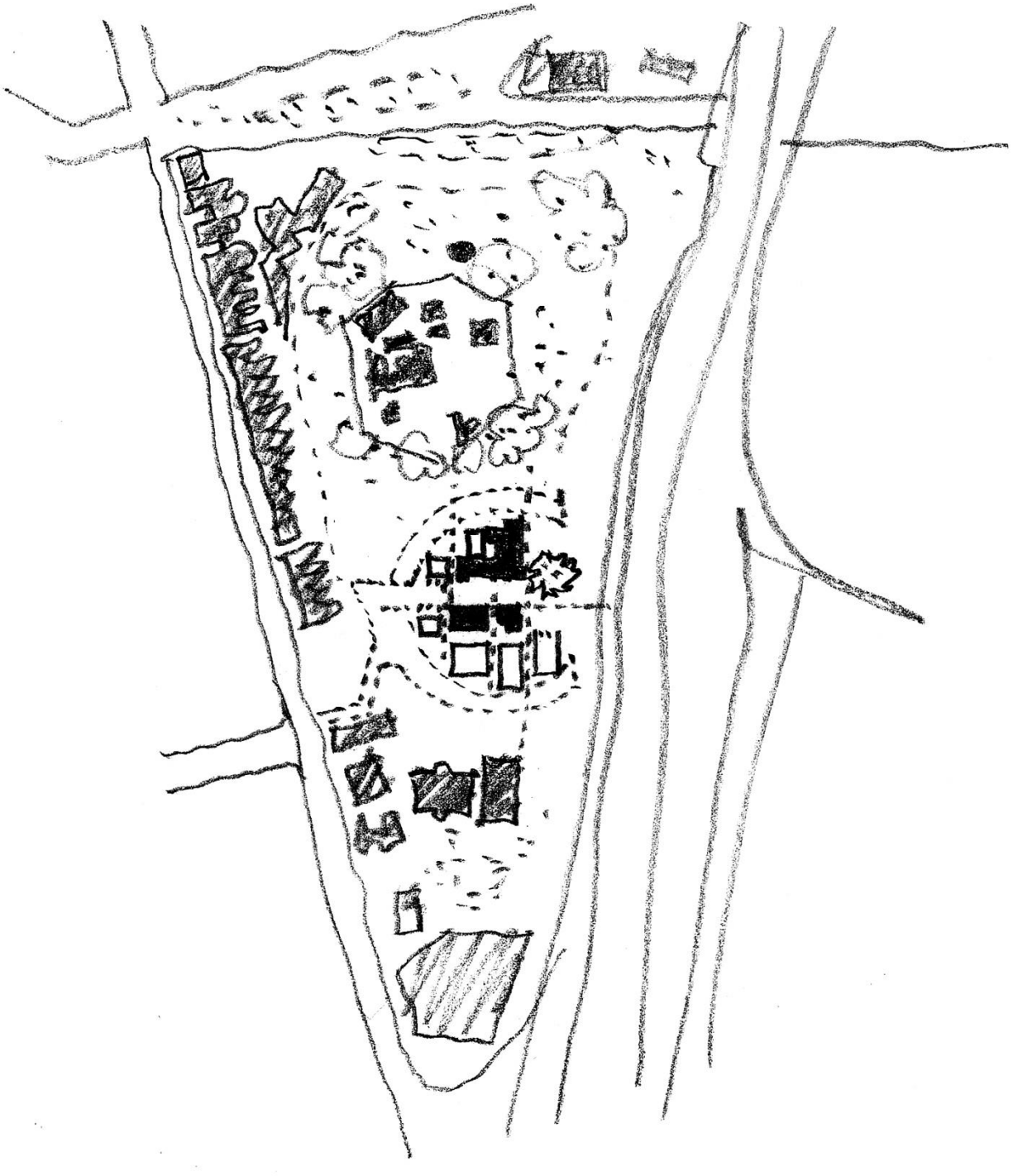
Fort Street Public School
Reflectivity Assessment

SSD 10340
Prepared by Arup
For School Infrastructure NSW
24 February 2020



Department of Education NSW

Fort Street Primary School

Reflectivity statement

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Contents

1 Executive summary

Arup have been engaged by the NSW Department of Education to provide a high-level experienced-based reflectivity statement for the proposed redevelopment of the Fort Street Primary School. As a guideline, this report addresses the façade performance against the objectives of the City of Sydney DCP Section 3.2.7 as it is not a specific requirement in the State Significant Development Application. One of these objectives may require a reflectivity report to address the potential solar glare from the proposed building to surrounding pedestrians, motorists or occupants of surrounding buildings.

Arup have prepared high level desktop study based on previous experience of buildings with similar conditions and preliminary calculations of maximum equivalent veiling luminance for the principal building elevation orientations, considering the travel directions of main nearby roads. Arup have calculated this according to the methodology in in Hassall D. N. H. (1991): *Reflectivity. Dealing with Rogue Solar Reflections*, Faculty of Architecture, University of New South Wales.

Arup have reviewed the *State significant Development Application* Drawings (18/12/2019) provided by FJMT. The drawings indicate that there is not a significant change to the existing building mass and therefore the impact of additional glazing is limited. As this building is not much taller than surrounding context, much of the eastern façade (which is identified to have the most potential for glare) is shaded by Circular Quay building at times with low sun angles and can therefore not produce reflections.

Preliminary studies, which are based on simplified geometry and high-level assessments, highlight that a more in-depth assessment should be carried out to confirm if there is a risk of reflectivity, especially to the Cahill Expressway traffic and identify the required mitigation. Reflections to this façade can likely be controlled by the positioning of glazing and by adapting glazing reflectivity specifications. Other orientations, like the northern façade facing the Harbour Bridge, are unlikely to produce unfavourable reflections based on the orientation of traffic flow to the façade.

1.1 Disclaimer

This assessment of the solar access and reflectivity is based on engineering judgement and preliminary calculations. No detailed simulation study has been made to develop the judgements and recommendations presented in this report.

2 Introduction

This report addresses the façade performance against the objectives of the City of Sydney DCP Section 3.2.7. This section of the DCP requires that buildings are designed with the following objectives:

a) *Minimise the reflection of sunlight from buildings to surrounding areas and buildings.*

b) *Ensure that building materials do not lead to hazardous, undesirable or uncomfortable glare to pedestrians, motorists or occupants of surrounding buildings.*

To adhere to the above objectives, building materials must not exceed 20% in reflectivity and a reflectivity report may be needed to address the potential solar glare from the proposed building for tall buildings. While Fort Street Public school is not a tall building, it is located in a prominent location, with major roads in the form of the Harbour Bridge and the Cahill Expressway surrounding the site.

3 Site and building description

Fort Street Primary school is located at the top of Observatory Hill to the north of the Sydney CBD. Immediately surrounding the school is mostly mature trees and low-rise buildings. For the purpose of the reflectivity study, the key façades that can be seen from major roads are the northern façade (coming over the Harbour Bridge) and the Eastern Facades (Coming from the Cahill expressway). The topography of the site, with the steep incline the west, indicates that it is unlikely that the western façade will be in view to key roads.

Figure 1: Location of building

The proposed building mass has not significantly changed from the existing site conditions. A significant change to the building occurs to the north of the site where there is an increase from 2 to 3 stories. This may be more critical to the view of cars travelling west along the Cahill Expressway.

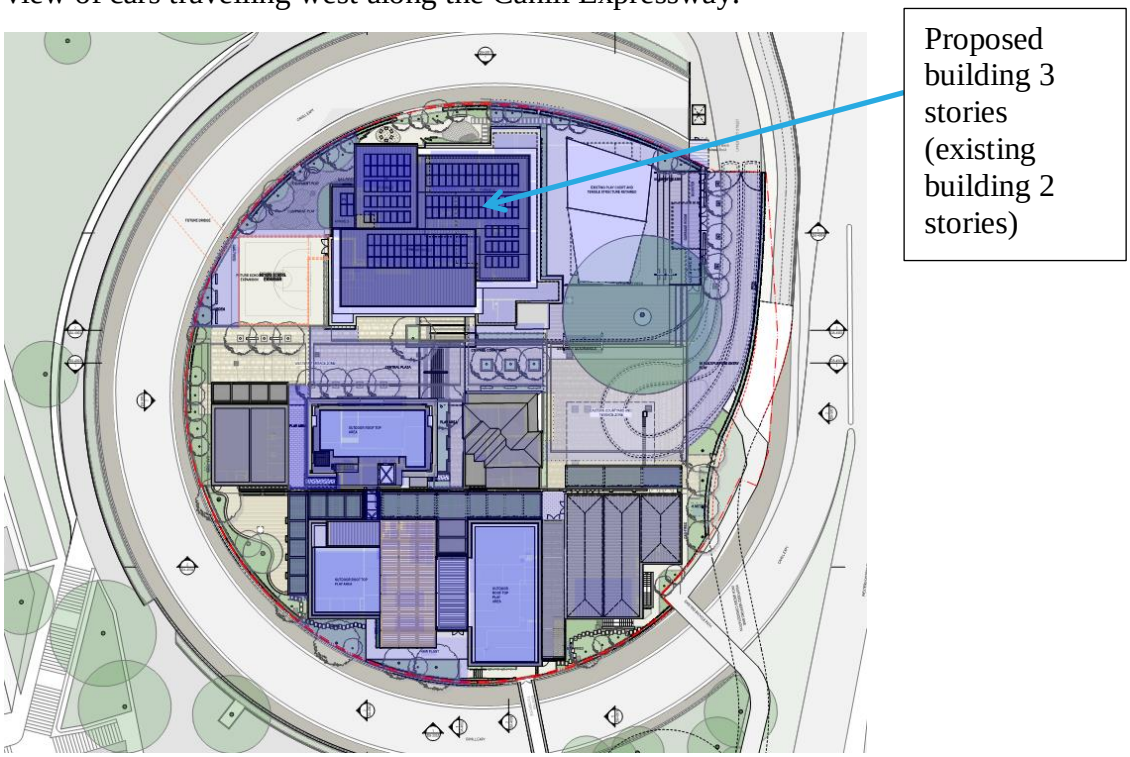

Figure 2: Proposed plan

4 Methodology

This preliminary study uses high level calculations from software that analyses the reflections from simplified 3D models, as well as experience with detailed reflectivity assessments in the Sydney CBD, to reach the judgements presented about reflectivity in this report.

The preliminary assessment assumes all façade glazed elements have a reflectivity of 20%

Areas of interest were established based on experience on previous reflectivity studies, as well as considering the visibility of the sun in the reflected sky portion, angle of incidence of reflection, surface reflectivity, and angle of reflection direction to view direction. Spot check calculations were carried out at these locations to calculate equivalent veiling luminance as a measure of reflected glare potential, following the methodology established by D.N.H. Hassall of the University of New South Wales. This method is widely used in reflectivity assessments in Sydney (Hassall, 1991i). This source nominates a limit of acceptability of reflections of 500Cd/m^2.

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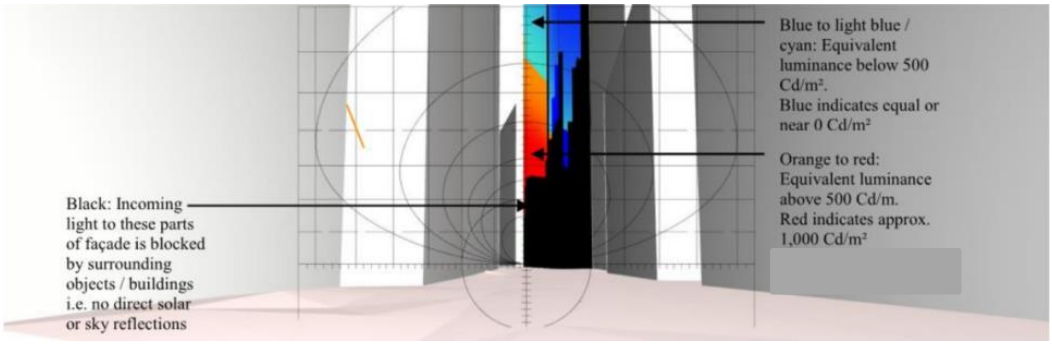

5 Observations

Based on the method above, Arup have made observations and judgements about the predicted locations of glare potential around the site.

5.1 Impact on traffic

- Reflection impact on traffic and pedestrians potentially exceeding the Hassall 500Cd/m^2 equivalent veiling luminance threshold and causing glare would likely be limited to Cahill Expressway heading west. Reflections would occur in the early morning. Glare from reflections off

vertical facades usually only occurs at low sun angles, when they reach viewers at angles close to their plane of vision.

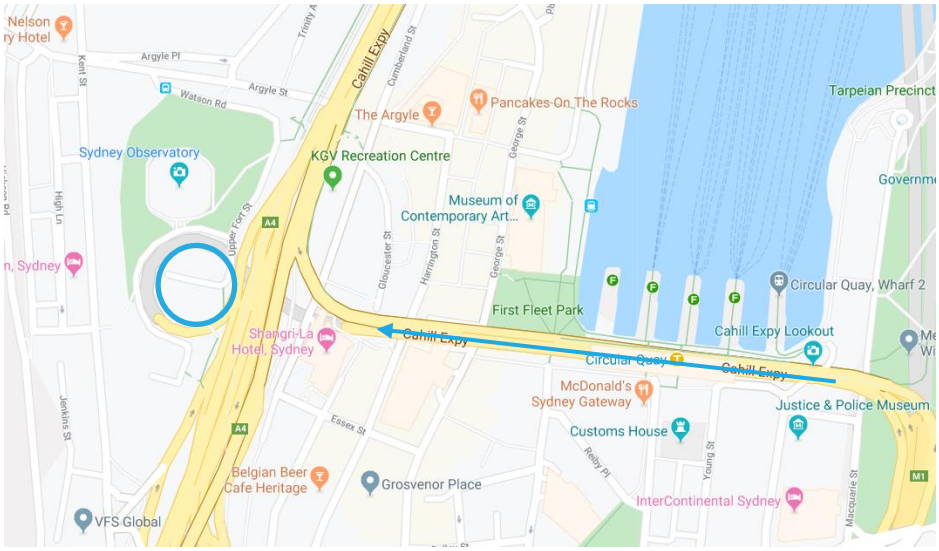

Figure 3: Direction of traffic assessed for glare potential

As shown in the following snapshot of the assessment, the area identified as having glare potential is limited to the top right of the eastern façade. The redevelopment height is only slightly higher than surrounding buildings and therefore, much of the eastern façade (especially towards the south) are shaded by Circular quay building at times with low sun angles and can therefore not produce reflections.

Note that detailed geometry and individual glazed areas are not modelled in this assessment. This assessment highlights potential areas on the whole proposed envelope that could cause potential glare issues. There is a limited area that can be seen from the Cahill Expressway to cause reflections and this may be reduced further with the modelling of vegetation and shading devices to the eastern façade.

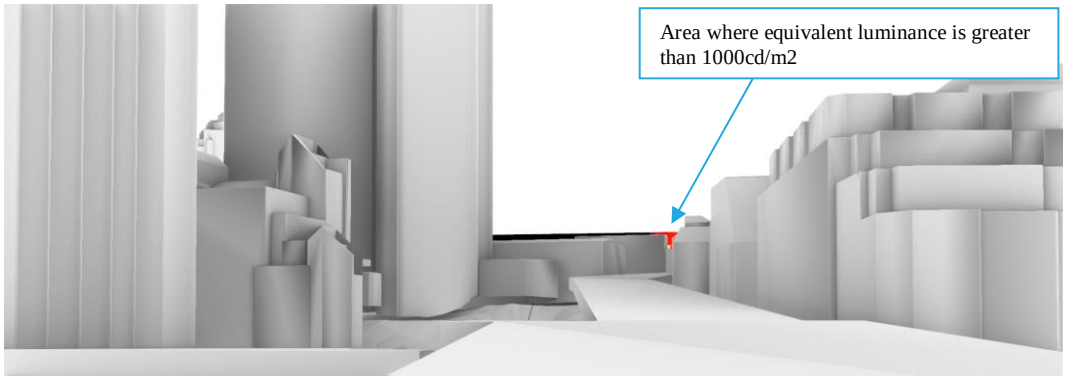

Figure 4:Snapshot from glare analysis

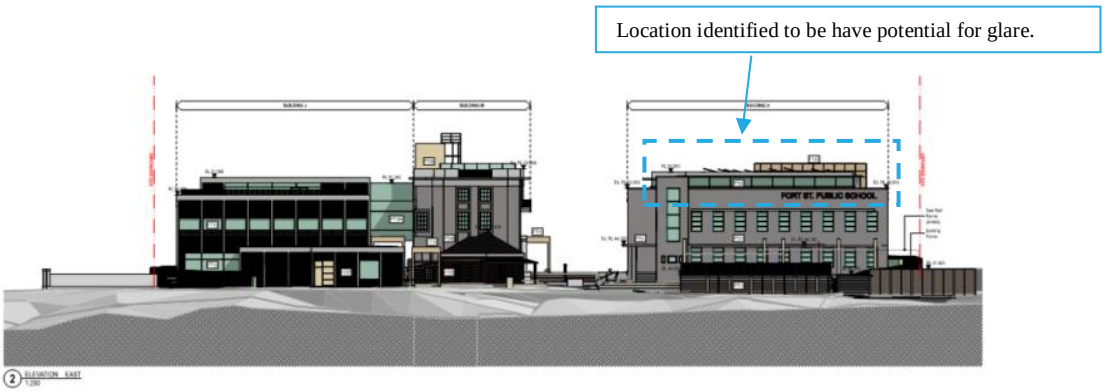

Figure 5: Eastern elevation

Figure 6:Vegetation to the eastern facade

- Other nearby main traffic routes, such as the Harbour Bridge heading south, are unlikely to present with reflectivity issues. Reflections cast into the directions of traffic on these routes from the main facades would originate from sun positions higher in the sky and would be well above the field of view of drivers, and thus are unlikely to be an issue

The potential reflectivity issues on Cahill Expressway may need to be assessed in the coming project stages. If required, they may be mitigated by the following measures:

- **Selecting low reflectivity glass**: the reflectivity of the glass may be reduced below the general DCP limit of 20%. As potentially problematic reflections are expected predominantly close to normal angle of incidence, where reducing the normal angle reflectivity of glass has a close to

proportional reducing effect on the intensity of reflections. Preliminary high level calculations suggest that selecting low reflectivity glass within feasible parameters for typical façade glazing products (reflectivity 8-10%) may be sufficient to limit reflection intensity to acceptable levels per the Hassall methodology.

- Solar shading devices are not as effective as reducing the reflectivity of the glass for reflections along the Cahill Expressway which are close to normal.

5.2 Impact on pedestrians

From the perspective of pedestrians moving along roadways, the incidence of reflections from the building is generally similar to the examined road traffic locations. Glare from reflections is therefore expected in similar locations.

Furthermore, pedestrian observers are easily able to adjust their view and thus reduce the glare impact of reflections. They move at a rate significantly slower than that of a vehicle. For this reason, it can be assumed that it will be safe for pedestrians to divert their vision in order to avoid glare.

5.3 Impact on other buildings

Solar reflections off the facade may reach surrounding buildings in the area. This may occur for limited time periods throughout the day, i.e. during the morning sun may be reflected off the east facades towards buildings further to the east, and afternoon sun may be reflected towards buildings further west.

In general, reflections from facades with external reflectance below 20% are much less likely to cause discomfort to occupants of surrounding buildings than facades with strongly reflective glazing. The proposed building will be targeting a glass reflectance below 20% in accordance with the City of Sydney DCP, which will serve to reduce potential glare reflections that may occasionally be produced towards other buildings.

6 Conclusions

This initial high-level review of building and site conditions has highlighted the potential for reflections to exceed limits of glare acceptability under the commonly used methodology by Hassall on the Cahill Expressway heading west, assuming the maximum allowable reflectivity of 20%.

The extent of the impact is limited to a small area, as most of the reflections in this direction will be obstructed by surrounding buildings.

Glazing will be selected to have a normal reflectivity not exceeding 20% in line with the requirements of the City of Sydney DCP. A solution that may be suitable if reflections are unfavourable could be to lower the reflectivity to lower than 20%.

A more in-depth assessment, with detailed geometry modelled, should be carried out to confirm if there is a risk to this location and identify the required mitigation. Reflections towards this area can likely be controlled by positioning of windows and glazing and by adapting glazing reflectivity specifications.