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BRE Client Report

POTENTIAL SOLAR GLARE, WATERFRONT SOUTH CENTRAL RESIDENTIAL

Prepared for: Waterside Block 9 Developments Limited

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Executive Summary

Solar glare, or dazzle, can occur when sunlight is reflected from a glazed façade or area of metal cladding. This can affect road users and train drivers outside and the occupants of nearby buildings.

This report has assessed the potential for reflected solar glare from a proposed residential development (the Waterfront South Central SHD application) in North Wall Quay, Dublin. The report has focused on potential disability glare to motorists as they drive along the roads with a view of the site.

Eleven points have been selected where drivers will have a view of the new development, and are at key locations such as road junctions or with a view of traffic signals. For each of these points the times of day and year for which reflection can occur have been determined. Disability glare has also been calculated, using a metric called the threshold increment. This is a measure of how much harder it is to see with the glare source in place. Predicted levels of glare have been compared with recommendations for night time road lighting. This is a very cautious approach, because the road lighting recommendations are conservative. During the day, it is a lot easier to see, and drivers can use visors to control glare.

The proposed development would reflect sunlight to a variety of locations. At points further from the development, both south of the river and approaching from the M50, there would only be short durations of reflection and glare would be well within the recommendations.

Closer to the development, in North Wall Quay, North Wall Avenue, Castleforbes Road and Mayor Street, there would be longer durations of reflection. In each case the reflected sun would be to one side of the drivers' field of view, which limits glare. The residential development is planned either to have conventional clear low emissivity glazing or special glass with a grey interlayer which has an even lower reflectance, further limiting glare.

In nearly all cases the reflected glare levels would be within the stringent recommendations for road lighting. At one of the points analysed, on North Wall Avenue at the junction with Mayor Street, the glare would be above the road lighting recommendation. This would count as a minor adverse impact, because the level of glare is only marginally above the recommendations, and the duration of glare is short and happens in mid winter when the sun is often obscured by cloud. Drivers would have the low sun ahead of them, and would be prepared for glare with their visors down.

A commercial scheme is proposed to the west of the proposed residential development, and a cumulative analysis has been undertaken. For six of the eleven key points analysed, the commercial scheme would make no, or very little, difference to the duration of reflection. For a seventh point the commercial scheme would block reflection from the residential scheme and itself cause no reflection. For the other four points, the commercial scheme would result in additional reflections. In nearly all cases the additional reflected glare levels would be within the recommendations for road lighting. At one of the points analysed, on North Wall Quay at the junction with Castleforbes Road, the glare from the commercial scheme would be marginally above the road lighting recommendation for a limited time. This would count as a minor adverse impact.

Discomfort glare is a less serious problem because it does not impair the ability to see. There are offices to the north, east and west which would normally have shading fitted, and the new building could be expected to reduce the incidence of glare. Discomfort glare is therefore not expected to be a significant issue.

Accordingly the development would cause negligible or minor solar glare problems. No mitigation measures are therefore necessary.

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1 Introduction

1.1 Solar glare, or dazzle, can occur when sunlight is reflected from a glazed façade or area of metal cladding. This can affect road users and train drivers outside and the occupants of nearby buildings.

1.2 This report assesses the potential for reflected solar glare from a new residential development (the Waterfront South Central SHD application) at North Wall Quay, Dublin.

1.3 The assessment is based on plans of the development by Henry J Lyons. These included site location plan P0001 revision 2, dated 29/11/19 and elevations P2001A, P2002A, P2003A and P2004, all revision 5 and dated 19/05/2020. They were supplemented by a Sketchup model provided by Henry J Lyons.

2 Solar glare: principles

2.1 Planning guidance on solar glare is limited. Section 16.2.1.2 of the Dublin City Development Plan states that design should 'minimise glare'.

2.2 With a glazed building, there are two types of reflected glare problem that can occur. Discomfort glare causes visual discomfort without necessarily affecting the ability to see. Disability glare happens when a bright source of light impairs the vision of other objects. Outdoors, disability glare is easily the more serious problem, as it can affect motorists' and train drivers' ability to drive safely. A typical example is when an oncoming vehicle at night dazzles a driver and makes it impossible to see the road. For this reason, guidance on limiting solar reflection (ref 1) has concentrated on disability glare.

Disability glare

2.3 The first stage in the assessment of disability glare is to identify key locations from which the building could be seen and where solar glare could be an issue. These could include road junctions, traffic lights, pedestrian crossings and railway lines at the approach to signals. The most important locations are those where drivers will be travelling directly towards the building; glare is much less likely if the building is well to one side of the field of view.

2.4 The next stage is to work out whether sunlight can be reflected to these viewpoints, and if so at which times of year. A BRE Information Paper IP 3/87 'Solar dazzle reflected from sloping glazed facades' (ref 2) gives details on how to carry out the calculations. Sometimes a façade, especially a north facing one, may only reflect the sky or other buildings, and not direct sunlight.

2.5 Where solar reflection can happen, the next step is to calculate the angle between the driver's line of view and the reflected sun. For vertically mounted clear double glazing facing the driver, solar dazzle could be a significant issue if this angle is less than 10 degrees. With a sloping façade (reflecting bright sun from high in the sky), or high reflectance glazing or cladding, solar dazzle might be a problem at higher angles of view as well. Sunlight that reflects off the façade at a glancing angle might also be bright enough to cause problems at higher angles of view.

2.6 Cochran (ref 3) has developed a technique to assess disability glare from reflective façades. Disability glare occurs when a bright source creates a veiling luminance in the eye. This looks like a bright veil over the visual field, making it harder to see everything else. The veiling luminance is proportional to the illuminance at the eye due to the light source. It is also proportional to the inverse square of the angle between the glare source and the observer's line of sight. This is important; it means that glare sources off to one side, or above the observer, are less likely to cause disability glare. Usually, glare sources at more than 25 degrees to the line of sight can be discounted (ref 4).

2.7 The impact of the veiling luminances depends on the overall brightness of the lit scene. A veiling luminance at night (caused by car headlights for example) will have a bigger impact on visibility

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compared with the same veiling luminance during the day, when objects are brighter and easier to see.

2.8 Solar reflections in planar glazing can be readily assessed using Cochran's technique. The reflected sun appears as a single bright source. For each part of the glazing the sun is reflected at certain times of day and year depending on the geometry of the building and the observer (ref 2).

2.9 Where solar reflection is geometrically possible, the severity of disability glare can be quantified using the Threshold Increment or TI. TI is a relative measure of how much harder it is to see with the veiling glare. With no glare, TI is 0%. A TI of 100% means it is impossible to see anything.

2.10 The following calculation (ref 3) is undertaken:

(i) Calculate the reflected illuminance E_G in a plane perpendicular to the line of sight, given by $E_G = E_{GN} \cos \theta$. θ is the angle in degrees between the window and the line of sight of the observer. E_{GN} is the reflected illuminance in a plane directly facing the window; this was found by multiplying the direct illuminance from the sun by the specular reflectance of the glazing. Glass reflects more light at oblique angles, so this includes the effect of the angle of incidence of the sun; the reflectance was extrapolated from the manufacturers' data, assuming proportionality to Fresnel's equations.

(ii) Calculate the veiling luminance L_V in the eye based on this illuminance. This is given by $L_V = 10\ E_G / \theta^2$. Hassall (ref 5) has proposed a limiting veiling luminance of 500 cd/m^2; this is quite a conservative value.

(iii) Calculate the threshold contrast T_{CG} with solar glare. This is given by $54/(3400 + L_V)$. 3400 cd/m^2 is a typical background luminance when the sun is low in the sky. Under these conditions, a small person 100m away would just be visible, if there was no glare and they were 54 cd/m^2 brighter or darker than the background (this is a threshold contrast of 54/3400 or 0.016). The formula measures the reduction in this contrast caused by the additional veiling glare.

(iv) Calculate the Threshold Increment TI (ref 7), given by $TI = (1 – T_{CG} / 0.016) \times 100\%$.

2.11 Close to the building (at distances of up to 50 metres or so) the reflected illuminance E_G does not vary greatly with distance, if the glazing is of good quality and well installed. Further away, two additional factors come into play. The first is that the sun is not a point source, but has an apparent diameter of 0.5°. If the angle subtended by the glazing at the viewer is less than this, then only part of the sun will be visible. A correction has been made for this.

2.12 The second factor, which is more difficult to quantify, occurs because the glazing will not be entirely flat. Typically glazing will tend to bow very slightly in the middle under air pressure, and act like a curved mirror, spreading the light at long distances and reducing the effective illuminance E_G. No correction has been made for this second factor.

2.13 The analysis of reflection from the glass has included the worst case assumptions:

- The glass is perfectly clean and flat
- With the double glazing, reflection is always possible from both the outer leaf and the inner leaf.

2.14 In practice solar glare is therefore likely to be less than predicted, especially in cases where the sun presents an oblique angle to the reflecting façade.

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2.15 The resulting threshold increments can then be compared with internationally recommended values for road lighting. IS EN13201-2 (ref 6) gives recommendations for threshold increments in roads of different classes. Guidance on the classification of roads is given in BS5489-1 (ref 7) and IS CEN TR 13201-1 (ref 8). For roads surrounding the site, a classification of ME3 or ME4 would be appropriate depending on traffic flow. These have a recommended maximum threshold increment of 15%.

2.16 This approach is a very conservative one, for several reasons:

a. The road lighting recommendations are themselves very conservative, because the aim of road lighting is to help the driver to see more clearly.

b. Under road lighting the driver is exposed to a constant or near constant level of glare. Solar reflection tends to occur in isolated locations, and as the driver drives out of the reflected beam he or she is then able to see at peak performance again. Any impairment of vision is strictly temporary.

c. During the day, it is a lot easier to see things because of the higher light levels, so a worsening in threshold contrast is not as important as it is at night when the visual task is much more demanding.

d. Where a single source of light causes glare, drivers can often reduce it by moving their heads or using sun visors. This is less easy to do with road lighting from a number of light sources.

2.17 This is backed by everyday experience with the real sun when it is rising or setting. Low altitude sun can cause very high threshold increments, of the order of 80%-90%, but drivers can still cope by using visors.

Discomfort glare

2.18 Discomfort glare is less important than disability glare, but may be an issue if there are locations nearby where people could be sensitive to glare, and sunlight could be reflected there for a significant duration. These could include offices, schools, hospitals and security posts. Reflected glare is likely to be more of a concern for north facing windows which may be unshaded, and less important for windows which already receive direct sunlight for much of the year and where blinds may be lowered most of the time.

2.19 For discomfort glare, the key issue is the total duration of time for which the sun can be reflected to the sensitive location. Durations of less than 50 hours per year are unlikely to cause serious problems, except in very sensitive locations. Longer durations of reflection could result in significant discomfort glare issues depending on the type of space, the height of the reflected sun (low angle sun usually presents the most problems), whether shading devices are already in use, and the way the space is used. If people have fixed workstations facing the window (for example, receptionists or security staff) they will be more susceptible to glare.

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3 The proposed development

3.1 Figure 1 shows the proposed development.

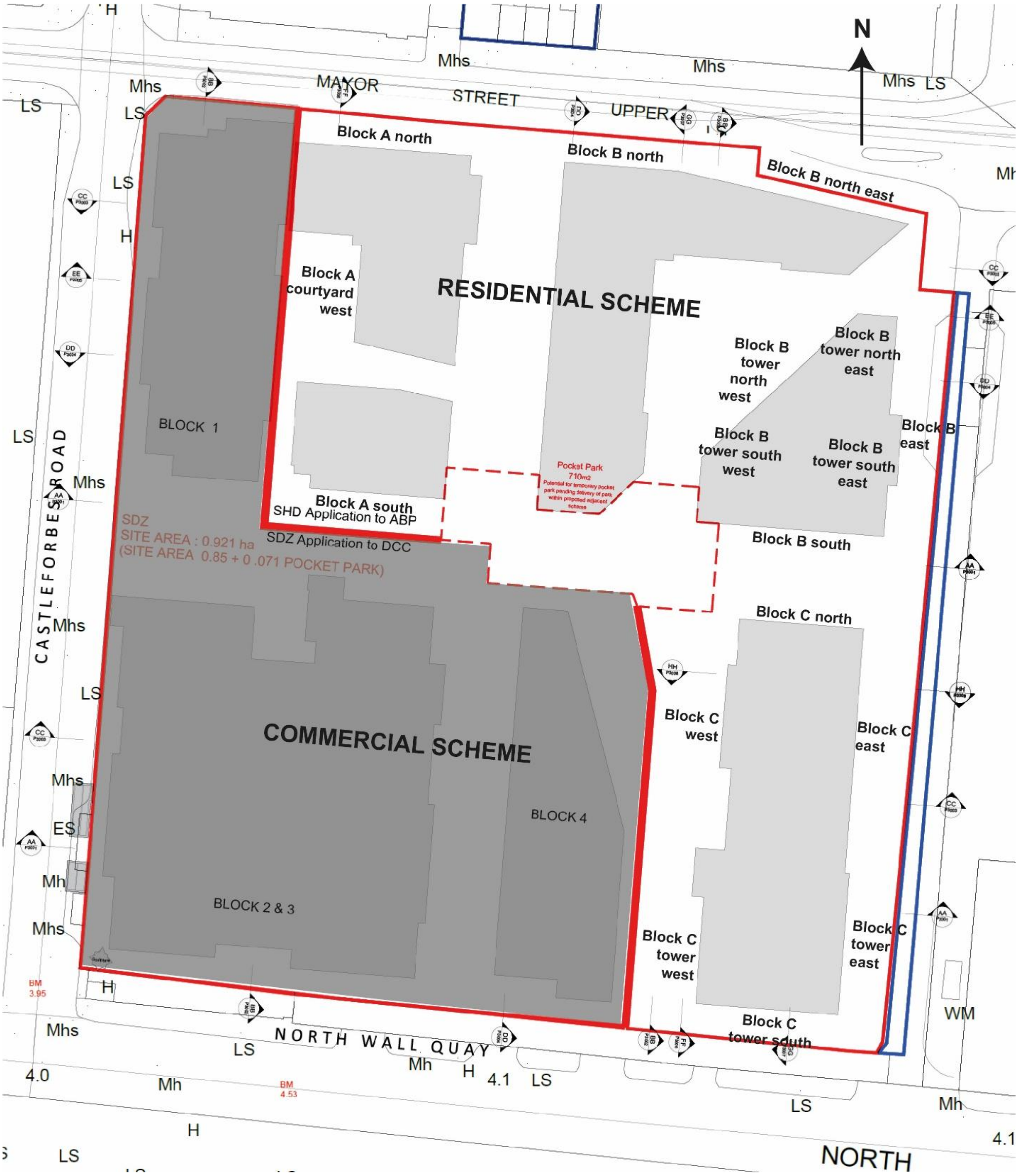

Figure 1. Plan of the proposed development, by Henry J Lyons.

3.2 There are three blocks in the residential (SHD) development. Blocks B and C both incorporate tall towers. The tower to Block C is located at the south of the building. The tower to Block B is set in the middle of the block and is skewed on plan at 45 degrees, so it has sides facing north east, north west, south west and south east.

3.3 To the west of the development is a site earmarked for a commercial scheme. Two scenarios have been assessed in this report: the residential development on its own, assuming an empty site to the west (see section 5), and both developments together (see section 6).

3.4 Apart from the two towers, the residential development is fitted with conventional clear low emissivity double glazing, and a visible reflectance of 0.15 has been taken. The towers have a graduated glazing system; the lowest part of the Block C tower has a dark grey interlayer with an overall reflectance of 0.09, the next section of the Block C tower and the lowest part of the Block B tower have a medium grey interlayer with an overall reflectance of 0.10, the next section of both towers a light grey interlayer with an overall reflectance of 0.12, and the top section is clear low emissivity double glazing with a visible reflectance of 0.15. Thus the lower part of the towers will tend to reflect less light, decreasing the potential for glare.

3.5 At higher angles of incidence the glass will reflect more light. This was modelled using Fresnel's equations.

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4 Reflection to roads in the locality

4.1 The main issue, addressed in this report, is potential glare to motorists as they drive along the roads around the site. Reflected glare to railways is not expected to be significant; there are railway sidings to the north of the site, but there are other buildings in between which would block views of the development.

4.2 In assessing points where disability glare could occur, the following factors should be borne in mind:

- Because the amount of glare decreases rapidly as the angle between the reflecting glazing and line of sight increases, disability glare is only a problem for drivers approaching the building and facing it.
- For the same reason, if an existing building restricts the driver's view of the lower parts of the proposed building, and they have to look upwards, at an angle of 25° or more, over the existing building to see it, disability glare would not be an issue.
- Disability glare is likely to be especially important at locations where a driver has to make a key decision, for example a motorist approaching a road junction or pedestrian crossing, or traffic lights.
- The sun does not occupy most of the northern part of the sky, so viewers to the north of the buildings will not experience direct reflection from the glazing, except at a very oblique angle which is unlikely to cause glare. Also, viewers looking at east or west facing windows from the south east or south west are less likely to experience glare.

4.3 Based on these factors, the following points (Figure 2) have been identified as key locations for disability glare assessment:

A. Travelling east along North Wall Quay, approaching the junction with Castleforbes Road.

B. Travelling west along North Wall Quay, approaching the junction with North Wall Avenue.

C. Travelling west along Mayor Street, approaching traffic lights near the junction with North Wall Avenue.

D. Travelling south along North Wall Avenue, approaching the junction with Mayor Street.

E. Travelling south along North Wall Avenue, approaching the access ramp for car parking under the proposed Block C.

F. Travelling south along Castleforbes Road, approaching the junction with Mayor Street.

G. Travelling east along Mayor Street, approaching the junction with Castleforbes Road.

H. Travelling south west exiting the M50 Port Tunnel, approaching the junction with East Wall Road.

I. Travelling south west along East Wall Road, approaching the junction with Alexandra Road.

J. Travelling north along East Link, as the road curves round to cross the River Liffey.

K. Travelling north along Benson Street, approaching the junction with Sir John Rogerson's Quay.

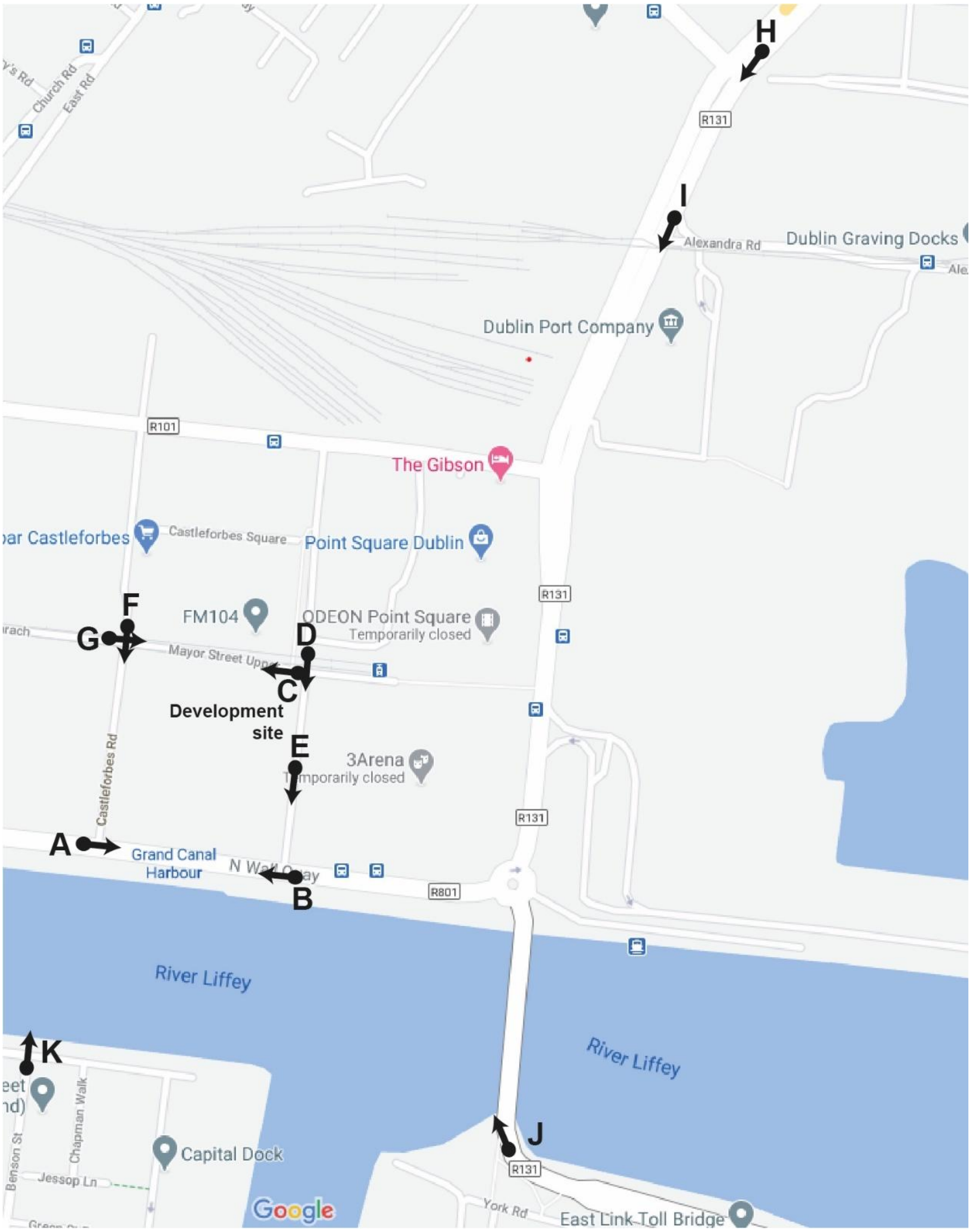

Figure 2. Map (taken from Google Maps) showing points used in the analysis (in black). North is at the top of the plan.

5 Potential impacts

A. Travelling east along North Wall Quay, approaching the junction with Castleforbes Road.

5.1 This point is shown in the map in Figure 2. Motorists approaching from the west along North Wall Quay would have a view of the new development to their left. A point just before Castleforbes Road has been chosen. There are no traffic lights, pedestrian crossings or bus stops here, but it is possible that people emerging from Castleforbes Road might want to cross North Wall Quay in order to walk along the river.

5.2 Figure 3 is a sunpath diagram which shows the days and times for which reflection could occur. The axes of the diagram are the solar azimuth (degrees clockwise from north, so 180° is due south), and altitude above the horizon. In each diagram the positions of the sun for which it could be reflected to point A are plotted as a red outline. The curved thick lines indicate sunpaths for the 21st of each month. If part of the sunpath lies within the coloured outline, that means the sun can be reflected. The thin lines give the times at which the sun is at that particular altitude and azimuth. These times are given in solar time, which approximates to Greenwich Mean Time. To convert to clock time:

- if summer time is in operation, add one hour. So 1200 on the diagram corresponds to 1300 Irish Standard Time (IST) from April-October
- apply an extra correction called the equation of time. Add the values in Table 1. So at London in November, 1200 on the diagram is actually 1200 -14 minutes = 1146 GMT
- apply an extra correction for longitude. For longitudes west of Greenwich, add the longitude multiplied by four minutes. For Dublin (6.25° W) this is 25 minutes. So in Dublin in November, 1200 on the diagram is actually 1146+25= 1211 GMT.

TABLE 1. Mean values (in minutes) of the equation of time on the 21st of each month

January	+12	July	+6
February	+14	August	+3
March	+7	September	-7
April	-1	October	-15
May	-3	November	-14
June	+1	December	-2

5.3 In practice the corrections make little difference to the impact of the reflection; they simply alter the exact times at which sun could be reflected.

5.4 The sunpath diagram shows the outlines of the buildings only. In practice reflections will not always occur when the sun is inside the red outlines, because balconies and green walls will tend to break up the reflection. So the red outlines represent a worst case situation.

5.5 The sunpath diagrams only cover direct reflection from one building and not situations where the sun bounces off one building then another before reaching the driver. Such multiple reflections would not cause significant glare because of the attenuation of the sun each time it is reflected.

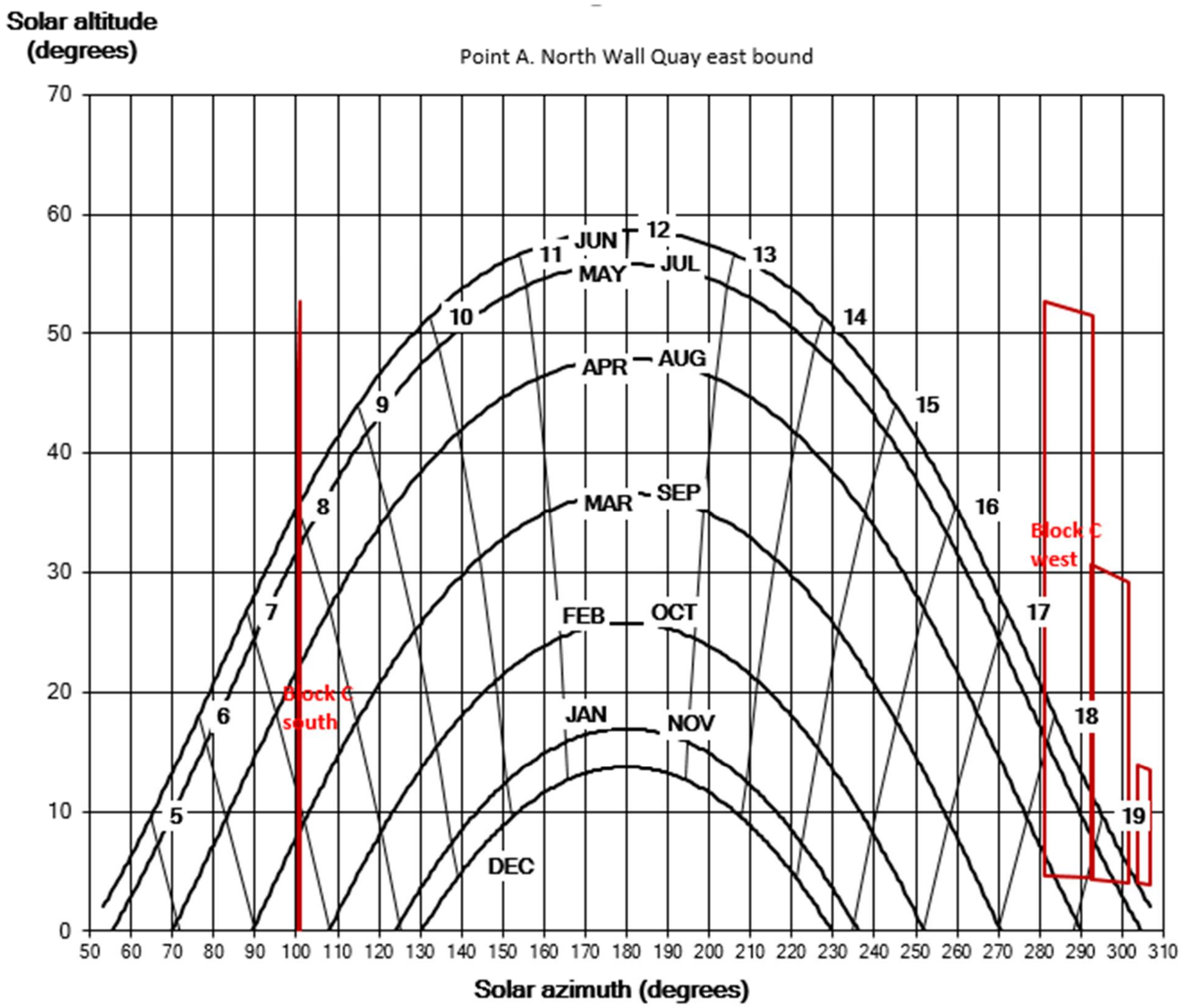

Figure 3. Sunpath diagram showing times of day and year for which sunlight can be reflected to point A.

5.6 Reflection could occur from the southern end of the Block C tower, from March until early October for two minutes at around 0700 GMT in early March, 0900 IST in April and August, and 0930 IST in June. The reflected sun would be around 7° to the left of the drivers' line of sight. At these times drivers will be travelling towards the sun and should be prepared for glare, with their visors down.

5.7 A longer period of reflection could occur from 1900-1930 IST onwards from mid-April to late August, from the western face of Block C. The reflected sun would be further to one side, between 7-32° to the left of the drivers' line of sight.

5.8 From the south side of Block C, the maximum threshold increment would be 11%, within the recommended 15% for road lighting. This level of glare would be noticeable but not significant. From the west side of Block C there would be a lower level of glare, between 2-3% threshold increment, which would be negligible.

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B. Travelling west along North Wall Quay, approaching the junction with North Wall Avenue.

5.9 This point is shown in the map in Figure 2. It corresponds to drivers coming from the east along North Wall Quay, approaching the junction with North Wall Avenue. This is a more sensitive location, because there are traffic lights here. The new development would be visible to the right.

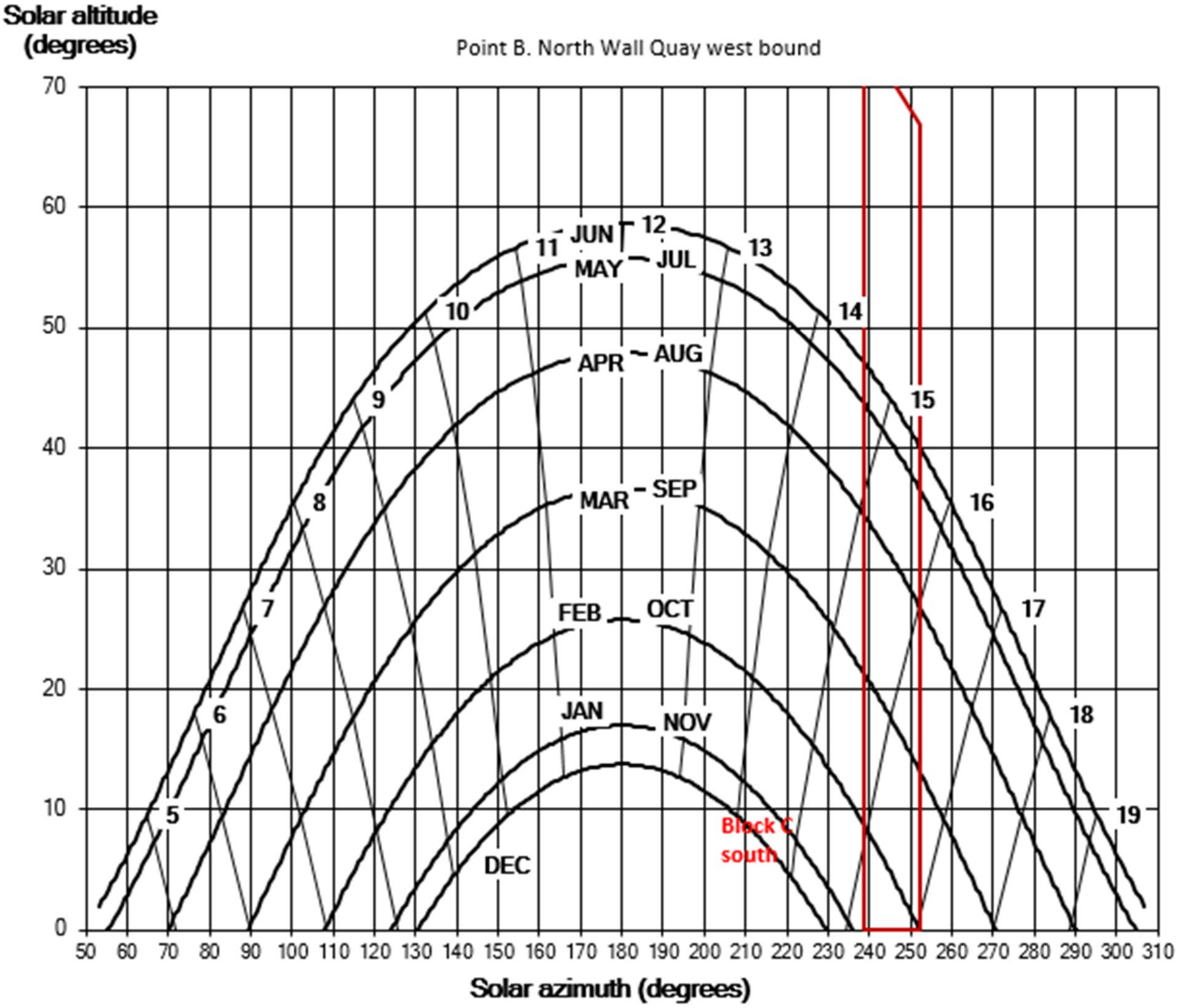

Figure 4. Sunpath diagram showing times of day and year for which sunlight can be reflected to point B.

5.10 Figure 4 is a sunpath diagram which shows the days and times for which reflection could occur. Only the southern face of the Block C tower could reflect sunlight to this location; the eastern side would reflect the north eastern sky or the building opposite, not the sun. From the southern face, sunlight could be reflected for up to an hour in the mid to late afternoon.

5.11 Glare would be negligible, with threshold increments no more than 3-4%, compared to the recommended maximum for road lighting of 15%. This is because the proposed development would be off to one side of the drivers' field of view, between 21-35 degrees away from the driver's centre of view.

C. Travelling west along Mayor Street, approaching traffic lights near the junction with North Wall Avenue.

5.12 Mayor Street ends after North Wall Avenue with the Point LUAS station. The point chosen has been for drivers turning left into Mayor Street from North Wall Avenue. There is a set of traffic lights here (Figure 5) to stop drivers pulling out into Mayor Street when a tram is approaching.

Figure 5. View (from Google Streetview) along Mayor Street towards traffic lights. The new development would be off to the left.

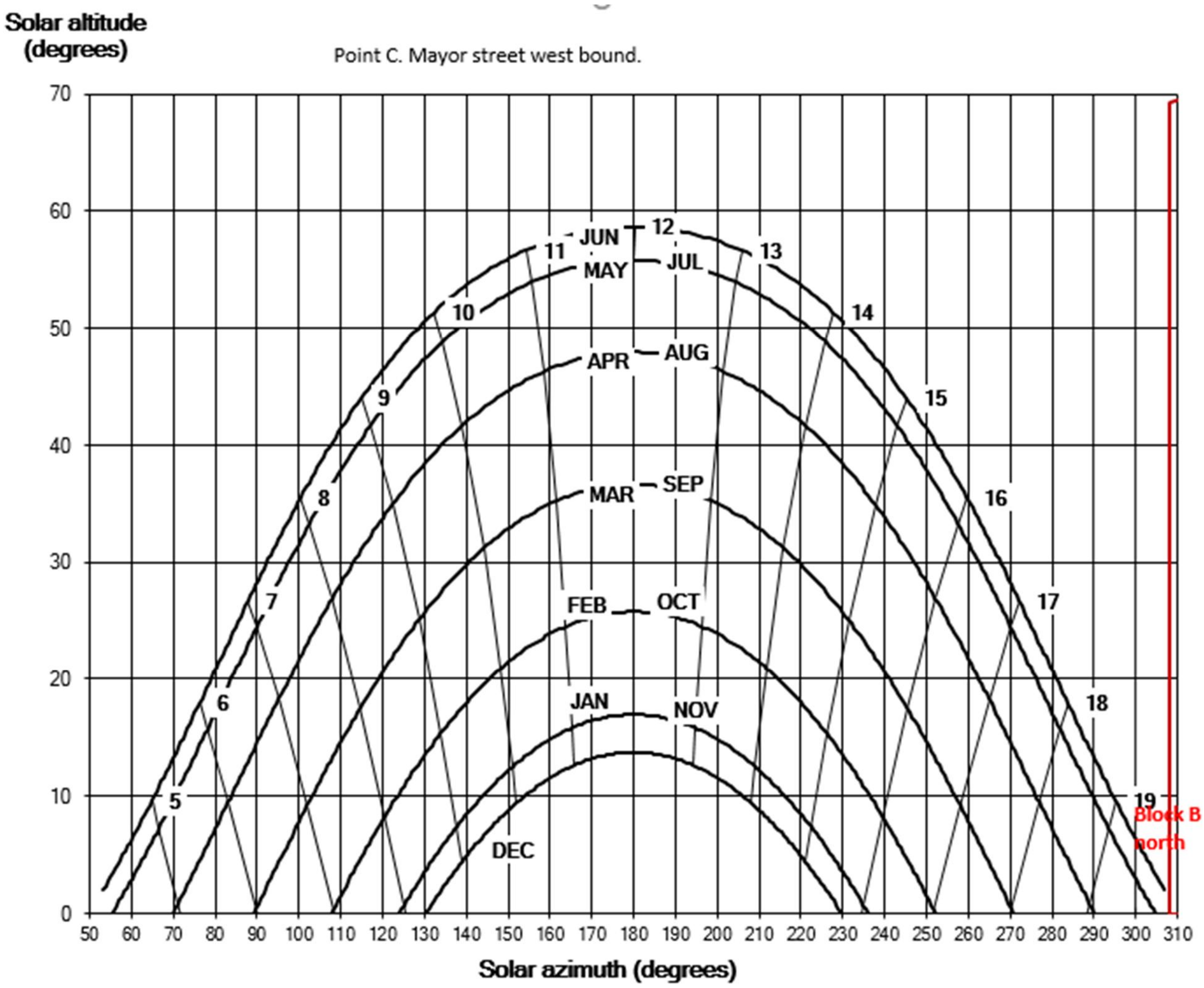

Figure 6. Sunpath diagram showing times of day and year for which sunlight can be reflected to point C.

5.13 Figure 6 is a sunpath diagram which shows the days and times for which reflection could occur. Sunlight could be reflected from the north east face of Block B, but only for a short time just before sunset in mid-summer. Drivers travelling westwards should be expecting glare and have their visors down.

5.14 The level of reflected glare would be negligible, well within the recommended values. The maximum threshold increment would be around 3-4%, well below the recommended 15% limit. This is partly because the reflected sun would be well to the left of the drivers' field of view, at more than 22 degrees to their line of sight.

D. Travelling south along North Wall Avenue, approaching the junction with Mayor Street.

5.15 This point is shown on the map in Figure 2. It is a sensitive location as there are traffic lights here, as North Wall Avenue crosses the Luas line on Mayor Street. The new development would be visible to the right across Mayor Street.

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5.16 Figure 7 is a sunpath diagram which shows the days and times for which reflection could occur. Sunlight could not be reflected from the Mayor Street frontage of Block B, or from the north east façade of the tower of Block B, because they would reflect the northern part of the sky. Sunlight could glance off the north west façade of the tower of Block B, for up to 25 minutes in summer, but it would be well to the right of the drivers' line of sight.

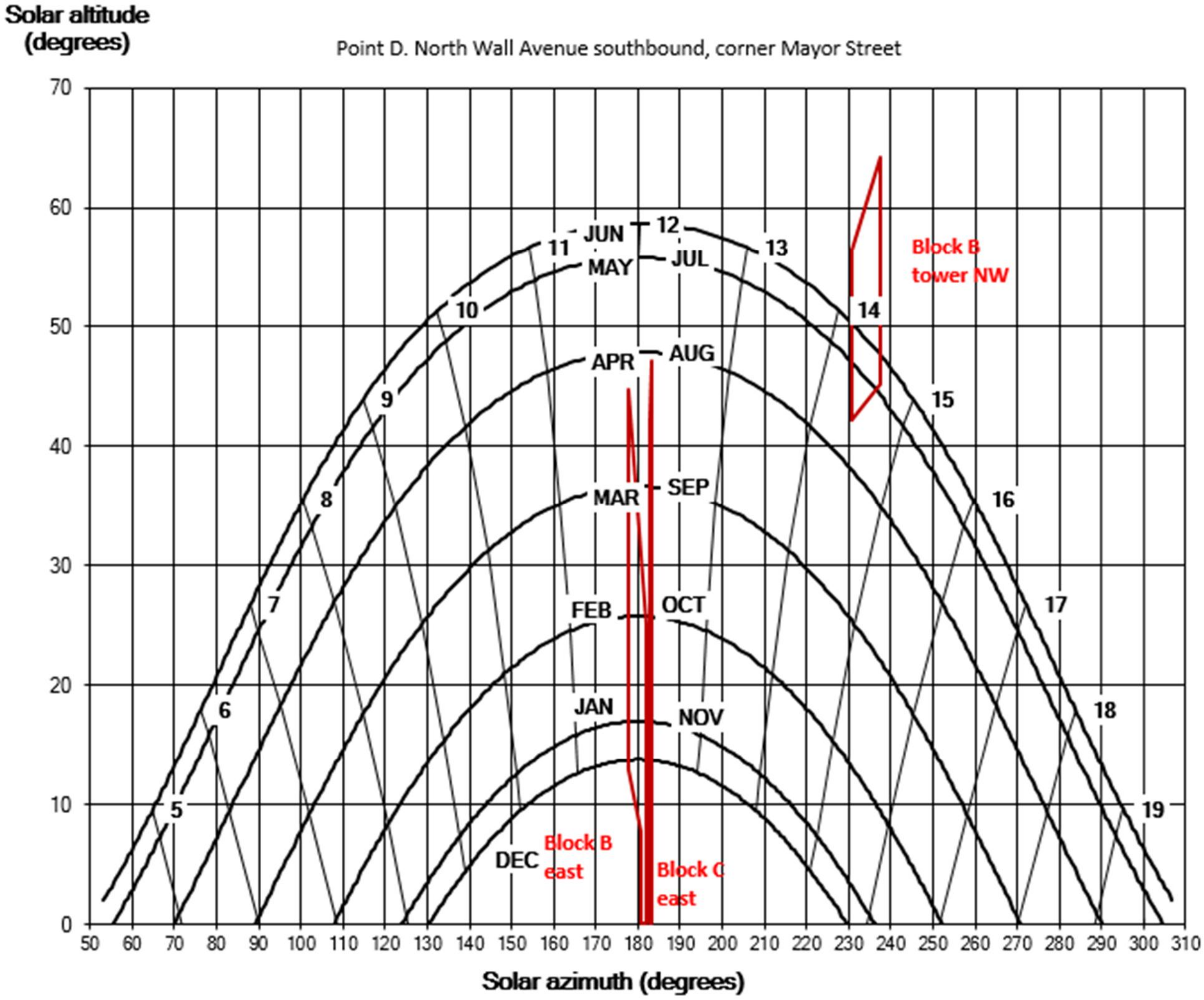

Figure 7. Sunpath diagram showing times of day and year for which sunlight can be reflected to point D.

5.17 There would also be some reflection along North Wall Avenue from the eastern sides of Blocks B and C. This would happen for up to 20 minutes around midday, from September until the end of March.

5.18 For most of the reflections, threshold increments would be in the 1-10% range, well within the recommended 15% for road lighting. However, the maximum threshold increment would be 16%, just above the road lighting recommendations. This would occur at 1230 GMT in December, when the sun would glance off the far end of Block B. At this point the reflected sun would be 4° to the right of the drivers' line of sight and at an altitude of 13° above the horizon.

5.19 This would count as a minor adverse impact for the following reasons:

- The level of glare is only marginally above the strict road lighting recommendations
- Drivers would be travelling south with the low sun ahead of them, and would be prepared for glare with their visors down
- The duration of glare is short and happens at a time of year when the sun is often obscured by cloud

E. Travelling south along North Wall Avenue, approaching the access ramp for car parking under the proposed Block C.

5.20 Further south along North Wall Avenue, drivers will have the new development to the right of them. There are currently no traffic lights or pedestrian crossings in this stretch of road, but people emerging from the new development or the Wintertide Lands development to the east may want to cross the road here. A point has been chosen to the north of the access ramp under Block C, as traffic may be emerging from this ramp.

5.21 Figure 8 is a sunpath diagram which shows the days and times for which reflection could occur. Sunlight could be reflected from the eastern side of Block C, for up to half an hour in total throughout the year, in the late morning and around midday. The reflected sun would be well to the right of the drivers' line of sight (11-59° to the right) and most of the time at high altitude.

5.22 Glare would be well within the recommended values. The maximum threshold increment would be 9%, well below the recommended 15% maximum for street lighting.

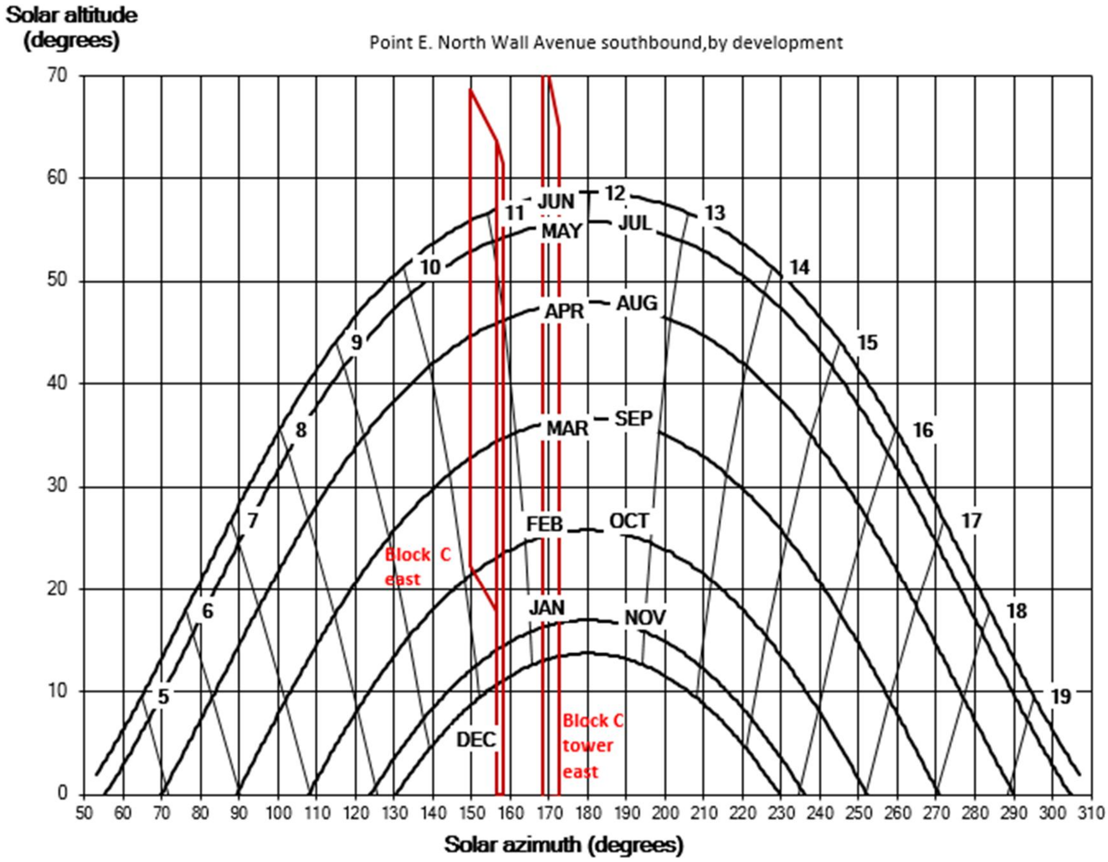

Figure 8. Sunpath diagram showing times of day and year for which sunlight can be reflected to point E.

F. Travelling south along Castleforbes Road, approaching the junction with Mayor Street.

5.23 This point is shown on the map in Figure 2. It is a sensitive location as there are traffic lights here, as Castleforbes Road crosses the Luas line on Mayor Street. The nearest parts of the new development (Block A) would be visible to the left across Mayor Street. However most of the residential development would be hidden behind an existing building at the north east corner of Castleforbes Road and Mayor Street.

5.24 Figure 9 is a sunpath diagram which shows the days and times for which reflection could occur. Sunlight cannot be reflected from the north façade of Block A, and the western end elevations of the block are unglazed. However sunlight could be reflected from the west facing courtyard elevation of Block A, for up to 20 minutes in March and late September/early October, at around 1430 GMT in March and 1530 IST in Sept/Oct. Sunlight could also be reflected from the western side of the Block C tower, for up to 15 minutes at the same times of day in late March-mid April and late August-mid September. Most of the time the reflected sun would be well to the left of the drivers' line of sight (28-36° to the left) and at high altitude.

5.25 This means that glare would be negligible and well within the recommended values. The maximum threshold increment would be 2-3%, well below the recommended 15% limit.

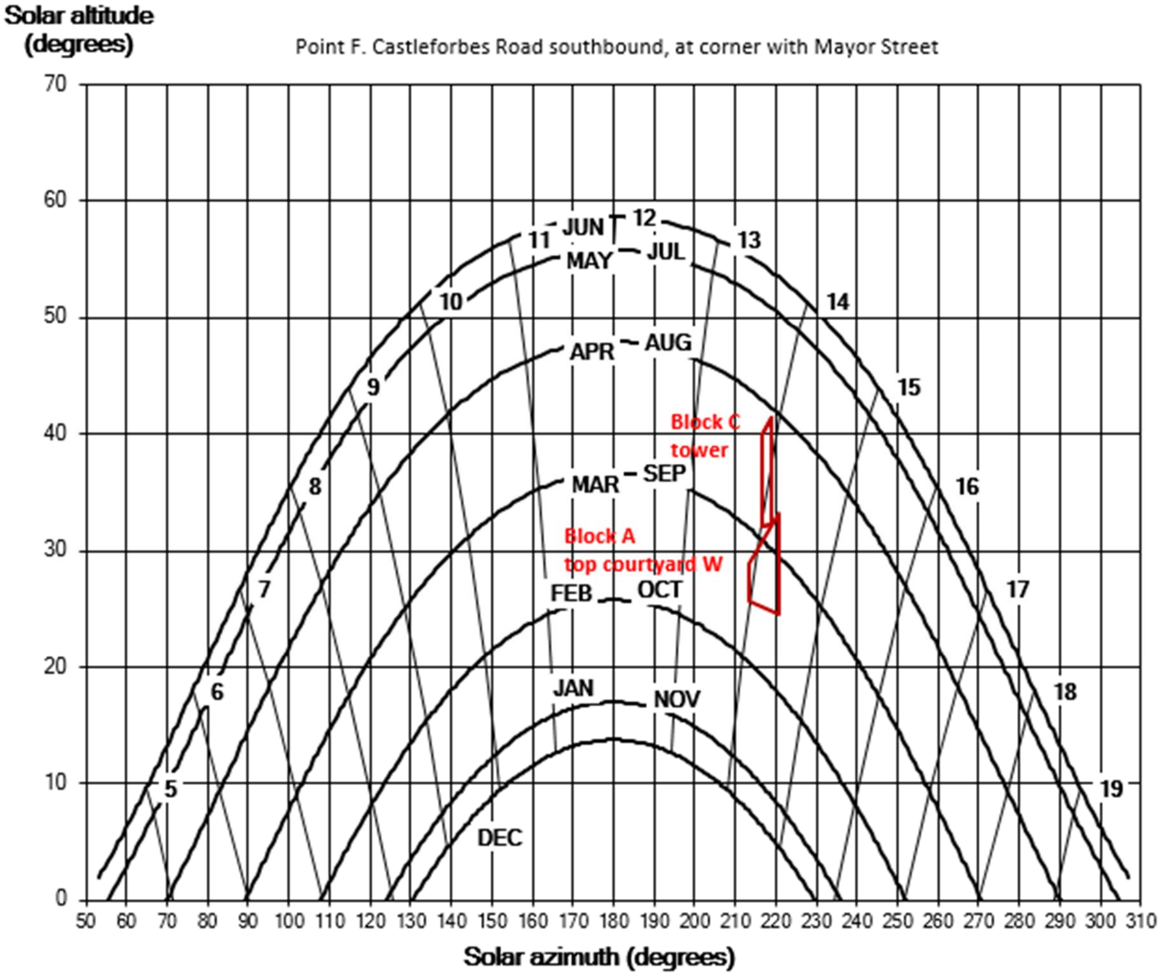

Figure 9. Sunpath diagram showing times of day and year for which sunlight can be reflected to point F.

G. Travelling east along Mayor Street, approaching the junction with Castleforbes Road.

5.26 This point, shown on the map in Figure 2, is at the same junction as Point F but approaching it from the west along Mayor Street, towards the traffic lights at Castleforbes Road. The nearest parts of the new development (Block A) would be visible ahead and to the right across Mayor Street. However the Block C tower would be hidden behind an existing building at the south west corner of Castleforbes Road and Mayor Street.

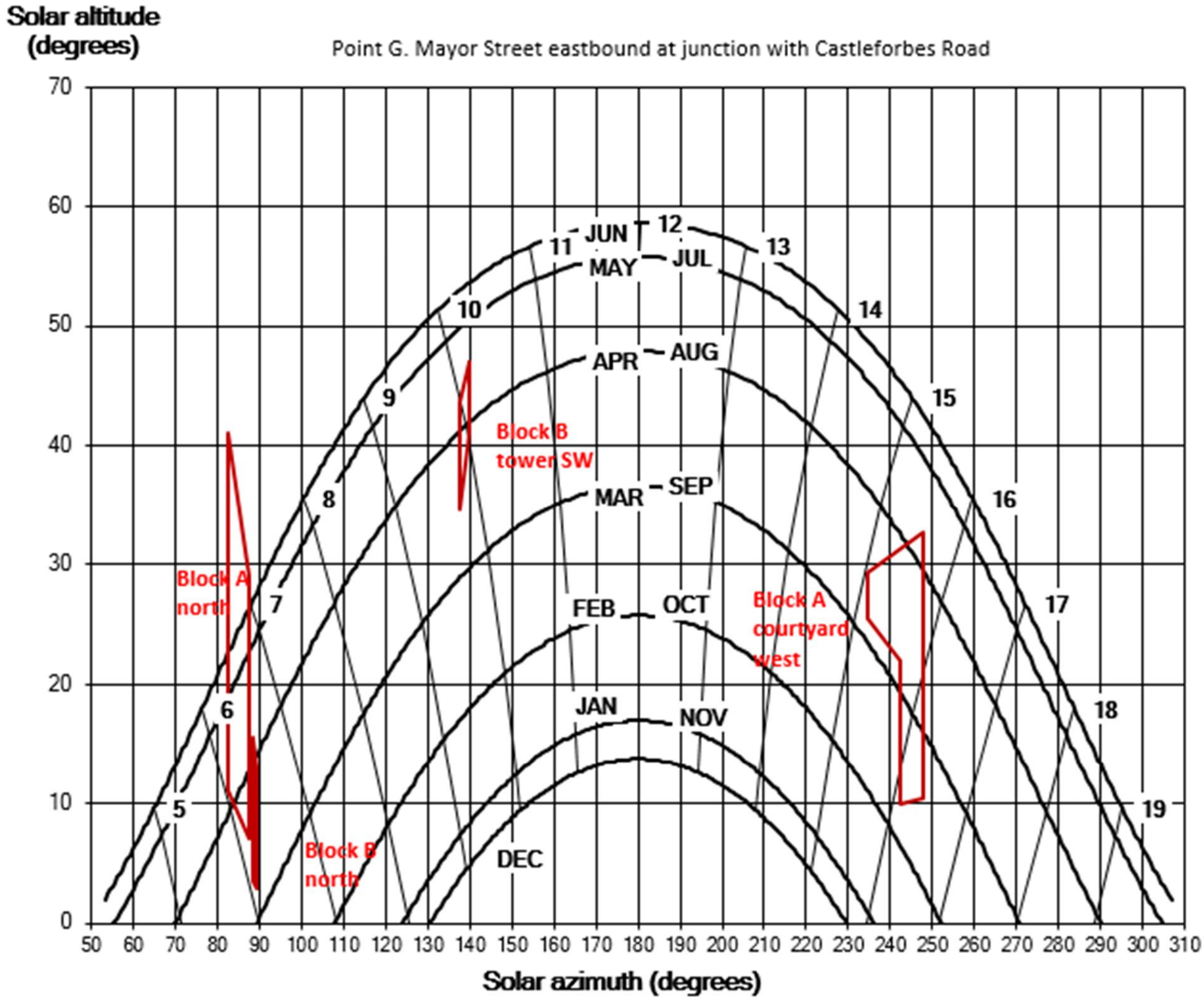

Figure 10. Sunpath diagram showing times of day and year for which sunlight can be reflected to point G.

5.27 Figure 10 is a sunpath diagram which shows the days and times for which reflection could occur. Sunlight could be reflected from the north façade of Blocks A and B in the early morning (between 0730 and 0830 IST) from April to early September. Sunlight could also be reflected from the west facing courtyard elevation of Block A, for up to 45 minutes in March/April and late August/ September/early October, at around 1600 GMT in March and 1700 IST in Sept/Oct. Sunlight could not be reflected from the north west side of the tower of Block B, but could glance off the south west side of the tower, for up to 15 minutes around 1130 IST in April and August.

5.28 The maximum threshold increment would be 14-15%, just within the recommended 15% for road lighting. It would happen when the sun reflects off the north side of Block B, at around 0750 IST in mid April and late August. The reflected sun would be 6° to the right of the drivers' line of sight and at 12° above the horizon. At this time drivers will be travelling towards the low morning sun and be prepared for glare, with their visors down. The level of reflected glare would be noticeable but not significant.

5.29 Glare from the Block A courtyard and Block B tower would be much lower and well within the recommended values. The maximum threshold increment from the courtyard would be 1-2%, and from the Block B tower 4-6%, well below the recommended 15% limit for road lighting.

H. Travelling south west exiting the M50 Port Tunnel approaching the junction with East Wall Road.

5.30 This point is shown on the map in Figure 2. It is a sensitive location as there are traffic lights here, as the Port Tunnel joins East Wall Road. The new development would be visible almost directly ahead. Most of it would be hidden behind the Point development, but the two towers would be visible.

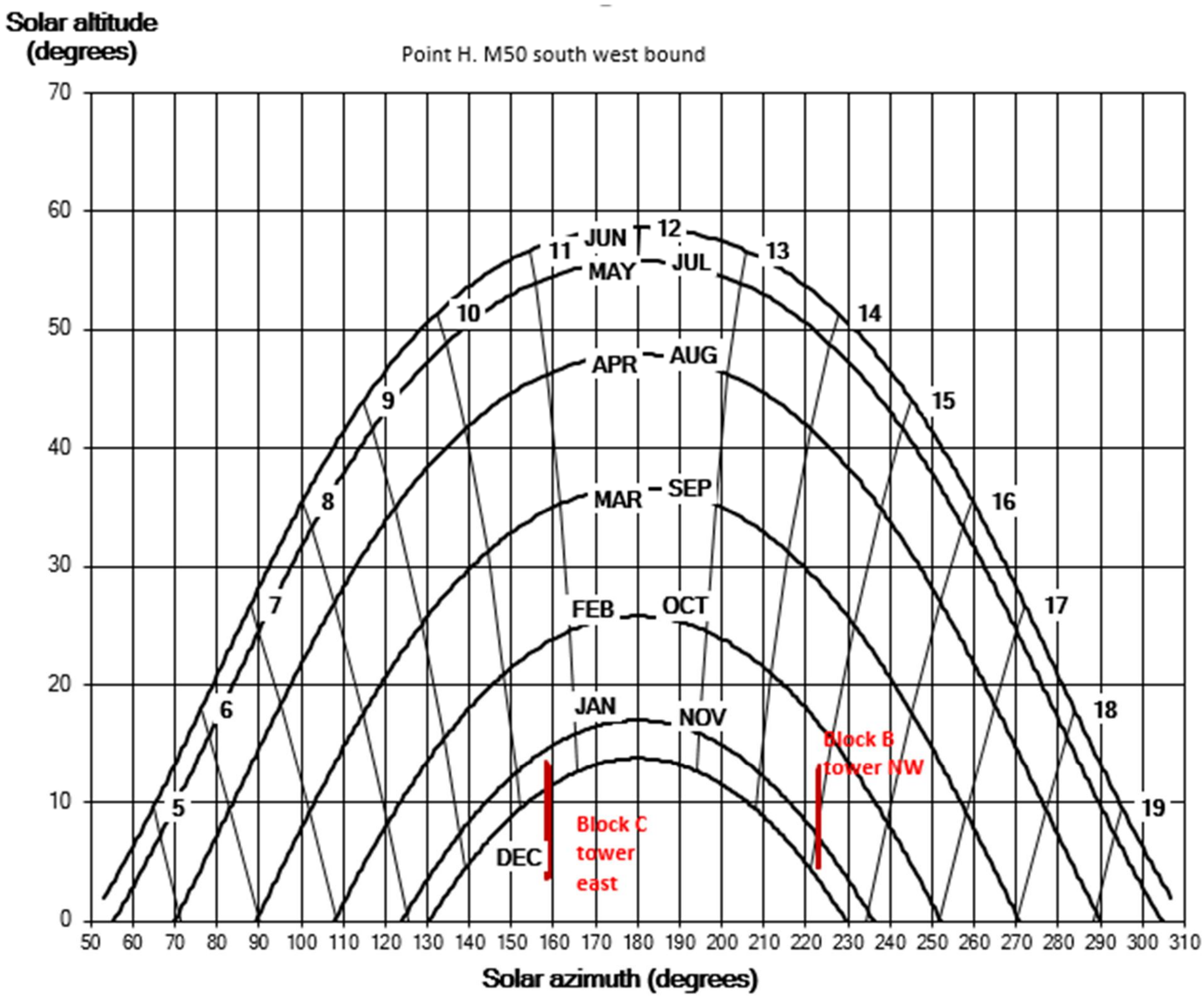

Figure 11. Sunpath diagram showing times of day and year for which sunlight can be reflected to point H.

5.31 Figure 11 is a sunpath diagram which shows the days and times for which reflection could occur. Sunlight could not be reflected from the north east façade of the tower of Block B, because it would reflect the northern part of the sky. Sunlight could glance off the north west façade of the tower of Block B, for up to two minutes in January and November at around 1530 GMT.

bre

5.32 There would also be some reflection from the eastern side of the Block C tower. This would happen for three minutes at around 1130 GMT, from December until mid January.

5.33 Glare would be within the recommended values. The maximum threshold increment would be 11%, below the recommended 15% limit.

I. Travelling south west along East Wall Road, approaching the junction with Alexandra Road.

5.34 This point is shown on the map in Figure 2. There are traffic lights here, as East Wall Road crosses Alexandra Road. The new development would be visible almost ahead and to the right. Most of it would be hidden behind the Point development, but the two towers would be visible.

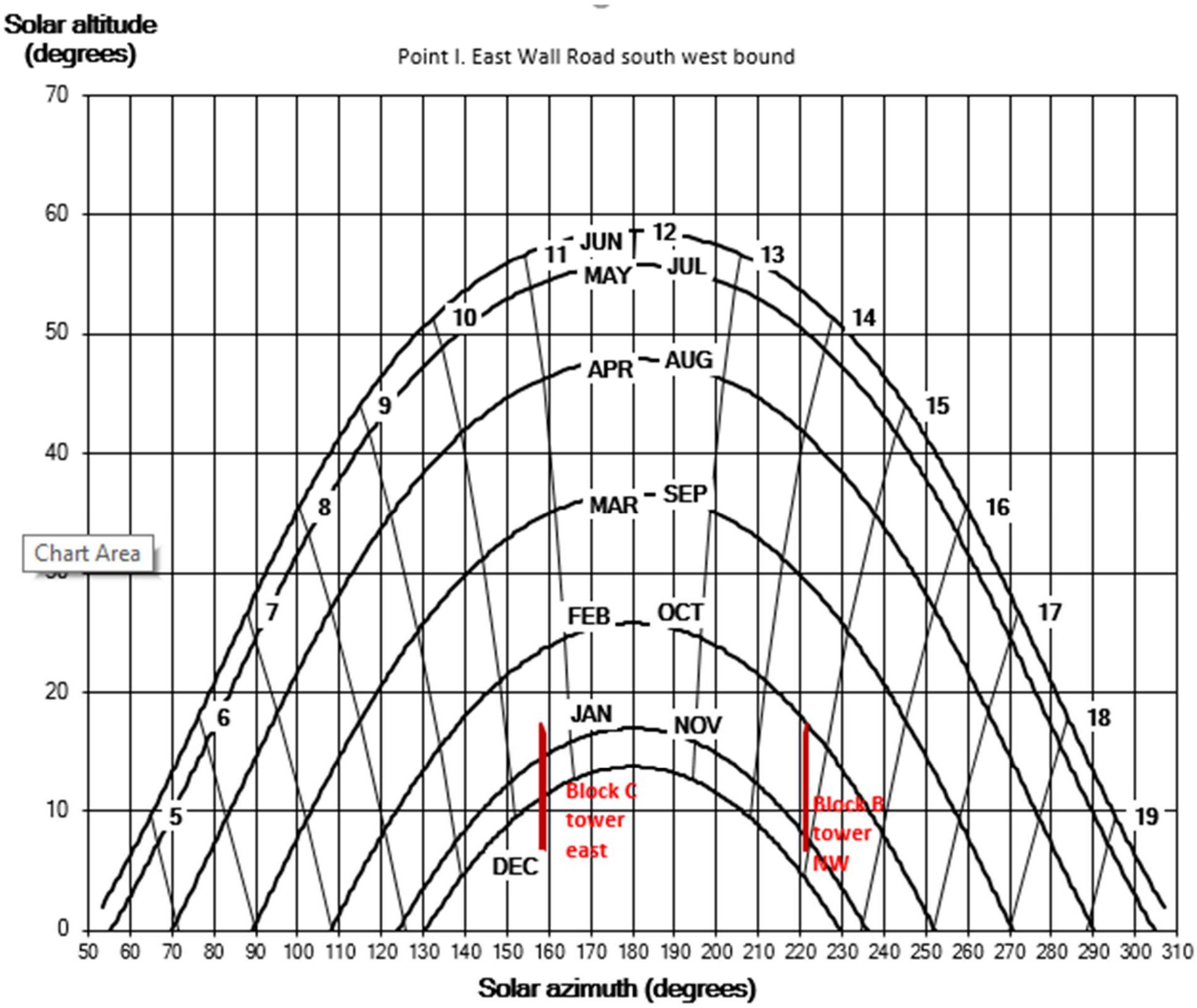

Figure 12. Sunpath diagram showing times of day and year for which sunlight can be reflected to point I.

5.35 Figure 12 is a sunpath diagram which shows the days and times for which reflection could occur. Sunlight could not be reflected from the north east façade of the tower of Block B, because it would reflect the northern part of the sky. Sunlight could glance off the north west façade of the tower of

Block B, for up to three minutes in January, February, late October and November at around 1530 GMT.

5.36 There would also be some reflection from the eastern side of the Block C tower. This would happen for two minutes at around 1100 GMT, from mid November until the end of January.

5.37 Glare would be within the recommended values. The maximum threshold increment would be 6%, below the recommended 15% limit.

J. Travelling north along East Link, as the road curves round to cross the River Liffey.

5.38 This point is shown in the map in Figure 2. It is across the River Liffey on the East Link. Initially drivers travel west leaving the toll booth and bend to the right to cross the river. On the bend, they would momentarily be facing the new development across the river. There are no traffic lights or dedicated pedestrian crossings here.

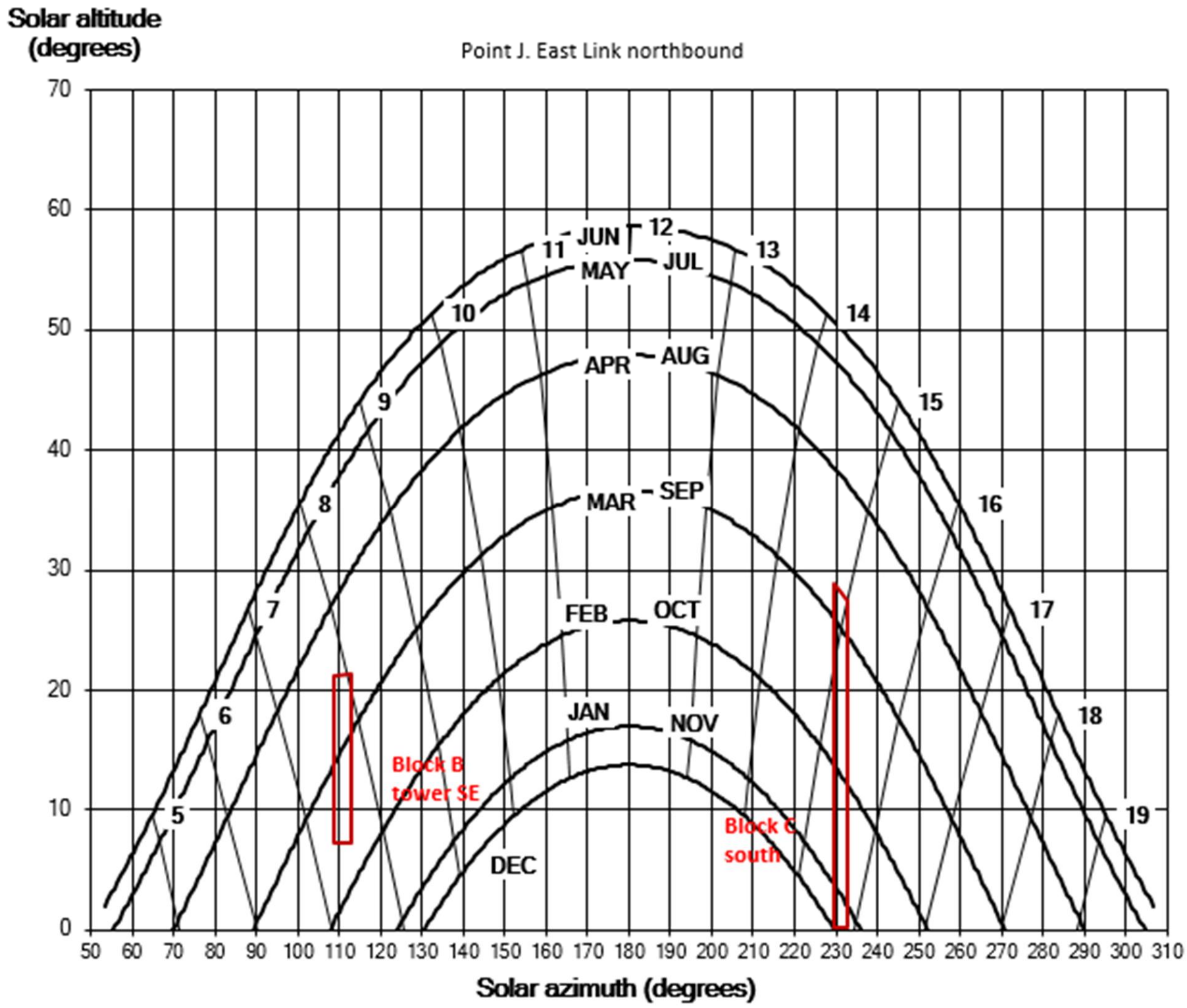

Figure 13. Sunpath diagram showing times of day and year for which sunlight can be reflected to point J.

bre

5.39 Figure 13 is a sunpath diagram which shows the days and times for which reflection could occur. The southern face of the Block C tower could reflect sunlight to this location; the eastern side would reflect the north eastern sky or the building opposite, not the sun. From the southern face, sunlight could be reflected for up to fifteen minutes in the mid to late afternoon from mid September until the end of March. Sunlight could also be reflected from the south east face of the Block B tower for up to 20 minutes in March and September at around 0800 GMT (0900 IST in September).

5.40 Glare would be negligible, with threshold increments of 3%, compared to the recommended maximum for street lighting of 15%.

K. Travelling north along Benson Street, approaching the junction with Sir John Rogerson's Quay.

5.41 This point is also across the River Liffey. Drivers travelling down Benson Street towards the river would see the new development ahead of them and to the right. This is a less sensitive viewpoint as Benson Street is a minor road.

5.42 Figure 14 is a sunpath diagram which shows the days and times for which reflection could occur. The southern sides of Blocks A and B are too low on the horizon to reflect the sun. The southern face of the Block C tower could reflect sunlight for up to 20 minutes in mid morning from mid September until the end of March. Sunlight could also be reflected from the south west face of the Block B tower for up to twelve minutes in February, early March and October at around 1530 GMT (1630 IST in October).

5.43 Glare would be negligible, with threshold increments no more than 1-2%, compared to the recommended maximum for road lighting of 15%. This is because the proposed development would be off to one side of the drivers' field of view, between 24-40 degrees to the right of the driver's line of sight.

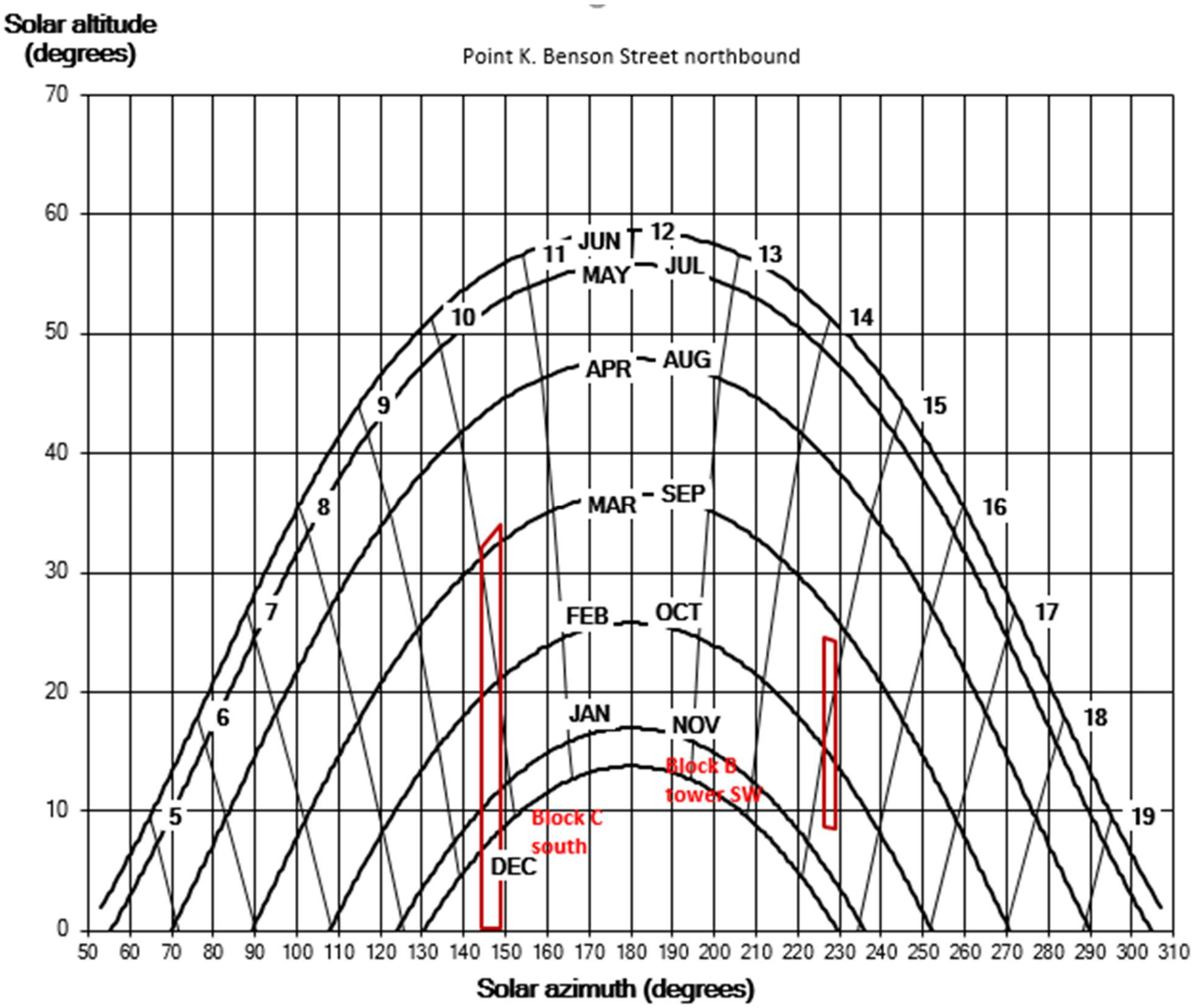

Figure 14. Sunpath diagram showing times of day and year for which sunlight can be reflected to point K.

Discomfort glare to occupants of nearby buildings

5.44 Discomfort glare is a less serious problem because it does not impair the ability to see. Inside a building where glare could be an issue, shading devices such as blinds or curtains are generally provided, and therefore occasional discomfort glare can easily be controlled using such shading devices. In such spaces, discomfort glare due to reflected sun would only be a significant issue if its occurrence was so prolonged as to affect the amenity of the space by requiring the continual additional use of blinds and curtains over long periods.

5.45 There are offices to the north, east and west which would normally have shading fitted, and the new building could be expected to reduce the incidence of glare. Discomfort glare is therefore not expected to be a significant issue.

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6 Cumulative impacts with commercial scheme

6.1 A commercial scheme is proposed for the site to the west. Figure 15 shows the two schemes together.

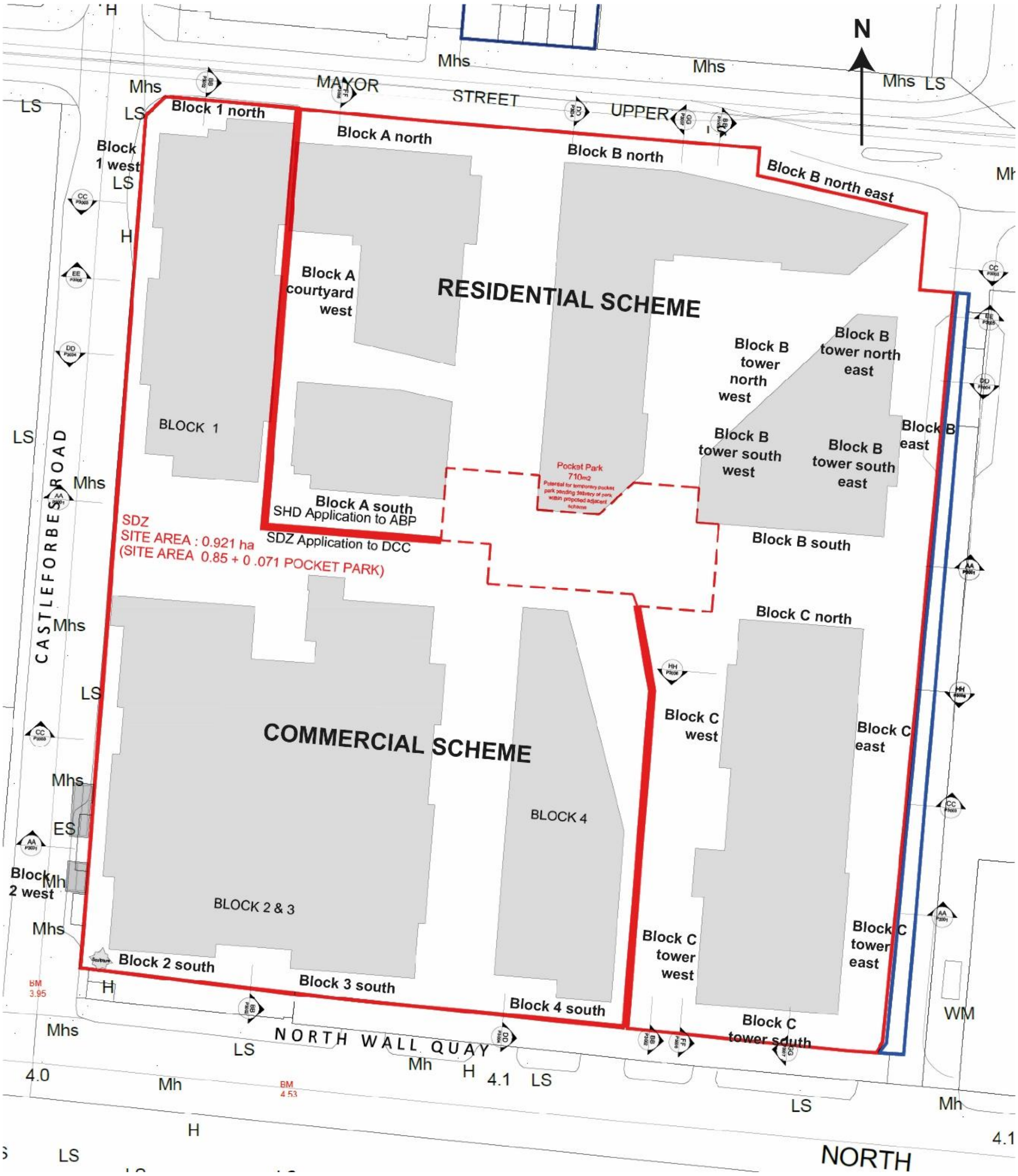

Figure 15. Plan showing commercial scheme to west.

6.2 The commercial scheme would have no effect on the solar glare received at points C, D, E, H and I. For points C, D and E it would be hidden behind the residential scheme. At point I it would be hidden behind other buildings. At point H most of it would be hidden, and the part that would be visible could not reflect the sun.

6.3 The commercial scheme would make very little difference to the solar glare received at Point K because nearly all of the commercial scheme would be too low on the horizon to reflect the sun. There is a possibility of reflection from the very top corner of the Block 4 south elevation for a minute or two close to the winter solstice, but this would cause negligible glare.

6.4 At point F the commercial scheme would block views of the parts of the residential scheme (Block C tower and Block A courtyard) which could cause reflection to this point. The commercial scheme itself could not reflect sunlight to point F (it is fitted with louvres which break up reflection), so there would be no solar reflection to this point with both schemes in place.

6.5 There could be cumulative impacts at points A, B, G and J and these are discussed below.

A. Travelling east along North Wall Quay, approaching the junction with Castleforbes Road.

6.6 Here there would be additional reflections from the south faces of the commercial buildings (Blocks 2, 3 and 4). Figure 16 shows them on the sunpath diagram. The west faces of the blocks cannot reflect sunlight to this point as they are obstructed by other buildings.

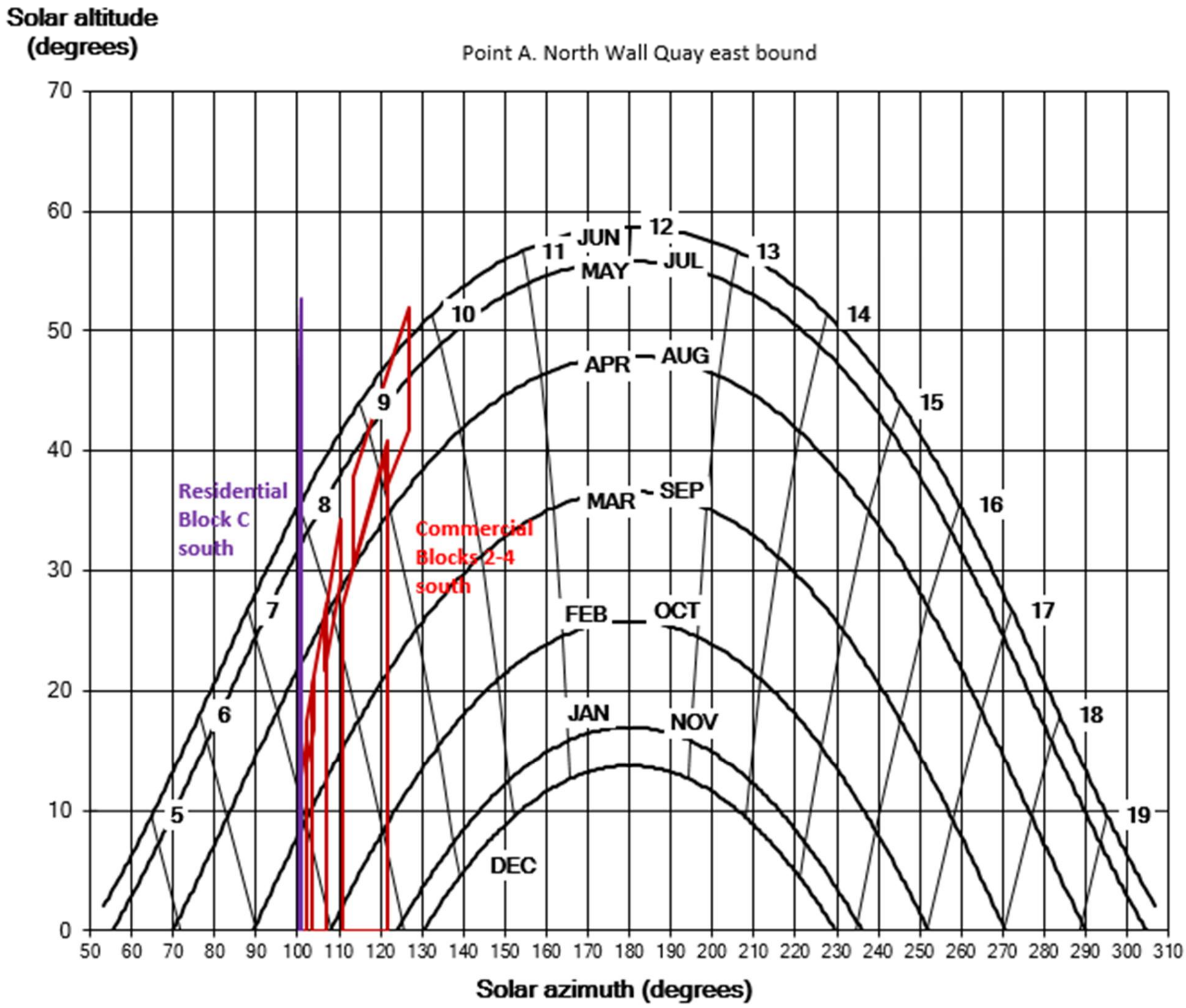

Figure 16. Sunpath diagram showing times of day and year for which sunlight can be reflected to point A (both schemes together).

6.7 The commercial scheme would block reflection from the western face of Block C in the residential scheme. Reflection could still occur from the southern end of the Block C tower, from March until early October for two minutes in the morning (marked in purple in Figure 16). In addition there would be longer periods of reflection (up to an hour and a half) from the southern ends of Blocks 2-4 of the commercial scheme. These are marked in red in Figure 16. The reflected sun would be from 7°-27° to the left of the drivers' line of sight. At these times drivers will be travelling towards the sun and should be prepared for glare, with their visors down.

6.8 From the south sides of Blocks 2 and 3, threshold increments would be in the 1-12% range, meeting the recommendation for road lighting of no more than 15%. However, in the limited times when the sun could glance off the upper parts of Block 4, the maximum threshold increment would be 16%, just above the road lighting recommendations. This would occur at around 0735 GMT in March and 0820 IST in September. At this time the reflected sun would be 7° to the left of the drivers' line of sight and at an altitude of 13° above the horizon.

6.9 This would count as a minor adverse impact for the following reasons:

- The level of glare is only marginally above the strict road lighting recommendations

bre

- Drivers would be travelling south with the low sun ahead of them, and would be prepared for glare with their visors down
- The duration of glare is short and happens at a time of year when the sun is often obscured by cloud

B. Travelling west along North Wall Quay, approaching the junction with North Wall Avenue.

6.10 Here there would be additional reflections from the south faces of the commercial buildings (Blocks 2, 3 and 4). Figure 17 shows them on the sunpath diagram. The east faces of the blocks cannot reflect sunlight to this point as they are obstructed by Block C of the residential scheme.

6.11 Reflection could still occur from the southern face of the Block C residential tower, for up to an hour in the mid to late afternoon. In addition there would be reflections from the southern faces of Blocks 2-4 of the commercial scheme, visible further along North Wall Quay. These would occur for up to an hour in the late afternoon from the end of February until mid April, and from the end of August until mid October.

6.12 The maximum threshold increment from the commercial scheme would be 12%, within the recommended 15% for road lighting. This level of glare would be noticeable but not significant. Drivers would be travelling towards the low sun and would be prepared for possible glare, with their visors down.

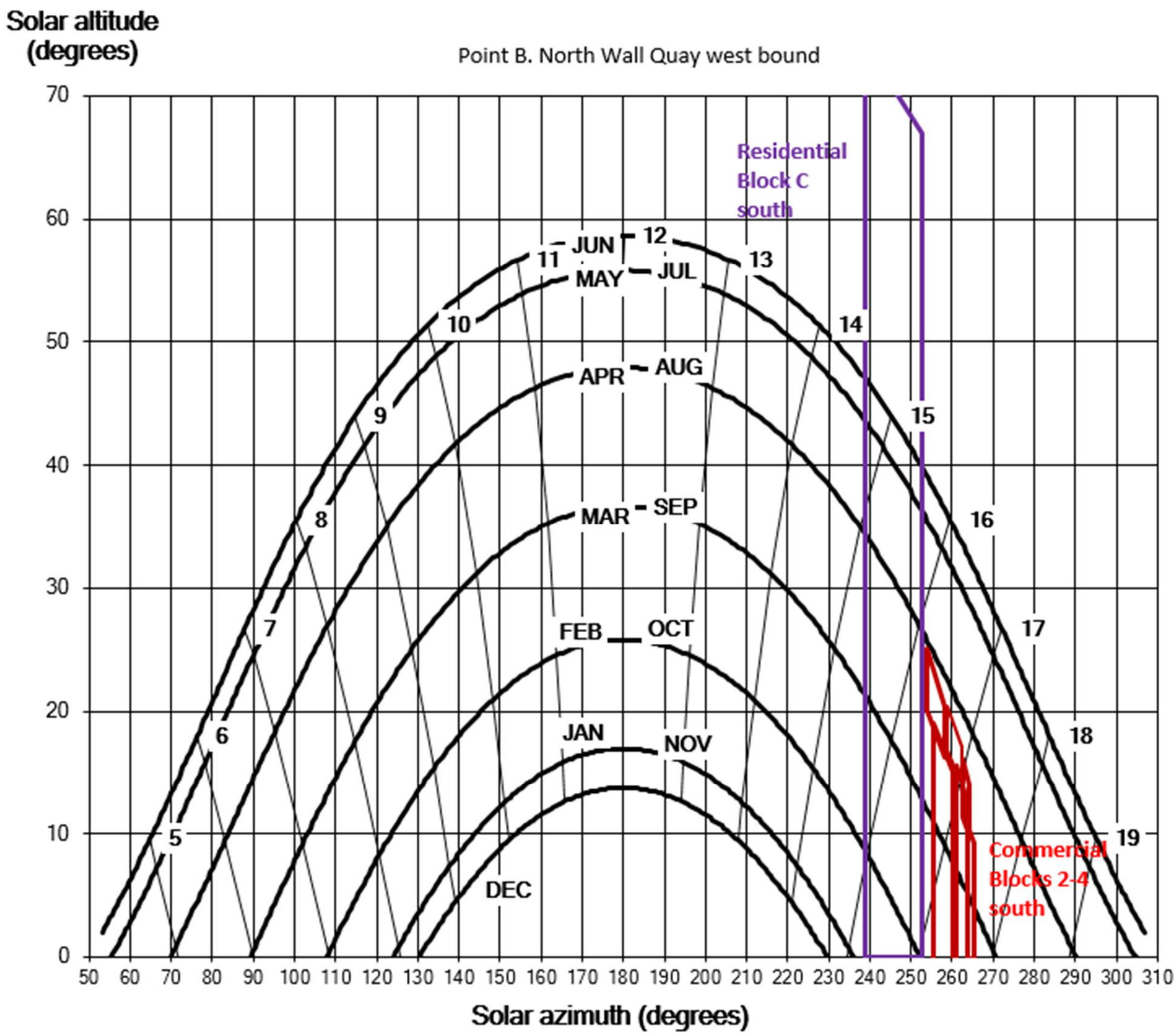

Figure 17. Sunpath diagram showing times of day and year for which sunlight can be reflected to point B (both schemes together).

G. Travelling east along Mayor Street, approaching the junction with Castleforbes Road.

6.13 This point is situated near the north west corner of the commercial scheme, and the commercial scheme would block most of the drivers' views of the residential scheme. Thus reflected sunlight from the Block A courtyard and Block B tower would be intercepted by the commercial scheme before it reached point G. However the northern faces of Blocks A and B would still be visible along Mayor Street and could reflect the sun (see Figure 18).

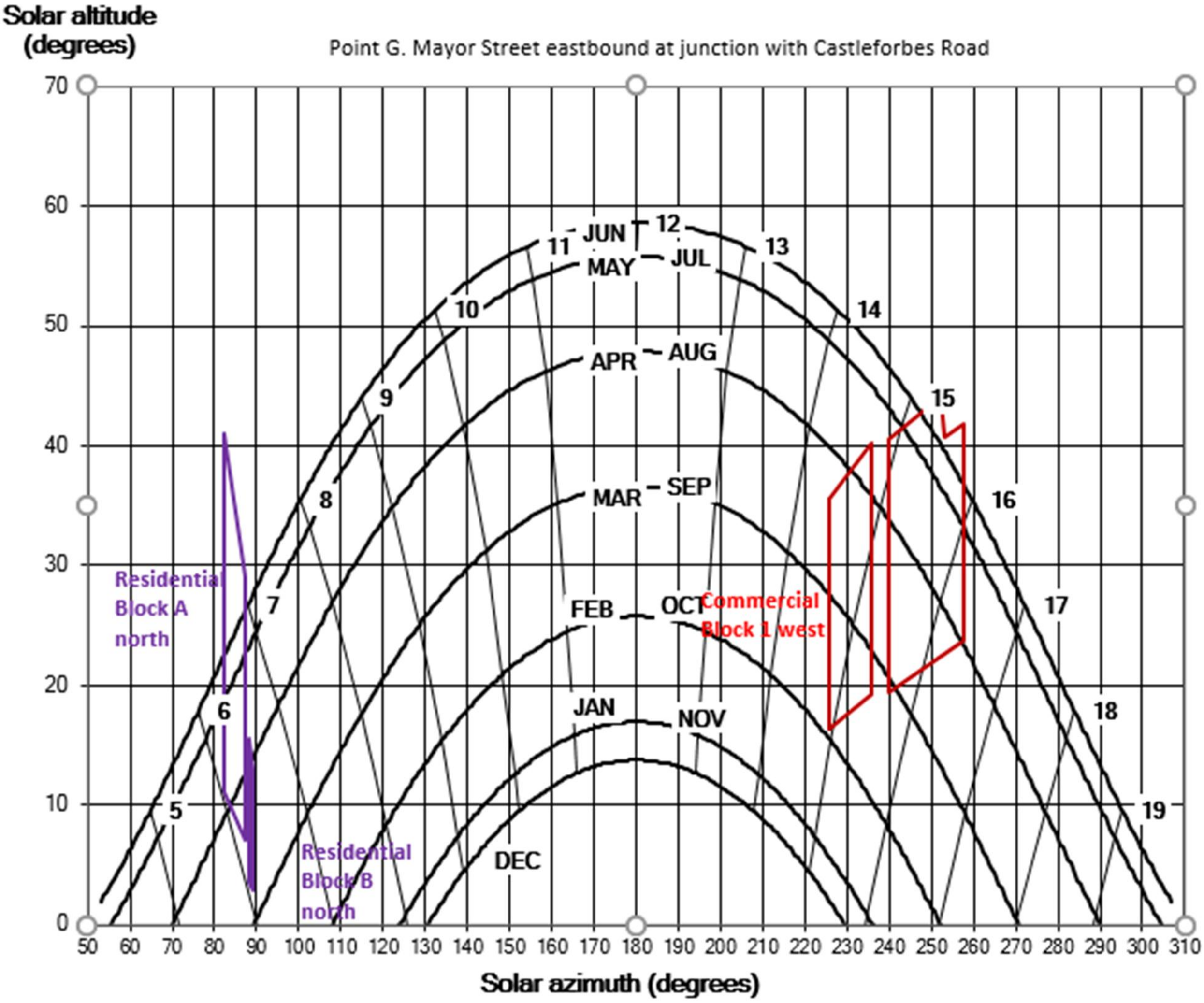

Figure 18. Sunpath diagram showing times of day and year for which sunlight can be reflected to point G.

6.14 Thus sunlight could still be reflected from the north façade of Blocks A and B in the early morning (between 0730 and 0830 IST) from April to early September. Sunlight could not be reflected from the north face (Mayor Street façade) of the commercial Block 1, because this building is designed with vertical fins that intercept the reflected sun.

6.15 However there could be additional reflection from the upper parts of the western (Castleforbes Road) façade of the commercial Block 1 for up to an hour and a half in the afternoon from the end of February to mid October. This would cause negligible glare, as the façade would be well to one side (17-49° to the right) of the drivers' line of sight. The maximum threshold increment would be 2%, well below the recommended 15% limit.

J. Travelling north along East Link, as the road curves round to cross the River Liffey.

6.16 Here the commercial development would be visible to the left of the residential development and could reflect sunlight to Point J.

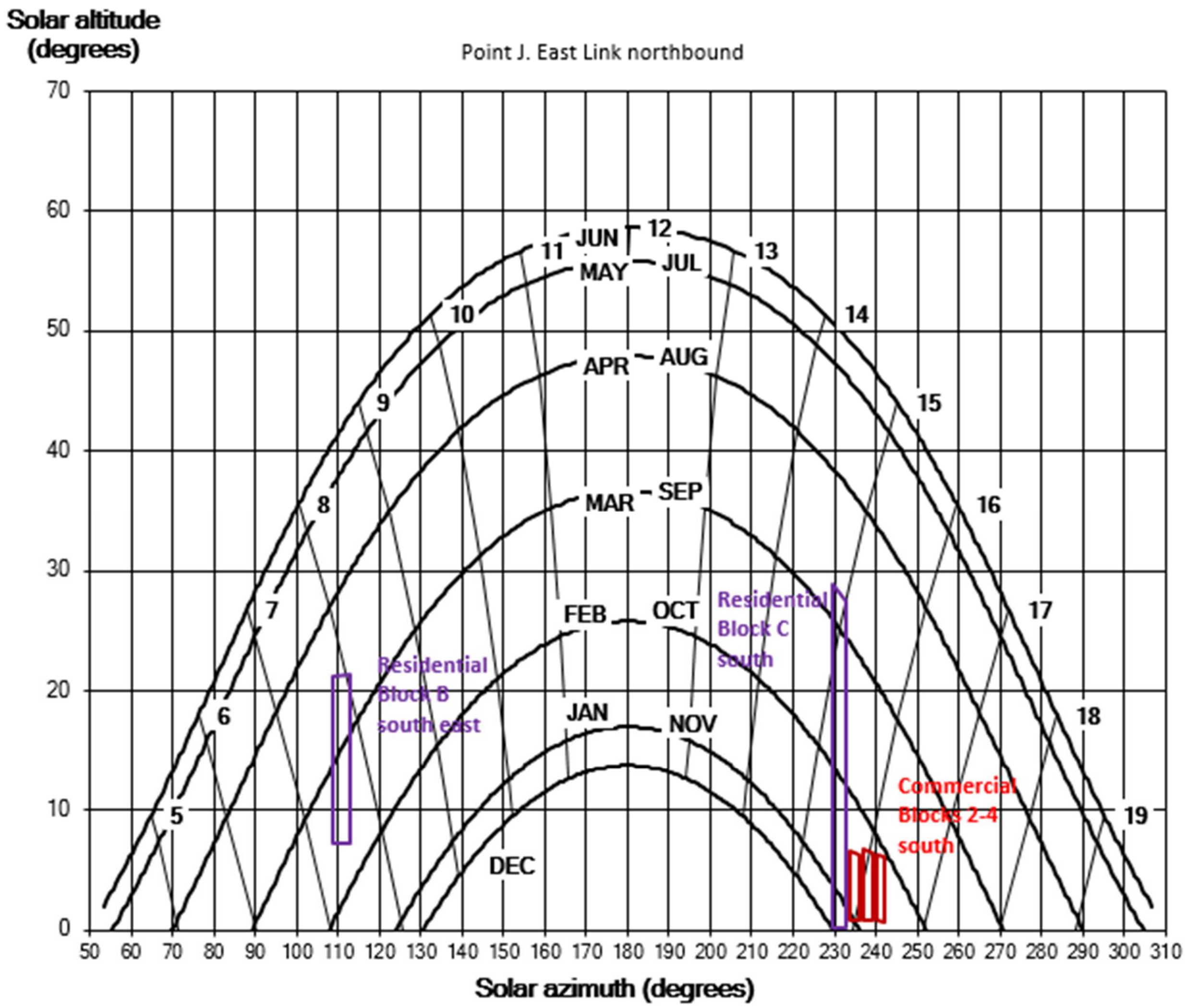

Figure 19. Sunpath diagram showing times of day and year for which sunlight can be reflected to point J.

6.17 In the residential scheme, the southern face of the Block C tower and the south east face of the Block B tower could still reflect sunlight to this location (see Figure 19). In addition, the south faces of Blocks 2-4 of the commercial scheme could reflect sunlight for up to half an hour in the late afternoon (around 1630 GMT) in late January, most of February, late October and most of November.

6.18 Glare from the commercial scheme would be negligible, with threshold increments no more than 1-2%, compared to the recommended maximum for road lighting of 15%. This is because the proposed development would be off to one side of the drivers' field of view.

7 Conclusions

7.1 This report has assessed the potential for reflected solar glare from a proposed residential development (the Waterfront South Central SHD application) in North Wall Quay, Dublin. The report has focused on potential disability glare to motorists as they drive along the roads with a view of the site.

7.2 Eleven points have been selected where drivers will have a view of the new development, and are at key locations such as road junctions or with a view of traffic signals. For each of these points the times of day and year for which reflection can occur have been determined. Disability glare has also been calculated, using a metric called the threshold increment. This is a measure of how much harder it is to see with the glare source in place. Predicted levels of glare have been compared with recommendations for night time road lighting. This is a very cautious approach, because the road lighting recommendations are conservative. During the day, it is a lot easier to see, and drivers can use visors to control glare.

7.3 The proposed development would reflect sunlight to a variety of locations. At points further from the development, both south of the river and approaching from the M50, there would only be short durations of reflection and glare would be well within the recommendations.

7.4 Closer to the development, in North Wall Quay, North Wall Avenue, Castleforbes Road and Mayor Street, there would be longer durations of reflection. In each case the reflected sun would be to one side of the drivers' field of view, which limits glare. The residential development is planned either to have conventional clear low emissivity glazing or special glass with a grey interlayer which has an even lower reflectance, further limiting glare.

7.5 In nearly all cases the reflected glare levels would be within the stringent recommendations for road lighting. At one of the points analysed, on North Wall Avenue at the junction with Mayor Street, the glare would be above the road lighting recommendation. This would count as a minor adverse impact, because the level of glare is only marginally above the recommendations, and the duration of glare is short and happens in mid winter when the sun is often obscured by cloud. Drivers would have the low sun ahead of them, and would be prepared for glare with their visors down.

7.6 A commercial scheme is proposed to the west of the proposed residential development, and a cumulative analysis has been undertaken. For six of the eleven key points analysed, the commercial scheme would make no, or very little, difference to the duration of reflection. For a seventh point the commercial scheme would block reflection from the residential scheme and itself cause no reflection. For the other four points, the commercial scheme would result in additional reflections. In nearly all cases the additional reflected glare levels would be within the recommendations for road lighting. At one of the points analysed, on North Wall Quay at the junction with Castleforbes Road, the glare would be marginally above the road lighting recommendation for a limited time. This would count as a minor adverse impact.

7.7 Discomfort glare is a less serious problem because it does not impair the ability to see. There are offices to the north, east and west which would normally have shading fitted, and the new building could be expected to reduce the incidence of glare. Discomfort glare is therefore not expected to be a significant issue.

7.8 Accordingly the residential development would cause negligible or minor solar glare problems. No mitigation measures are therefore necessary.

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Report Ends