Prepared for
Transport for NSW
ABN: 18 804 239 602

AECOM

Pollution Assessment (SSP Study No. 3.3)

Redfern North Eveleigh - Paint Shop Sub-Precinct

June-2022
Redfern North Eveleigh Precinct Renewal
Doc No. 606346-RP-IU-03

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Client: Transport for NSW

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			Name/Position	Signature
A	10-Aug-2021	For Information	Gijs Roeffen Principal Civil Engineer	
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G	12-Apr-2022	Final Report	Gijs Roeffen Principal Civil Engineer	
H	14-Apr-2022	Final Report	Gijs Roeffen Principal Civil Engineer	
I	21-Jun-2022	Final Report following updated Preamble	Jeannie van Zyl Principal Civil Engineer	

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Executive Summary

The NSW Government is investing in the renewal of the Redfern North Eveleigh Precinct to create a unique mixed-use development, located within the important heritage fabric of North Eveleigh. The strategic underpinning of this proposal arises from the Greater Sydney Region Plan and District Plan. These Plans focus on the integration of transport and land use planning, supporting the creation of jobs, housing and services to grow a strong and competitive Sydney.

The Redfern North Eveleigh Precinct is one of the most connected areas in Sydney, and will be a key location for Tech Central, planned to be Australia's biggest technology and innovation hub. Following the upgrading of Redfern station currently underway, the Precinct's renewal is aimed at creating a connected destination for living and working, and an inclusive, active and sustainable place around the clock.

The Redfern North Eveleigh Precinct comprises three Sub-Precincts, each with its own distinct character:

- The Paint Shop Sub-Precinct which is the subject of this rezoning proposal;
- The Carriageworks Sub-Precinct, reflecting the cultural heart of the Precinct where current uses will be retained; and
- The Clothing Store Sub-Precinct which is not subject to this rezoning proposal.

The purpose of this report is to present a Pollution Assessment for the proposal that identifies and assesses potential pollution impacts resulting from the proposal and which includes an analysis of the potential impact on adjoining uses and recommends development standards to be applied to subsequent development stages. Furthermore the report demonstrates how the planning and design process for the Precinct has identified risks and has identified appropriate recommendations for future initiatives.

The report also demonstrates how the SSP Study Requirements have been met and includes recommendations for further investigations and opportunities in future design, construction and operation.

In addressing the SSP Study Requirements, the following approach was undertaken:

- Identify Existing Environment Context – the Existing Environment Report established a base case for the Precinct, including the regulatory context applicable to the site.
- Assess Air, Lighting and Water Pollution impacts – impacts from construction and operational phases of the development were identified and where possible quantified and assessed against regulatory controls;
- Recommendations and mitigation measures – mitigation measures have been proposed, with their impact reduction quantified where appropriate. Where planning or design controls are proposed to manage implementation of the measures these have been summarised.

Based on the context and analysis conducted and detailed in this report, the proposed masterplan is generally able to meet the required controls for the area. Furthermore there are several opportunities to mitigate pollution impacts from the development through innovative design considerations.

Air pollution

Existing sources of air emissions in the area would largely be attributed to transport emissions; including vehicle emissions and diesel emissions from trains traveling through Redfern Station; immediately to the south east of the site. Other minor sources of emissions within the local airshed may occur from Alexandria Industrial estate approximately 1.5km to the south.

When completed, the project work of relevance to this assessment is not expected to result in the generation of significant levels of air pollution. The only pollutants expected because of the overall development are related to demolition, excavation and construction works and would be considered temporary.

Recommended Development Controls

Ensuring that sensitive land uses are sited to avoid or appropriately manage vehicle emissions from within and around the site during the planning and building construction stages. These planning and design considerations are in line with the DP&E's *Development Near Rail Corridors and Busy Roads – Interim Guideline*, (DoP 2008) and supports the specific rail and road provisions of the *State Environmental Planning Policy (Transport and Infrastructure) 2021 (SEPP 2021).*

Water pollution

Impacts to stormwater runoff from the proposed development could potentially occur from an increased impervious fraction within the site extent because of additional road resurfacing, footpath upgrades, general site levelling and increased building footprint.

Contaminants leaving the site would include lubricants, effluents, chemicals and sediments. These, by entering downstream waterways and watercourses, are likely to trigger increased turbidity, lowered dissolved oxygen levels, increased nutrient and pollutants. Hence, on-site containment and treatment of contaminated waters will ensure safe discharge of runoff from the site.

When completed, the project work of relevance to this assessment is not expected to result in the generation of significant levels of water pollution. The design objectives and targets are documented in detail within the Water Quality, Flooding and Stormwater Assessment (SSP Study No. 13) report.

Recommended Development Controls

Through the introduction of water quality control measures on site, the impact of site development on water bodies downstream of the precinct can be minimised. Site specific design would be required to meet stormwater targets. In summary, the following options should be considered, in order of preference:

- Rainwater tanks can be used to treat runoff from each roof catchment.
- Rainwater can be used to meet irrigation demands and toilet flushing.
- Proprietary products such as filter cartridges may be required where treatment cannot be accommodated within the landscape.

Initial findings are that the abovementioned stormwater controls should be able to achieve required targets. However, improved outcomes requiring less dedicated treatment can be achieved through optimising the use of multipurpose infrastructure elements between built environment disciplines, including architecture, building services, landscaping, civil engineering and stormwater and greening.

Light Pollution

The new buildings along the southern perimeter adjacent to the rail corridor are commercial in nature. Four of the buildings are 18 storeys or higher, and generally 10m or more away from the site boundary/rail corridor. Façade/outdoor terrace lighting on these buildings (if any) may affect the rail corridor, and must be taken into account during detail design to minimise the obtrusive lighting effects.

The internal site lighting design is to be compliant with *Sydney Lights: Public Domain Design Code as required by City of Sydney*. Any potential street lighting within the southern perimeter of the site is to be aimed away from the rail corridor to reduce any potential light spill onto the rail track.

As per AS/NZS4282, clause (e) in the preface, the standard does not apply to public lighting that provides safe movement. However, design strategy will be in place to minimise the obtrusive lighting effect. Examples include the use of full cut off luminaires with zero light distribution above the horizontal, luminaire aiming principles such that 100% of the light distribution falls on a solid object, and concealment of bare light sources.

Recommended Development Controls

Planning conditions will reference that external lighting systems associated with the Redfern North Eveleigh (RNE) Paint Shop sub-precinct will be required to limit light spill in accordance with the light technical parameters and calculation requirements outlined in *AS/NZS 4282 'Control of the obtrusive* *effects of outdoor lighting'.* During detailed design the lighting designer should demonstrate conformity of the lighting design of the installation with the light technical parameters of AS/NZS4282.

The relevant Authority shall also confirm if public street lighting associated with the RNE Paint Shop precinct shall be subject to the associated light spill limits outlined in AS/NZS4282.

Other pollution types

Although the Study Requirements mainly focus on air pollution, water pollution and light pollution, other potential pollution types associated with urban developments may include management of existing contamination onsite as well as the management of solid waste/ litter generated by the future land use.

Existing contamination

As per the remediation strategy for the North Eveleigh Rail Yard as produced by SMEC in April 2008 (ref. 3001510.001) there are a number exceedances in relation to the proposed land uses for specific soil borne and groundwater borne contaminants. The report recommends further investigations prior to finalising a Remediation Action Plans (RAP) for the site and notes that a series of management plans will be prepared as part of the development of the works to appropriately manage these contaminants and mitigate their impact to future users of the land. It is recommended that the findings of this report be considered as part of the next stage of works.

Solid waste

Solid waste generated on the development site should be managed through the City of Sydney's Development Controls. By managing the waste streams at the point of generation and implementing appropriate management systems the environmental impacts as noted below can be mitigated.

- Land and surface water contamination as a result of spills or inappropriate storage, handling, transportation and disposal of waste;
- Noise impacts associated with waste collection, movement and transport;
- Odours and vermin resulting from improper storage and treatment putrescible wastes;
- Visual amenity impacts resulting from waste storage and movements at the site (e.g. bins storage, collection and transport); and
- Off-site land and water pollution due to windblown wastes following inappropriate storage, handling, and transportation of wastes.

1.0 Introduction

The NSW Government is investing in the renewal of the Redfern North Eveleigh Precinct to create a unique mixed-use development, located within the important heritage fabric of North Eveleigh. The strategic underpinning of this proposal arises from the Greater Sydney Region Plan and District Plan. These Plans focus on the integration of transport and land use planning, supporting the creation of jobs, housing and services to grow a strong and competitive Sydney.

The Redfern North Eveleigh Precinct is one of the most connected areas in Sydney, and will be a key location for Tech Central, planned to be Australia's biggest technology and innovation hub. Following the upgrading of Redfern station currently underway, the Precinct's renewal is aimed at creating a connected destination for living and working, and an inclusive, active and sustainable place around the clock.

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This State Significant Precinct (SSP) Study proposes amendments to the planning controls applicable to the Paint Shop Sub-Precinct to reflect changes in the strategic direction for the Sub-Precinct. The amendment is being undertaken as a State-led rezoning process, reflecting its status as part of a State Significant Precinct located within the *State Environmental Planning Policy (Precincts - Eastern Harbour City) 2021*.

The amended development controls will be located within the City of Sydney Local Environmental Plan. Study Requirements were issued by NSW Department of Planning and Environment (DPE) in December 2020 to guide the investigations to support the proposed new planning controls.

1.1 Purpose of this Report

The purpose of this report is to provide a detailed assessment of the air quality impacts, noise pollution, light pollution associated with the proposed changes. The study considers any potential impacts that may result within and surrounding the Paint Shop Sub-precinct.

This report addresses study requirement 3.3 – Pollution Assessment. The relevant study requirements, considerations and consultation requirements, and location of where these have been responded to is outlined in Table 1-1 below.

Table 1-1 Study Requirements, Considerations and Consultation Requirements

Ref.	Study Requirement	Report Section
Pollution Assessment		
Study Requirements		
3.3	• Identify and assess any potential pollution impacts – air quality	2.4.1 (p40)
	• Analysis of the potential impact on adjoining uses – air quality	2.4.2.1 (p45() – 2.4.2.3 (p47)
	• Recommended development standards to be applied – air quality	2.5 (p50)
	• Identify and assess any potential pollution impacts – light	3.2 (p56)
	• Analysis of the potential impact on adjoining uses – light	3.2.2 (p56)
	• Recommended development standards to be applied – light	3.3 (p57)
	• Identify and assess any potential pollution impacts – water	4.2 (p62)
	• Analysis of the potential impact on adjoining uses – water	4.2 (p62)

	• Recommended development standards to be applied – water	4.3 (p63)
Considerations		
Page 11	• Identify, map and describe current and approved sensitive receptors	2.4 (p40 Figure 3.9) and 3.4 (p58)

1.2 Redfern North Eveleigh Precinct

The Redfern North Eveleigh Precinct is located approximately 3km south-west of the Sydney CBD in the suburb of Eveleigh (refer to **Figure 1-1**). It is located entirely within the City of Sydney local government area (LGA) on government-owned land. The Precinct has an approximate gross site area of 10.95 hectares and comprises land bounded by Wilson Street and residential uses to the north, an active railway corridor to the south, residential uses and Macdonaldtown station to the west, and Redfern station located immediately to the east of the Precinct. The Precinct is also centrally located close to well-known destinations including Sydney University, Victoria Park, Royal Prince Alfred Hospital, the University of Technology Sydney, and South Eveleigh, forming part of the broader Tech Central District.

The Precinct is located within the State Heritage-listed curtilage of Eveleigh Railway Workshops and currently comprises the Platform Apartments with 88 private dwellings, Sydney Trains infrastructure and key state heritage buildings including the Paint Shop, Chief Mechanical Engineer's Building, and the Carriageworks and Blacksmith Shop which provide shared community spaces for events including the Carriageworks Farmers Markets.

A map of the Precinct and relevant boundaries is illustrated in **Figure 1-1.**

Figure 1-1 Location Plan of Redfern North Eveleigh Precinct (Source: Ethos Urban)

1.3 Redfern North Eveleigh Paint Shop Sub-Precinct

The Redfern North Eveleigh Paint Shop Sub-Precinct is approximately 5.15 hectares and is bounded by Wilson Street to the north, residential terraces and Redfern station to the east, the Western Line rail corridor to the south and the Carriageworks Sub-Precinct to the west. The Sub-Precinct has a significant level change from a Reduced Level (RL) height of RL25 metres to RL29 metres on Wilson Street.

The Paint Shop Sub-Precinct currently hosts a number of items of heritage significance, including the Paint Shop Building, Fan of Tracks, Science Lab Building, Telecommunications Building, and Chief Mechanical Engineer's Building. The Sub-Precinct has a number of disused spaces adjacent to the rail corridor as well as functioning Sydney Trains' infrastructure, offices and operational space. Vehicle and pedestrian access to this area is used by Sydney Trains. The site has a clear visual relationship to South Eveleigh and the Eveleigh Locomotive Workshops across the active rail corridor.

A map of the Paint Shop Sub-Precinct and relevant boundaries is illustrated in Figure 1-2 .

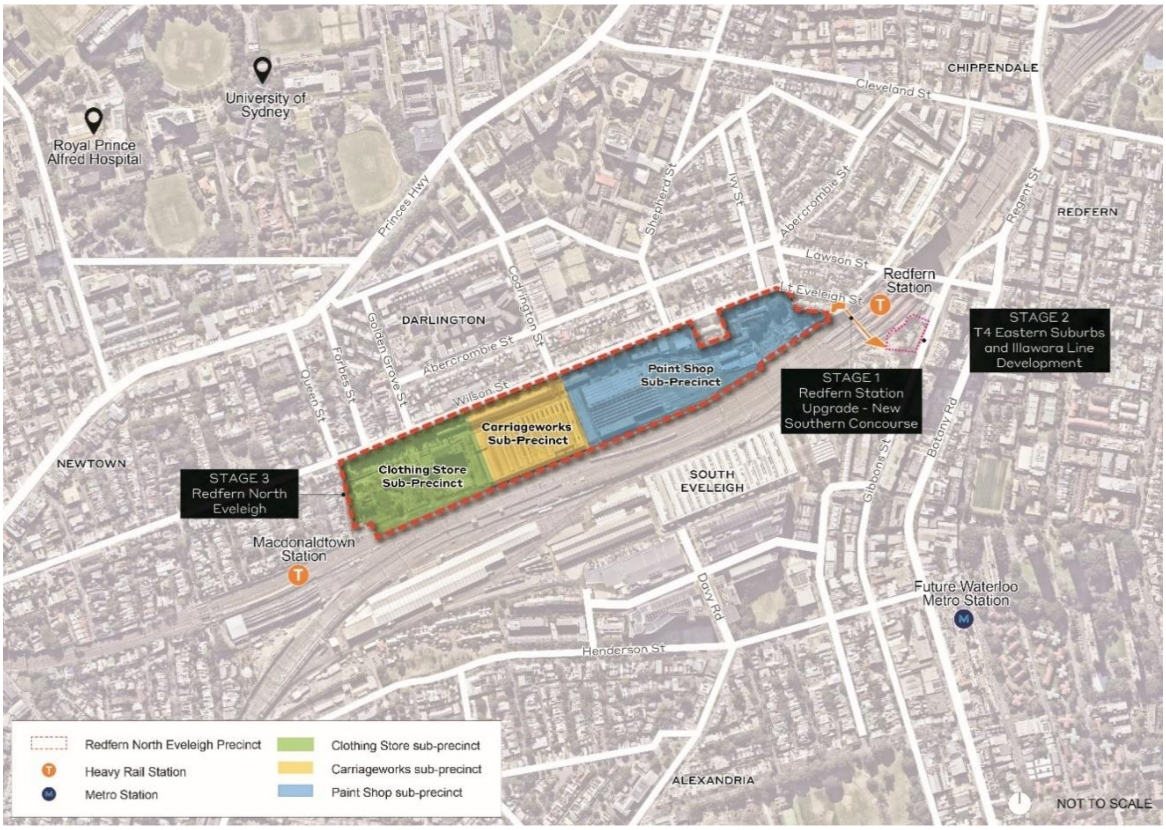


Figure 1-2 Redfern North Eveleigh and Sub-Precincts (Source: Ethos Urban)

1.4 Renewal Vision

The Redfern North Eveleigh Paint Shop Sub-Precinct will be a connected centre for living, creativity and employment opportunities that support the jobs of the future, as well as providing an inclusive, active and sustainable place for everyone, where communities gather.

Next to one of the busiest train stations in NSW, the Sub-Precinct will comprise a dynamic mix of uses including housing, creative and office spaces, retail, local business, social enterprise and open space. Renewal will draw on the past, adaptively re-using heritage buildings in the Sub-Precinct and will acknowledge Redfern's existing character and particular significance to Aboriginal peoples, culture and communities across Australia. The Sub-Precinct will evolve as a local place contributing to a global context.

1.5 Project Description

An Urban Design and Public Domain Study has been prepared to establish the urban design framework for the Redfern North Eveleigh Paint Shop Sub-Precinct. The Urban Design and Public Domain Study provides a comprehensive urban design vision and strategy to guide future development of the Sub-Precinct and has informed the proposed planning framework of the SSP Study.

The Urban Design Framework for the Paint Shop Sub-Precinct comprises:

- Approximately 1.4 hectares of publicly accessible open space, comprising:
  - A public square – a 7,910 square metre public square fronting Wilson Street;
  - An eastern park – a 3,871 square metre park located adjacent to the Chief Mechanical Engineer's Building and the new eastern entry from Platform 1 of the Redfern station; and
  - Traverser No1 - a 2,525 square metre public square edged by Carriageworks and the Paint Shop.
- Retention of over 90% of existing high value trees.
- An overall greening coverage of 40% of the Sub-Precinct.
- A maximum of 142,650 square metre gross floor area (GFA), comprising:
  - between 103,700 - 109,550 square metres of gross floor area (GFA) for employment and community facility floor space (minimum 2,500 square metres). This will support approximately 6,200 direct jobs on the site across numerous industries including the innovation, commercial and creative sectors.
  - between 33,100 - 38,950 square metres of GFA for residential accommodation, providing for between 381 and 449 new homes (including 15% for the purposes of affordable housing).
- New active transport infrastructure and routes to better connect the Paint Shop Sub-Precinct with other parts of Tech Central and the surrounding localities.
- Direct pedestrian connections to the new Southern Concourse at Redfern station.
- Residential parking rates, comprising:
  - Studio at 0.1 per dwelling
  - 1 Bed at 0.3 per dwelling
  - 2 Bed at 0.7 per dwelling
  - 3 Bed at 1.0 per dwelling
- Non-residential car parking spaces (including disabled and car share) are to be provided at a rate of 1 space per 700 square metres of GFA.
- 66 car spaces are designated for Sydney Trains maintenance and operational use.

The key features of the Urban Design Framework, include:

- The creation of a new public square with direct pedestrian access from Wilson Street to provide a new social and urban hub to promote outdoor gatherings that will accommodate break out spaces and a pavilion structure.
- An eastern park with direct access from Redfern station and Little Eveleigh Street, which will provide a high amenity public space with good sunlight access, comfortable wind conditions and community character.
- Upgraded spatial quality of the Traverser No1 yard, retaining the heritage setting, and incorporating complementary uses and good access along Wilson Street to serve as a cultural linkage between Carriageworks and the Paint Shop Building.
- The establishment of an east-west pedestrian thoroughfare with new public domain and pedestrian links.
- A range of Water Sensitive Urban Design (WSUD) features.
- Activated ground level frontages with commercial, retail, food and beverage and community and cultural uses.
- Adaptive reuse of heritage buildings for employment, cultural and community uses.
- New buildings for the Sub-Precinct, including:
  - Commercial buildings along the rail corridor that range between 3 and 26 occupied storeys;
  - Mixed use buildings along the rail corridor, comprising a three-storey non-residential podium with residential towers ranging between 18 to 28 occupied storeys;
  - Mixed use buildings (commercial and residential uses) along Wilson Street with a four-storey street wall fronting Wilson Street and upper levels at a maximum of 9 occupied storeys that are set back from the street wall alignment;
  - A commercial building on the corner of Wilson Street and Traverser No.1 with a four-storey street wall fronting Wilson Street and upper levels at a maximum of 8 occupied storeys that

are set back from the street wall alignment. There is flexibility to allow this building to transition to a mixed-use building with active uses at ground level and residential uses above; and

- Potential options for an addition to the Paint Shop Building comprising of commercial uses. These options (all providing for the same GFA) include:
  - A 5-storey commercial addition to the Paint Shop Building with a 3m vertical clearance, with the adjacent development site to the east comprising a standalone 3-storey commercial building (represented in Figure 1-3);
  - A 3-storey commercial addition to the Paint Shop Building with a 3m vertical clearance which extends and connects to the commercial building on the adjacent development site to the east; and
  - No addition to the Paint Shop Building, with the adjacent development site to the east comprising a standalone 12-storey commercial building.

- Commitment to a 5 Star Green Star Communities rating, with minimum 5 Star Green Star Buildings rating.
- All proposed buildings are below the Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) to ensure Sydney Airport operations remain unaffected.

The proposed land allocation for the Paint Shop Sub-Precinct is described in Table 1-2 below.

Table 1-2 Breakdown of Land Allocation within the Paint Shop Sub-Precinct

Land allocation	Existing	Proposed
Developed area	15,723 sqm / 30% of total site area	20,824 sqm / 40% of total site area
Public open space	Area not publicly accessible	14,306 sqm / 28% of total site area
Other public domain areas (including streets, shared zones, pedestrian paths and vehicular zones)	Area not publicly accessible	15,149 sqm / 29% of total site area (Excludes privately accessible public links and private spaces ~ 3% of total site area)

The Indicative Concept Proposal for the Paint Shop Sub-Precinct is illustrated in Figure 1-3

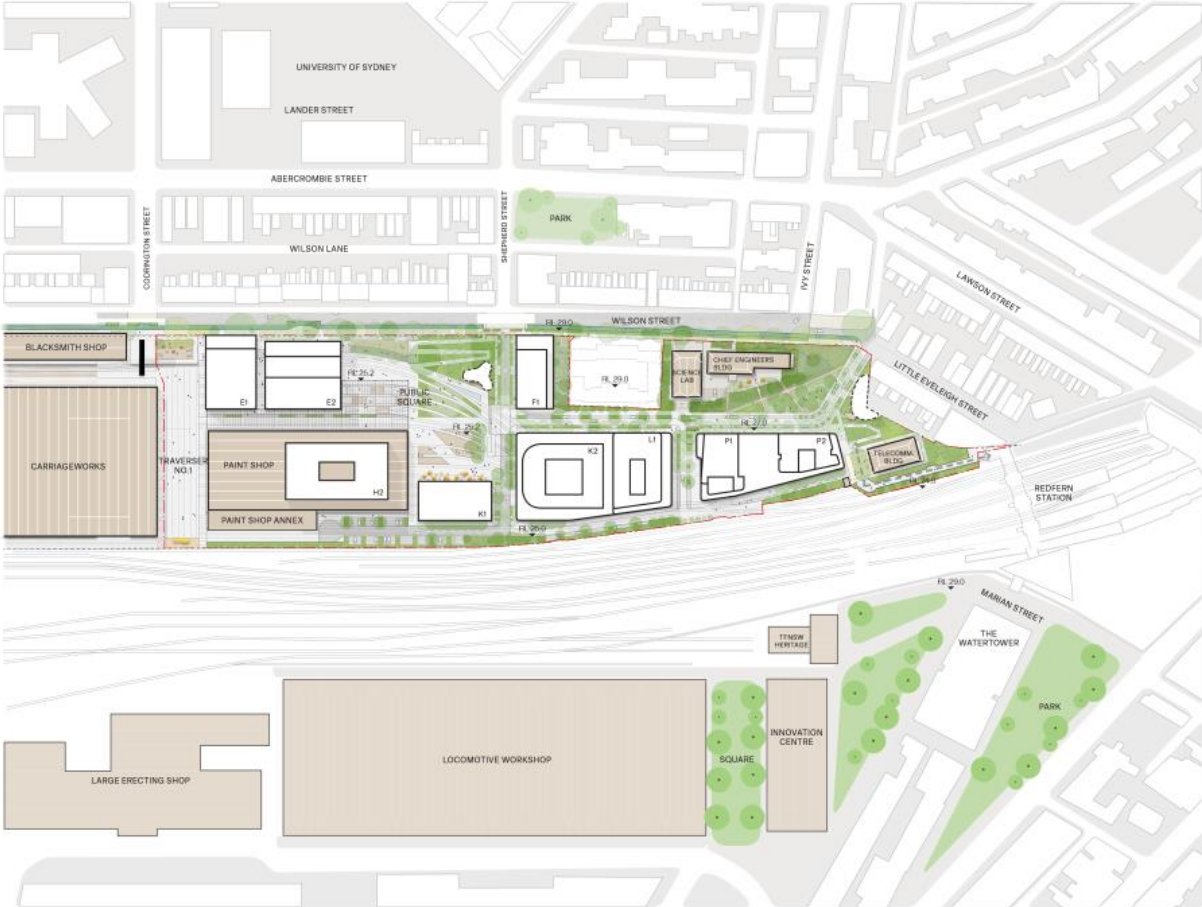


Figure 1-3 Indicative Concept Proposal (Source: Bates Smart and Turf)

1.6 Consultation

As part of the consultation of the proposed Masterplan adjustment Transport for NSW have approached EPA for comment. In an email response from Paul Wearne on the 12th of November 2021 EPA note they will provide comment (if required) during the exhibition period of the proposal.

2.0 Air Quality Investigation

2.1 Air Quality Regulatory Framework

2.1.1 Commonwealth Legislation

2.1.1.1 National Environment Protection Council Act 1994

The *National Environment Protection Council Act 1994* (Cth) establishes and provides authority to the National Environment Protection Council (NEPC) to make National Environment Protection Measures (NEPMs) and to assess and report on their implementation and effectiveness in participating jurisdictions. NEPMs are a special set of national objectives designed to assist in protecting or managing aspects of the environment. Regarding concentrations of air pollutants, there are two relevant NEPMs the:

- *National Environment Protection (Ambient Air Quality) Measure 1998*
- *National Environment Protection (Air Toxics) Measure 2004*

The air quality standards associated with the Ambient Air Quality NEPM are provided in Section 2.2.2.

The *National Environment Protection Council Act 1994* (Cth) also administers the *National Environment Protection (National Pollutant Inventory) Measure 1998* which is used the collect a broad base of information on emissions including air emissions from all industry sectors and reports and disseminates this information to the community in a useful as accessible form.

2.1.2 NSW Air Quality Legislation

2.1.2.1 Protection of the Environment Operations Act 1997 (NSW) (POEO Act)

The *Protection of the Environment Operations Act 1997 (NSW)* (POEO Act 1997) is the key piece of environmental protection legislation administered by the NSW EPA. The objective of the POEO Act 1997 is to achieve the protection, restoration and enhancement of the quality of the NSW environment.

The Act provides board allocation of environmental responsibilities between the NSW EPA, local councils, and other public authorities. The POEO Act also allows for the provision of Protection of the Environment Polices (PEPs), Environmental Protection Licences (EPLs) and environmental protection notices. It also has a three-tier regime relating to environmental protection offences.

The objectives of this Act relevant to air quality are to:

- to protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development,
- to ensure that the community has access to relevant and meaningful information about pollution,
  - to reduce risks to human health and prevent the degradation of the environment using mechanisms that promote the following—
  - pollution prevention and cleaner production,
  - the reduction to harmless levels of the discharge of substances likely to cause harm to the environment,
  - the making of progressive environmental improvements, including the reduction of pollution at source,
  - the monitoring and reporting of environmental quality on a regular basis,
- to rationalise, simplify and strengthen the regulatory framework for environment protection,
- to improve the efficiency of administration of the environment protection legislation,

The POEO also allows for the provision of delegate legislation including the *Protection of the Environment Operations (Clean Air) Regulation 2021* as described in **Section 2.1.2.2**.

The POEO Act is supported by NSW EPA documents that provide statutory methods for assessing and sampling air pollutants including:

- *Approved methods for the modelling and assessment of air pollutants in NSW.*
- *Approved methods for the sampling and analysis of air pollutants in NSW.*

Assessment criteria for air pollutants is discussed in **Section 2.2**

2.1.2.2 Protection of the Environment Operations (Clean Air) Regulation 2010 (NSW)

The *Protection of the Environment Operations (Clean Air) Regulation 2010 (NSW)* ("POEO Clean Air Regulation") under the *Protection of the Environment Operations Act 1997 (NSW)* ("POEO Act 1997") prescribes the requirements for a number of air pollutant generating activities in NSW. Requirements include domestic solid fuel heater certification, controlled burning, and installation of pollution control devices on certain motor vehicles, petrol supply standards, emission standards for industry groups and control storage and transport of volatile organic compounds.

The POEO Clean Air Regulations refer to EPA documents that provide statutory methods for assessing and sampling air pollutants including the Approved methods for the modelling and assessment of air pollutants in NSW discussed in Section 2.2.1.

2.1.3 Guidance Documents

The DPE's *Development Near Rail Corridors and Busy Roads – Interim Guideline* (DoP 2008) (the Guideline) supports the specific rail and road provisions of the *Transport and Infrastructure SEPP 2021*. The aim of the Guideline is to aid in reducing the health impacts of both noise and air quality impacts on sensitive adjacent development by assisting in the planning, design and assessment of development in or adjacent to rail corridors and busy roads. Under the guideline a busy road is defined as:

- Roads specified under Clause 2.119 of the Transport and Infrastructure SEPP (2021) including freeways, tollways, transit ways and any other road with 20,000 annual average daily traffic (AADT) volume or more;
- Any other road with a high level of truck movements or bus traffic.

Section 4 of the Guideline provides consideration for how to identify the potential for vehicle exhausts to impact on development adjacent to roadways and how to address potential air quality issues from vehicle exhausts for development near busy roads at the design stage. Section 4.4 of the Guideline lists the triggers for when air quality should be a design consideration for developments and provides guidance on design considerations that may be considered to mitigate air quality impacts. These triggers and are provided in Table 2-1.

Table 2-1 Triggers for Air Quality as a Design Consideration (DoP 2008)

Trigger	Design Consideration (Y/N)	Comment
Within 10 metres of a congested collector road (traffic speeds of less than 40 km/hr at peak hour) or a road grade > 4% or heavy vehicle percentage flows > 5%	No	• Eastern border of site is bound by Wilson Road which is a Local Road and is not located within 10m of a congested collector road
Within 20 metres of a freeway or main road (with more than 2500 vehicles per hour, moderate congestions levels of less than 5% idle time and average speeds of greater than 40 km/hr)	No	• Site is not located within 20m of a freeway or main road
Within 60 metres of an area significantly impacted by existing sources of air pollution (road tunnel portals, major intersection / roundabouts, overpasses or adjacent major industrial sources)	Yes	• Site not located within 60m of any road tunnels, major intersections, or overpasses which are significant sources of air pollution. • Site is located within 60m of two roundabouts on Wilson Road

Trigger	Design Consideration (Y/N)	Comment
As considered necessary by the approval authority based on consideration of site constraints, and associated air quality issues	Yes	• Transport have requested air quality related design advice/inputs as part of the Paint Shop sub-precinct masterplan assessment

The overall RNE site is generally not bound by any roads experiencing significant congestion; or within close proximity to a freeway or main road experiencing moderate levels of congestion.

The site is however located adjacent to a rail corridor and Transport have requested air quality design advice as part of the Paint Shop sub-precinct masterplan assessment. A qualitative assessment of transport emissions is presented in Section 2.4 and design considerations in accordance with the guideline for future development at the site are provided in Section 2.5.

2.2 Assessment Criteria

2.2.1 NSW EPA Criteria

When assessing a project with significant air emissions, it may be necessary to compare the impacts of the project with relevant air quality goals. Air quality standards or goals are used to assess the potential for ambient air quality to give rise to adverse health or nuisance effects. The criteria can also be used to assess the existing air quality in a region and provide an indication of the capacity the airshed to receive additional air pollutants from a development or activity.

The NSW EPA have released assessment criteria as part of their Approved Methods document (EPA 2016). The pollutant specific criteria and corresponding averaging period for individual pollutants are shown in Table 2-2. Assessment of the impacts from the individual pollutants is based on the pollutant type. For the pollutants listed in Table 2-2, the assessable location is either at sensitive receptor locations (e.g. residential property) or “at or beyond” a facility boundary.

Given the nature of the RNE project site; operation of the development is unlikely to generate ongoing significant air pollution sources, quantitative assessment using dispersion modelling has not been undertaken. As such, the comparison of emissions from the project with EPA criteria has not been undertaken. Criteria listed in Table 2-2 represent pollutants that may be present in small quantities in the ambient environment and are relevant for the construction period of the project. Criteria have also been included to provide a reference for local air quality conditions as described in Section 2.3.2.

Table 2-2 Air Quality Impact Assessment Criteria

Pollutant	Averaging Period	Criteria ($\mu g/m^3$)
Total Suspended Particles	Annual Average	8
PM_{10}	24 Hour Maximum	25
	Annual Average	8
$PM_{2.5}$	24 Hour Maximum	25
	Annual Average	8
Nitrogen Dioxide	1 Hour Maximum	246
	Annual Average	62
Sulphur Dioxide	1 Hour Maximum	570
	24 Hour Maximum	228
	Annual Average	60
Carbon Monoxide	1 Hour Maximum	30,000
	8 Hour Maximum	10,000

2.2.2 National Environment Protection Measure Standards

As discussed in Section 2.1.1.1 the *National Environment Protection (Ambient Air Quality) Measure 1998* (AAQ NEPM) falls under the *National Environment Protection Council Act 1994* (Cth). The AAQ NEPM requires participating jurisdictions to undertake monitoring, evaluation, and reporting activities for the following criteria pollutants:

- Carbon monoxide;
- Nitrogen dioxide;
- Sulfur dioxide;
- PM_{10}
- $PM_{2.5}$
- Photochemical oxidants (as ozone); and
- Lead.

The AAQ NEPM standards are aimed at achieving adequate protection of human health and wellbeing and apply to air quality experienced by the general population within a region. Under this general exposure approach the standards are applicable to urban sites away from specific sources of pollution such as heavily trafficked streets and industrial smokestacks. The AAQ NEPM does not prescribe sanctions for-noncompliance with the air quality standards and does not compel or direct air pollution control measures (NEPC 2021).

The ambient air quality standards as recently amended on 18 May 2021 are shown in Table 2-3**.**

Table 2-3 NEPM Air Quality Standards as updated 18 May 2021

Item	Pollutant	Averaging period	Maximum concentration standard	
			ppm	µg/Nm^3
1	Carbon monoxide	8 hours	9.0	11,250
2	Nitrogen dioxide	1 hour	0.08	164
		1 year	0.015	31
3	Photochemical oxidants (as ozone)	8 hours	0.065	139
4	Sulfur dioxide	1 hour	0.10	286
		1 day	0.02	57
5	Lead	1 year	-	0.50
6	Particles as PM_{10}	1 day	-	50
		1 year	-	25
7	Particles as $PM_{2.5}$	1 day	-	25
		1 year	-	8
ppm = parts per million µg/Nm^3 = micrograms per normal cubic metre (under standard temperature and pressure).				

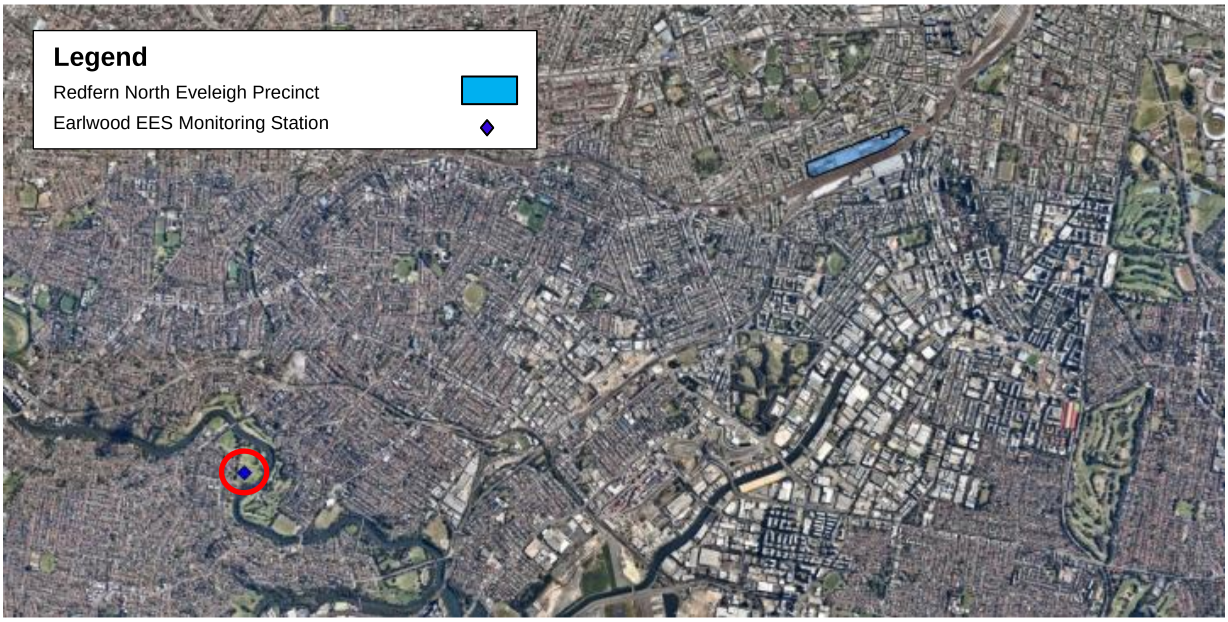
The May 2021 amendment to the AAQ NEPM standards included changes to the standards for nitrogen dioxide (NO_2), sulfur dioxide (SO_2) and ozone (O_3) concentrations and averaging periods. These changes have resulted in recommended maximum 1-hour and annual average concentrations for NO_2 and maximum 1-hour and 24-hour concentrations for SO_2 that are lower than the NSW Criteria under the approved methods as described in **Section 2.2.1.**

In the *Key Changes to the Ambient Air Quality Measure agreed by Ministers April 2021* statement issued by the NEPC (NEPC 2021a) it was asserted that standards in the AAQ NEPM are not intended to be applied as an environmental standard by regulators without consideration of regulatory impacts in their jurisdictions. The Explanatory Statement clarifies this intent of the NEPM as a standard for reporting representative ambient air quality within an airshed, and not as a regulatory standard.

2.3 Existing Environment

2.3.1 Meteorology

The NSW Environment, Energy and Science Group (EES) as part of the NSW Department of Planning and Environment (DPE) and the Australian Bureau of Meteorology (BoM) operate a series of monitoring stations throughout NSW. The closest stations to the Redfern site are the BoM Observatory Hill station 3.7km from the site and the EES Cook and Phillip Sydney CBD station. The BoM Observatory Hill station no longer measures wind speed and wind direction, and meteorological data collected at the EES Cooks and Phillip and Rozelle stations (2.7km and 4.0km from the site) is considered unreliable due to siting reasons. Based on similarities in terrain; the most representative meteorological monitoring station of the Redfern project site would be the EES Earlwood monitoring station located approximately 5.8km to the southwest located in Beaman Park off Riverview Road, Earlwood. The station has been in place since 1978 and is considered to be a good long-term data set to use as the basis of the analysis of weather patterns in the region. The location of the Redfern project site in relation to the EES monitoring station in Earlwood is shown in Figure 2-1**.**



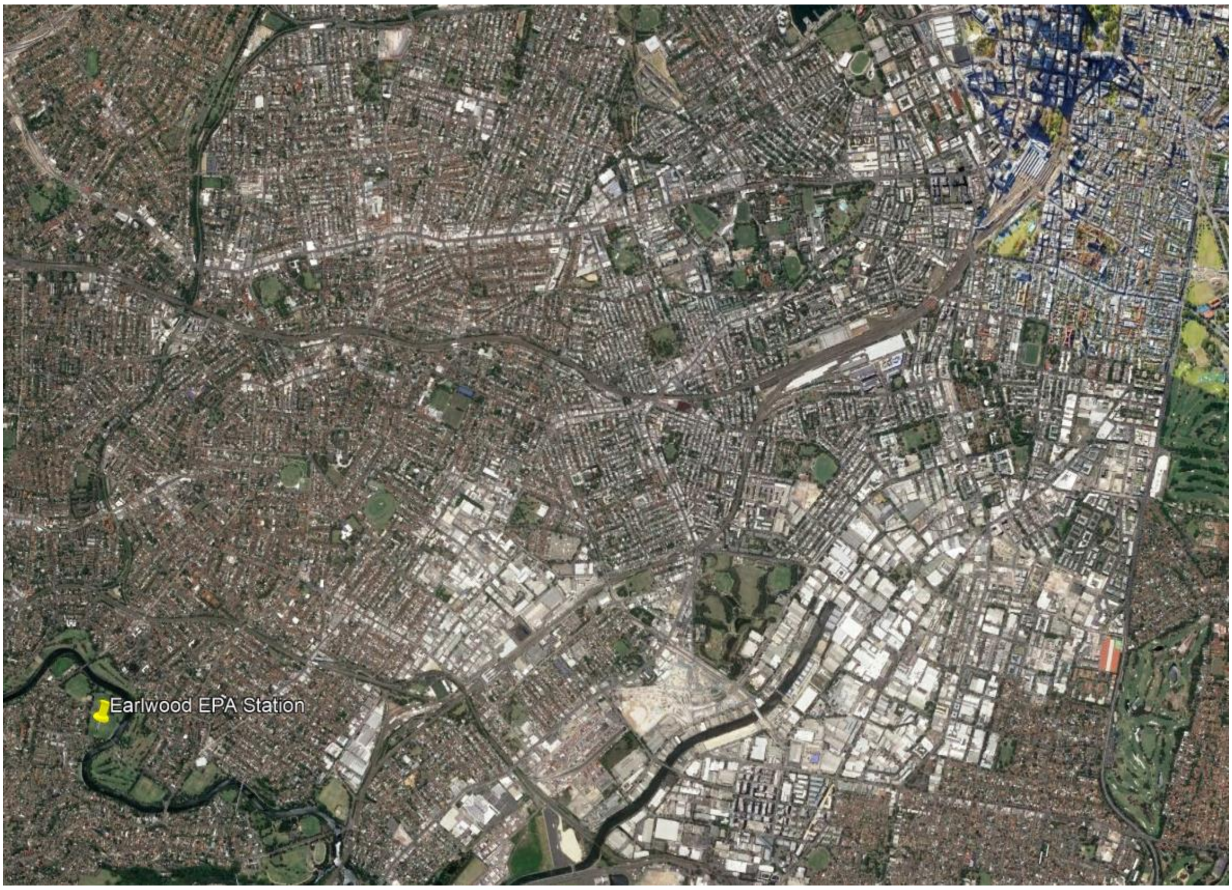


Figure 2-1 Location of EES Earlwood Monitoring Station and Proximity to the Redfern North Eveleigh Precinct

Despite the proximity of the EES monitoring station, it is considered prudent to undertake an analysis of the on-site meteorology as part of this baseline environmental analysis for the site. In the absence of site-specific meteorological observations, a meteorological dataset has been prepared using a combination of regional meteorological observations from BoM stations, databases of terrain and land use, as well as gridded meteorological data from the CSIRO The Air Pollution Model (TAPM) prognostic meteorological model. The following section provides a brief overview of each of the processes.

2.3.1.1 Meteorological Modelling

The meteorological modelling included several data inputs to enable the generation of a meteorological data set for the Redfern area for further analysis. The different inputs have been discussed in the following section.

The Air Pollution Model

TAPM is a prognostic meteorological and air pollution model developed by CSIRO. The model can be used to predict three-dimensional meteorology, including terrain-induced circulations and is connected to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic-scale meteorological analyses for various regions around the world. TAPM was used in this assessment to generate individual upper air meteorological file for input into the California Meteorological Model (CALMET). The TAPM model was run over a three-year period between 2016 and 2018 and upper air data at six locations were extracted from the model outputs for CALMET.

CALMET

CALMET is the meteorological pre-processor for the Californian Puff Model (CALPUFF) dispersion model. CALMET has been used in this process to collectively process the gridded TAPM and surface observation data in conjunction with terrain and land use data to produce hourly 3-dimensional gridded arrays of meteorological parameters.

TAPM upper air files have been used within CALMET as an 'initial guess' field in which meteorological parameters are initialised prior to the application of a range of diagnostic flow corrections, which are based on physical and empirical algorithms. This process involves resolving blocking, channelling, slope flow and kinematic effects across the CALMET grid, as based on iterative processes. Once this stage is complete, surface observations are incorporated in an objective process, using domain specific weighting values. This approach allows the model to incorporate actual observations, whilst also reflecting variations in micrometeorology at across the modelling.

Table 2-4 CALMET modelling parameters for the project domain

Parameter	Value
Meteorological grid domain	75 km x 60 km
Meteorological grid resolution	250 metre resolution (300 x 240 grid cells)
Reference grid coordinate (SW corner)	247.500 km E, 6174.800 km S
Cell face heights in vertical grid (m)	0,20,40,80,160,320,640,1200,2000,3000,4000
Simulation length	3 years (2016 to 2018)
Surface meteorological stations	• BoM stations at Mangrove Mountain, Mount Boyce, Fort Denison, Sydney Airport, Little Bay, Terry Hills, Bankstown, Holsworthy, Canterbury, Manly, North Head, Sydney Olympic Park, Richmond RAAF, Badgerys Creek, Penrith Lakes, Horsley Park, Camden and Campbelltown. • EES stations at Bargo, Campbelltown West, Chullora, Earlwood, Liverpool, Macquarie Park, Prospect, Randwick, Richmond and St Marys.
Upper air meteorology	7 x TAPM derived up.dat files
CALMET Modelling Mode	Observations mode
Terrain data	Terrain elevations were extracted from NASA Shuttle Radar Topography Mission Version 3 data set (SRTM1 30 metre resolution).
Land use data	Site-specific data based on USGS land use codes and ABARES Land use Data
Wind field guess	Compute internally
Seven critical CALMET parameters	TERRAD = 12 km RMAX1 = 5 km RMAX2 = 8 km R1 = 5 km R2 = 10 km IEXTRP = -4 BIAS = -1,-0.5,0,0.5,1,1,1,1,1,1 (biased toward surface station observations at lower levels)

BoM Surface Station Meteorological Analysis

The representativeness of the surface observation station closest to the RNE Precinct project site is critical to the configuration of the CALMET control files. A station that is nearby and is representative of the project location is given more weight so that its influence extends to the project location. For a station that is nearby and not representative, such as a surface station located in a complex terrain situation or is situated a significant distance from the project location, then the surface observation is weighted less (or discounted for use in the model) and will have less influence over the model domain and the nearby project location.

To provide an indication of local meteorological conditions at the site; a total of 27 observation stations within approximately 50km radius within the Sydney basin were examined. The location of these monitoring stations is provided in Table 2-5**.**

Table 2-5 Redfern Area Surface Station Locations used in the model

Weather Station	Operator	Easting (km UTM)	Northing (km UTM)	Distance from Project Site (km)
Mangrove Mountain	BoM	333388	6315201	91.1
Mount Boyce	BoM	247112	6276810	67.2
Fort Denison	BoM	335831	6252493	5.4
Sydney Airport	BoM	331173	6242272	6.0
Little Bay	BoM	338367	6238360	11.0
Terry Hills	BoM	335508	6270713	23.0
Bankstown	BoM	313855	6245099	19.3
Holsworthy	BoM	310553	6236779	25.1
Canterbury	BoM	325572	6246697	7.4
Manly, North Head	BoM	342531	6257032	13.2
Sydney Olympic Park	BoM	321575	6254600	13.2
Richmond RAAF	BoM	293650	6279932	50.5
Badgerys Creek	BoM	289920	6246952	42.9
Penrith Lakes	BoM	284871	6266542	51.6
Horsley Park	BoM	301708	6252298	31.4
Camden	BoM	286659	6231110	49.2
Campbelltown	BoM	294516	6228788	43.1
Bargo	EES	277354	6201230	72.4
Campbelltown West	EES	296563	6228258	41.4
Chullora	EES	319315	6248148	13.5
Earlwood	EES	327663	6245573	5.8
Liverpool	EES	306572	6243489	26.7
Macquarie Park	EES	325691	6262277	16.1
Prospect	EES	306900	6258700	28.5
Randwick	EES	337587	6244018	5.6
Richmond	EES	291021	6278096	51.7
St Marys	EES	293254	6258314	41.0

A review of ten years of meteorological data from the EES Earlwood meteorological station between 2010 and 2019 was carried out to determine three representative years of data for use in the CALMET modelling. Consideration was given to a range of different parameters for the selected years 2016 to 2018, including wind speed, percentage of calms and a comparison of the 2016 to 2018 calendar years to the long-term ESS trends over 10 years. Additionally, an analysis of the Southern Oscillation Index (SOI) was undertaken to ensure the year of meteorological data selected for the model was not adversely impacted by either an El Nino or La Nina event.

The data comparison shows that there were only minor differences between the calms and wind speeds across the different years. The years 2016 to 2018 are relatively neutral years with SOI values between -7 and 7. Annual average wind speeds for 2016 to 2018 ranged from 1.26 to 1.29 m/s which is close to the ten-year average of 1.34 m/s. Calms for 2016 to 2018 were slightly higher than the 10-year annual trend but this is considered more conservative as increased calm conditions generally lead to poorer dispersal of air pollutants. On this basis, it was considered that the 2016 to 2018 data set was appropriate year for further analysis using CALMET.

Table 2-6 Multi-Year Meteorological Data Analysis - Earlwood EES Station

Earlwood Data	Calm (%)	Annual Average Wind Speed (m/s)	SOI Avg.
10-year trend	18.5	1.34	0.5
2010	13.4	1.55	9.8
2011	13.6	1.50	13.3
2012	17.7	1.36	-0.8
2013	18.9	1.37	4.0
2014	17.9	1.32	-3.0
2015	19.1	1.26	-11.2
2016	20.1	1.29	-3.1
2017	20.4	1.26	2.2
2018	21.1	1.28	1.0
2019	22.0	1.23	-7.0

A comparison of 2010 to 2019 wind roses for the EES Earlwood station is shown in Figure 2-2. This plot also shows that there is only a minor difference in average wind speeds, calm frequency, and wind direction from year to year. On an annual basis winds most frequently occur from west to west northwest direction; with southerly and north-easterly winds also occurring on a regular basis.

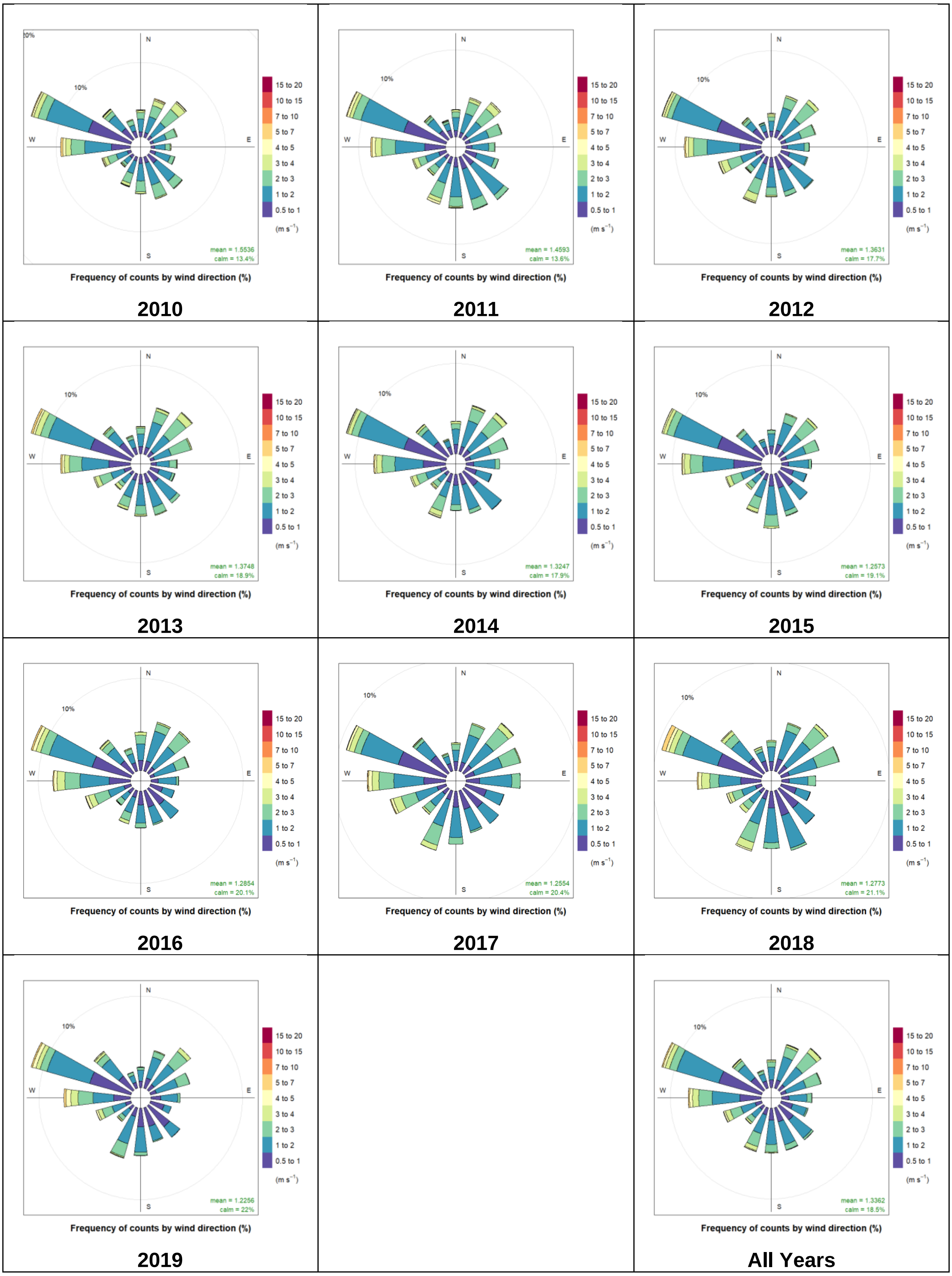


Figure 2-2 Analysis of wind roses for EES Earlwood monitoring station between 2010 and 2019

2.3.1.2 Redfern Meteorological Analysis

Meteorological Analysis at the Redfern project site has been undertaken using the results of the CALMET model outputs. The meteorological conditions have been discussed below with conditions presented in terms of the following parameters:

- Wind speed and direction
- Temperature
- Mixing height (measure of potential for inversions)
- Stability Class

Wind Speed and Direction

Wind predictions were extracted from CALMET at the Redfern project site for reference against longer term (2010 to 2019) regional observations at the Earlwood EES station. The following wind roses present a comparison between the two data sets.

Annual winds data are shown in Figure 2-3, which allows a comparison of the modelled winds at the at the Redfern project site and EES observational data at Earlwood for 2016, 2017 and 2018. Annual average wind speeds for the CALMET data are higher than at Earlwood with annual average winds speeds of 3.2 to 3.3 m/s compared to approximately 1.3 m/s at Earlwood. The proportion of calms is also significantly lower at Redfern indicating better dispersal conditions for air pollutants are likely to occur at Redfern.

Overall, the wind roses show a pattern consistent with other locations along the southern Sydney basin and is consistent with the observed land use and terrain features in the area.

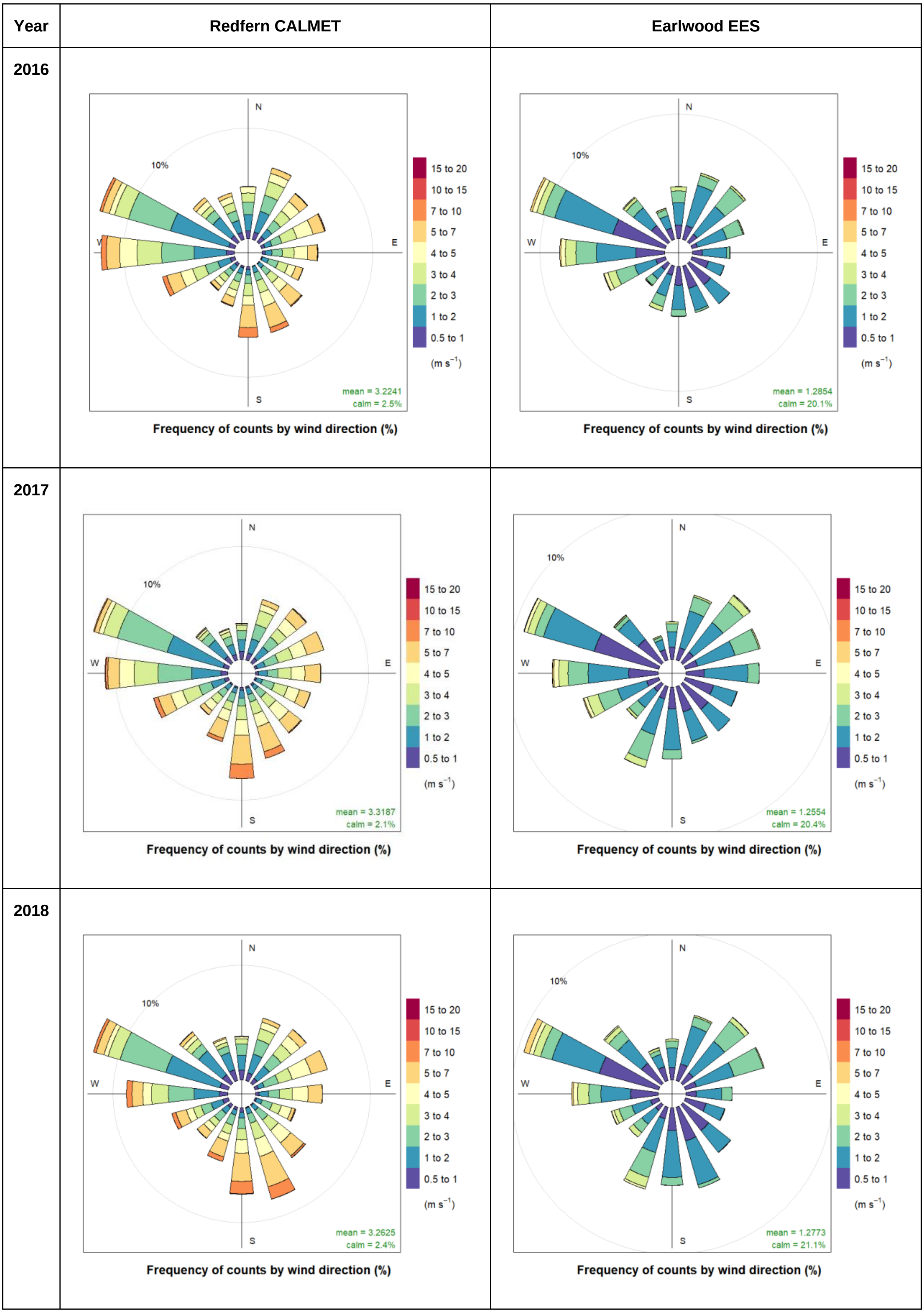


Figure 2-3 Analysis of wind roses for Redfern CALMET and Earlwood EES between 2016 and 2018

Temperature

Temperature data is estimated within CALMET for each hour of the meteorological data set. A plot of the temperature data predicted by CALMET at ground level at the Redfern project site is presented in **Figure 2-4**. The results are consistent with expected long-term observations as shown in Figure 2-4**.**

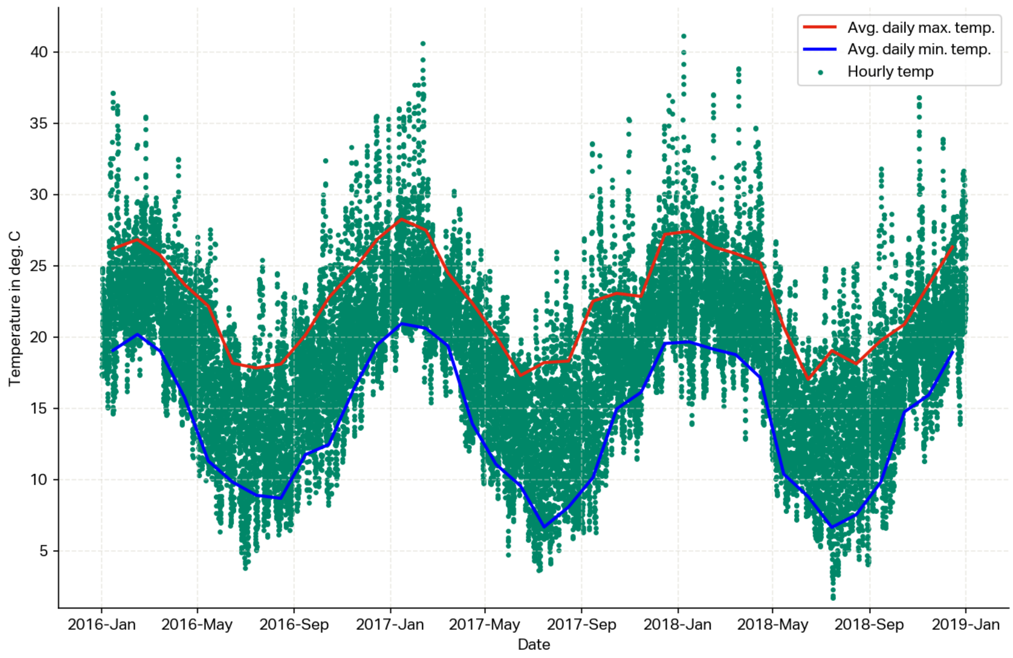


Figure 2-4 Predicted temperature data at Redfern Project Site

Mixing Height

Mixing height is a meteorological parameter which can be used to show the potential for temperature inversions to occur in an area. When temperature inversion occur, emissions can be trapped beneath a layer of air reducing the vertical mixing potential and resulting in higher pollutant concentrations. Inversions commonly occur in cool periods of the day (typically at night) when wind speeds are low.

Mixing heights are estimated within CALMET for stable and convective conditions (respectively), with a minimum mixing height of 50m. Figure 2-5 presents mixing height statistics by hour of day across the meteorological dataset, as generated by CALMET at the Project site. These results are consistent with general atmospheric processes that show increased vertical mixing with the progression of the day, as well as lower mixing heights during the night. Peak mixing heights observed in the data set of up to 3000m are consistent with typical ranges for mixing heights in Australia during the daytime.

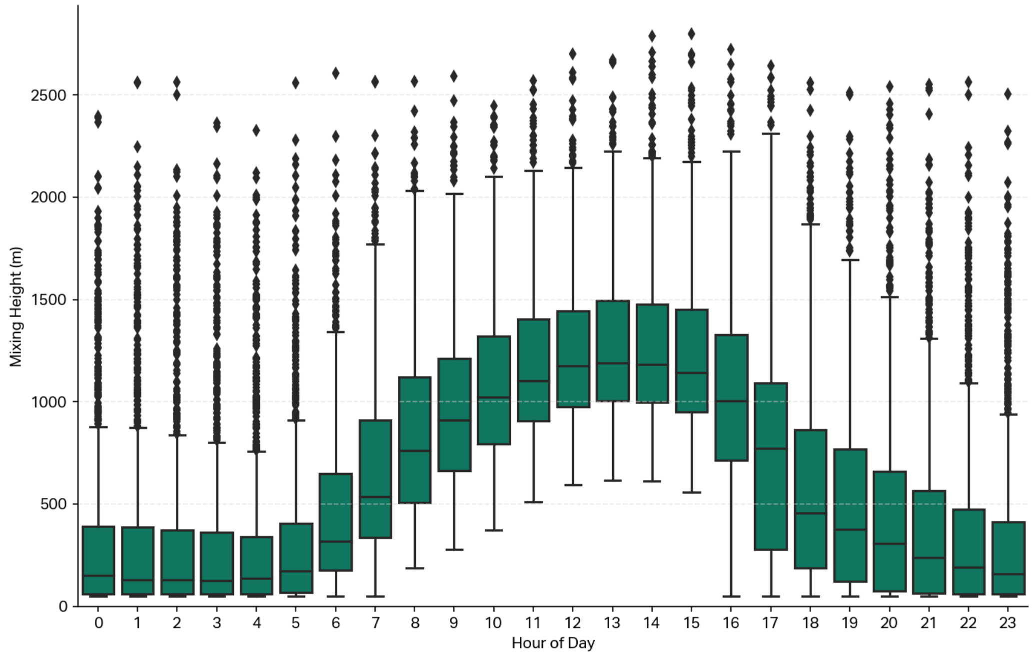


Figure 2-5 Predicted mixing height data at Redfern project site

Atmospheric Stability

Stability class is used as an indicator of atmospheric turbulence for use in meteorological models. The class of atmospheric stability generally used in these types of assessments is based on the Pasquill-Gifford-Turner (PG) scheme where six categories are used (A to F) which represent atmospheric stability from extremely unstable to moderately stable conditions respectively. The stability class of the atmosphere is based on three main characteristics, these being:

- Static stability (vertical temperature profile/structure)
- Convective turbulence (caused by radiative heating of the ground)
- Mechanical turbulence (caused by surface roughness).

Whilst CALPUFF centrally uses Monin-Obukhov (MO) similarity theory to characterise the stability of the surface layer, conversions are made within the model to enable the calculation of the PG class based on Golders method (Golder 1972[1]) as a function of both MO length and surface roughness height.

Figure 2-6 presents an analysis of stability class frequency against wind speed for the CALMET data. The pattern shown in the figure is representative of a coastal area and confirms a typical distribution for stability class at different wind speeds. Lower wind speeds are dominated by moderately stable conditions, and high winds speeds are dominated by neutral conditions.

[1] Golder, D. 1972, "*Relations among stability parameters in the surface layer*", Boundary Layer Meteorology, 3, 47-58

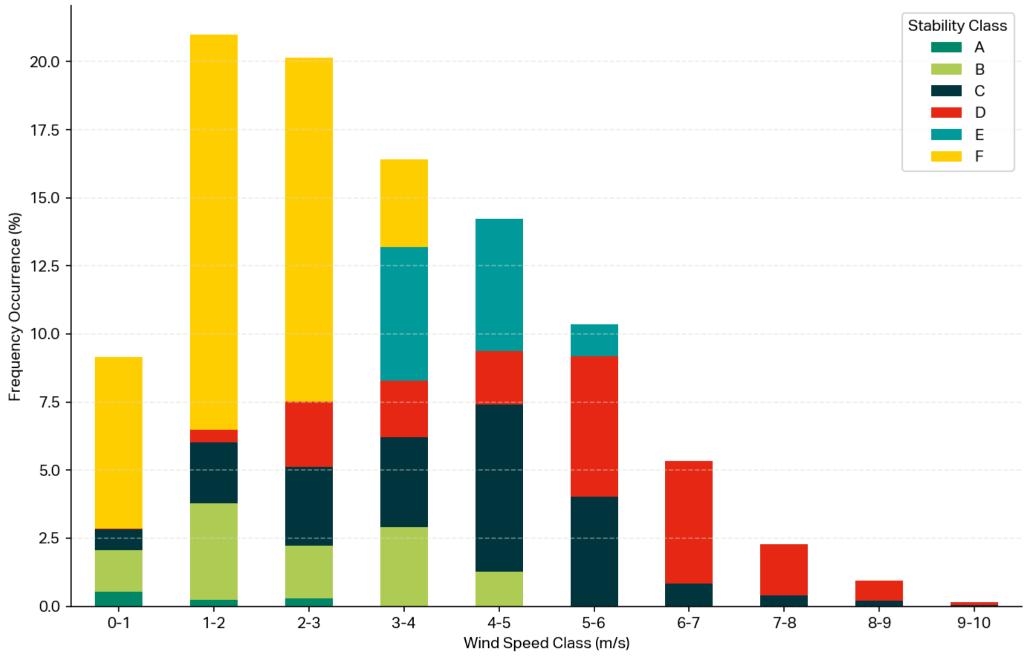


Figure 2-6 Predicted stability class data at different wind speed classes at Redfern project site

Figure 2-7 presents an analysis of CALMET stability class data by hour of the day. The data shows that night-time hours are dominated by moderately stable conditions, daytime hours are dominated by slightly and moderately unstable conditions.

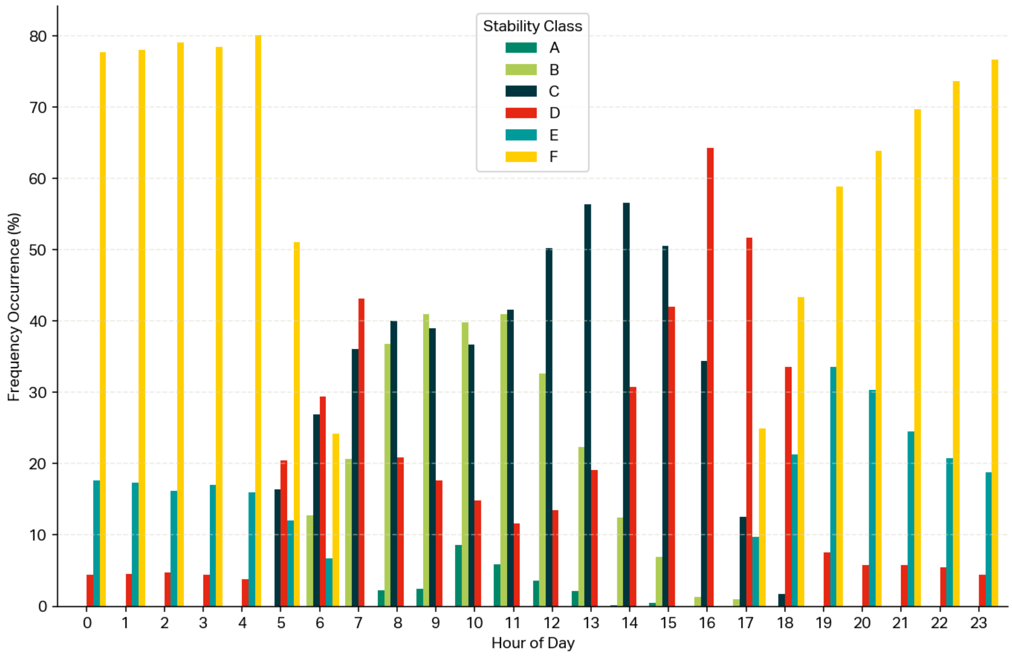


Figure 2-7 Predicted stability class data at different times of day at Redfern project site

Long Term Meteorological Data Summary

Long-term meteorological data relating to wind speed and wind direction at EES Earlwood (from 2010 – 2019) is discussed in Section 2.3.1.1; noting an average annual wind speed of 1.3m/s and winds most commonly occurring from the west and west-northwest.

Figure 2-8 below also provides a summary of monthly minimum and maximum temperatures between 2010 and 2019. The highest average monthly temperatures occur in January, while the coldest month on average is July.

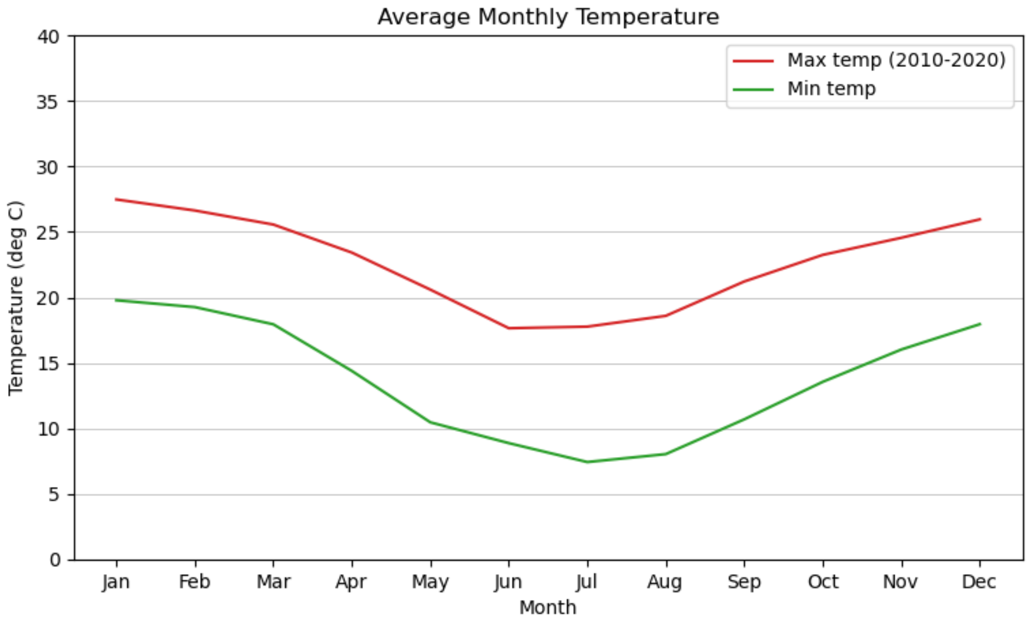


Figure 2-8 Average monthly minimum and maximum temperatures at Earlwood between 2010 and 2019

2.3.2 Existing Air Quality

The pollutants of prime interest in NSW are ozone, NO_2 and particulates, with regional levels of certain pollutants approaching or exceeding the national standards prescribed in the National Environment Protection Measure for Ambient Air Quality (NEPM).

This assessment will not be assessing the emissions from the site quantitatively and as such the background pollutant concentrations are not required to enable a cumulative assessment. However, to understand the potential background pollution concentrations, an analysis of available pollutant data was undertaken to try and understand the existing pollutant levels in the Redfern area.

No project specific regional air quality modelling has been undertaken for the project (a qualitative assessment is provided in Section 2.4). Background air pollution is characterised through regional ambient monitoring undertaken at locations throughout NSW by the NSW Environment, Energy and Science (EES) under the NSW DPE. There are four EES ambient air quality monitoring stations within a 10km radius of the site as listed in the table below. The closest station to the site is the EES Cooks and Phillip CBD monitoring station 2.9km to the northeast of the RNE precinct. Existing local sources of air emissions have also been discussed in Section 2.3.3.

Table 2-7 EES Monitoring Stations

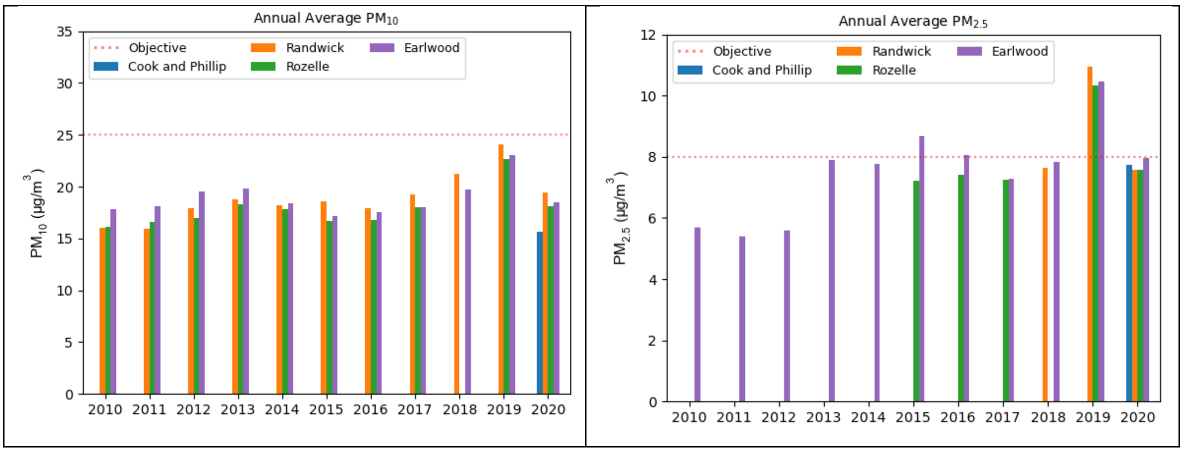
Station Name	Distance from RNE Precinct	Description
Cooks and Phillip Sydney CBD	2.9km to the northeast	Located in the north-western corner of Cooks and Phillip Park and measures air quality within the Sydney CBD.
Rozelle	4.0km to the northwest	Located in the grounds of Rozelle Hospital, off Balmain Road, Rozelle situated in a residential area in the Parramatta River valley.
Randwick	5.6km to the southeast	Located in the grounds of the Randwick Army Barracks, on the corner of Avoca and Bundock Streets, situated in the eastern suburbs of Sydney in a residential area.
Earlwood	5.8km to the southwest	Located in Bearman Park, off Riverview Road, Earlwood, situated in a residential area in the Cook's River Valley.

As outlined above, there are 4 EES air quality monitoring stations within a 10km radius of the Redfern project site, providing a good indication of background regional air quality within the local airshed. The EES monitoring network measures a range of pollutants relevant to this study including:

- Oxides of Nitrogen (including Nitrogen Dioxide);
- PM_{10} particulate matter
- $PM_{2.5}$ particulate matter.
- Carbon Monoxide
- Sulphur dioxide

Data covering 2010 to 2020 for the Cooks and Phillip, Rozelle, Randwick and Earlwood monitoring stations have been extracted from the EES online data portal and have been summarised below. When observing the monitoring data, it should be noted that the year 2019 and 2020 are not considered representative of normal background air quality conditions; for particulates and NO_2 concentrations. This is due to extremely elevated particulate emissions in 2019-2020 during black summer bushfires and a reduction in anthropogenic emission sources in 2020 due to the Covid-19 pandemic such as major changes within the transport sector.

Annual average pollutant concentrations with the exception to some exceedances in $PM_{2.5}$ were generally compliant with the relevant EPA criteria for all pollutants across all monitoring stations between 2010 and 2020. A summary of the annual data for particulates, NO_2 and SO_2 are presented graphically in Figure 2-9. Maximum concentrations for all pollutants and year to year concentrations for all pollutants are discussed in detail in Section 2.3.2.1 to Section 2.3.2.4. The "Objective" noted in the graphs are the NEPM maximum concentrations listed in Table 2-3.



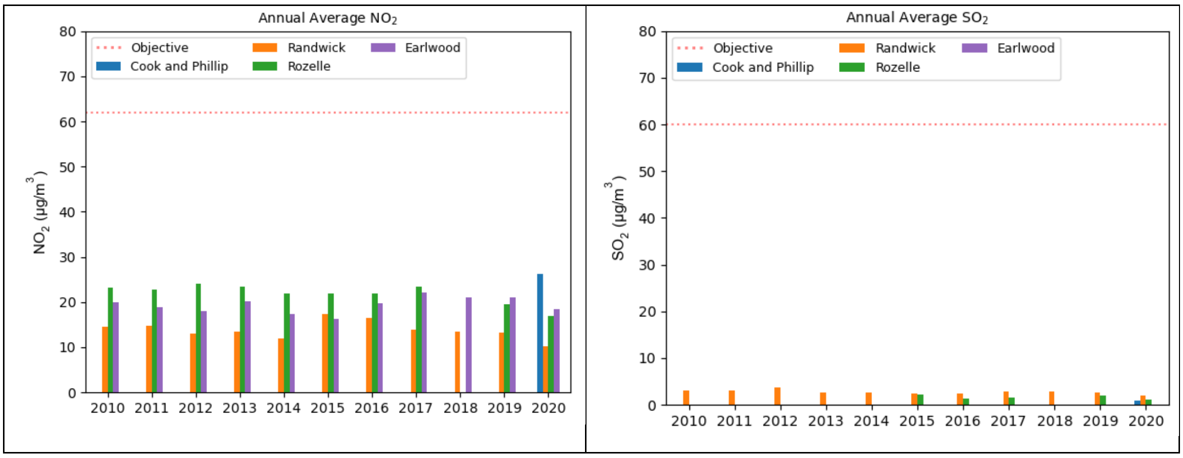


Figure 2-9 2009-2020 Average Pollutant Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle

2.3.2.1 PM_{10} and $PM_{2.5}$

PM_{10} and $PM_{2.5}$ concentrations recorded at Cooks and Phillip, Randwick, Rozelle and Earlwood EES stations are presented in Table 2-8 and Table 2-9. When reviewing this data, it is important to consider that elevated Maximum 24-Hour Concentrations and exceedances generally occurred over the 2019-2020 Black Summer period. This period is considered an extreme event and not representative of general background particulate concentrations.

Table 2-8 provides a summary of the maximum 24-hour concentrations and annual averages for PM_{10} at the EES monitoring stations. It can be seen from Table 2-8 that while annual average PM_{10} concentrations recorded comply with annual average PM_{10} criterion of 25µg/m³ some exceedances of the Maximum 24-hour PM_{10} concentration of 50µg/m³ occur in most years. These exceedances are also shown graphically in Figure 2-10

Table 2-8 EES Monitoring Data 24 Hour Maximum and Annual Average PM_{10} Concentrations for 2010-2020

Year	24 Hour Maximum (µg/m³)				24 Hr Criteria Exceedances				Annual Average (µg/m³)			
	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood
2010		42.7	37.6	47.8		0	0	0		16.0	16.1	17.9
2011		40.1	39.4	**124.9***		0	0	2		15.9	16.6	18.1
2012		43.7	40.7	44.2		0	0	0		18.0	17.0	19.6
2013		**55.4**	**58.5**	**63.1**		3	3	5		18.8	18.3	19.9
2014		46.1	43.8	45.2		0	0	0		18.2	17.8	18.3
2015		**77.4**	**60.3**	**66.5**		1	1	1		18.6	16.7	17.2
2016		44.1	**58.8**	42.9		0	1	0		17.9	16.8	17.5
2017		**56.0**	**54.1**	**59.8**		1	1	1		19.2	18.0	18.0
2018		**95.6**	**88.3**	**86.5**		5	2	5		21.2		19.8
2019	**116.8**	**127.7**	**142.7**	**129.4**	15	19	18	17		24.0	22.7	23.0
2020	**130.8**	**137.3**	**113.5**	**116.7**	4	9	7	9	15.6	19.5	18.1	18.5

**Exceedances of the maximum have been highlighted in bold text*

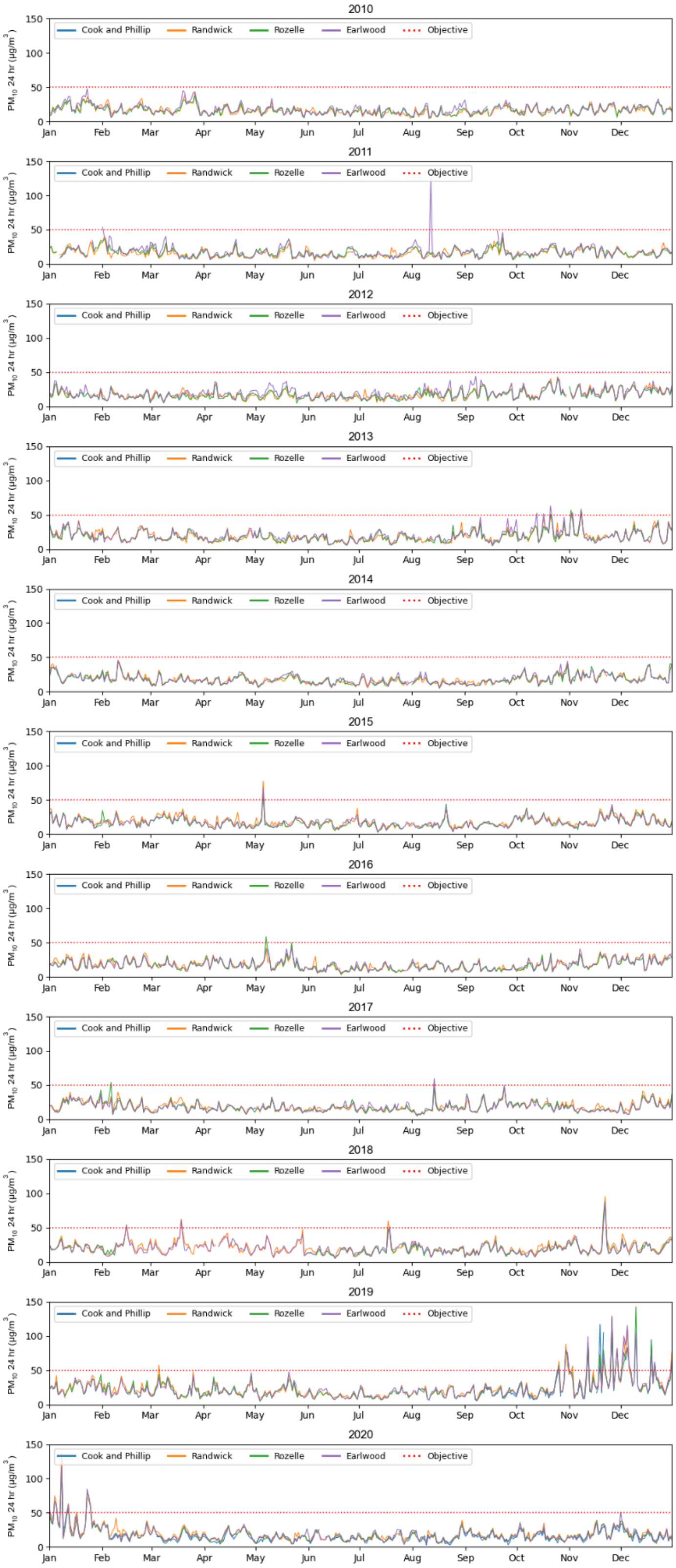


Figure 2-10 **2009-2020 24 Hour PM_{10} Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle**

Table 2-9 shows the Maximum 24-hour concentrations and annual averages for $PM_{2.5}$ at the EES monitoring stations for 2010 to 2020. The data shows there are generally some exceedances of the maximum 24-hour PM_{10} concentration of 25µg/m^3 occur in most years. These exceedances are also shown graphically in Figure 2-11. Annual average $PM_{2.5}$ concentrations recorded are generally compliant with the annual average PM_{10} criterion of 8µg/m^3 with exception to the Black Summer period and two occurrences in 2015 and 2016 at the Earlwood EES station.

Table 2-9 EES Monitoring Data 24 Hour Maximum and Annual Average $PM_{2.5}$ Concentrations for 2010-2020

Year	24 Hour Maximum (µg/m^3)				24 Hr Criteria Exceedances				Annual Average (µg/m^3)			
	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood
2010				22.5				0				5.7
2011				23.6				0				5.4
2012				20.7				0				5.6
2013				**37.3***				4				7.9
2014				22.7				0				7.8
2015			**33.4**	**28.0**			1	2			7.2	**8.7**
2016			**49.4**	**33.3**			5	5			7.4	**8.1**
2017		**45.3**	**36.3**	**50.9**		1	2	2			7.2	7.3
2018		**31.8**	19.2	**28.5**		1	0	1		7.6		7.8
2019	**96.5**	**95.2**	**101.8**	**86.2**	21	18	21	22		**11.0**	**10.3**	**10.5**
2020	**112.5**	**114.8**	**87.3**	**85.1**	7	8	8	9	7.7	7.6	7.6	**8.0**

**Exceedances of the maximum have been highlighted in bold text*

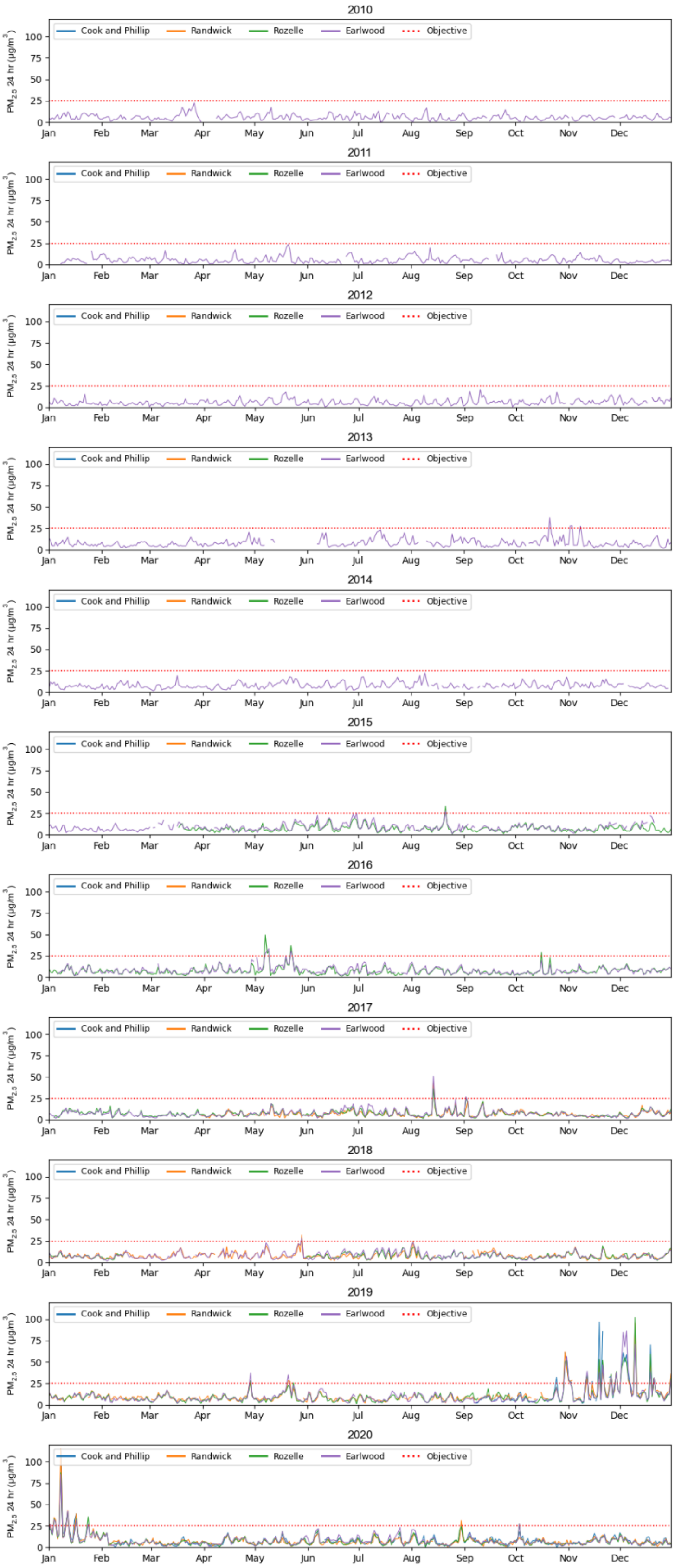


Figure 2-11 2009-2020 24 Hour $PM_{2.5}$ Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle

2.3.2.2 NO_2

NO_2 concentrations recorded at Cooks and Phillip, Randwick, Rozelle and Earlwood EES stations are presented in Table 2-10. When reviewing this data, it is important to consider that background concentrations in 2020 are generally lower than average and are not likely to be representative of typical background NO_2 concentrations. This is likely attributed to changes in anthropogenic NO_2 emissions during the Covid-19 pandemic, particularly due to major disruptions to the transport sector.

It can be seen from Table 2-10 that both Maximum 1-hour NO_2 and annual average NO_2 concentrations are compliant with the EPA criteria of 246µg/m^3 and 62µg/m^3 respectively at each monitoring station. The 2010 to 2020 NO_2 is also presented visually in Figure 2-12.

Table 2-10 EES Monitoring Data 1 Hour Maximum and Annual Average NO_2 Concentrations for 2010-2020

Year	24 Hour Maximum (µg/m^3)				24 Hr Criteria Exceedances				Annual Average (µg/m^3)			
	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood
2010		102.5	100.5	77.9		0	0	0		14.5	23.2	20.0
2011		108.7	102.5	94.3		0	0	0		14.8	22.8	18.9
2012		84.1	127.1	104.6		0	0	0		13.0	24.0	18.0
2013		94.3	143.5	98.4		0	0	0		13.5	23.4	20.2
2014		96.4	112.8	82.0		0	0	0		12.1	21.9	17.3
2015		88.2	123.0	108.7		0	0	0		17.3	21.9	16.2
2016		90.2	102.5	88.2		0	0	0		16.4	21.9	19.7
2017		84.1	125.1	137.4		0	0	0		13.9	23.5	22.2
2018		82.0	116.9	102.5		0	0	0		13.5		21.0
2019	225.5	104.6	184.5	125.1	0	0	0	0		13.3	19.5	21.0
2020	94.3	75.9	88.2	82.0	0	0	0	0	26.3	10.2	16.8	18.5

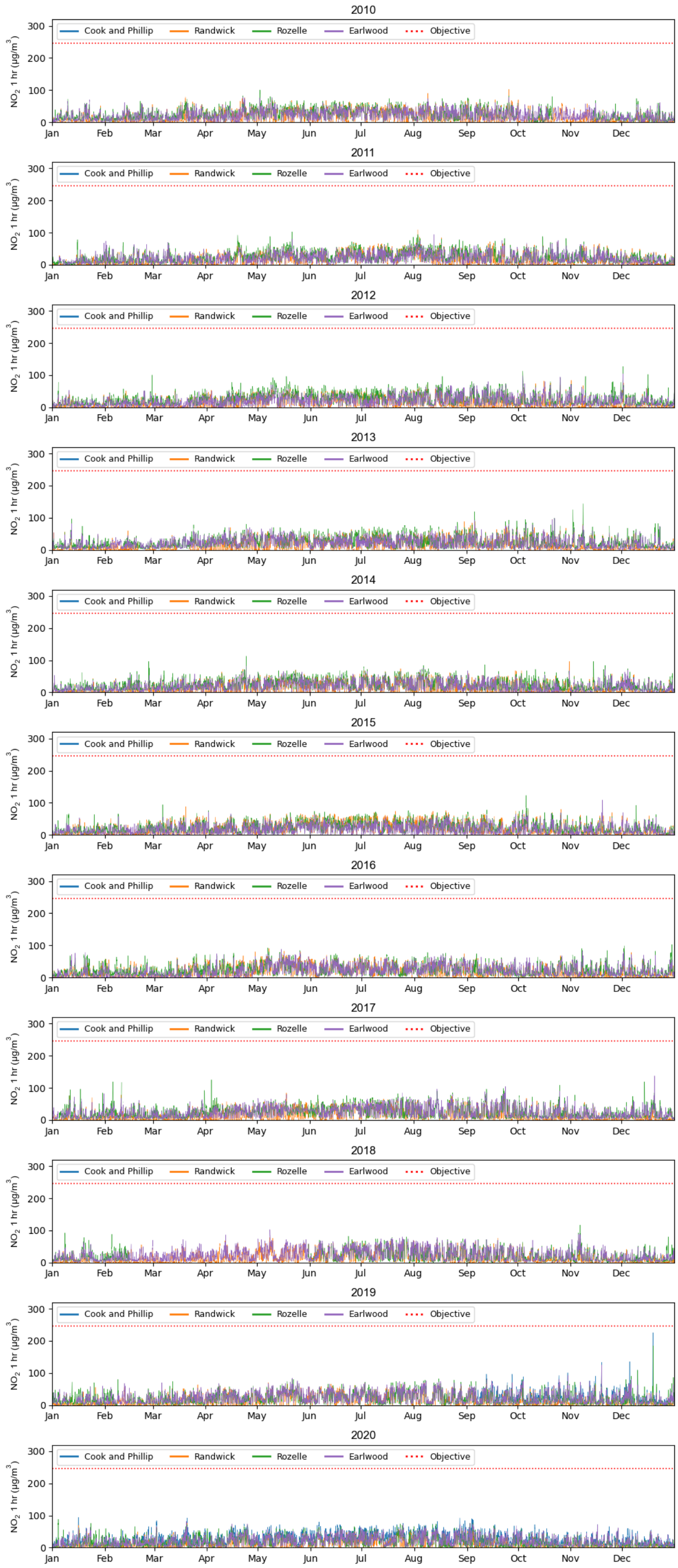


Figure 2-12 **2009-2020 1 Hour NO_2 Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle**

2.3.2.3 SO_2

SO_2 concentrations recorded at Randwick, Rozelle and Earlwood EES stations are presented Table 2-11. No SO_2 monitoring has not been undertaken at Cooks and Phillip EES station for the 2010 to 2020 monitoring period. It can be seen from Table 2-11 that the maximum 1-hour, maximum 24 hour and annual average SO_2 concentrations are well below the EPA criteria of 570µg/m^3, 228µg/m^3 and 62µg/m^3 respectively at each monitoring station. The 2010 to 2020 Maximum 1 Hour and 24-hour SO_2 are presented visually in Figure 2-13 and Figure 2-14.

Table 2-11 EES Monitoring Data 1 and 24 Hour Maximum and Annual Average SO_2 Concentrations for 2010-2020

Year	1 Hour Maximum (µg/m^3)				24 Hour Maximum (µg/m^3)				Annual Average (µg/m^3)			
	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood
2010		65.78				16.4				3.0		
2011		65.78				13.6				3.0		
2012		65.78				13.2				3.6		
2013		77.22				12.6				2.6		
2014		74.36				12.2				2.6		
2015		88.66	80.08			10.8	14.9			2.4	2.1	
2016		97.24	57.2			9.8	14.3			2.4	1.4	
2017		82.94	68.64			21.8	9.7			2.9	1.5	
2018		60.06	85.8			12.7	13.5			2.9		
2019	51.48	82.94	91.52		7.3	14.5	13.5			2.7	2.0	
2020	54.34	40.04	45.76		9.2	10.6	7.8		1.0	1.9	1.2	

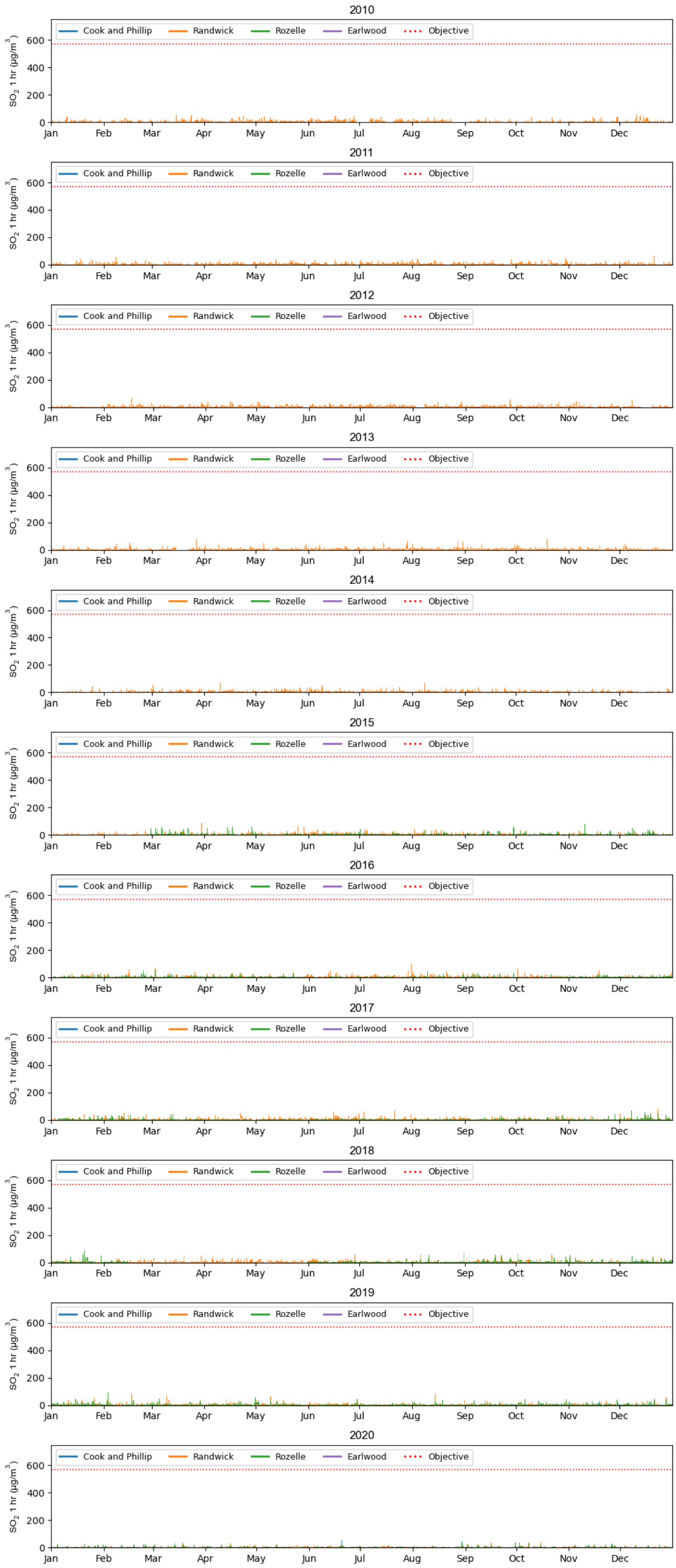


Figure 2-13 2009-2020 1 Hour SO_2 Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle

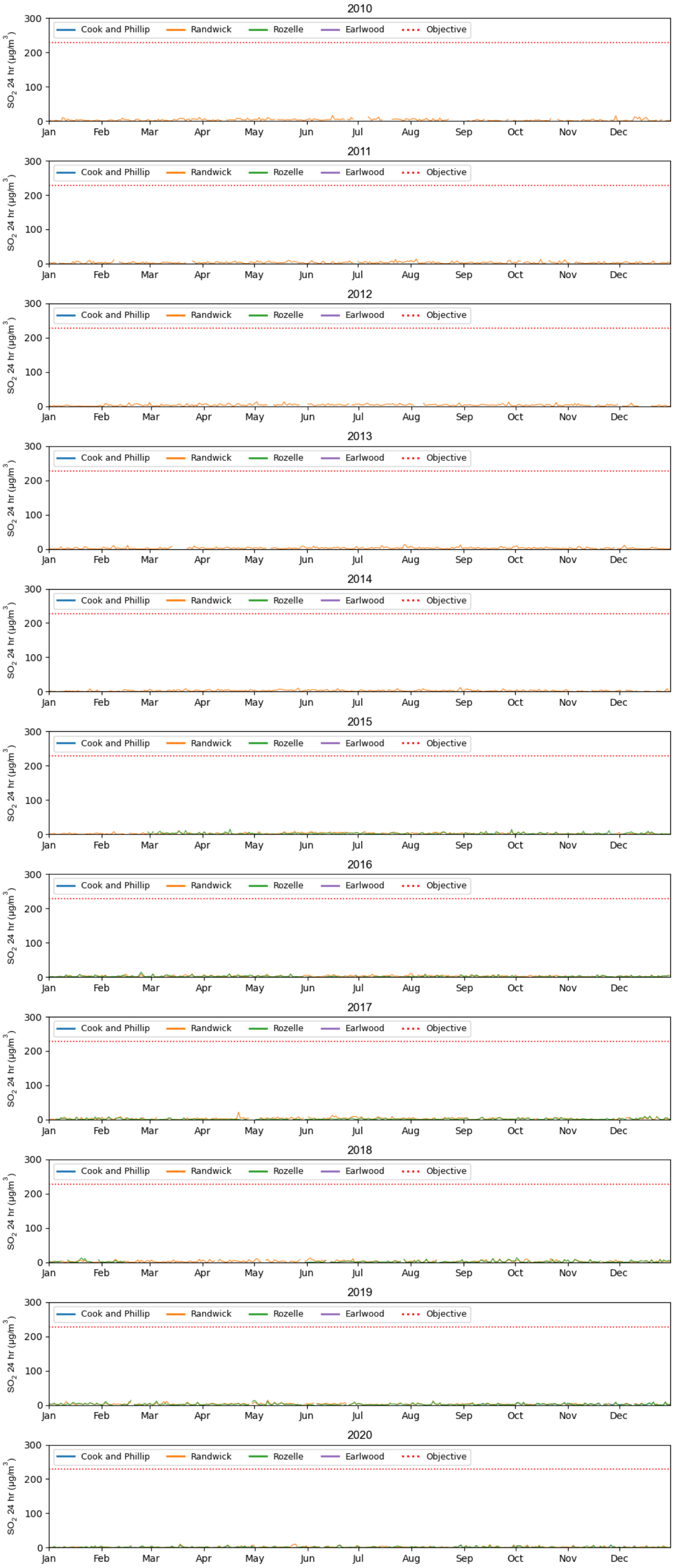


Figure 2-14 **2009-2020 24 Hour SO_2 Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle**

2.3.2.4 CO

Carbon monoxide (CO) concentrations recorded at Cooks and Phillip, Rozelle and Earlwood EES stations are presented Table 2-12. No CO monitoring has not been undertaken at Randwick EES station for the 2010 to 2020 monitoring period. It can be seen from Table 2-12 that the maximum 1-hour and maximum 8 hour and CO concentrations are well below the EPA criteria of 30,000µg/m^3 and 10,000µg/m^3 respectively at each monitoring station. The 2010 to 2020 maximum 1 hour and 8-hour CO are presented visually in Figure 2-15 and Figure 2-16.

Table 2-12 EES Monitoring Data 1-Hour Maximum CO and 8-hour Maximum CO Concentrations for 2010-2020

Year	1 Hour Maximum (µg/m^3)				8 Hour Maximum (µg/m^3)			
	Cook & Phillip	Randwick	Rozelle	Earlwood	Cook & Phillip	Randwick	Rozelle	Earlwood
2010			2875				1781	
2011			2500				1484	
2012			3250				2719	
2013			3125				2125	
2014			1750				1214	
2015			2000	1625			1232	1281
2016			2125				1339	
2017			1500				1063	
2018			1250				656	
2019	5500		6500		2078		2563	
2020	4375		4125		2607		2859	

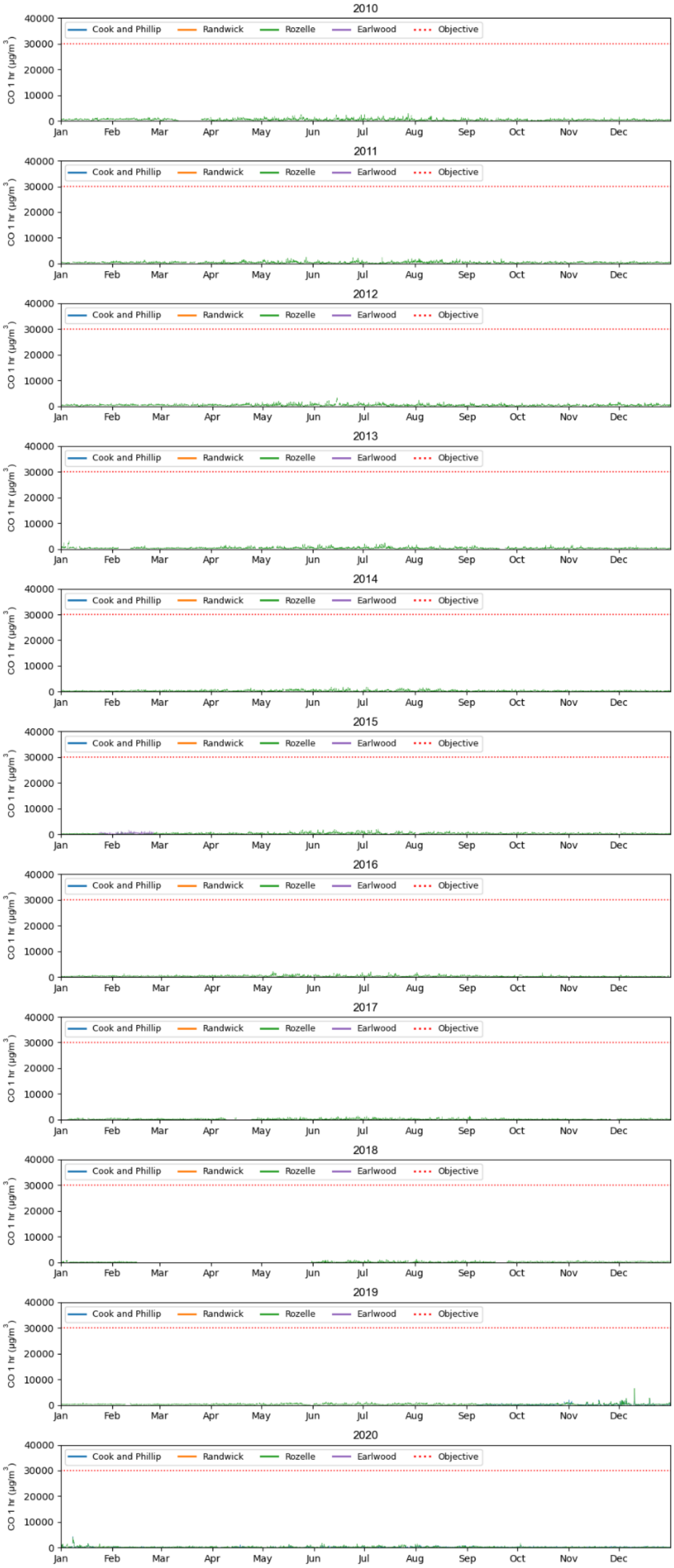


Figure 2-15 2009-2020 1 Hour CO Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle

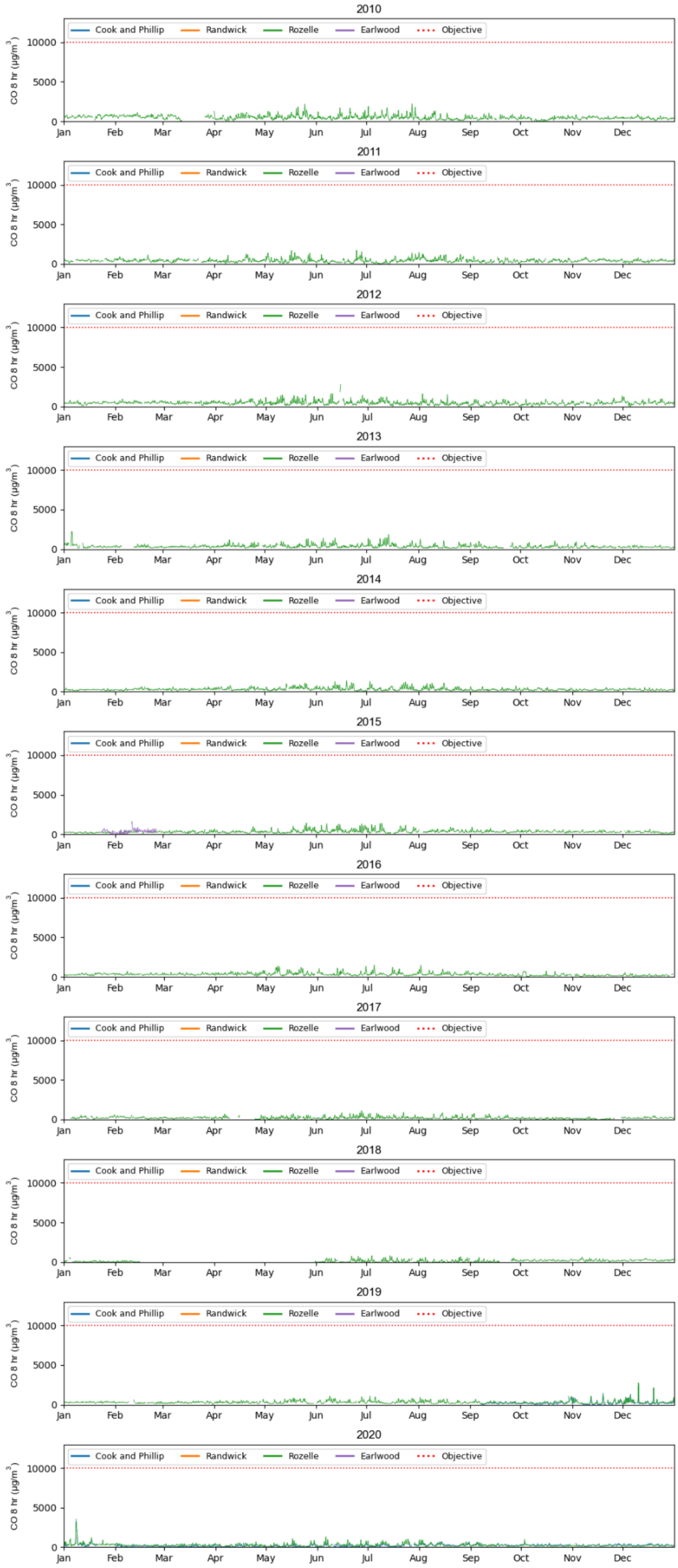


Figure 2-16 2009-2020 8 Hour CO Concentrations at EES Cook and Phillip, Earlwood, Randwick, and Rozelle

2.3.3 Existing Air Emission Sources

In addition to regional existing air quality monitoring data discussed in Section 2.3.4 a review of local potential sources of emissions surrounding the RNE Precinct has been undertaken below. Potential amenity impacts with regards to local air quality has been assessed qualitatively in Section 2.4.

Existing sources of air emissions in the area would largely be attributed to transport emissions; including vehicle emissions and diesel emissions from trains traveling through Redfern Station; immediately to the south east of the site. Other minor sources of emissions within the local airshed may occur from Alexandria Industrial estate approximately 1.5km to the south.

The nearest sources of air emissions to the RNE site, contributing to local pollutant ground level concentrations would be vehicle emissions along the northern boundary of the development on Wilson Street and diesel train emissions along the rail line on the southern border. In general exhaust emissions from vehicles and diesel trains have a highly localised influence on air pollutant concentrations adjacent to road and rail corridors with pollutant concentration gradients usually returning to close to regional concentration levels within 50 to 100m of the rail corridor or roadway.

As defined in Section 2.1.3 the adjacent Wilson Road is a local road that does not currently experience significant levels of congestion and is therefore unlikely to be a significant contributor to local existing air pollutant concentrations.

Combustion emissions from diesel trains adjacent to the RNE site are more likely to have a higher influence on local air pollutant concentrations than the local road network. A breakdown of daily diesel services that traverse the corridor adjacent to the RNE site based on June 2021 diesel train numbers provided by Transport on 21st June 2021 is provided in Table 2-13. It can be seen from Table 2-13 approximately 50 trains per day would pass the rail corridor adjacent to the site; with a slightly higher number of trains on weekends.

Planning and design considerations to minimise the potential impacts to sensitive receptors within the RNE Precinct and promote dispersal or air pollutants are discussed in Section 2.4.5 and Section 2.5.2

Table 2-13 Northbound and Southbound Diesel Train Volumes Passing Redfern Station

	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Total
Upline	28	25	25	28	26	24	27	**183**
Downline	28	24	24	26	26	23	25	**176**
Total	**56**	**49**	**49**	**54**	**52**	**47**	**52**	**359**

2.3.4 Terrain and Land Use

Local terrain and land use influence local meteorological conditions and the dispersal of air pollutants. Terrain data from the NASA STRM and land use data from ABARES was used to predict meteorological conditions for the site using CALMET as discussed above in Section 2.3.1.1. A summary of local terrain and land conditions has been provided below.

The Paint Shop sub-precinct is located at the eastern most end of the RNE Precinct and is bound by Wilson Street to the north, Redfern Station to the southeast and the associated rail line and associated facilities to the south. On the southern side of the rail line there is a mix of residential, and commercial development as well as the Alexandria industrial estate approximately 1.5km to the south. North of Wilson Street is primarily residential development. Given the area is a highly urbanised complex-built environment, meteorological conditions at the micro-scale are more likely to be influenced by the built environment, particularly in the case of multi-story buildings. This is discussed with relevance to the dispersal of air pollutants in Section 2.4.5.

The terrain immediately surrounding the proposed RNE is best described as relatively flat at an elevation of approximately 29m above mean sea level (MSL). Terrain around the RNE location is shown below in Figure 2-17. The local relief surrounding the project area is relatively minor and is not expected to greatly influence the dispersal of air pollutants.

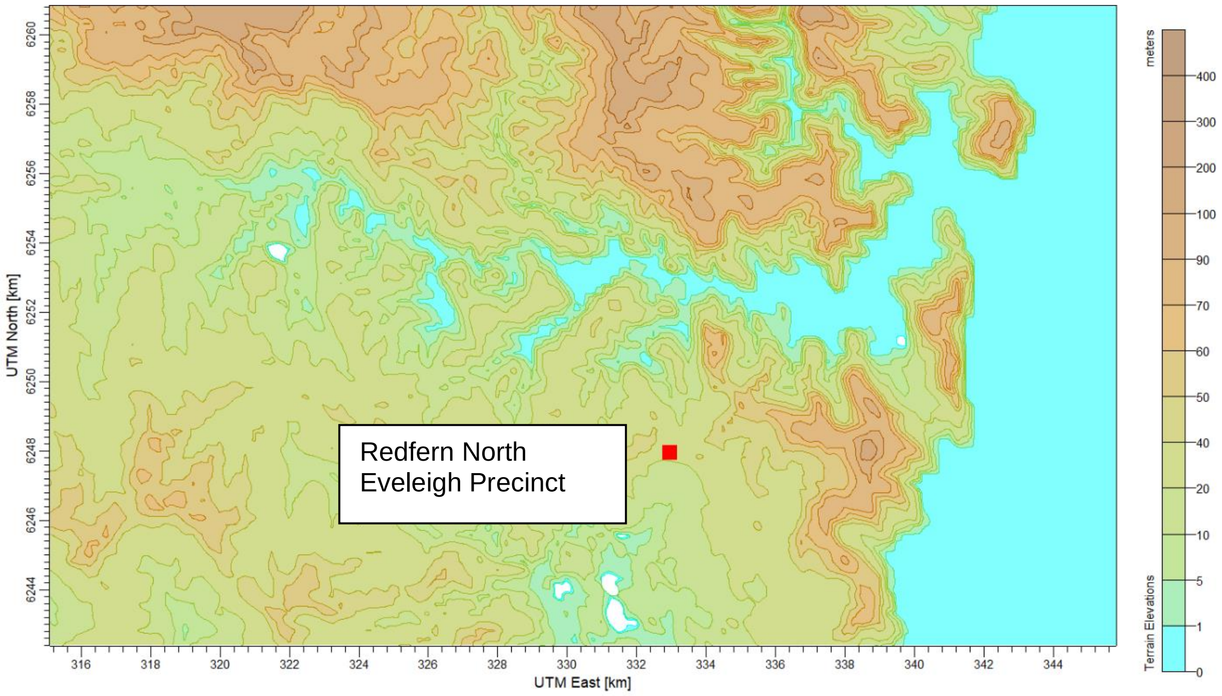


Figure 2-17 Terrain Elevations **Potential Impact Assessment**

2.4 Potential Impact Assessment

This section considers the potential impacts on air quality from the proposed developments within the masterplan.

2.4.1 Assessment Methodology: Assessment of Construction Impacts

A preliminary assessment of potential impacts from dust generation during construction from the RNE Proposed Masterplan have been assessed using the UK Institute of Air Quality Management (IAQM), 2014 *Guidance on the assessment of dust from demolition and construction*. This document provides a qualitative risk assessment process for the potential unmitigated impact of dust generated from demolition, earthmoving and construction activities.

The IAQM methodology assesses the risk of impacts associated with demolition and construction without the application of any mitigation measures. The assessment provides a classification of the risk of dust impacts which then allows the identification of appropriate mitigation measures commensurate with the level of risk.

The IAQM guidance process is a four-step risk-based assessment of dust emissions associated with demolition, land clearing and earth moving, and construction activities. The IAQM assessment process is described in the following sections.

This construction dust assessment provided in **Section 2.4.2** t is based on a preliminary estimate construction and demolition volumes and equipment usage for an excavation and remediation project of the size of the proposed RNE Paint Shop sub-precinct

Step 1 – Screening Assessment

Step 1 of the IAQM assessment requires the determination of whether there are any receptors close enough to warrant further assessment. An assessment is required where there is a human receptor within:

- 350 m from the boundary of a site, or
- 50 m from the route used by construction vehicles on public roads up to 500 m from a site entrance.

Step 2 – Dust Risk Assessment

Step 2 in the IAQM is a risk assessment tool designed to appraise the potential for dust impacts due to unmitigated dust emissions. The key components of the risk assessment involve defining:

- dust emission magnitudes (Step 2A),
- the surrounding area's sensitivity to dust emissions (Step 2B), and
- combining these in a risk matrix (Step 2C) to determine a potential risk rating for dust impacts on surrounding receptors.

Step 2A – Dust Emission Magnitude

Dust emission magnitudes are estimated according to the scale of works being undertaken classified as small, medium or large. The IAQM guidance provides examples of demolition, earthworks, construction and trackout to aid classification (refer **Table 2-14**).

Table 2-14 Classification criteria for small, medium and large demolition and construction activities

Activity	Activity Criteria	Small	Medium	Large
Demolition	Total building volume (m^3)	<20,000	20,000–50,000	>50,000
Earthworks	Total site area (m^2)	<2,500	2,500–10,000	>10,000
	Number of heavy earth moving vehicles active at one time	<5	5-10	>10
	Total material moved (tonnes)	<20,000	20,000–100,000	>100,000
Construction	Total building volume (m^3)	<25,000	25,000–100,000	>100,000
Trackout	Number of heavy vehicle movements per day	<10	10-50	>50

Step 2B – Sensitivity of Surrounding Area

The "sensitivity" component of the risk assessment is determined by defining the surrounding areas sensitivity to dust soiling, human health effects and ecologically important areas. This is described further below.

Sensitivity of the area to dust soiling and human health effects

The IAQM methodology classifies the sensitivity of an area to dust soiling and human health impacts due to particulate matter effects as high, medium, or low. The classification is determined by a matrix for both dust soiling and human health impacts (refer **Table 2-15** and **Table 2-16** respectively). Factors used in the matrix tables to determine the sensitivity of an area are as follows:

- receptor sensitivity (for individual receptors in the area):
  - high sensitivity: locations where members of the public are likely to be exposed for eight hours or more in a day. (e.g. private residences, hospitals, schools, or aged care homes)
  - medium sensitivity: places of work where exposure is likely to be eight hours or more in a day
  - low sensitivity: locations where exposure is transient, around one or two hours maximum. (e.g. parks, footpaths, shopping streets, playing fields)
- number of receptors of each sensitivity type in the area
- distance from source
- annual mean PM_{10} concentration (only applicable to the human health impact matrix).

Table 2-15 Surrounding area sensitivity to dust soiling effects on people and property

Receptor Sensitivity	Number of Receptors	Distance from the source (m)			
		<20	<50	<100	<350
High	>100	High	High	Medium	Low
	10-100	High	Medium	Low	Low
	1-10	Medium	Low	Low	Low
Medium	>1	Medium	Low	Low	Low
Low	>1	Low	Low	Low	Low

The IAQM guidance provides human health sensitivities for a range of annual average PM_{10} concentrations (i.e. >32, 28-32, 24-28 and <24 µg/m³). It is noted in the IAQM guidance that the human health sensitivities are tied to criteria from different jurisdictions in the UK (where the annual average criteria are higher for England, Wales and Northern Ireland when compared to Scotland). The annual average PM_{10} criteria for Australia differ from the UK, and as such, concentrations corresponding to the risk categories need to be modified to match Australian conditions.

The annual average criterion for PM_{10} in NSW is 25µg/m³ (refer **Section 2.2.2**) and therefore the scaled criteria for NSW is:

- >25 µg/m³
- 22-25 µg/m³
- 19-22 µg/m³
- <19 µg/m³.

The background PM_{10} concentrations in the region surrounding the Project are outlined in **Section 2.3.2.1** and fit within the lowest PM_{10} category (<19µg/m³ concentration range). Note that 2019 annual average data is not used for this assessment as it is heavily influenced by the 2019 bushfire period and is not considered representative of long-term conditions.

Table 2-16 provides the IAQM guidance sensitivity levels for human health impacts for the ranges outlined above for the annual average PM_{10} concentrations and highlights (in bold outline) the relevant range for NSW.

Table 2-16 Surrounding area sensitivity to human health impacts for annual average PM_{10} concentrations

Receptor Sensitivity	Annual average PM_{10} Concentration	Number of Receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
High	>25 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	22-25 µg/m³	>100	High	High	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	19-22 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<19 µg/m³	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low

Receptor Sensitivity	Annual average PM_{10} Concentration	Number of Receptors	Distance from the source (m)				
			<20	<50	<100	<200	<350
		1-10	Low	Low	Low	Low	Low
Medium	>25 µg/m³	>10	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	22-25 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	19-22 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<19 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low	Low

The sensitivity for each construction activity defined by the IAQM guidance is assessed for the RNE site. This results in a sensitivity rating for the construction footprint along with ratings for portions of the construction footprint for each construction activity. The ratings depend on the sensitivity of the receptors and the distance from the edge of the construction footprint. As shown in **Table 2-15** and **Table 2-16** the greater the distance from the construction footprint (the source), the lower the rating. The highest rating achieved is adopted as the final rating for that group of receptors.

It should be noted that this is not a quantitative human health assessment and risks discussed in this context need to be understood in terms of the IAQM guidance. For a group of receptors, a risk rating indicates the risk that group of receptors may experience unmitigated dust concentrations above the NSW criteria, with the associated potential health effects linked to that criterion.

Sensitivity of area to ecological impacts

Ecological impacts from construction activities occur due to deposition of dust on ecological areas. The sensitivity of ecological receptors can be defined by the following:

- High sensitivity ecological receptors
  - locations with international or national designation and the designation features may be affected by dust soiling
  - locations where there is a community of particularly dust sensitive species
- Medium sensitivity ecological receptors
  - locations where there is a particularly important plant species, where its dust sensitivity is uncertain or unknown
  - locations within a national designation where the features may be affected by dust deposition
- Low sensitivity ecological receptors
  - locations with a local designation where the features may be affected by dust deposition.

The sensitivity of an ecological area to impacts is assessed using the criteria listed in Table 2-17.

Table 2-17 Sensitivity of an area to ecological impacts

Receptor sensitivity	Distance from source (m)	
	<20	20–50
High	High	Medium
Medium	Medium	Low
Low	Low	Low

Step 2C – Unmitigated Risks of Impacts

The dust emission magnitude as determined in Step 2A is combined with the sensitivity as determined in Step 2B to determine the risk of dust impacts with no mitigation applied. **Table 2-18** provides the risk ranking for dust impacts from construction activities for each scale of activity as listed in **Table 2-14**.

Table 2-18 Risk of dust impacts (for dust soiling and human health impacts)

Activity	Surrounding area sensitivity	Dust emission magnitude		
		Large	Medium	Small
Demolition	High	High	Medium	Medium
	Medium	High	Medium	Low
	Low	Medium	Low	Negligible
Earthworks	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Construction	High	High	Medium	Low
	Medium	Medium	Medium	Low
	Low	Low	Low	Negligible
Trackout	High	High	Medium	Low
	Medium	Medium	Low	Negligible
	Low	Low	Low	Negligible

Step 3 – Management Strategies

The outcome of Step 2C is used to determine the level of management that is required to ensure that dust impacts on surrounding sensitive receptors are maintained at an acceptable level. A high or medium-level risk rating suggests that suitable management measures must be implemented during the Project.

Step 4 – Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from a proposed development. The IAQM guidance states:

For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be "not significant".

Based on this expectation, as well as experience within Australia, construction activities with targeted mitigation measures can achieve high degrees of dust mitigation which significantly reduce dust impacts to a negligible level.

Assessment of Operational Impacts

A qualitative assessment of potential operational air quality impacts was undertaken for the proposed RNE Paint Shop sub-precinct in **Section 2.4.2.3**.

Potential air emissions during operation of the sub-precinct would include combustion emissions from traffic generating development and potentially minor air emissions from commercial businesses discussed as discussed below. Potential adverse impacts examined included vehicle emissions, formation of urban canyons that may restrict dispersion of local air pollutants from vehicles and diesel trains and proposed commercial actives.

Potential beneficial impacts to air quality were also examined through the potential inclusion of green infrastructure. Planning and design recommendations and green infrastructure planning considerations have been provided in **Section 2.5.2** and **Section 2.5.3.**

2.4.2 Construction Assessment Findings

2.4.2.1 Stage 1 Screening Assessment

An initial screening assessment was undertaken to identify whether there were any human receptors within 350m of the boundary or within 50m of the route used by construction vehicles. A 350m screening line was drawn around the RNE Paint Shop sub-precinct which is shown in **Figure 2-18**. This line shows that the project area is situated within a built-up urban environment with many residential receptors within a 350m radius of the site. As such a Stage 2 assessment was required.

Figure 2-18 350m Receptor Screening Line

2.4.2.2 Stage 2 Assessment

The Stage 2 assessment considers the construction footprint within the property boundary shown as a blue outline in **Figure 2-18**. The construction magnitudes and the potential risks associated with dust soiling and due to PM_{10} concentration have been discussed below.

Construction Activity Magnitudes

The construction activity magnitudes and dust sensitivities for the different construction activities are provided in Table 2-19 and are based on the following assumptions:

- Demolition volume was estimated to be between 20,000 and 50,000 m^3 for the removal of buildings and redundant infrastructure
- Earthworks expected at the site were conservatively estimated cover an area of >10,000m which equates to approximately one fifth of the site area.
- Construction works is expected to include a total building volume of > 10,000m^3
- Trackout for the site was estimated to consist of less than 10 heavy duty vehicle loads per day during the construction period.

These are estimates based on experience with similar projects and from information provided in the Masterplan. The estimates may need to be refined once the construction designs have been finalised, however it is not expected that there would be changes to the above assumptions that would materially change the overall findings of the study.

Risk Associated with Dust Soiling

The RNE Paint Shop sub-precinct is sited within a built-up urban environment with many highly sensitive residential receptors immediately to the north of the site. There are also many moderately sensitive commercial receptors within the study area. The receptor sensitivity of the area was therefore rated high due to the large number of residential receptors within twenty metres of the northern boundary of the site.

Risk Associated with Exposure to PM_{10} Particulates

As detailed in Section **2.3.2.1**, the highest non-bushfire affected background annual average PM_{10} concentration round the site is generally less than 19mg/m^3. The risk to human health from exposure to PM_{10} particulates has been determined based around distance to receptors. As discussed above the RNE Paint Shop sub-precinct is sited within a built-up urban environment with many highly sensitive residential receptors immediately to the north of the site. There are also many moderately sensitive commercial receptors within the study area. The overall sensitivity to human health effects for annual average PM_{10} was rated as medium.

Ecological Risk Ratings

Ecological risks are linked to the presence of sensitive ecological receptors that may be affected by dust deposition. The surrounding environment is highly urbanised with vegetation largely limited to trees used for streetscaping within 50m of the RNE Paint Shop sub-precinct. Ecological sensitivity of the area was therefore assumed to be low.

Overall Dust Risk Ratings

The outcome of the semi-quantitative air quality risk assessment shows that the unmitigated air emissions from the construction, track out and construction activities poses a risk ranging from low to high risk of dust soiling (depending on the activity) and a negligible to medium risk of human health impacts. Once mitigation measures are applied (as discussed in Section 2.5.3), the residual impacts, post mitigation, arising from a proposed development are as described below in Table 2-19.

Table 2-19 Summary of unmitigated risk assessment for excavation activities

Activity	Step 2A: Potential for dust emissions	Step 2B: Sensitivity of area			Step 2C: Risk of unmitigated dust impacts		
		Dust soiling	Human health	Ecological Health	Dust soiling	Human health	Ecological Health
Demolition	Medium	High	Medium	Low	Medium	Medium	Low
Earthworks	Large	High	Medium	Low	High	Medium	Low
Construction	Large	High	Medium	Low	High	Medium	Low
Trackout	Small	High	Medium	Low	Low	Negligible	Negligible

Mitigation Strategies

A range of in-principle and site-specific mitigation strategies aimed at reducing the likelihood of air quality impacts to offsite sensitive receptors were identified. These mitigation strategies should be considered for all work elements during construction activities carried out on site. Recommended mitigation strategies are discussed in **Section 2.5.** Additionally, further air quality impacts assessment would be required at the individual development application stage for each parcel of work to ensure no significant impacts occur as a result of construction.

Reassessment

The final step of the IAQM methodology is to determine whether there are significant residual impacts, post mitigation, arising from a proposed development. The guidance states:

"For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant'."

Provided that appropriate project-specific mitigation strategies aimed at reducing the likelihood of air quality impacts to offsite sensitive receptors are implemented, the Project would not constitute an atypical case as defined under the IAQM. As such residual effect (impacts) would be "**not significant**" at all locations for both dust soiling and human health impacts.

Mitigation strategies listed in **Section 2.5** should be incorporated into the development controls for the project so that these can be considered during later project stages. This would include implementation via the future Construction Environmental Management Plan (CEMP) to ensure the measures are implemented during construction of the site.

2.4.2.3 Operational Assessment Findings

Potential Adverse Impacts

Emissions from Traffic Generating Development

The proposed changes in land use based on the Masterplan; including the introduction of commercial and retail space, and residential apartments and the additional public domain and cultural spaces proposed would influence road vehicle movements to and from the study area. Changes to traffic movements along Wilson Street and the newly proposed extension of Shepard Street would result in changes to motor vehicle emissions from fuel combustion, fluid evaporation, brake and tyre wear, and re-suspended road dust. Emissions from motor vehicles would comprise mainly hydrocarbons, PM_{10}, $PM_{2.5}$, CO, NO_x and SO_2.

Based on the Masterplan there is potential for increased emissions at the Wilson Street and Shepard Street intersection, due to the extension of Shepherd Street. The newly proposed onsite vehicle route is generally limited to extension of Shepard Street just north of the rail corridor before heading west to provide access to the Paint Shop sub-precinct. Pedestrian and cycle movement within the RNE precinct is largely sited along proposed vehicle drop-off zone away from continuous traffic.

Urban Canyons

Ground level concentrations of combustion pollutants adjacent to roads are influenced directly by the fleet mix or ratio of light to heavy vehicles, fuel type mix (for example, petrol, diesel and EV), and the distribution of vehicles by age of manufacture. They are also influenced by air circulation and set back distances, and heights of adjacent buildings as are combustion emissions from diesel trains. Dispersion of vehicle and train emissions is less affective when development along a road or rail corridor is confined restricting airflow which would typically disperse and transport air pollutants from vehicles and trains away from the source area. The degree to which pollutants disperse is influenced by the orientation and continuity of open spaces, their dimension and shape, topography and the layout of buildings surrounding the subject area. Urban canyons for example where a road or rail corridor is flanked by high density development on each site may channel plumes and prevent them from reaching road level depending on their shape, dimension and orientation. The more confined a space is by buildings, walls or embankments adjacent to or over a roadway, the less opportunity air pollutants have to disperse (DoP 2008).

As discussed in **Section 2.3.3** the nearest sources of air emissions to the RNE site would be vehicle emissions along the northern boundary of the Development on Wilson Street and diesel train emissions along the rail line on the southern border. The adjacent Wilson Road is a typical inner-city suburban road that does not currently experience significant levels of congestion and is therefore unlikely to be a significant contributor to local existing air pollutant concentrations. Combustion emissions from diesel trains adjacent to the RNE site however are more likely to have a higher influence on local air pollutant concentrations. It is therefore important to ensure that the proposed development minimises the potential for the development of urban canyons and promotes opportunities for dispersal of air pollutants through design. This is discussed below and further in Section 2.5.

The proposed RNE Paint Shop sub-precinct includes several multistorey buildings which have the potential to create moderate to deep urban canyon effects which may impede the sites ability to adequately disperse air pollutants from the adjoining rail and road corridors. Currently proposed design characteristics have the potential to minimise adverse air quality impacts on sensitive receptors from vehicle and train emissions. These characteristics include:

- There is some variation in building heights and interspersion with the cross street between Building F1 and E2 and K1 and K2 to minimise the formation of urban canyons.
- Alternating building heights between high rise buildings P2 and P1 and L1 and K2. Limiting K1 building to three floors will also aid in dispersion between K2 Highrise and H2 buildings.
- Higher storeys along the rail corridor and Wilson Street are set back from lower levels; which increases the street aspect ratio and improves dispersion within urban corridors.
- Public and community facilities would largely be sited away from the road corridor;
- Residential apartments adjacent to the rail corridor are limited to Buildings P1 and P2 and all ground floor buildings (and some lower storeys) are designated for non-residential purposes. Residential apartments within buildings, P1 and P2 are approximately 15m from the rail corridor.
- Propose primary frontages facing open spaces away from main sources of emissions; and less sensitive land uses designated for tertiary frontage only.
- Pedestrian and cycle movement within the RNE precinct is largely sited along proposed vehicle drop-off zone away from continuous traffic.
- Provision of open space network including a public square, garden and eastern park would promote dispersion of air pollutants and contribute to improved air quality.
- Retention of some existing trees and establishment of tree canopy coverage objectives (refer to **Section 2.5.3**).

The above concept design features are consistent with the DPE’s design guidelines outlined in *Development Near Rail Corridors and Busy Roads – Interim Guideline*, (DoP 2008; which is discussed in **Section 2.1.3** of this report

Emissions from Commercial Activities

The Paint Shop sub-precinct provisions for a number of retail and commercial outlets within the development. Many commercial businesses include potential air emission sources from various processes including combustion, fuel and organic liquid storage and handling operations, process fugitive emissions and surface coating operations. Potential pollutants may generally include particulates, NOx, SO_2, CO and volatile organic compounds (VOCs) (DECC & PAE 2007).

The particulars on commercial properties occupying the future development are currently unknown; however, they may include minor potential air emissions from sources such as food product manufacture, laundries and dry cleaners and printing, publishing and recorded media establishments.

In general, emissions from commercial facilities only contribute a minor proportion of air emissions to the Sydney region when compared to other major sources such as vehicle and industrial emissions and commercial activities typically do not require environmental protection licences (EPL) under the *Protection of the Environment Operations Act 1997 (NSW)* POEO Act. As such no significant air quality emissions are anticipated from the operation of commercial facilities within the development area at this stage.

Potential Beneficial Impacts

The RNE Precinct provides opportunities to incorporate Green Infrastructure (GI). GI such as street scaping, green roofs and green walls can be used as a method for reducing sensitive receptors exposure to air pollutants in urban environments by increasing deposition rates and acting as a barrier between.

Urban vegetation has the potential to reduce air pollutant concentrations through both direct and indirect pathways (Yang *et al*. 2008, *Currie and Bass* 2008 and *Rowe* 2010):

- Urban vegetation directly affects local air pollutant concentrations by:
  - Increasing surface roughness due to the presence of foliage, branches and twigs; which raises dry deposition rates of particulates; and
  - Uptake of gaseous pollutants through stomata on plant leaves; which then react with water to form acids and other compounds; and breaking down of certain organic compounds such as polycyclic hydrocarbons (PAHs) in plant tissue and in soil.
- Urban vegetation also has the potential to modify the existing microclimate indirectly reducing pollution by:
  - Lowering indoor temperatures through shading; resulting in a reduction in electricity usage for cooling purposes; and
  - Lowering ambient temperatures by changing the albedo of urban surfaces and evapotranspiration cooling; which in turn slows down photochemical reactions and leads to less secondary air pollutants such as ozone

There are several opportunities to incorporate GI into the Pain Shop sub-precinct. Specifically, the masterplan includes a large array of multistorey buildings which could include a number of green roof spaces. Green roofs entail growing plants on rooftops; which partially replaces vegetation that was removed prior to urbanisation; providing several environmental benefits; including to air quality while enhancing local aesthetics. Further information on the potential air quality benefits from green roofs are discussed in **Section 2.5.3**.

For urban canyons along road and rail corridors local scale manipulation of roadside pollutants can be achieved through GI where used appropriately. Introduction of GI can however both promote or disrupt the dispersion of air pollution by either exerting additional mechanical turbulence or decreasing turbulent kinetic energy. It is therefore important to consider the local characteristics that influence the dispersion of air pollution including the relationships between vegetation characteristics or form, street geometry and meteorological conditions.

The strategic placement of GI such as open areas and vegetated areas such as street scaping would need to be considered as part of the development including within the landscape Masterplan. General guidance around street scaping based on street aspect ratios is provided in **Section 2.5.3**.

2.5 Planning Controls

2.5.1 Construction Mitigation Measures

Construction mitigation measures are focused on the minimisation of the most likely pollutant from the construction activities i.e. dust emissions. Management controls aimed at reducing emissions of dust during construction works are presented in Table 2-20.

It is anticipated that with these management controls in place, no adverse dust effects would occur at any of the surrounding receptors.

Table 2-20: Dust management controls

Source of Dust	Controls
Earthworks	• Stabilise exposed areas not required for construction, access or parking, along with completed fill and spoil areas as soon as practicable. Stabilising may be achieved via seeding with grass or use of chemical stabilisers. • Minimise the extent of surface disturbance • Limit drop heights • Water exposed areas using a water cart during dry periods or strong winds
Access roads/ driveways	• Compact all unconsolidated surfaces where practicable • Limit exposed surfaces as much as possible • Keep exposed surfaces damp in dry, windy weather conditions • Stabilise cleared areas not required for construction, access or for parking if liable to cause excessive dust during windy conditions
Stockpiles	• All material deposited in temporary stockpiles will be in areas specified by the contractor • Limit the height of uncovered stockpiles to reduce wind entrainment. Stockpiles exceeding 3 m in height have a higher risk of discharging dust • Maximise shelter from winds as far as practicable
Vehicles	• Limit load sizes to avoid spillages • Cover loads of fine materials • Minimise mud and dust track-out onto surrounding road network by using wheel cleaning facilities at site exits to sealed roads • Where necessary sweep public roads to remove any tracked dust • Switch engines off when not in use • Maintain all plant and equipment according to manufacturer specifications to reduce exhaust emissions • Where possible, utilise modern plant and equipment with low emission ratings
Miscellaneous	• Take account of daily forecast wind speed, wind direction and soil conditions before commencing an operation that has a high dust potential

2.5.2 Planning and Design Considerations

Strategic planning should ensure that sensitive land use developments are sited to avoid or appropriately manage vehicle and rail emissions from within and around the site during planning and building construction stages. Planning and design considerations to minimise exposure to vehicle and train emissions, are presented in **Table 2-21**. The planning and design considerations in **Table 2-21** are in line with the DPE's *Development Near Rail Corridors and Busy Roads – Interim Guideline*, (DoP 2008) and supports the specific rail and road provisions of the *Transport and Infrastructure SEPP 2021*.

As discussed above, the RNE site is bound by a rail corridor to the south of the Precinct. Section 2.1.3 identified that RNE is generally not bound by any busy roads experiencing notable levels of congestion. The planning considerations listed below in **Table 2-21** however can be considered best practice for development adjacent to the road corridor also.

Table 2-21 Planning and Design Considerations for Development near Rail Corridors and Busy Roads

Consideration	Comment
Building Siting, Heights, and Orientation	• Incorporating an appropriate separation distance between sensitive uses and the road using broad scale site planning principles such as building siting and orientation. • For residential apartments the location of living areas, outdoor space and bedrooms should be as far away as practicable from the major source of air pollution • Building heights adjacent to roads and the rail corridor should be varied and interspersed with open areas to minimise the formation of urban canyons. • Where possible step back the upper storeys of buildings adjacent to the rail corridor to increase dispersion of air pollutants and minimise canyoning effects of tall buildings.
Frontages	• Where possible primary frontages should face open spaces away from the main sources of emissions including the rail corridor and Wilson Street. • Less sensitive land uses should be designated for tertiary frontages along the rail corridor
Public Domain and Open Space Network	• Maximise the size of potential open space network to promote dispersal of air pollutants from road and rail operations.
Landscaping	• Using vegetative screens, air amenity barriers or earth mounds where appropriate to assist in maintaining ambient air quality. This may include planting street trees and other vegetation to assist in maintaining ambient air quality • Landscaping has the added benefit of improving aesthetics and minimising visual intrusion from an adjacent roadway. • Where possible maximise the amount of space used for green roofs as an air quality abatement strategy. Where possible intensive green roofs that include tall herbaceous plants and/or deciduous trees should be included to maximise potential beneficial air quality impacts.
Ventilation	• For ventilation of indoor areas, adjacent to road or rail corridor the mechanical ventilation air inlet ports should be sited to maximise the distance from the road and/or rail to reduce inflows of air pollutants • The location of open-able windows should be considered in the design of the development located adjacent to the road and rail emission sources. • Additional mitigation measures may include the consideration of the use of winter gardens as an alternative to conventional balconies
Land Use	• Propose less sensitive land use for development that will front/closest to the rail corridor such as open space or for commercial or retail use. Here buildings may act as a barrier that shields and protects highly sensitive areas from high-emission zones.

2.5.3 Green Infrastructure

The Paint Shop sub-precinct provides opportunities to incorporate Green Infrastructure (GI). GI such as street scaping, green roofs and green walls can be used as a method for reducing sensitive receptors exposure to air pollutants in urban environments by increasing deposition rates and acting as a barrier between.

Urban vegetation has the potential to reduce air pollutant concentrations through both direct and indirect pathways (Yang *et al*. 2008, *Currie and Bass* 2008 and *Rowe* 2010):

- Urban vegetation directly affects local air pollutant concentrations by:
  - Increasing surface roughness due to the presence of foliage, branches and twigs; which raises dry deposition rates of particulates; and
  - Uptake of gaseous pollutants through stomata on plant leaves; which then react with water to form acids and other compounds; and breaking down of certain organic compounds such as polycyclic hydrocarbons (PAHs) in plant tissue and in soil.

- Urban vegetation also has the potential to modify the existing microclimate indirectly reducing pollution by:
  - Lowering indoor temperatures through shading; resulting in a reduction in electricity usage for cooling purposes; and
  - Lowering ambient temperatures by changing the albedo of urban surfaces and evapotranspiration cooling; which in turn slows down photochemical reactions and leads to less secondary air pollutants such as ozone.

Green Roofs

The Paint Shop sub-precinct masterplan includes several multistorey buildings which could include several green roof spaces. Green roofs entail growing plants on rooftops; which partially replaces vegetation that was removed prior to urbanisation; providing several environmental benefits; including to air quality while enhancing local aesthetics.

The effectiveness of green roofs as a pollutant abatement strategy is largely dependent on the area and type of vegetation. Green roofs can be classified as 'intensive' or 'extensive' based on their design and intended use. Intensive green roofs a generally designed as public spaces and generally include a mix of trees, shrubs and hardscapes. Extensive green roofs are designed to be low maintenance and are generally comprised of grasses, herbaceous perennials, annuals and drought tolerant succulents (Rowe 2010).

In 2008 Yang *et al.* used big-leaf resistance model used to quantify dry deposition of air pollutants from green roof tops in Chicago, United States of America. The study examined the effectiveness of three vegetation types 'short grass' 'tall herbaceous plants' and 'deciduous trees' to remove SO_2, NO_2, PM_{10} and O_3 from the local air shed. The results of the study are presented in **Table 2-22**; and are consistent with other studies such as Currie and Bass (2008) that show a higher pollutant load removal rate for trees and shrubs typically found in intensive green roofs (largely due to greater leaf surface area), compared to extensive green roofs, predominantly comprised of grass.

Table 2-22 Annual Removal Rate of Air Pollutants per canopy cover by different vegetation type (Yang *et al*, 2008)

Vegetation Type	Annual Removal Rate ($g/m^2/y$)				
	SO_2	NO_2	PM_{10}	O_3	Total
Short Grass	0.65	2.33	1.12	4.49	8.59
Tall Herbaceous plants	0.83	2.94	1.52	5.81	11.10
Deciduous Trees	1.01	3.57	2.16	7.17	13.91

Any proposed green roofs for the RNE development may incorporate intensive and or extensive designs including a mix of trees, shrubs and grass. Potential pollutant abatement rates for green roofs may be loosely approximated for each block and assessed semi-quantitatively using the values in **Table 2-22** once surface vegetation types and coverage are finalised. It should be noted that estimated pollutant abatement values would be indicative only as localised pollutant deposition rates would be influenced by a number of factors including vegetation type, pollution concentration, length of growing season and local meteorological conditions. The rate at which pollutants would be removed would also vary seasonally with higher rates observed in spring (when the greatest amount of growth would be expected) and the lowest rates of removal were observed during winter when plants may be dominant or slow growing.

Green Infrastructure Adjacent to Road and Rail Corridors

For urban canyons along road and rail corridors local scale manipulation of roadside pollutants can be achieved through GI where is used appropriately. Introduction of GI can however both promote or disrupt the dispersion of air pollution by either exerting additional mechanical turbulence or decreasing turbulent kinetic energy. It is therefore important to consider the local characteristics that influence the dispersion of air pollution including the relationships between vegetation characteristics or form, street geometry and meteorological conditions.

- High level vegetation can limit the exchange of air from above trapping pollution at ground level, although increased deposition rates may offset decreases in dispersal of air pollutants.
- Highly porous vegetation (low density) vegetation barries can reduce wind speed as it penetrates gaps, potentially in resulting in pollutant accumulation downwind (i.e. within and beyond the barrier)
- Low porosity vegetation can limit pollution removal by restricting infiltration and forcing pollutants to flow above and around the barrier or to recirculate and accumulate on the upwind or source side

The strategic placement of GI such as open areas and vegetated areas such as street scaping would need to be considered as part of the development. Placement of GI in urban canyons can used to manage roadside pollutant concentrations at the local scale. Within urban canyons trees have the potential to reduce wind speeds and reduce air exchange between the air above rooftops and within the canyon leading to the accumulation of pollutants inside the street canyon. For street canyons, the aspect ratio is critical to the appropriate GI form. **Table 2-23** provides a general guide for the determination of appropriate green infrastructure for street canyons based on Aspect Ratio.

Table 2-23 Determination of Appropriate Green Infrastructure for Street Canyons Based on Aspect Ratio (Barwise & Kumar 2020)

Classification	Aspect Ratio	GI Recommendation
Deep Street Canyon	H/W ≥ 2	• Green walls only
Mid-Depth Street Canyon	H/W 0.5-2	• Green walls • Low-level vegetation (shrubs and low hedges)
Shallow Street Canyon	H/W ≥ 0.5	• Green walls • Low-level vegetation (shrubs and low hedges) • Small and open-crowned trees on the windward side of the canyon spaced broadly apart.

The aspect ratio is determined by the average height-to-width (H/W) ratio of the street canyon. Multistorey buildings adjacent to the rail corridor vary in height between 3 to 28 storeys. Development to the south of the rail corridor is comprised of 1 to 2 storey buildings resulting in a street aspect ratio of less than 2 or shallow to mid-depth street canyon. Here green walls or low-level vegetation such as shrubs and low hedges would be recommended for planting.

The Wilson Street frontage would include 5 storey buildings (with some higher storeys set back). The street has a number of existing high to moderate value trees to be retained as part of the redevelopment. Existing housing to the north of Wilson Road are generally 2 storey residential buildings. Street aspect ratios are likely to be between 0.5-2 forming mid-depth street canyons. If existing trees are to be retained only minimal additional plantings should be considered to minimise urban canyon effects.

Street aspect ratio between proposed building K1 (3 floors) and K2 (25 floors) on the proposed extension of Shepherd Street would have a street aspect ratio of greater than 0.5-2 and would be classified as a mid-depth street canyon. Any GI here should be limited to green walls and low-level vegetation.

The street aspect ratio between proposed buildings F1 (8 storeys) and E4 (2 storeys) and between F1 and E2 (9 storeys) would be less than 0.5 and classified as a shallow street canyon, allowing for a wider variety of vegetation planting. Streetscape planting on the extension of Shepherded Street should consider the use of low-level vegetation as opposed to trees with large crowns to better promote dispersion of vehicle emissions.

Design for Function

Designers and building owners should document maintenance requirements and costs for GI by involving end users in the design to help ensure that maintenance can be undertaken safely and efficiently while ensuring the design objectives can be maintained.

3.0 Light Pollution

3.1 Existing Amenity

The area neighbouring the proposed RNE Paint Shop sub-precinct on Wilson Street is predominantly residential in nature.

The southern boundary is parallel to the Transport rail corridor between Redfern and MacDonald Town stations, while Redfern station is located at the north-eastern corner of the precinct.

The South Eveleigh area, directly across and adjacent to the railway corridor are either railway workshops, or commercial properties less than 10 storeys high

3.1.1 Wilson Street

Wilson Street is a local through road allowing local traffic access to residential properties and access into the Clothing Store sub-precinct. Street lighting which is considered a ‘Public Lighting’ system is the predominant lighting in the area, as shown in Table 3-1. The intention of public lighting systems is to provide safety to pedestrians, cyclists and motorists and the general public along the length of the road. The majority of the street lighting on Wilson Street is provided by High Pressure Sodium luminaires, however several LED luminaires have also been installed at various locations along the street.

Table 3-1 Site photographs

		
1) Queen Street Intersection	2) Shepherd Street with raised shared zone	3) Pedestrian Zone between Ivy Street & Ivy Lane

3.1.2 Existing Site

Currently, the existing Paint Shop sub-precinct is dark in nature with minimal existing public and architectural lighting. There are dark surrounds within the site and the existing luminaires within the site exhibit little to no obtrusive light spill into the surrounding residential area. This can be seen in **Table 3-2.**

Table 3-2 Lighting within Proposed Site (Looking East towards the Paint Shop sub-precinct)

		
1) Lighting within Proposed site (looking east towards the Paint Shop sub-precinct)	2) Forbes Street – Looking towards Carriageworks Way	3) View from Carriageworks Way

Within the Carriageworks sub-precinct which has undergone development in recent times, lighting is well controlled through the use of full cut-off luminaires which consist of a controlled and directed light distribution in the downward direction with zero lighting above the horizontal. This in combination with the significant lower RL of the site in comparison to Wilson Street and other adjacent buildings result in little to no light spill onto adjacent residential areas.

3.1.3 Redfern Station and Rail Corridor

The lighting within the Redfern Station is designed to a high intensity for security reasons, as per Transport standards. The main entrance to the station is located along Lawson Street, with no direct frontage towards the overall RNE Precinct. Lighting along Little Eveleigh Street is only illuminated by street lighting.

No lighting is installed along the rail corridor outside of the station, as per the aerial photo in **Figure 3-2** (source: Getty images). The rail corridor would not affect the RNE precinct. Instead, care must be taken with the new site lighting design to ensure that light spill to the rail corridor is minimised / mitigated.

Figure 3-1 Redfern Station and rail corridor evening lighting (source: Getty images)

3.1.4 South Eveleigh

The closest buildings at South Eveleigh to the Paint Shop sub-precinct are:

- train maintenance facilities
- low level commercial buildings including:
  - 2 Cornwallis Street (2 levels commercial building), approximately 70m away from the RNE boundary
  - Eveleigh Locomotive Workshops (2 levels retail), approximately 80m
  - The Water Tower (4 levels commercial), approximately 90m away
  - National Innovation Centre (2 levels high retail/commercial), approximately 100m
  - 1-9 Marian Street (10+ levels high residential), separated by the Redfern Station and 190m+ away from the RNE boundary
  - The external circulation around this area is primarily pedestrian nature.

With the long distance away from the proposed Paint Shop sub-precinct, being separated by the rail corridor, it is unlikely that the existing lighting at South Eveleigh would affect the Paint Shop sub-precinct and vice versa.

Table 3-3 Properties at South Eveleigh along the rail corridor

		
1) Pedestrian at South Eveleigh, outside MacPherson Greenleaf	2) Eveleigh Locomotive Workshops	3) Eveleigh Locomotive Workshops (view from Locomotive Street)

3.2 Potential Lighting Design and Impacts

Since the greatest potential for achieving satisfactory control of light spills at the design stage, *Appendix A Design, Installation, Operation and Maintenance* of AS/NZS4282 provides guidance on design measures which can be implemented to minimise the obtrusive effects of outdoor lighting.

The neighbouring properties surrounding the northern and western perimeter of the project are mainly residential in nature. Redfern Station is located at the north-eastern corner and the railway corridor is along the southern perimeter.

3.2.1 Building Lighting

The proposed new buildings within the RNE development along the Wilson Street are either residential in nature, or less than 2 levels in height (with the exception of Building E1 with 8 levels). These buildings' lighting is unlikely to affect the neighbouring properties.

The new buildings along the southern perimeter adjacent to the rail corridor are commercial in nature. Five of the buildings are 18 storeys or higher, and generally 10m or more away from the site boundary/rail corridor. Façade/outdoor terrace lighting on these buildings (if any) may affect the rail corridor and must be considered during detail design to minimise the obtrusive lighting effects.

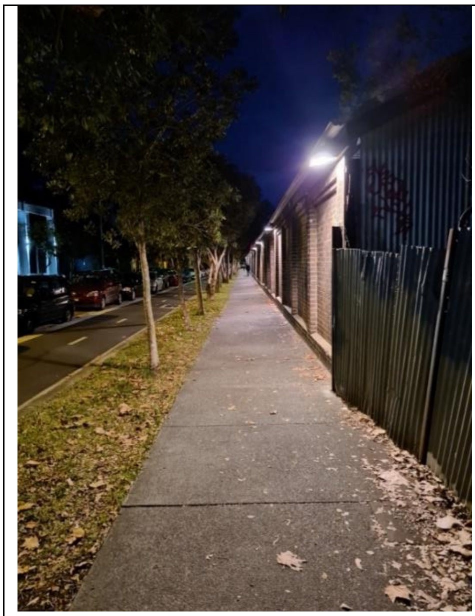
3.2.2 Street Lighting

There is existing street lighting along Wilson Street. Should lighting upgrade be required, the design is to be compliance with Sydney Lights: Public Domain Design Code as required by City of Sydney. Any potential street lighting within the southern perimeter of the site is to be aimed away from the rail corridor to reduce any potential light spill onto the rail track. Refer to **Figure 3-2** for an example of existing lighting installation along the railway corridor near Redfern Station.

As per AS/NZS4282, clause (e) in the preface, the standard does not apply to public lighting that provides safe movement. However, design strategy will be in place to minimise the obtrusive lighting effect. Examples include the use of full cut off luminaires with zero light distribution above the horizontal, luminaire aiming principles such that 100% of the light distribution falls on a solid object, and concealment of bare light sources.

Figure 3-2 Street lighting adjacent to rail corridor (Google Maps photo, located at South Eveleigh near MacPherson Greenleaf adjacent to Redfern Station)

Table 3-4 Examples of existing full cut-off luminaires around the RNE precinct

	
1) Existing full cut-off luminaires used for pathway lighting	2) Existing street lighting with concealed luminaires

Refer to **Section 3.4** for the proposed lighting design parameters in place to mitigate the potential obtrusive lighting effects.

3.3 Recommended Planning Controls

Appendix B Design Documentation of AS/NZS4282 outlines the specific information that should be provided to a development approval authority for assessment of the lighting scheme against the light technical parameters of the Standard.

Planning conditions will reference that external lighting systems associated with the RNE Paint Shop sub-precinct will be required to limit light spill in accordance with the light technical parameters and calculation requirements outlined in *AS/NZS4282 ‘Control of the obtrusive effects of outdoor lighting’*.

The lighting designer should demonstrate conformity of the lighting design of the installation with the light technical parameters of AS/NZS4282.

City of Sydney shall confirm whether the street lighting within the site boundary is required to be subject to the associated light spill limits outlined in AS/NZS4282, prior to commencement of detailed design as part of the DA conditions.

3.4 Future Obtrusive Lighting Assessment Parameters

As the design progress, the following design parameters will be applied to ensure that potential obtrusive lighting from the RNE precinct will be minimised or mitigated.

3.4.1 Neighbouring Properties

The northern site boundary is directly adjacent to Wilson Street with predominantly residential developments, with traffic controllers such as roundabouts and raised shared zones at multiple intersections (Queen Street, Golden Grove Street, Codrington Street and Shepherd Street).

The southern site boundary is parallel to the Transport rail corridor between MacDonaldtown and Redfern Station. Towards the south-eastern side (directly adjacent to the station) the developments are primarily commercial and retail.

Figure 3-3 is a diagram with reference to photos taken on site, demonstrating some of the traffic control devices as well as the properties generally along Wilson Street. The corresponding site photographs are included in **Table 3-5**.

Figure 3-3 Mapping of site photographs related to traffic control devices and properties along Wilson Street

Table 3-5 Site photographs

		
1) Queen Street Intersection	2) Forbes Street – Looking towards Carriageworks Way	3) View from Carriageworks Way
		
4) Shepherd Street with raised shared zone	5) Pedestrian Zone between Ivy Street & Ivy Lane	

3.4.2 Relevant Standards

AS/NZS4282:2019 'Control of the obtrusive effects of outdoor lighting' is the primary standard that defines recommended limits when considering light spill minimisation. This standard detailed the potential obtrusive effects of poor outdoor lighting systems, appropriate light technical parameters, relevant field measurements and design calculations which can be undertaken to minimise light spill. This is

It is noted that *AS/NZS4282:2019 'Control of the obtrusive effects of outdoor lighting'*, does not apply to public street lighting systems unless specifically requested by the relevant Authority. It is assumed public lighting will be owned by the City of Sydney with an expectation that the control of outdoor lighting to be further assessed during detailed design across the development (considering public safety and passive surveillance. Where the Authority specifies that AS/NZS4282 shall be applied to public street lighting, the Standard outlines various light spill limits that should be achieved.

Any outdoor architectural lighting, building façade lighting, off-street carpark lighting, sports lighting systems, building signage lighting are required to limit obtrusive spill light to within the permissible limits outlined in AS/NZS4282.

3.4.3 AS/NZS4282 Environmental Zones Classifications

AS/NZS4282:2019 recommends obtrusive lighting assessments to be carried out at residential property boundaries. While Australian Standards and Transport did not have any specific requirement regarding spill light to rail corridor, the obtrusive lighting effect can potentially affect the performance of the rail drivers. Therefore it is proposed that assessments are carried out along the rail corridor as well to ensure that any potential spill lighting from the development is mitigated.

Based on assessment of the project from both site inspection conducted as well as information received, it is assumed that the surrounding properties falls under the following environmental zones as outlined in AS/NZS 4282:2019, Table 3.1, reproduced below as **Table 3-6**. The category highlighted in **blue** is applicable to the rail corridor, while the category highlighted in **red** are applicable to residential properties. It should be noted that the design parameters are indicative only, and is subject to the road lighting design category to be confirmed at detail design stage.

Table 3-6 Environmental zones (AS/NZS 4282:2019)

ENVIRONMENTAL ZONES

Zones	Description	Examples
A0	Intrinsically dark	UNESCO Starlight Reserve. IDA Dark Sky Parks. Major optical observatories No road lighting -unless specifically required by the road controlling authority
A1	Dark	Relatively uninhabited rural areas No road lighting - unless specifically required by the road controlling authority
A2	Low district brightness	Sparsely inhabited rural and semi-rural areas
A3	Medium district brightness	Suburban areas in towns and cities
A4	High district brightness	Town and city centres and other commercial areas Residential areas abutting commercial areas
TV	High district brightness	Vicinity of major sports stadium during TV broadcasts
V	Residences near traffic routes	Refer AS/NZS1158.1.1
R1	Residences near local roads with significant setback	Refer AS/NZS 1158.3.1
R2	Residences near local roads	Refer AS/NZS 1158.3.1
R3	Residences near a roundabout or local area traffic management device	Refer AS/NZS 1158.3.1
RX	Residences near a pedestrian crossing	Refer AS/NZS 1158.4

3.4.4 AS/NZS4282 Assessment Planes and Design Parameters

Based on the earlier site environmental zone assessment, calculation planes are to be set up at the boundaries as per **Figure 3-4** below:

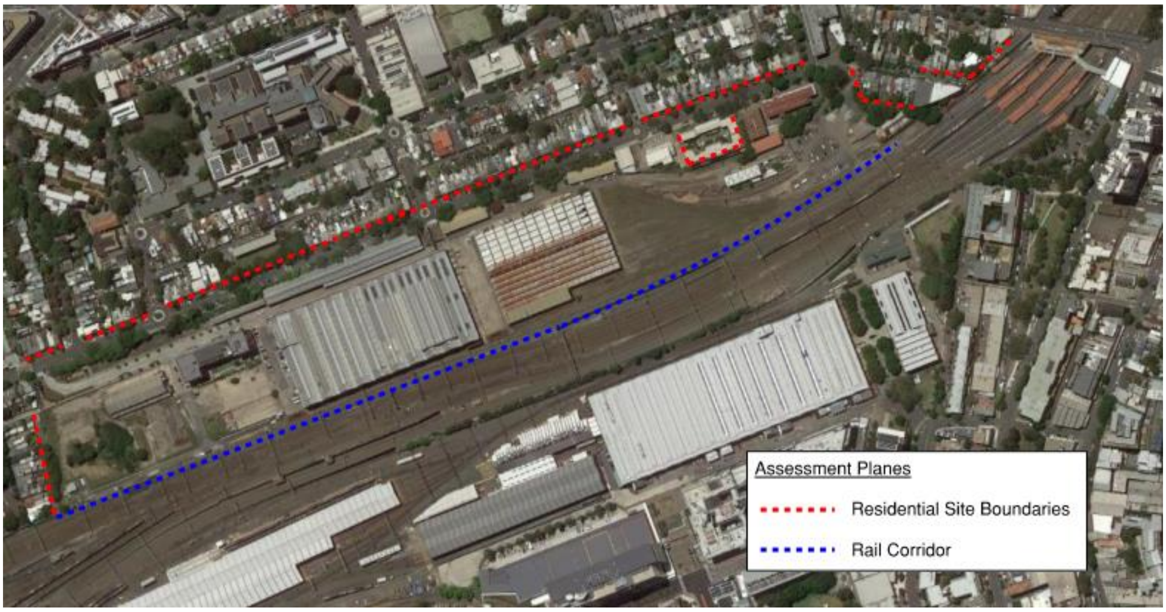


Figure 3-4 Proposed AS/NZS 4282 Calculation Planes

The maximum light value design parameters for the zones are to be as follows outlined in AS/NZS4282:2019, Table 3.2, reproduced below as **Table 3-7**.

Table 3-7 Maximum Values of Light Technical Parameters (AS/NZS 4282:2019)

MAXIMUM VALUES OF LIGHT TECHNICAL PARAMETERS

Zones	Vertical illuminance levels (E_v) lx		Threshold increment (TI)		Sky glow
	Non-curfew	Curfew	%	Default adaptation level (L_{ad})	Upward light ratio
A0	See Note 1	0	N/A	N/A	0
A1	2	0.1	N/A	N/A	0
A2	5	1	20%	0.2	0.01
A3	10	2	20%	1	0.02
A4	25	5	20%	5	0.03
TV	See Table 3.4	N/A	20%	10	0.08
V	N/A	4	Note 2	Note 2	Note 2
R1	N/A	1	20%	0.1	Note 3
R2	N/A	2	20%	0.1	Note 3
R3	N/A	4	20%	0.1	Note 3
RX	N/A	4	20%	5	Note 4

Where these design values are adopted it is anticipated that impacts that light impacts can be maintained within acceptable limits.

4.0 Water Pollution

This section is based on the *Water Quality, Flooding and Stormwater Assessment Report* (SSP Study No. 13, 2021) and should be read in conjunction with this report.

4.1 Existing Environment – Baseline

The site is highly urbanised and largely impervious, covering a mix of commercial and residential buildings. The site includes part Lot 4 and part lot 5 of DP 1175706 and covers a total area of 10.7ha. It contains a mix of different buildings including:

- Blacksmith's shop;
- Traverser no 1 and 2, adjoining Carriageworks building to the east and west respectively;
- RWA training centre in the former Carpenters, Plumbers and Food distribution building;
- General Store/ Clothing store;
- Chief Mechanical Engineer's Building;
- Telecommunications Building;
- Science Lab;
- Paint shop; and
- Fan of tracks.

Wilson Street to the north of the site is estimated to be 3-5 m above the level of the site, with a retaining wall along the Wilson Street boundary. The site is generally flat in topography with vehicular and pedestrian access from Wilson Street on the western end of the site.

4.2 Potential Development Impacts

Potential impacts to stormwater runoff from the proposed development could potentially occur from an increased impervious fraction within the site extent because of additional road resurfacing, footpath upgrades, general site levelling and increased building footprint.

Contaminants leaving the site would include lubricants, effluents, chemicals and sediments. These, by entering downstream waterways and watercourses, are likely to trigger increased turbidity, lowered dissolved oxygen levels, increased nutrient and pollutants. Hence, on-site containment and treatment of contaminated waters will ensure safe discharge of runoff from the site.

4.2.1 Construction

During construction of the RNE precinct, various categories of activities could result in pollution of waterways downstream of the site if adequate controls and management measures are not in place:

- Plant and machinery: The introduction of heavy construction plant, leakage of oil and diesel from vehicles, washing of vehicles on site;
- Earthworks and erosion: Disturbance of soil, construction of stockpiles and/ or batter slopes (which can erode and lead to sediment movement if left untreated),
- Construction materials e.g. cement, fillers, binders, paints, plastic fittings, etc that can end up in waterways if not stored/contained properly,
- Human factors, including littering or incorrect disposal of solid waste/ portable sanitary facilities.

4.2.2 Operation

Based on the proposed masterplan composition of residential and commercial buildings, in its developed state, the development site can increase the generation and concentration of potential pollutants in various ways:

- Introduction of oils, fuels and other chemicals through the use/ parking of plant, machinery and vehicles on site. Activities that can release pollutants include the washing of vehicles on site.
- Grey water and wastewater, from kitchens and ablutions respectively. These can contain organic and inorganic pollutants, as well as grease or fats.
- The use of pesticides, fertilisers and other chemicals on site for residential, light industrial and commercial purposes.
- Increasing the impervious, hardened land area. The introduction of roofed and paved areas reduces the area of pervious natural vegetated areas where stormwater run-off can infiltrate the soil. The impervious surfaces accelerate run-off flow velocity across the site, thereby increasing the potential impacts of erosion in downstream natural areas if not discharged in a controlled fashion.
- Exposed batter slopes, flowerbeds and other untreated surfaces can erode and lead to release of sediment into downstream watercourses.

4.3 Relevant Standards

In addition to the Director General Requirements which guided the North Eveleigh Concept Plan in 2008, the City of Sydney adopted a set of Development Control Plans (DCPs) in 2012 against which proposed developments are to comply for key issues inclusive of flooding, drainage and stormwater management. Best practice levels in the precinct that were described included Pollutant load reductions for Total Suspended Solids, Total Nitrogen, Total Phosphorus and Gross Pollutants.

Water quality objectives are defined in terms of pollutant reduction targets. According to the general provisions of the Sydney Development Control Plan 2012, the development site is to achieve the following post-development pollutant load reduction targets:

- 90% reduction of baseline annual pollutant load for litter and vegetation, larger than 5mm;
- 85% reduction of baseline annual pollutant load for total suspended solids;
- 65% reduction of baseline annual pollutant load for total phosphorus; and
- 45% reduction of baseline annual pollutant load for total nitrogen.

The North Eveleigh Concept Plan highlighted the need for bio-retention zones to be integrated as part of the drainage system and the inclusion of swales and pervious surfaces to drain the majority of runoff from the site. These stormwater management controls are to be tested through appropriate modelling to confirm the effectiveness of the proposed measures at detailed design stage.

4.4 Water Quality Assessment Outcome

The Redfern North Eveleigh Precinct Renewal Environmental Sustainability report was produced by Arup last dated April 2022, highlighting the relevant site opportunities and constraints towards sustainability and implementation of water-sensitive urban design initiatives.

The points of relevance towards addition of WSUD incentives included:

- Collection and retention rather than discharge
- Incorporation of bioswales and improvement of water quality
- Incorporation of green open spaces for liveability
- Passive water treatments as part of the landscape design.

4.4.1 Water Quality Modelling

MUSIC (Model for Urban Stormwater Improvement Conceptualisation) software has been used to model a range of treatment devices to identify the best way to capture and reuse stormwater runoff, remove contaminants from surface runoff and reduce runoff frequency. These treatment strategies can be applied at a lot, precinct or catchment scale.

In order to assess the post-development water quality outcomes, a “developed conditions” MUSIC model was set up, representing the different land use types such as roof, paved sections and public domain/open space areas. A measurement of these areas was undertaken with reference to the overall Masterplan Layout and the Area Schedule S12470 Redfern North Eveleigh Masterplan.

Given uncertainty concerning the ownership of the respective stormwater management controls across different buildings at this stage of design, it is assumed that water quality treatment would be implemented at a lot scale, meaning that individual buildings would be expected to meet water pollution reduction targets before discharging to the stormwater drainage network.

For the public domain, it is assumed that stormwater treatment would be provided within the public domain. It is assumed that all the sub-catchments would eventually discharge into TC1 (being the primary discharge across the railway corridor). A graphic presentation of the MUSIC model is represented in **Figure 4-2**.

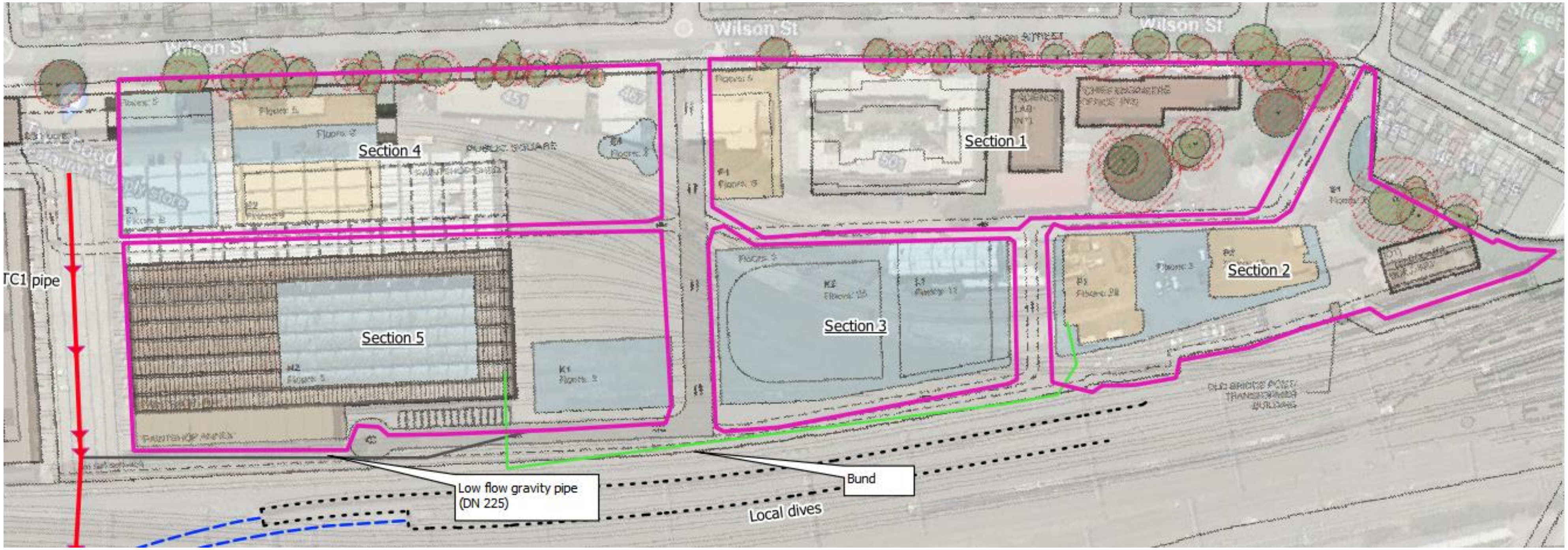


Figure 4-1 Section delineation for water quality assessment

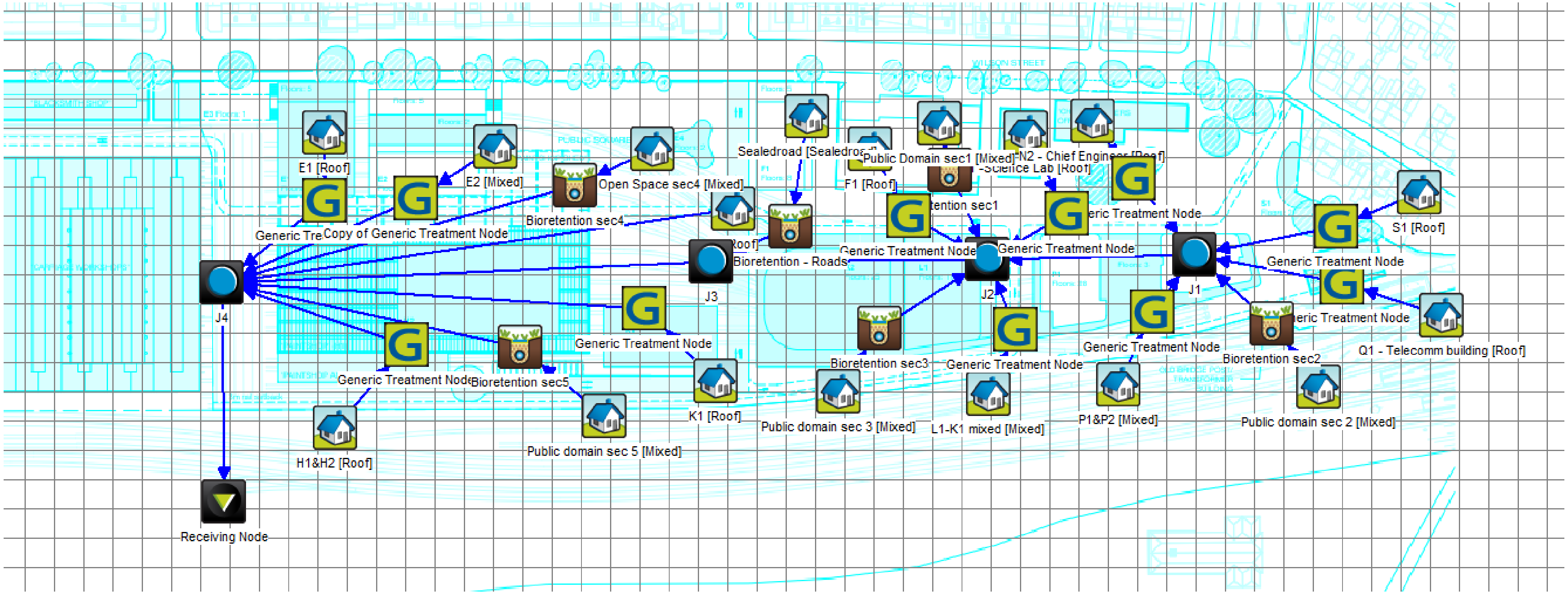


Figure 4-2 Layout of MUSIC model

4.4.1.1 Opportunities for individual lots

For individual lots or buildings, site specific design is required to meet stormwater targets. The following options can be considered, in order of preference:

- Rainwater tanks can be used to treat runoff from each roof catchment.
- Rainwater can be used to meet irrigation demands and toilet flushing.
- Proprietary products such as filter cartridges may be required where treatment cannot be accommodated within the landscape.

4.4.1.2 Public domain

Treatment by bioretention systems has been modelled as the minimum treatment requirement. Treatment devices will need to be spread out across the public domain, including at regular intervals in the streetscape.

Better design outcomes may be possible if runoff can be directed to passively water street trees and landscapes. The benefits are an improvement in the health and longevity of trees and plants and a greater canopy cover for trees.

4.4.2 Preliminary water quality outcomes

Water quality outcomes for the proposed site layout with the implementation of the stormwater controls have been quantified through pollutant load results at the receiving node outletting from the overall Paint Shop sub-precinct in MUSIC. These outcomes are summarised in more detail in the Water Quality, Flooding and Stormwater Assessment (SSP Study No. 13) Report.

Initial findings are that the abovementioned stormwater controls should be able to achieve required targets. However, improved outcomes requiring less dedicated treatment can be achieved through optimising the use of multipurpose infrastructure elements between built environment disciplines, including architecture, building services, landscaping, civil engineering and stormwater and greening.

5.0 Other pollution types

Although the Study Requirements mainly focus on air pollution, water pollution and light pollution, other potential pollution types associated with urban developments may include management of existing contamination onsite as well as the management of solid waste/ litter generated by the future land use.

5.1 Groundwater contamination

As per the remediation strategy for the North Eveleigh Rail Yard as produced by SMEC in April 2008 (ref. 3001510.001) there are a number exceedances in relation to the proposed land uses for specific soil borne and groundwater borne contaminants. The report recommends further investigations prior to finalising a Remediation Action Plans (RAP) for the site and notes that a series of management plans will be prepared as part of the development of the works to appropriately manage these contaminants and mitigate their impact to future users of the land. It is recommended that the findings of this report be considered as part of the next stage of works.

5.2 Solid waste

Solid waste will be managed and collected through the City of Sydney. In AECOMs Utilities and Servicing Strategy report (Nov 2021) the objectives for the management of waste generated by the Paint Shop sub-precinct are summarised. These have been referenced below:

- To maximise opportunities for re-use through source separation and on-site storage;
- To minimise waste generation and maximise re-use and recycling; and
- To ensure efficient collection, storage and transport and disposal of waste in an environmentally friendly manner.

These objectives are in line with the Waste Avoidance and Resource Recovery Strategy, Sydney DCP 2012 and industry best practice. By managing the waste streams at the point of generation and implementing appropriate management systems the environmental impacts as noted below can be mitigated.

- Land and surface water contamination as a result of spills or inappropriate storage, handling, transportation and disposal of waste;
- Noise impacts associated with waste collection, movement and transport;
- Odours and vermin resulting from improper storage and treatment putrescible wastes;
- Visual amenity impacts resulting from waste storage and movements at the site (e.g. bins storage, collection and transport); and
- Off-site land and water pollution due to windblown wastes following inappropriate storage, handling, and transportation of wastes.

5.3 Development Controls

5.3.1 Development controls: existing contamination

Alignment with SMEC in April 2008 (ref. 3001510.001). This recommends the preparation of Remediation Action Plans (RAPs) and Construction Operation Health and Safety Management Plans for the site. RAPs and OHS Management Plans should be prepared in accordance with the latest relevant controls and policies from NSW EPA.

5.3.2 Development controls: solid waste

Solid waste generated on the development site should be managed by the *Guidelines for Waste Management in New Developments* as issued by the City of Sydney.

6.0 Conclusion

6.1 Air pollution

6.1.1 Summary

Existing sources of air emissions in the area would largely be attributed to transport emissions; including vehicle emissions and diesel emissions from trains traveling through Redfern Station; immediately to the south east of the site. Other minor sources of emissions within the local airshed may occur from Alexandria Industrial estate approximately 1.5km to the south.

When completed, the project work of relevance to this assessment is not expected to result in the generation of significant levels of air pollution. The only pollutants expected because of the overall development are related to demolition, excavation and construction works and would be considered temporary.

6.1.2 Recommended Development Controls

In view of the RNE site location adjacent to road and rail infrastructure, strategic planning should ensure that sensitive land use developments are sited to avoid or appropriately manage road/ vehicle and rail emissions from within and around the site during the planning and building construction stages.

Planning and design considerations to minimise exposure to vehicle and train emissions, are presented in Table 6-1. These planning and design considerations are in line with the DPE's *Development Near Rail Corridors and Busy Roads – Interim Guideline*, (DoP 2008) and supports the specific rail and road provisions of the *Transport and Infrastructure SEPP 2021*.

Table 6-1 Planning and Design Considerations for Development near Road Corridors and Roads

Consideration	Comment
Building Siting, Heights, and Orientation	• Incorporating an appropriate separation distance between sensitive uses and the road using broad scale site planning principles such as building siting and orientation. • For residential apartments the location of living areas, outdoor space and bedrooms should be as far away as practicable from the major source of air pollution • Building heights adjacent to roads and the rail corridor should be varied and interspersed with open areas to minimise the formation of urban canyons. • Where possible step back the upper storeys of buildings adjacent to the railway to increase dispersion of air pollutants and minimise canyoning effects of tall buildings close to the road.
Frontages	• Where possible primary frontages should face open spaces away from the main sources of emissions including the rail corridor and Wilson Street. • Less sensitive land uses should be designated for tertiary frontages along the rail corridor
Public Domain and Open Space Network	• Maximise the size of potential open space network to promote dispersal of air pollutants from road and rail operations.
Landscaping	• Using vegetative screens, air amenity barriers or earth mounds where appropriate to assist in maintaining ambient air quality. This may include planting street trees and other vegetation to assist in maintaining ambient air quality • Landscaping has the added benefit of improving aesthetics and minimising visual intrusion from an adjacent roadway. • Where possible maximise the amount of space used for green roofs as an air quality abatement strategy. Where possible intensive green roofs that include tall herbaceous plants and/or deciduous trees should be included to maximise potential beneficial air quality impacts.
Ventilation	• For ventilation of indoor areas, adjacent to road or rail corridor the mechanical ventilation air inlet ports should be sited to maximise the distance from the road and/or rail to reduce inflows of air pollutants • The location of open-able windows should be considered in the design of the development located adjacent to the road and rail emission sources. • Additional mitigation measures may include the consideration of the use of winter gardens as an alternative to conventional balconies

Consideration	Comment
Land Use	• Propose less sensitive land use for development that will front the rail corridor such as open space or for commercial or retail use. Here buildings may act as a barrier that shields and protects highly sensitive areas from high-emission zones.

6.2 Water pollution

6.2.1 Summary

Impacts to stormwater runoff from the proposed development could potentially occur from an increased impervious fraction within the site extent because of additional road resurfacing, footpath upgrades, general site levelling and increased building footprint.

Contaminants leaving the site would include lubricants, effluents, chemicals and sediments. These, by entering downstream waterways and watercourses, are likely to trigger increased turbidity, lowered dissolved oxygen levels, increased nutrient and pollutants. Hence, on-site containment and treatment of contaminated waters will ensure safe discharge of runoff from the site.

When completed, the project work of relevance to this assessment is not expected to result in the generation of significant levels of water pollution. The design objectives and targets are documented in detail within the Water Quality, Flooding and Stormwater Assessment (SSP Study No. 13) report.

6.2.2 Recommended Development Controls

Through the introduction of water quality control measures on site, the impact of site development on water bodies downstream of the precinct can be minimised. Site specific design would be required to meet stormwater targets. In summary, the following options should be considered, in order of preference:

- Rainwater tanks can be used to treat runoff from each roof catchment.
- Rainwater can be used to meet irrigation demands and toilet flushing.
- Proprietary products such as filter cartridges may be required where treatment cannot be accommodated within the landscape.

Initial findings are that the abovementioned stormwater controls should be able to achieve required targets. However, improved outcomes requiring less dedicated treatment can be achieved through optimising the use of multipurpose infrastructure elements between built environment disciplines, including architecture, building services, landscaping, civil engineering and stormwater and greening.

6.3 Light Pollution

6.3.1 Summary

Currently, the existing Paint Shop sub-precinct is dark in nature with minimal existing public and architectural lighting. There are dark surrounds within the site and the existing luminaires within the site exhibit little to no obtrusive light spill into the surrounding residential area.

6.3.1.1 Building Lighting

The new buildings along the southern perimeter adjacent to the rail corridor are commercial in nature. Five of the buildings are 18 storeys or higher, and generally 10m or more away from the site boundary/rail corridor.

Façade/outdoor terrace lighting on these buildings (if any) may affect the rail corridor, and must be taken into account during detail design to minimise the obtrusive lighting effects.

Any outdoor architectural lighting, building façade lighting, off-street carpark lighting, sports lighting systems, building signage lighting are required to limit obtrusive light spill to within the permissible limits outlined in AS/NZS4282.

6.3.1.2 Street Lighting

Should lighting upgrade be required, the design is to be compliance with *Sydney Lights: Public Domain Design Code* as required by City of Sydney.

Any potential street lighting within the southern perimeter of the site is to be aimed away from the rail corridor to reduce any potential light spill onto the rail track.

As per AS/NZS4282, clause (e) in the preface, the standard does not apply to public lighting that provides safe movement. However, design strategy will be in place to minimise the obtrusive lighting effect.

Examples include the use of full cut off luminaires with zero light distribution above the horizontal, luminaire aiming principles such that 100% of the light distribution falls on a solid object, and concealment of bare light sources.

6.3.2 Recommended Development Controls

Planning conditions will reference that external lighting systems associated with the RNE Paint Shop precinct will be required to limit light spill in accordance with the light technical parameters and calculation requirements outlined in *AS/NZS4282 'Control of the obtrusive effects of outdoor lighting'.*

The lighting designer should demonstrate conformity of the lighting design of the installation with the light technical parameters of AS/NZS4282.

The relevant Authority shall also confirm if public street lighting associated with the RNE Paint Shop precinct shall be subject to the associated light spill limits outlined in AS/NZS4282.

6.4 Green Infrastructure

The RNE Precinct provides opportunities to incorporate Green Infrastructure. Elements such as streetscaping, green roofs and green walls can be used as a method for reducing sensitive receptors exposure to air pollutants in urban environments by increasing deposition rates and acting as a barrier between.

Green infrastructure can also be used to contribute to the water quality treatment train, thereby reducing the development water pollution impact and the requirement for dedicated water treatment equipment.

6.5 Other pollution types

Other pollution types identified in this study include groundwater contamination and solid waste/ litter.

6.5.1 Development controls: existing contamination

Alignment with SMEC in April 2008 (ref. 3001510.001). This recommends the preparation of Remediation Action Plans (RAPs) and Construction Operation Health and Safety Management Plans for the site. RAPs and OHS Management Plans should be prepared in accordance with the latest relevant controls and policies from NSW EPA.

6.5.2 Development controls: solid waste

Solid waste generated on the development site should be managed by the *Guidelines for Waste Management in New Developments* as issued by the City of Sydney.