

# Solar Light Reflectivity Analysis

for the proposed development known as

## Precinct 2 Pemulwuy, Redfern

December 7, 2011

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## Document Control

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## 1.0 Executive Summary

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An analysis has been undertaken to assess the potential for solar glare from the proposed development known as Precinct 2, Pemulwuy, Redfern. The analysis has been undertaken based on architectural drawings prepared by the project architects Nordon Jago Architects, dated 2<sup>nd</sup> December 2011.

With regards to solar light reflectivity, this study addresses the provisions of the Sydney Development Control Plan 2010 Section 2.1.6 "*Reflectivity*" which states:

1. Generally, light reflectivity from building materials on facades is not to exceed 20%
2. 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 results of the study indicate that to avoid any adverse glare to drivers and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the Sydney Development Control Plan 2010 Section 2.1.6 "*Reflectivity*", it is recommended that the portion of glazing on the curved aspect of the Precinct 2 development between the northern aspect and the Commercial Entrance have a maximum normal specular reflectivity of visible light of 8%. All remaining areas of the façade of the Precinct 2 development should have a maximum normal specular reflectivity of visible light of 20%.

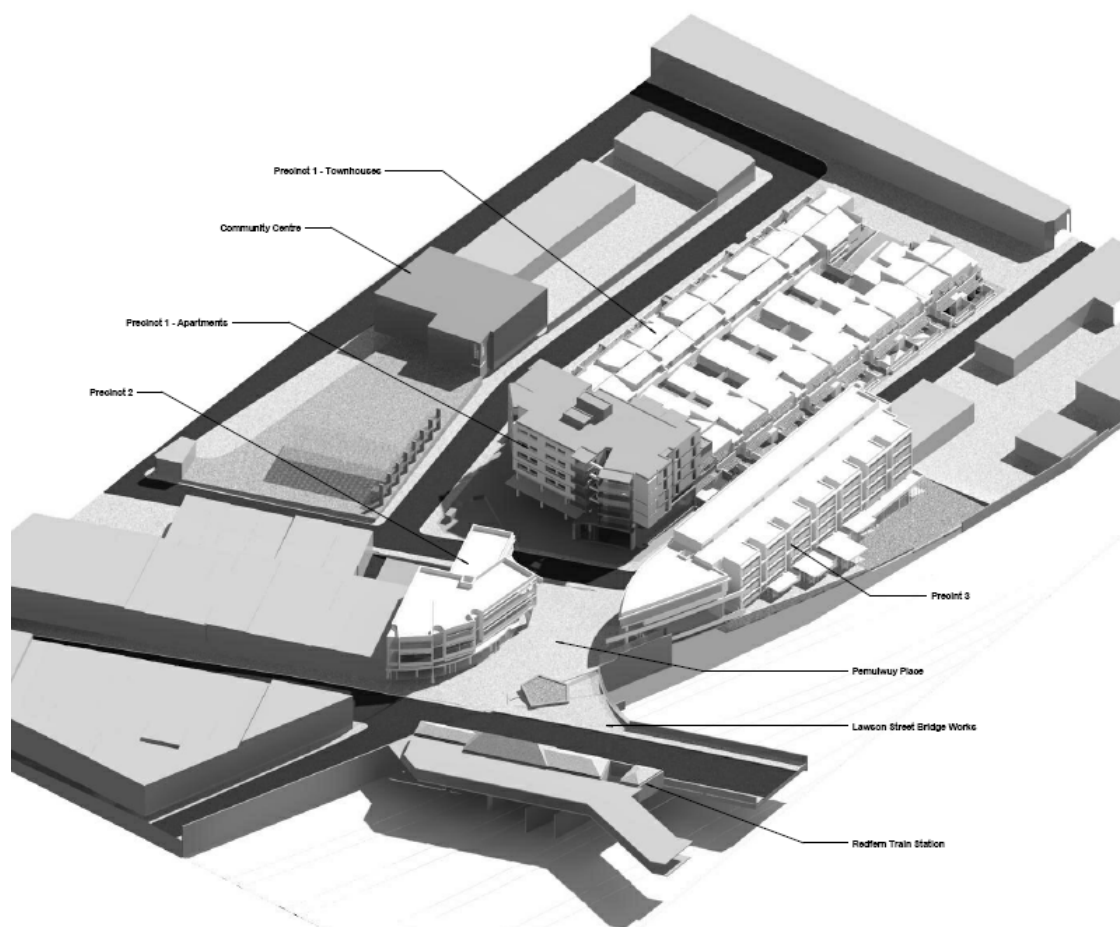
With these recommendations satisfied, the proposed Precinct 2 development will not cause adverse solar glare to vehicle drivers, train drivers or pedestrians in any of the surrounding streets and other outdoor areas. It is also expected that no adverse glare impact will result with regards to the occupants of neighbouring buildings.

## **2.0 Description of the Proposed Development and Surrounds**

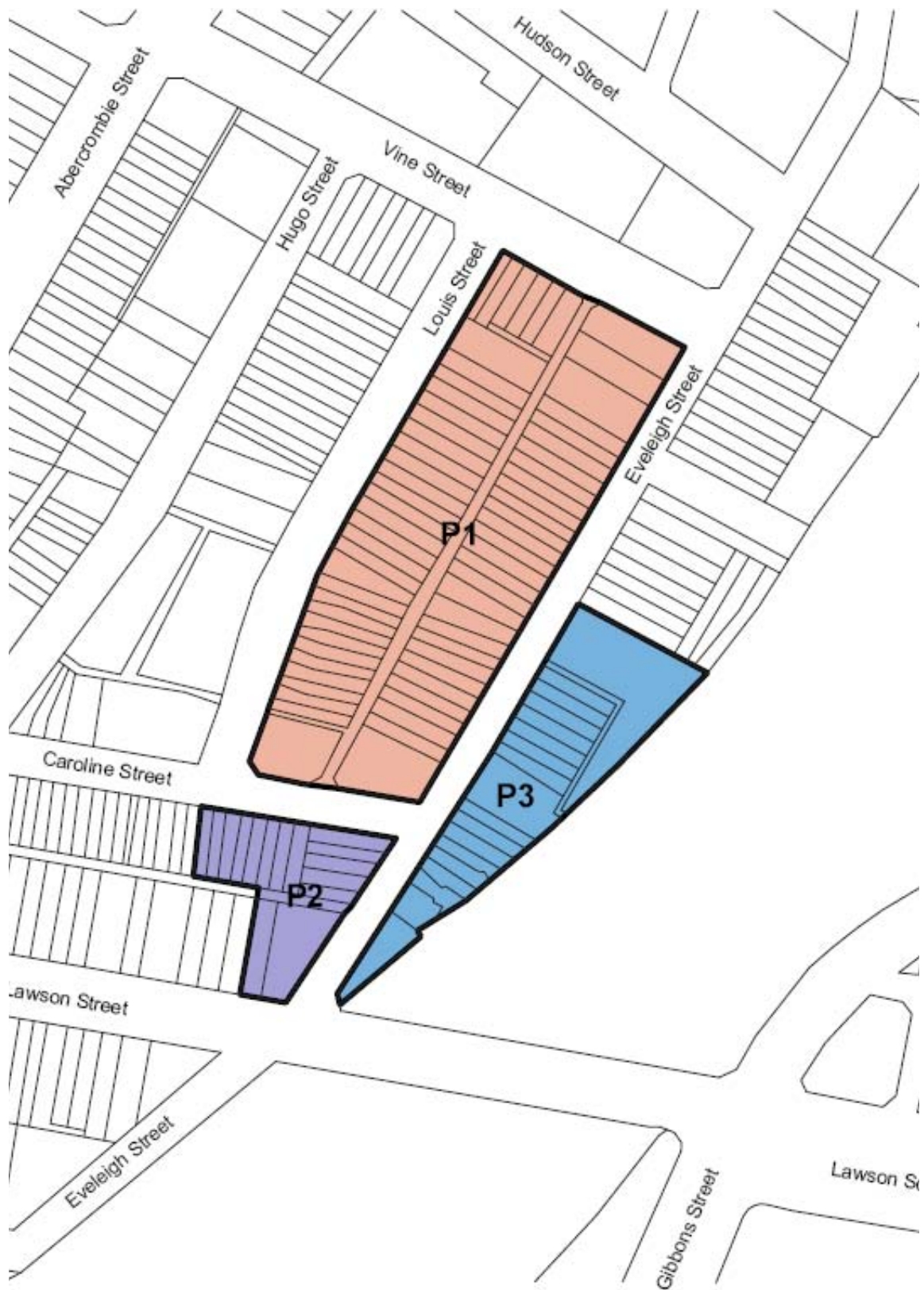
Precinct 2 of the Pemulwuy development is located within Redfern, and is bounded by Caroline Street to the North, Eveleigh Street to the east, Lawson Street to the south and existing local surrounding buildings to the west. The Precinct 2 development is one of three development precincts, with Precinct 1 located north across Caroline Street to the north and Precinct 3 located east across Eveleigh Street. The proposed Precinct 2 development is a 4 level mixed development with children's facilities on Level 1, retail on Level 2 and office space on the remaining upper levels.

The existing surrounding buildings to the south-west through north-west are between 2-3 levels in height above ground. The proposed Precinct 1 development to the north, ranges between 2 to 5 levels in height above ground. Precinct 3 to the east of the subject development is proposed to be 7 levels in height above ground.

The land gradually slopes down to the north-east and there are no major topographical changes to the further away from the site. Aerial images of the site are shown in Figures 2a to 2b.



**Figure 2a: Site Location  
(View from the South)**



**Figure 2b: Site Location  
(Aerial View)**

## 4.0 Methodology

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The reflectivity analysis of the subject development has been carried out using the technique published by Mr David N. H. Hassall (1991)<sup>1</sup>. The limiting veiling luminance of 500 candelas per square metre for the comfort of vehicle drivers, suggested in Hassall (1991) has been adopted as a basis of assessing the glare impact from the subject development. 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 aspects were determined for Precinct 2 development as shown in Figure 3. Solar charts for each of these aspects is presented in Appendix B. Check zones are then determined from the solar charts of the selected aspects. The check zones highlight the zones that are potentially affected by solar reflections from each aspect. The check zones for the subject development are shown in Figure 4. It should be noted that the check zones shown in Figure 4 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 5 of this report.

Study point locations are selected within the check zone areas where motorists are facing the general direction of the subject development. For each of the study point locations, except for the points on the railway, 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. For the points on the railway, a detailed site survey has been carried out to determine whether light can be reflected to drivers of trains.

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<sup>2</sup>.

If it is found that a section of the subject development 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 on that section of the façade of the development to ensure that solar glare will not cause discomfort or threaten the safety of motorists or pedestrians, and hence to allow the subject development to comply with Sydney Development Control Plan 2010 Section 2.1.6 *"Reflectivity"*.

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<sup>1</sup> D.N. Hassall, 1991, Reflectivity, Dealing with Rogue Solar Reflections (published by author)

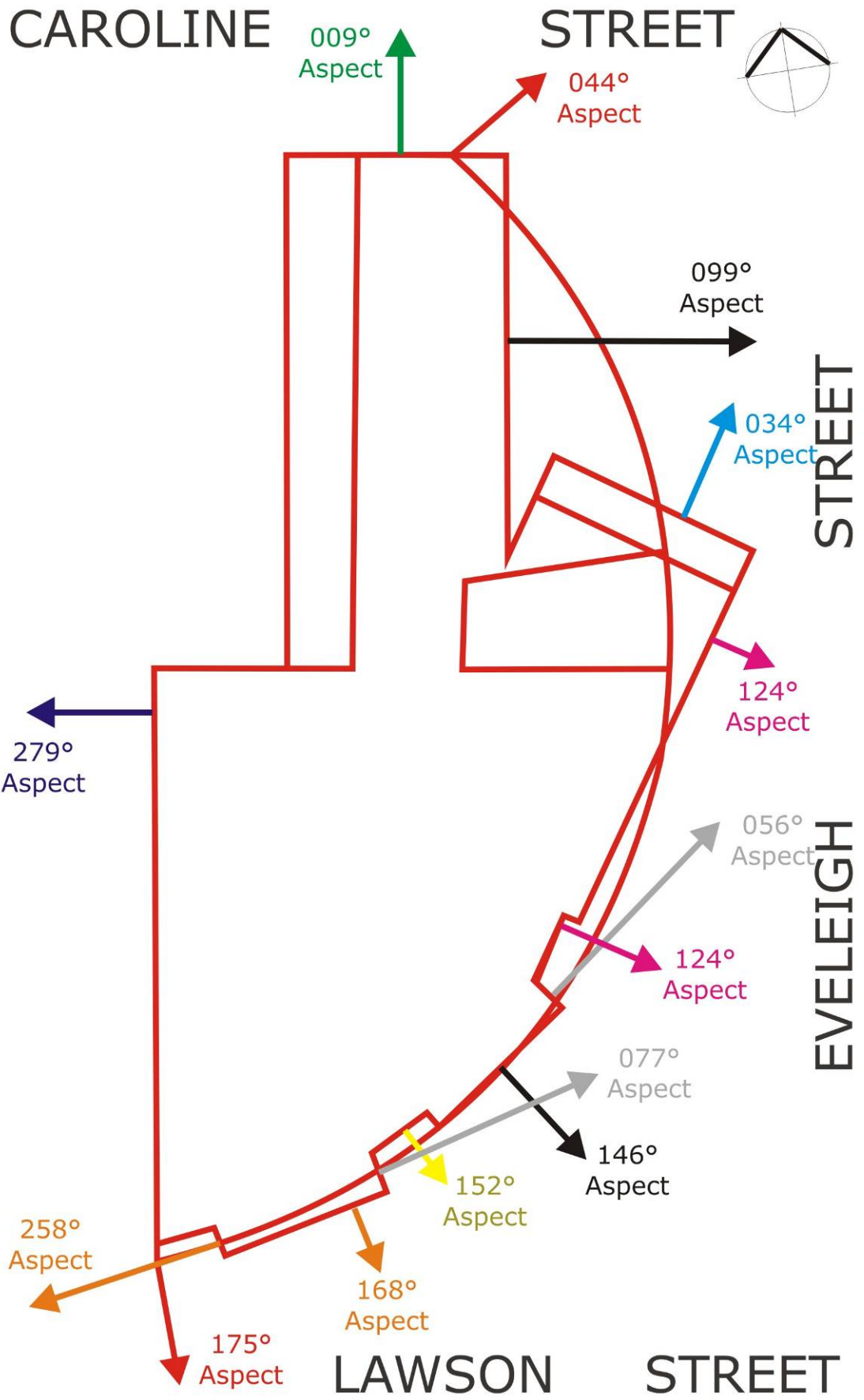


Figure 3: Critical Aspects of the Precinct 2 Development



**Figure 3: Check Zones and Layout of Study Points**

## 5.0 Analysis

### 5.1 Impact onto Drivers and Pedestrians

From the study of the check zones shown in Figure 3, a total of 17 street level locations have been identified for detailed analysis. These locations are also indicated in Figure 3. Tables 2 summarise the points which lie in each particular check zone for each aspect of the development.

**Table 2: Aspects of Precinct 2 that Affect the Study Points**

Aspects	Study Points Affected
1	056° and 077° aspects and Curved Aspect
2	077° aspect and Curved Aspect
4	099° aspect and Curved Aspect
5	099° and 124° aspects and Curved Aspect
6	099° aspect and Curved Aspect
7	056° aspect and Curved Aspect
8	056° aspect and Curved Aspect
9	056° and 077° aspects and Curved Aspect
10	034° and 056° aspects and Curved Aspect
11	124° and 146° aspects and Curved Aspect
13	009° and 279° aspects
14	009° and 279° aspects
15	279° aspect
16	124° and 146° aspects and Curved Aspect
17	124° aspect and Curved Aspect
18	077° and 056° aspects and Curved Aspect
19	077° and 056° aspects and Curved Aspect

### ***5.1.1 Drivers turning left onto Regent Street from Cleveland Street***

Point 1 is located to the north-east of the Precinct 2 development turning left onto Regent Street from Cleveland Street. This point represents a critical sightline of drivers heading south-west, and is located within the check zone for the 056° and 077° aspects and Curved Aspect of the Precinct 2 development.

A site survey of this point has been undertaken, and photograph showing the viewpoint of drivers turning left onto Regent Street from Cleveland 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 A1 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 1 indicates that the view of the Precinct 2 development is obscured by the existing densely foliating trees to the north-east of the site. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians turning left onto Regent Street from Cleveland Street at Point 1.

### ***5.1.2 Drivers heading west along Renwick Street***

Point 1 is located to the north-east of the Precinct 2 development on Renwick Street. This point represents a critical sightline of drivers heading west along Renwick Street, and is located within the check zone for the 077° aspect and Curved Aspect of the Precinct 2 development.

A site survey of this point has been undertaken, and photograph showing the viewpoint of drivers heading west along Renwick 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 A2 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 2 indicates that the view of the Precinct 2 development is obscured by the existing densely foliating trees to the north-east of the site. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians heading west along Renwick Street at Point 2.

### ***5.1.3 Drivers heading west along Redfern Street***

Points 4 and 6 are located to the south-east of the Precinct 2 development on Redfern Street, with Point 6 located closer to the development than Point 4. These points represent the critical sightlines of drivers heading west along Redfern Street, and are located within the check zones for the 099° aspect and Curved Aspect of the Precinct 2 development.

A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading west along Redfern 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 A3 and A5 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 4 indicates that the view of the 099° aspect and Curved Aspect of Precinct 2 development are either obscured or not within the zone of sensitive vision. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians heading west along Redfern Street at Point 4.

An analysis of the glare meter overlaid onto the viewpoint at Point 6 indicates that the view of the 099° aspect and Curved Aspect of Precinct 2 development are either obscured or not within the zone of sensitive vision. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians heading west along Redfern Street at Point 6.

#### ***5.1.4 Drivers heading north along Regent Street***

Point 5 is located to the south-east of the Precinct 2 development on Regent Street. This point represents a critical sightline of drivers heading north along Regent Street, and is located within the check zones for the 099° and 124° aspects and Curved Aspect of the Precinct 2 development.

A site survey of this point has been undertaken, and photograph showing the viewpoint of drivers heading north along Regent 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 A4 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 5 indicates that the view of the Precinct 2 development is obscured by existing surrounding buildings to the south-east of the site. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians facing north along Regent Street at Point 5.

#### ***5.1.5 Drivers heading south along Hart Street***

Point 7 is located to the north of the Precinct 2 development on Hart Street. This point represents a critical sightline of drivers heading south along Hart Street, and is located within the check zone for the 056° aspect and Curved Aspect of the Precinct 2 development.

A site survey of this point has been undertaken, and photograph showing the viewpoint of drivers heading south along Hart 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 A6 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 7 indicates that the view of the Precinct 2 development is obscured by existing local surrounding buildings to the north of the site. Hence there

will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians facing north along Hart Street at Point 7.

### ***5.1.6 Drivers heading south-west along Eveleigh Street***

Points 8 and 9 are located to the north-east of the Precinct 2 development on Eveleigh Street, with Point 9 located further along Eveleigh Street than Point 8. These points represent the critical sightlines of drivers heading south-west along Eveleigh Street. Point 8 is located within the check zones for the 056° aspect and Curved Aspect of the Precinct 2 development. Point 9 is located within the check zones for 056° and 077° aspects and Curved Aspect of the Precinct 2 development.

A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading south-west along Eveleigh 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 A7 and A8 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 8 indicates that a portion of the Curved Aspect of the Precinct 2 development is within the zone of sensitive vision. It is recommended that this portion of glazing on the curved aspect between the northern aspect and the Commercial entrance have a maximum normal specular reflectivity of visible light of 8%. With this recommendation taken into consideration adverse glare will not be reflected from the Precinct 2 development to divers and pedestrians facing south-west on Eveleigh Street at Point 8.

An analysis of the glare meter overlaid onto the viewpoint at Point 9 indicates that a negligible portion of the Curved Aspect of the Precinct 2 development is within the zone of sensitive vision hence adverse glare will not be reflected from the Precinct 2 development to divers and pedestrians facing south on Eveleigh Street at Point 9.

### ***5.1.7 Drivers heading south-west along Louis Street***

Point 10 is located to the west of the Precinct 2 development on Louis Street. This point represents a critical sightline of drivers heading south-west along Louis Street, and is located within the check zones for the 034° and 056° aspects and Curved Aspect of the Precinct 2 development.

A site survey of this point has been undertaken, and photograph showing the viewpoint of drivers heading south-west along Louis 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 A9 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 10 indicates that no part of the Precinct 2 development falls within the zone of sensitive vision. Hence there will be no adverse glare reflected from the

Precinct 2 development to drivers and pedestrians facing south-west along Louis Street at Point 10.

### ***5.1.8 Drivers heading north-east along Eveleigh Street***

Point 11 is located to the south-east of the Precinct 2 development on Eveleigh Street. This point represents a critical sightline of drivers heading north-east along Eveleigh Street, and is located within the check zones for the 124° and 146° aspects and Curved Aspect of the Precinct 2 development.

A site survey of this point has been undertaken, and photograph showing the viewpoint of drivers heading north-east along Eveleigh 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 A10 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 11 indicates that no part of the Precinct 2 development falls within the zone of sensitive vision. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians facing north-east along Eveleigh Street at Point 11.

### ***5.1.9 Drivers heading east along Caroline Street***

Points 13 and 14 are located to the north-east of the Precinct 2 development on Caroline Street, with Point 14 located further along Caroline Street than Point 13. These points represent the critical sightlines of drivers heading east along Caroline Street. Points 13 and 14 are located within the check zones for the 009° and 279° aspects of the Precinct 2 development.

A site survey of these points has been undertaken, and photographs showing the viewpoint of drivers heading east along Caroline 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 A11 and A12 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 13 indicates that the view of the Precinct 2 development is obscured by existing surrounding buildings and densely foliation trees to the north-west of the site. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians facing east along Caroline Street at Point 13.

An analysis of the glare meter overlaid onto the viewpoint at Point 14 indicates that no part of the Precinct 2 development falls within the zone of sensitive vision. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians facing east along Caroline Street at Point 14.

### ***5.1.8 Drivers heading east along Lawson Street***

Point 15 is located to the south-west of the Precinct 2 development on Lawson Street. This point represents a critical sightline of drivers heading east along Lawson Street, and is located within the check zone for the 279° aspect and the Curved Aspect of the Precinct 2 development.

A site survey of this point has been undertaken, and photograph showing the viewpoint of drivers heading east along Lawson 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 A13 of Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 15 indicates that the view of the Precinct 2 development is obscured by existing surrounding buildings to the west of the site. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers and pedestrians facing east along Lawson Street at Point 15.

### ***5.1.9 Drivers of Trains***

Points 16 and 17 are located to the south of the Precinct 2 development. The points represent critical sightlines of train drivers heading north-east along the railway. Point 16 is located within the 124° and 146° aspects and Curved Aspect of the Precinct 2 development. Point 17 is located within the 124° aspect and Curved Aspect of the Precinct 2 development. For both Points 16 and 17, the view of the proposed Precinct 2 development would be obscured by Redfern Station. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers of trains facing north-east along the railway at Points 16 and 17.

Points 18 and 19 are located to the south of the Precinct 2 development. The points represent critical sightlines of train drivers heading south-west along the railway. Points 18 and 19 are located within the 077° and 056° aspects and Curved Aspect of the Precinct 2 development. For both Points 18 and 19, the view of the proposed Precinct 2 development would be obscured by the Precinct 3 development. Hence there will be no adverse glare reflected from the Precinct 2 development to drivers of trains facing south-west along the railway at Points 18 and 19.

## 5.2 Occupants of Neighbouring Buildings

Our past experience involving more than 200 projects, and also research by Rofail and Dowdle (2004)<sup>2</sup>, 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 Section 5.8 of the City of Sydney Development Control Plan 2011 for the Harold Park Precinct.

Hence, a general recommendation is made that all glazing used on the facades of the subject development have a maximum normal specular reflectivity of visible light of 20% to avoid adverse solar glare to occupants of neighbouring buildings, and to comply with Section 5.8 of the City of Sydney Development Control Plan 2011 for the Harold Park Precinct.

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

## 6.0 Conclusion

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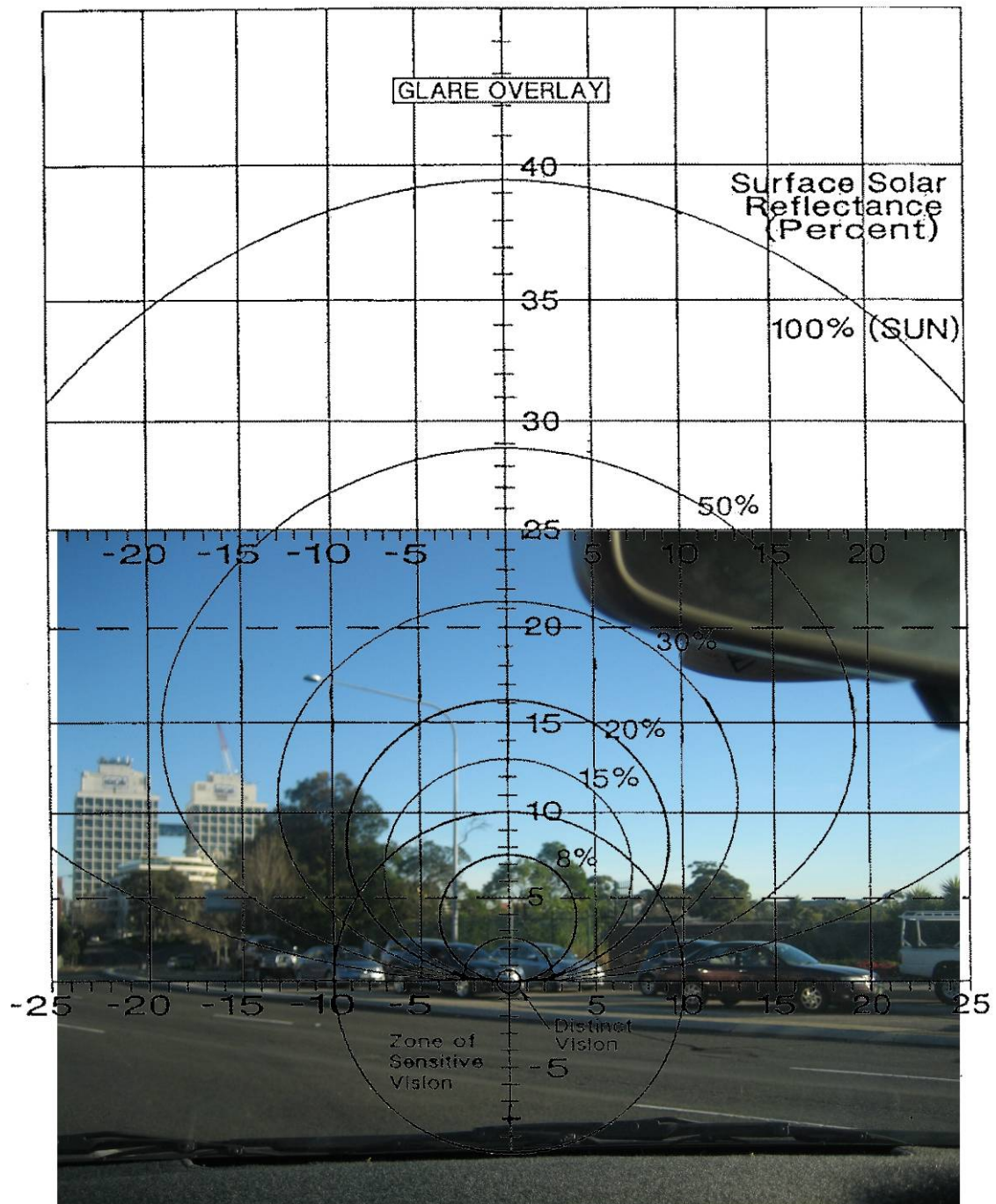
An analysis has been undertaken to assess the potential for solar glare from the proposed development known as Precinct 2, Pemulwuy, Redfern. The analysis has been undertaken based on architectural drawings prepared by the project architects Nordon Jago Architects, dated 2<sup>nd</sup> December 2011.

The results of the study indicate that to avoid any adverse glare to drivers and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the Sydney Development Control Plan 2010 Section 2.1.6 "*Reflectivity*", it is recommended that the portion of glazing on the curved aspect of the Precinct 2 development between the northern aspect and the Commercial Entrance have a maximum normal specular reflectivity of visible light of 8%. All remaining areas of the façade of the Precinct 2 development should have a maximum normal specular reflectivity of visible light of 20%.

With these recommendations satisfied, the proposed Precinct 2 development will not cause adverse solar glare to vehicle drivers, train drivers or pedestrians in any of the surrounding streets and other outdoor areas. It is also expected that no adverse glare impact will result with regards to the occupants of neighbouring buildings.

# **Appendix A**

Analysis of Sight-Lines from the  
Various Study Locations



**Figure A1: Glare Overlay for Point 1**

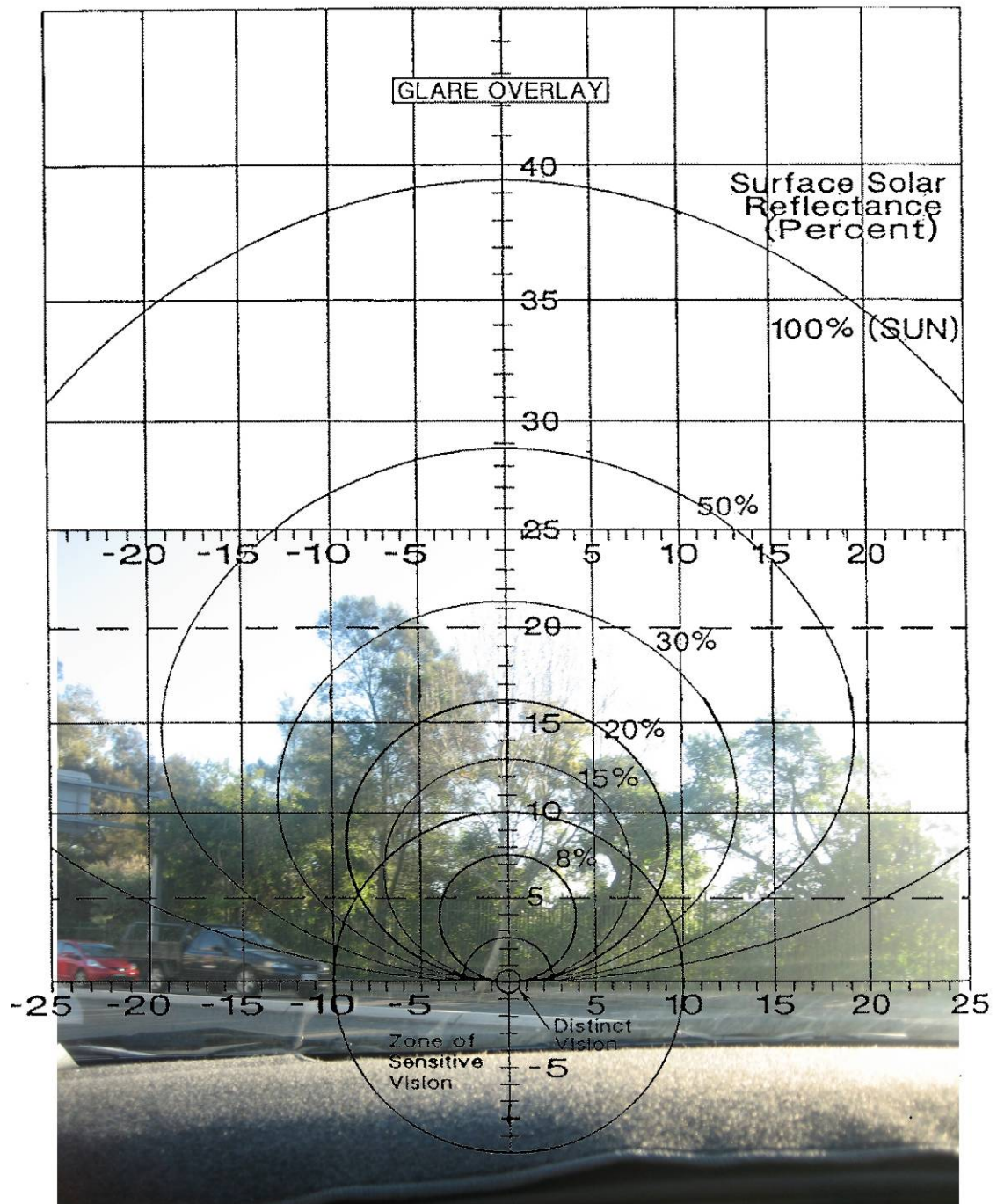


Figure A2: Glare Overlay for Point 2

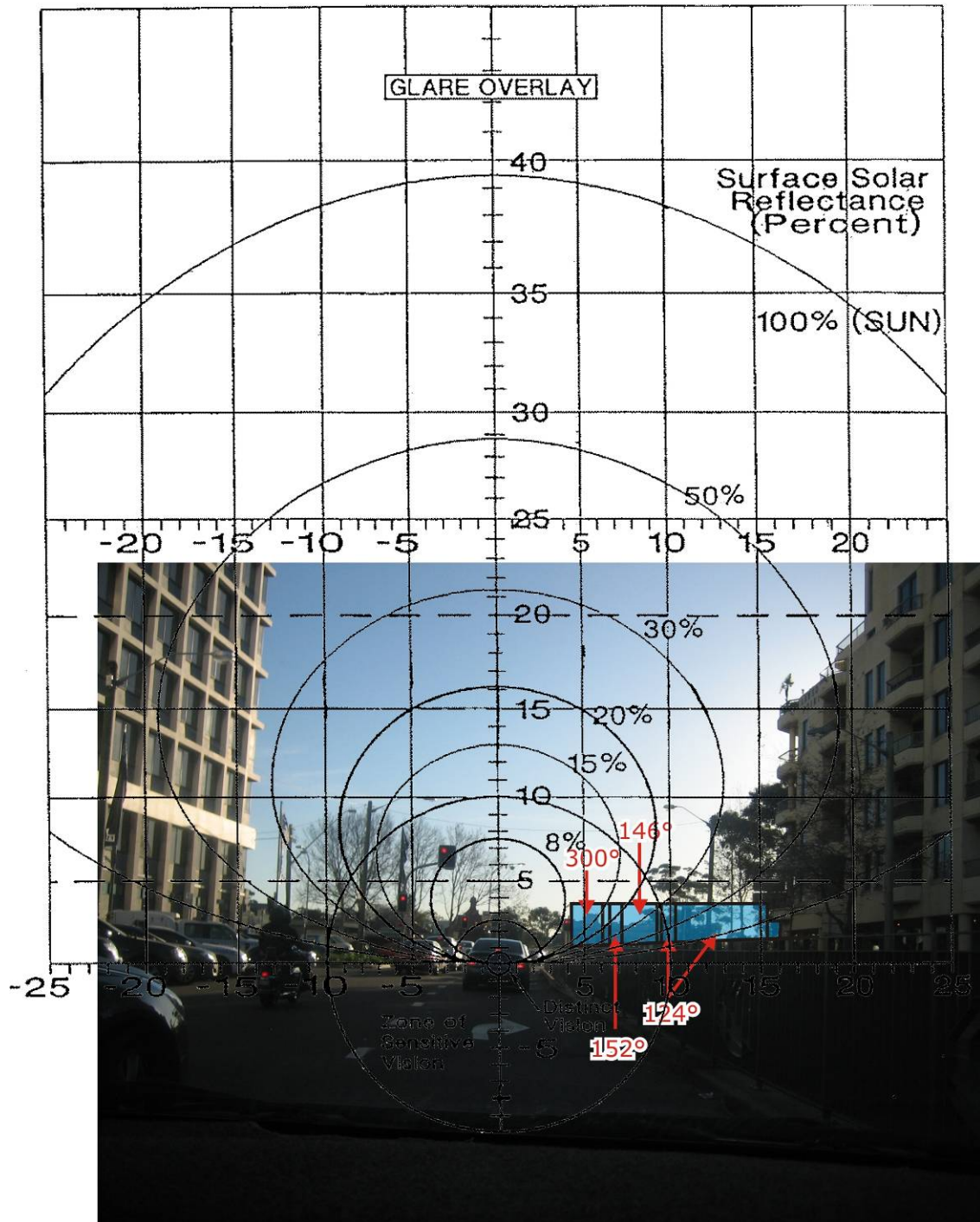
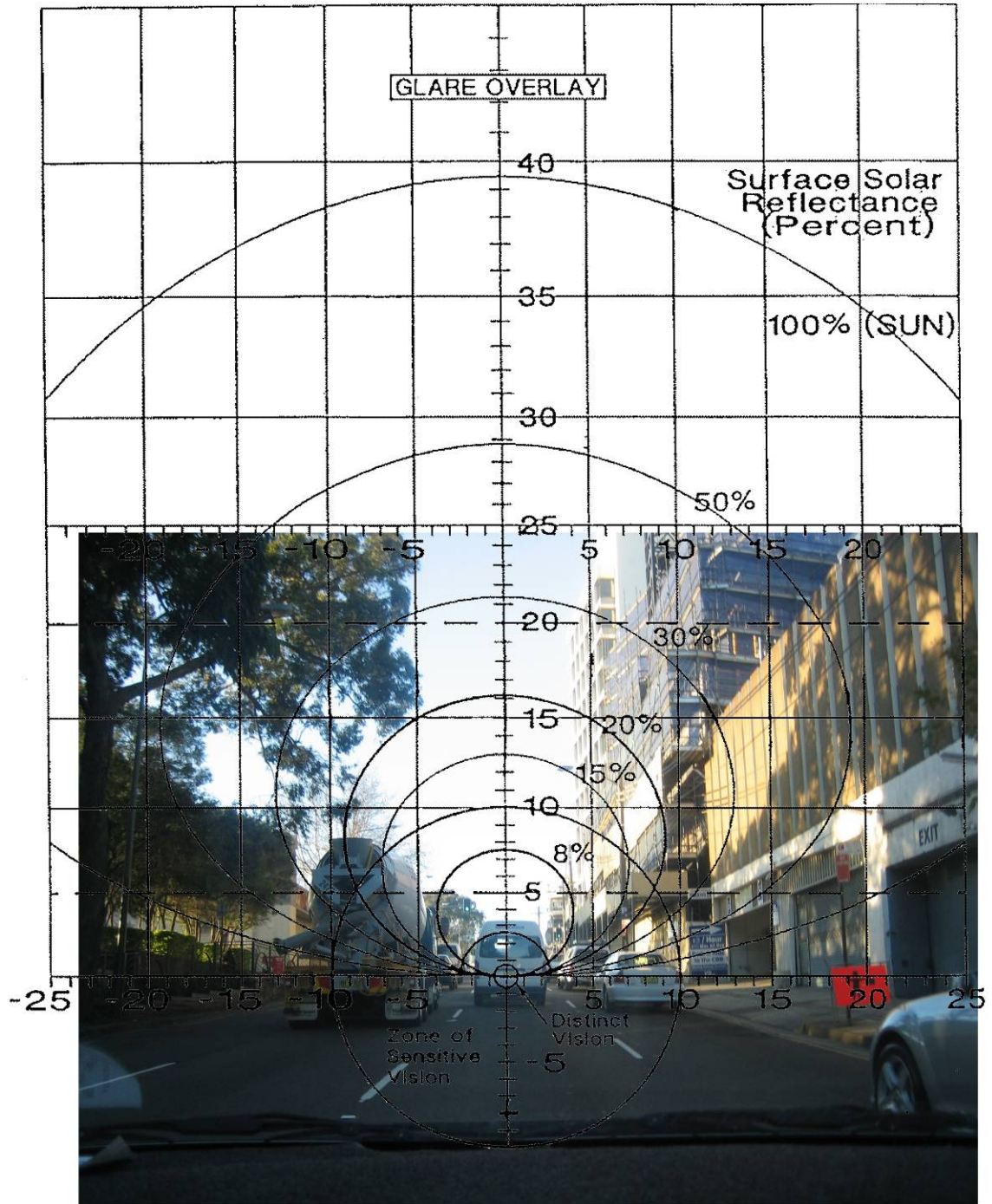


Figure A3: Glare Overlay for Point 4



**Figure A4: Glare Overlay for Point 5**

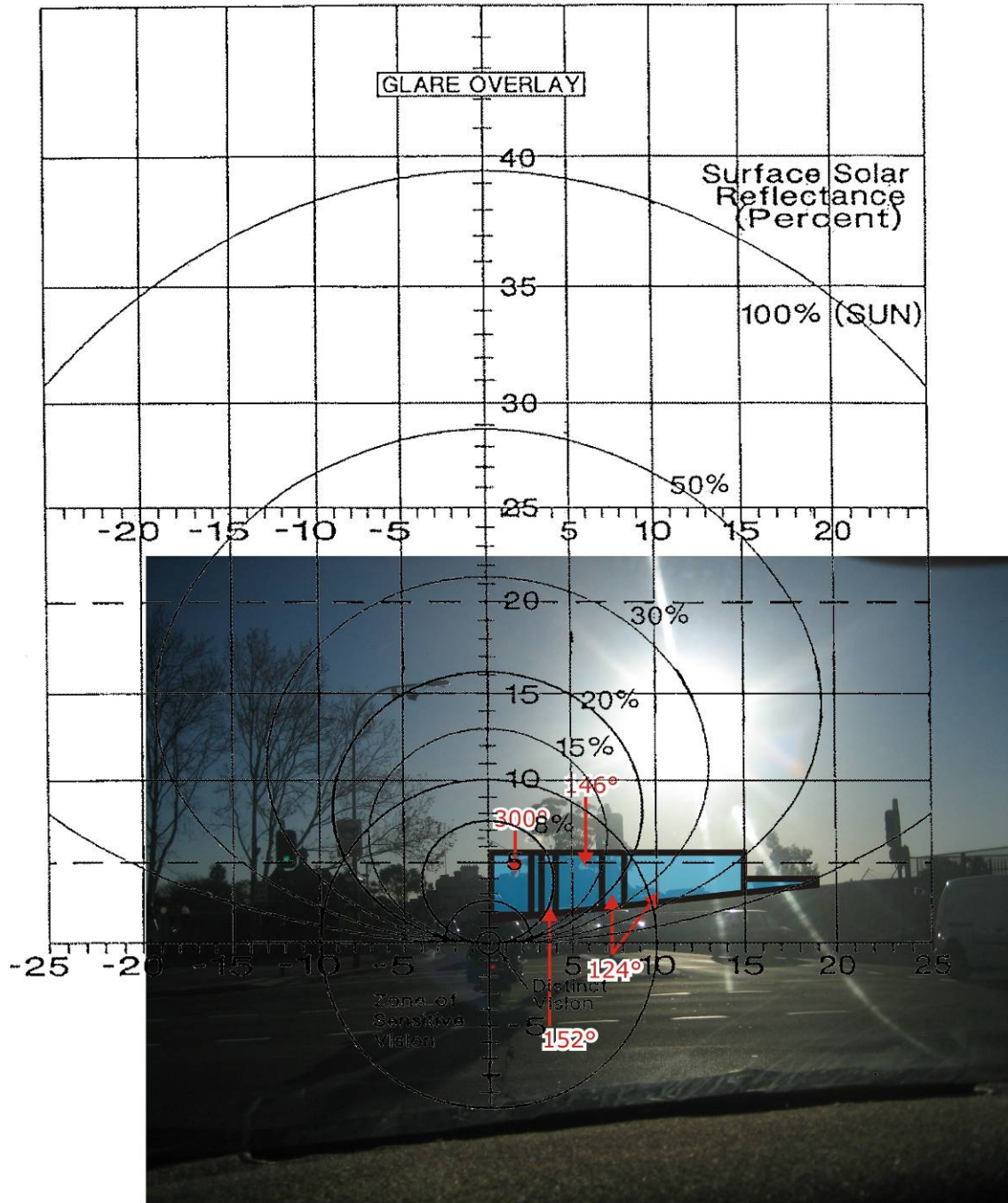
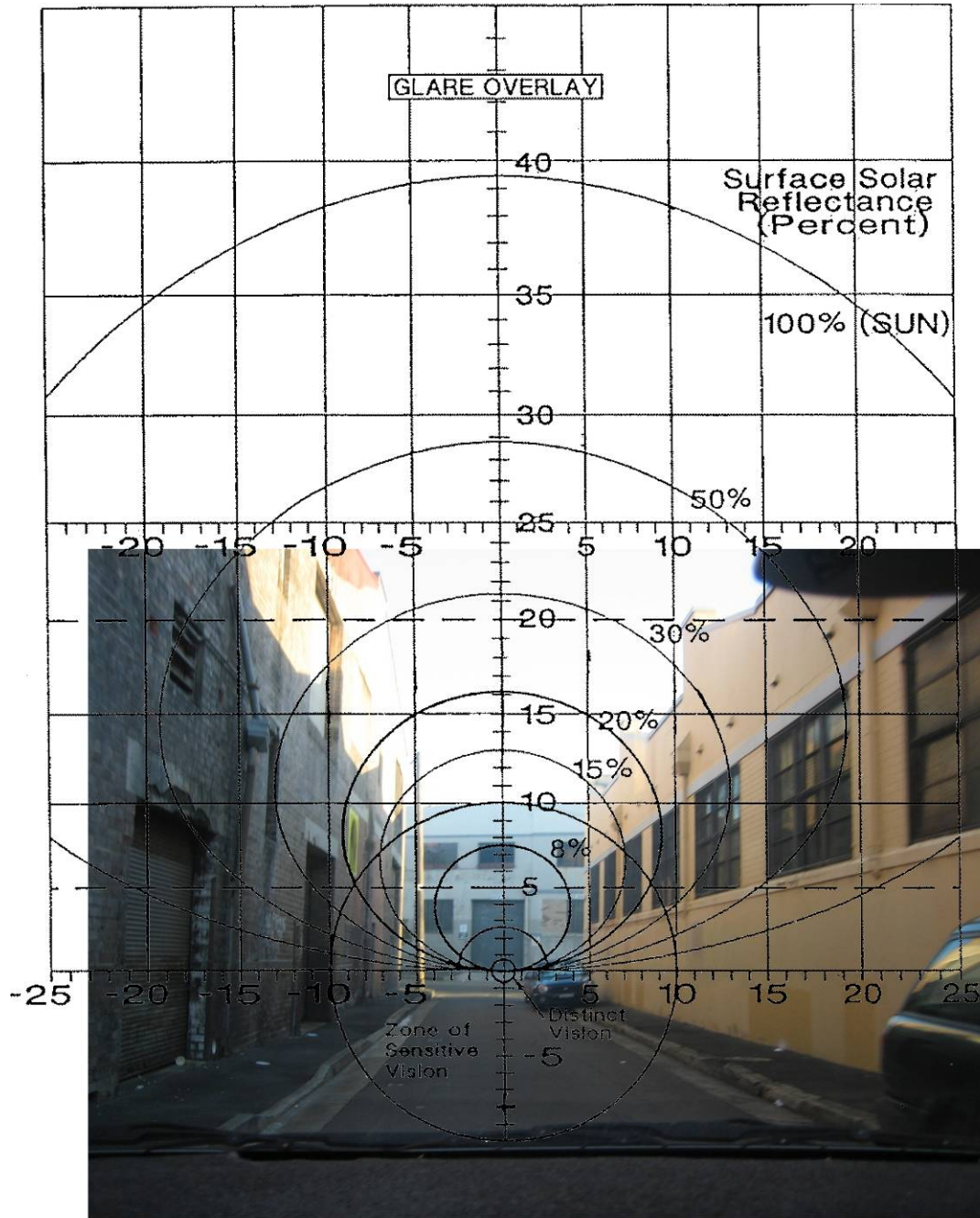
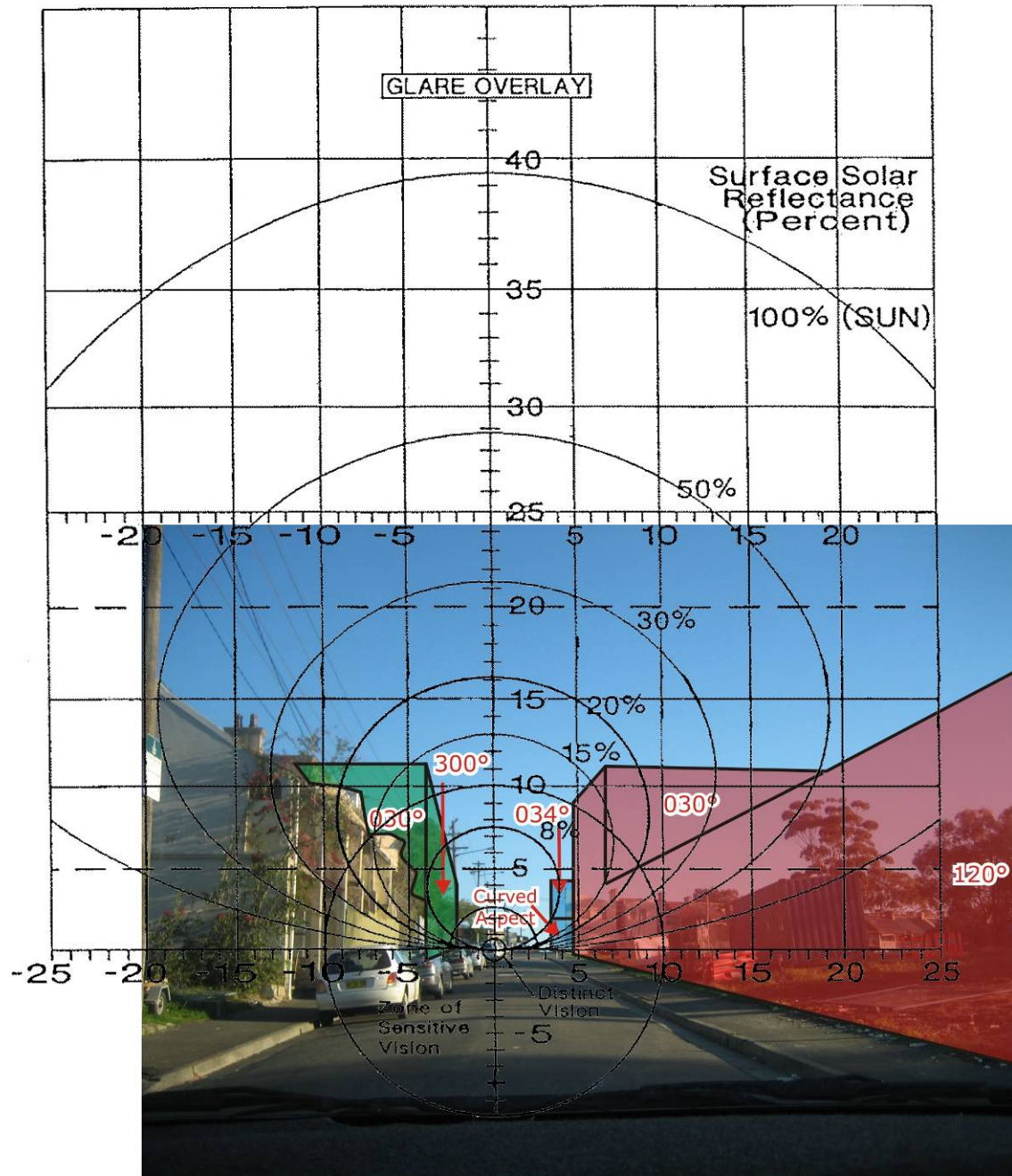


Figure A5: Glare Overlay for Point 6



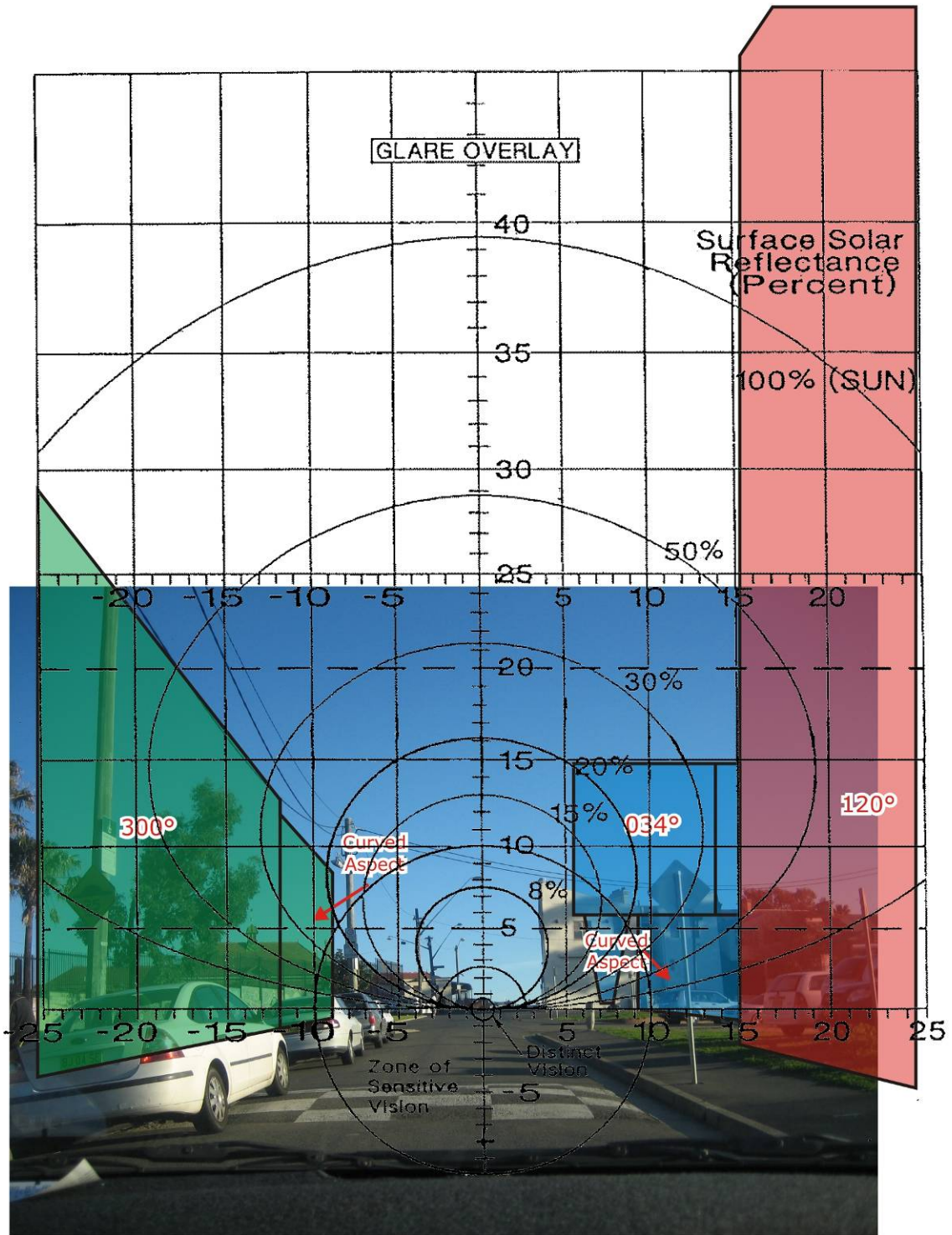
**Figure A6: Glare Overlay for Point 7**

- Precinct 1
- Precinct 2
- Precinct 3



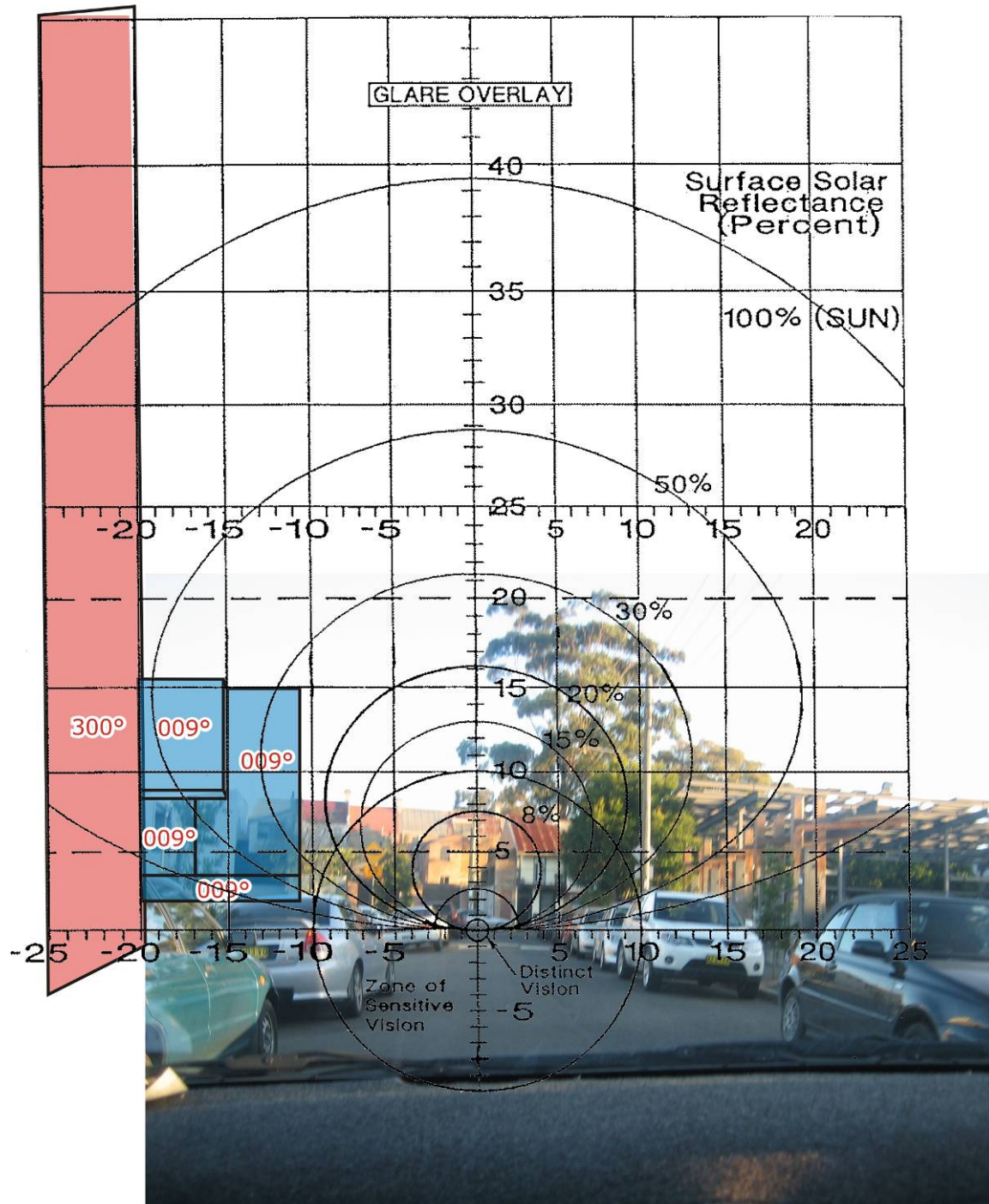
**Figure A7: Glare Overlay for Point 8**

- Precinct 1
- Precinct 2
- Precinct 3



**Figure A8: Glare Overlay for Point 9**

■ Precinct 1  
■ Precinct 2



**Figure A9: Glare Overlay for Point 10**

- Precinct 1
- Precinct 2
- Precinct 3

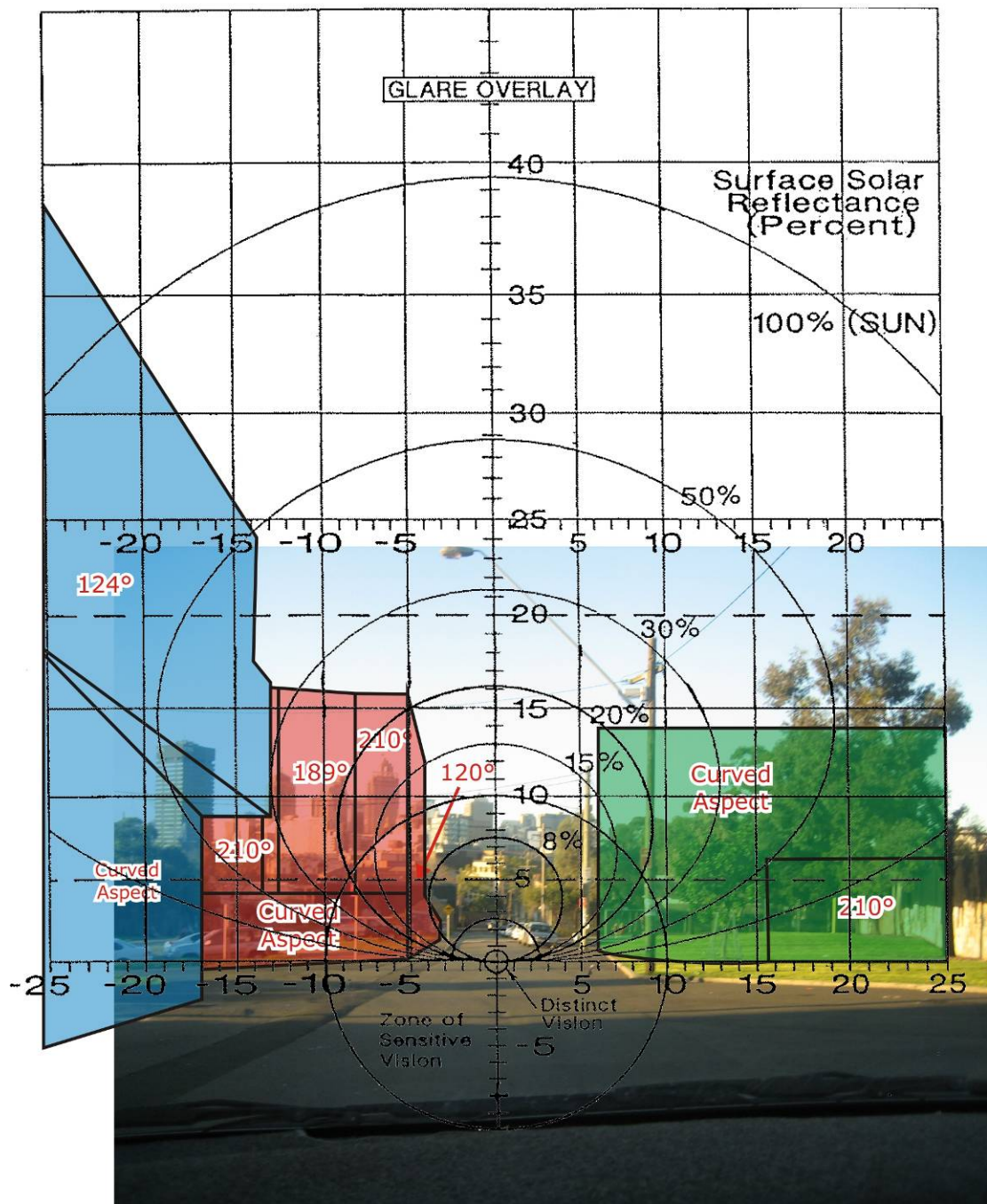


Figure A10: Glare Overlay for Point 11

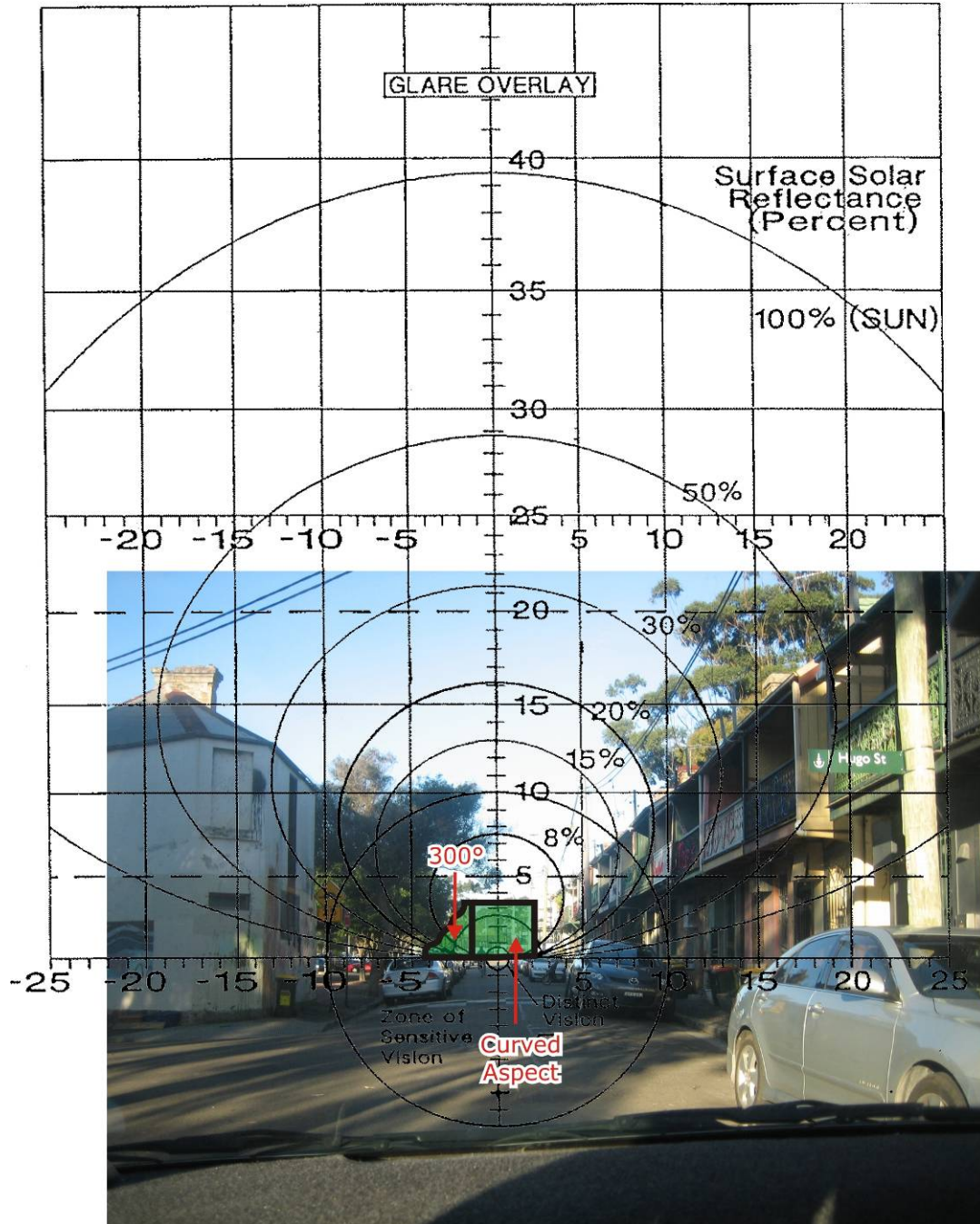


Figure A11: Glare Overlay for Point 13

- Precinct 1
- Precinct 2
- Precinct 3

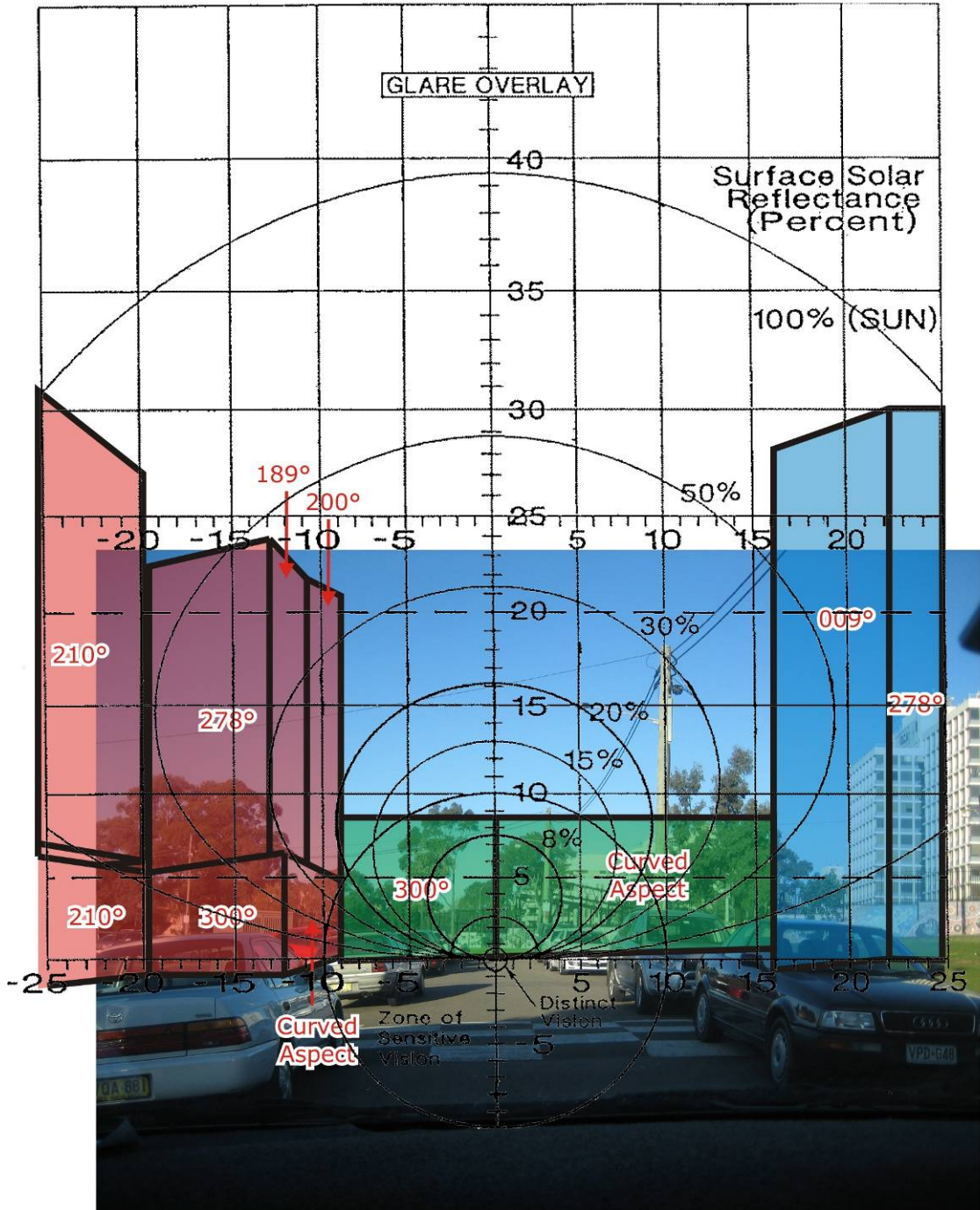


Figure A12: Glare Overlay for Point 14

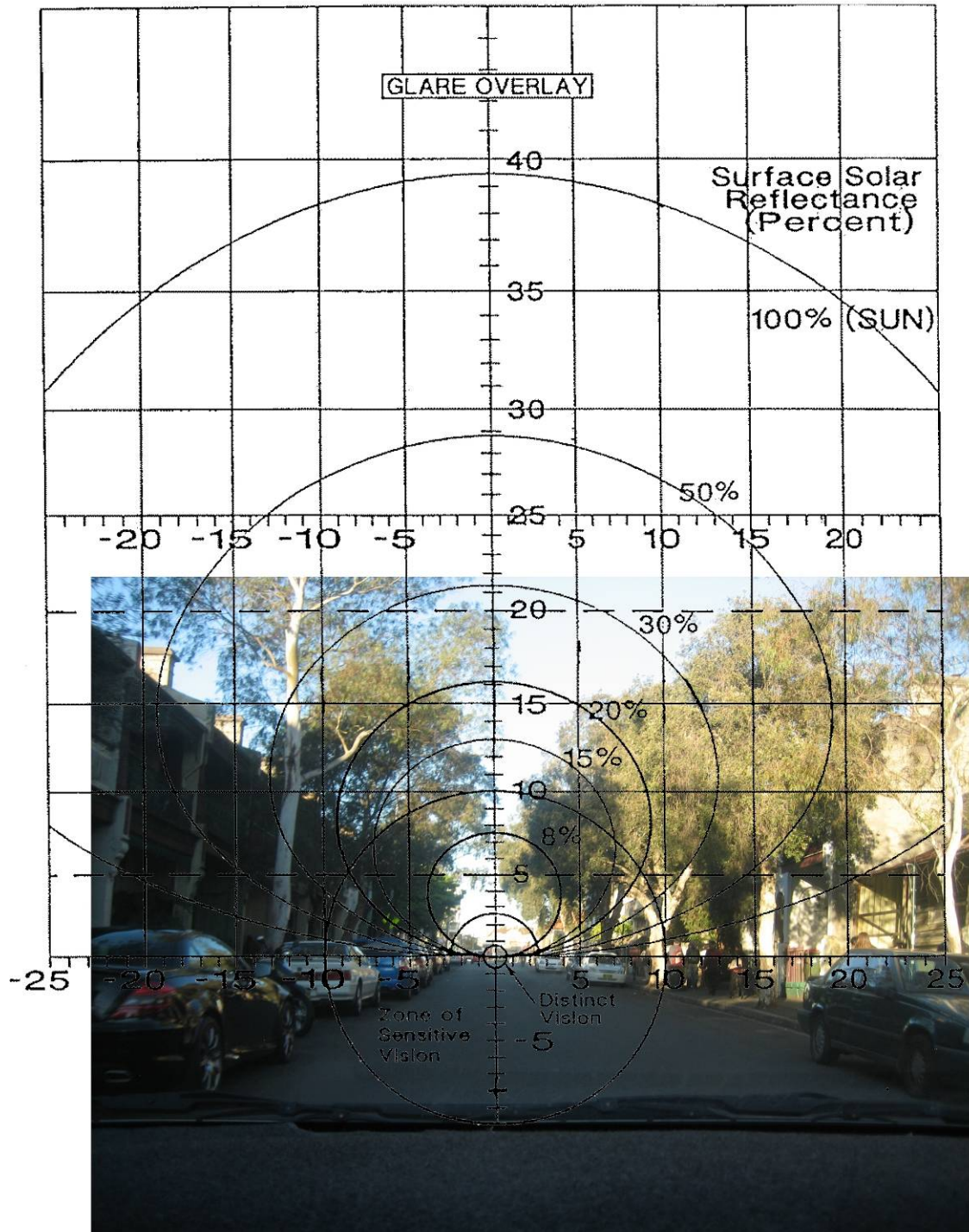


Figure A17: Glare Overlay for Point 15



# **Appendix B**

Solar Charts for the  
Various Critical Aspects of the  
Proposed Development

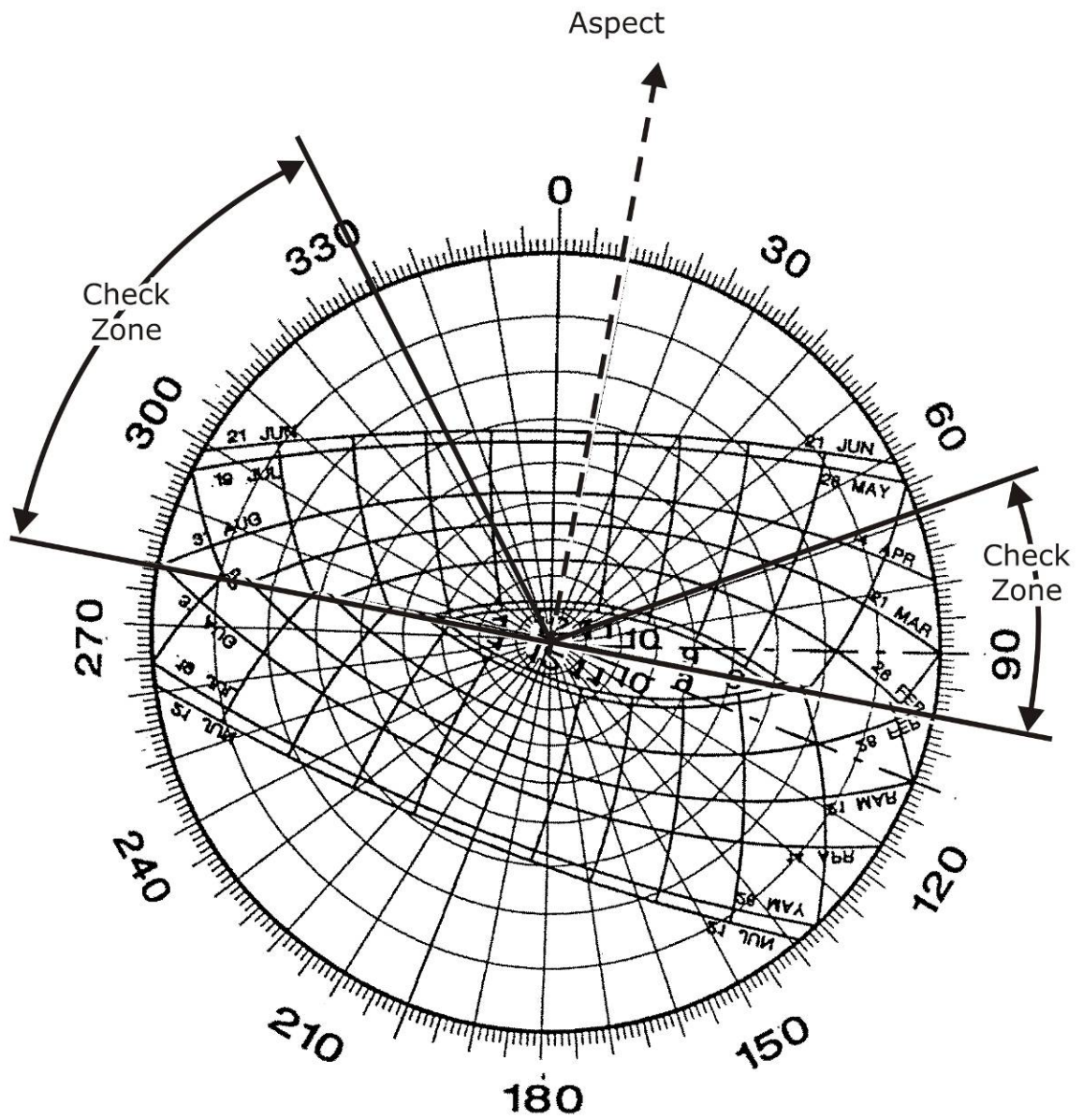


Figure B1: Sun Chart for Aspect 009°

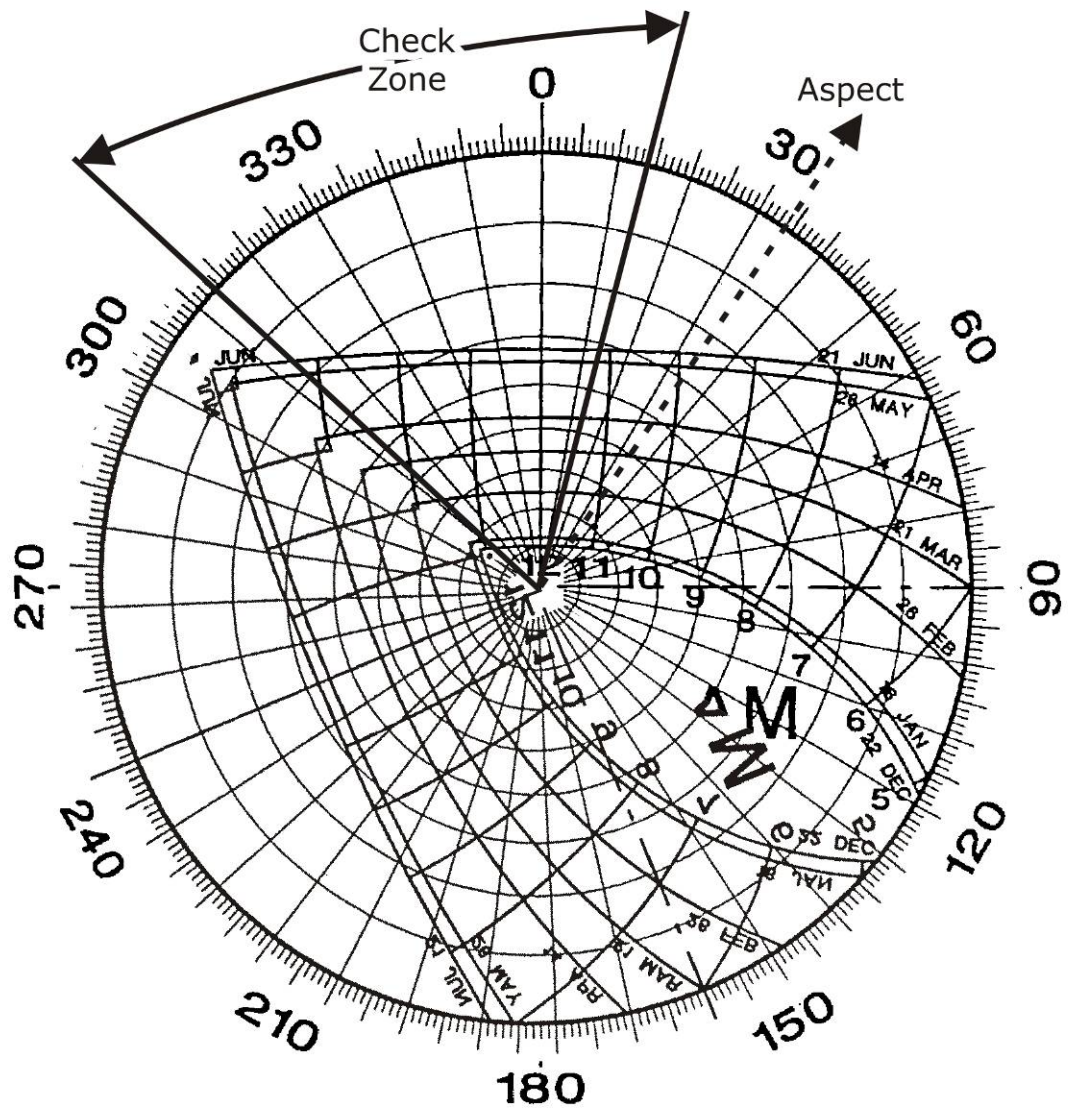


Figure B2: Sun Chart for Aspect 034°



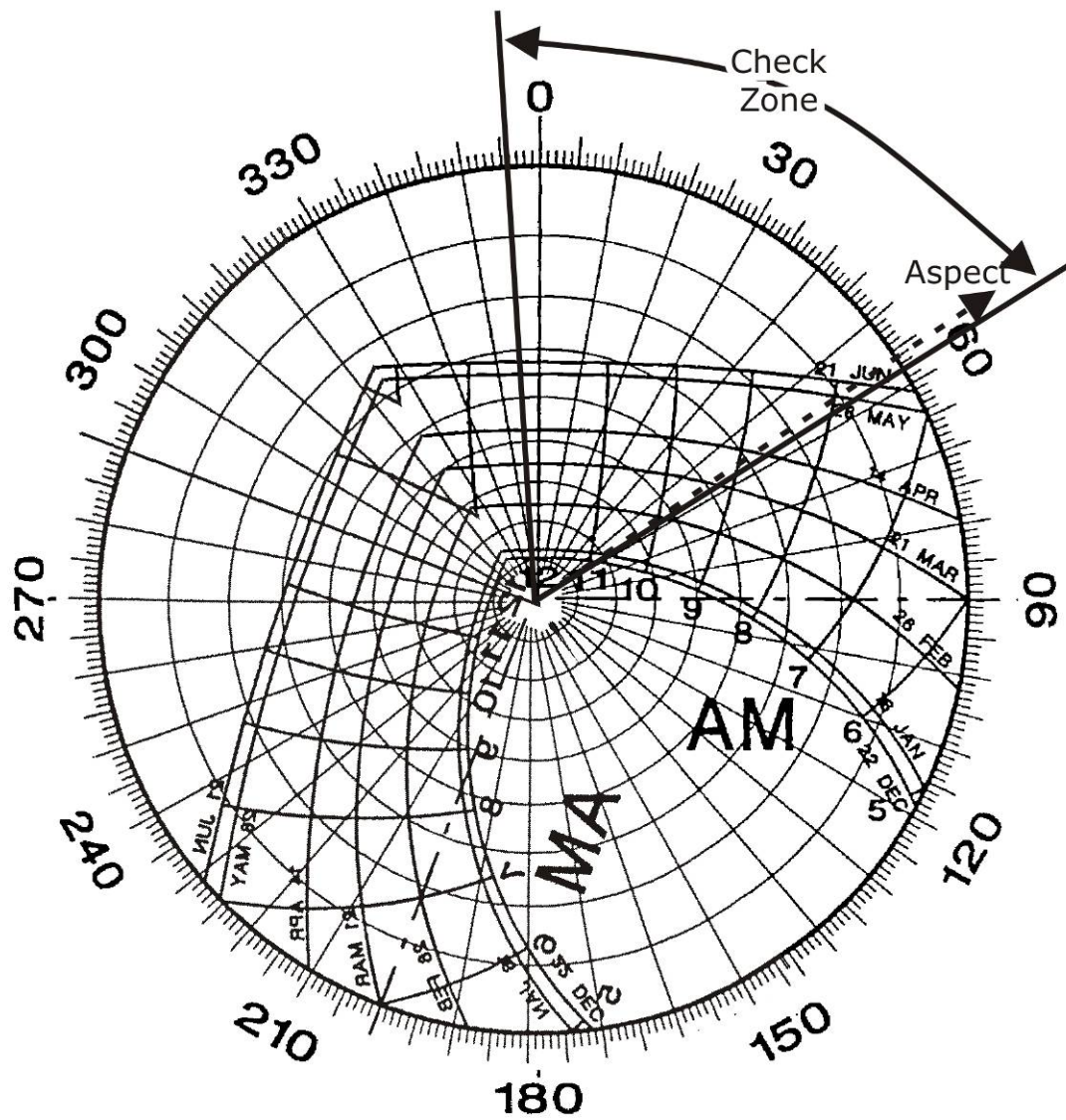


Figure B4: Sun Chart for Aspect 056°

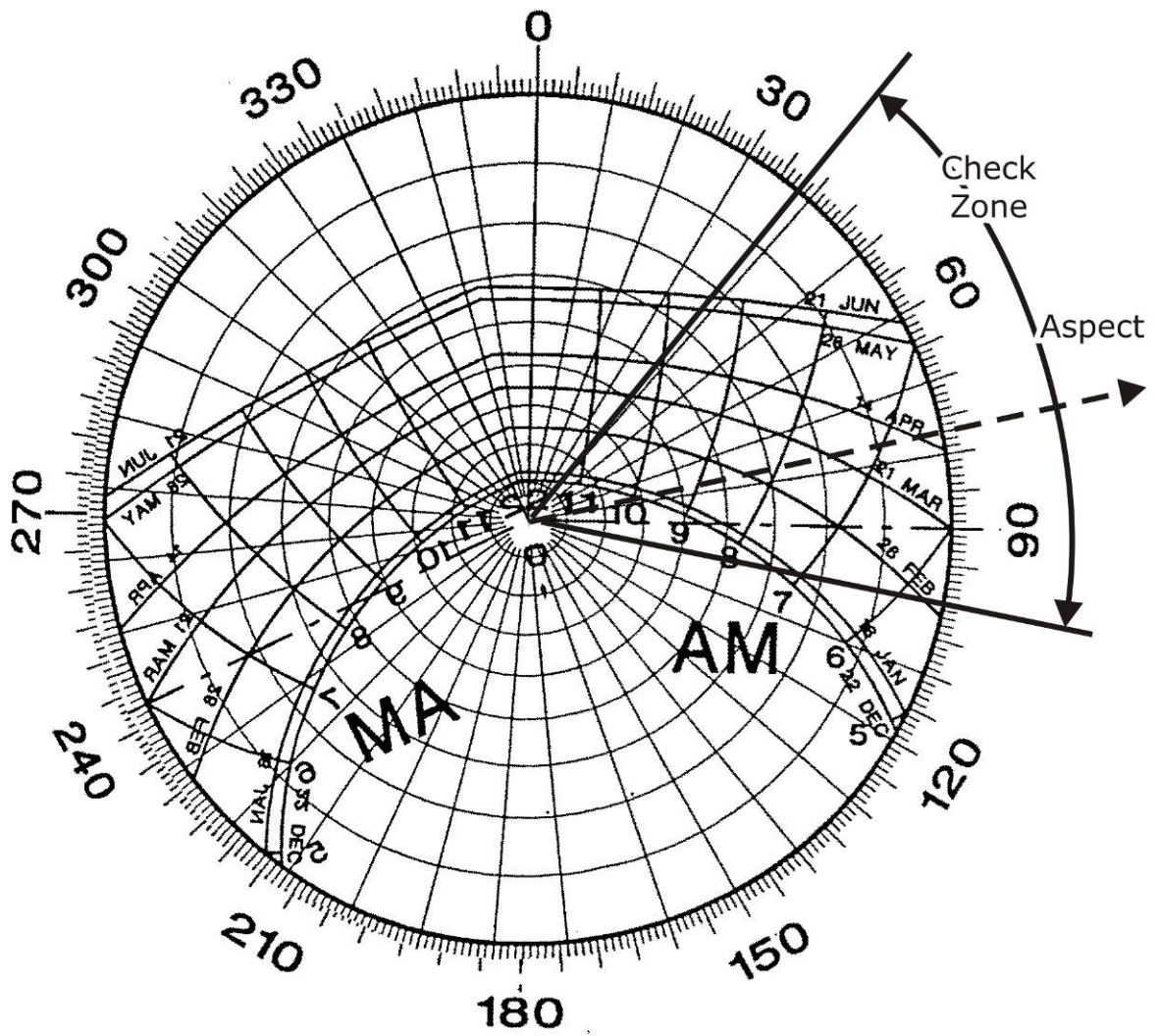


Figure B5 Sun Chart for Aspect 077°

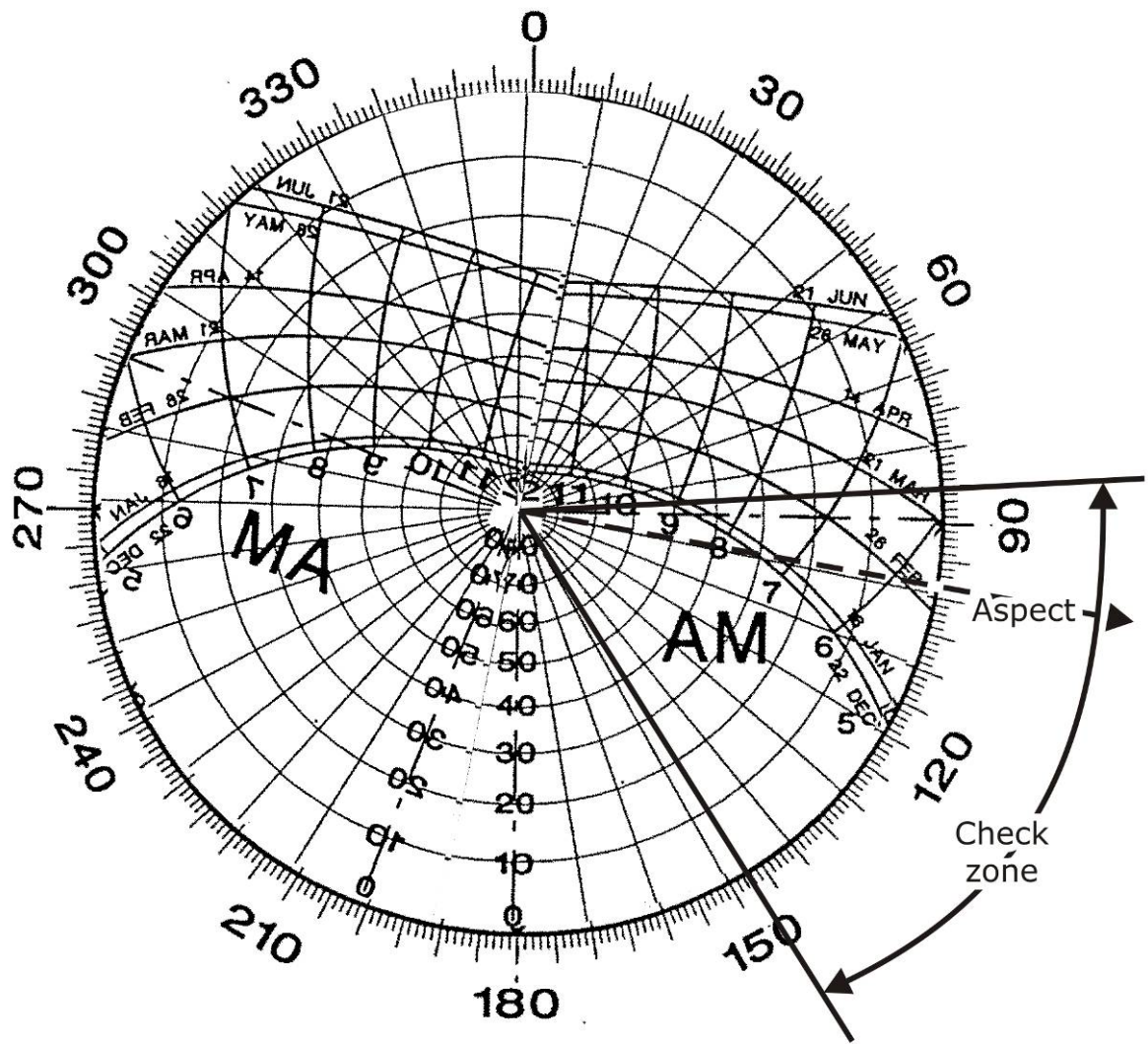


Figure B6: Sun Chart for Aspect 099°

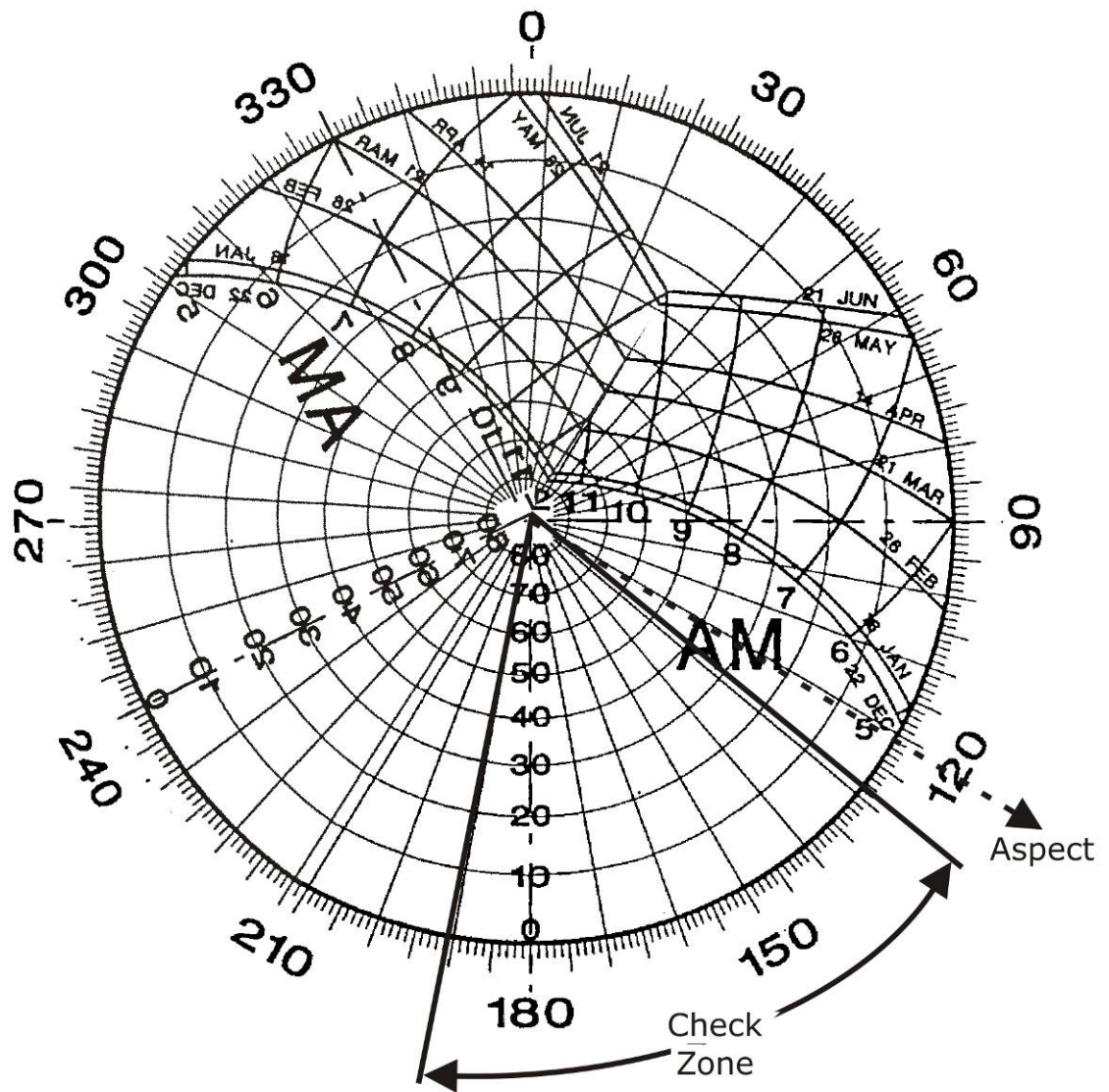


Figure B7: Sun Chart for Aspect 121°

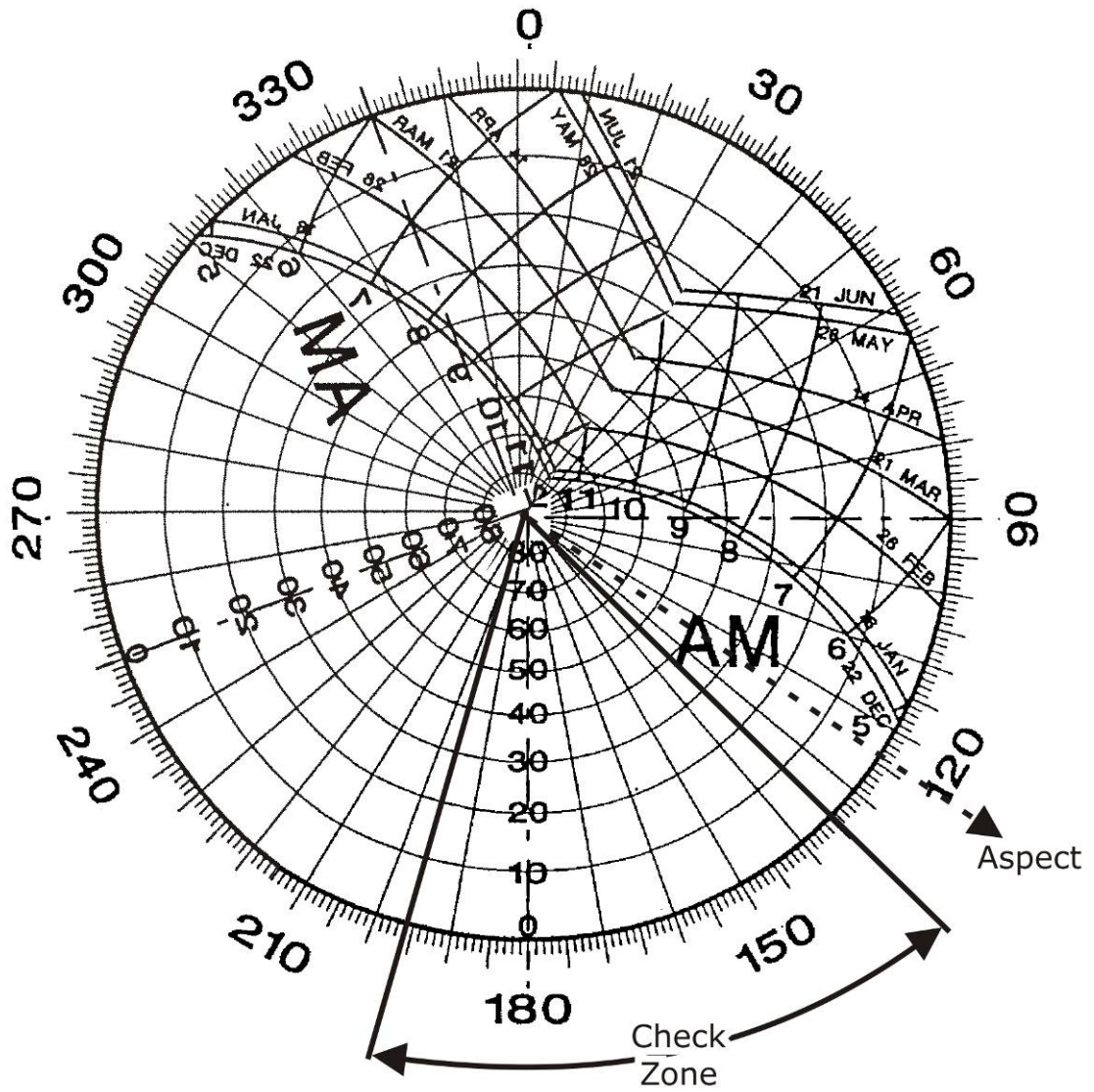


Figure B8: Sun Chart for Aspect 124°

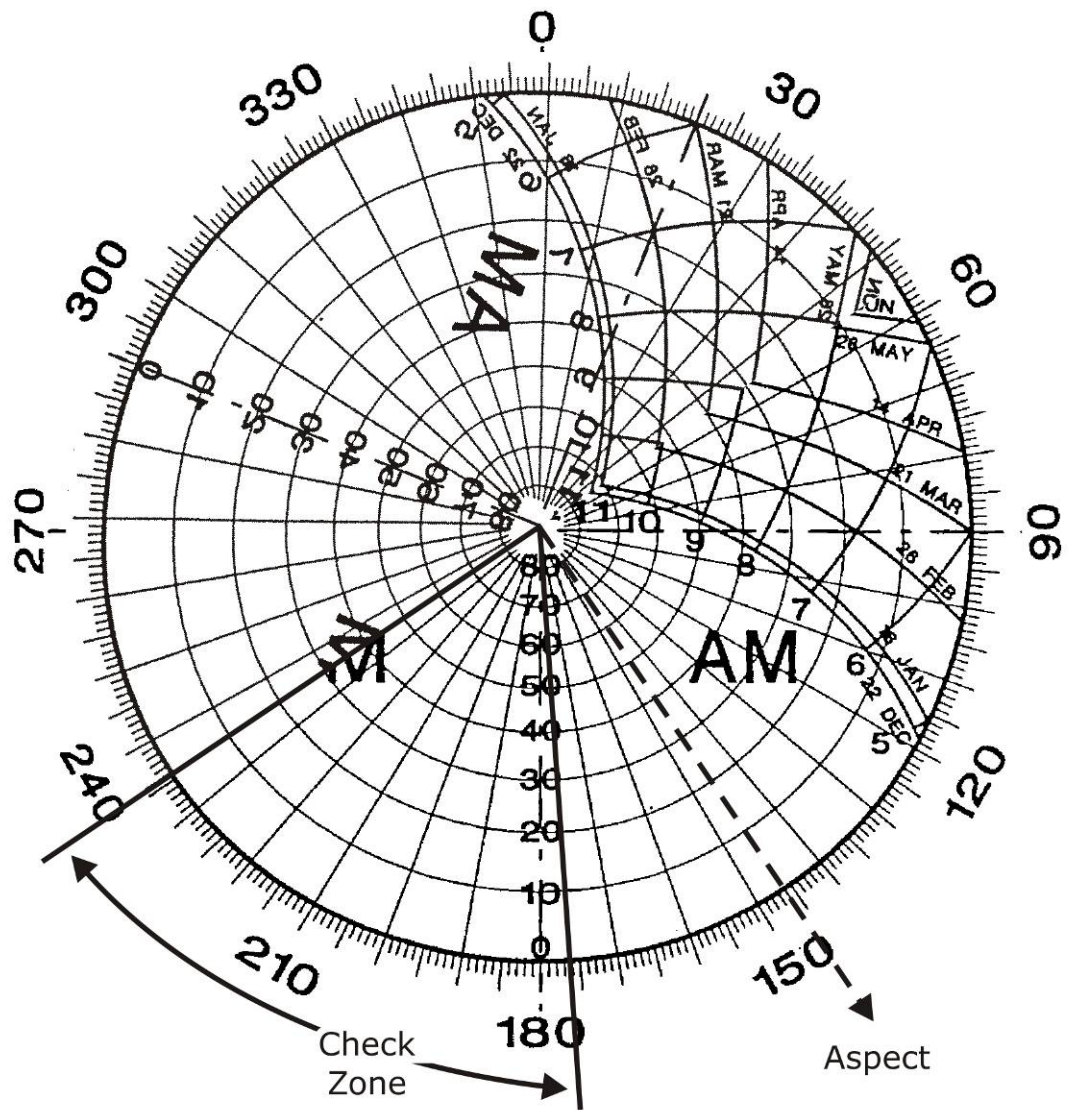


Figure B9: Sun Chart for Aspect 146°

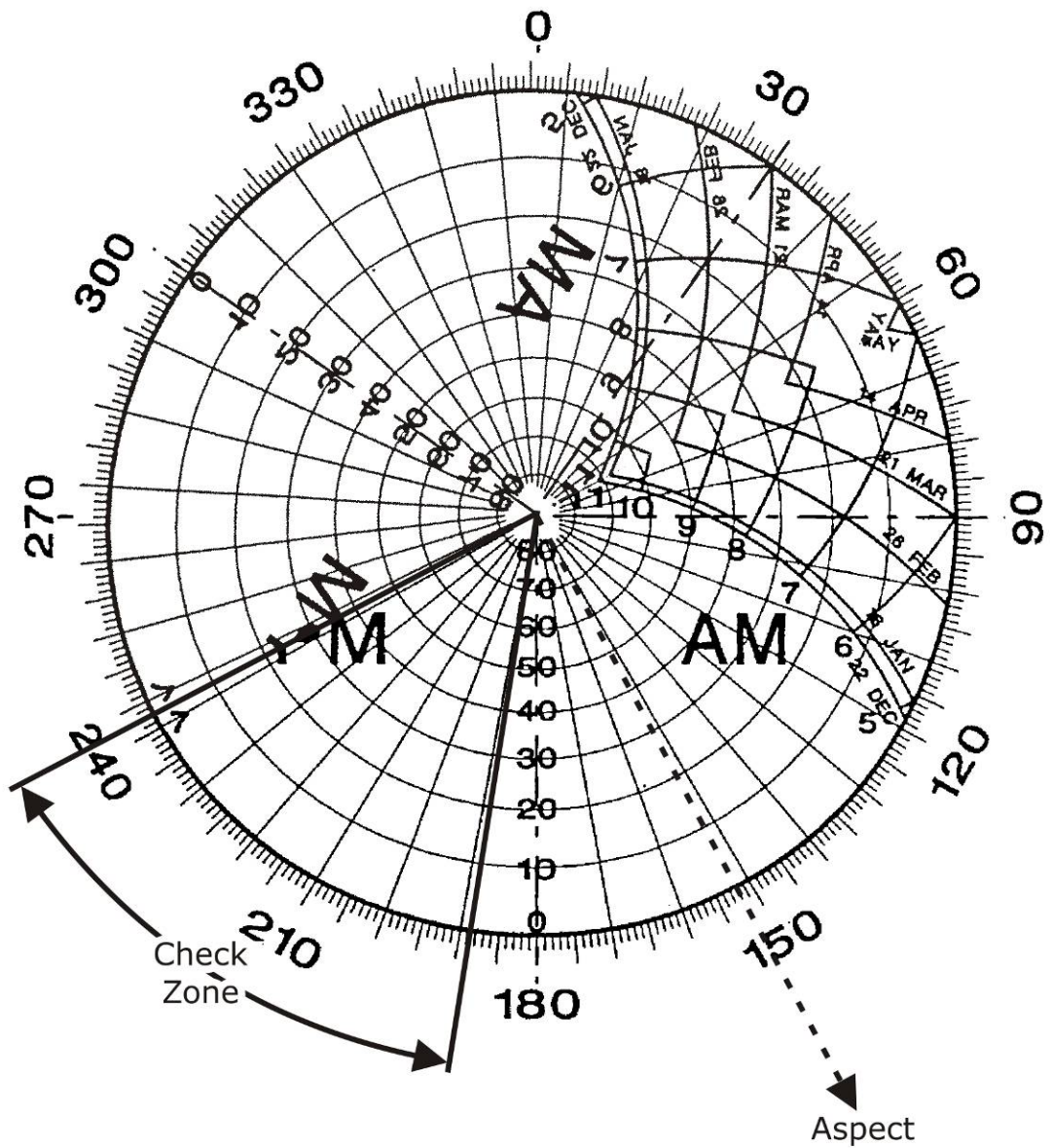


Figure B10: Sun Chart for Aspect 152°

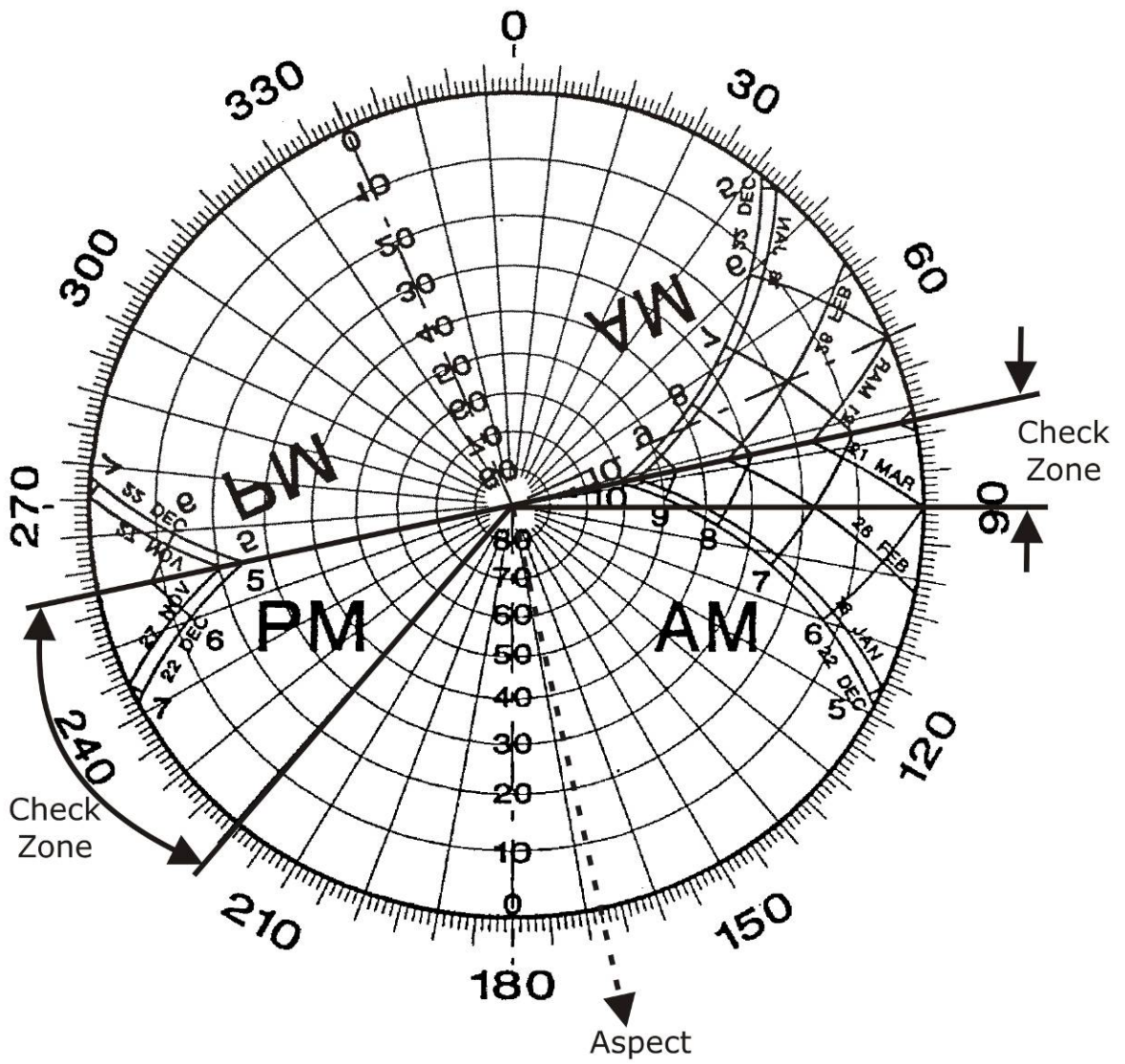


Figure B11: Sun Chart for Aspect 168°

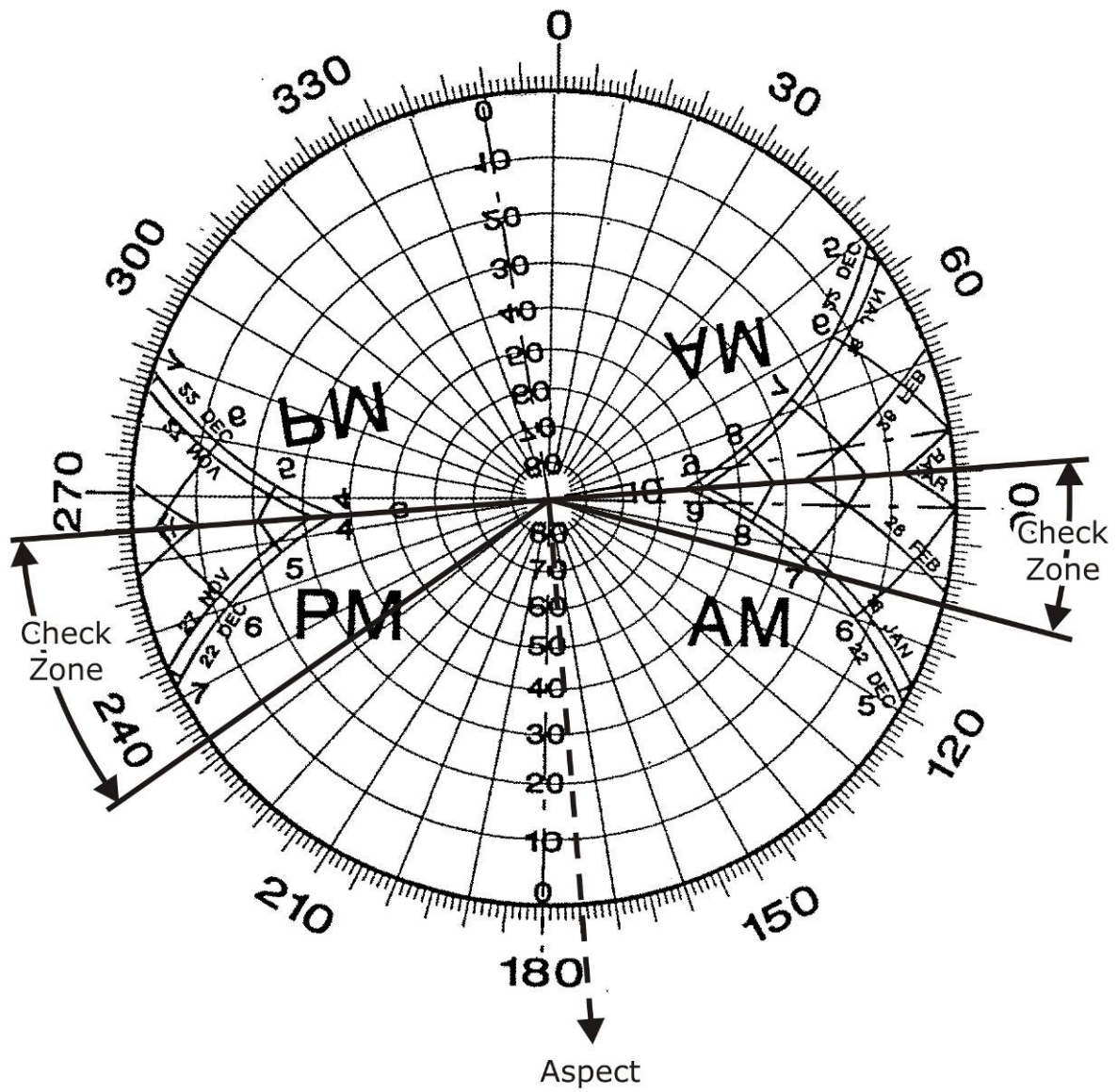


Figure B12: Sun Chart for Aspect 175°

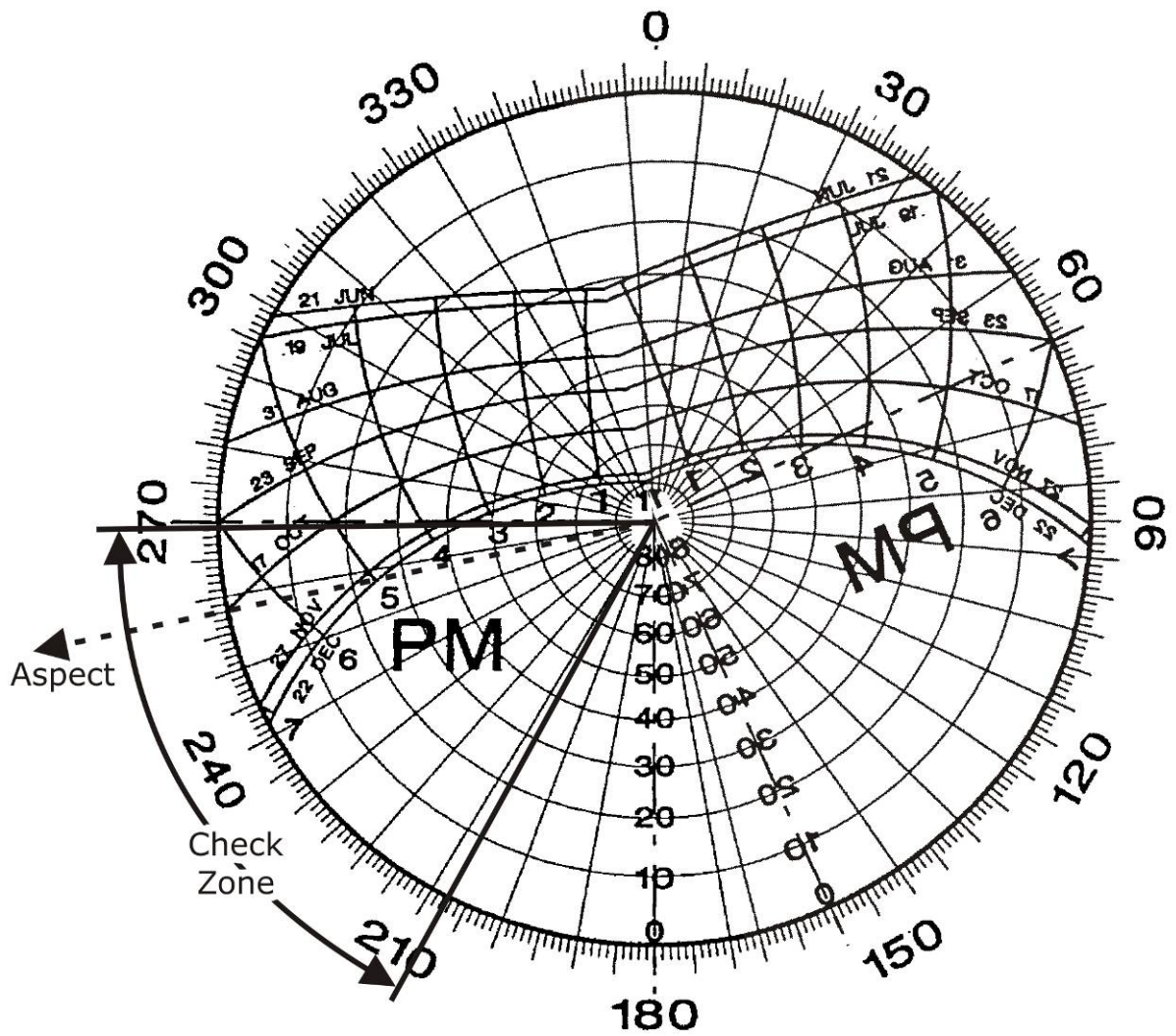


Figure B13: Sun Chart for Aspect 258°

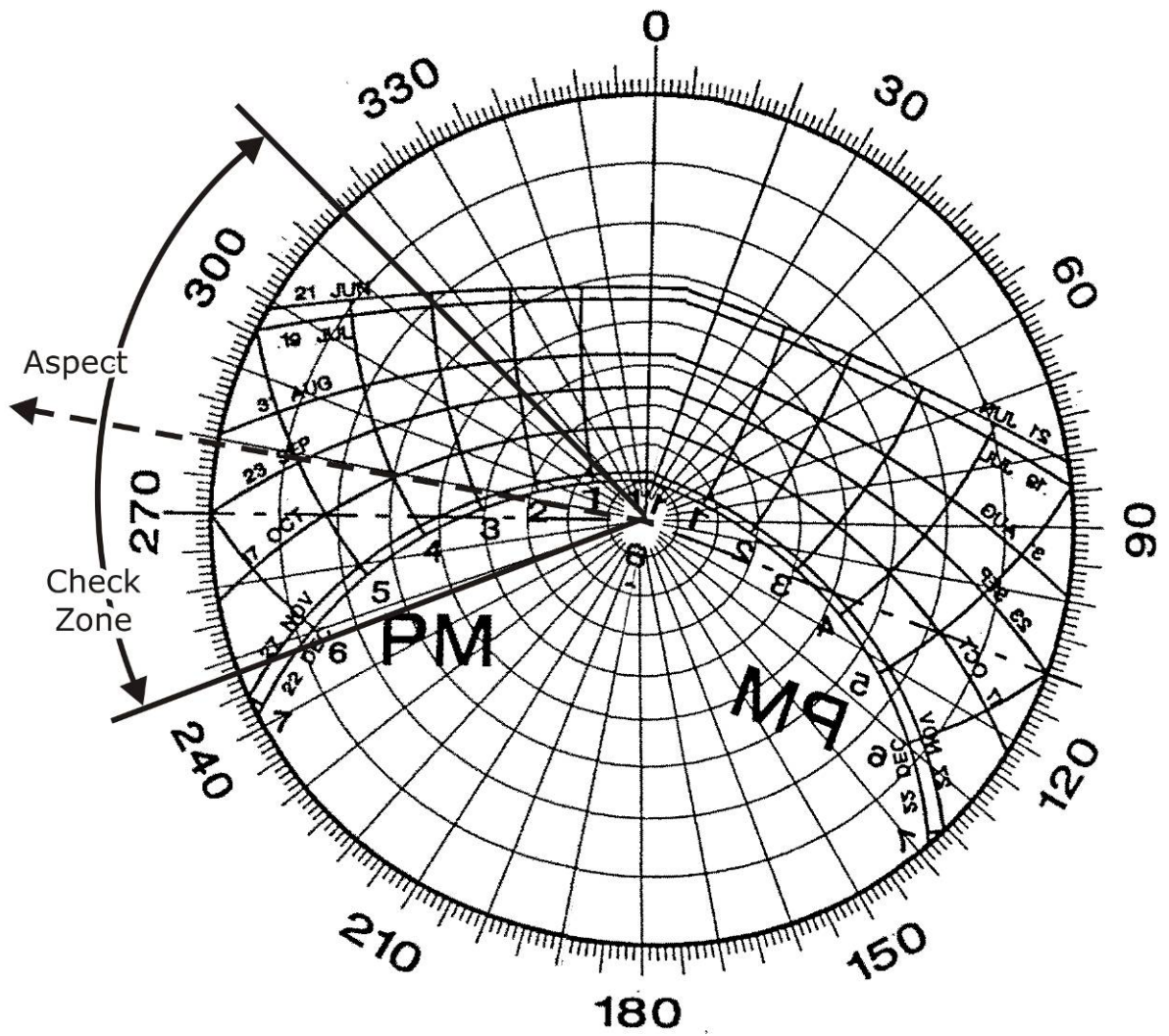


Figure B14: Sun Chart for Aspect 279°

# **Appendix C**

## Standard Sun Chart for Sydney Region

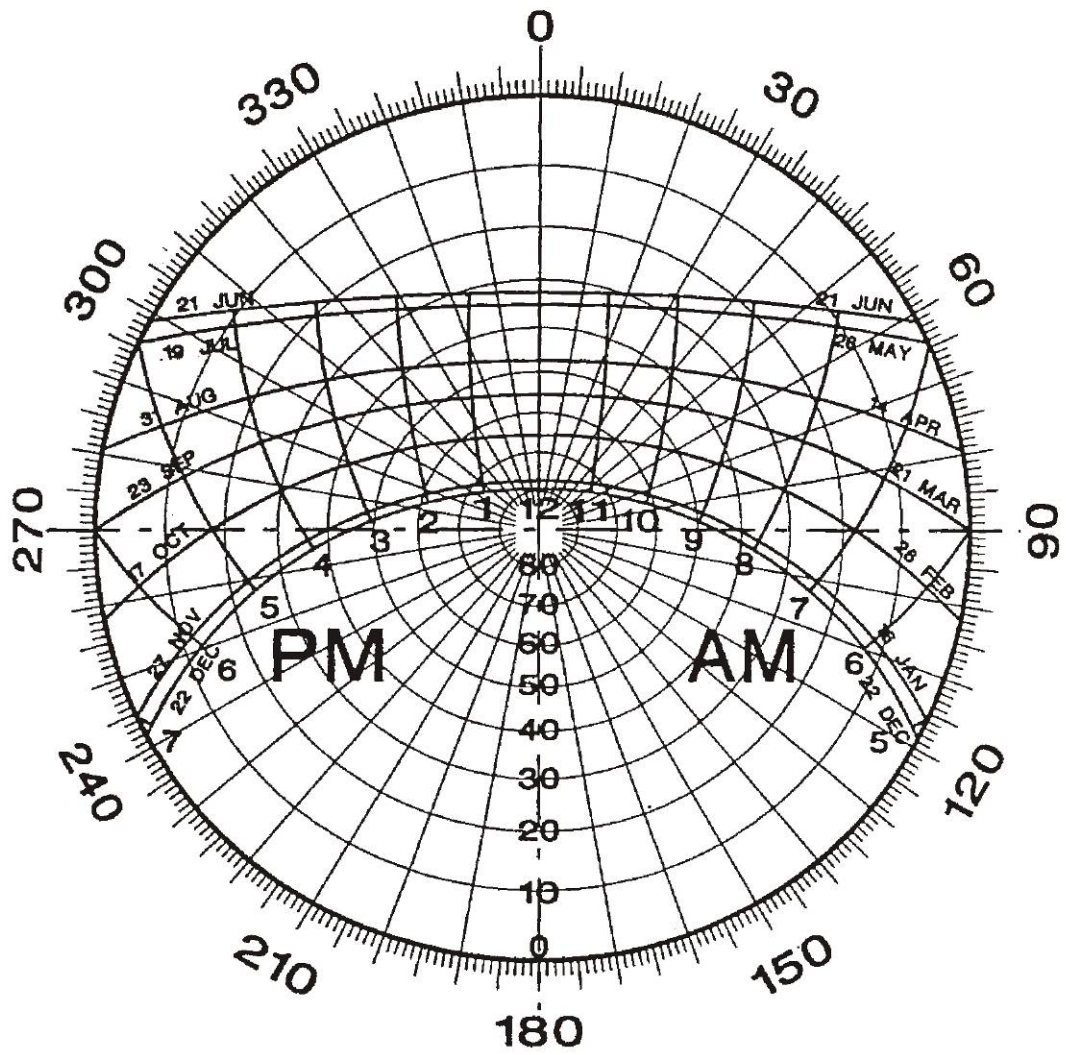


Figure C1: Standard Sun Chart for Sydney Region