REFLECTIVITY IMPACT ASSESSMENT REPORT

APPENDIX U

Sydney Metro City & Southwest: Waterloo Over Station Development

Reflectivity impact assessment report

Applicable to:	Sydney Metro City & Southwest
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Table of Contents

1.0 Introduction ... 3
1.1 Purpose of this report ... 3
1.2 Overview of the Sydney Metro in its context ... 4
1.3 Nominated State Significant Precinct - Waterloo ... 7
1.4 Planning relationship between Waterloo Station and the OSD ... 7
1.5 The site ... 9
1.5.1 Location ... 9
1.5.2 Site context ... 10
1.6 Overview of the proposed development ... 13
1.7 Staging and framework for managing environmental impacts ... 17
2.0 Scope of Assessment ... 19
3.0 Reflectivity Impact Methodology and Criteria ... 19
3.1 Glare Characteristics ... 19
3.2 Glare Acceptability Criteria ... 19
3.3 Reflectivity Methodology ... 20
4.0 Glare Impact Assessment ... 21
4.1 Traffic Disability Glare ... 21
4.1.1 Reflectivity Impact Summary ... 23
4.1.2 Initial Calculations ... 23
4.1.3 Further Analysis ... 24
4.2 Pedestrian Discomfort Glare ... 25
5.0 Recommendations ... 26
6.0 Conclusion ... 28

1.0 Introduction

1.1 Purpose of this report

This report accompanies a concept State Significant Development Application (concept SSD Application) submitted to the Department of Planning and Environment (DPE) pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). The concept SSD Application is made under Section 4.22 of the EP&A Act.

This report should be read in conjunction with the Nominated State Significant Precinct (SSP) Study – Waterloo, submitted to the Minister for Planning (The Minister) in July 2018. That study proposes new planning controls to facilitate the development proposed.

Sydney Metro is seeking to secure concept approval for over station development (OSD) above and adjacent to Waterloo Station comprising a podium and three taller buildings which include commercial, residential, and community land uses. The concept SSD Application seeks consent for a building envelope and use for residential, retail, commercial, entertainment, community and recreational purposes, maximum building height, maximum gross floor area (GFA), pedestrian and vehicular access, circulation arrangements and associated car parking and the strategies and design parameters for the future detailed design of development.

Sydney Metro proposes to procure the construction of the OSD as part of an integrated station development package, which would result in the combined delivery of the station, OSD and public domain improvements. The station and its public domain elements form part of a separate planning approval for Critical State Significant Infrastructure (CSSI) approved by DPE on 9 January 2017.

As the development is within a rail corridor, is associated with railway infrastructure and is for "commercial premises or residential accommodation" with a Capital Investment Value of more than $30 million, the project is identified as State Significant Development (SSD) pursuant to Schedule 1, 19(2)(a) of the *State Environmental Planning Policy (State and Regional Development) 2011* (SRD SEPP).

This report has been prepared to outline the Reflectivity impacts and specifically respond to the Secretary's Environmental Assessment Requirements (SEARs) issued for the concept SSD Application on 29th June 2018 which states that the Environmental Impact Statement (EIS) is to address the following requirements:

Reference	SEARs Requirement	Where Addressed in Report
8	*Address solar access, acoustic impacts, visual privacy, views and visual impacts, reflectivity, overshadowing and noise and vibration impacts to the surrounding area, including neighbouring properties and the public domain*	**Section 4.0** and **Section 5.0**

1.2 Overview of the Sydney Metro in its context

Sydney Metro is Australia's biggest public transport project. A new standalone metro railway system, this 21st century network will deliver 31 metro stations and 66km of new metro rail for Australia's biggest city — revolutionising the way Sydney travels. Services start in the first half of 2019 on Australia's first fully-automated railway.

Sydney Metro was identified in *Sydney's Rail Future*, as an integral component of the *NSW Long Term Transport Master Plan*, a plan to transform and modernise Sydney's rail network so it can grow with the city's population and meet the future needs of customers. In early 2018, *the Future Transport Strategy 2056* was released as an update to *the NSW Long Term Transport Master Plan* and *Sydney's Rail Future*. Sydney Metro City & Southwest is identified as a committed initiative in the *Future Transport Strategy 2056*.

Sydney Metro is comprised of three projects:

Sydney Metro Northwest — formerly the 36km North West Rail Link. This $8.3 billion project is now under construction and will open in the first half of 2019 with a metro train every four minutes in the peak.

Sydney Metro City & Southwest — a new 30km metro line extending the new metro network from the end of Sydney Metro Northwest at Chatswood, under Sydney Harbour, through the CBD and south west to Bankstown. It is due to open in 2024 with an ultimate capacity to run a metro train every two minutes each way through the centre of Sydney.

Sydney Metro West – a new underground railway connecting the Parramatta and Sydney central business districts. This once-in-a-century infrastructure investment will double the rail capacity of the Parramatta to Sydney CBD corridor and will establish future capacity for Sydney's fast growing west. Sydney Metro West will serve five key precincts at Westmead, Parramatta, Sydney Olympic Park, The Bays and the Sydney CBD. The project will also provide an interchange with the T1 Northern Line to allow faster connections for customers from the Central Coast and Sydney's north to Parramatta and the Sydney CBD.

Sydney's new metro, together with signalling and infrastructure upgrades across the existing Sydney suburban rail network, will increase the capacity of train services entering the Sydney CBD – from about 120 an hour currently to up to 200 services beyond 2024. That's an increase of up to 60 per cent capacity across the network to meet demand.

Figure 1: Sydney Metro alignment map

Sydney Metro City & Southwest includes the construction and operation of a new metro rail line from Chatswood, under Sydney Harbour through Sydney's CBD to Sydenham and on to Bankstown through the conversion of the existing line to metro standards.

The project also involves the delivery of six (6) new metro stations, including at Waterloo, together with new underground platforms at Central. Once completed, Sydney Metro will have the ultimate capacity for a train every two minutes through the CBD in each direction - a level of service never seen before in Sydney.

On 9 January 2017, the Minister approved the Sydney Metro City & Southwest - Chatswood to Sydenham application lodged by TfNSW as a CSSI project (reference SSI 15_7400.

The CSSI Approval includes all physical work required to construct the CSSI, including the demolition of existing buildings and structures on each site. Importantly, the CSSI Approval also includes provision for the construction of below and above ground structures and other components of future OSD (including building infrastructure and space for future lift cores, plant rooms, access, parking and building services, as relevant to each site). The rationale for this delivery approach, as identified within the CSSI application is to enable the OSDs to be more efficiently built and appropriately integrated into the metro station structures.

The EIS for the Chatswood to Sydenham alignment of the City & Southwest project identified that the OSD would be subject to a separate assessment process.

Since the CSSI Approval was issued, Sydney Metro has lodged four modification applications to amend the CSSI Approval as outlined below:

- Modification 1 - Victoria Cross and Artarmon Substation which involves relocation of the Victoria Cross northern services building from 194-196A Miller Street to 50 McLaren Street together with inclusion of a new station entrance at this location referred to as Victoria Cross North. The modification also involves the relocation of the substation at Artarmon from Butchers Lane to 98 – 104 Reserve Road. This modification application was approved on 18 October 2017.
- Modification 2 - Central Walk which involves additional works at Central Railway Station including construction of a new eastern concourse, a new eastern entry, and upgrades to suburban platforms. This modification application was approved on 21 December 2017.
- Modification 3 - Martin Place Station which involves changes to the Sydney Metro Martin Place Station to align with the Unsolicited Proposal by Macquarie Group Limited (Macquarie) for the development of the station precinct. The proposed modification involves a larger reconfigured station layout, provision of a new unpaid concourse link and retention of the existing MLC pedestrian link and works to connect into the Sydney Metro Martin Place Station. It is noted that if the Macquarie proposal does not proceed, the original station design remains approved. This modification application was approved on 22 March 2018.
- Modification 4 - Sydenham Station and Sydney Metro Trains Facility South which incorporated Sydenham Station and precinct works, the Sydney Metro Trains Facility South, works to Sydney Water's Sydenham Pit and Drainage Pumping Station and ancillary infrastructure and track and signalling works into the approved project. This modification application was approved on 13 December 2017.

The CSSI Approval as modified allows for all works to deliver Sydney Metro between Chatswood and Sydenham Stations and also includes upgrade of Sydenham Station.

The remainder of the City & Southwest alignment (Sydenham to Bankstown) proposes the conversion of the existing heavy rail line from west of Sydenham Station to Bankstown to metro standards. This part of the project, referred to as the Sydenham to Bankstown upgrade, is the subject of a separate CSSI Application (Application No. SSI 17_8256) for which an EIS was exhibited between September and November 2017. A Response to Submissions and Preferred Infrastructure Report was submitted to DPE in June 2018 for further exhibition and assessment. This application is subject to assessment and determination by DPE, taking into consideration a further Response to Submissions Report which was submitted to DPE in September 2018.

1.3 Nominated State Significant Precinct - Waterloo

Following the decision to locate a metro station in Waterloo, the Minister determined that parts of Waterloo are of State planning significance which should be investigated for urban renewal through the SSP process. SSP study requirements for such investigations were issued by the Minister on 19 May 2017.

Investigation of the Precinct is being undertaken by UrbanGrowth NSW Development Corporation (UrbanGrowth NSW), in partnership with Sydney Metro and the Land and Housing Corporation (LAHC). The outcome of the SSP process will be new planning controls that will enable future development applications for renewal of the Precinct.

The Precinct includes two separate but contiguous and inter-related parts:

- The Waterloo Metro Quarter (the Metro Quarter)
- The Waterloo Estate (the Estate)

A separate SSP Study for the Metro Quarter was lodged in July 2018 in advance of the SSP Study for the Estate to provide a planning framework for the construction of OSD within the Metro Quarter. The staged submission of the Metro Quarter SSP Study also facilitates the proposed development to be delivered concurrently with the metro station, as an integrated station development.

As this concept SSD Application relies upon the planning framework proposed in the Metro Quarter SSP Study, it is anticipated that the SSP Study and the Environmental Impact Statement (EIS) for the SSD Application will be exhibited concurrently.

1.4 Planning relationship between Waterloo Station and the OSD

While Waterloo Station and the OSD will form an integrated station development, the planning pathways defined under the EP&A Act require separate approval for each component of the development. In this regard, the approved station works (CSSI Approval) are subject to the provisions of Part 5.1 of the EP&A Act (now referred to as Division 5.2) and the OSD component is subject to the provisions of Part 4 of the EP&A Act.

For clarity, the approved station works under the CSSI Approval included the construction of below and above ground structures necessary for delivering the station and also enabling construction of the integrated OSD. This includes but is not limited to:

- demolition of existing development
- excavation
- integrated station and OSD structure (including concourse and platforms)
- lobbies
- retail spaces within the station building

- public domain improvements associated with the station
- access arrangements including vertical transport such as escalators and lifts
- space provisioning and service elements necessary to enable the future development of the OSD, such as lift cores, plant rooms, access, parking, retail, utilities connections and building services.

The vertical extent of the approved station works above ground level is defined by the 'transfer level' level (which for Waterloo is defined by approximately RL 33.1 over the northern station box and RL 35.1 over the southern station box), above which would sit the OSD. An example of this delineation is illustrated in Figure 2.

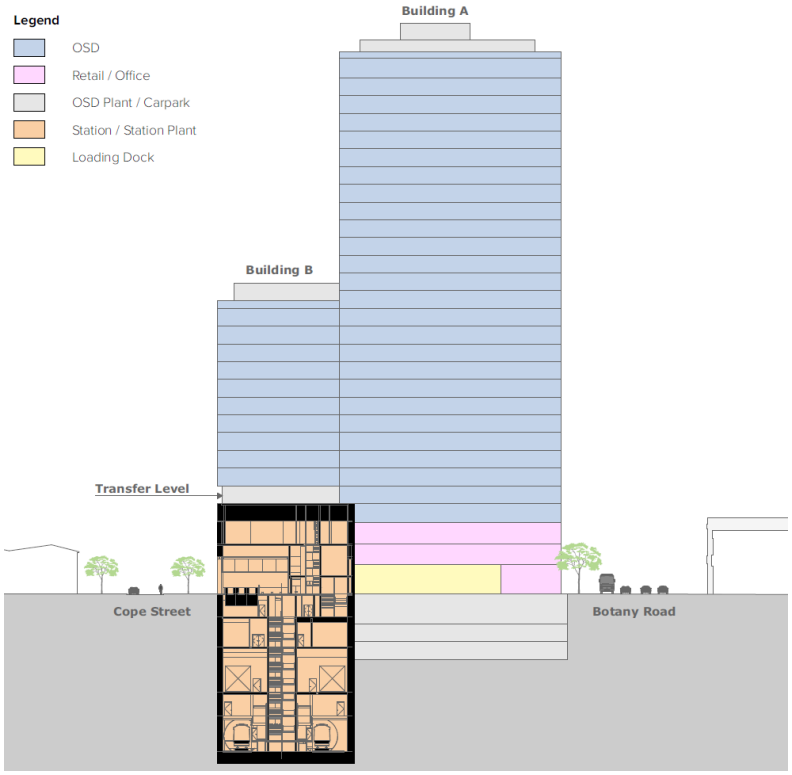


Figure 2: Delineation between the Metro station and OSD

It is noted that the structural and service requirements and space provisioning to support OSD vary from station to station. For example, based on the current level of design, Waterloo Station is not expected to provide for OSD lobbies, end of trip facilities and plant rooms. However, the detailed design may be amended to incorporate these elements as part of the integrated station development.

The CSSI Approval also establishes the general concept for the ground plane of Waterloo Station including access strategies for commuters, pedestrians and workers. In this regard, the main pedestrian access to the station would be via an entry located at the corner of Raglan and Cope Streets. The station design has continued to be developed having regard

to its integration with the Metro Quarter OSD, and as a result, a second entrance to the station is to be provided from a proposed public plaza adjacent to Cope Street. Retail uses (approved under the CSSI Approval) would be located on the ground floor of the station development along the Cope Street frontage of the site.

Since the issue of the CSSI Approval, Sydney Metro has undertaken design work to determine the technical requirements for the structural integration of the OSD with the station. This level of design work, together with the planning and design undertaken for the remainder of the Metro Quarter has informed the concept proposal for the OSD. It is noted that ongoing design development of the works to be delivered under the CSSI Approval would continue with a view to developing an Interchange Access Plan (IAP) and Station Design Precinct Plan (SDPP) for Waterloo Station to satisfy Conditions E92 and E101 of the CSSI Approval. The detailed design for the Metro Quarter would continue to evolve having regard to the IAP and SDPP.

Public domain improvement works immediately adjacent to Waterloo Station would be delivered as part of the CSSI Approval to support pedestrian movements between transport modes (including to new and relocated bus stops, bike parking on Cope Street, and taxi and kiss-and-ride bays on Cope Street), while other public domain works within the Metro Quarter are proposed as part of the OSD. Final details of public domain works for the OSD will be provided with the detailed SSD Application(s) following finalisation of the SDPP and IAP for the CSSI Approval.

1.5 The site

1.5.1 Location

The site is located within the City of Sydney Local Government Area (LGA).

The Metro Quarter comprises land to the west of Cope Street, east of Botany Road, south of Raglan Street and north of Wellington Street. The heritage listed Waterloo Congregational Church located at 103–105 Botany Road is within this block but is not part of the site.

The site has an approximate area of 1.287 hectares (refer to Figure 3).

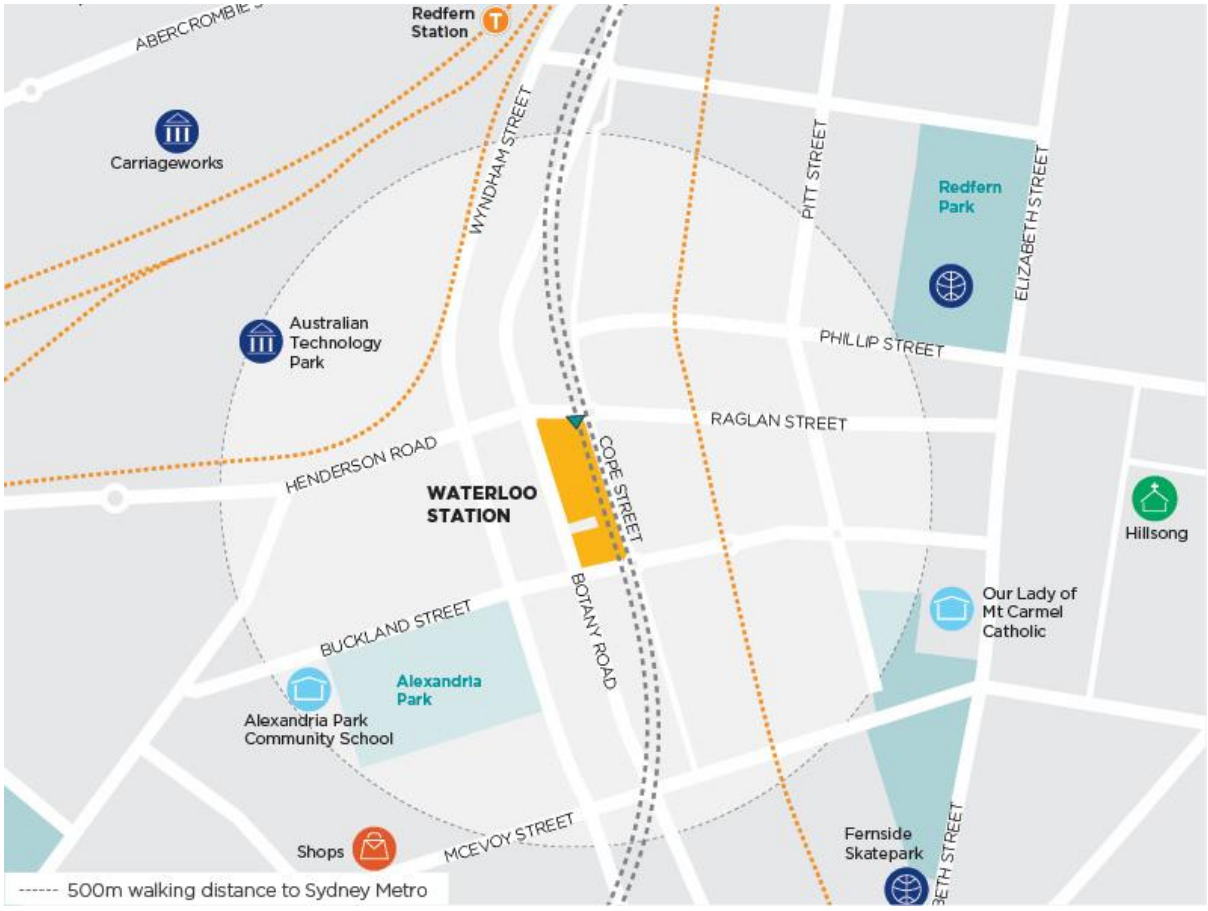


Figure 3: Waterloo Station location plan

1.5.2 Site context

The Metro Quarter is located in Redfern Street Village (see Figure 4) in the City of Sydney LGA approximately 3.3 kilometres south of Sydney CBD, 1 kilometre north of Green Square and less than 1 kilometre south of Redfern Station.

Directly east is the Waterloo Estate, which is owned by the NSW Government and is under the management of NSW LAHC. The Waterloo Estate comprises 2,012 social housing dwellings and a small number of private dwellings in medium and high density forms, ranging from single storey attached dwellings to apartment buildings of up to thirty storeys.

The Metro Quarter is less than 1 kilometre south-east of the Australian Technology Park (ATP), a technology micro-cluster that currently contains around 3,000 – 3,500 workers with a range of businesses in technology and creative industries; and a start-up/business incubator hub. It is set to grow into a business park that will soon accommodate new premises currently under construction (i.e. Commonwealth Bank Australia (CBA) has committed to two major office towers).

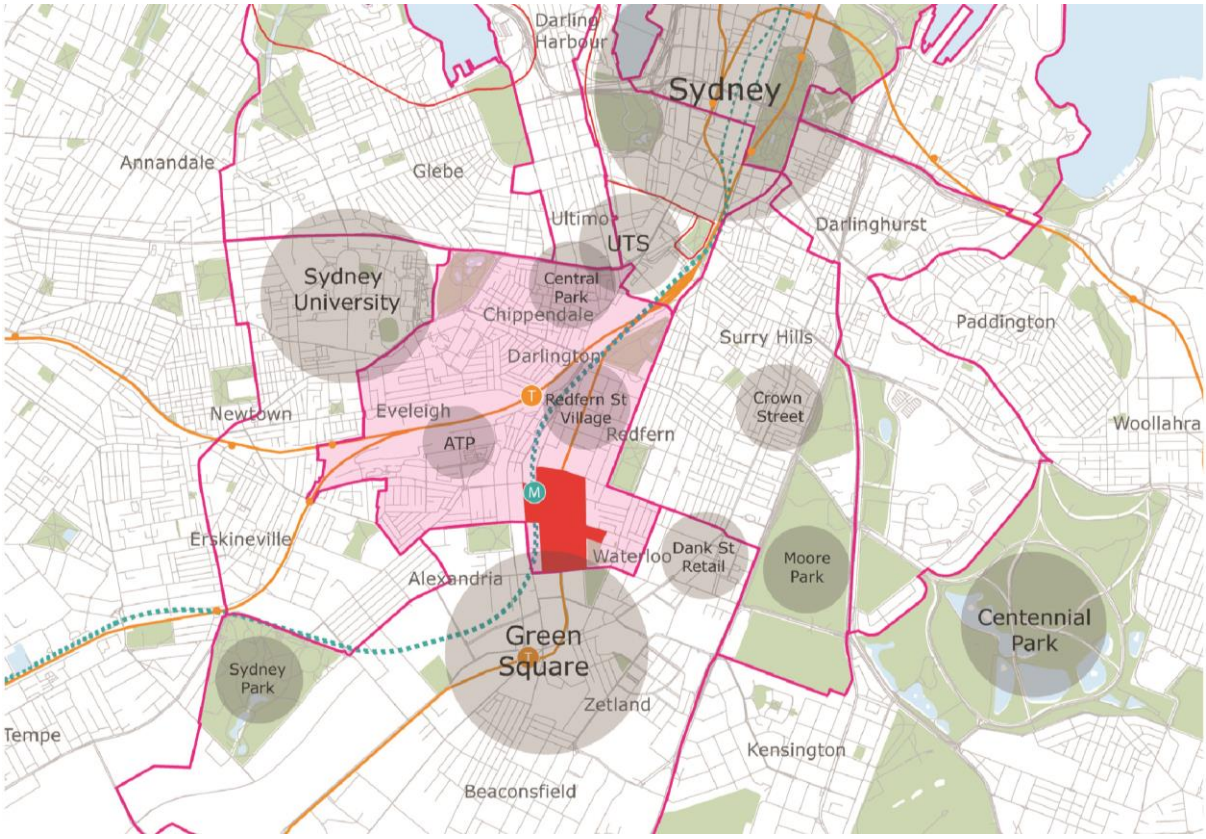


Figure 4: Location and site plan of the Waterloo State Significant Precinct (in red) and Redfern Street Village (in pink)

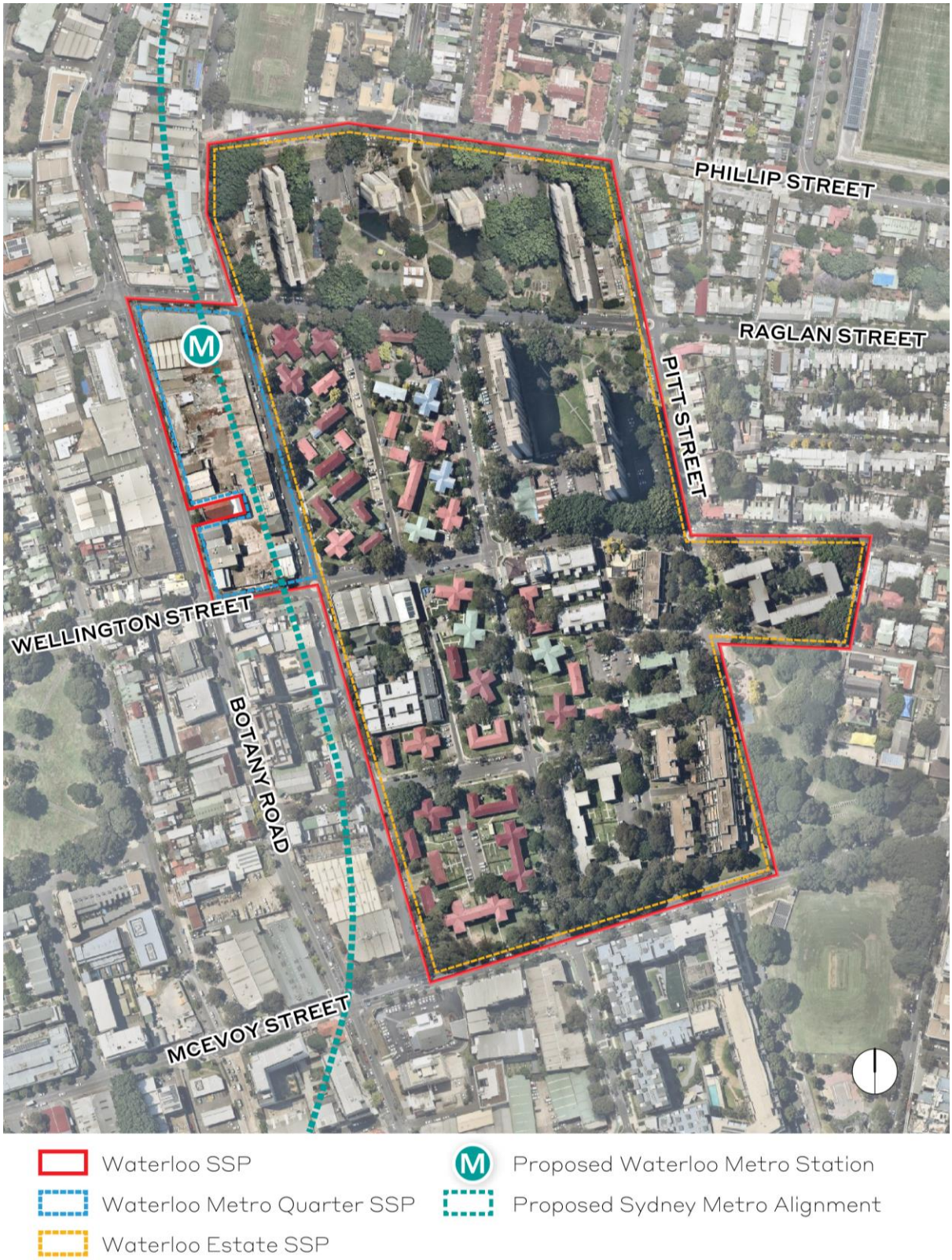


Figure 5: Nominate State Significant Precinct - Waterloo

The site comprises the following properties:

- 136B Raglan Street — Lot 4 DP 215751
- 59 Botany Road — Lot 5 DP 215751
- 65 Botany Road — Lot 1 DP814205
- 67 Botany Road — Lot 1 DP228641
- 124-128 Cope Street — Lot 2 DP228641
- 69-83 Botany Road — SP75492
- 130-134 Cope Street — Lot 12 DP399757
- 136-144 Cope Street — Lots A-E DP108312
- 85 Botany Road — Lot 1 DP27454
- 87 Botany Road — Lot 2 DP27454
- 89-91 Botany Road — Lot 1 DP996765
- 93-101 Botany Road — Lot 1 DP433969 & Lot 1 DP738891
- 156-160 Cope Street — Lot 31 DP805384
- 107-117A Botany Road — Lot 32 DP805384 & Lot A DP408116
- 119-121 Botany Road — Lot 1 DP205942 & Lot 1 DP436831
- 170-174 Cope Street — Lot 2 DP205942

The buildings and structures on the site are now demolished in accordance with the CSSI Approval with the exception of one building which is being used to support construction.

1.6 Overview of the proposed development

This concept SSD Application follows the submission of a SSP Study which supports a proposal to amend existing controls to facilitate the proposed development. The concept SSD Application will in turn comprises the first stage of seeking SSD development consent for the Waterloo OSD project. It will be followed by a future detailed SSD Application(s) for the design and construction of the OSD built form.

This concept SSD Application seeks approval for the planning and development framework and strategies to inform the future detailed design of the OSD. It specifically seeks approval for:

- maximum building envelopes, including maximum building heights, street-wall heights and ground and upper level setbacks
- a maximum gross floor area (GFA) of 68,750 square metres, comprising:

  - approximately 56,200 square metres GFA of residential accommodation, providing for approximately 700 dwellings, including 5 to 10 percent affordable housing and 70 social housing dwellings
  - approximately 3,905 square metres GFA of retail premises and entertainment facilities
  - approximately 8,645 square metres GFA for business and commercial premises and community, health service and recreational facilities (indoor), including at least 2,000 square metres of floor space for community uses
- a three storey podium and a free standing building located within a public plaza, accommodating non-residential land uses
- residential uses above podium level in various building forms including three taller buildings of 23, 25 and 29 storeys (Reduced Level (RL) 96.9, 104.2 and 116.9 metres AHD respectively)
- use of OSD space provisioning within the footprint of the CSSI Approval
- public domain works, including open spaces, through-site links, footpaths, provision for cycle facilities and enhanced pedestrian crossings and roads.
- car parking for up to 427 vehicles
- cycle parking to support residential and non-residential land uses and visitors to the Metro Quarter. Approval is also being sought for space within the future basement for a bike hub which would also support future bike parking for Waterloo Station
- loading, vehicular and pedestrian access arrangements
- strategies for utilities and services provision
- strategies for managing stormwater and drainage
- a strategy for the achievement of ecologically sustainable development
- a public art strategy
- provision for future signage zones
- a design excellence framework
- the future subdivision of parts of the OSD footprint (if required).

It is noted that the Sydney Metro comprises GFA of approximately 8,415 square metres on the site, approved under CSSI Approval. The total GFA for the integrated station development, including the station GFA is approximately 77,165 square metres, which is equivalent to an FSR of approximately 6:1.

Key parameters of the concept proposal based on the current level of design development are indicated at Figure 6 and Figure 7.

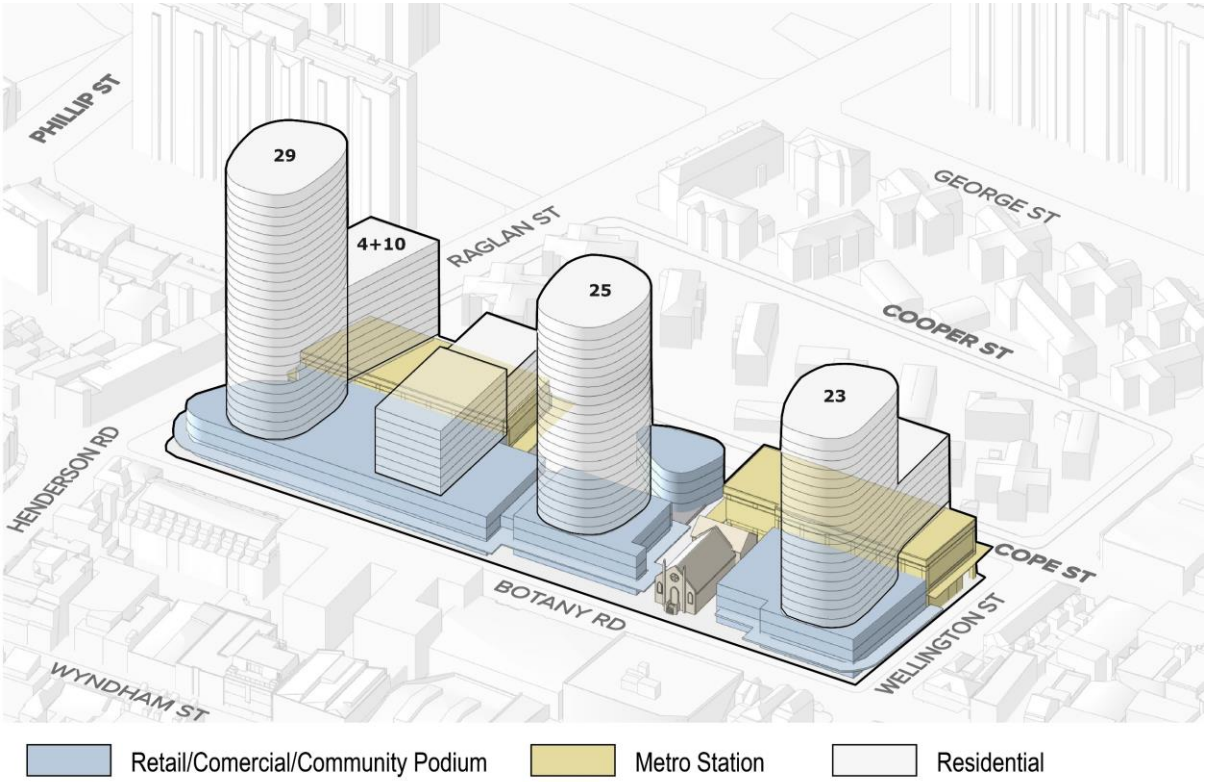


Figure 6: Proposed massing, viewed from the west

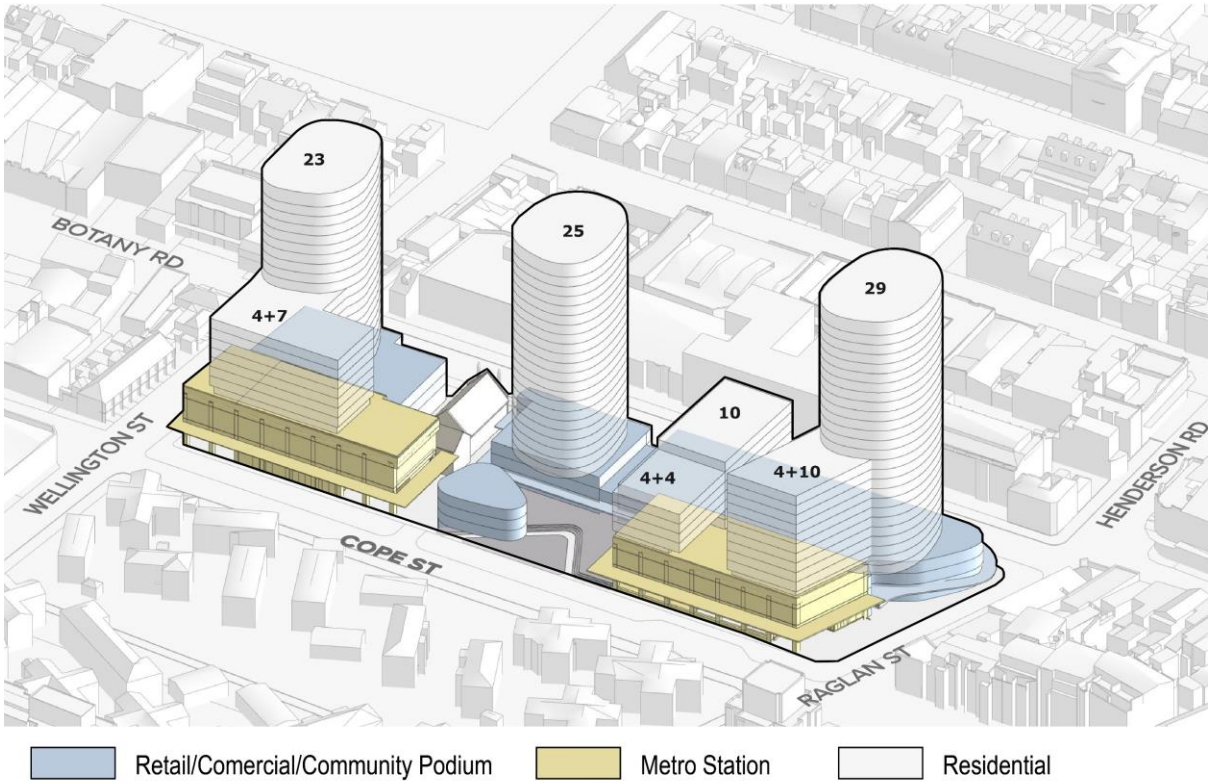


Figure 7: Proposed massing, viewed from the east

The proposal is a significant opportunity to contribute to the urban renewal process for the Waterloo SSP. The objective to deliver the Metro Quarter project as soon as reasonably possible after completion of the Sydney Metro works (earmarked to open 2024) would ensure buildings within the Metro Quarter are occupied to support maximum patronage of the proposed metro station.

The Metro Quarter would contain a mix of uses including residential, commercial, retail, community facilities and services and cultural opportunities sufficient for daily life to be provided for within the wider neighbourhood and to support the activation of the precinct. This would help make Waterloo one of the most connected and attractive inner-city places to live, work and visit.

1.7 Staging and framework for managing environmental impacts

Sydney Metro proposes to procure the delivery of the Waterloo integrated station development in one single package, which would entail the following works:

- station structure fit-out, including mechanical and electrical
- OSD structure fit-out, including mechanical and electrical.

Separate delivery packages are also proposed by Sydney Metro to deliver the excavation of the station boxes/shafts ahead of the integrated station development delivery package, and linewide systems (e.g. track, power, ventilation) and operational readiness works prior to the Sydney Metro City & Southwest metro system being able to operate.

For the purposes of considering construction related impacts, three possible staging scenarios have been identified for delivery of the integrated station development:

1. Scenario 1 – the station and OSD are constructed concurrently by constructing the transfer slab first and then building in both directions. Both the station and OSD would be completed in 2024.
2. Scenario 2 – the station is constructed first and ready for operation in 2024. OSD construction may still be incomplete or soon ready to commence after station construction is completed. This means that some or all OSD construction is likely to still be underway upon opening of the station in 2024.
3. Scenario 3 – the station is constructed first and ready for operation in 2024. The OSD is built at a later stage, with timing yet to be determined. This creates two distinct construction periods for the station and OSD.

The final staging for the delivery of the OSD would be resolved as part of the detailed SSD Application(s).

For the purposes of providing a high level assessment of the potential environmental impacts associated with construction, the following have been considered:

- Impacts directly associated with the OSD, the subject of this SSD Application
- Cumulative impacts of the construction of the OSD at the same time as the station works (subject of the CSSI Approval).

Given the integration of the delivery of the Sydney Metro City & Southwest metro station with an OSD development, Sydney Metro proposes the framework detailed in Figure 8 to manage the design and environmental impacts, in relation to Reflectivity, consistent with the framework adopted for the CSSI Approval.

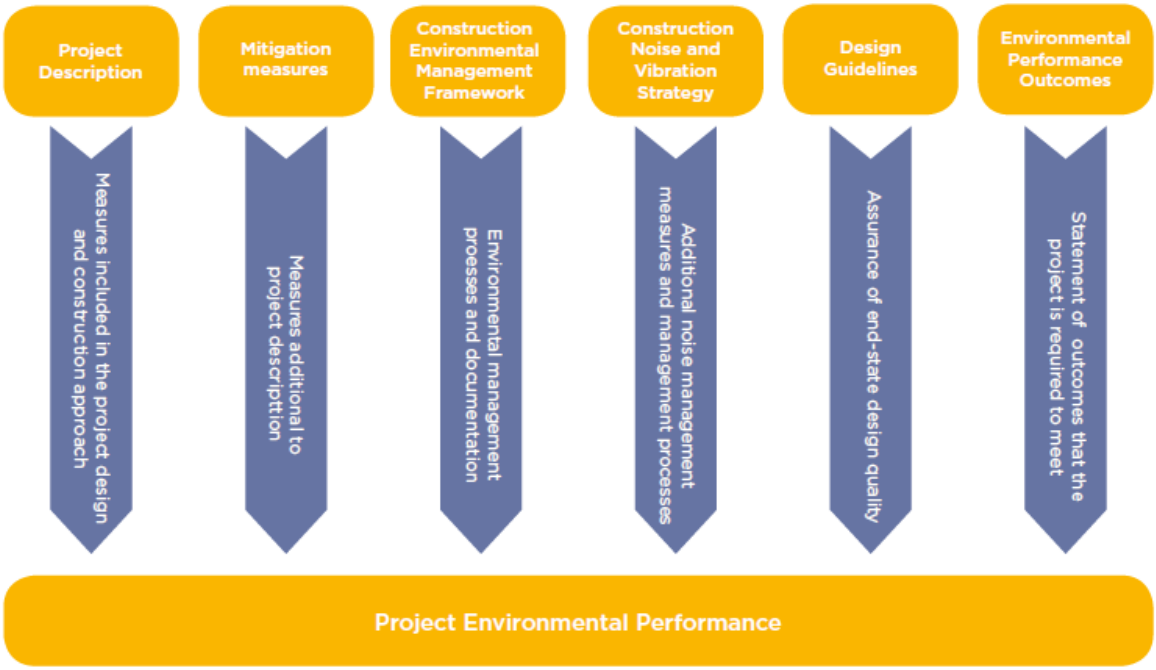


Figure 8 Project approach to environmental mitigation and management

This approach would be implemented until such time as completion of the station works (i.e. works under the CSSI Approval) is achieved. Beyond that point, standard construction environmental management practices would be implemented by the OSD developer in accordance with relevant guidelines and any conditions of approval.

2.0 Scope of Assessment

As outlined in **Section 1.1**, the purpose of this report is to address the SEARs pertaining to potential glare and reflectivity impacts.

3.0 Reflectivity Impact Methodology and Criteria

3.1 Glare Characteristics

With respect to the reflectivity impact of the proposed development, the following issues are relevant:

- At large incident angles (typically greater than 70°), the reflectivity of all glazing types increases dramatically. Thus, regardless of the glazing type, the potential for glare increases significantly when incoming solar rays can impact on a building close to parallel to the plane of the glazing.
- On a practical level, incoming solar rays with an altitude angle greater than 20° are intersected and obstructed by a typical windscreen roof-line. In this report, it is assumed that the sun altitude angle must be less than 25° to have the potential to produce a traffic disability glare event.
- Pedestrian discomfort glare can occur when the sun altitude is greater than 25°. However, in most such instances, a pedestrian has the ability to adjust their line of sight to a more horizontal view away from the glare source.
- It is assumed that glare events can only occur when the solar altitude is greater than about 3°, enabling the entire solar disc to be visible.

3.2 Glare Acceptability Criteria

The criteria used within this report to assess the acceptability or otherwise of glare events are the limiting values of the so-called “Threshold Increment Value”, or TI Value, of the reflection condition, as shown in .

Table 1 Threshold Increment (TI) Criteria

Glare Category	Classification	TI Acceptable Limit
Disability Glare (for motorists)	Major Roads	10
	Minor Roads	20
Discomfort Glare (for pedestrians)	Pedestrian Crossings	2
	Other Footpath Locations	3

3.3 Reflectivity Methodology

Reflectivity TI calculations have been carried out using a three-stage screening process:

In the first stage, road traffic conditions are examined to exclude reflection conditions which are “not possible”.

- For example, traffic along streets can be one-way. Thus, it may not be possible for drivers to be impacted by solar reflections in certain instances if the reflected ray off a building of interest is in the same direction as the direction of travel of the motorist, i.e. the incoming reflection is from “behind” the motorist.
- The orientation of a building may mean that certain situations are not possible.

In the second stage, the potential for reflections is established by carrying out a “baseline” screening calculation.

- In the “baseline” analysis, the facade of interest is assumed to consist totally of reflection-producing glazing. The reflectivity coefficient of the glazing to be used is however taken into account in these baseline screening calculations.

If a reflection potential is established, accurate TI values are calculated in the third stage:

- Detailed TI calculations utilise the actual details of the facade geometry, taking into account recessing of glazing, blockage produced by horizontal and vertical shading elements, sections of masonry facade, etc.

4.0 Glare Impact Assessment

4.1 Traffic Disability Glare

The proposed development has frontages along Raglan Street to the north, Cope Street to the east, Wellington Street to the south and Botany Road to the west. It is assumed that there will be glazed areas on all these facades. The lower level facades to the west will receive shielding from existing and proposed landscaping along Cope Street. The built environment surrounding the site is predominantly low-level with some higher level development from the north clockwise around to the east. Figure 9 and Figure 10 show possible reflection conditions.

For the purposes of this analysis it is assumed that the development's glazing will have a reflectivity coefficient of less than 20 percent.

For this report Botany Road and Henderson Road can be considered as major roads, therefore the TI value will be required to be less than 10. All other roads in question can be considered as minor roads, which require a calculated TI value to be less than 20.

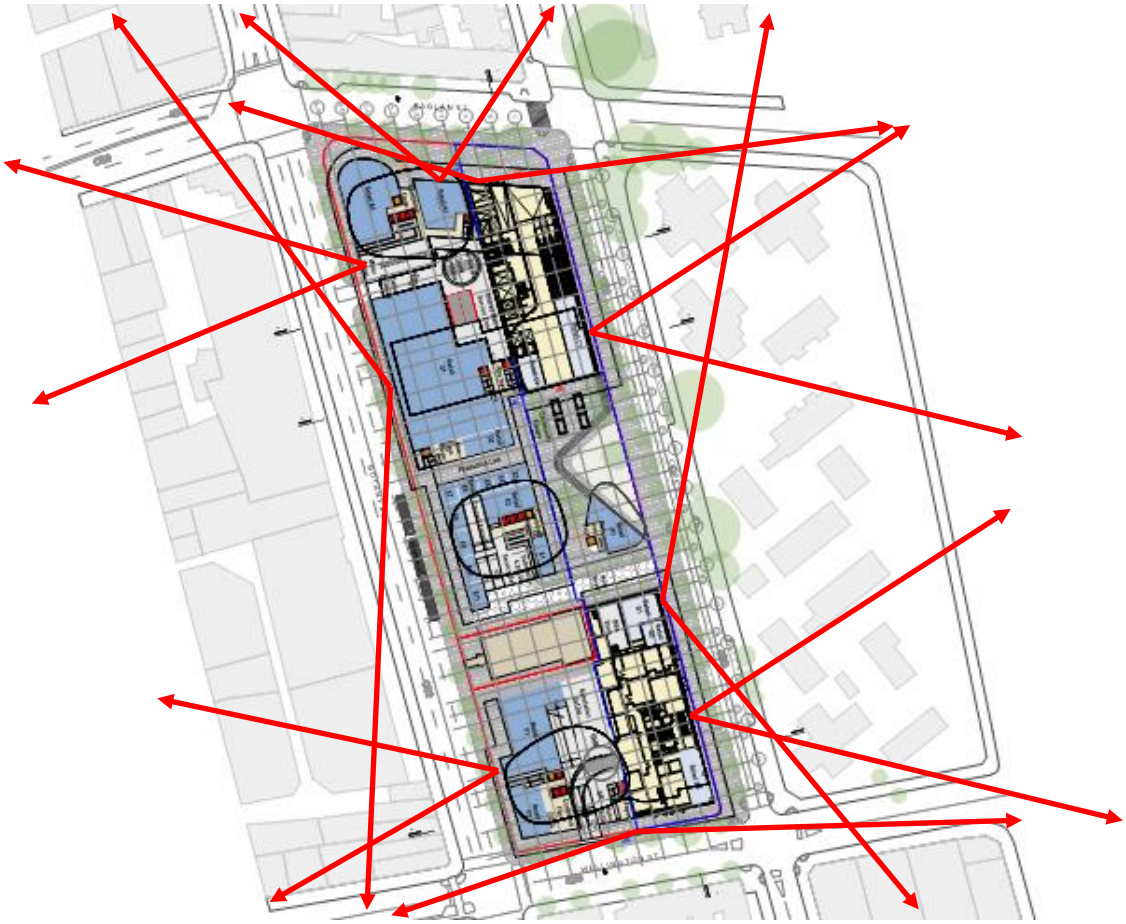


Figure 9 Possible Reflection Conditions – Lower Levels

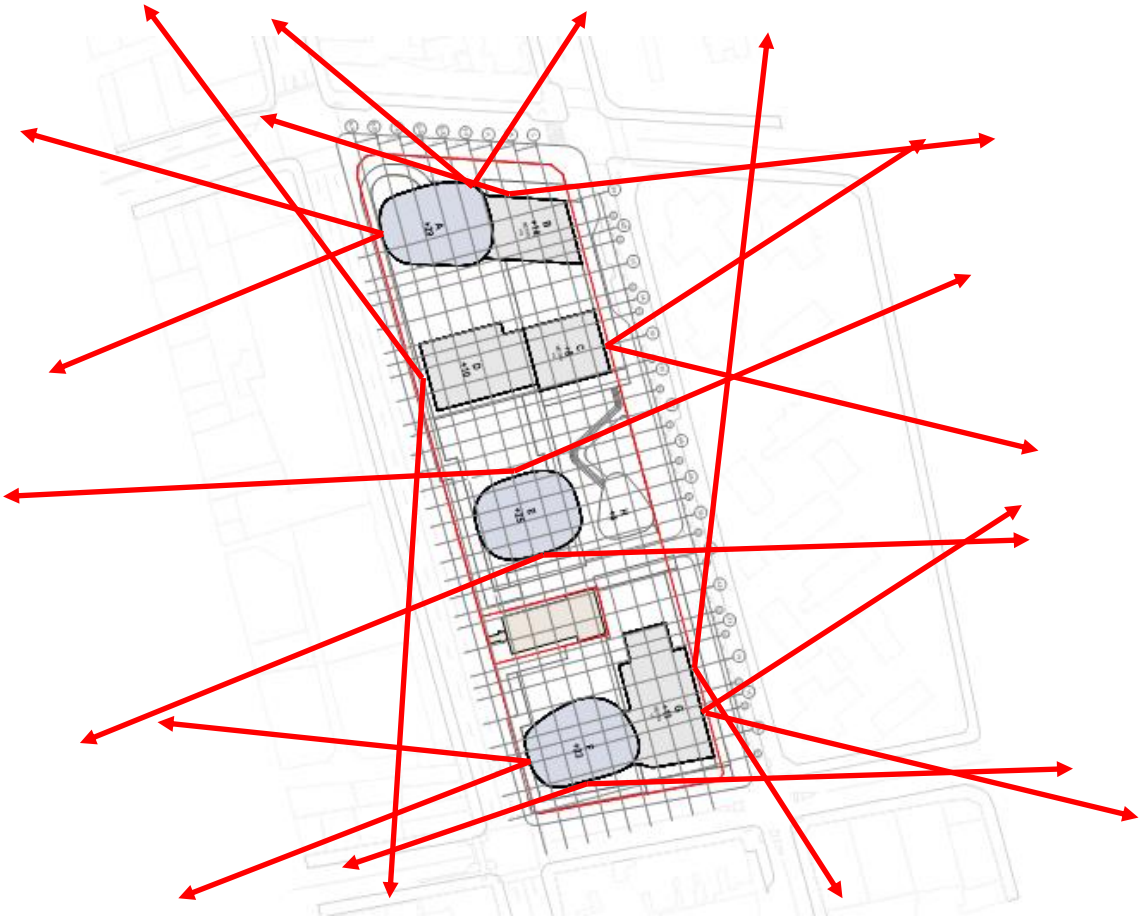


Figure 10 Possible Reflection Conditions – Upper Levels

4.1.1 Reflectivity Impact Summary

Table 2 summarises potentially adverse reflectivity conditions for the proposed site, inclusive of impacted traffic and associated building facades. Referenced reflectivity conditions are illustrated in Figure 9 and Figure 10.

Table 2 Potentially Adverse Reflectivity Conditions

Street	Traffic Direction	Time	Facades
Botany Road	- South bound - North bound	- Afternoon rays	- West
Brennan Street	- North bound	- Afternoon rays	- West
Buckland Street	- East Bound	- Afternoon rays - Morning rays	- West - South
Cope Street	- North bound - South bound	- Morning rays	- East
Garden Street	- North bound	- Afternoon rays	- West
George Street	- North bound	- Afternoon rays	- East
Henderson Road	- East Bound	- Afternoon rays - Morning rays	- West - North
Loveridge Street	- North bound	- Afternoon rays	- West
Raglon Street	- West bound	- Afternoon rays - Morning rays	- East - North
Wellington Street	- West bound	- Morning rays - Afternoon rays	- East - South
Wyndham Street	- North bound	- Afternoon rays	- West

4.1.2 Initial Calculations

Table 3 details preliminary reflectivity calculations and any exceedances of the associated acceptable TI value for motorists and general traffic. Preliminary calculations assume uninterrupted glazing flush with the building façade.

Table 3 Initial Reflectivity Calculations Assuming Uninterrupted Glazing

Street	Acceptable TI Value Limit	Max Traffic TI Calculation
Botany Road	10	5.1
Brennan Street	20	No Value Occurrence
Buckland Street	20	51.9[1]
Cope Street	20	24.2[2]
Garden Street	20	No Value Occurrence

Street	Acceptable TI Value Limit	Max Traffic TI Calculation
George Street	20	No Value Occurrence
Henderson Road	10	52.8[3]
Loveridge Street	20	No Value Occurrence
Raglon Street	20	41.4[4]
Wellington Street	20	49.3[5]
Wyndham Street	20	3.5

Note 1: This occurrence was recorded on March 31 at 6:35 am

Note 2: This occurrence was recorded on May 16 at 3:55 pm

Note 3: This occurrence was recorded on April 17 at 7:00 am.

Note 4: This occurrence was recorded on March 28 at 5:15 pm

Note 5: This occurrence was recorded on February 11 at 5:50 pm.

4.1.3 Further Analysis

Upon further refinement of the current scheme, it is evident the building exterior will not be 100 percent glazing and will contain a number of features that should reduce the solar reflectivity off the façades. These include:

- Materials other than glazing used. There will be areas of the façade that are not glazed.
- There will be articulations and setbacks in the building façade which will provide further shading to glazed areas.
- Planned and existing vegetation around the site and neighboring streets. As seen in Figure 11.
- The model used assumed that there were no surrounding buildings. In reality it can be seen that there is significant building density around the site to the north, east, south and west. It is likely that these buildings will provide shielding at certain times of the year, particularly to lower levels. As seen in Figure 11.

These will help to reduce the amount of glare experienced by motorists.

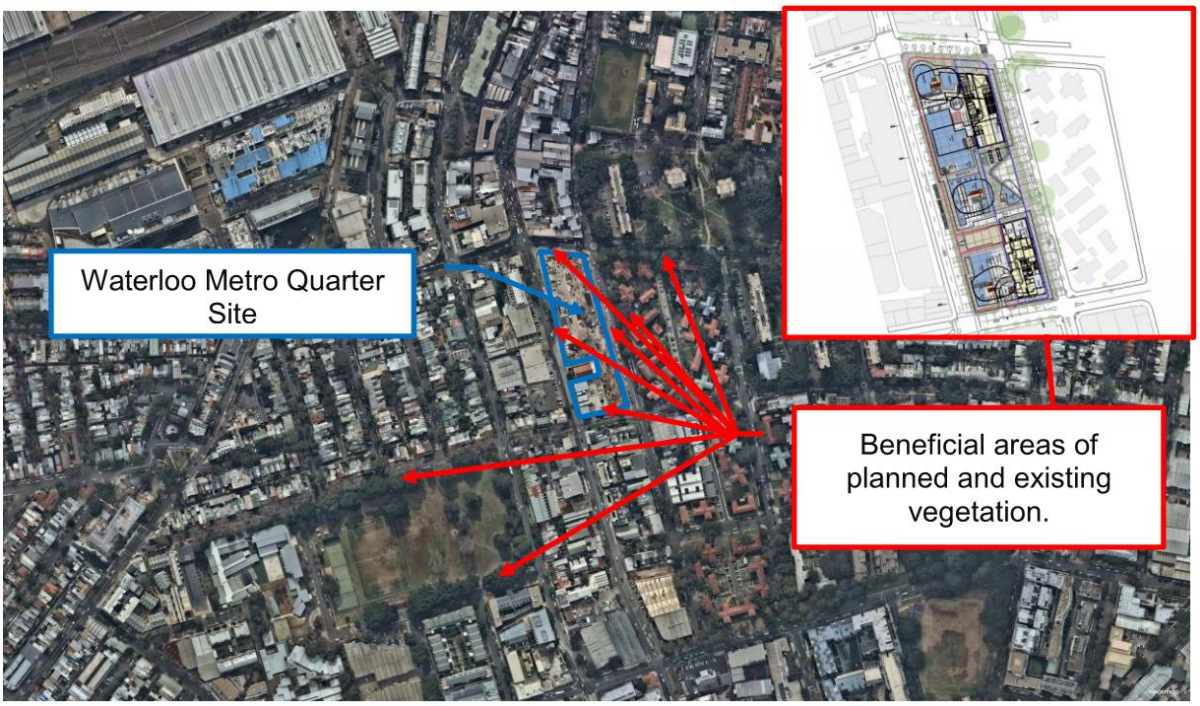


Figure 11 **Aerial Image of Existing Site**

4.2 Pedestrian Discomfort Glare

The initial calculations show that there will be some glare for pedestrians around the proposed development. With there being instance of pedestrian discomfort glare being recorded for Botany Road, Buckland Street, Cope Street, Henderson Road, Raglan Street, Wellington Street and Wyndham Street. These values were all above the allowable limits of 3 and 2 for footpaths and pedestrian crossings.

TI values will likely be reduced due the reasons mentioned in **Section 4.1.3**.

Pedestrians are also able to adjust their line of sight to reduce the effects of discomfort glare.

5.0 Recommendations

The following recommendations for the proposed development, as a means for significantly improving the glare and reflectivity impact of the proposed site:

- Incorporation of glazing with 10 percent reflectivity coefficient to southern and northern aspect glazing.
- Landscaping and trees to be provided where possible around external pedestrian pathways.
- Awnings over lower level building entries and surrounding pedestrian pathways.
- Balustrades material to be solid or dark low reflectivity alternative.
- Building façade to incorporate protruding wing walls or setbacks around areas of significant façade glazing, see **Figure 12** and **Figure 13**.
- Fins or screens to be used near areas of significant façade glazing, see **Figure 12** and **Figure 13**.

Given the current stage of the proposed design it is recommended the design be progressed with the above recommendations incorporated, with the glare and reflectivity assessment to be revisited during the later detailed design stages.

It is likely that the buildings will comply with the relevant TI values if the above recommendations are implemented.

Figure 12 Example of Screens used Around Building Façade

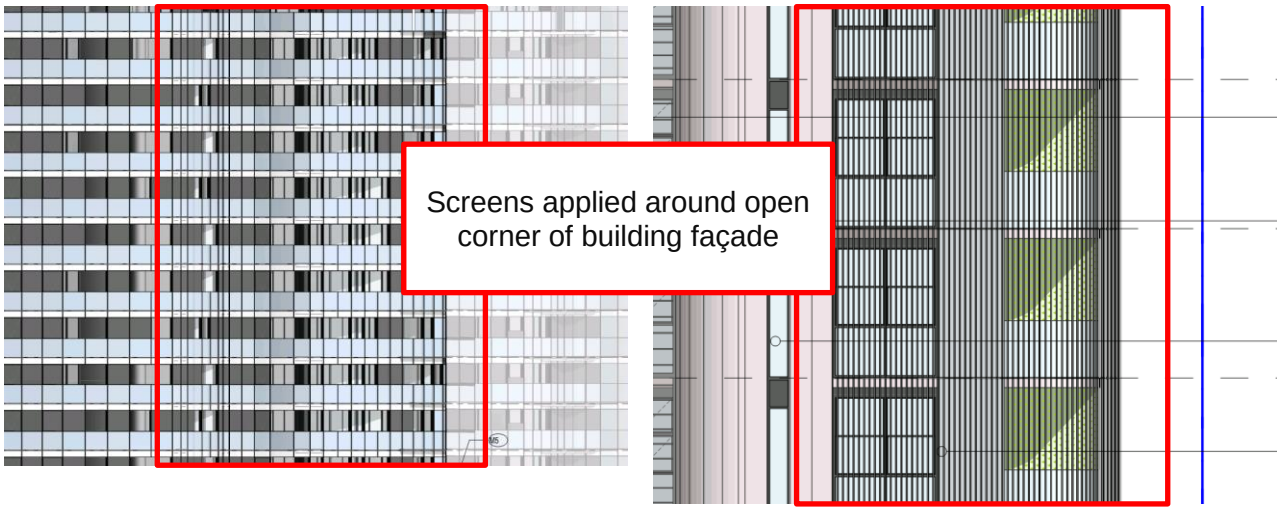
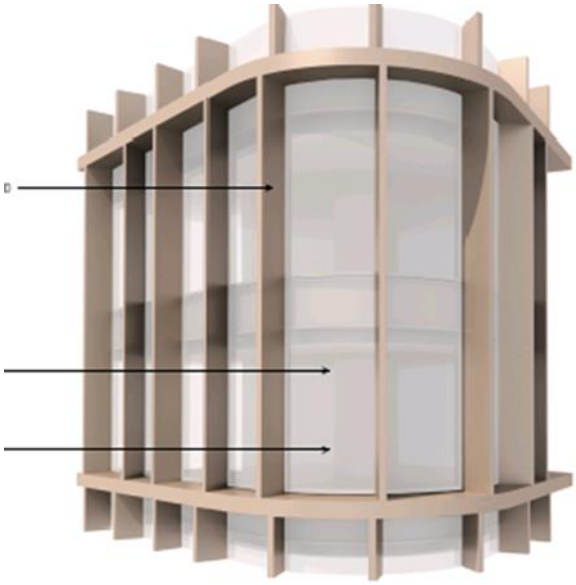


Figure 13 Example of Fins and screens



6.0 Conclusion

SLR has undertaken a glare and reflectivity impact assessment associated with the redevelopment of the Metro Quarter.

SLR has identified areas that may be affected by adverse glare. Initial calculations showed that with an uninterrupted glazed façades there will be some glare for motorists traveling along neighbouring streets.

Further analysis assumes that as the design is progressed a combination of factors outlined in **Section 4** will reduce the amount of reflective glare impacting on the surrounding areas. It has also been recommended that glazing with a reflectivity coefficient of less than 10 percent be used on the north and south aspect façades. All other glazing will have a reflectivity coefficient of less than 20 percent.

There will also be glare for pedestrians around the site but again it is likely that this will be reduced from the reasons outlined in **Section 3**.

In summary, analysis of the initial design shows that there will be glare for motorists and pedestrians moving around the site. However, through a combination of choice of glazing, other façade materials and façade design; adverse glare conditions can be reduced to an acceptable level. The following are recommended to reach an appropriate reduction in adverse glare conditions:

- Incorporation of glazing with 10 percent reflectivity coefficient to southern and northern aspect glazing.
- Landscaping and trees to be emphasised around external pedestrian pathways.
- Awnings over lower level building entries and surrounding pedestrian pathways.
- Balustrades material to be solid or dark low reflectivity alternative.
- Building façade to incorporate protruding wing walls or setbacks around areas of significant façade glazing.
- Fins or screens to be used near areas of significant façade glazing.

Given the current stage of the proposed design it is recommended the design be progressed with the above recommendations incorporated, with the glare and reflectivity assessment to be revisited as part of the detailed development application.

It is likely that the buildings will comply with the relevant TI values if the above recommendations are implemented.