SOLAR LIGHT REFLECTIVITY STUDY

QANTAS GROUP FLIGHT TRAINING CENTRE, MASCOT

WE665-01F03(REV2)- SR REPORT

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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 Qantas Group Flight Training Centre & Car Park development located in Mascot. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, and to occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the Botany Bay Development Control Plan 2013.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following limitations to the maximum normal specular reflectance of visible light of the external façade glazing is recommended:

- The maximum normal specular reflectance of visible light on the façade and windows on all levels of the 279° western aspects of the car park development is to be 11%.

  Note that if glazed balustrades are used along the 279° western aspects of the car park development, they are to have a maximum normal specular reflectance of visible light of 8%.

- All other glazing (windows and balustrades) should have a maximum normal specular reflectance of visible light of 20%.

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 (i.e. less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the abovementioned limit.

Hence, with the incorporation of the abovementioned recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to motorists or pedestrians in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from the Botany Bay Development Control Plan 2013.

CONTENTS

1 GLOSSARY

Term	Definition
The Site	Qantas Airways Limited owned land in Mascot to the north of Sydney Kingsford Smith Airport consisting of Lots 2-5 DP 234489, Lot 1 DP 202747, Lot B DP 164829 and Lot 133 DP 659434. Current site improvements include including at-grade car parking for Qantas staff, an industrial shed to store spare aviation parts, a substation, a disused gatehouse, a Sydney Water Asset with two driveways over it, the Qantas catering facility and Qantas tri-generation plant.
The Project	The construction of a new Flight Training Centre and ancillary uses to replace the existing facility on the Qantas Jetbase that will be impacted by RMS' Sydney Gateway Project.
Mascot Campus	Over 19ha of Qantas Airways Limited controlled land in Mascot to the north of Sydney Kingsford Smith Airport consisting of freehold and leased land. The following lots are owned by Qantas: Lot 133 DP 659434; Lots 4 & 5 DP 38594 Lot 23 DP 883548; Lots 1 & 2 DP 738342; Lot 3 DP 230355; Lot 4 DP 537339; Lots 2 & 4 DP 234489; Lot 4 234489; Lot 1 DP 81210; Lot 1 DP 202093; Lot 1 DP 721562; Lot 2 DP 510447; Lot 1 DP 445957; Lot B DP 164829 and Lot 1 DP 202747 and equates to 16.5ha of land. The following lots are leased by Qantas: Lot 14 DP 1199594 and Lot 2 DP 792885 and equates to 2.7ha of land.
Jetbase	Qantas leased land within the boundaries of Sydney Kingsford Smith Airport.
Sydney Gateway Project	A RMS Project including a road and rail component that is intended to increase capacity and improve connections to the ports to assist with growth in passenger, freight and commuter movements across the region, by expanding and improving the existing road and freight rail networks.

Abbreviations	Definition
cd/m2	Candela per metre square
SEARs	Secretary's Environmental Assessment Requirements
QFTC	Qantas Flight Training Centre

2 IMAGE INDEX

3 INTRODUCTION

Windtech Consultants has been commissioned by Qantas Airways Ltd (Qantas) to prepare this report in accordance with the technical requirements of the Secretary's Environmental Assessment Requirements (SEARs), and in support of the SSD 10154 for the development of a new flight training centre at 297 King Street, Mascot.

4 DESCRIPTION OF SITE AND LOCALITY

The site is located at 297 King Street, Mascot and comprises of land known as Lots 2-5 DP 234489, Lot 1 DP 202747, Lot B DP 164829 and Lot 133 DP 659434. The site is identified in Figure 2.

Key features of the site are as follows:

- The site is approximately 5.417ha and is an irregular shape. It is approximately 240m in length and maintains a variable width of between approximately 321m in the Northern Portion of the site and approximately 90m along the King Street frontage (refer to Figure 2)
- The site possesses a relatively level slope across the site. An open Sydney Water drainage channel bisects the northern portionof the site in an east-west direction. There are some isolated changes in level immediately adjacent to this channel. A Site Survey Plan accompanies the application which details the topographc characteristics of the site.
- Multiple mature Plane Trees are scattered throughout the site. A variety of native and exotic tress and vegetation also exist around the perimeter of the site which help screen the site from surrounding uses.
- Site improvements include at-grade car parking for Qantas staff, an industrial shed to store spare aviation parts, a substation, a disused gatehouse, a Sydney Water Asset with two driveways over it, the Qantas catering facility and Qantas tri-generation plant.
- The site forms part of a larger land holding under the ownership of Qantas that generally extends between Qantas Drive to the west, Ewan Street to the south, Coward Street to the north, with the Qantas "Corporate Campus" fronting Bourke Road.
- Vehicular access to the site from the local road network is available from King Street. The site has intracampus connections along the northern boundary in the form of two connecting driveways in the northeastern and north-western corner of the site along the northern boundary which link it to the broader Mascot Campus.
- The site is located within the Bayside LGA.

Key features of the locality are:

- **North:** The site is bounded to the north low scale industrial development, beyond which is Coward Street. Further north of the site is the Mascot Town Centre which is characterised by transport-oriented development including high density mixed-use development focussed around the Mascot Train Station.

- **East:** The site is bordered to the east by commercial development including a newly completed Travelodge hotel which includes a commercial car park. Additional commercial development to the east includes the Ibis Hotel and Pullman Sydney Airport fronting O'Riordan Street.
- **South:** The site is bounded to the south by King Street, beyond which is Qantas owned at-grade car parking and other industrial uses. Further south is the Botany Freight Rail Line and Qantas Drive beyond which is the Domestic Terminal at Sydney Airport.
- **West:** The site is bordered to the west by the Botany Freight Rail Line and Qantas Drive, beyond which lies Sydney Kingsford Smith Airport and the Qantas Jetbase (location of the current Flight Training Centre)

Figure 1: Aerial Image of the Site Location

5 PROJECT DESCRIPTION

Safety is Qantas' first priority. The flight training centre is a key pillar of this value. The facility enables pilots and flight crews to undertake periodic testing to meet regulatory requirements by simulating both aircraft and emergency procedural environments. The Project seeks consent for the construction and operation of a new flight training centre, and associated ancillary uses including a multi-deck car park. The Project is comprised of the following uses:

Flight Training Centre

The proposed flight training centre will occupy the southern portion of the site. It is a building that comprises 4 core elements as follows:

- An emergency procedures hall that contains;
    - cabin evacuation emergency trainers,
    - an evacuation training pool, o door trainers,
    - fire trainers
    - slide descent towers,
    - security room,
    - aviation medicine training and equipment rooms.
- A flight training centre that contains:
    - a flight training hall with 14 bays that will house aircraft simulators,
    - integrated procedures training rooms, computer rooms, a maintenance workshop, storerooms, multiple de-briefing and briefing rooms, pilot's lounge and a shared lounge.
- Teaching Space that contains
    - training rooms,
    - classrooms and two computer based exam rooms.
- Office Space
    - Office space for staff and associated shared amenities including multiple small, medium and large meeting rooms, think tank rooms, informal meeting spaces, a video room and lunch/tea room.
- Ancillary spaces including the reception area at the ground floor, toilets, roof plant and vertical circulation. The external ground floor layout will include a loading dock, at-

grade car parking for approximately 35 spaces and a bus drop-off zone at the northern site boundary.

Car Park

The proposed multi-deck car park will be located to the north-east of the flight training centre and adjacent the existing Qantas catering facility and tri-generation plant. The car park is 13 levels and will provide 1,500 spaces for Qantas staff. Vehicle access to the car park will be provided via King Street, Kent Road and from Qantas Drive via the existing catering bridge.

6 GLARE OBSERVED BY MOTORISTS

6.1 Methodology

The reflectivity analysis of the subject development has been carried out using the technique published by Hassall (1991). The limiting veiling luminance of 500 cd/m^2 for the comfort of motorists, as suggested in Hassall (1991), has been adopted as a basis of assessing the glare impact from the subject development.

The various critical glazed aspects of the development were determined and are shown in Figure 2. Solar charts for each of these critical glazed aspects are presented in Appendix B, and these are used to derive the check zones which are shown in Figures 3a and 3b. The solar chart of each critical aspect is determined from the standard sun chart of the region, provided in Appendix C (Phillips, 1992), using the method detailed in Hassall (1991). The check zones highlight the areas that are potentially affected by solar reflections from each critical glazed aspect. It should be noted that the check zones shown in Figure 3a and 3b 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 6.2 of this report.

Study point locations are selected within the check zone areas where motorists are facing the general direction of the subject development (within ±10° of the direct sight-line). These are shown in Figures 3a and 3b, and summarised in Table 1. Photographs have been taken from the viewpoint of motorists at each study point location using a calibrated camera. A scaled glare protractor has been superimposed over each viewpoint image.

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 cd/m^2. Alternatively, the glare protractor can be used to determine the maximum acceptable reflectivity index of the façade material of the development for the glare to be within the criterion of 500 cd/m^2, to ensure that solar glare will not cause discomfort or threaten the safety of motorists and hence to enable the subject development to comply with the relevant planning control requirements regarding solar light reflectivity.

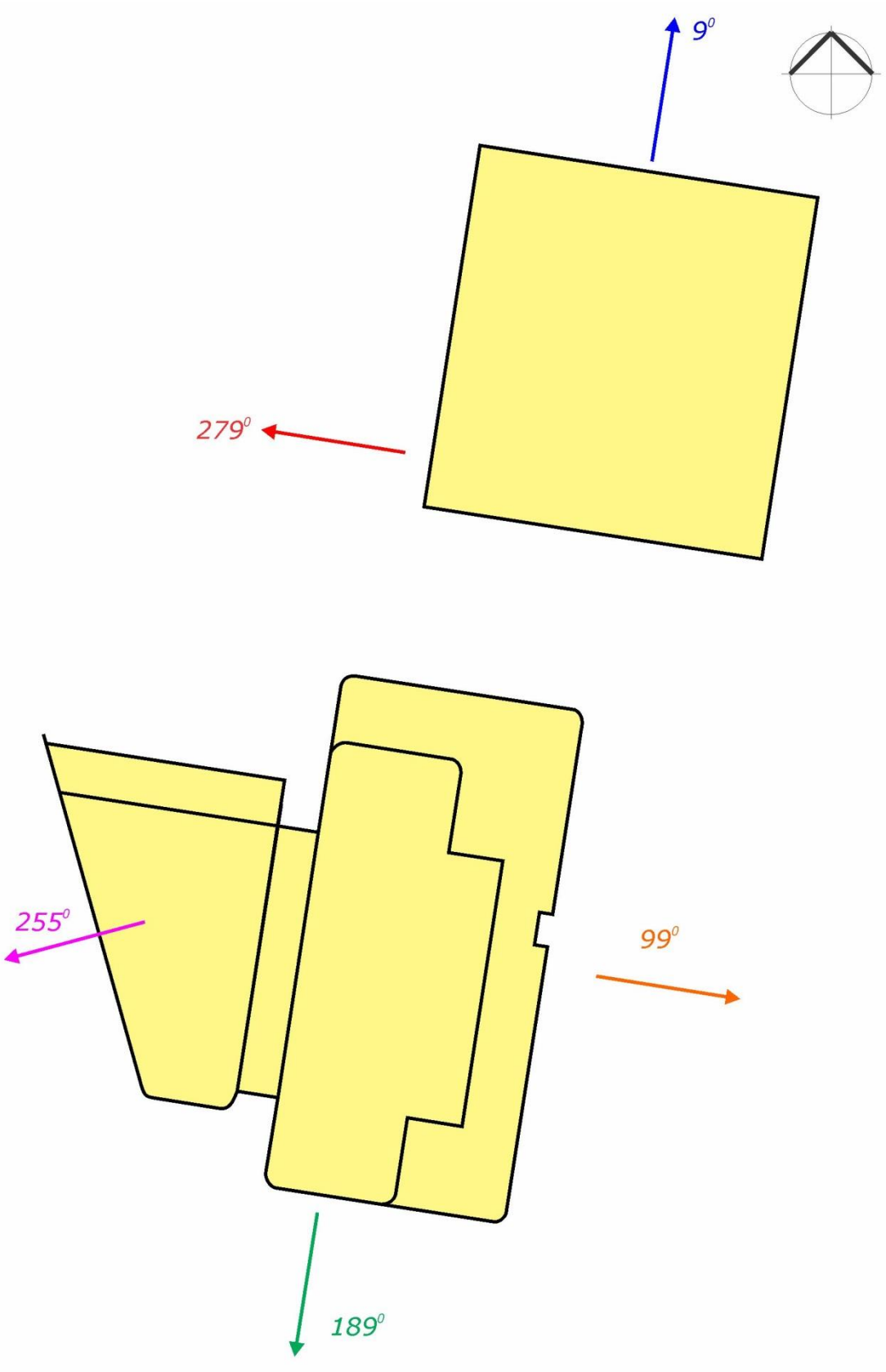

Figure 2: Critical Glazed Aspects of the Development (Training Centre and Car Park)

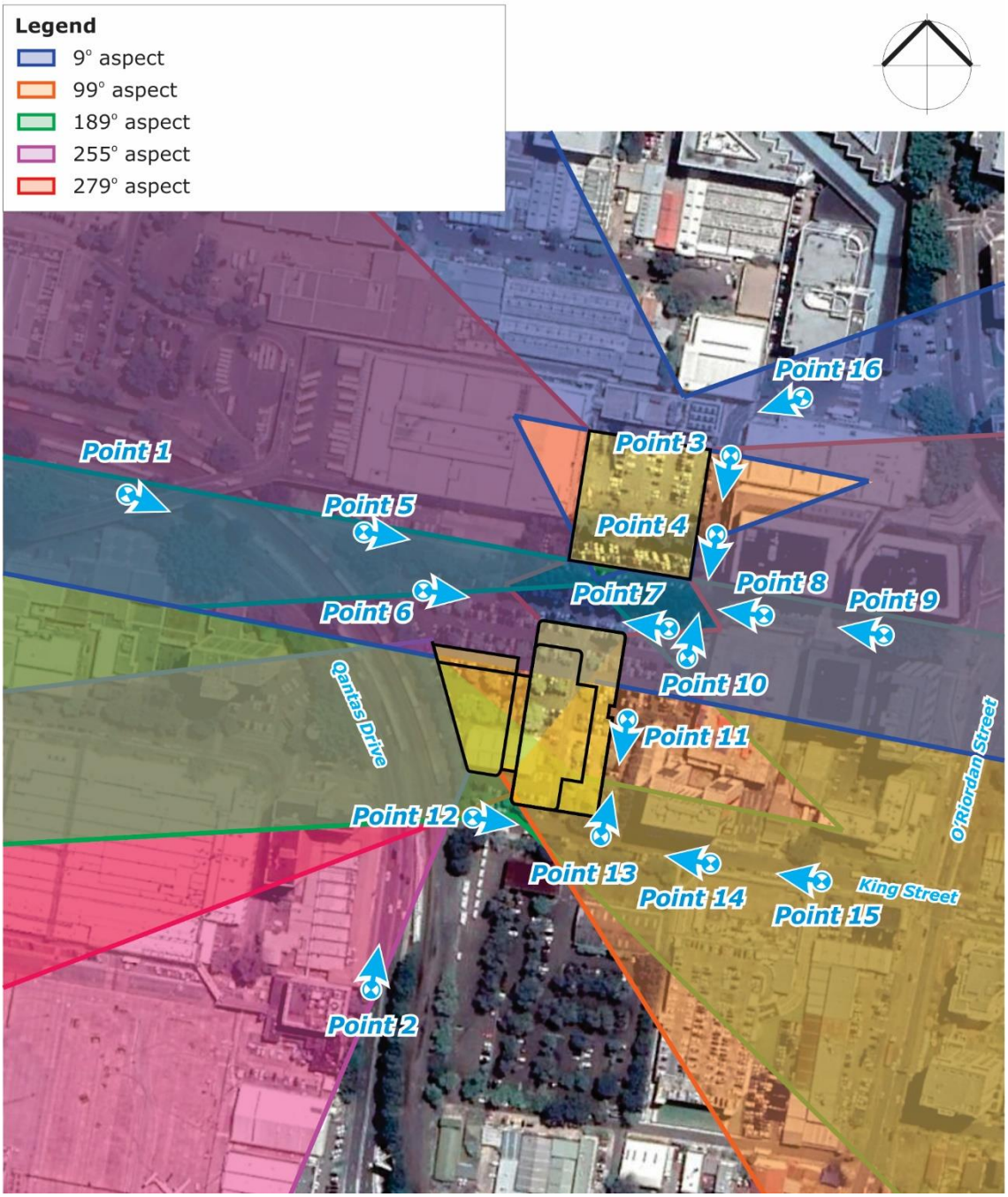

Figure 3a: Check Zones and Study Point Locations – Flat Aspects
(the check zones are the areas where glare could potentially be observed)

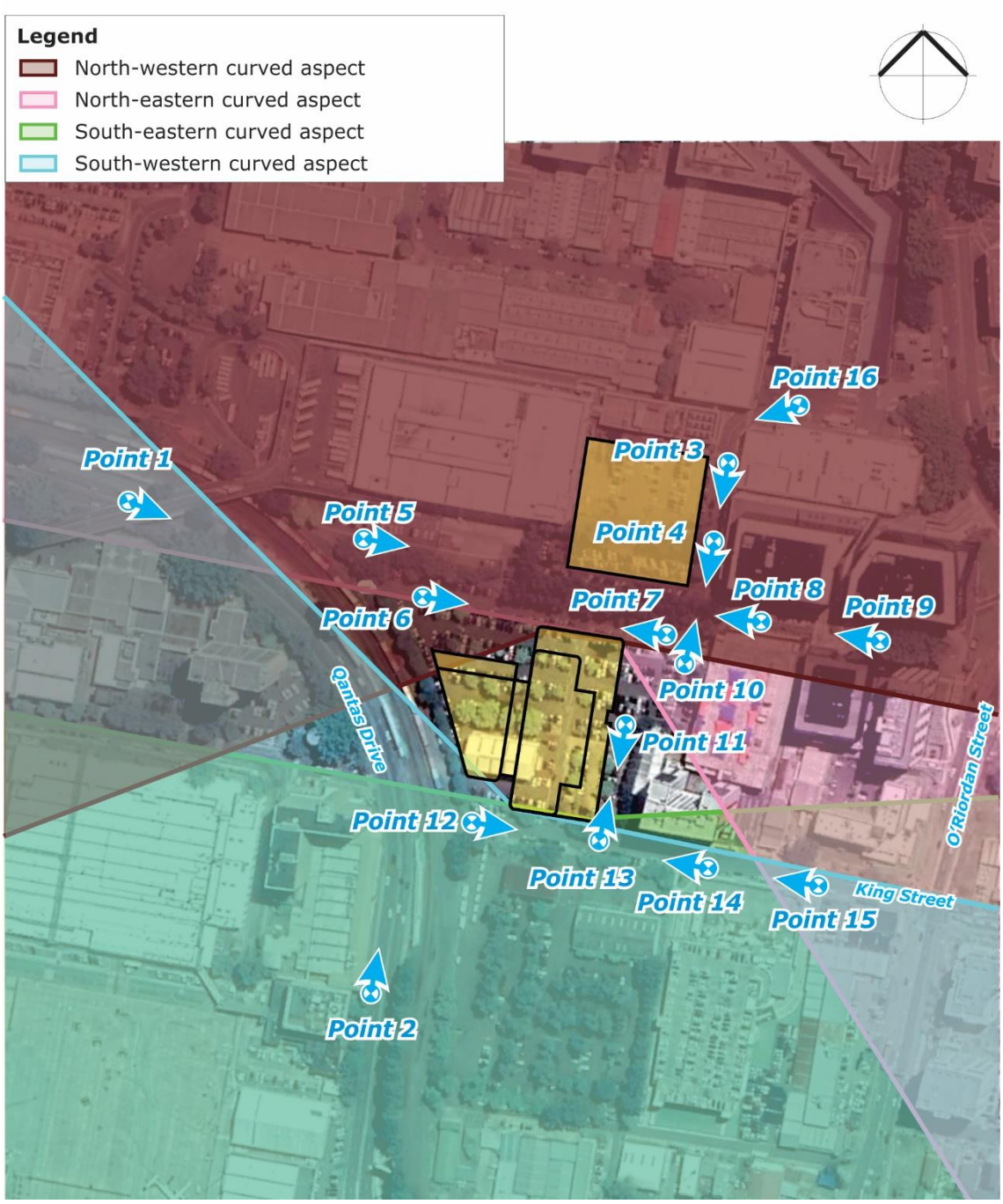

Figure 3b: Check Zones and Study Point Locations – Curved Aspects
(the check zones are the areas where glare could potentially be observed)

Table 1: Aspects of the Development that could reflect Solar Glare to Each Study Point for Motorists

Study Point	Location and Viewpoint	Aspect(s) of the Development
01	Qantas Drive, heading east.	9°, 189° and 279° flat aspects. NW, NE and SW curved aspects.
02	Qantas Drive, heading north.	255° flat aspect. SE and SW curved aspects.
03	QFTC C Site Access Road, heading south.	9° and 99° flat aspects. NW, NE and curved aspects.
04	QFTC C Site Access Road, heading south.	9° and 99° flat aspects. NW, NE and curved aspects.
05	QFTC South Access Road, heading east.	9°, 189° and 279° flat aspects. NW, NE and curved aspects.
06	Carpark Access Road North, heading east.	9°, 189° and 279° flat aspects. NW, NE and curved aspects.
07	Carpark Access Road North, heading west.	9° and 99° flat aspects. NW, NE and curved aspects.
08	Access Road between Pullman & Ibis Sydney Airport Hotel, heading west.	9° and 99° flat aspects. NW, NE and curved aspects.
09	Access Road between Pullman & Ibis Sydney Airport Hotel, heading west.	9° and 99° flat aspects. NW, NE and curved aspects.
10	Carpark Access Road East, heading north.	9° and 99° flat aspects. NW, NE and curved aspects.
11	Carpark Access Road East, heading south.	99° flat aspect.
12	King Street, heading east.	189° and 279° flat aspects. SE and SW curved aspects.
13	King Street, heading north.	99° and 189° flat aspects. SE and SW curved aspects.
14	King Street, heading west.	99° and 189° flat aspects. SE and SW curved aspects.
15	King Street, heading west.	99° and 189° flat aspects. NE, SE and SW curved aspects.
16	QFTC C Site Access Road, heading south-west.	9° flat aspect. NW, NE and curved aspects.

6.2 Analysis and Discussion

The amount of solar glare observed by motorists from the façade of the development at each study point location is presented in this section. Treatment options are provided if excessive solar glare conditions are observed.

6.2.1 Motorists heading east along Qantas Drive

Point 01 is located along Qantas Drive, to the west of the development site. This point represents the critical sightline of motorists heading east along Qantas Drive at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meters overlaid onto the viewpoint image at Point 01 indicates that the view of the development will not be visible from this location due to the obstruction from the local densely foliating vegetation. Hence there will be no adverse solar glare observed by motorists heading east along Qantas Drive at this location.

6.2.2 Motorists heading north along Qantas Drive

Point 02 is located along Qantas Drive, to the south-west of the development site. This point represents the critical sightline of motorists heading north along Qantas Drive at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meters overlaid onto the viewpoint image at Point 02 indicates that the view of the development will not be visible from this location due to the obstruction from the local densely foliating vegetation and billboard structures. Hence there will be no adverse solar glare observed by motorists heading north along Qantas Drive at this location.

6.2.3 Motorists heading south along QFTC C Site Access Road

Points 03 and 04 are located along QFTC C Site Access Road, to the east of the development site. These points represent the critical sightline of motorists heading south along QFTC C Site Access Road at these locations. Calibrated images of the viewpoint of motorists at these locations have been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meters overlaid onto the viewpoint image at Point 03 indicates that a part of the 99^{o} aspect of the car park development is visible and within the zone of sensitive vision. A further analysis indicates Point 03 is also within the check zone for 99^{o} aspect; however this portion of the facade will be overshadowed by the adjacent Travelodge building at the times when solar glare could have otherwise been observed. Hence there will be no adverse solar glare observed by motorists heading south along QFTC C Site Access Road at this location.

An analysis of the glare meters overlaid onto the viewpoint image at Point 04 indicates that the view of the development will not be visible from this location due to the obstruction from the

local densely foliating vegetation. Hence there will be no adverse solar glare observed by motorists heading south along QFTC C Site Access Road at this location.

6.2.4 Motorists heading east along QFTC South Access Road

Point 05 is located along QFTC South Access Road, to the north-west of the development site. This point represents the critical sightline of motorists heading east along QFTC South Access Road at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 05 indicates that a portion of the 189° and 279° aspects of the car park development will be visible and within the zone of sensitive vision. Point 05 is located within the check zones for these aspects and hence there is potential for solar glare to be observed. A further analysis indicates the building façade along these aspects are mainly comprised of by metallic lattice panels.

For solar glare to be reflected off the 189° southern aspect of the car park development, this would occur at certain times of the year in the early morning, however during early morning period when the reflected solar glare can be observed, the direct sun will also be visible and within the zone of sensitive vision of motorists at this location through the existing densely foliating vegetation. Hence the intensity of the reflected solar glare off the 189° aspect will be insignificant in comparison to the intensity of direct sunlight and a maximum normal specular reflectance of visible light of 20% is recommended to be used on the glazing along the 189° aspect of the proposed development

For solar glare to be reflected off the 279° southern aspect of the car park development, this would occur at certain times of the year in the late afternoon. To ensure that adverse solar glare does not affect motorists heading east along QFTC South Access Road, it is recommended the maximum normal specular reflectance of visible light for any façade element used on the car park building façade of the 279° western aspect should be 11%. Note that if glazed balustrades are used along these aspects, they are to have a maximum normal specular reflectance of visible light of 8%.

6.2.5 Motorists heading east along Carpark Access Road North

Point 06 is located along Carpark Access Road North, to the north-west of the development site. This point represents the critical sightline of motorists heading east along Carpark Access Road North at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 06 indicates that a portion of the 9°, 279° and north-western curved aspects of the training centre development will be visible and within the zone of sensitive vision. Point 06 is located within the check zones for these aspects and hence there is potential for solar glare to be observed. A further analysis indicates portion of the 9° aspect will be overshadowed by the adjacent Wilson Parking building at the times when solar glare could have otherwise been observed. For the remaining 279° and north-

western curved aspects, to ensure that adverse solar glare does not affect motorists heading east along QFTC South Access Road it is recommended the maximum normal specular reflectance of visible light for any façade element used on these aspects is 20%.

6.2.6 Motorists heading west along Carpark Access Road North

Point 07 is located along Carpark Access Road North, to the north-west of the development site. This point represents the critical sightline of motorists heading west along Carpark Access Road North at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 07 indicates that a portion of the 9° aspect of the training centre development will be visible and within the zone of sensitive vision. Point 07 is located within the check zones for this aspect and hence there is potential for solar glare to be observed. A further analysis indicates this would occur at certain times of the year in the early morning, however during early morning period when the reflected solar glare can be observed, the direct sun will also be visible and within the zone of sensitive vision of motorists at this location. Hence the intensity of the reflected solar glare off the 9° aspect will be insignificant in comparison to the intensity of direct sunlight and a maximum normal specular reflectance of visible light of 20% is recommended to be used on the glazing along the 9° aspect of the proposed development

6.2.7 Motorists heading west along the Access Road between Pullman & Ibis Sydney Airport Hotel.

Points 08 and 09 are located along the Access Road between Pullman & Ibis Sydney Airport Hotels; to the east of the development site. These points represent the critical sightline of motorists heading west along the Access Road at these locations. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 08 indicates that a portion of the 189° aspect of the car park development will be visible and within the zone of sensitive vision. Similarly an analysis of Point 09 indicates a portion of the 99° and 189° aspects of the car park development will be visible and within the zone of sensitive vision. Both Points 08 and 09 are located within the check zones for their respective aspects, hence there is potential for solar glare to be observed.

A further analysis indicates the portion of the 99° aspect within the zone of sensitive vision at Point 09 will be overshadowed by the adjacent Pullman Sydney Airport building at the times when solar glare could have otherwise been observed. For the remaining 189° aspect the building façade along this aspect is mainly comprised of by metallic lattice panels and reflected solar glare would would occur at certain times of the year in the late afternoon. However, during late afternoon period the direct sun will also be visible and within the zone of sensitive vision of motorists at this location through the existing densely foliating vegetation. Hence the

intensity of the reflected solar glare off the 189° aspect will be insignificant in comparison to the intensity of direct sunlight and a maximum normal specular reflectance of visible light of 20% is recommended to be used on the glazing along the 189° aspect of the proposed development

6.2.8 Motorists heading north along Carpark Access Road East

Point 10 is located along Carpark Access Road East, to the east of the development site. This point represents the critical sightline of motorists heading north along Carpark Access Road East at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meters overlaid onto the viewpoint image at Point 10 indicates that the view of the development will not be visible from this location due to the obstruction from the local densely foliating vegetation. Hence there will be no adverse solar glare observed by motorists heading north along Carpark Access Road East at this location.

6.2.9 Motorists heading south along Carpark Access Road East

Point 11 is located along Carpark Access Road East, to the east of the development site. This point represents the critical sightline of motorists heading south along Carpark Access Road East at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 11 indicates that a portion of the 99° aspect of the training centre development will be visible and within the zone of sensitive vision. Point 11 is located within the check zones for this aspect and hence there is potential for solar glare to be observed. For adverse glare to be reflected off the 99° aspect within the zone sensitive vision onto motorists at Point 11, the suns angular position would need to be within 0° to 10° inclination and 177° to 181° azimuth. According to the standard sun chart for Sydney, as shown in Appendix C, the sun does not operate at this angular position. Hence no adverse solar glare will be reflected from the development to driver heading south along Carpark Access Road East at this location.

6.2.10 Motorists heading east along King Street

Point 12 is located along King Street, to the south of the development site. This point represents the critical sightline of motorists heading east along King Street at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 12 indicates that a portion of the 189° aspect of the training centre development will be visible and within the zone of sensitive vision. Point 12 is located within the check zones for this aspect and hence there is potential for solar glare to be observed. A further analysis indicates this would occur at certain times of the year in the early morning, however during the early morning period when the

reflected solar glare can be observed, the direct sun will also be visible and within the zone of sensitive vision of motorists at this location. Hence the intensity of the reflected solar glare off the 189° aspect will be insignificant in comparison to the intensity of direct sunlight and a maximum normal specular reflectance of visible light of 20% is recommended to be used on the glazing along the 189° aspect of the proposed development

6.2.11 Motorists heading north along King Street

Point 13 is located along King Street, to the south of the development site. This point represents the critical sightline of motorists heading north along King Street at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 13 indicates that a portion of the 99° aspect of the training centre development and a portion of the 189° aspect of the car park development will be visible and within the zone of sensitive vision. Point 13 is not located within the check zone for the 189° aspect of the car park development and hence there will be no adverse solar glare observed by the motorists from the car park development. Point 13 is however located within the check zone for the 99° aspect of training centre development and hence there is potential for solar glare to be observed. A further analysis this portion of the facade will be overshadowed by the proposed car park development and the densely foliating vegetation at the times when solar glare could have otherwise been observed. Hence there will be no adverse solar glare observed by motorists heading north along King Street at this location.

6.2.12 Motorists heading west along King Street

Points 14 and 15 are located along King Street, to the south of the development site. These points represent the critical sightline of motorists heading west along King Street at these locations. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meter overlaid onto the viewpoint at Point 14 indicates that a portion of the 189° aspect of the training centre development will be visible and within the zone of sensitive vision. Point 14 is located within the check zone for this aspect, hence there is potential for solar glare to be observed. A further analysis indicates this would occur at certain times of the year in the late afternoon, however during late afternoon period when the reflected solar glare can be observed, the direct sun will also be visible and within the zone of sensitive vision of motorists at this location. Hence the intensity of the reflected solar glare off the 189° aspect will be insignificant in comparison to the intensity of direct sunlight and a maximum normal specular reflectance of visible light of 20% is recommended to be used on the glazing along the 189° aspect of the proposed development

An analysis of the glare meter overlaid onto the viewpoint at Point 15 indicates that a portion of the 99°, 189° and south-eastern curved aspects of the training centre development will be

visible and within the zone of sensitive vision. Point 15 is located within the check zone for this aspect, hence there is potential for solar glare to be observed. A further analysis the portion of the façade on the 99° aspect will be overshadowed by the adjacent Travelodge Hotel building at the times when solar glare could have otherwise been observed. Hence there will be no adverse solar glare observed off the 99° aspect. The adverse solar glare observed off the 189° and south-eastern curved aspects would occur at certain times of the year in the late afternoon, however during late afternoon period when the reflected solar glare can be observed, the direct sun will also be visible and within the zone of sensitive vision of motorists at this location. Hence the intensity of the reflected solar glare off the 189° and south-eastern curved aspects will be insignificant in comparison to the intensity of direct sunlight and a maximum normal specular reflectance of visible light of 20% is recommended to be used on the glazing along the 189° and south-eastern curved aspects of the proposed development.

6.2.13 Motorists heading south-west along QFTC C Site Access Road

Point 16 is located along QFTC C Site Access Road, to the north-east of the development site. This point represents the critical sightline of motorists heading south-west along QFTC C Site Access Road at this location. A calibrated image of the viewpoint of motorists at this location has been overlaid with a scaled glare meter, as shown in Appendix A.

An analysis of the glare meters overlaid onto the viewpoint image at Point 16 indicates that a part of the 99° aspect of the car park development is visible and within the zone of sensitive vision. A further analysis indicates Point 16 is also within the check zone for 99° aspect; however this portion of the facade will be overshadowed by the adjacent Tri-Generation Plant TG1 building at the times when solar glare could have otherwise been observed. Hence there will be no adverse solar glare observed by motorists heading south-west along QFTC C Site Access Road at this location.

7 GLARE OBSERVED BY TRAIN DRIVERS

The railway line runs parallel with Qantas Drive and as such the western side of the subject development will be somewhat directly in the line of sight. However, the view of the development will be blocked by the existing densely foliating trees between the railway line and the subject development. Hence there will be no adverse solar glare observed by train drivers on the railway line from the façade of the development.

8 GLARE OBSERVED BY PEDESTRIANS AND OCCUPANTS OF NEIGHBOURING BUILDINGS

Our past experience involving more than 250 projects, and also research by Rofail and Dowdle (2004), tends to indicate that buildings which cause a nuisance to pedestrians and 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. Hence a general recommendation is made that all glazing and other reflective materials used on the façade of the subject development have a maximum normal specular reflectivity of visible light of 20% to avoid adverse solar glare to pedestrians and occupants of neighbouring buildings.

9 TYPICAL NORMAL SPECULAR REFLECTANCE OF BUILDING SURFACES

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 following sub-sections provide some general reflectance values of more reflective materials used on building facades.

9.1 Glazed Surfaces

A glazing supplier will be able to provide information on the maximum normal specular reflectance of visible light of different types of glazing. Some typical reflectivity values of different types of glazing are listed as follows:

- Clear float glass – typically 5% to 8%
- Low-e solar control glazing – typically 8% to 12%
- Other types of compliant performance glazing – up to 20%

9.2 Painted and/or Powder-Coated Metallic Surfaces

In the event that some portions of the external façade of the development feature power-coated or painted metallic surfaces, it is not expected that adverse glare will be observed from those surfaces since the maximum normal specular reflectance of visible light of these types of façade materials range from 1% to 5%. This is well within the maximum limits specified in previous sections of this report.

10 CONCLUSION

A detailed study has been undertaken for the effect of potential solar glare from the proposed Qantas Group Flight Training Centre & Car Park development located in Mascot. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians, and to occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with the controls for solar glare from the Botany Bay Development Control Plan 2013.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, occupants of neighbouring buildings, and to comply with the abovementioned planning control requirements, the following limitations to the maximum normal specular reflectance of visible light of the external façade glazing is recommended:

- The maximum normal specular reflectance of visible light on the façade and windows on all levels of the 279° western aspects of the car park development is to be 11%.

  Note that if glazed balustrades are used along the 279° western aspects of the car park development, they are to have a maximum normal specular reflectance of visible light of 8%.

- All other glazing (windows and balustrades) should have a maximum normal specular reflectance of visible light of 20%.

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 (i.e. less than 1% normal specular reflectance) and hence will not cause any adverse solar glare effects. Note also that, for any painted or powder-coated metallic surfaces on the exterior façade of the development, the maximum normal specular reflectance of visible light for those types of surfaces is in the range of 1% to 5%, which is well within the abovementioned limit.

Hence, with the incorporation of the abovementioned recommendations, the results of this study indicate that the subject development will not cause adverse solar glare to motorists or pedestrians in the surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from the Botany Bay Development Control Plan 2013.

11 RISK ASSESSMENT AND MITGATION MEASURES

Matter	Potential Impact	Likelihood	Consequence	Risk Level	Proposed Mitigation Measure
Solar Reflectivity	Glare into the eyes of pedestrians, motorists or train drivers from building	C	4	Low	Limit Specular Reflectance values on the 279° western aspect of the car park façade to less than 11% and all other glazing on the development to less than 20% as per Solar Light Reflectivity Report Section 10.

12 REFERENCES

Botany Bay Council, 2013 "Botany Bay Development Control Plan 2013".

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

Phillips, R.O., 1992, "Sunshine and Shade in Australasia", Sixth Edition, CSIRO Publishing.

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

APPENDIX A GLARE OVERLAYS FOR THE CRITICAL SIGHT-LINES

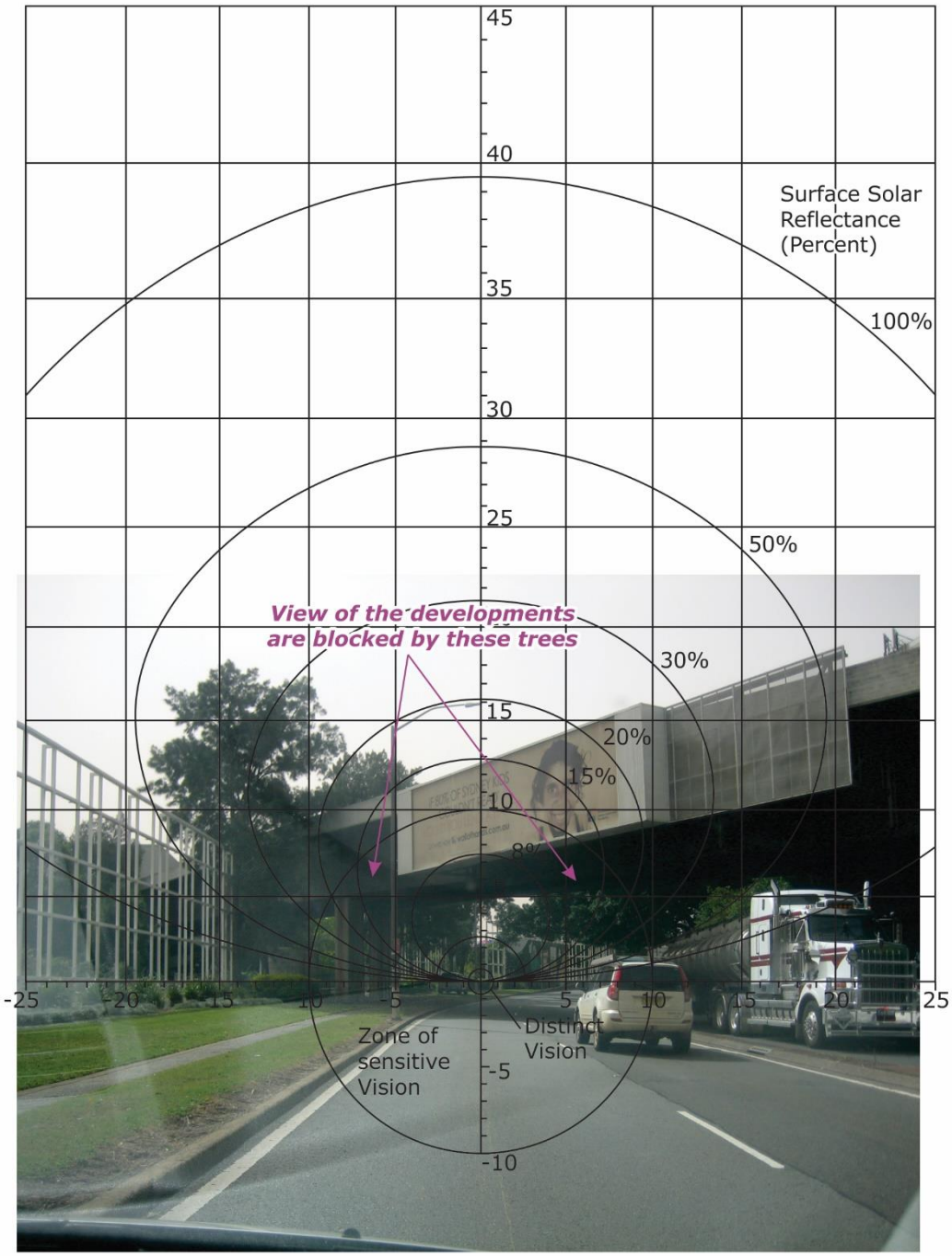

Figure A.1: Glare Overlay of the Viewpoint at Point 01

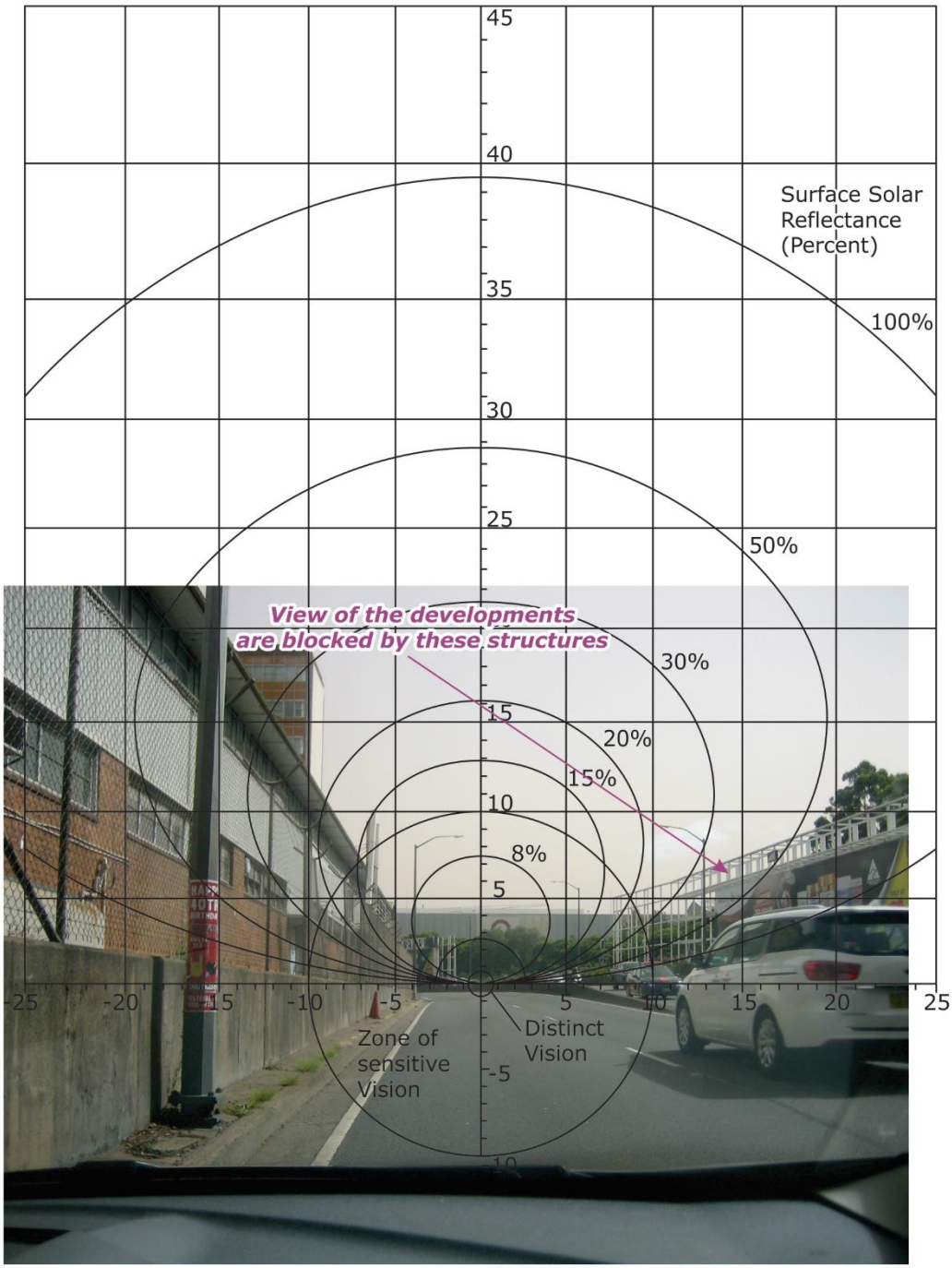

Figure A.2: Glare Overlay of the Viewpoint at Point 02

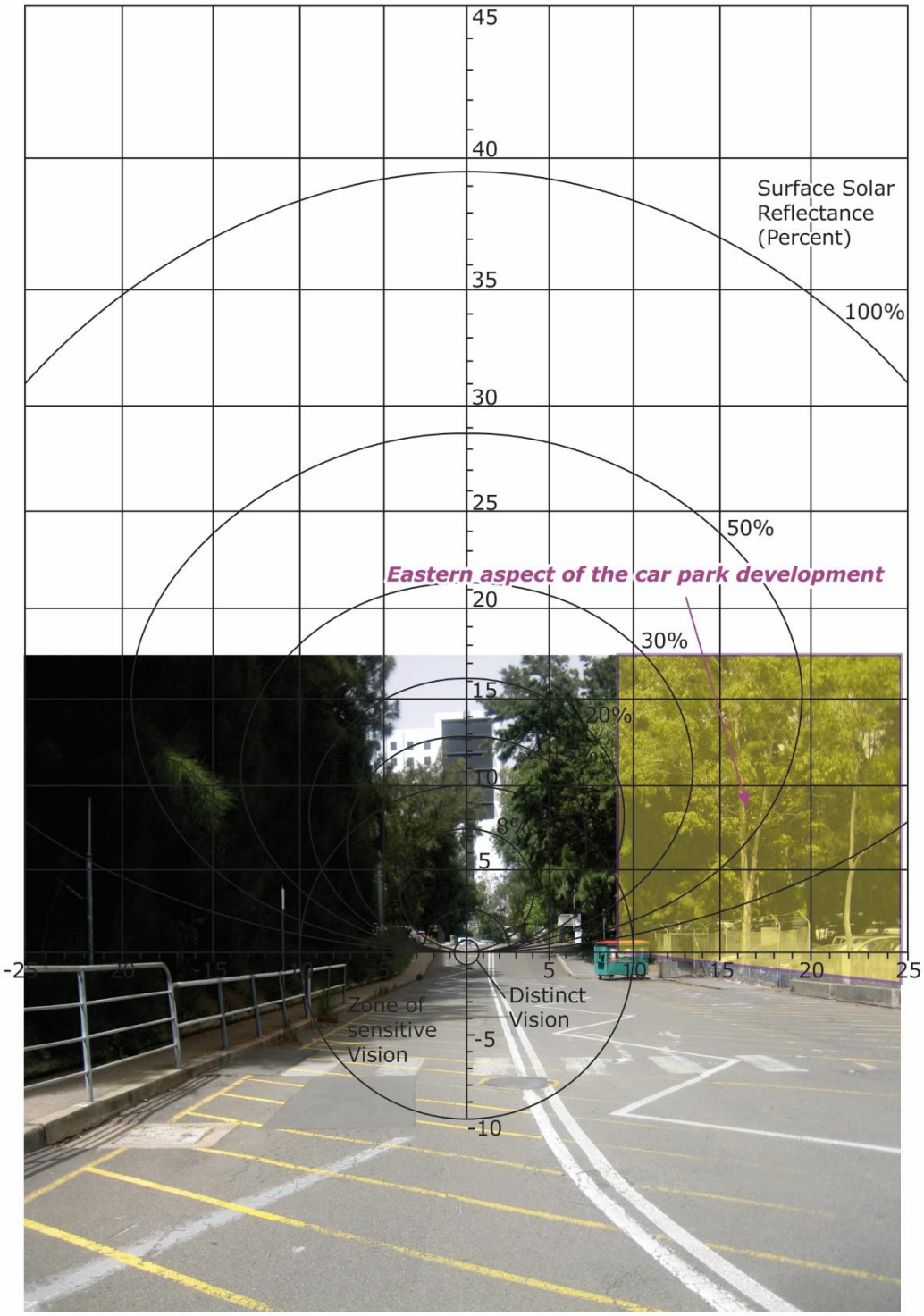

Figure A.3: Glare Overlay of the Viewpoint at Point 03

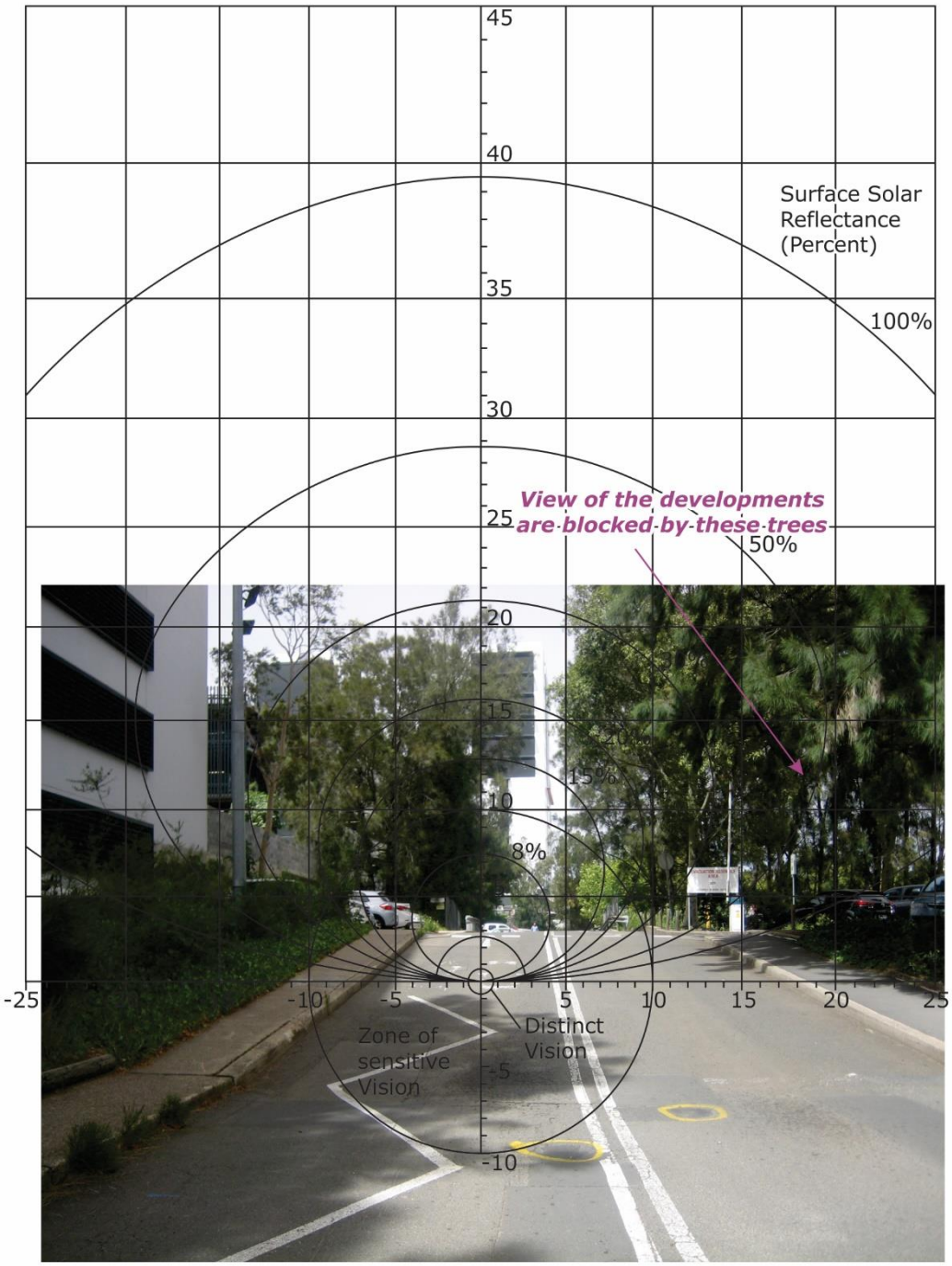

Figure A.4: Glare Overlay of the Viewpoint at Point 04

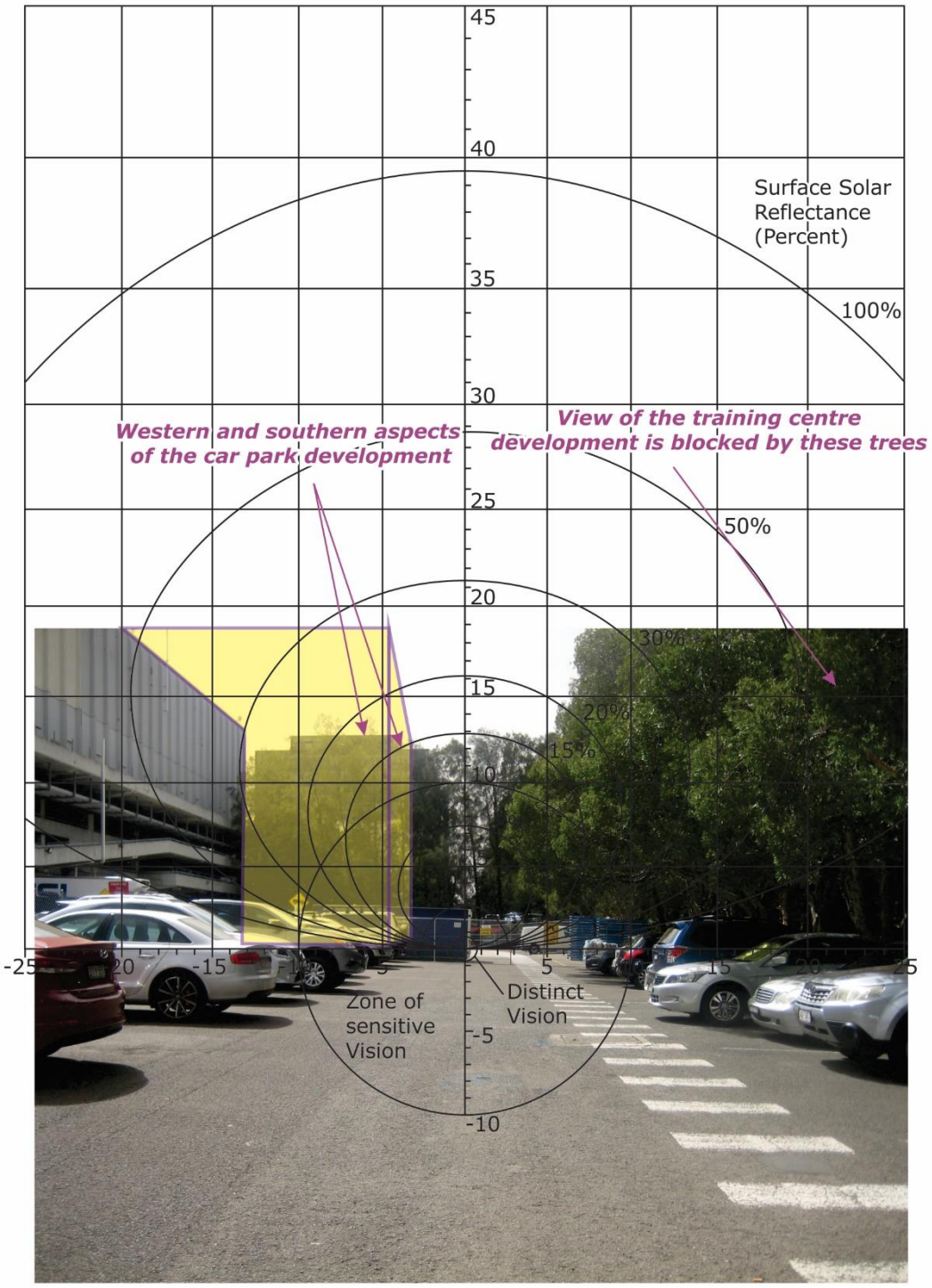

Figure A.5: Glare Overlay of the Viewpoint at Point 05

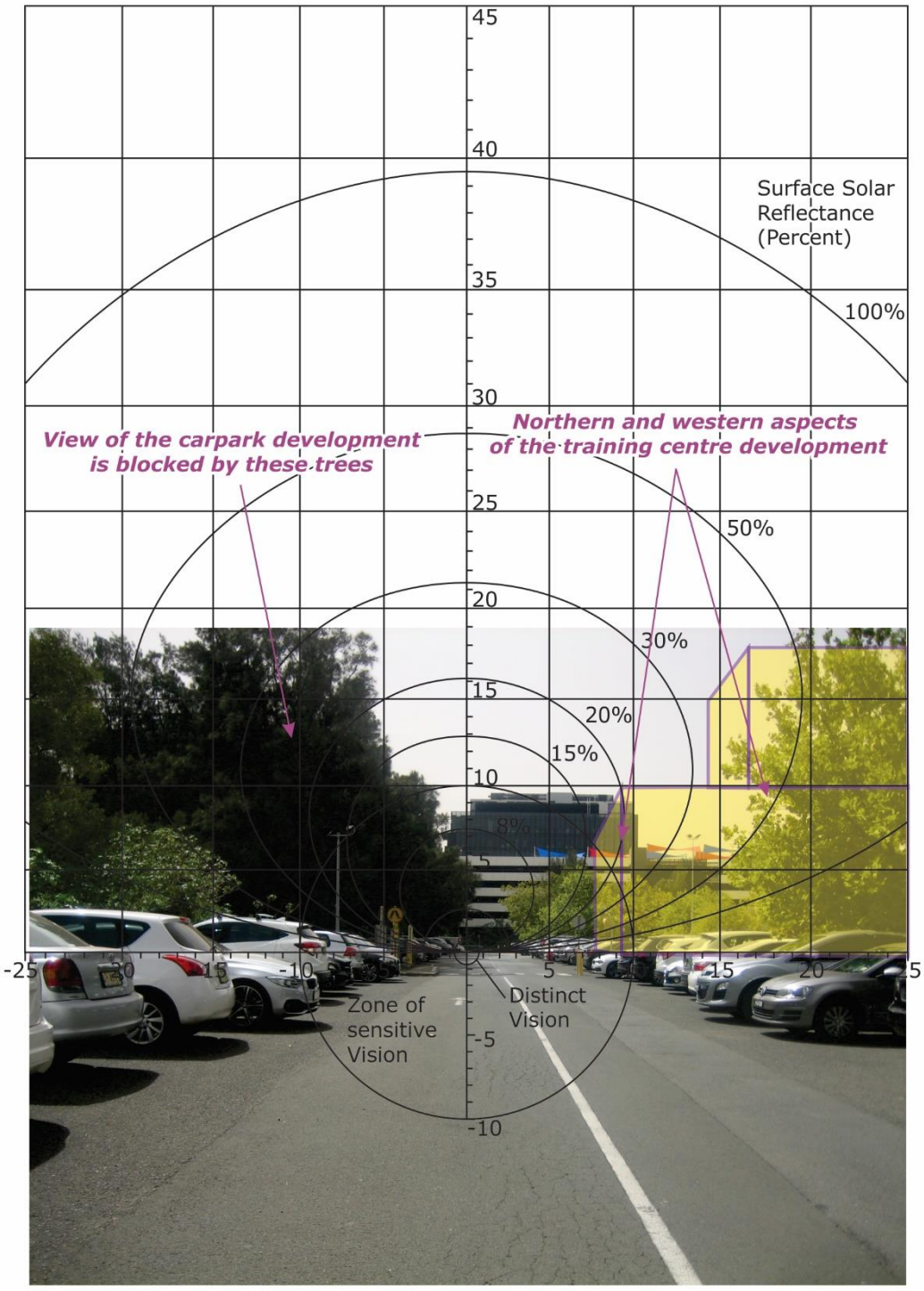

Figure A.6: Glare Overlay of the Viewpoint at Point 06

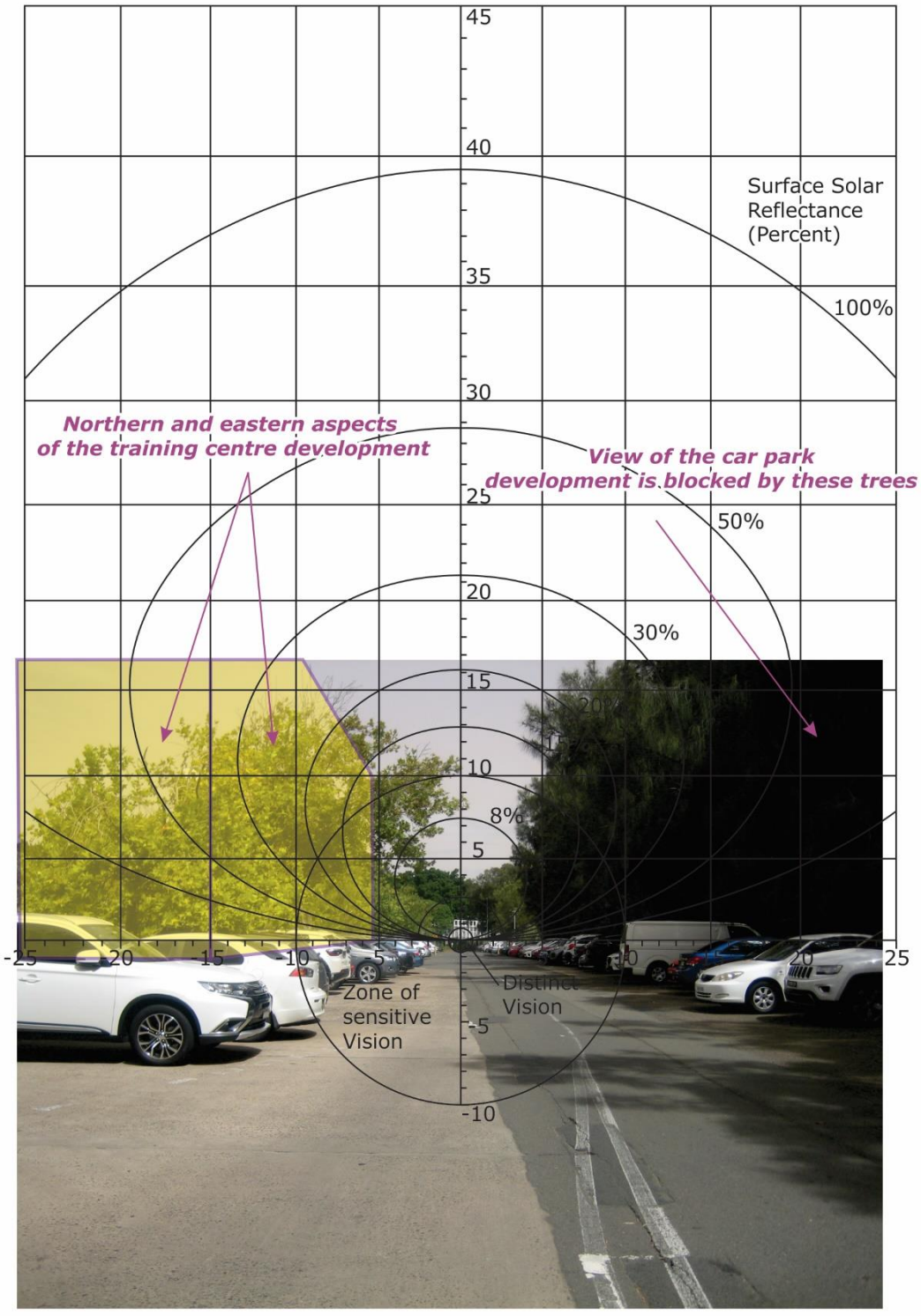

Figure A.7: Glare Overlay of the Viewpoint at Point 07

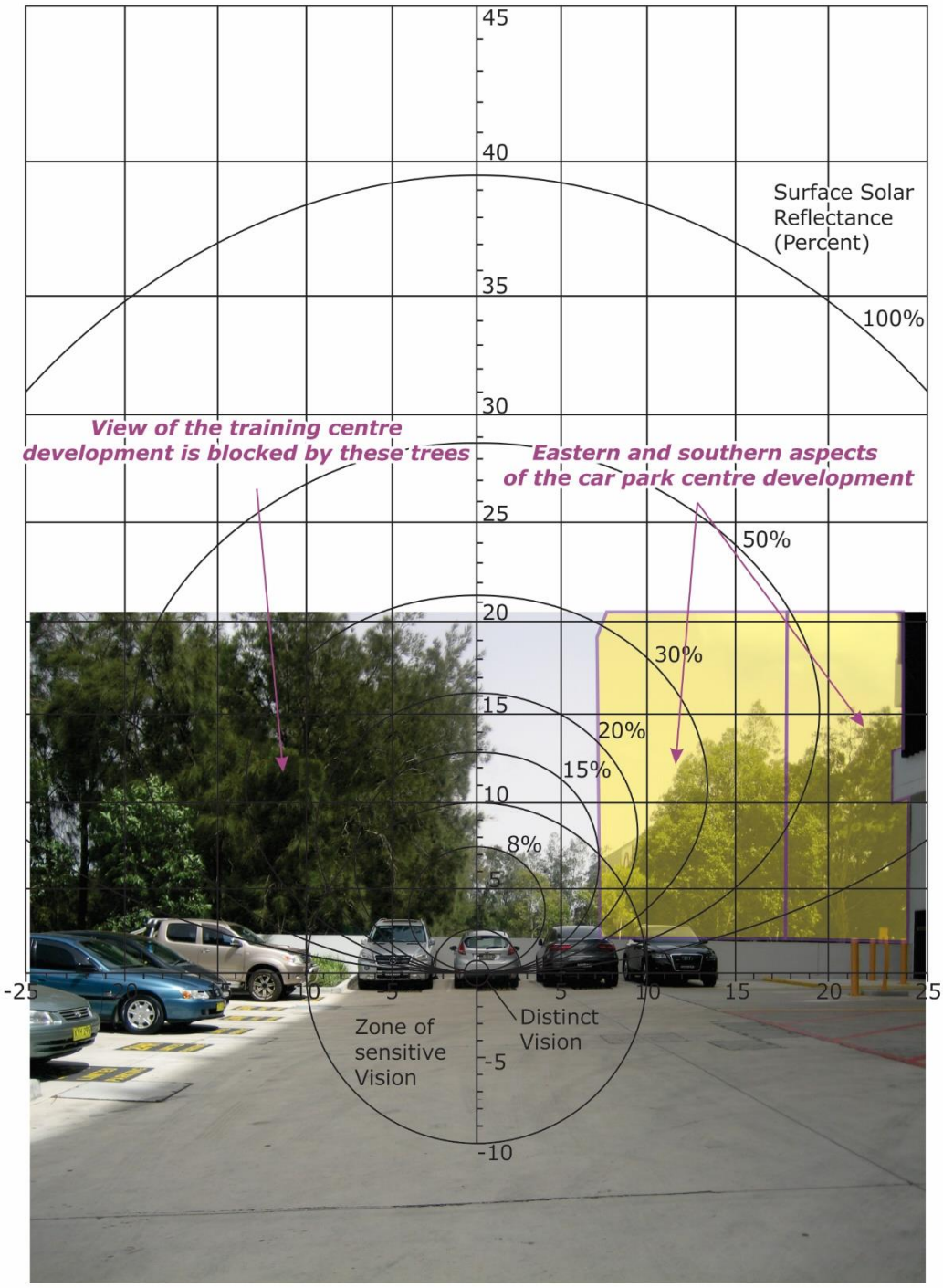

Figure A.8: Glare Overlay of the Viewpoint at Point 08

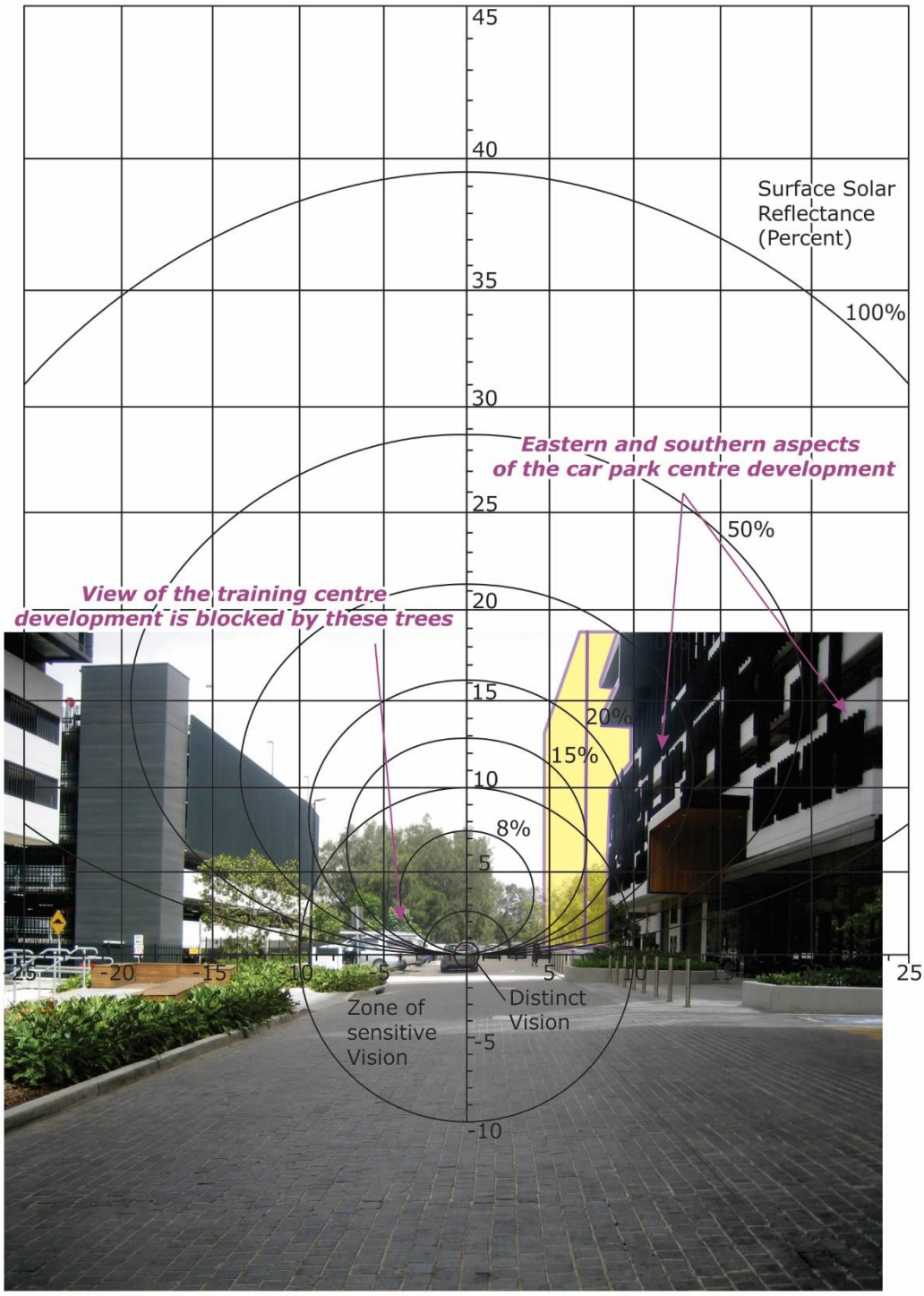

Figure A.9: Glare Overlay of the Viewpoint at Point 09

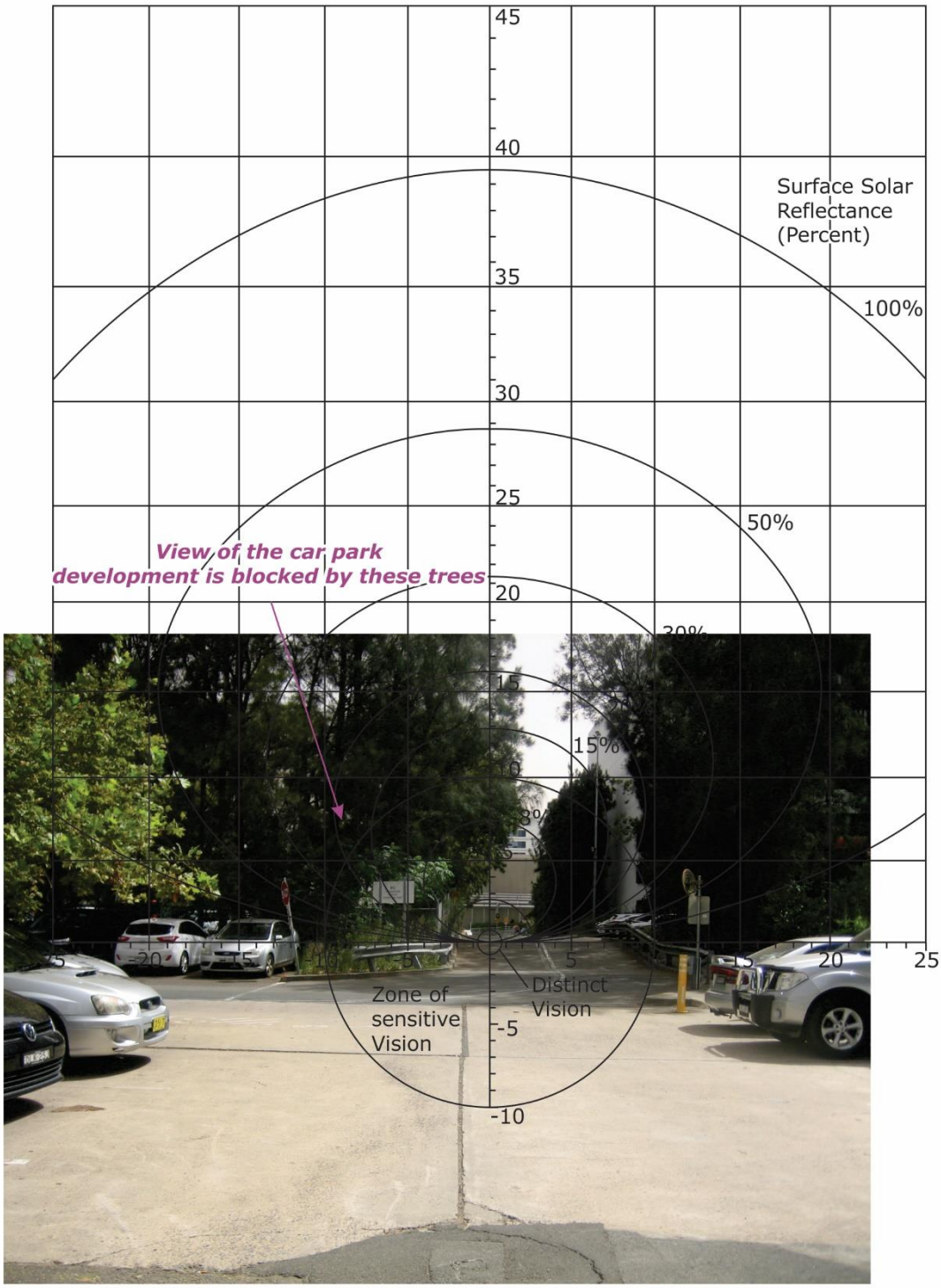

Figure A.10: Glare Overlay of the Viewpoint at Point 10

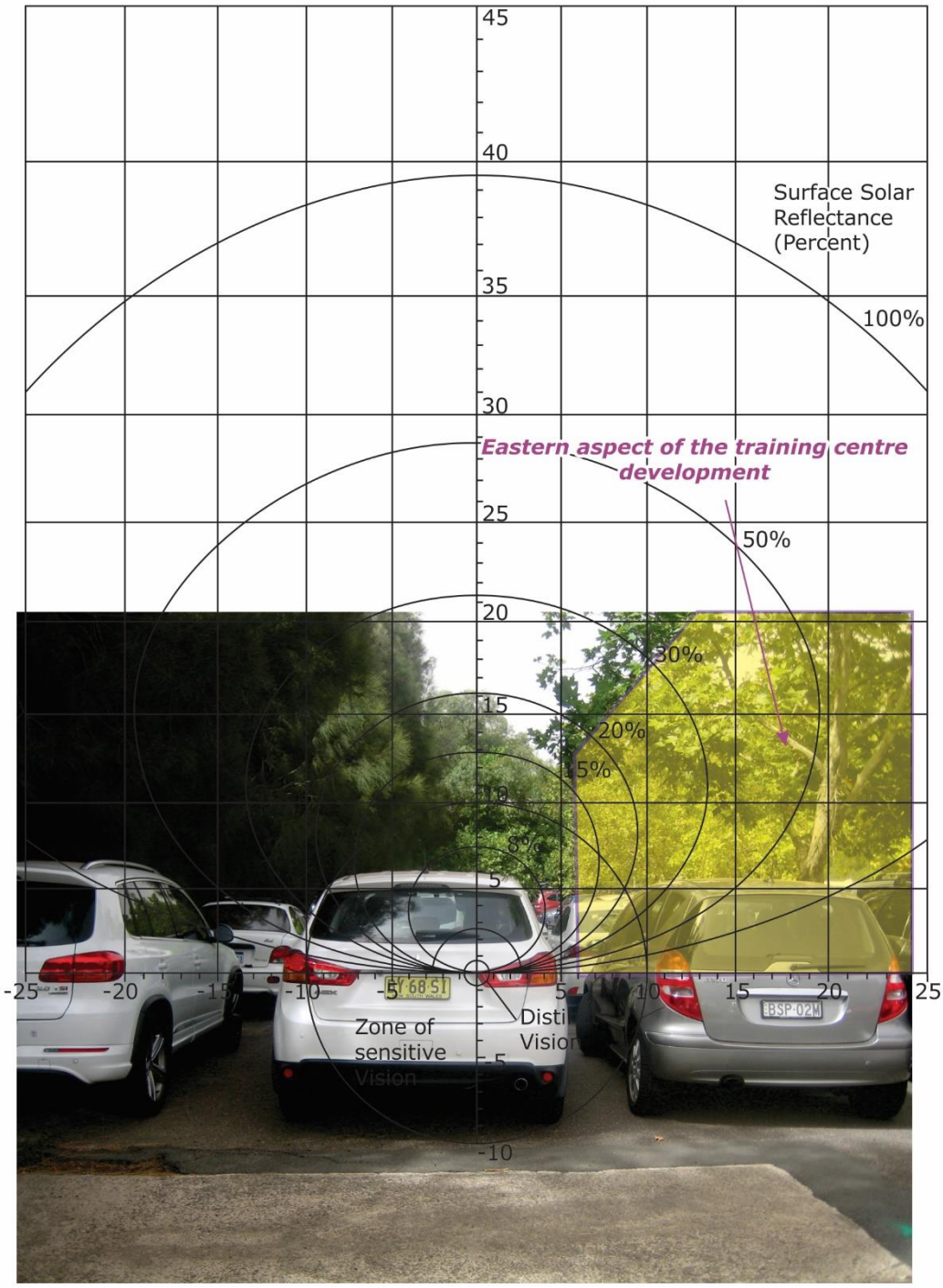

Figure A.11: Glare Overlay of the Viewpoint at Point 11

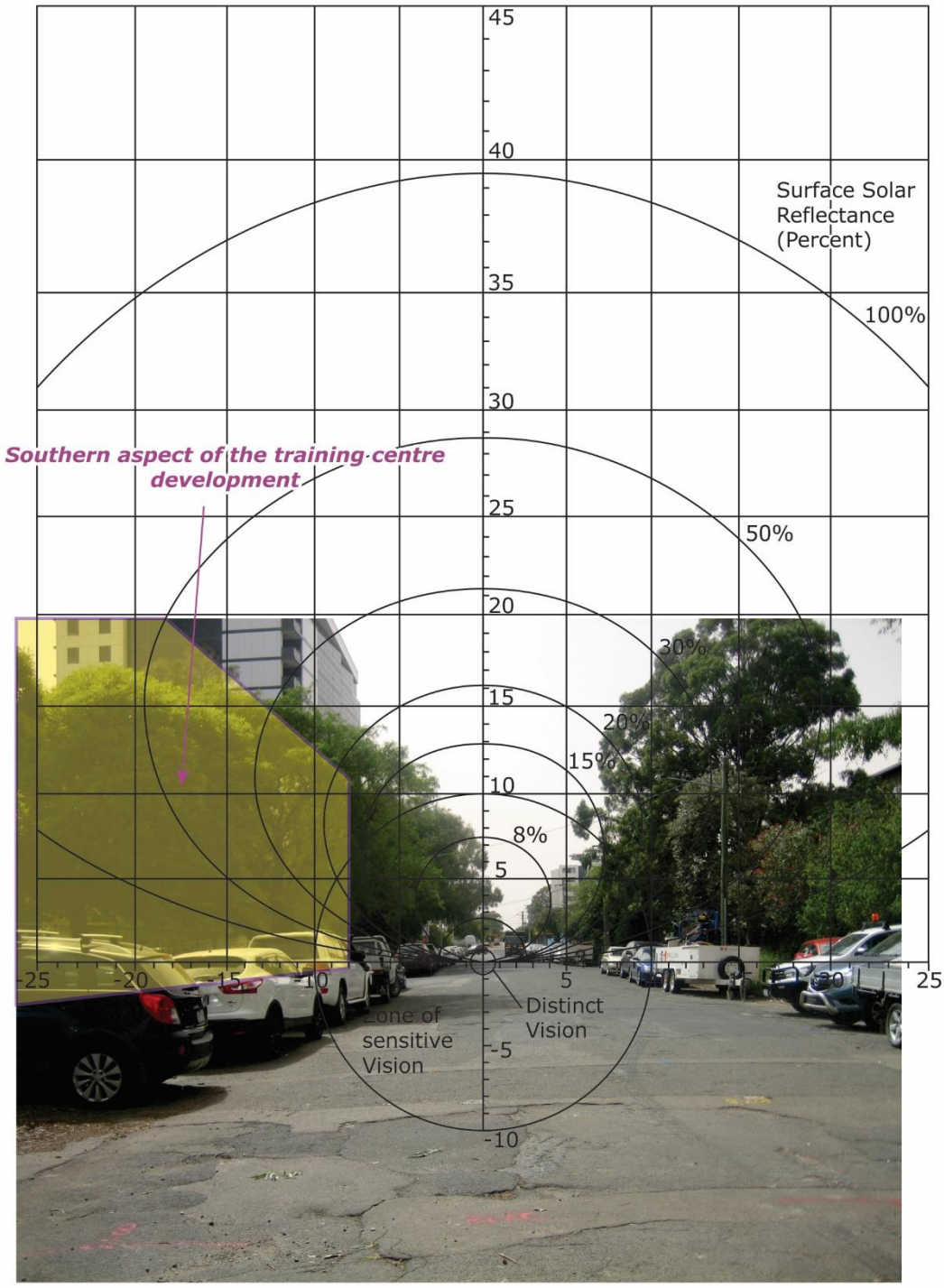

Figure A.12: Glare Overlay of the Viewpoint at Point 12

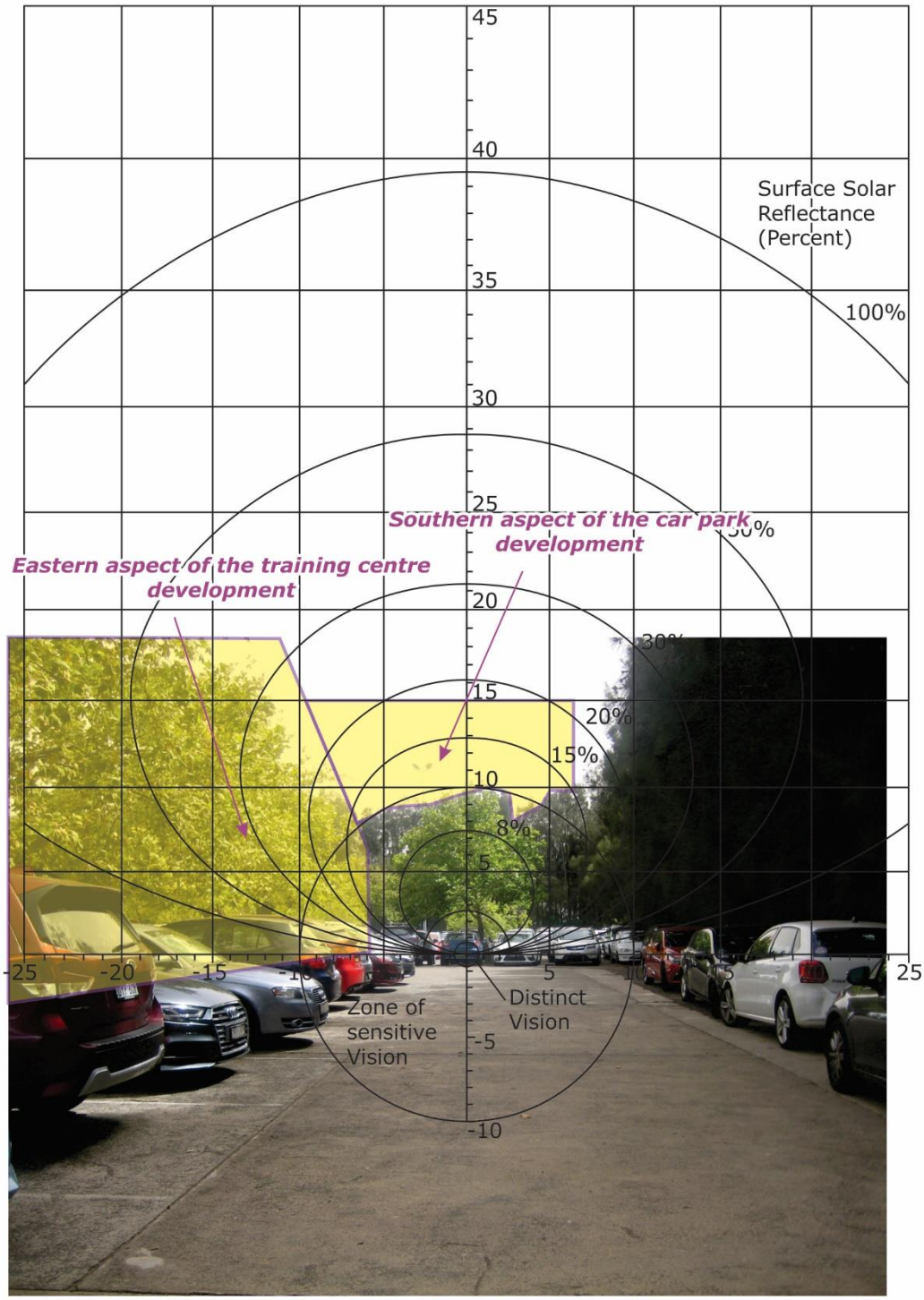

Figure A.13: Glare Overlay of the Viewpoint at Point 13

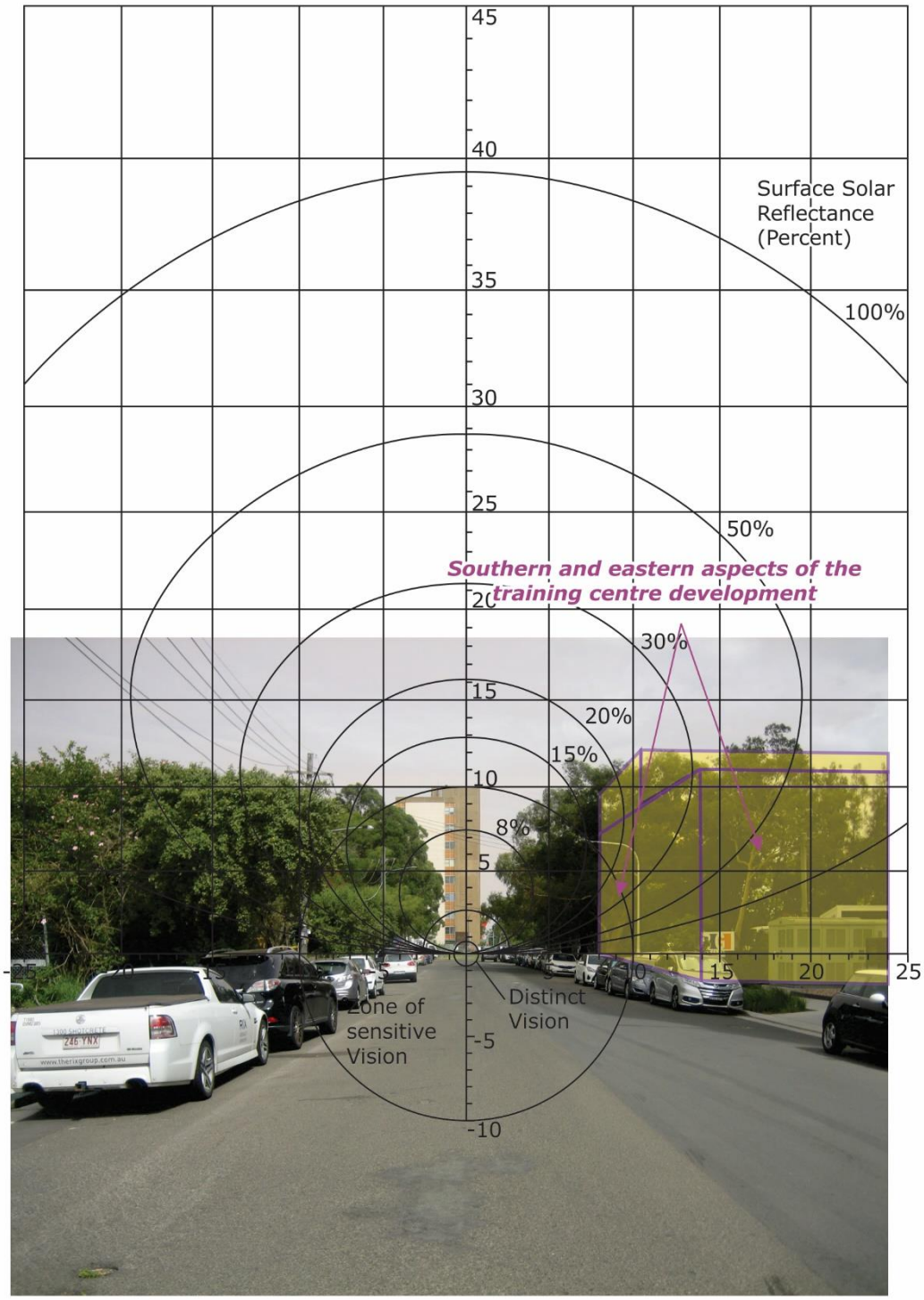

Figure A.14: Glare Overlay of the Viewpoint at Point 14

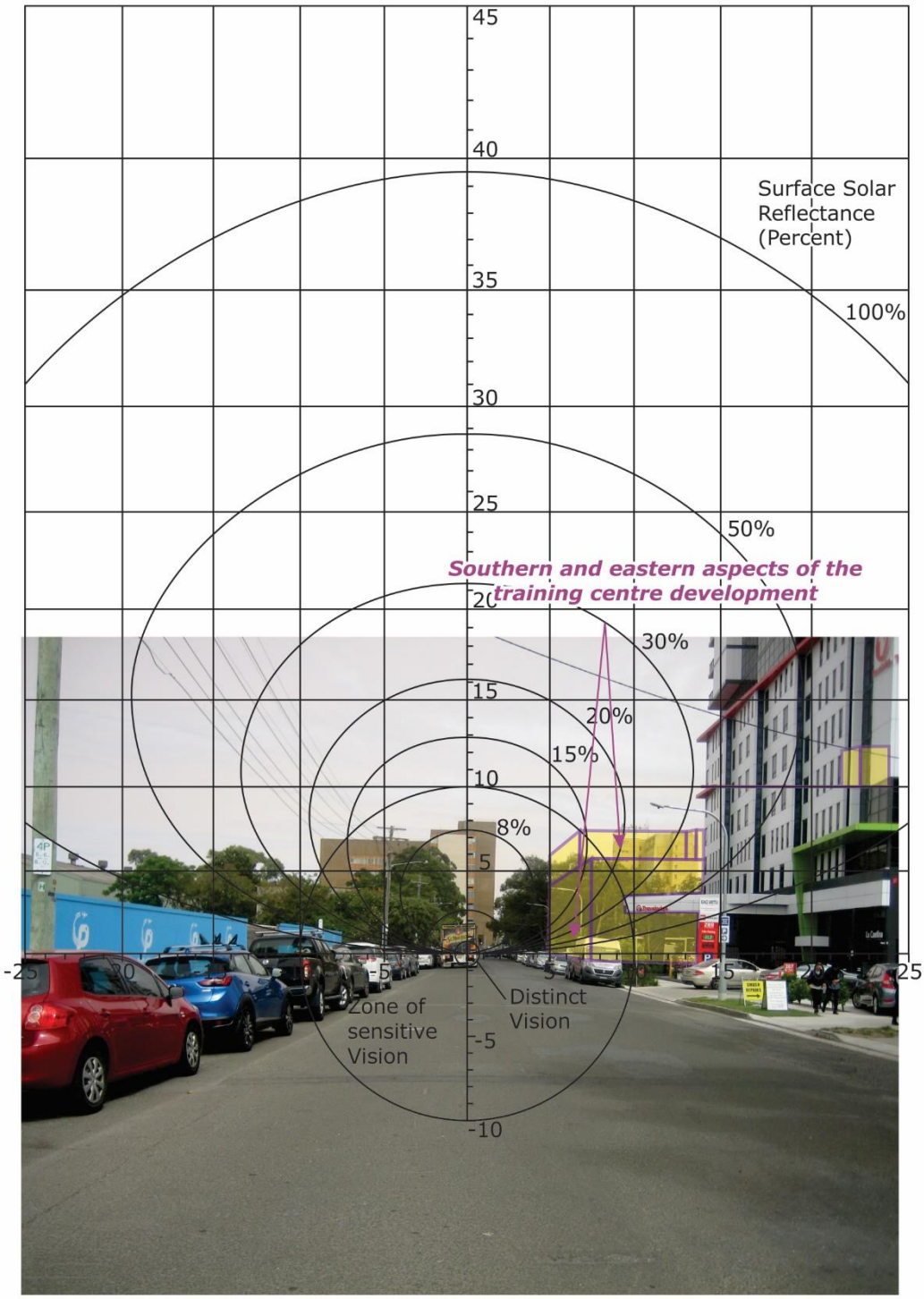

Figure A.15: Glare Overlay of the Viewpoint at Point 15

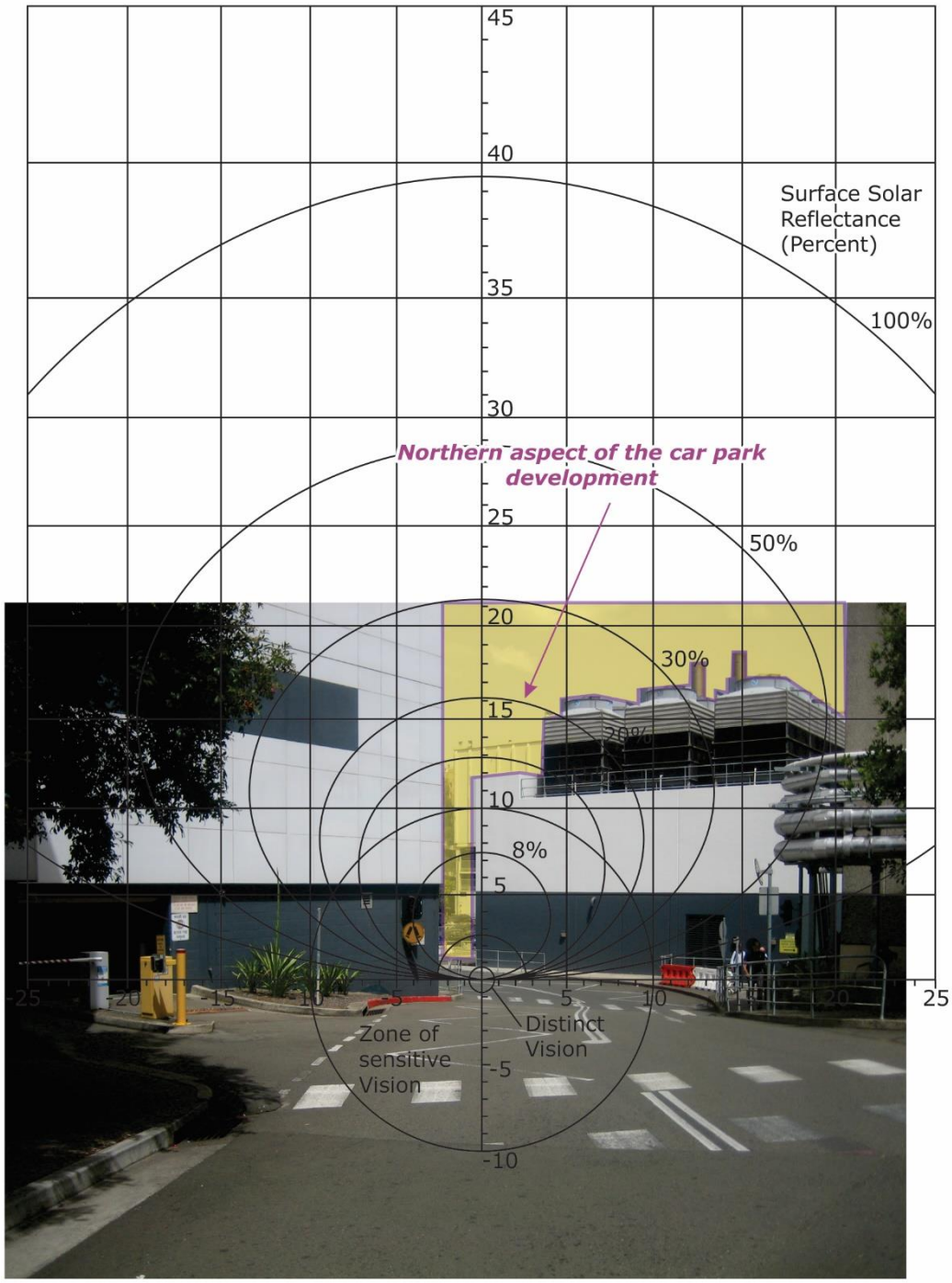

Figure A.16: Glare Overlay of the Viewpoint at Point 16

APPENDIX B SOLAR CHARTS FOR THE VARIOUS CRITICAL ASPECTS

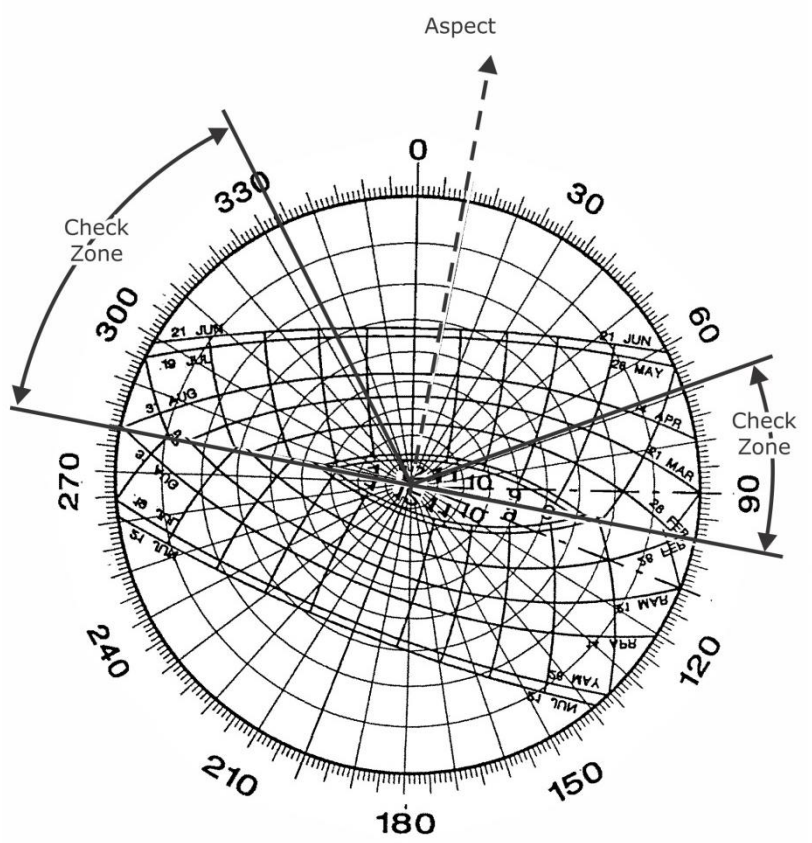

Figure B.1: Sun Chart for the 009° Aspect

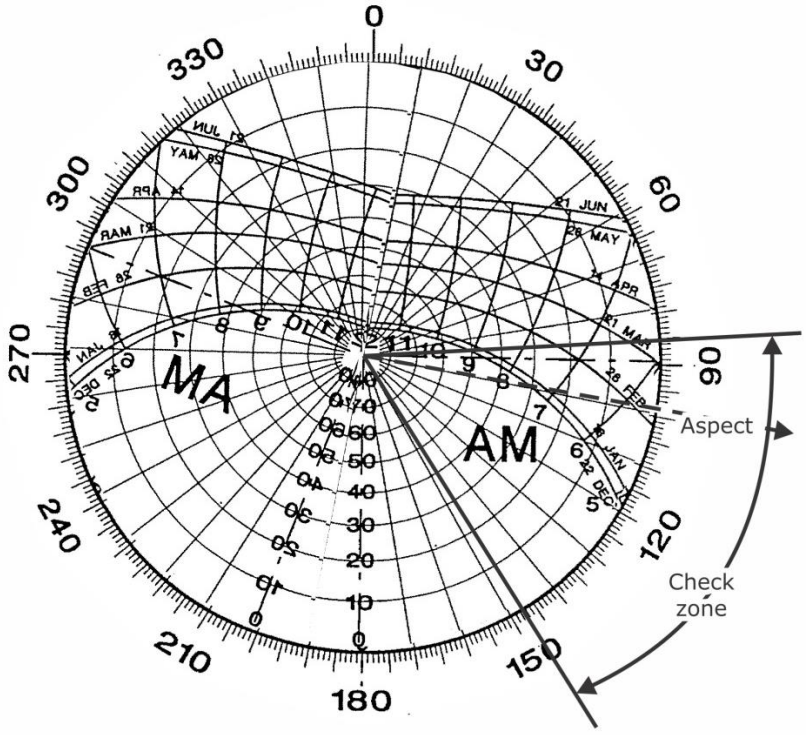

Figure B.2: Sun Chart for the 099° Aspect

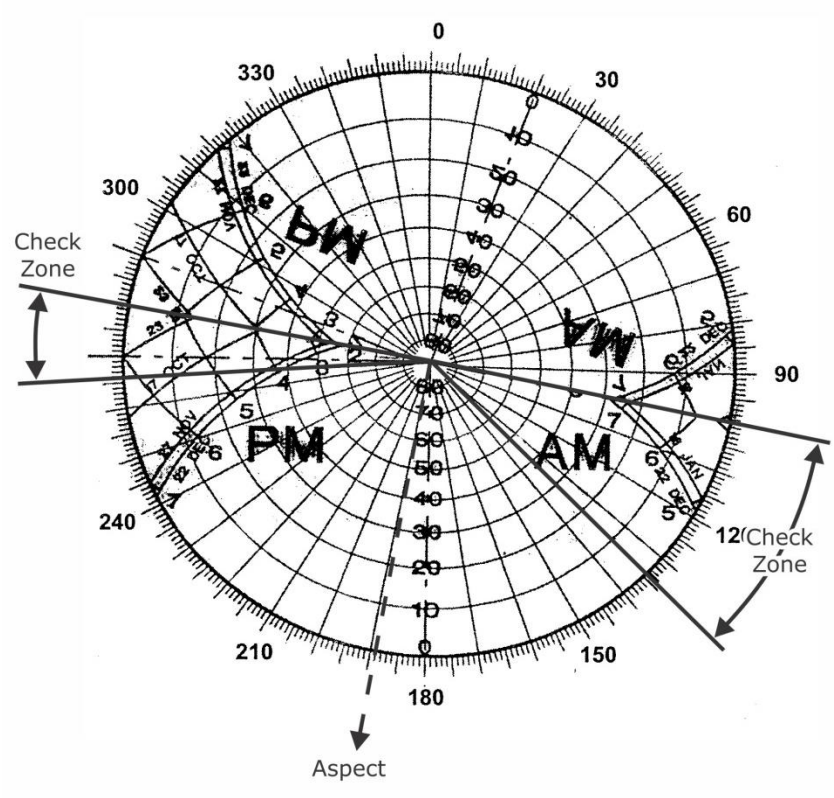

Figure B.3: Sun Chart for the 189° Aspect

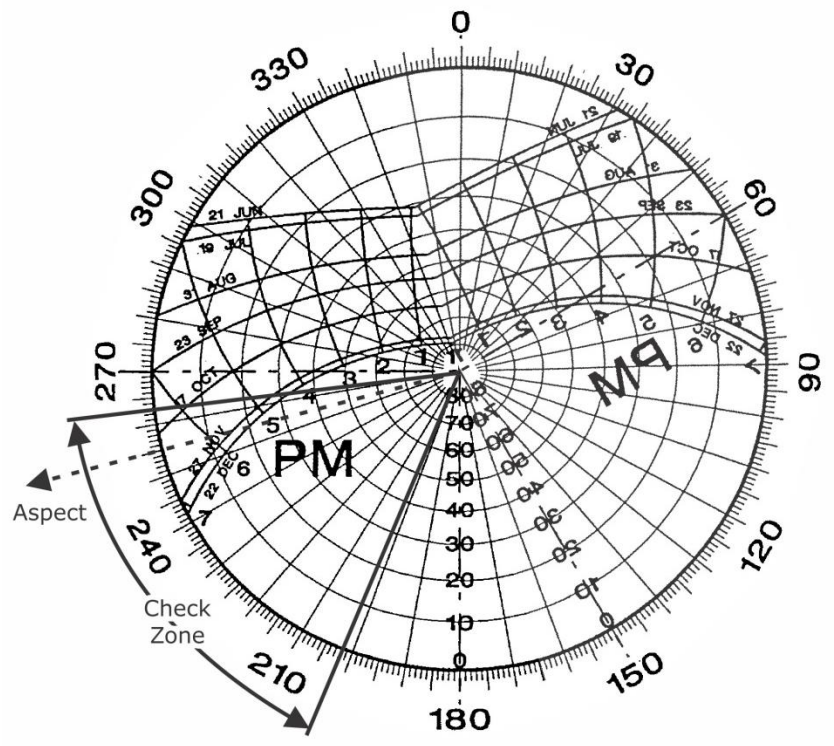

Figure B.4: Sun Chart for the 255° Aspect

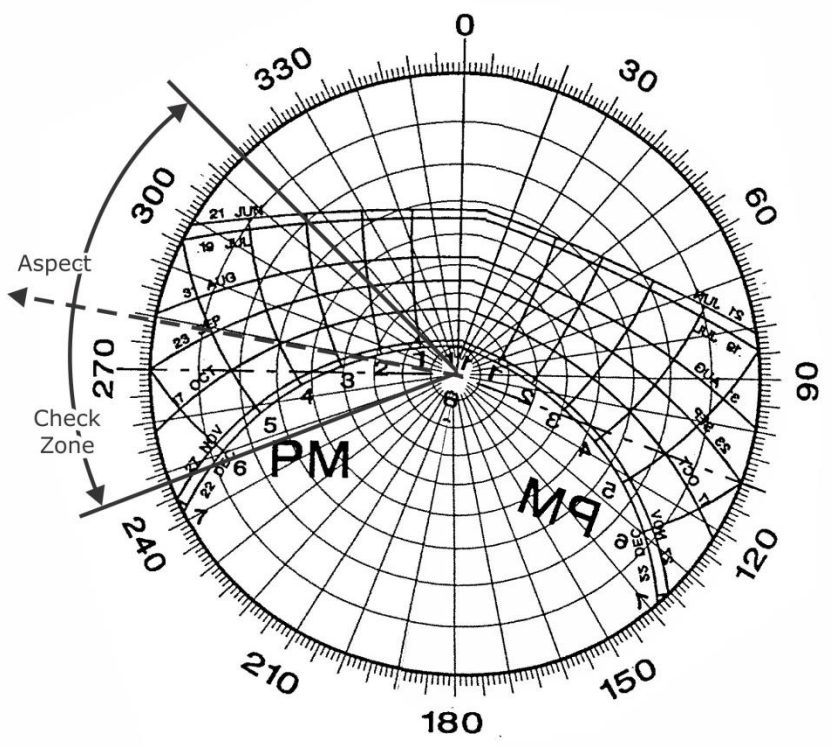

Figure B.5: Sun Chart for the 279° Aspect

APPENDIX C STANDARD SUN CHART FOR THE REGION

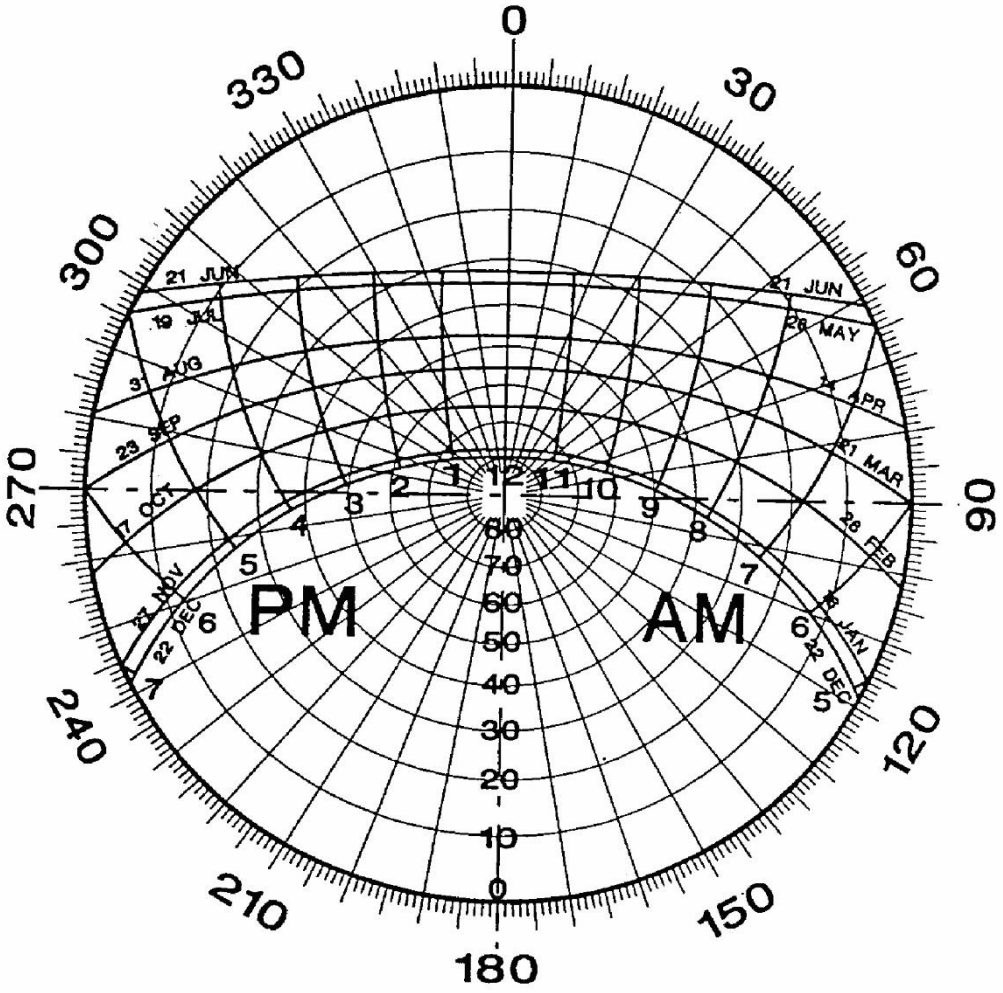

Figure C.1: Standard Sun Chart for the Sydney Region