SOLAR LIGHT REFLECTIVITY STUDY

CENTRAL COAST QUARTER – NORTH TOWER, GOSFORD

WF011-02F03(REV3)- SR REPORT

AUGUST 24, 2021

Prepared for:

SH Gosford Residential Pty Ltd

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DOCUMENT CONTROL

Date	Revision History	Issued Revision	Prepared By (initials)	Instructed By (initials)	Reviewed & Authorised by (initials)
March 30, 2021	Initial.	0	MB	AFM	AB
April 7, 2021	Insert reference to Concept SSDA Condition C7.	1	MB	AFM	RL
April 8, 2021	Correct reference to Concept SSDA Condition C7.	2	MB	AFM	TH
August 24, 2021	Insert reference to SEARs	3	RL	AFM	TH

EXECUTIVE SUMMARY

This Solar Light Reflectivity Study report is submitted to the Department of Planning, Industry and Environment (DPIE) on behalf of the SH Gosford Residential and in support of an application for SSD application number 23588910 at 26-30 Mann Street, Gosford. The SSDA seeks consent for:

- Demolition of the existing retaining wall on site.
- Removal of three trees located at the site interface with Baker Street.
- Excavation to a depth of approximately 1.3m to accommodate the proposed ground floor structure.
- Earthworks to level the site in readiness for the proposed building.
- Construction of a 25-storey (26 level) mixed-use building, comprising:
    - 621sqm of retail GFA.
    - 136 apartments, equating to 13,263sqm of residential GFA.
    - Four parking levels for 181 cars, with vehicular access from Baker Street.
    - Storage areas and services.
    - Communal open space.
- Publicly accessible through site link, including stairs, walkways, public lift, public art and landscaping.

This report addresses the Planning Secretary's Environmental Assessment Requirements (SEARs) Item 6 - Environmental and Residential Amenity (Doc. Ref.: SSD-23588910). To ensure a high level of environmental amenity is demonstrated, this report presents the results of a detailed study for the effect of potential solar glare from the proposed development known as the Central Coast Quarter - North Tower, located at 26-30 Mann Street, Gosford. This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians and boat drivers within the local surrounding area, and to occupants of neighbouring buildings. If necessary, recommendations are made to mitigate any potentially adverse effects. This study assesses compliance with Concept SSDA Condition C7 and the controls for solar glare from the State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG), and the Gosford City Centre Development Control Plan 2018.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, boat drivers within the local surrounding area, 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:

- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Levels 14-18 for the glazing at the northern end of the eastern aspect of the southern component of the development.

- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used for the glazing at the northern end of the eastern aspect of the southern component of the development at Levels 11-13 and 19-20.

- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Ground Level to Level 10 for the glazing on the western aspect of the development.

- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used on the glazing, windows and glass balustrades on Levels 11 to 17 for the western aspect of the development.

- A maximum normal specular reflectance of visible light of 12% is recommended to be used on the glazing, windows and glass balustrades on Levels 18 to 24 for the western aspect of the development.

- 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, pedestrians or boat drivers within the local surrounding area, or to occupants of neighbouring buildings, and will comply with Concept SSDA Condition C7 and the planning controls regarding reflectivity from SEPP65 and the Gosford City Centre Development Control Plan 2018.

CONTENTS

1 GLARE OBSERVED BY MOTORISTS

1.1 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 1. 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 Figure 2. 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 2 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 1.2 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 ±16° of the direct sight-line). These are shown in Figure 2, and summarised in Table 1. Images have been generated from a 3D computer model of the development and surroundings which depict the viewpoint of motorists at each study point location, and a scaled glare protractor has been superimposed over each viewpoint image (these are presented in Appendix A). Perspective views of the 3D computer model utilised in this study are provided in Figures 3.

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.

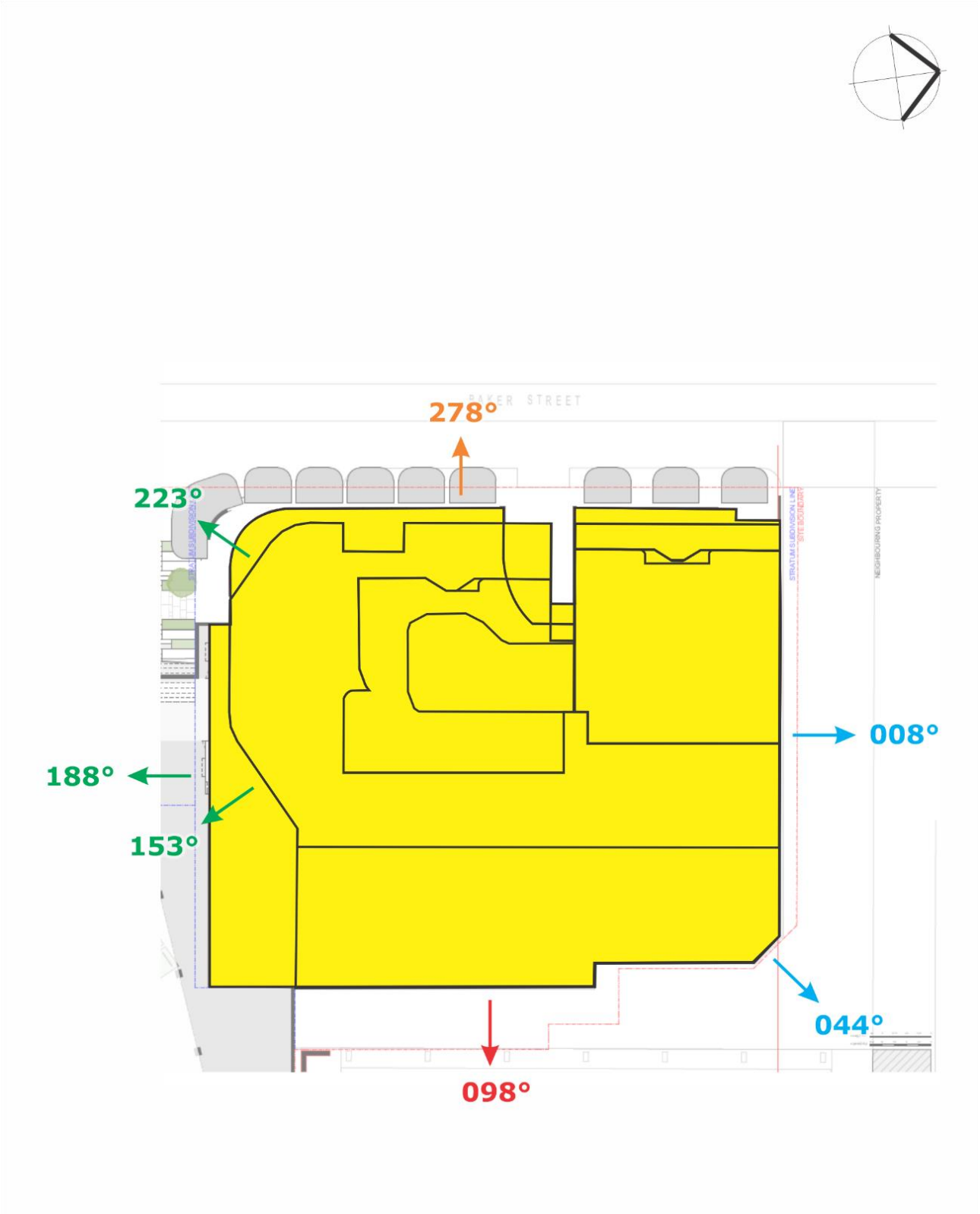


Figure 1: Critical Glazed Aspects of the Development

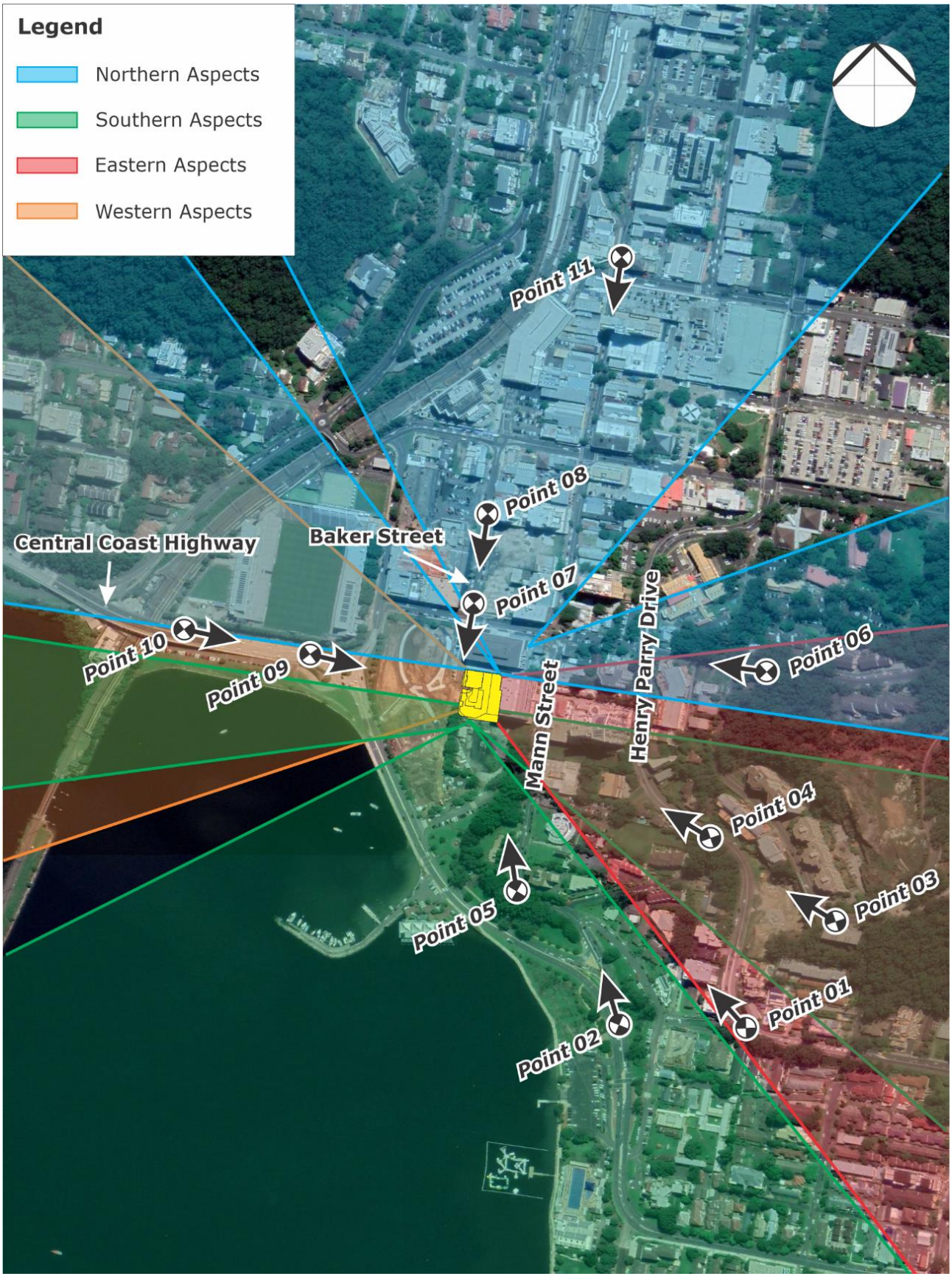


Figure 2: Check Zones and Study Point Locations
(the check zones are the areas where glare could potentially be observed)

Figure 3a: Perspective View of the 3D Computer Model (view from the south-west)

Figure 3b: Perspective View of the 3D Computer Model (view from the north-east)

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	Henry Parry Drive, heading north-west.	Eastern aspects.
02	Masons Parade, heading north.	Southern aspects.
03	John Whiteway Drive, heading north-west.	Eastern and southern aspects.
04	Henry Parry Drive, heading north-west.	Eastern and southern aspects.
05	Mann Street, heading north.	Southern aspects.
06	John Whiteway Drive, heading west.	Northern and eastern aspect.
07	Baker Street, heading south.	Northern aspects.
08	Baker Street, heading south.	Northern aspects.
09	Central Coast Highway, heading east.	Western aspect.
10	Central Coast Highway, heading east.	Western aspect.
11	Pacific Highway, heading south.	Northern aspect.

1.2 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.

1.2.1 Motorists heading north-west along Henry Parry Drive

Points 01 and 04 are located along Henry Parry Drive, to the south-east and east of the development site, respectively. These points represent the critical sightlines of motorists heading north-west along Henry Parry Drive 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 meter overlaid onto the viewpoint at Point 01 indicates that the development will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists heading north-west along Henry Parry Drive at this location.

An analysis of the glare meter overlaid onto the viewpoint at Point 04 indicates that a large portion of the eastern and southern aspects of the development will be visible within the zone of sensitive vision. Furthermore, Point 04 lies within the corresponding check zone that these aspects produce. The eastern aspects that lie in the zone of sensitive vision are Levels 10-20 of the southern component of the development, and Levels 11-24 of the northern component of the development. The southern aspects that lie in the zone of sensitive vision are Levels 16-20 of the southern component of the development, and Levels 22-24 of the northern component of the development. A detailed investigation shows that the majority of the visible glazing on these eastern and southern aspects will not be large enough to reflect sunlight for the level of glare to exceed 500cd/m^2 (provided that the maximum normal specular reflectance of visible light of that glazing is 20%). The only section of glazing of the development that is large enough to reflect sunlight that will affect drivers heading north-west along Henry Parry Drive is the glazing at the northern end of the eastern aspect of the southern component of the

development. Glare would be observed at Point 04 during the early morning periods of the Winter months. Hence the following treatments and/or limitations to the maximum normal specular reflectance of visible light of that section of external façade glazing are recommended:

- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Levels 14-18 for the glazing at the northern end of the eastern aspect of the southern component of the development.

- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used for the glazing at the northern end of the eastern aspect of the southern component of the development at Levels 11-13 and 19-20.

With the incorporation of the abovementioned treatments, the intensity of the visible glare will not exceed 500cd/m^2 and hence will not cause adverse glare conditions for motorists at Point 04.

1.2.2 Motorists heading north along Masons Parade

Point 02 is located along Masons Parade, to the south-east of the development site. This point represents the critical sightline of motorists heading north along Masons Parade 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 02 indicates that a portion of the eastern and southern aspects of the development will be visible within the zone of sensitive vision. However, Point 02 does not lie within the check zone produced by the glazing that is large enough to reflect sunlight for the level of glare that motorists will experience to exceed 500cd/m^2. Hence there will be no adverse solar glare observed by motorists heading north along Masons Parade at this location.

1.2.3 Motorists heading west along John Whiteway Drive

Points 03 and 06 are located along John Whiteway Drive, to the south-east and east of the development site, respectively. These points represent the critical sightline of motorists heading west along John Whiteway Drive 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 meter overlaid onto the viewpoint at Point 03 indicates that although a large portion of the eastern aspect of the development will be visible within the zone of sensitive vision, and also a small portion of the southern aspect of the northern component of the development, they will be outside the 20% glare loop of the glare overlay. Hence, provided that the maximum normal specular reflectance of visible light of the external façade glazing is 20% of the development, there will be no adverse solar glare observed by motorists heading west along John Whiteway Drive at this location.

An analysis of the glare meter overlaid onto the viewpoint at Point 06 indicates that a large portion of the eastern and northern aspects of the development will be visible within the zone of sensitive vision. Furthermore, Point 06 lies within the corresponding check zone that these aspects produce. A detailed investigation shows that the all of the visible glazing on these aspects will not be large enough to reflect sunlight for the level of glare to exceed 500cd/m^2 (provided that the maximum normal specular reflectance of visible light of that glazing is 20%). Hence there will be no adverse solar glare observed by motorists heading west along John Whiteman Drive at this location.

1.2.4 Motorists heading north along Mann Street

Point 05 is located along Mann Street, to the south of the development site. This point represents the critical sightline of motorists heading north along Mann 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 05 indicates that the view of the development will be blocked by a dense thicket of large existing densely foliating and evergreen trees, and hence will not be visible within the zone of sensitive vision. Hence there will be no adverse solar glare observed by motorists heading north along Mann Street at this location.

1.2.5 Motorists heading south along Mann Street

Point 11 is located along Mann Street, to the north of the development site. This point represents the critical sightline of motorists heading south along Mann 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 11 indicates that a portion of the northern and eastern aspects of the development will be visible within the zone of sensitive vision. However, Point 11 is not located within the check zones of these aspects, and hence there will be no adverse solar glare observed by motorists heading south along Mann Street at this location.

1.2.6 Motorists heading south along Baker Street

Points 07 and 08 are located along Baker Street, to the north of the development site. These points represent the critical sightline of motorists heading south along Baker Street 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 meter overlaid onto the viewpoint at Point 07 indicates that a portion of the northern aspect of the development will be visible within the zone of sensitive vision. However, Point 07 is not located within the check zones of these aspects, and hence there will be no adverse solar glare observed by motorists heading south along Baker Street at this location.

An analysis of the glare meter overlaid onto the viewpoint at Point 08 indicates that a portion of the northern aspect of the development will be visible within the zone of sensitive vision. However, Point 08 is not located within the check zone of this aspect, and hence there will be no adverse solar glare observed by motorists heading south along Baker Street at this location.

1.2.7 Motorists heading east along Central Coast Highway

Points 09 and 10 are located along Central Coast Highway, to the west of the development site. These points represent the critical sightline of motorists heading east along Central Coast Highway 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 viewpoints at these locations indicates that the entire western aspect of the development will be visible within the zone of sensitive vision. These locations lie within the corresponding check zone that this visible aspect produces. Glare will be observed at Points 09 and 10 during the late afternoon/evening periods of the Spring and Autumn months. Hence the following treatments and

limitations to the maximum normal specular reflectance of visible light of the external façade glazing are recommended:

- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Ground Level to Level 10 for the glazing on the western aspect of the development.
- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used on the glazing, windows and glass balustrades on Levels 11 to 17 for the western aspect of the development.
- A maximum normal specular reflectance of visible light of 12% is recommended to be used on the glazing, windows and glass balustrades on Levels 18 to 24 for the western aspect of the development.

With the incorporation of the abovementioned treatments, the intensity of the visible glare will not exceed 500cd/m^2 and hence will not cause adverse glare conditions for motorists at Points 09 and 10.

2 GLARE OBSERVED BY PEDESTRIANS, OCCUPANTS OF NEIGHBOURING BUILDINGS AND BOAT DRIVERS

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. This can also be extended to account for boat drivers on Brisbane Water. 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, boat drivers, and to occupants of neighbouring buildings.

3 TYPICAL REFLECTANCES OF FAÇADE MATERIALS

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.

3.1 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:

- Low reflectance glazing, such as Guardian Clarity – less than 5%
- 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%

3.2 Painted and/or Powder-Coated Metallic Surfaces

In the event that some portions of the external façade of the development feature powder-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.

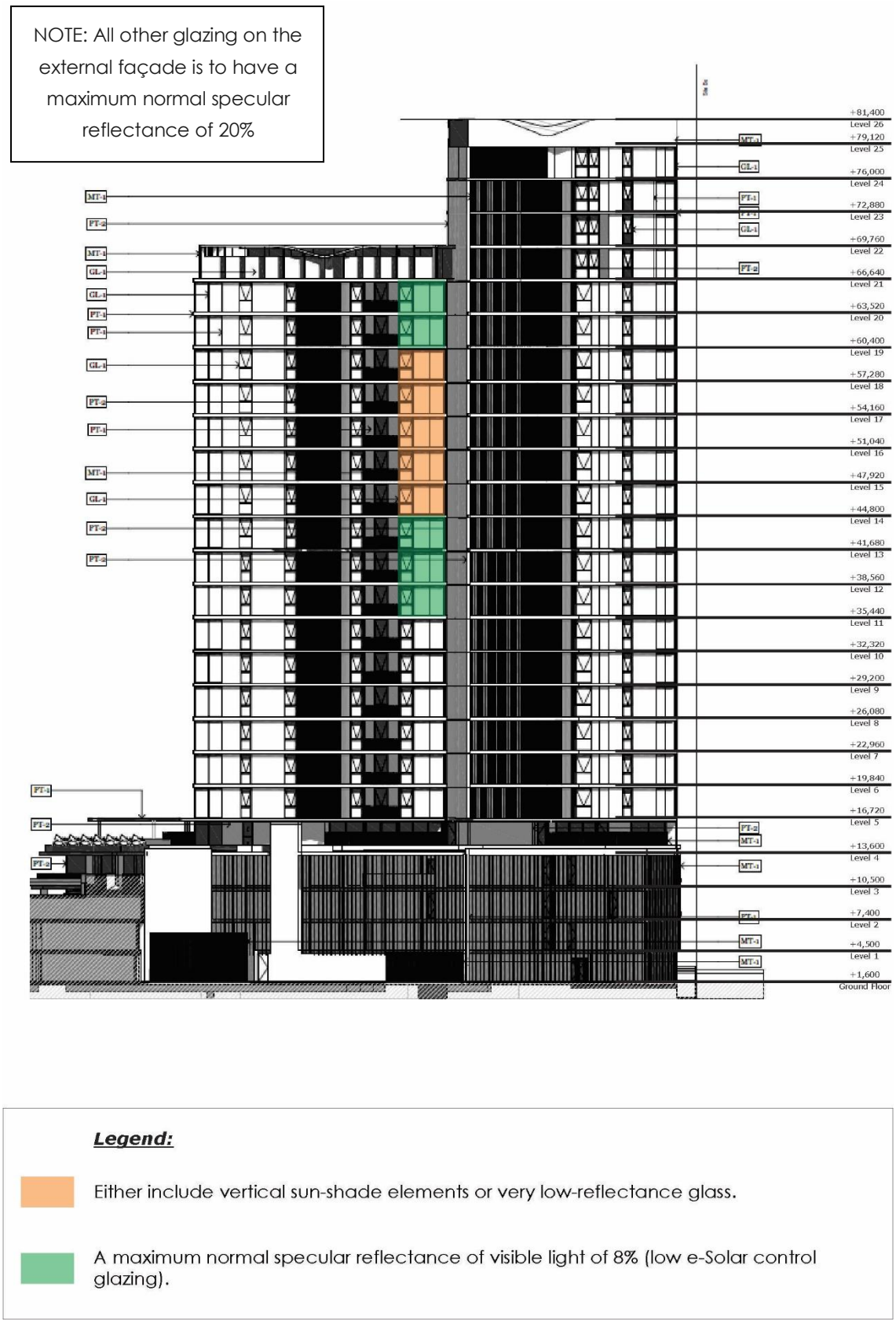
4 SUGGESTED TREATMENTS

The suggested treatments described in this report for ensuring the development does not cause adverse glare conditions are summarised as follows:

- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Levels 14-18 for the glazing at the northern end of the eastern aspect of the southern component of the development.
- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used for the glazing at the northern end of the eastern aspect of the southern component of the development at Levels 11-13 and 19-20.
- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Ground Level to Level 10 for the glazing on the western aspect of the development.
- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used on the glazing, windows and glass balustrades on Levels 11 to 17 for the western aspect of the development.
- A maximum normal specular reflectance of visible light of 12% is recommended to be used on the glazing, windows and glass balustrades on Levels 18 to 24 for the western aspect of the development.
- All other glazing (windows and balustrades) should have a maximum normal specular reflectance of visible light of 20%.

These suggested treatments are also shown in the following marked-up elevations.

NOTE: All other glazing on the external façade is to have a maximum normal specular reflectance of 20%



Legend:

Either include vertical sun-shade elements or very low-reflectance glass.

A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing).

Figure 4a: Suggested Treatments - Eastern Elevation

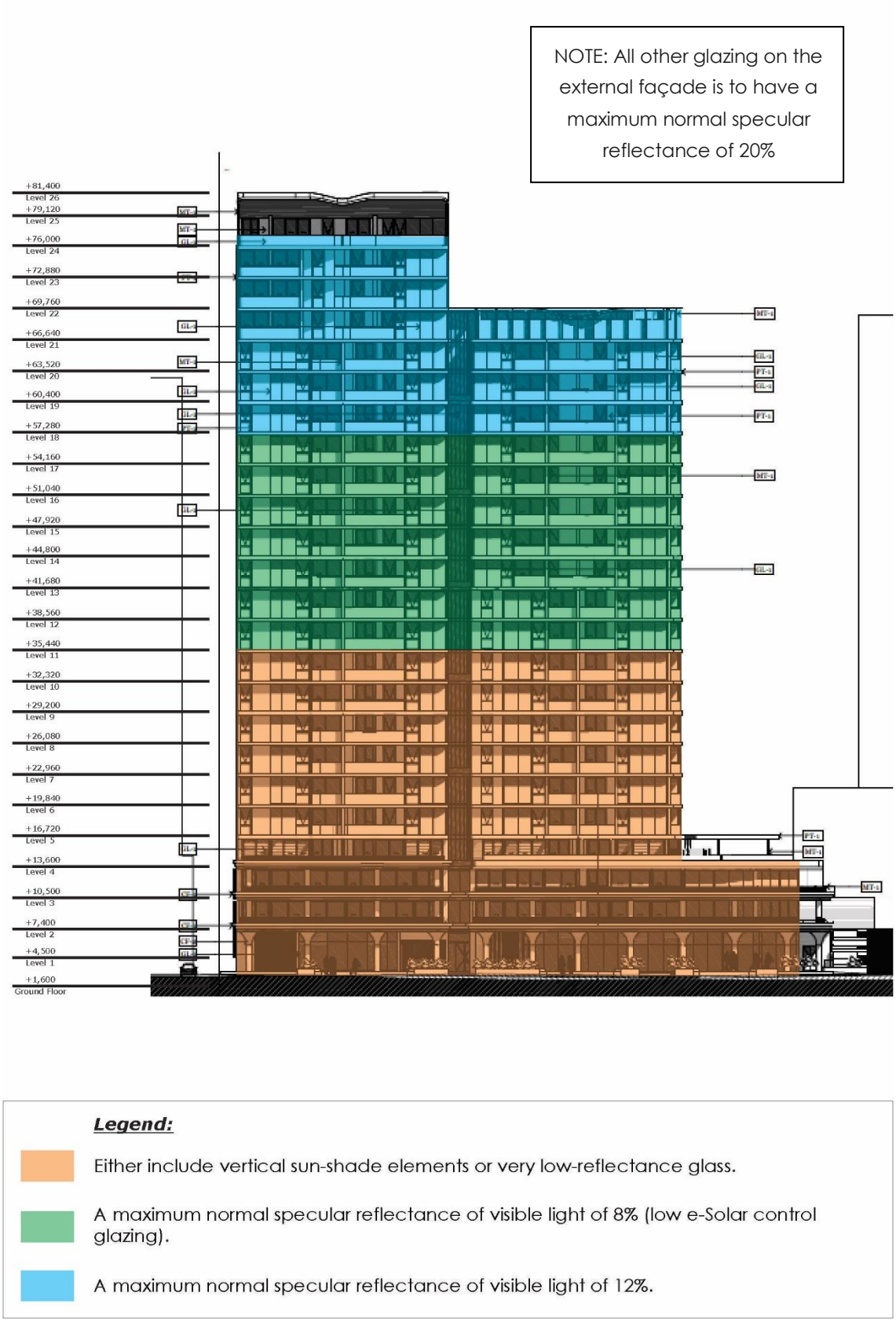


Figure 4b: Suggested Treatments - Western Elevation

5 CONCLUSION

A detailed study has been undertaken for the effect of potential solar glare from the proposed development known as the Central Coast Quarter - North Tower, located at 26-30 Mann Street, Gosford to address the Planning Secretary's Environmental Assessment Requirements (SEARs) Item 6 - Environmental and Residential Amenity (Doc. Ref.: SSD-23588910). This study identifies any possible adverse reflected solar glare conditions affecting motorists, pedestrians and boat drivers within the local surrounding area, 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 State Environmental Planning Policy No. 65 (SEPP65, Part 04 (Designing the Building) for Amenity), which contains the Apartment Design Guide (ADG), and the Gosford City Centre Development Control Plan 2018.

The results of the study indicate that, to avoid any adverse glare to motorists and pedestrians on the surrounding streets, boat drivers within the local surrounding area, 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:

- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Levels 14-18 for the glazing at the northern end of the eastern aspect of the southern component of the development.
- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used for the glazing at the northern end of the eastern aspect of the southern component of the development at Levels 11-13 and 19-20.
- Either include vertical sun-shade elements or very low-reflectance glass (eg: Guardian Clarity glass) on Ground Level to Level 10 for the glazing on the western aspect of the development.
- A maximum normal specular reflectance of visible light of 8% (low e-Solar control glazing) is recommended to be used on the glazing, windows and glass balustrades on Levels 11 to 17 for the western aspect of the development.
- A maximum normal specular reflectance of visible light of 12% is recommended to be used on the glazing, windows and glass balustrades on Levels 18 to 24 for the western aspect of the development.
- 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, pedestrians or boat drivers within the

local surrounding area, or to occupants of neighbouring buildings, and will comply with the planning controls regarding reflectivity from SEPP65 and the Gosford City Centre Development Control Plan 2018.

6 REFERENCES

Central Coast Council, 2018, "Gosford City Centre Development Control Plan 2018".

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.

State Environmental Planning Policy No. 65 (SEPP65), 2015, "Apartment Design Guide", NSW Department of Planning and Environment.

APPENDIX A SIGHT-LINES WITH GLARE OVERLAYS

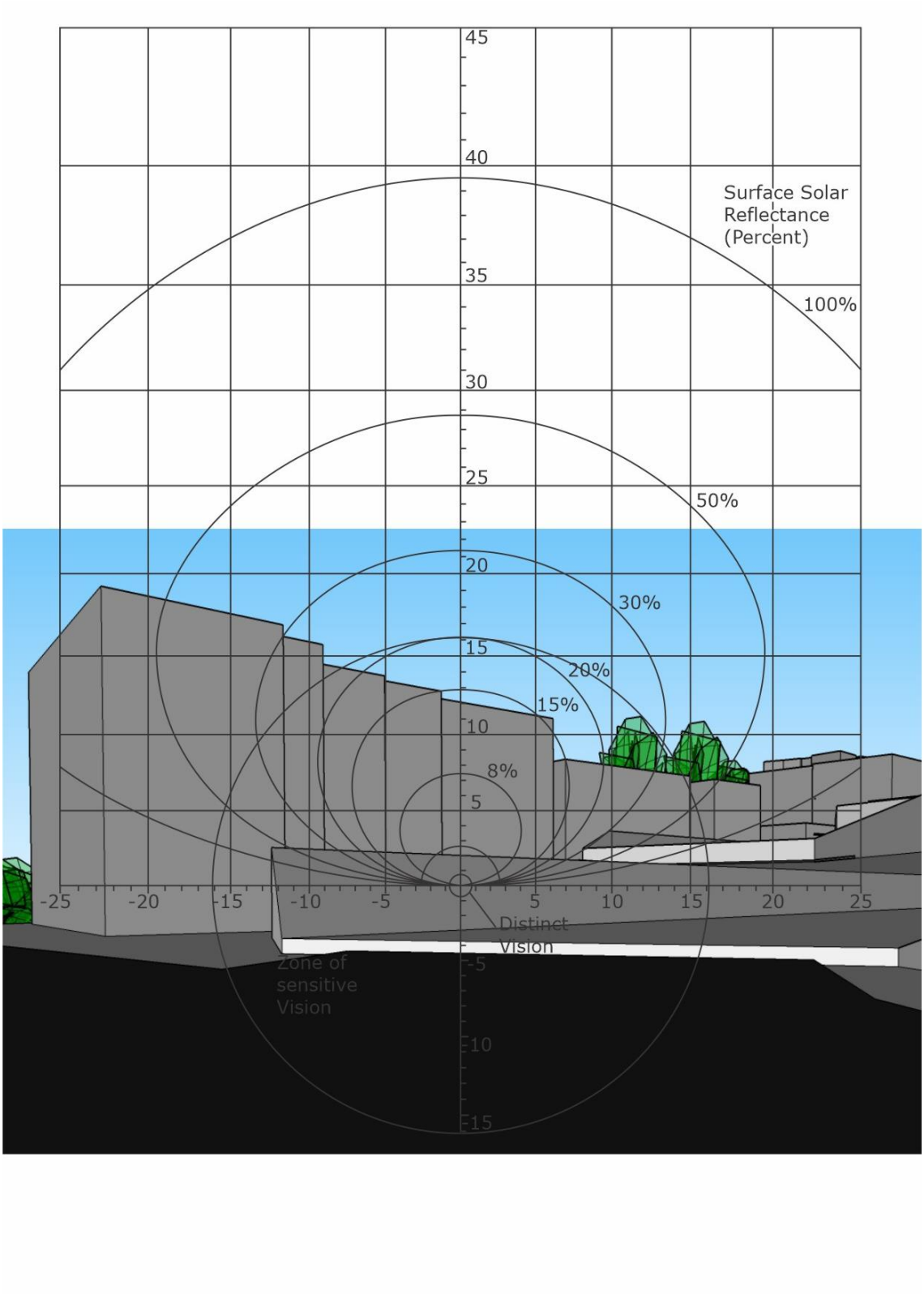


Figure A.1: Glare Overlay of the Viewpoint at Point 01

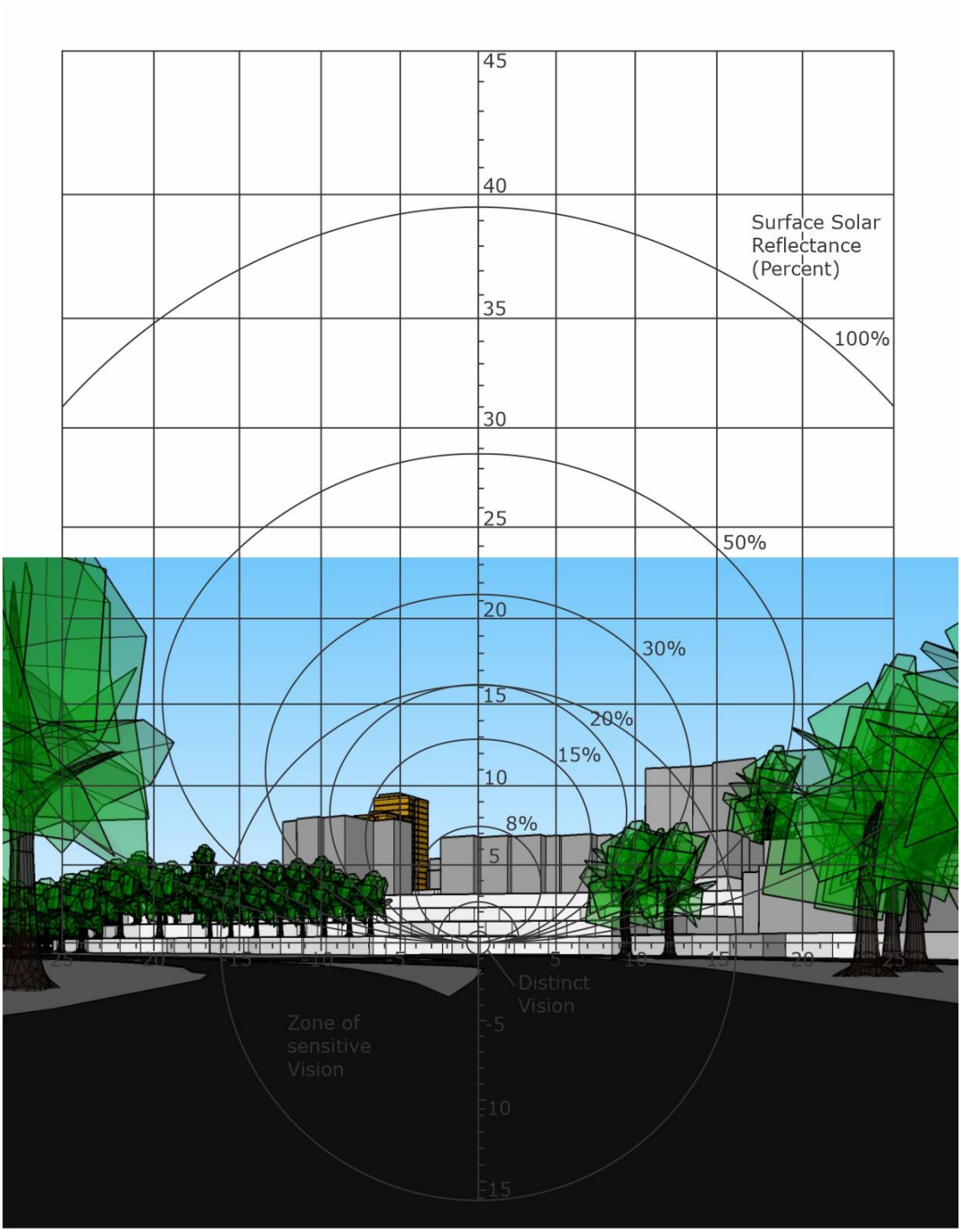


Figure A.2: Glare Overlay of the Viewpoint at Point 02

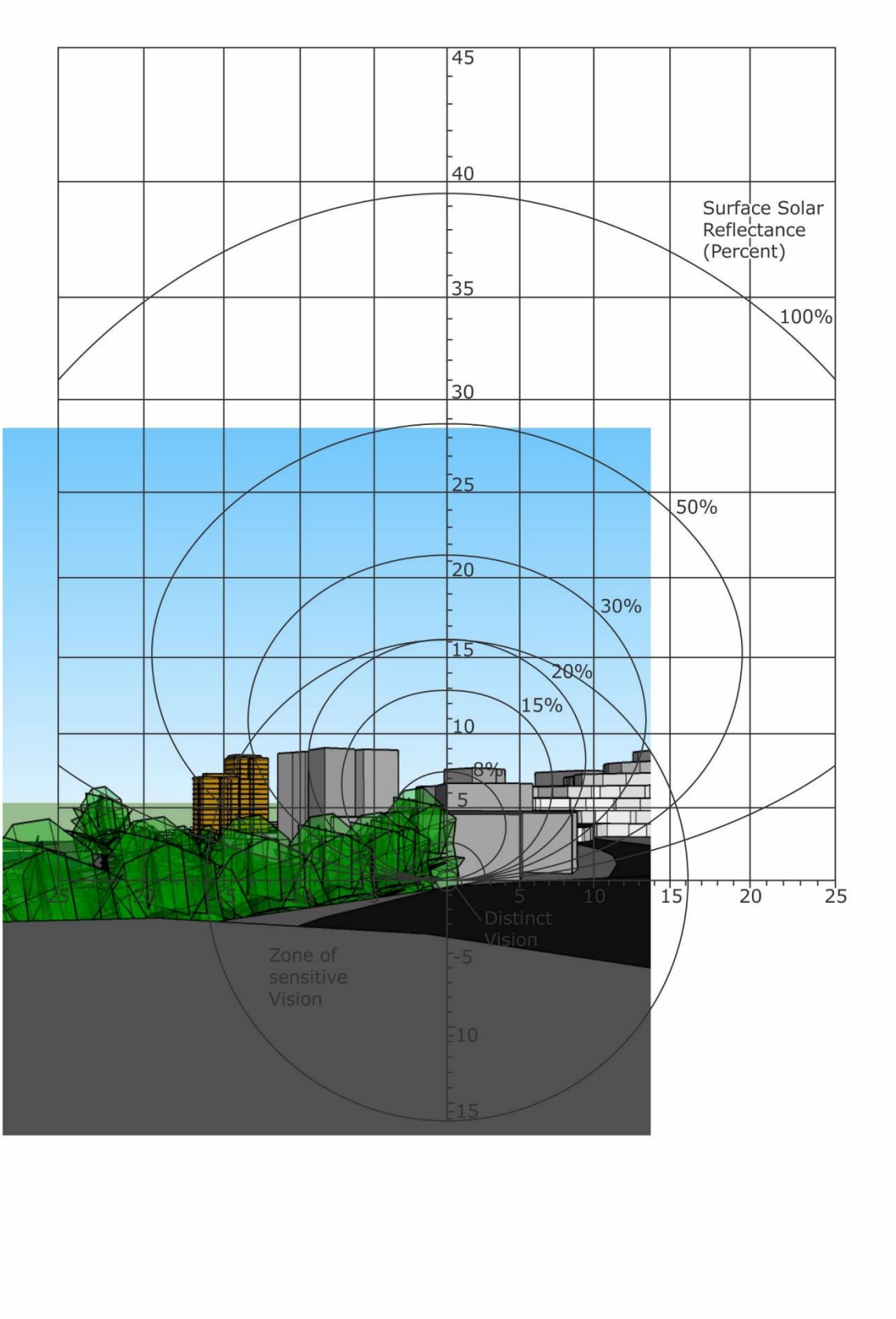


Figure A.3: Glare Overlay of the Viewpoint at Point 03

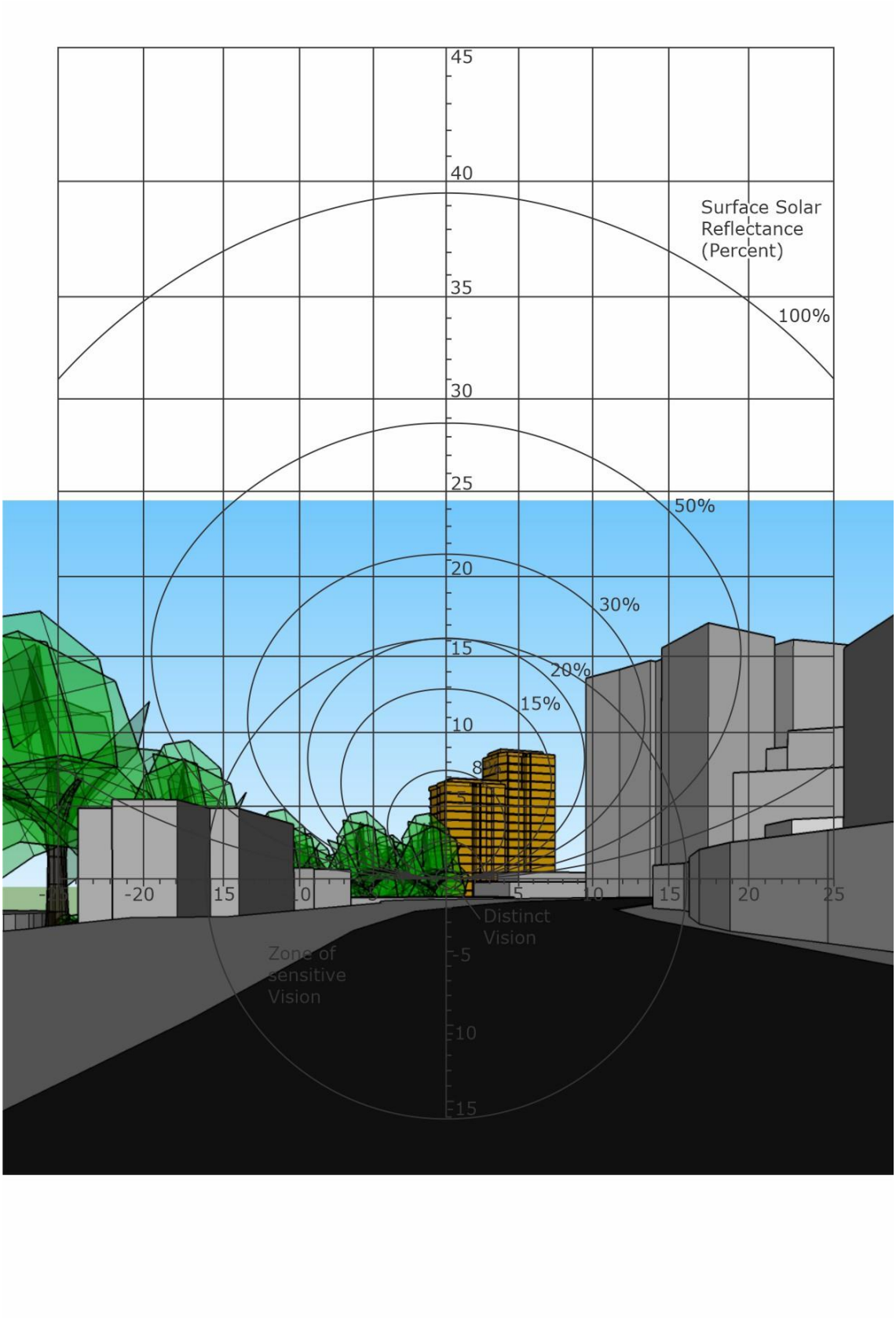


Figure A.4: Glare Overlay of the Viewpoint at Point 04

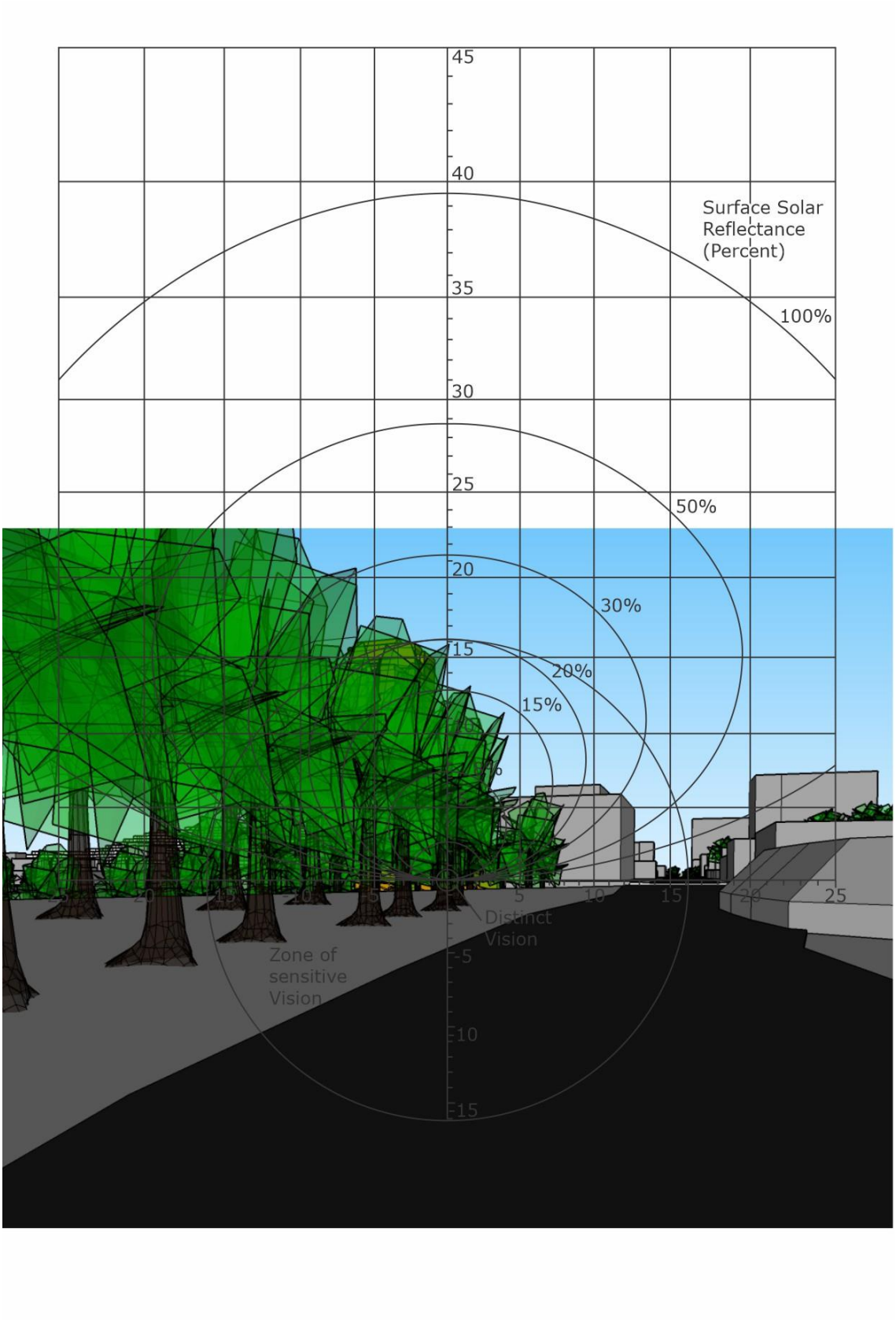


Figure A.5: Glare Overlay of the Viewpoint at Point 05

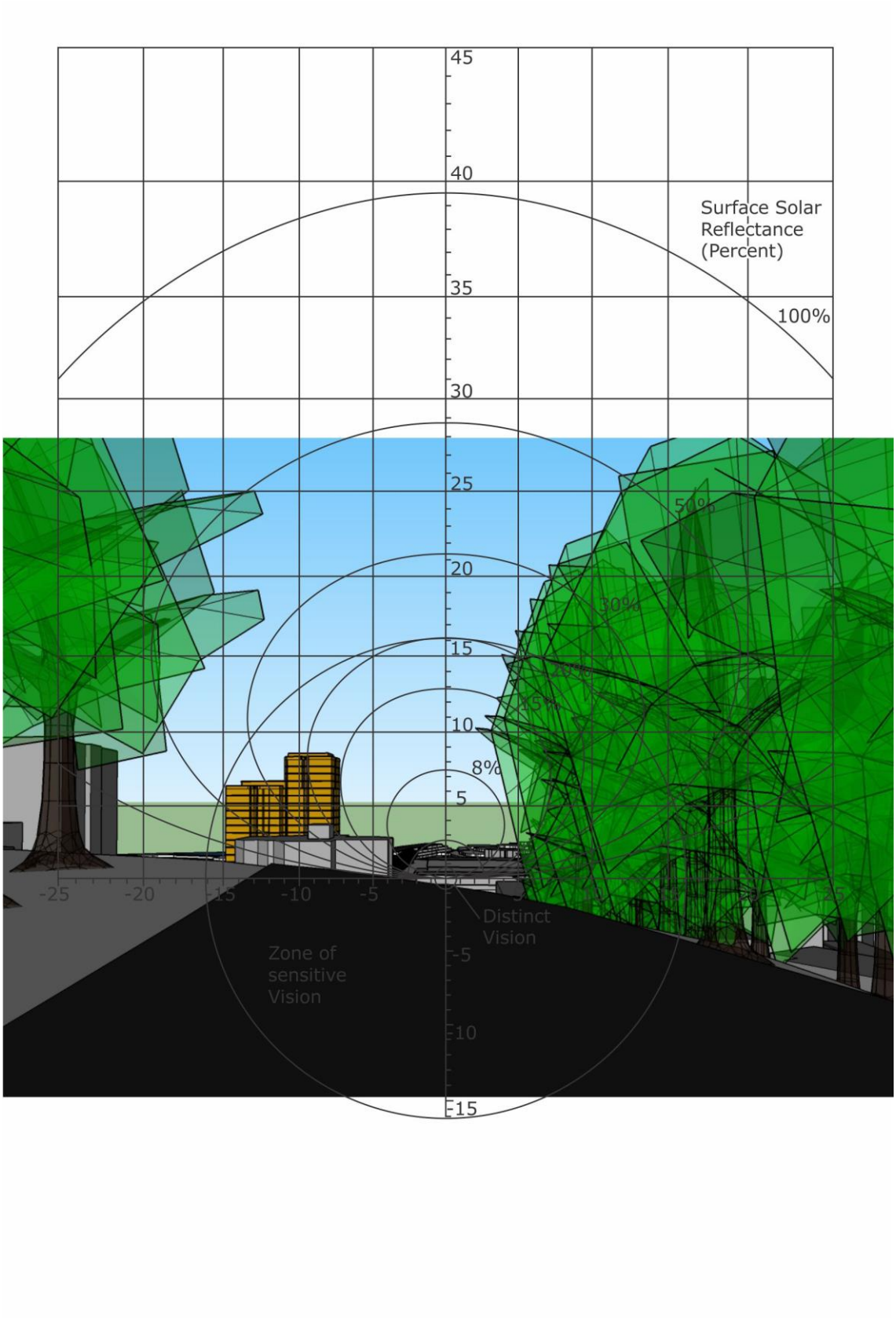


Figure A.6: Glare Overlay of the Viewpoint at Point 06

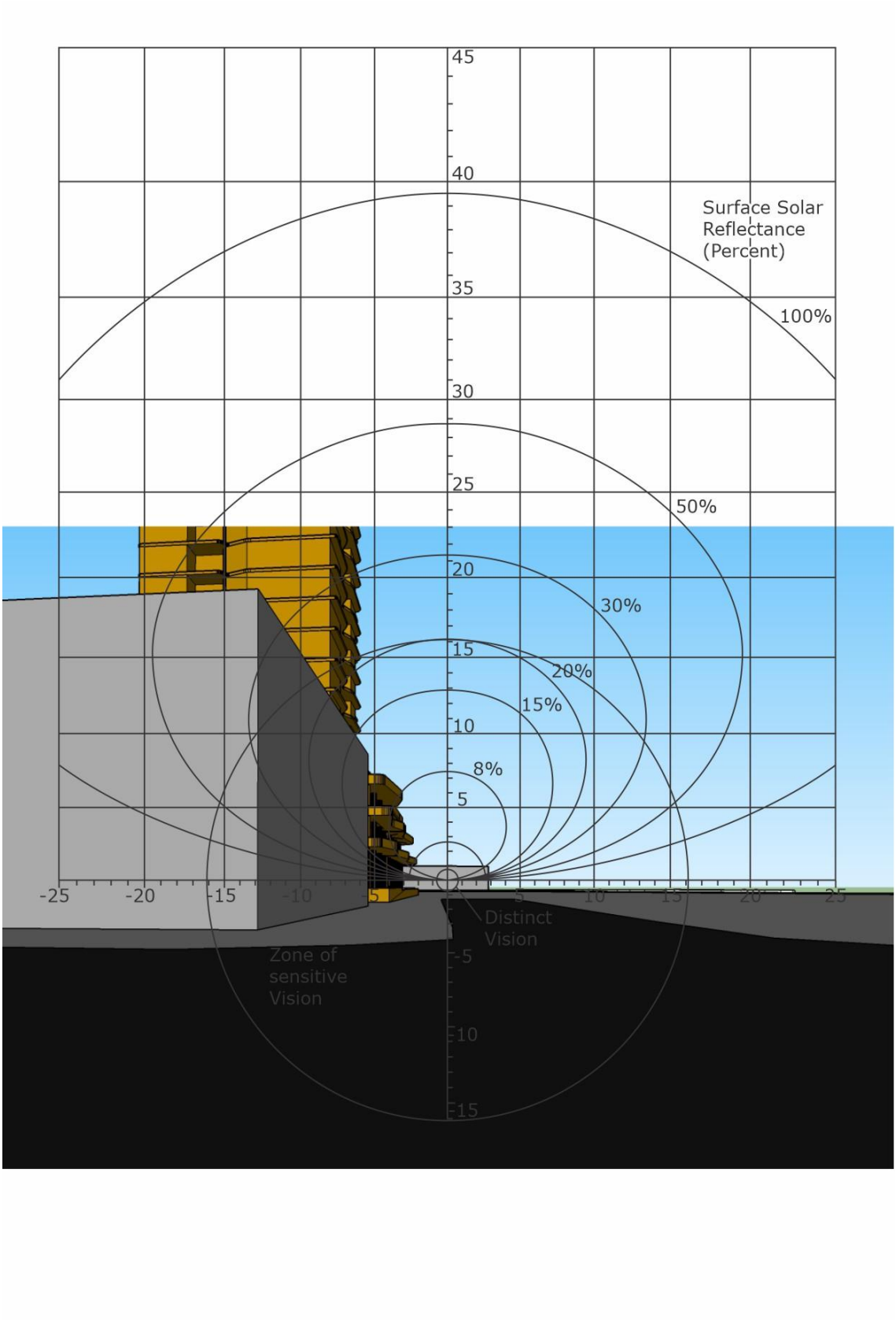


Figure A.7: Glare Overlay of the Viewpoint at Point 07

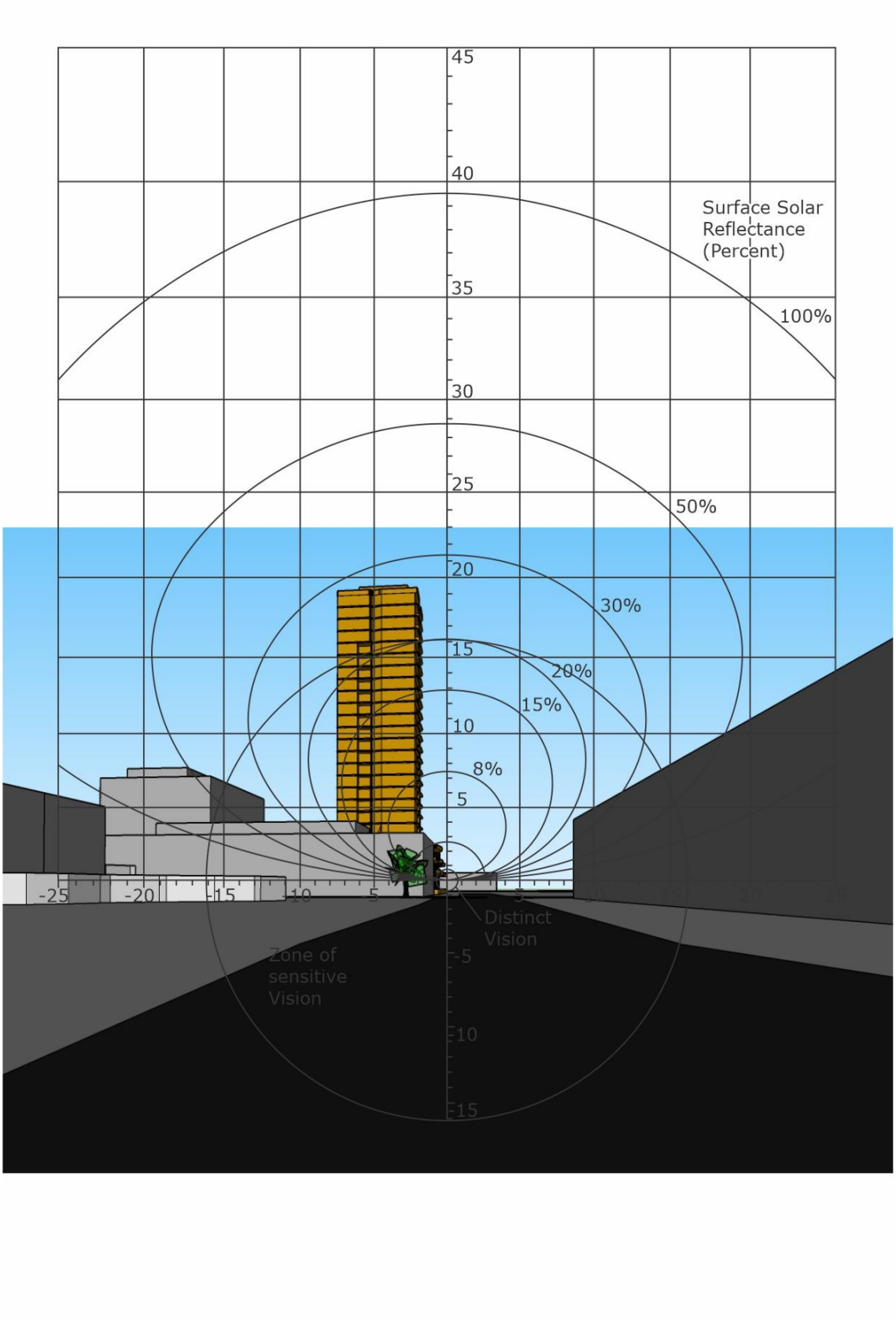


Figure A.8: Glare Overlay of the Viewpoint at Point 08

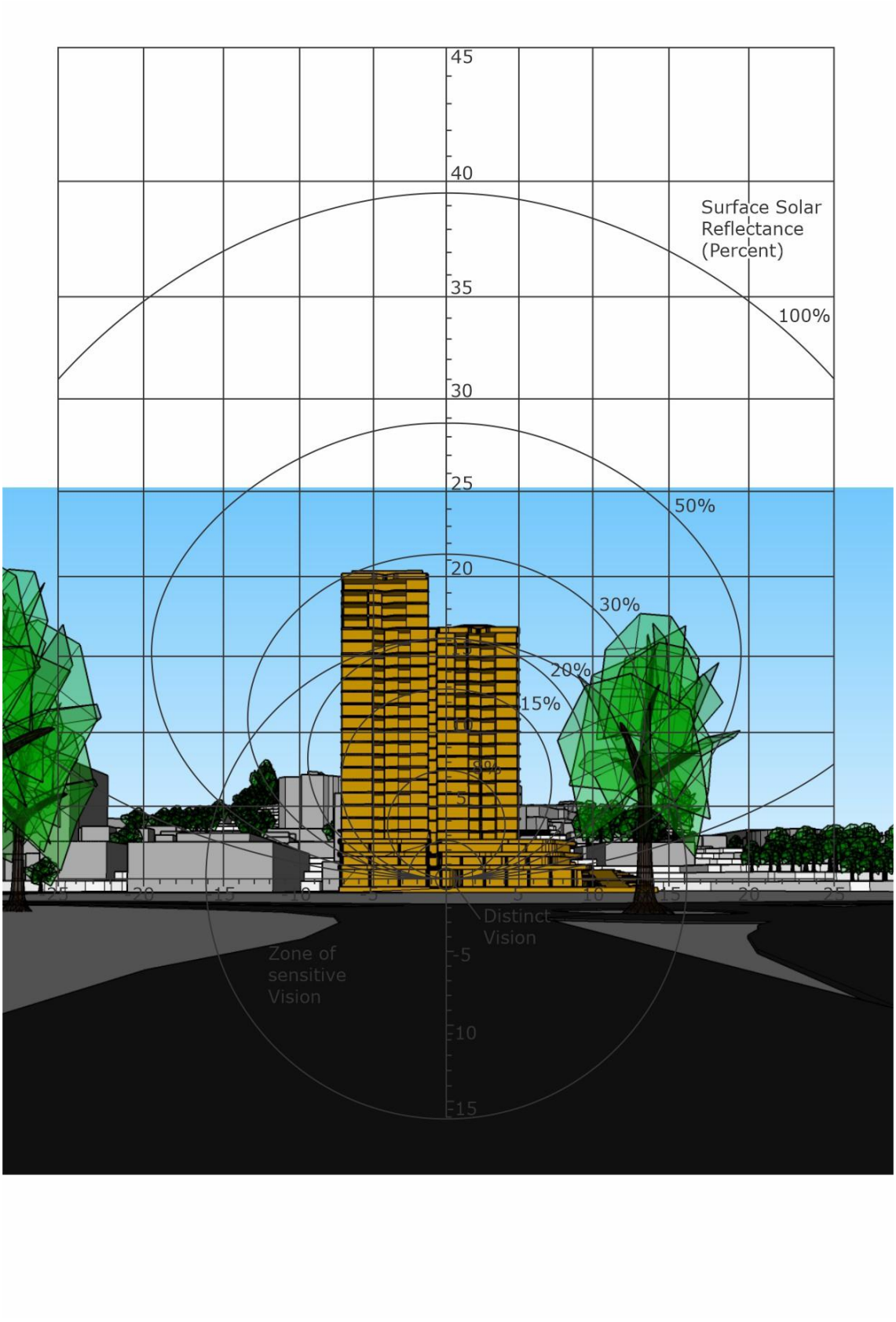


Figure A.9: Glare Overlay of the Viewpoint at Point 09

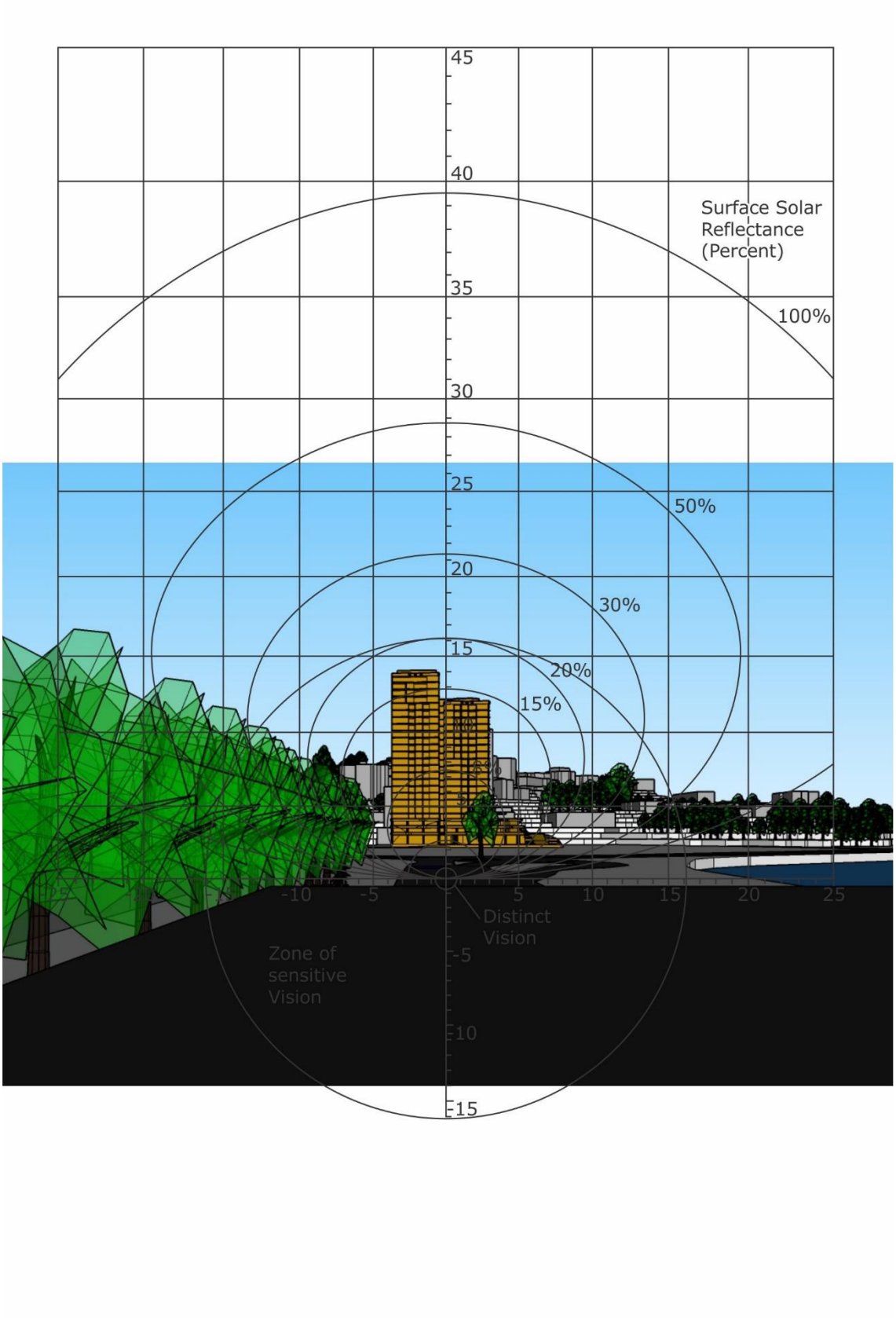


Figure A.10: Glare Overlay of the Viewpoint at Point 10

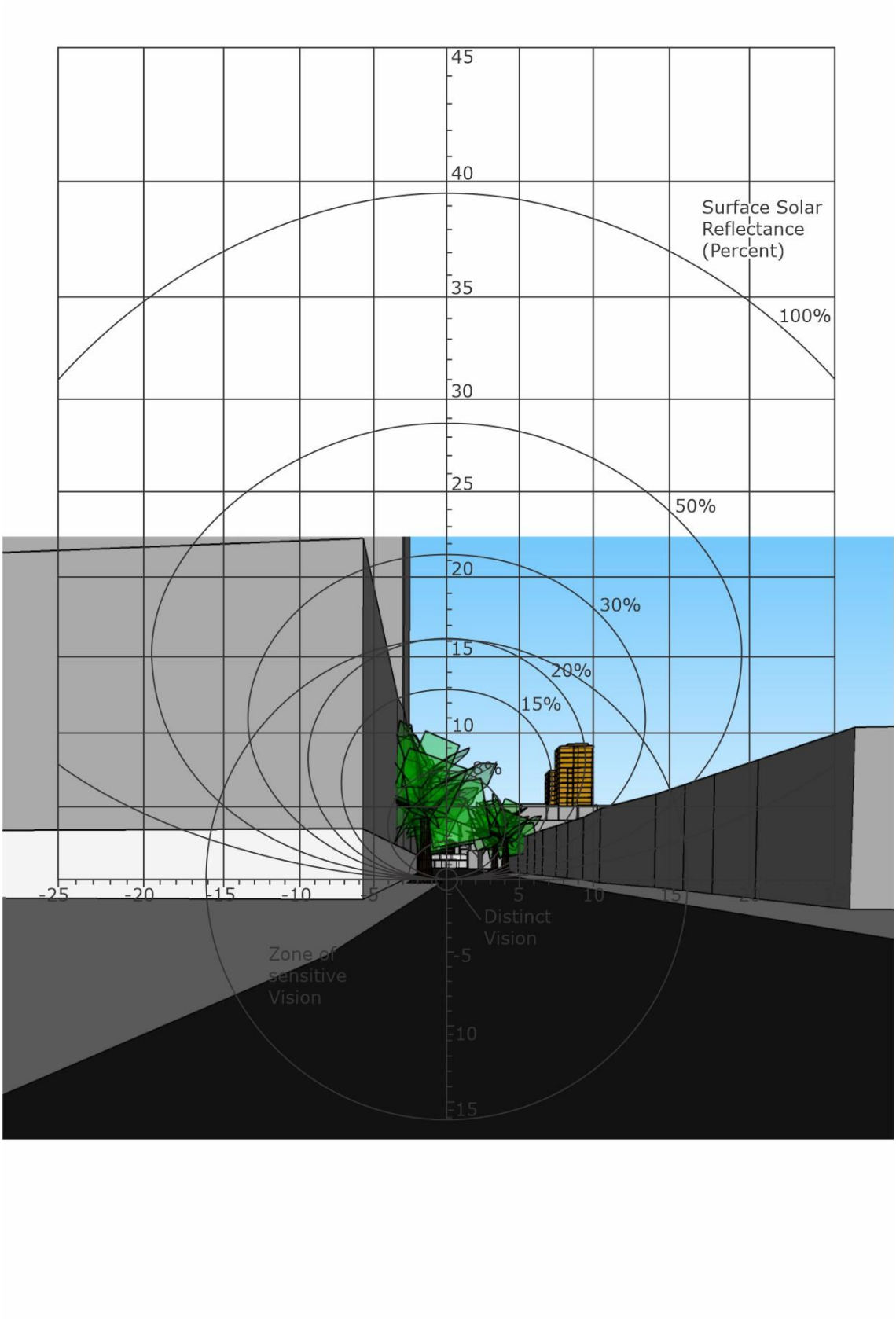


Figure A.11: Glare Overlay of the Viewpoint at Point 11

APPENDIX B CRITICAL ASPECT SOLAR CHARTS

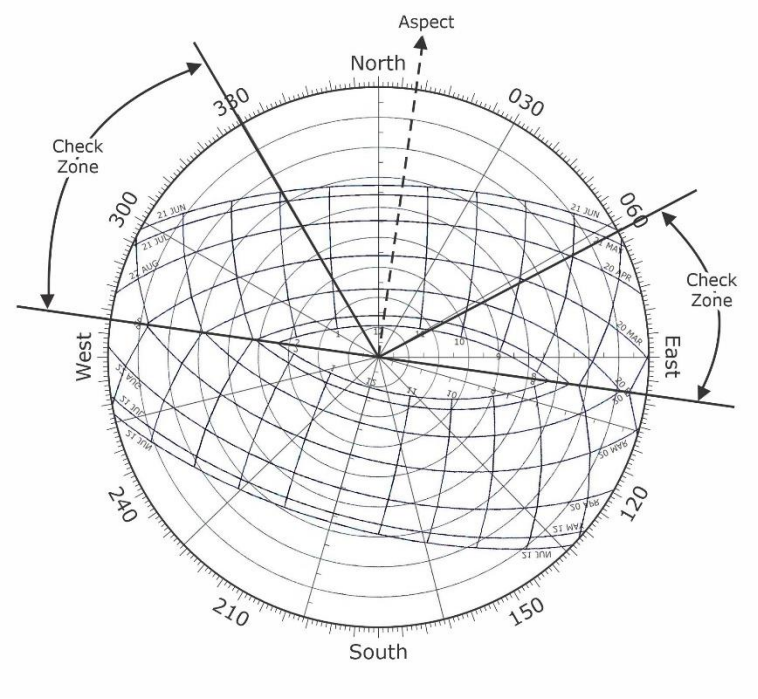


Figure B.1: Sun Chart for the 008° Aspect

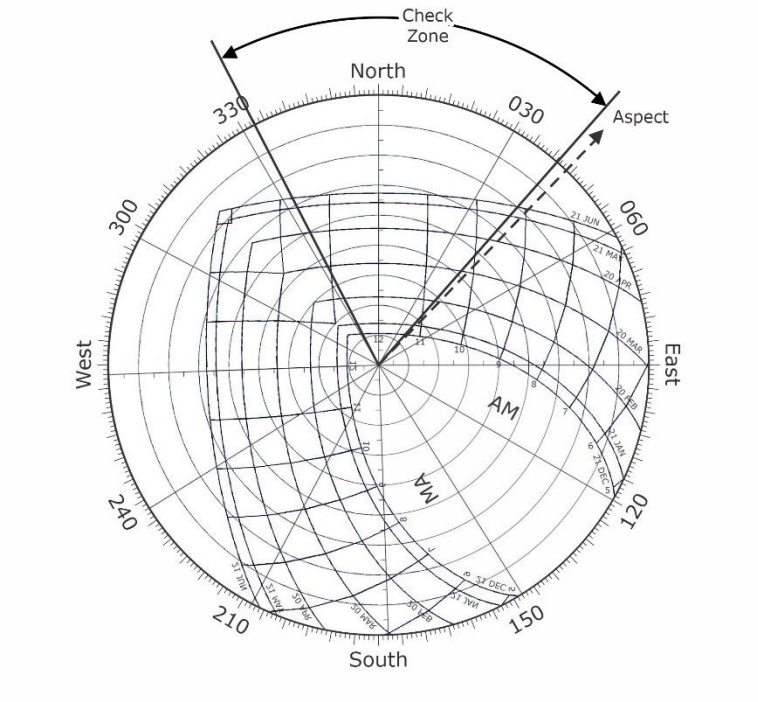


Figure B.2: Sun Chart for the 044° Aspect

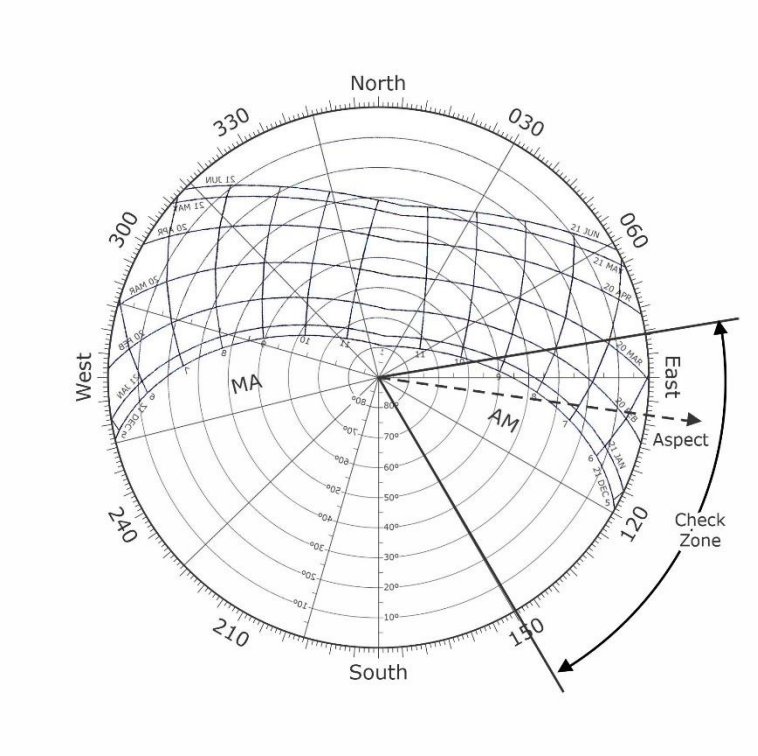


Figure B.3: Sun Chart for the 098° Aspect

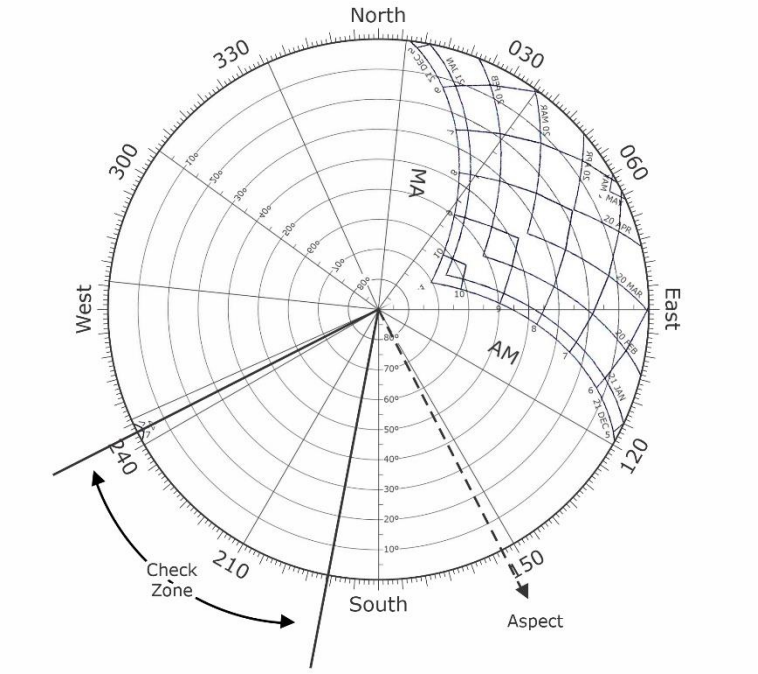


Figure B.4: Sun Chart for the 153° Aspect

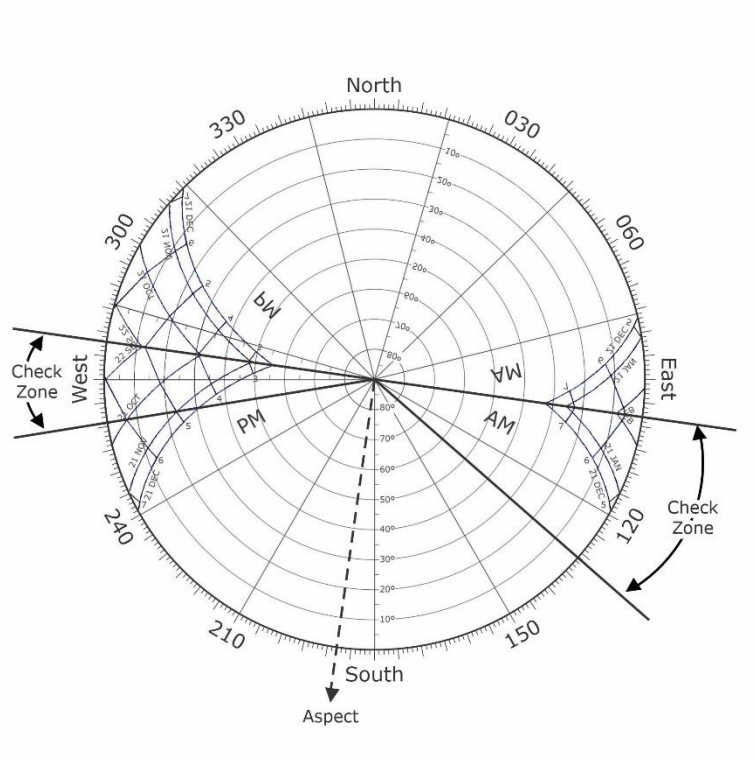


Figure B.5: Sun Chart for the 188° Aspect

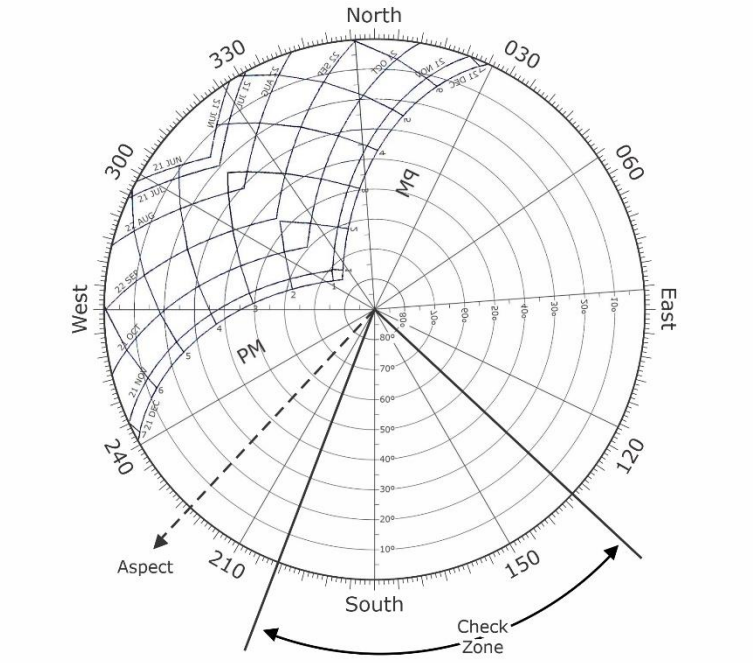


Figure B.6: Sun Chart for the 223° Aspect

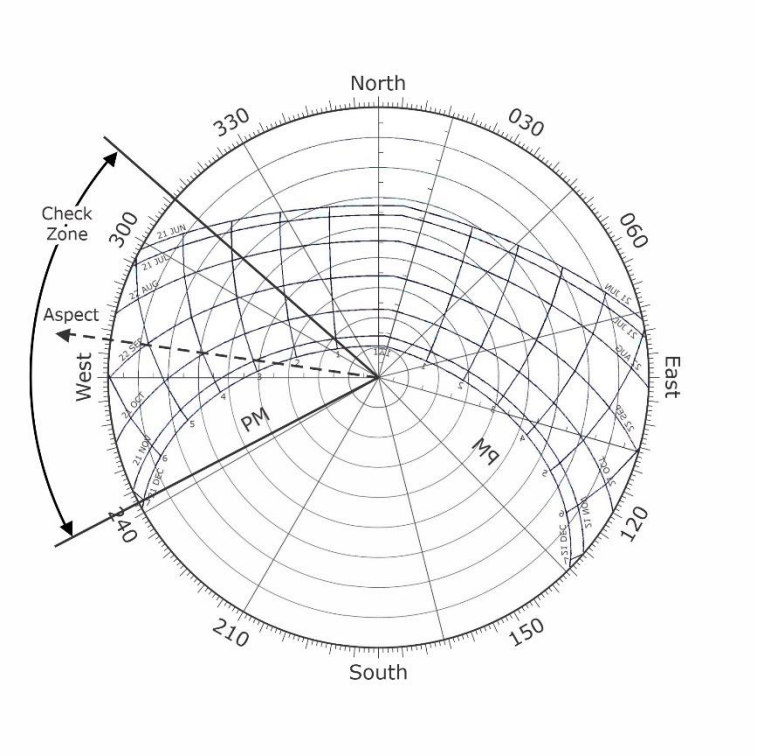


Figure B.7: Sun Chart for the 278° Aspect

APPENDIX C STANDARD SUN CHART FOR THE REGION

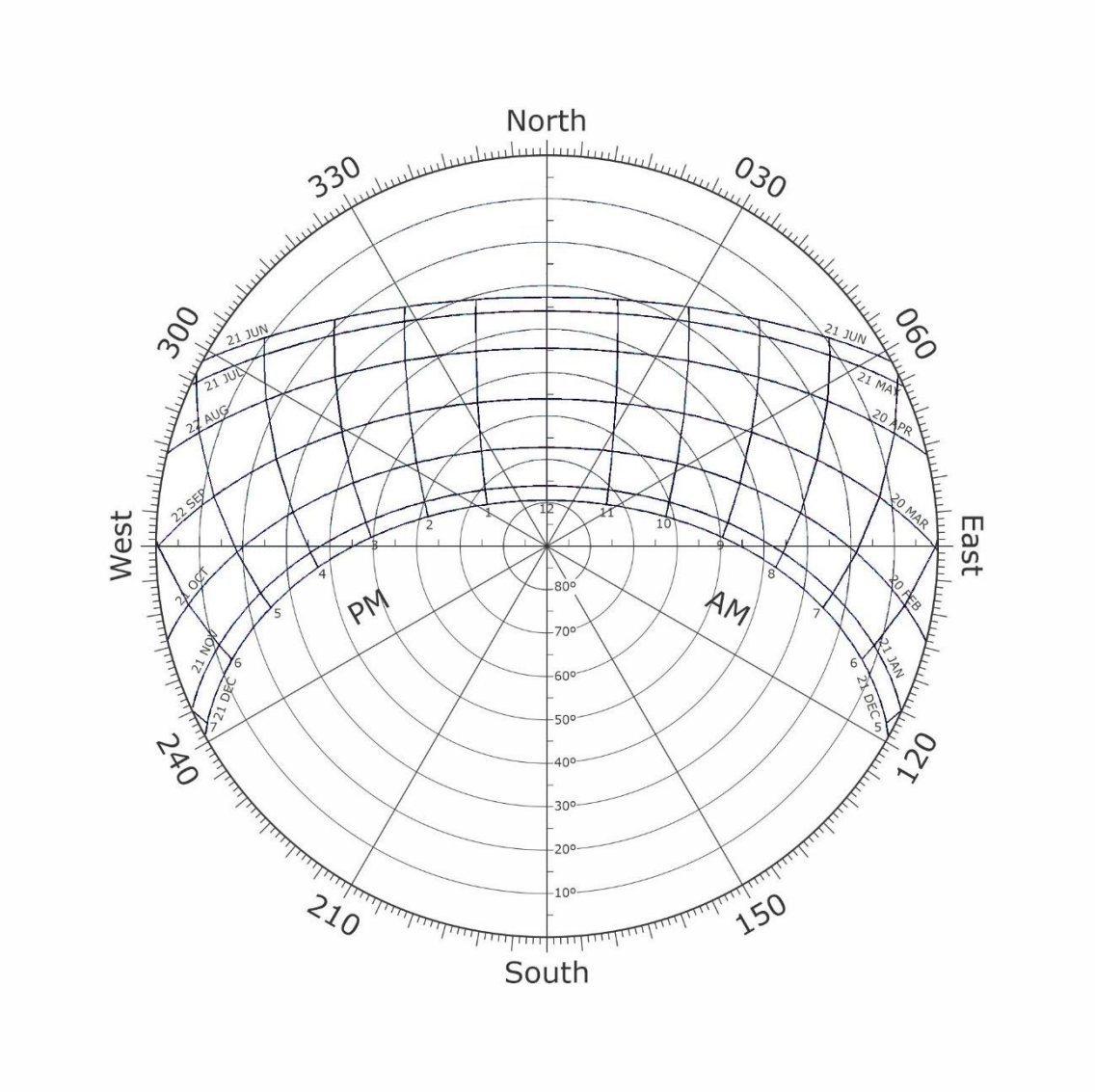


Figure C.1: Standard Sun Chart for the Gosford Region