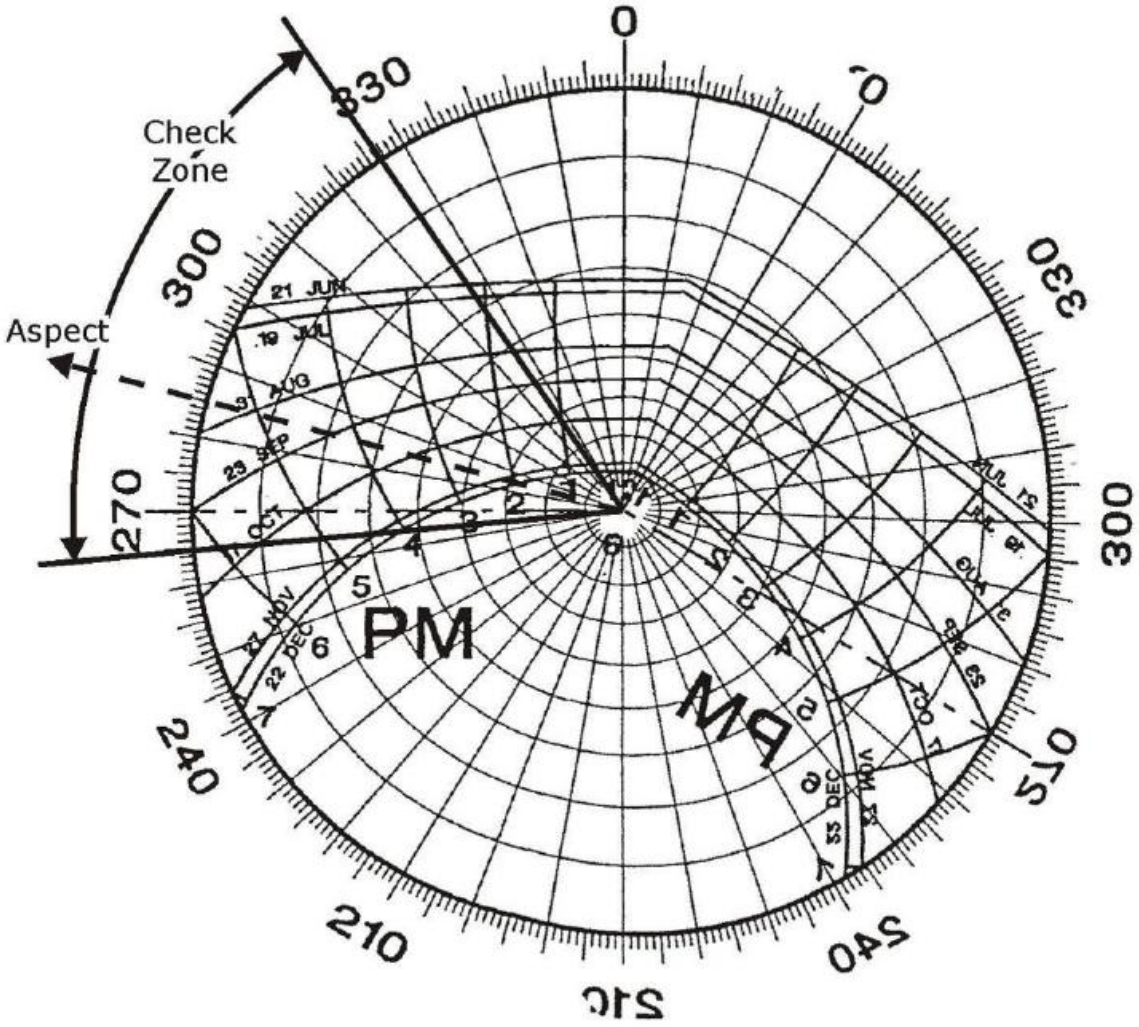

Figure B9: Sun Chart for Aspect 285°

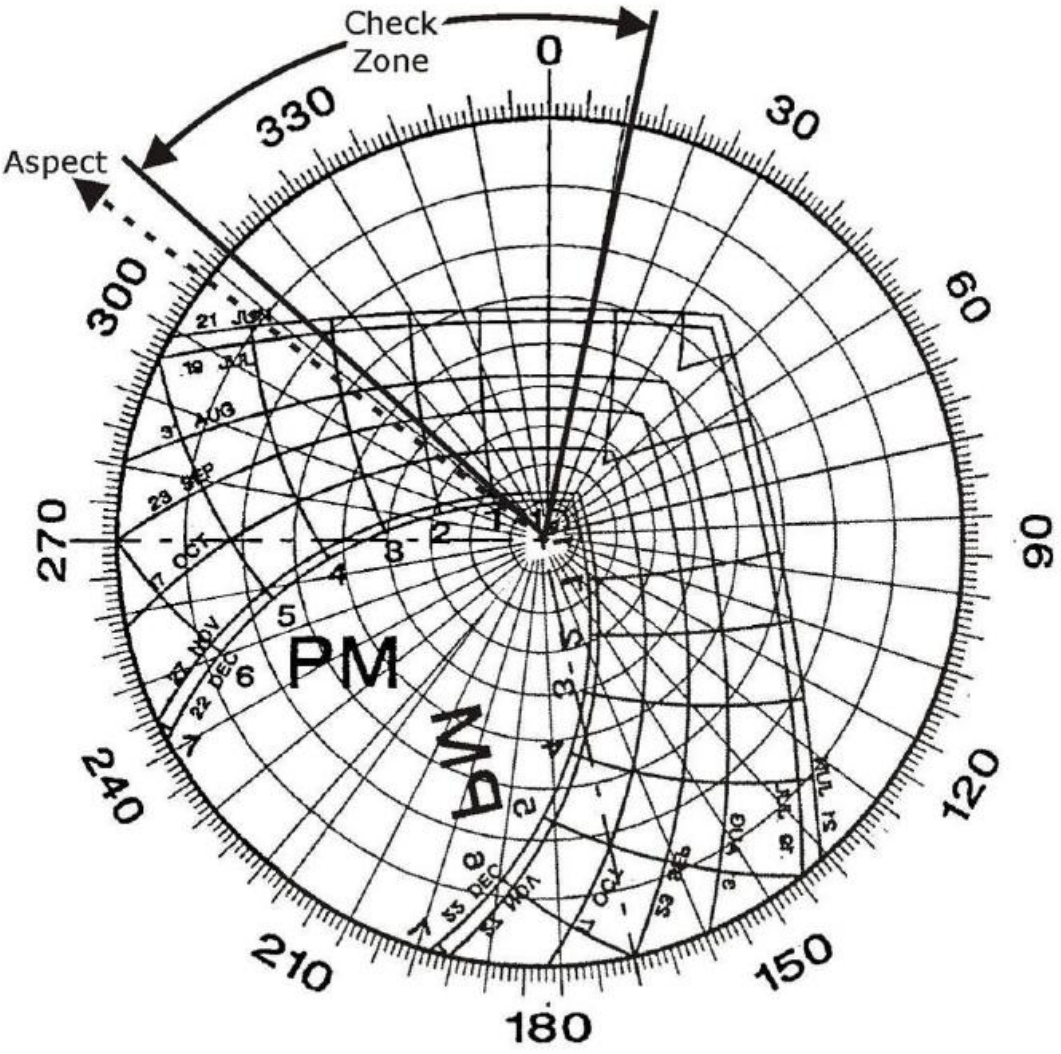

Figure B10: Sun Chart for Aspect 308°

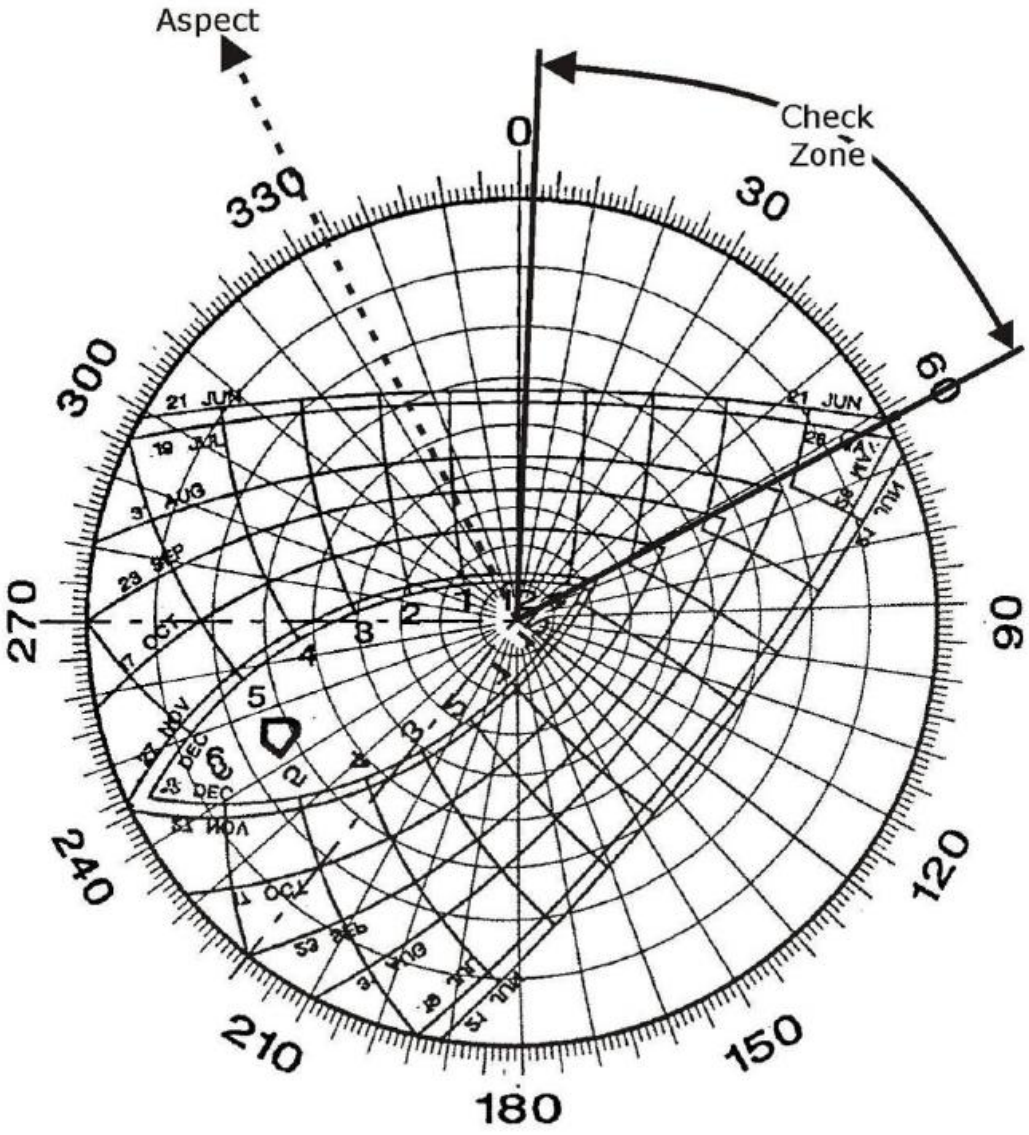

Figure B11: Sun Chart for Aspect 334°

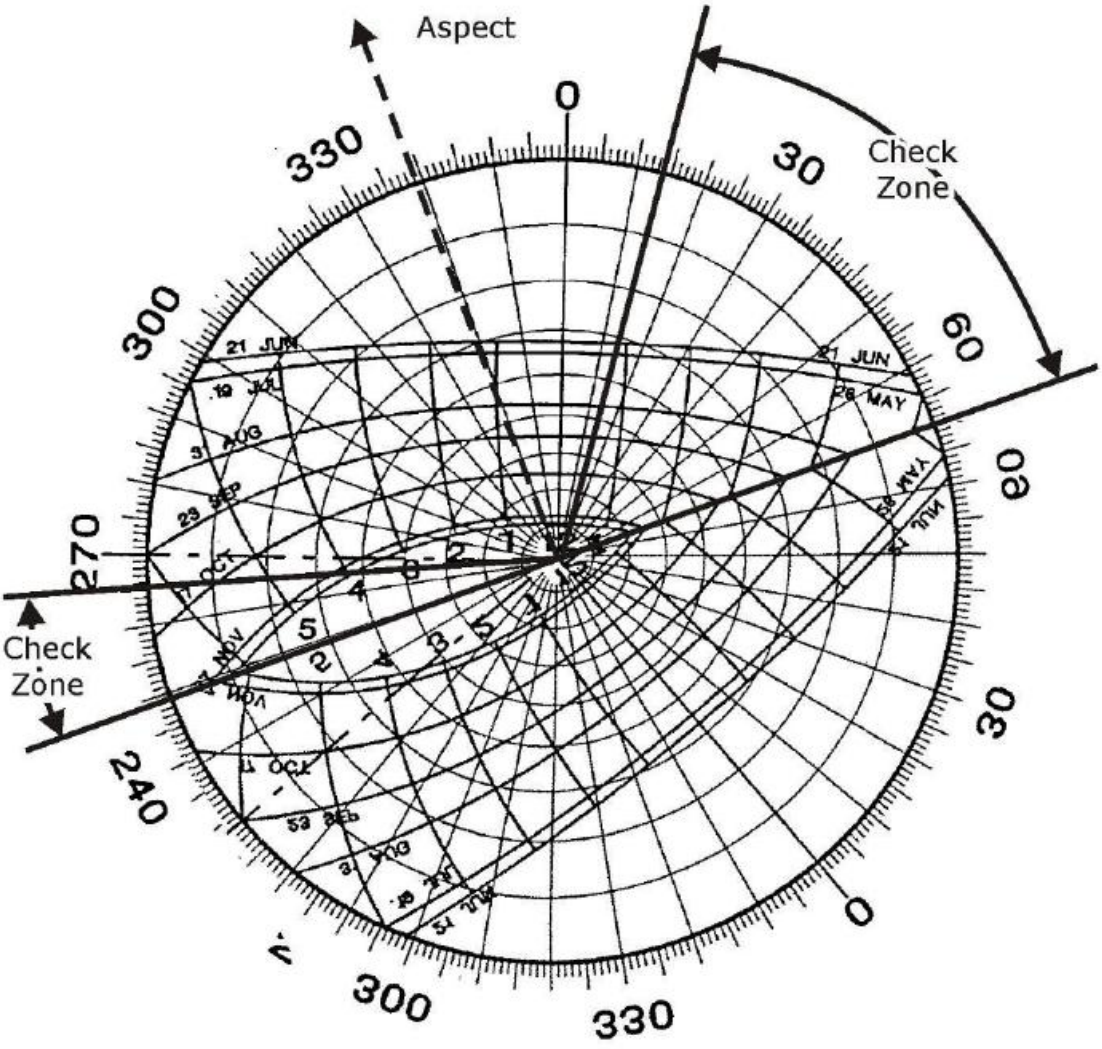

Figure B12: Sun Chart for Aspect 339°

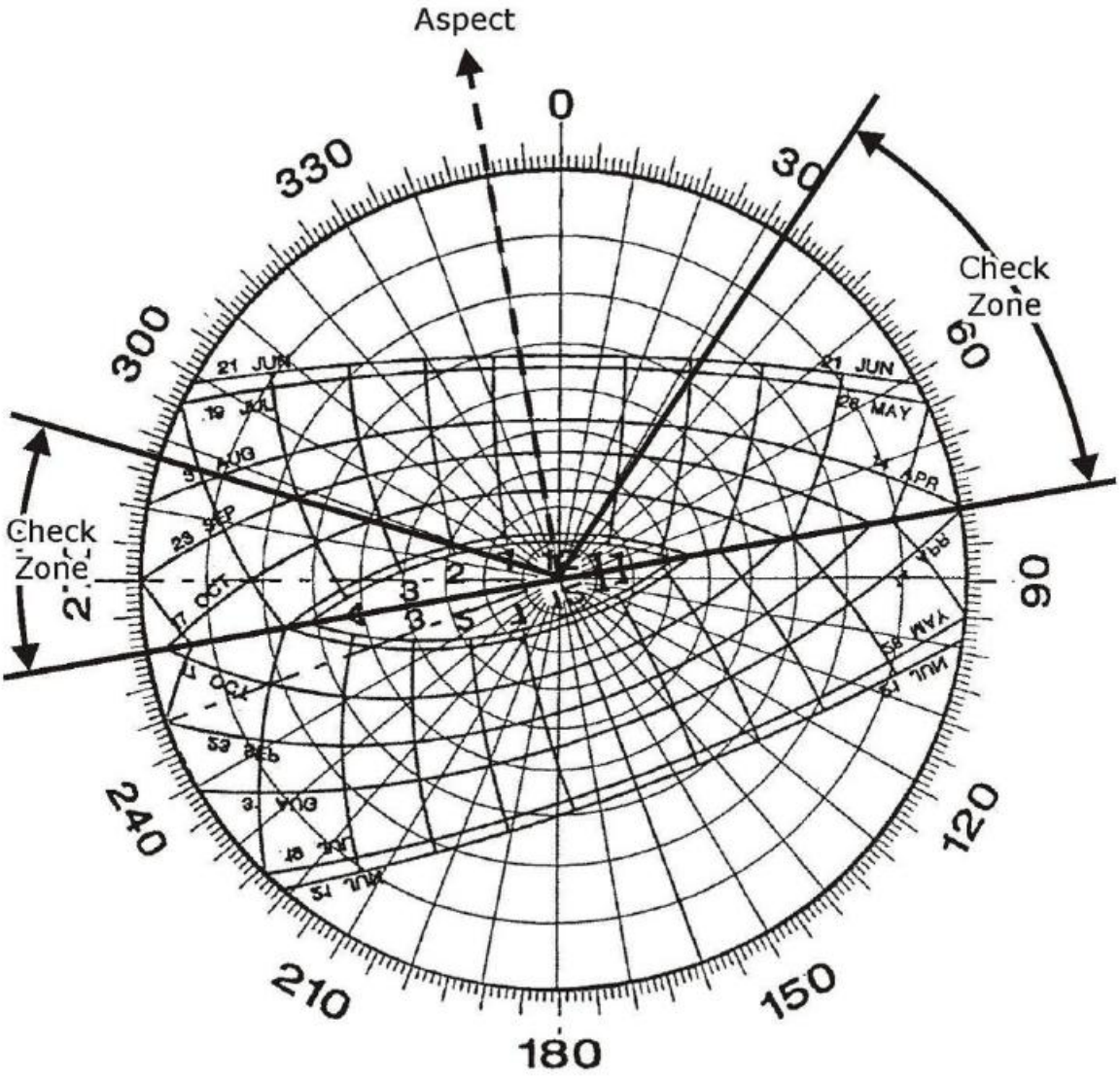

Figure B13: Sun Chart for Aspect 350°

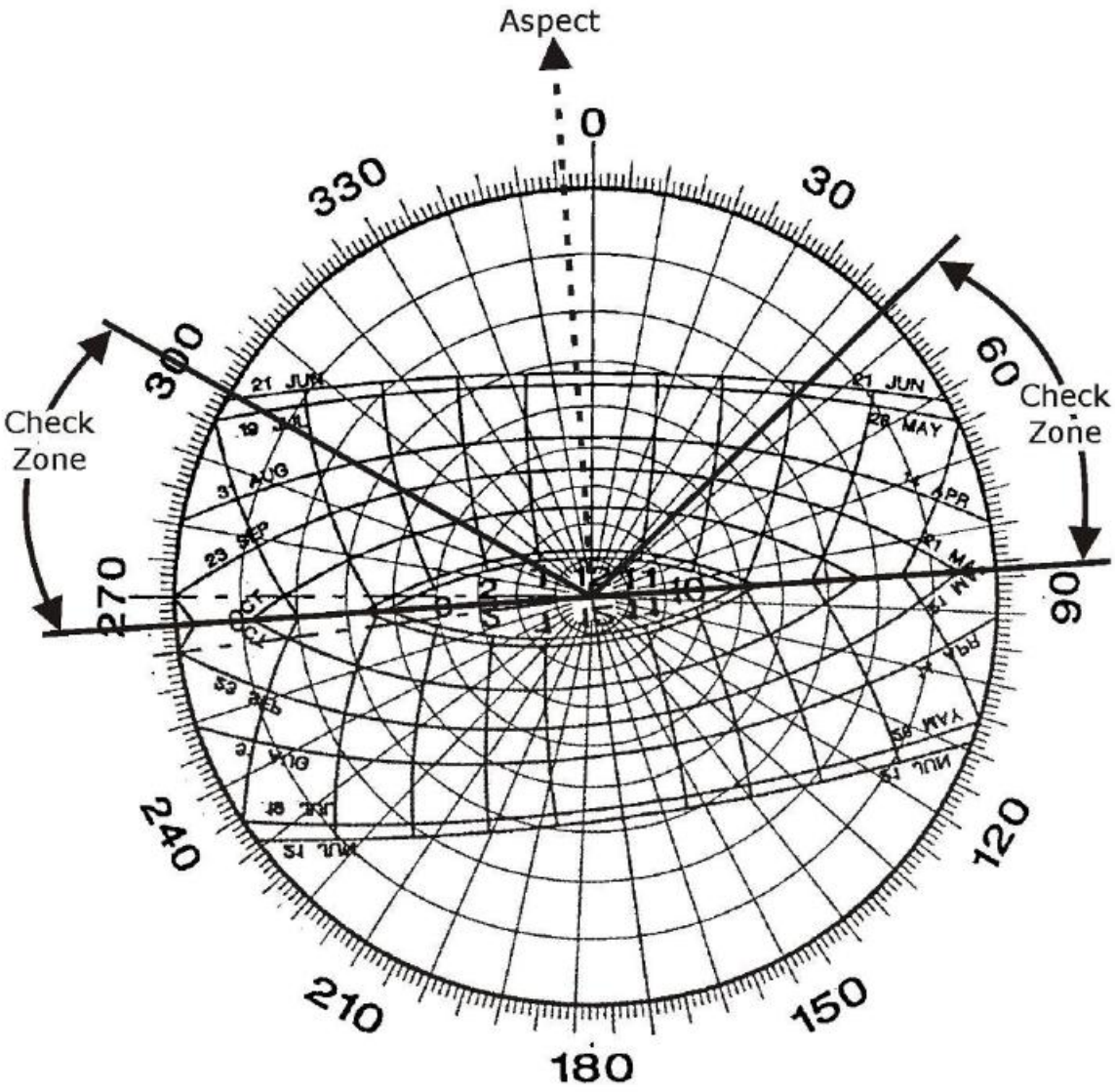

Figure B14: Sun Chart for Aspect 356°

APPENDIX C - STANDARD SUN CHART FOR SYDNEY REGION

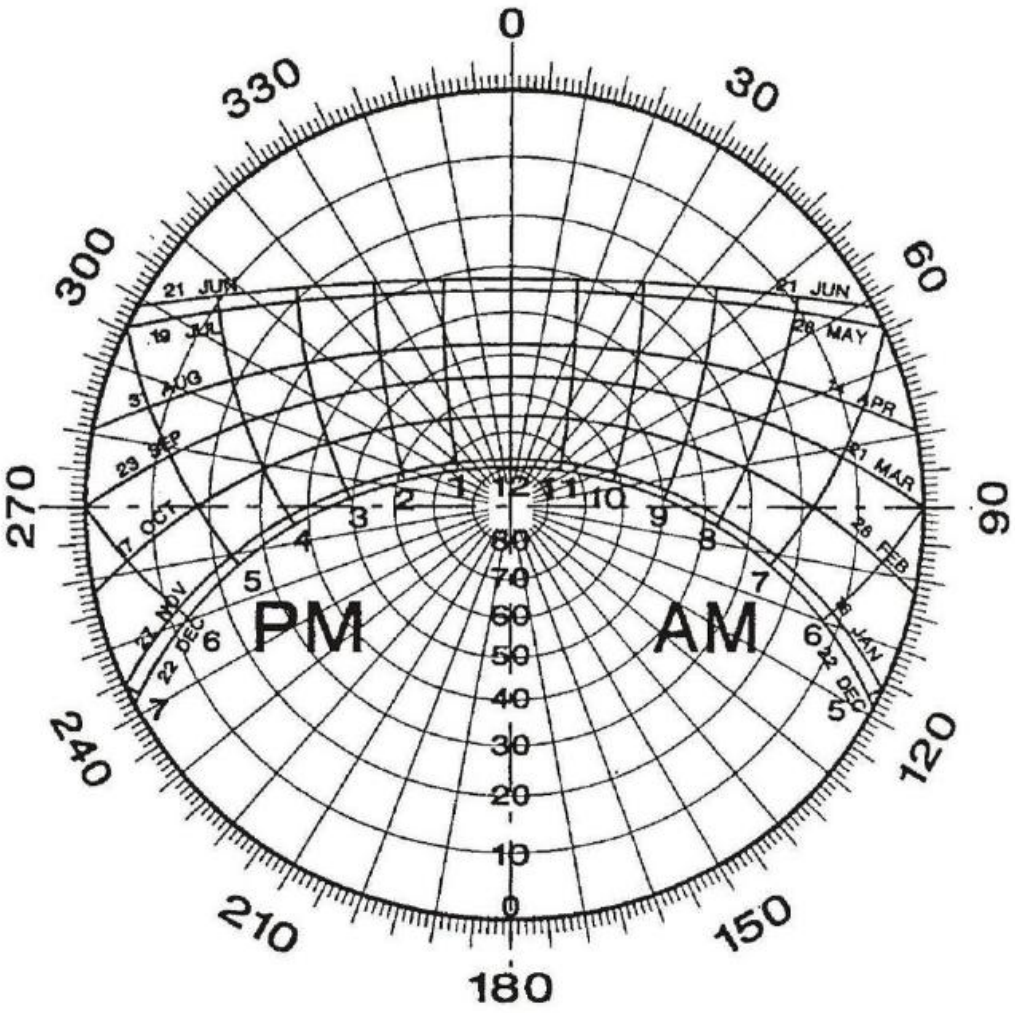

Figure C1: Standard Sun Chart for Sydney Region