Prepared for
Major Projects Canberra
ABN: 66 676 633 401

Air Quality Assessment

28-Sep-2021

Raising London Circuit

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Air Quality Assessment

Client: Major Projects Canberra

ABN: 66 676 633 401

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Executive Summary

AECOM Australia Pty Ltd (AECOM) has been commissioned to undertake an air quality impact assessment (AQIA) for the proposed works associated with the raising of London Circuit (RLC) (the Project). The Project includes the removal of existing infrastructure and services, earthworks and reintroducing the road network to a new design level.

A qualitative AQIA of construction activities for the Project was undertaken in accordance with the IAQM, 2014 *Guidance on the assessment of dust from demolition and construction*. The four-step risk-based assessment of dust emissions found that dust impacts from the Project were determined to be not significant provided that standard dust mitigation measures are implemented and a construction air quality management plan is administered.

A risk assessment of air quality impacts from construction of the Project was also undertaken for the Project. Given that potential air quality risks associated with infrastructure Projects are well known and can generally be managed using standard industry safeguard procedures the potential risks for the Project are considered low to very low.

The potential air quality emissions attributed to the operation of the Project would be negligible and, when compared to the existing environment, would be unlikely to have any significant air quality impacts.

In summary potential air quality emissions attributed to the construction of the Project are unlikely to have any significant impacts.

1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned to undertake an air quality impact assessment (AQIA) for the proposed works associated with the raising of London Circuit (RLC) (the Project).

The following report assesses the air quality as a result of the construction and operation of the Project, to identify the potential for impacts to occur.

1.1 Report scope

The scope of work for the report has been provided in **Table 1-1**.

Table 1-1 Project scope and corresponding report section

Project scope item	Report section
Project description	**Section 2.0**
Regulatory framework	**Section 3.0**
Assessment methodology	**Section 4.0**
Existing environment	**Section 5.0**
Impact assessment	**Section 6.0**
Conclusion	**Section 7.0**

2.0 Project description

Raising London Circuit (the Project) would involve raising London Circuit between Edinburgh Avenue and Constitution Avenue on a gradual filled embankment to meet the current height of Commonwealth Avenue, and provision of a new signalised intersection between London Circuit and Commonwealth Avenue.

The completed Project, including its main features and elements, is shown in **Figure 2-1**. Key elements of the Project are summarised in **Table 2-1**. Further details of the Project are provided in Chapter 3.0 of the Environmental Assessment.

Table 2-1 Key elements of the Project

Key element	Description
Main embankment	A main embankment with associated retaining walls and batters between Edinburgh Avenue in the west and Constitution Avenue in the east, rising in the centre to around the current height of Commonwealth Avenue. The main embankment would have a slope of up to 3.5 per cent, tapering off to around 2.0 per cent towards the new London Circuit-Commonwealth Avenue intersection
London Circuit West	A modified and reconstructed London Circuit West between Edinburgh Avenue and Commonwealth Avenue: • London Circuit West would be generally one travel lane in each direction, widening to two lanes between the potential future intersection with the proposed West Road and the new Commonwealth Avenue intersection.
London Circuit East	A modified and reconstructed London Circuit East between Commonwealth Avenue and Constitution Avenue: • London Circuit East would be two travel lanes in each direction
New and modified intersections	New and modified intersections would be delivered at Edinburgh Avenue (modified) and Commonwealth Avenue (new), as well as making provision for a future potential intersection to tie into the potential future West Road (which would run south from London Circuit West to the future New Acton Waterfront Precinct, but which does not form part of this project). ***Modified London Circuit-Edinburgh Avenue intersection*** The modified London Circuit-Edinburgh Avenue intersection would include tie-in works with London Circuit to the west of the intersection. No changes to Edinburgh Avenue outside the intersection are proposed. The intersection would retain three travel lanes in each direction on Edinburgh Avenue and one travel lane in each direction on London Circuit. ***New London Circuit-Commonwealth Avenue intersection*** The new London Circuit-Commonwealth Avenue intersection would be signalised and would include tie-in works on Commonwealth Avenue to the north and south of the intersection. The intersection would be designed to integrate into the local landscape and to minimise intrusion into the significant vista along the Commonwealth Avenue corridor between City Hill and Capital Hill. On Commonwealth Avenue, the southern approach would provide one left turn lane, two through lanes and a right turn lane into London Circuit East. On London Circuit there would be two travel lanes in each direction on both the eastern and western approaches. This intersection configuration would be integrated through tie-in works to the existing configuration of Commonwealth Avenue north and south of this intersection.

Key element	Description
	The new intersection would allow full vehicle movements in all directions between London Circuit and Commonwealth Avenue, except for: • No right turn from London Circuit westbound into Commonwealth Avenue northbound • No right turn from Commonwealth Avenue southbound into London Circuit westbound. • No right turn from London Circuit eastbound into Commonwealth Avenue southbound
Modification and removal of existing cloverleaf ramps	Modification and removal of existing cloverleaf ramp connections between Commonwealth Avenue, London Circuit and Parkes Way: • The cloverleaf ramp connections to the north west and to the south west of the existing London Circuit-Commonwealth Avenue interchange would be removed, with affected land stabilised and rehabilitated. • The cloverleaf ramp connection to the south east of the existing London-Circuit-Commonwealth Avenue interchange would be modified. This would remove the connection from London Circuit (westbound) on to Commonwealth Avenue (southbound), but would retain the connection between Parkes Way (eastbound) and Commonwealth Avenue (southbound).
Bicycle infrastructure	Provision of bicycle facilities: • Dedicated, separated off-road bicycle paths would be provided on the verge on both sides of London Circuit West and London Circuit East, which would operate as one-way pairs in each direction. • Dedicated, separated off-road bicycle paths bicycle paths would be provided along both sides of the tie-in works on Commonwealth Avenue to the north and to the south of the new London Circuit-Commonwealth Avenue intersection.
Pedestrian infrastructure	Provision of pedestrian facilities: • Dedicated, separated pedestrian paths would be provided on both sides of London Circuit West and London Circuit East, and along both sides of the tie-in works on Commonwealth Avenue around the new London Circuit-Commonwealth Avenue intersection.
Ancillary infrastructure	Ancillary infrastructure and works, including utility connections, lighting, street furniture, landscaping and drainage are included in the project.

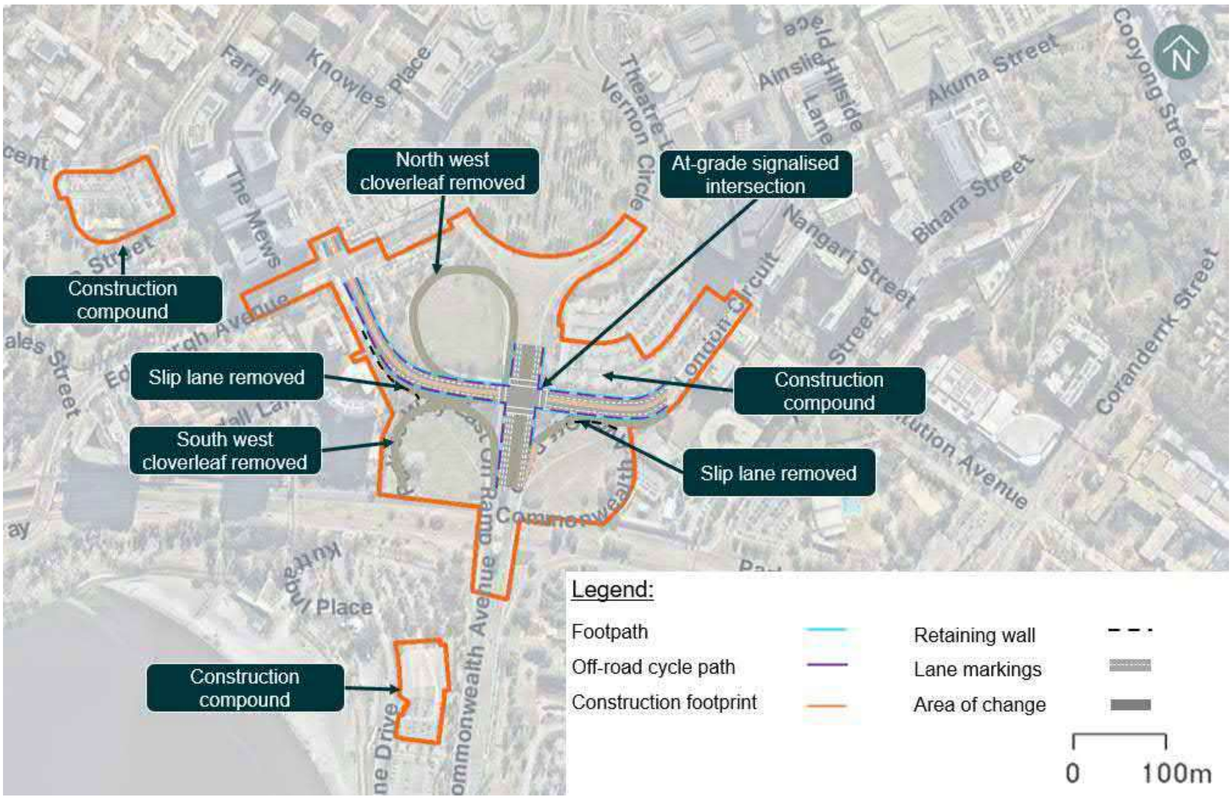


Figure 2-1 The Project and its key features

Subject to securing and complying with the conditions of environmental and planning approvals, construction of the Project would commence around April 2022 and would take approximately two years to complete. The construction footprint for the Project, and the areas affected by separate early works are show in **Figure 2-2**.

Construction of the Project would be preceded by a series of early works required to allow construction works to commence around April 2022. These early works are subject to separate assessment and approvals, and would include:

- Relocation of utilities currently located within the Project construction footprint
- Translocation of Golden Sun Moth (*Synemon plana*) larvae from areas affected by utility relocations
- Traffic management works at the London Circuit-Edinburgh Avenue intersection to allow closure of London Circuit during construction of the Project
- Traffic management works at the Commonwealth Avenue-Vernon Circle intersection, including signalisation, and at the London Circuit-Constitution Avenue intersection to allow closure of London Circuit and traffic management along Commonwealth Avenue during construction of the Project.

Further details of early works are provided in Chapter 4.0 of the Environmental Assessment.

Key construction activities for the Project are summarised in **Table 2-2**. Further details of the construction of the Project are provided in Chapter 4.0 of the Environmental Assessment.

Table 2-2 Key construction activities

Key construction activity	Description
Site establishment and preparation	Site establishment and preparatory works would involve: • Mobilisation and establishment of construction compound sites. Construction compounds approved for use as part of the utility relocation early works would continue to be used for construction of the Project (refer to **Figure 2-2**) • Implementation of temporary surface water and drainage management infrastructure, including temporary grass swales, along around areas of London Circuit to be filled and raised with bulk earthworks • Decommissioning and removal of utilities from within the Project construction footprint. Some decommissioning and removal works may also be carried out as part of construction works along London Circuit and around the new London Circuit-Commonwealth Avenue intersection • Implementation of traffic management measures, including reliance on early works carried out at the London Circuit-Edinburgh Avenue, Commonwealth Avenue-Vernon Circle and London Circuit-Constitution Avenue intersections, and closure of London Circuit to traffic between Edinburgh Avenue and Constitution Avenue.
Closure and raising of London Circuit	Closure and raising of London Circuit would involve: • Removal of existing street furniture, road pavement and vegetation along London Circuit and within the Project construction footprint • Removal of existing street furniture and road pavement along the north west and south west cloverleaf ramp connections between Commonwealth Avenue, London Circuit and Parkes Way, and stabilisation and rehabilitation of land in those areas • Removal of existing street furniture and road pavement for the connection between London Circuit East and the south east clover leaf ramp connection between London Circuit, Commonwealth Avenue and Parkes Way. Only the connection with London Circuit would be affected, with the remainder of the ramp connection retained with potential minor modification to accommodate the embankment batter for London Circuit East. Land affected by removal of the London Circuit connection would be stabilised and rehabilitated • Construction of retaining walls and batters, and staged filling of the London Circuit road corridor between Edinburgh Avenue and Constitution Avenue. The infilling along London Avenue would continue concurrently and in coordination with demolition and infilling beneath the Commonwealth Avenue northbound and southbound bridges (refer below)
Demolition and infilling of Commonwealth Avenue bridges	Demolition and infilling of the Commonwealth Avenue bridges would be carried out in stages to allow continued passage of traffic during the works. Indicative staging would be as follows: • A temporary sidetrack would be constructed to the east of the existing Commonwealth Avenue southbound bridge and associated temporary pavement of the existing Commonwealth Avenue median to allow traffic diversion around the Commonwealth Avenue bridges during demolition works. The sidetrack would provide two traffic lanes as shown in **Figure 2-3** • Implementation of traffic management measures, including reliance on early works carried out at the Commonwealth Avenue-Vernon Circle intersection, to divert traffic on Commonwealth Avenue so that:

Key construction activity	Description
	- Southbound traffic travels via the temporary sidetrack - Northbound traffic crosses onto the existing southbound carriageway - The Commonwealth Avenue northbound bridge is free of traffic • Demolition of the Commonwealth Avenue northbound bridge • Infilling and stabilisation of the area beneath the demolished Commonwealth Avenue northbound bridge as part of the staged program to infill along London Circuit • Construction of the western part of the new London Circuit-Commonwealth Avenue intersection, including a new northbound carriageway • Implementation of traffic management measures following completion of the demolition and infilling of the Commonwealth Avenue northbound bridge so that: - Southbound traffic continues to travel via the temporary sidetrack - Northbound traffic travels via the new northbound traffic lanes and western part of the London Circuit-Commonwealth Avenue intersection - The Commonwealth Avenue southbound bridge is free of traffic • Demolition of the Commonwealth Avenue southbound bridge • Infilling and stabilisation of the area beneath the demolished Commonwealth Avenue southbound bridge as part of the staged program to infill along London Circuit • Construction of the eastern part of the new London Circuit-Commonwealth Avenue intersection, including a new southbound carriageway • Implementation of traffic management measures to return southbound traffic on Commonwealth Avenue to the new southbound traffic lanes and eastern part of the London Circuit-Commonwealth Avenue intersection • Demolition of the temporary sidetrack and infilling the area beneath it as part of the staged program to infill along London Circuit.
Permanent road works	Permanent road pavement, median works and kerb and guttering would be constructed in coordination with the completion of infilling London Circuit to provide the permanent reconstructed London Circuit. Road works would include intersection works at Edinburgh Avenue and Commonwealth Avenue, and tie-in works at Constitution Avenue and around the modified and new intersections with Edinburgh and Commonwealth Avenues.
Ancillary infrastructure and finishing works	Ancillary infrastructure and finishing works would be completed prior to commissioning and opening London Circuit to traffic, including: • Construction of active transport infrastructure, permanent drainage and utilities works • Installation of lighting and street furniture, and road line marking • Landscaping • Demobilisation, and stabilisation and rehabilitation of disturbed areas, including construction compound sites.

Figure 2-2 The Project construction footprint

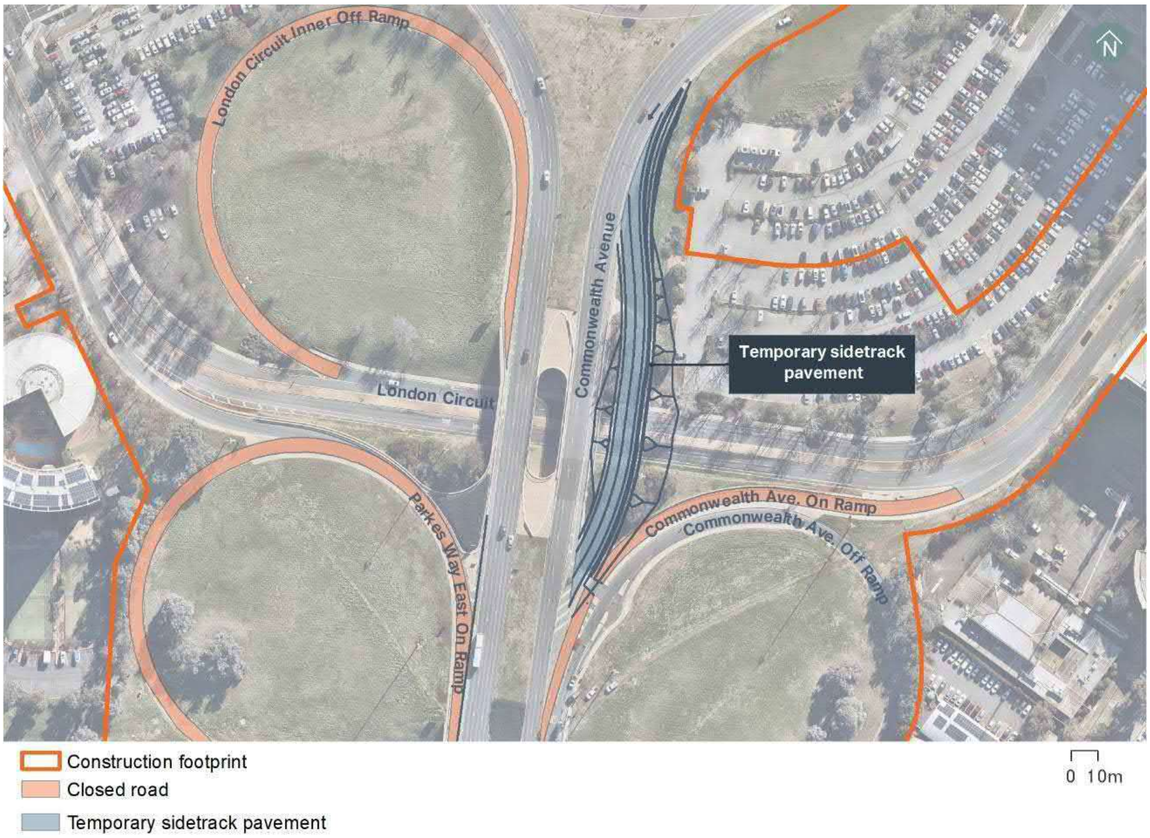


Figure 2-3 Temporary Commonwealth Avenue sidetrack configuration

3.0 Regulatory framework

3.1 Air quality regulatory framework

The following section provide an outline of the regulatory framework relating to the assessment of air quality impacts for the Project. In the ACT the *National Environmental Protection Measure standards under the National Environment Protection Council Act 1994* (Cth) have been adopted as ambient air quality criteria.

3.1.1 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 and Air Toxic NEPM are provided below.

3.1.1.1 National Environment Protection Measures

National Environment Protection Measures (NEPMs) are broad framework-setting statutory instruments that outline agreed national objectives for protecting or managing particular aspects of the environment. Air quality from a federal perspective in ACT is governed by the *National Environment Protection (Ambient Air Quality) Measure* (the Air Quality NEPM) as varied (2021). This NEPM provides guidance relating to air in the external environment, which does not include air inside buildings or structures.

The Air Quality NEPM outlines monitoring, assessment and reporting procedures for the following criteria pollutants:

- Carbon monoxide (CO)
- Nitrogen dioxide (NO_2)
- Sulfur dioxide (SO_2)
- Particles as PM_{10} (particles with diameters less than or equal to 10 microns (µ))
- Particles as $PM_{2.5}$ (particles with diameters less than or equal to 2.5 µ
- Photochemical oxidants (as ozone)
- Lead.

The Air Quality NEPM standards apply to air quality experienced by the general population within a region, and not to air quality in areas within the region affected by localised air emissions, such as heavily trafficked streets. The goal of the Air Quality NEPM was to achieve the standards with the allowable exceedances, as assessed in accordance with the associated monitoring protocol, by 2008 and the standards were set at a level intended to adequately protect human health and well-being.

The ambient air quality standards defined in the Ambient Air Quality NEPM are listed in **Table 3-1**, with future goals for $PM_{2.5}$ displayed in **Table 3-2**.

Table 3-1 NEPM Air Quality Standards

Item	Pollutant	Averaging period	Maximum concentration standard (ppm)	Maximum concentration standard (µg/m^3)
1	CO	8 hours	9.0	1,125
2	NO_2	1 hour 1 year	0.08 0.015	164 31
3	Photochemical oxidants (as ozone)	8 hours	0.065	139
4	SO_2	1 hour 1 day	0.10 0.02	286 57
5	Lead	1 year	Non applicable (na)	0.50
6	Particles as PM_{10}	1 day 1 year	na	50 25
7	Particles as $PM_{2.5}$	1 day 1 year	na	25 8
ppm = parts per million µg/m^3 = micrograms per cubic metres				

Table 3-2 NEPM $PM_{2.5}$ goals by 2025

Pollutant	Averaging period	Maximum concentration
SO_2	1 hour	0.075 ppm
Particles as $PM_{2.5}$	1 day 1 year	20 µg/m^3 by 2025 7 µg/m^3 by 2025

In addition to the Air Quality NEPM, the *National Environment Protection (Air Toxics) Measure* (Air Toxics NEPM) provides a framework for monitoring, assessing and reporting on ambient levels of air toxics. The purpose of this NEPM was to collect information to facilitate the development of standards for ambient air toxics.

The Air Toxics NEPM includes monitoring investigation levels for use in assessing the significance of monitored levels of air toxics with respect to human health. The monitoring investigation levels are levels of air pollution below which lifetime exposure, or exposure for a given averaging time, does not constitute a significant health risk. If these limits are exceeded in the short term, it does not mean that adverse health effects automatically occur; rather some form of further investigation by the relevant jurisdiction of the cause of the exceedance is required.

For the purpose of this assessment it is assumed air toxics, as defined in the NEPM, are not likely to be emitted in significant quantities.

4.0 Air quality assessment methodology

4.1 Potential sources of air pollutants and pollutants of concern

4.1.1 Potential air emission sources

Potential air quality impacts from the construction of the Project have been assessed. Potential sources of air emissions during construction from the Project include:

- Dust emissions from:
  - materials handling from, cut and fill and land forming activities
  - demolition works
  - wind generated dust from stockpiles and exposed surfaces
  - wheel generated dust from on-site truck movements
- Combustion emissions from:
  - Mobile plant equipment using diesel fuels
  - Stationary plant equipment using diesel fuel
- Pollutants of concern based on the identified potential sources of air emissions above are provided below.

The Project is not expected to generate additional traffic nor significantly affect the distribution of traffic on the road network, as such, no increase in vehicle emissions are anticipated. A brief discussion on operational impacts from the project has been provided in **Section 6.2**.

4.1.2 Pollutants of Concern

The RLC project is expected to generate construction dust and vehicle emissions, with the emission of pollutants mostly associated with earthworks. The pollutants expected during excavation and fill activities, and associated materials handling, are as follows:

- Excavation, fill and materials handling dust pollutants:
  - Total suspended particulates (TSP)
  - Particulates with a diameter less than 10 μ (PM_{10})
- Combustion emissions from mobile and stationary plant equipment
  - Carbon monoxide (CO)
  - Oxides of nitrogen (NO_X)
  - Particulate matter (PM_{10})
  - Particulate matter ($PM_{2.5}$).

There are only minor amounts of excavation planned for trenching related to services and structure installs (for example (e.g.) footings). The Contamination Impact Assessment for the Project identified there is a potential risk from uncontrolled fill used during earthworks. The report notes that potential risks from onsite contamination can be effectively managed prior to and during construction through the implementation of risk management strategies. For the purpose of the air quality assessment it is assumed that there would not be any significant air emissions generally associated with contaminated land, such as benzene, toluene, ethylbenzene and xylene (BTEX), polycyclic aromatic hydrocarbon (PAH), heavy metals or asbestos. If significant contamination of soil was identified as part of future site investigations to assess the vertical and lateral extent of contamination within construction footprint additional assessment of potential air quality impacts may be required.

4.2 Assessment of dust impacts during construction

Potential impacts from dust generation during construction 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 assessment is based on estimated construction and demolition volumes and equipment usage for the Project site.

A qualitative discussion on the potential air quality impacts from vehicle emissions has also been presented in **Section 6.1.3**.

4.2.1 Step 1 – screening assessment

Step 1 of the IAQM assessment requires the determination of whether there are any sensitive receptors (as defined in **Section 4.2.2.2**) 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 (trackout).

4.2.2 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.

4.2.2.1 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 4-1**).

Table 4-1 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 (t))	<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
< represents less than *> represents greater than*				

4.2.2.2 Step 2B – sensitivity of the surrounding area

Under the IAQM Guidance document a sensitive receptor is defined as a location that may be affected by dust emissions during demolition and construction. Human receptors include locations where people spend time and where property may be impacted by dust. Ecological receptors are habitats that might be sensitive to dust.

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 4-2** and **Table 4-3** 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 4-2 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 (UK and Scotland). The annual average PM_{10} criteria for Australia differ from the UK and Scotland 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 25 µg/m³ (refer **Section 4.3**) 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 5.4** and fit within the lowest PM_{10} category (<19 µg/m³ concentration range). Note that 2019 and 2020 annual average data is not used for this assessment as it is heavily influenced by the 2019/2020 bushfire period and is not considered representative of long-term conditions.

Table 4-3 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 4-3 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
		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 Project. 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 4-2** and **Table 4-3** 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 a given 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 4-4**.

Table 4-4 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

4.2.2.3 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 4-5** provides the risk ranking for dust impacts from construction activities for each scale of activity as listed in **Table 4-1**.

Table 4-5 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

4.2.3 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 able management measures must be implemented during the Project.

4.2.4 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.

4.3 Assessment 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 of the airshed to receive additional air pollutants from a development or activity.

The relevant air pollutant ground level criteria and corresponding averaging periods are taken from the air quality NEPM, and are shown in **Table 4-6**. Assessment of the impacts from the individual pollutants is based on the pollutant type. For the pollutants listed in **Table 4-6,** the assessable location is at sensitive receptor locations (e.g. residential, commercial property).

Given that the nature of the Project i.e. common earthworks activities with no ongoing significant air pollution sources, a quantitative assessment using dispersion modelling has not been undertaken. As such, the comparison of emissions from the project with NEPM criteria has not been undertaken. Criteria listed in **Table 4-6** 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 number against which on-site monitoring can be compared should it be deemed necessary as part of the environmental management.

Table 4-6 Air quality impact assessment criteria

Pollutant	Averaging period	Maximum concentration standard (ppm)	Maximum concentration standard (ug/m^3)
Particles as PM_{10} [1]	1 day 1 year	na	50 25
Particles as $PM_{2.5}$ [2]	1 day 1 year	na	25 8

[1] Main particulate emissions expected on the site during construction
[2] Very low levels of these pollutants expected from combustion engine machinery and vehicles used on-site

4.4 Risk assessment method

As part of the Project an environmental risk assessment is required for potential environmental impacts from the construction and operation of the Project. A risk assessment for potential air quality impacts associated with the Project was carried out to:

- Facilitate a consistent approach to risk assessment across the various specialist studies for the environmental assessment.
- Identify key project risks to inform the detailed investigations where required

- Ensure the level of investigation is proportionate to the relative environmental risk
- Assess the effectiveness of proposed mitigation measures and whether additional measures may be required.

Risks can be defined as a combination of:

- The magnitude of potential consequences of an event
- The likelihood of the event occurring

The risk assessment process developed for the project involved the assignment of consequence and likelihood ratings which were combined to give an overall risk level for each identified risk. The environmental risk assessment for the project is described below and summarised in **Figure 4-1**. Key steps include:

- Description of impacting process
- Description of environmental values affected
- Description of likelihood of impacting process occurring (assumes no mitigation or controls applied) (**Table 4-7**)
- Description of consequence of impact on environmental value (assume no mitigation or controls applied) (**Table 4-8**)
- Calculate risk level (**Table 4-9**)
- Identify mitigation and management measures:
  - Apply industry standard management measures to relevant impacts (e.g. dust suppression) to impacts of all risk levels
  - Where risk level is medium or above, identify additional controls to reduce impacts
- Determine residual risk:
  - Likelihood and consequence of impact on environmental values with industry standard and additional controls applied.

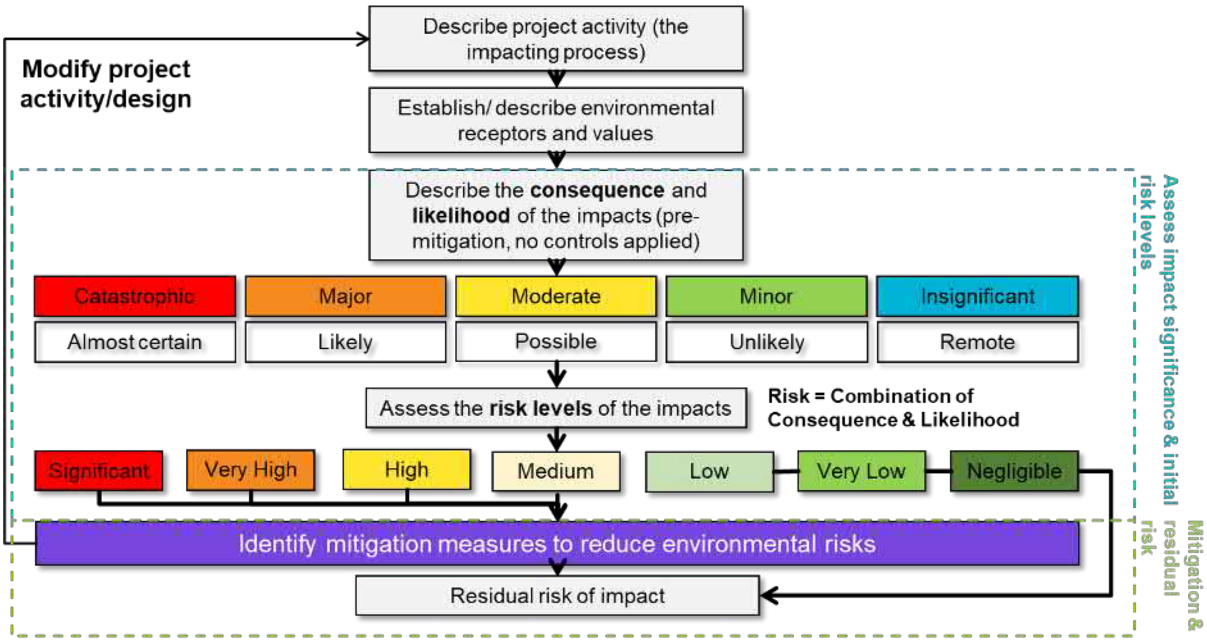


Figure 4-1 Risk assessment approach

Table 4-7 Quantitative likelihood descriptors

Item	Likelihood	Description
1	Remote	Extremely rare/unprecedented
2	Unlikely	Not expected to occur in most circumstances
3	Possible	Could occur
4	Likely	Probably would occur
5	Almost Certain	Expected to occur

Table 4-8 Consequence descriptors

Descriptor	Environment	Economic	Social
Insignificant	No environmental damage	Minimal losses	No noticeable change experienced by people in the locality
Minor	Minor instances of environmental damage that could be reversed. I.e negative impact on a specific species	Several thousand dollars lost revenue or remediation costs	Mild deterioration, for a reasonably short time, for a small number of people who are generally adaptable and not vulnerable
Moderate	Isolated but significant instances of environmental damage that might be reversed with intense efforts	Half million dollars lost revenue or remediation costs	Noticeable deterioration to something that people value highly, either lasting for an extensive time, or affecting a group of people
Major	Severe loss of environmental amenities and a danger of continuing	One million dollars lost revenue or remediation costs	Substantial deterioration to something that people value highly, either lasting for an indefinite time, or affecting many people in a widespread area
Catastrophic	Major widespread loss of environmental amenity and progressive irrecoverable environmental damage.	Several million dollars in lost revenue or remediation costs	Substantial change experienced in community wellbeing, livelihood, amenity, infrastructure, services, health, and/or heritage values; permanent displacement or addition of at least 20% of a community

Table 4-9 Risk matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Catastrophic
Almost Certain	Medium	High	Very High	Significant	Significant
Likely	Low	Medium	High	Very High	Significant
Possible	Very Low	Low	Medium	High	Very High
Unlikely	Negligible	Very Low	Low	Medium	High
Rare	Negligible	Negligible	Very Low	Low	Medium

An initial set of mitigation measures as described in **Section 6.1.4** have been developed as part of this air quality impact assessment. These mitigation measures are based on compliance with legislation and standard requirements that are typically incorporated into the delivery of infrastructure projects of a similar type, scale and complexity.

Initial risk ratings were applied to each identified risk pathway assuming that these initial mitigation measures were in place. Additional mitigation measures were then developed where the initial risk ratings were categorised as medium or higher.

5.0 Existing environment

5.1 Meteorology

The Bureau of Meteorology (BoM) operates two automatic weather monitoring stations (AWS) near London Circuit, located at the Canberra Airport and Tuggeranong, as shown in **Figure 5-1**. The Canberra Airport and the Tuggeranong AWS's are well situated in open areas, with no built environment or obtrusive features nearby to influence parameters such as wind direction or speed. The Canberra Airport has a long-term dataset dating back to 2008 in its current location, and back to 1939 in its previous location. Tuggeranong also has a reasonable dataset dating back to 1996.

Relative to London Circuit, the Canberra Airport AWS is located approximately 7 kilometre (km) to the south-east and the Tuggeranong AWS is located approximately 15 km to the south-south-west. The Canberra Airport AWS is considered to be more representative of the meteorological conditions at London Circuit than Tuggeranong due to being closer in proximity and in a similar terrain setting. Both the Airport and London Circuit are located at a midpoint between two ridges on relatively flat ground, whereas Tuggeranong is located in a basin setting, with elevated ground in all directions. Though the terrain setting is similar between London Circuit and the Canberra airport, there would be some meteorological differences due to nearby terrain influences, land use and the built CBD setting of London Circuit.

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, the Computer Aided Learning in Meteorology (CALMET) model was employed to create an on-site meteorological file. CAMLET uses a combination of regional meteorological observations from BoM stations, databases of terrain and land use, as well as gridded meteorological data from the Commonwealth Scientific and Industrial Research Organisation (CSIRO) prognostic meteorological model, The Air Pollution Model (TAPM).

CALMET is unable to determine the localised effects of the built environment near London Circuit, however some wind tunnelling and blocking would be assumed due to high rise nature of the buildings in the city. It is unlikely that these localised effects would have a large impact on air quality as relevant to the Project.

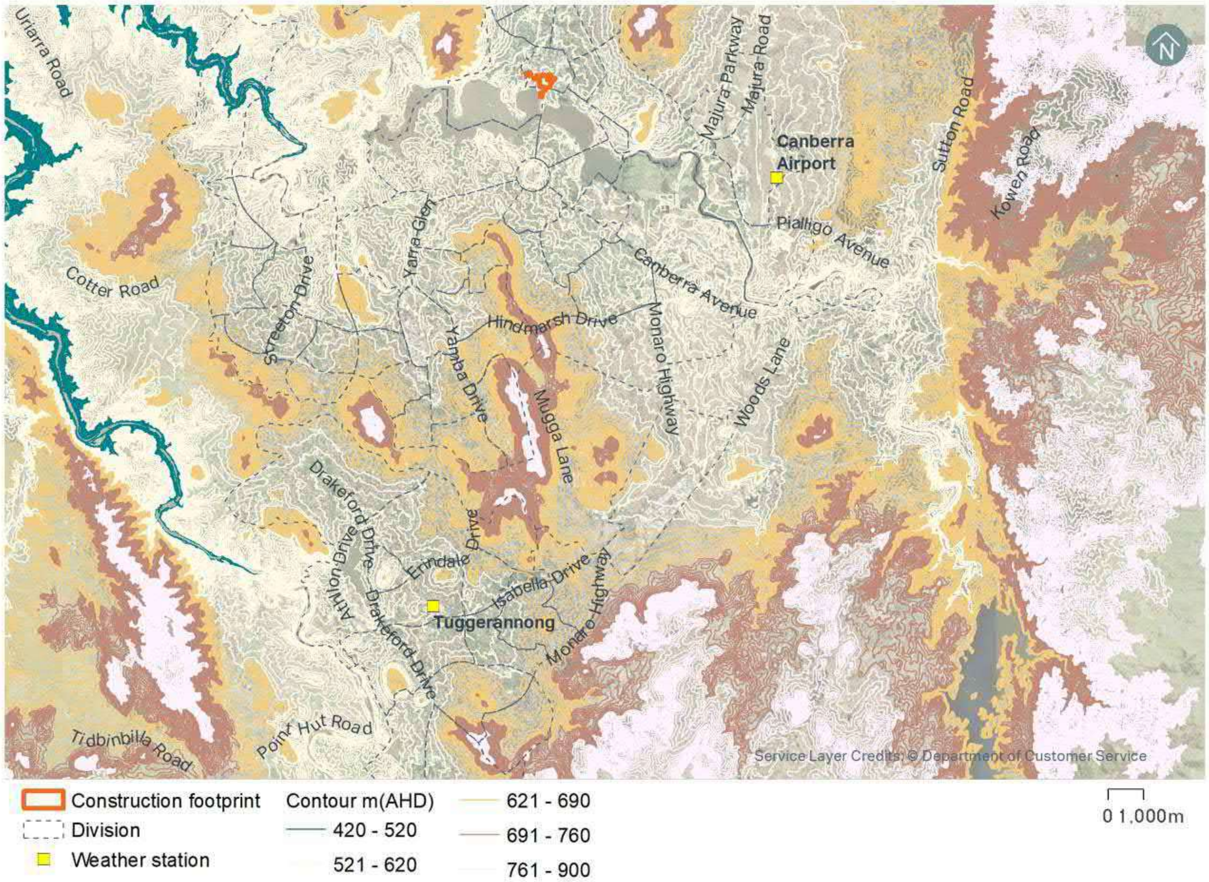


Figure 5-1 Monitoring station locations and terrain

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

TAPM

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 CALMET model.

The initial and lateral boundary conditions for the TAPM simulation use 6-hourly three-dimensional analysis fields from the Global Forecast System (GFS). Settings within the TAPM model have been outlined in **Table 5-1**.

Table 5-1 TAPM settings

Parameter	Setting
TAPM version	4.0.5
Grid centre coordinates (km UTM)	693.589, 6093.603
Date parameters	2017 12 31 to 2019 01 01
Number of west-east grid points (nx)	25
Number of south-north grid points (ny)	25

Parameter	Setting
Grid spacing	Outer = 30,000 m
	Inner = 1,000 m
Number of grid domains	4
Number of vertical grid levels (nz)	25
Observation file	Not used
Locations of upper air data extracted for CALMET (km UTM)	1. (1,1) – 681.589, 6081.603 2. (1,25) – 681.589, 6081.603 3. (14,14) – 694.589, 6094.603 4. (21,5) – 701.589, 6085.603

CALMET

CALMET is the meteorological pre-processor for the CALPUFF dispersion model. CALMET has been used in this process to collectively process the gridded TAPM and surface observation data from AWS in conjunction with terrain and land use data to produce hourly 3-dimensional gridded arrays of meteorological parameters. CAMLET modelling parameters are presented in **Table 5-2**.

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 across the modelling.

Table 5-2 CALMET modelling parameters for the Project domain

Parameter	Value
Meteorological grid domain	50 km x 50 km
Meteorological grid resolution	250 m resolution (200 x 200 grid cells)
Reference grid coordinate (south-west corner)	668.215 km east, 6065.771 km south
Cell face heights in vertical grid (m)	0,20,40,80,160,320,640,1200,2000,3000,4000
Simulation length	1 year (2018)
Surface meteorological stations	Canberra Airport (BoM) Tuggeranong (BoM)
Upper air meteorology	4 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 m resolution).
Land use Data	Site-specific data based on United States Geological Survey (USGS) land use codes
Wind field guess	Compute internally
Seven critical CALMET parameters	TERRAD = 8 km RMAX1 = 6 km RMAX2 = 6 km R1 = 3 km R2 = 3 km IEXTRP = -4

Parameter	Value
	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 AWS nearest the 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.

There are two surface observation stations within approximately 15 km of the Project site. The location details of these stations is provided in **Table 5-3**.

Table 5-3 London Circuit surface station locations used in the model

Weather station	Operator	Easting (km UTM)	Northing (km UTM)	Distance from Project Location (km)
Canberra Airport	BoM	700.049	6090.490	7
Tuggeranong	BoM	690.090	6078.543	15

A review of ten years of meteorological data from the BoM Canberra Airport AWS between 2011 and 2020 was carried out to determine a representative year of data for use in the CALMET modelling. Consideration was given to a range of different parameters for the selected year (2018), including wind speed, percentage (%) of calms and a comparison of the 2018 calendar year to the long-term BoM 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 Niño or La Niña event.

Southern Oscillation Index (SOI) data is presented in **Figure 5-2** with monthly averages at the top and annual averages at the bottom. This shows that the years 2012 and 2018 were the most neutral with an average SOI index of close to zero and no large fluctuations in monthly average SOI. This indicates that meteorological data for these years were less likely to be impacted by an El Niño/La Niña event. 2012, 2017 and 2018 were considered suitable contenders for the representative meteorological year, subject to further analysis.

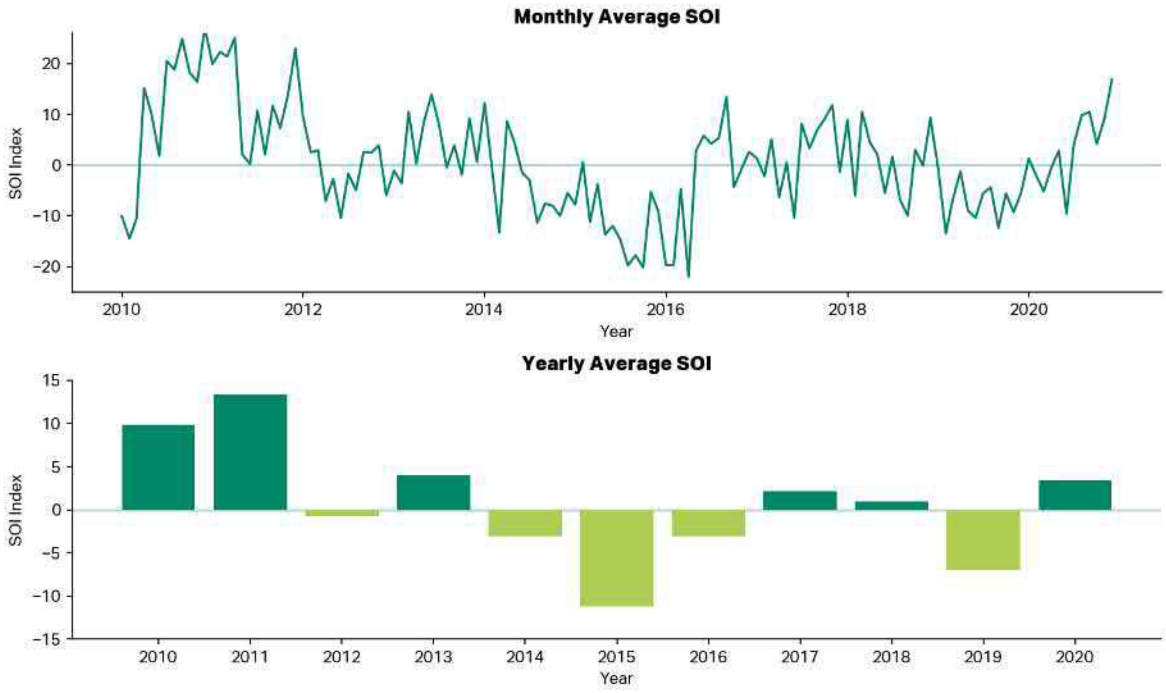


Figure 5-2 SOI data, 2010-2020

A comparison of 2011 to 2020 wind speed and calms frequency data by hour of day for the BoM Canberra Airport AWS is shown in **Figure 5-3**. This plot also shows that there is only a minor difference in average wind speeds and calm frequency from year to year. Night-time hours are characterised by a high frequency of calms and lower wind speeds. Daytime conditions show a much lower frequency of calms with higher winds speeds.

The chosen year for modelling, 2018, shows near average wind speeds during the day and near average frequency of calms during the early morning compared with the other years. However, the differences are not great when compared with other years or the longer-term conditions.

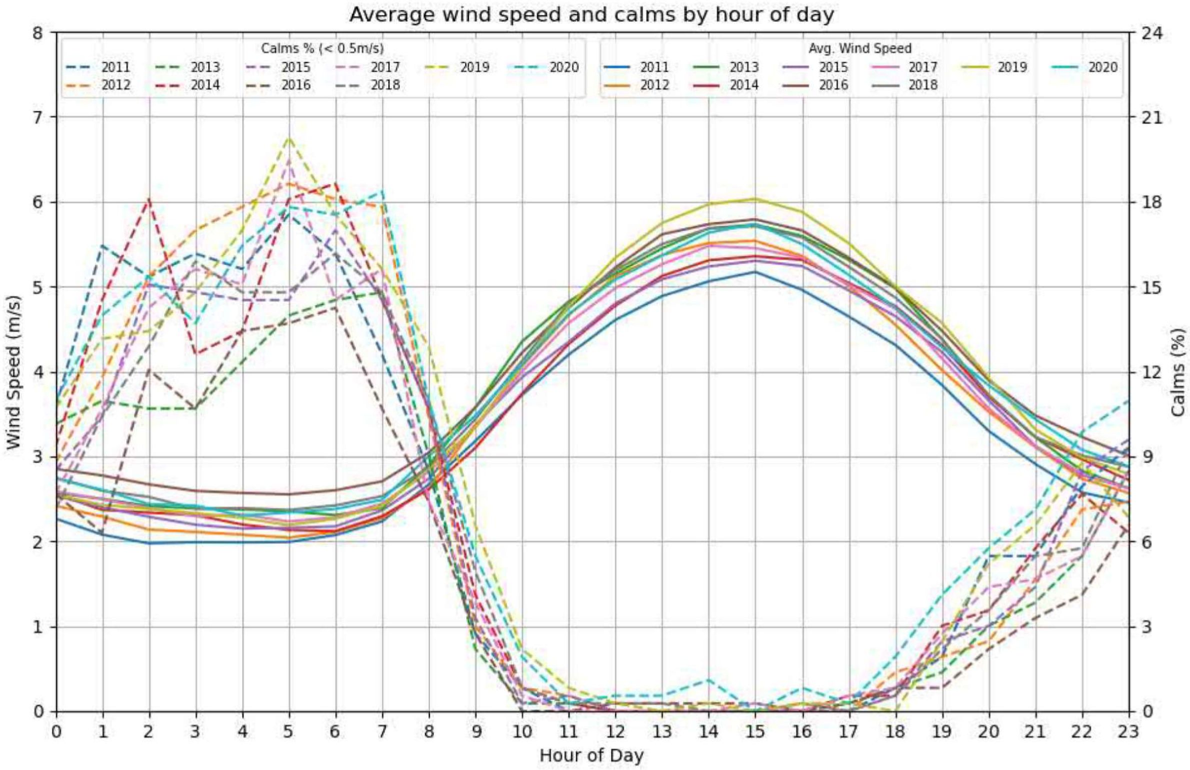


Figure 5-3 Analysis of wind speeds recorded at the BOM Canberra Airport AWS from 2011 to 2020.

The data comparison shows that there were only minor differences between the calms and wind speeds across the different years. Daytime windspeeds are considered most relevant to the Project as daytime is when emissions due to construction and earthworks will take place. Of the 10 years the highest daytime windspeeds are in 2019 and the lowest are in 2011. When comparing 2012, 2017 and 2018 there are no significant differences in wind speeds or frequency of calm winds (<0.5 m/s).

As the wind speed analysis found no significant differences, 2018 was selected as the representative year for further analysis using CALMET due to its near neutral SOI value.

5.1.1 London Circuit meteorological analysis

Meteorological analysis at the 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 Project site for reference against longer term (2011 to 2020) regional observations at the Canberra Airport BoM AWS.

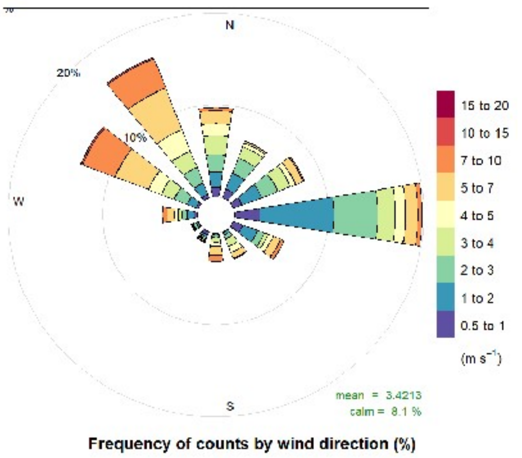
The annual wind roses in **Figure 5-4** presents a comparison of the modelled winds at the Project site and the Canberra Airport for 2018 with the measured winds at the Canberra Airport BoM AWS between 2011 and 2020.

When comparing the modelled winds to the measured winds at the Canberra Airport, CALMET has predicted slightly higher average wind speed (3.8 metres per second (m/s) vs 3.6 m/s) and a slightly lower percentage of calm wind speeds (6.0 vs 6.5%). Wind direction and frequency of occurrence is very similar, with a predominantly north-west and south-east distribution pattern.

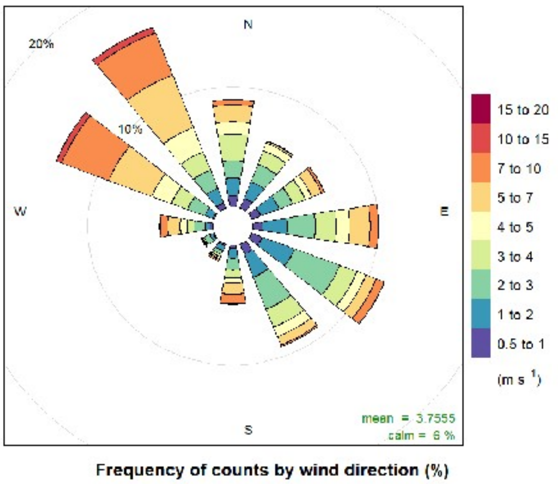
The Project site was predicted to have a lower average wind speed of 3.4 m/s, and a higher frequency of calms of 8.1%. The wind distribution was predicted to have a more predominant easterly component, as well as the regional north-west component similar to the Canberra Airport. The different wind distribution is expected due to the terrain setting of the Project site, being locally influenced by the nearby hills of Mount Ainslie, Black Mountain and Mount Pleasant. Similar effects on wind patterns between Canberra Airport and the Project site were observed in all four seasons, as shown in **Figure 5-5**.

Overall, the wind roses show a pattern consistent with the Canberra region and is consistent with the observed land use and terrain features in the area.

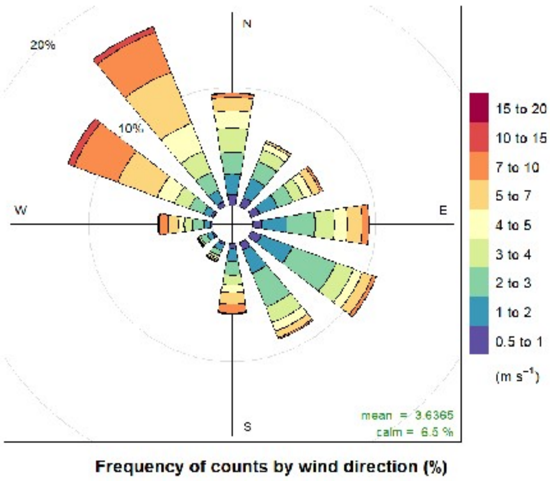
Based on the CALMET data; and the higher occurrence of easterly and north easterly winds sensitive receptors to the west and the southeast of the construction footprint are more likely to be downwind of dust emissions from construction of the Project. There is however the potential for other sensitive receptors to be impacted by onsite air emissions due to the occurrence of less prevalent winds. The air quality impact assessment for the project addresses potential impacts from the site within a 350m radius of the construction footprint boundary as discussed in **Section 4.2.1**.



RLC Project Site (CALMET, 2018)



Canberra Airport (CALMET, 2018)



Canberra Airport (BoM, 2011-2020)

Figure 5-4 Annual wind roses for the Project site and Canberra Airport AWS

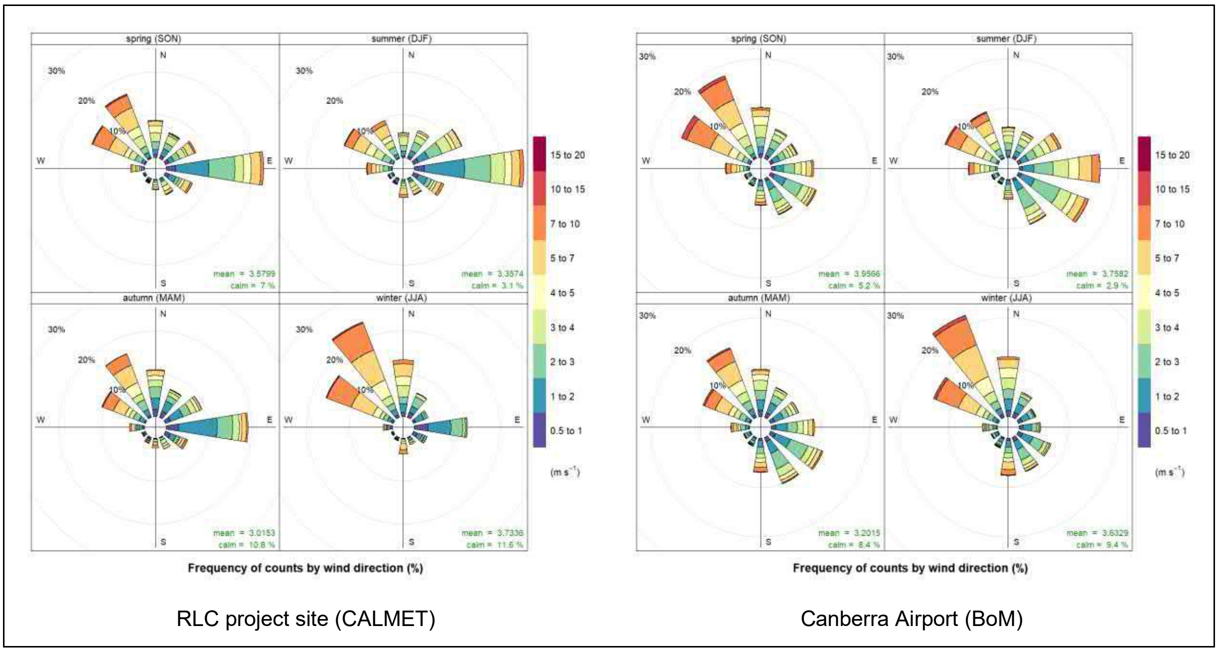


Figure 5-5 Seasonal wind roses for the Project site and BoM Canberra Airport AWS

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 Project site is presented in **Figure 5-6**. The results are consistent with expected long-term observations as shown in **Table 5-4**.

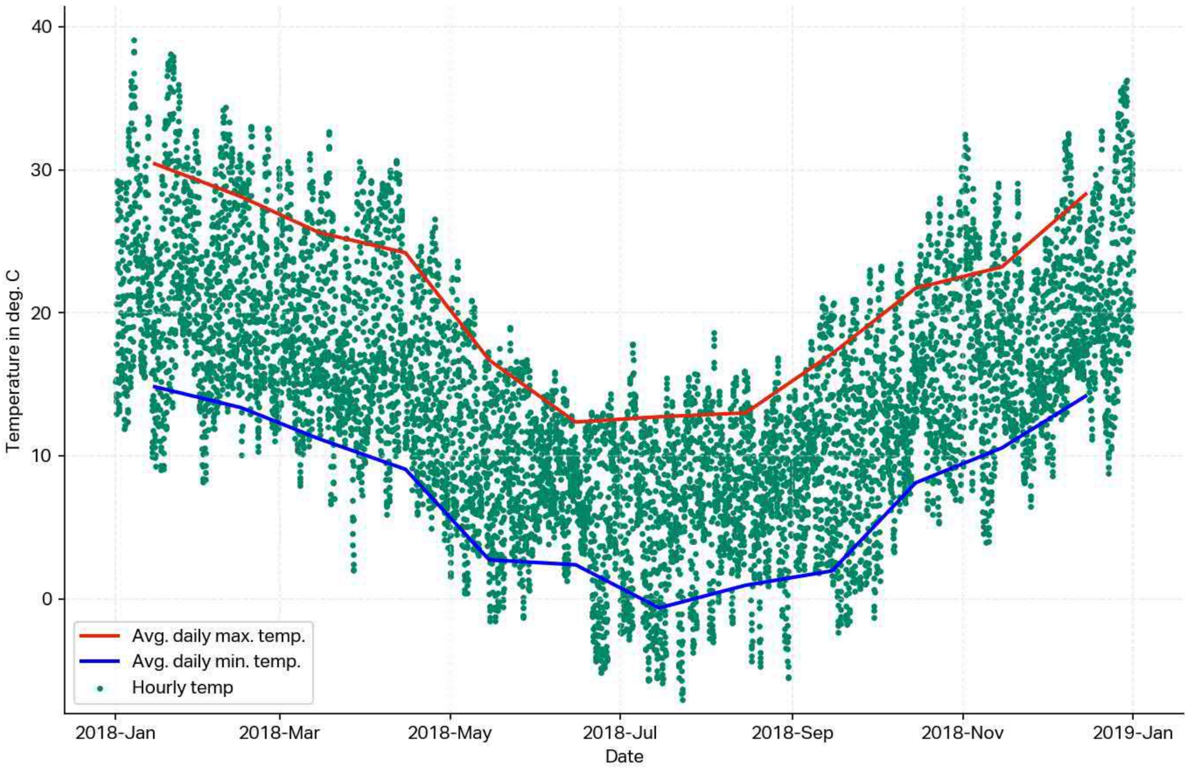


Figure 5-6 Predicted temperature data at the Project site

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 occurs, 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 50 m. **Figure 5-7** 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 3000 m are consistent with typical ranges for mixing heights in Australia during the daytime.

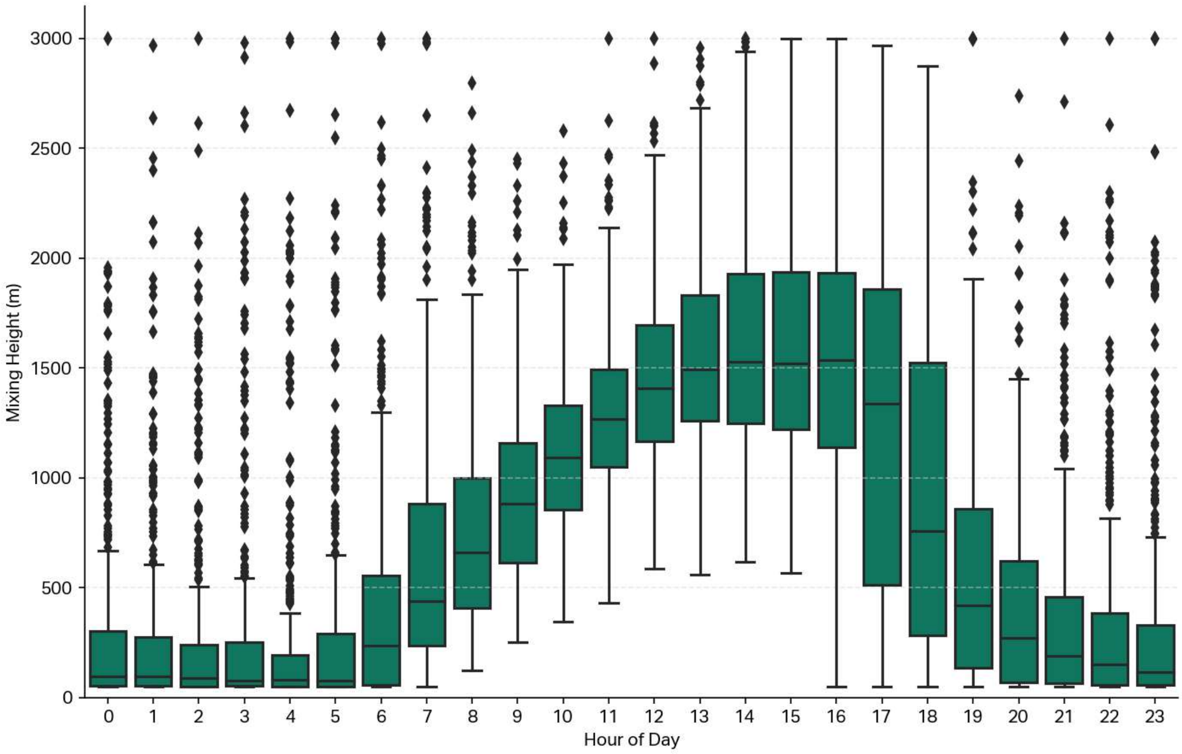


Figure 5-7 Predicted mixing height data at the Project site

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 5-8 presents an analysis of stability class frequency against wind speed for the CALMET data. The pattern shown in the figure 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.

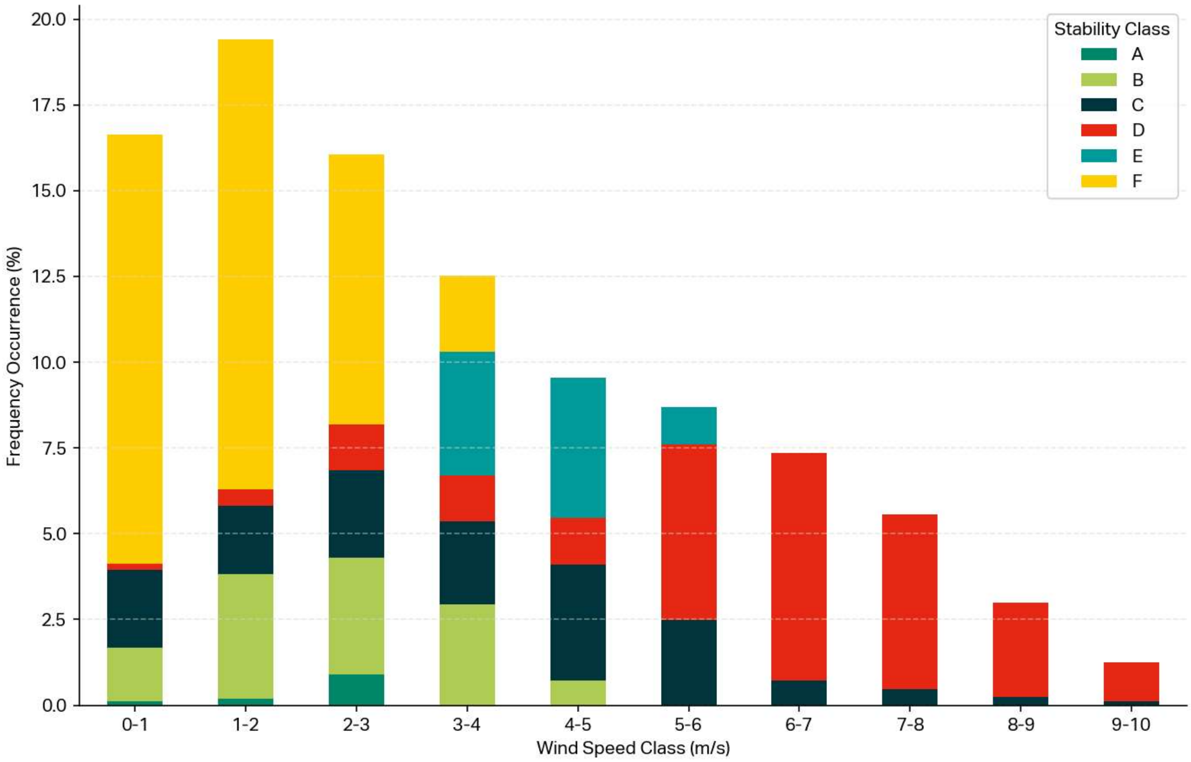


Figure 5-8 Predicted stability class data at different wind speed classes at Project site

Figure 5-9 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.

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

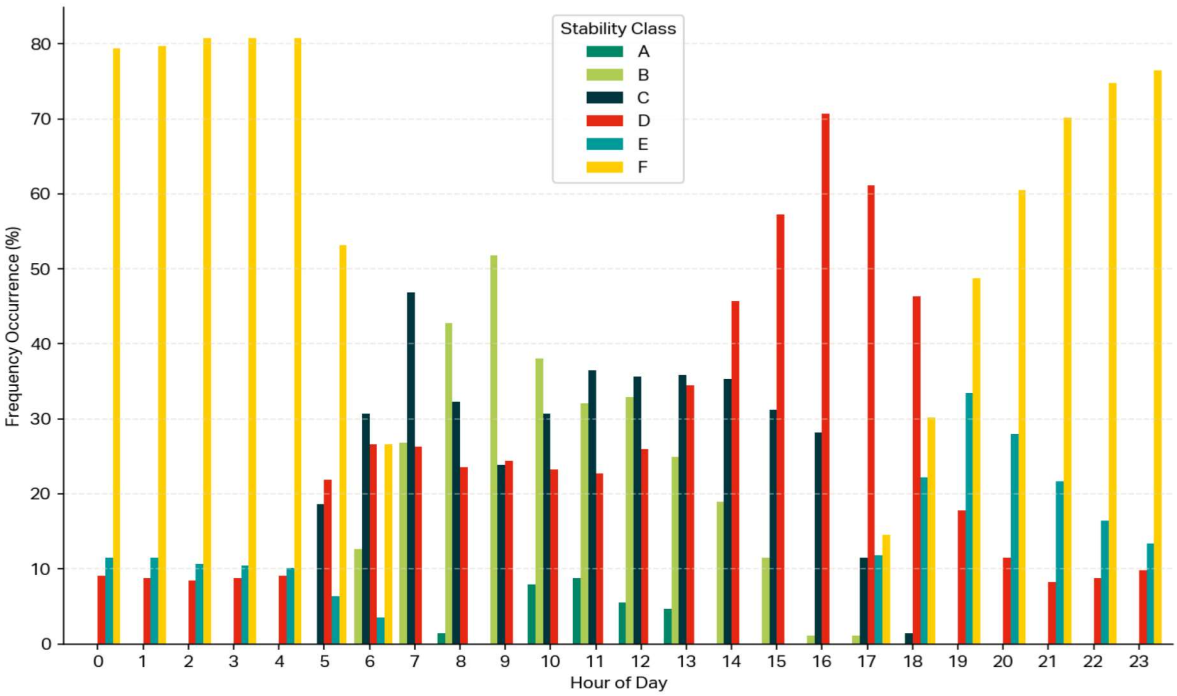


Figure 5-9 Predicted stability class data at different times of day at the Project site

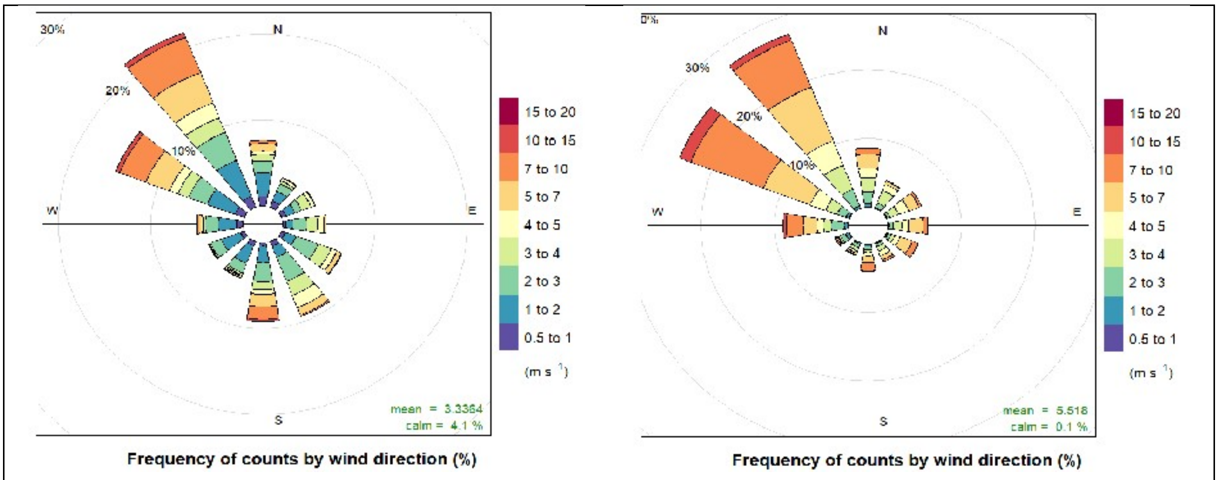
Long term meteorological data summary – Canberra Airport

A summary of the long-term data recorded at BoM Canberra Airport AWS (from 2008 – 2021 for average, minimum and maximum data, and 2011 – 2020 for 9am and 3pm data) has been extracted and is shown below in **Table 5-4**.

The warmest temperatures occur between November and March with a mean monthly maximum temperature of 30.6 degrees Celsius (°C) occurring in January. The coolest months are May to September with the mean minimum monthly temperature of 0.0 °C occurring in July.

The highest average rainfall occurs in December, with April, May and July being the driest months.

Wind roses for 9am and 3pm are presented in below in **Figure 5-10**. For 9am and 3pm winds are predominantly from the north-west, however at a higher frequency of occurrence at 3pm. 9am has a higher frequency of occurrence of winds from the south-east. Calm wind conditions are also more prevalent at 9am than 3pm, at 4.1 % and 0.1 % respectively.



Canberra Airport – 9am

Canberra Airport – 3pm

Figure 5-10 Canberra Airport wind roses, 2010-2020

Table 5-4 Canberra Airport BoM climate statistics summary

Statistic element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Start year	End year
Mean maximum temperature (°C)	30.6	28.1	25	21	16.6	13.4	12.8	14	18.1	21.6	25.3	27.6	21.2	2008	2021
Mean minimum temperature (°C)	14.2	13.5	11.1	6.8	2.4	1.1	0	0.9	3.1	6.2	9.9	12.2	6.8	2008	2021
Highest temperature (°C)	44	42.7	35.5	31.8	24.5	17.7	18.8	21.3	30.2	32.1	39.9	41.1	44	2008	2021
Lowest temperature (°C)	1.6	2.8	0.6	-2.7	-6.9	-7	-8.7	-7.6	-6.8	-3.4	-1.5	0.3	-8.7	2008	2021
Mean rainfall (millimetres (mm))	47.2	66.6	66.9	33	28	45.8	32	46.4	47.6	49.1	66	75	600.4	2008	2021
Mean number of days of rain[1]	7.2	8.2	9.2	7	6.8	11.4	11.2	9.7	7.4	8.9	8.8	9.1	104.9	2008	2021
Mean 9am temperature (°C)	21.4	19.5	16.8	14.4	9.5	7.0	6.2	7.7	12.0	14.5	17.6	19.6	21.4	2011	2020
Mean 9am relative humidity (%)	59.4	65.8	72.6	70.9	76.4	83.2	81.3	73.8	62.2	62.2	58.7	57.5	59.4	2011	2020
Mean 9am wind speed (km/hour)	11.4	10.7	10.4	10.7	10.5	11.2	12.6	13.9	15.1	12.9	13.6	12.7	11.4	2011	2020
Mean 3pm temperature (°C)	28.8	26.4	23.5	19.6	15.0	12.0	11.3	12.5	16.2	20.3	23.5	26.1	28.8	2011	2020
Mean 3pm relative humidity (%)	35.6	40.4	45.1	47.5	52.1	59.5	56.9	51.6	45.6	41.1	37.8	35.4	35.6	2011	2020
Mean 3pm wind speed (km/hour)	19.7	18.7	18.4	17.2	18.9	17.0	19.9	22.3	23.5	23.0	22.0	20.5	19.7	2011	2020

[1] Data from Camden BOM station used for analysis due to no rainfall data collected at Bargo

5.2 Terrain

The terrain immediately surrounding the Project site in the CBD is relatively flat, however in most directions from a distance of approximately 2 km from the Project site, there are complex terrain features such as hills, mountains, valleys and plains. On a broader scale, there are significant terrain features such as the Molonglo River and Molonglo Valley running from Lake Burley Griffin to the Brindabella Range approximately 20 km to the west. Approximately 12 km to the east is Mount Reedy in the Kowen escarpment.

The Project site has an elevation of approximately 570 m, with the two nearby mountains, Black Mountain and Mount Ainslie, at around 800 m elevation. The Brindabella Range to the west is a more significant range of up to approximately 1900 m, and Mount Reedy to the east has an elevation of around 740 m, with other areas of the Kowen escarpment having an elevation of around 800 m. Terrain around the RLC Project site location is shown below in **Figure 5-11**.

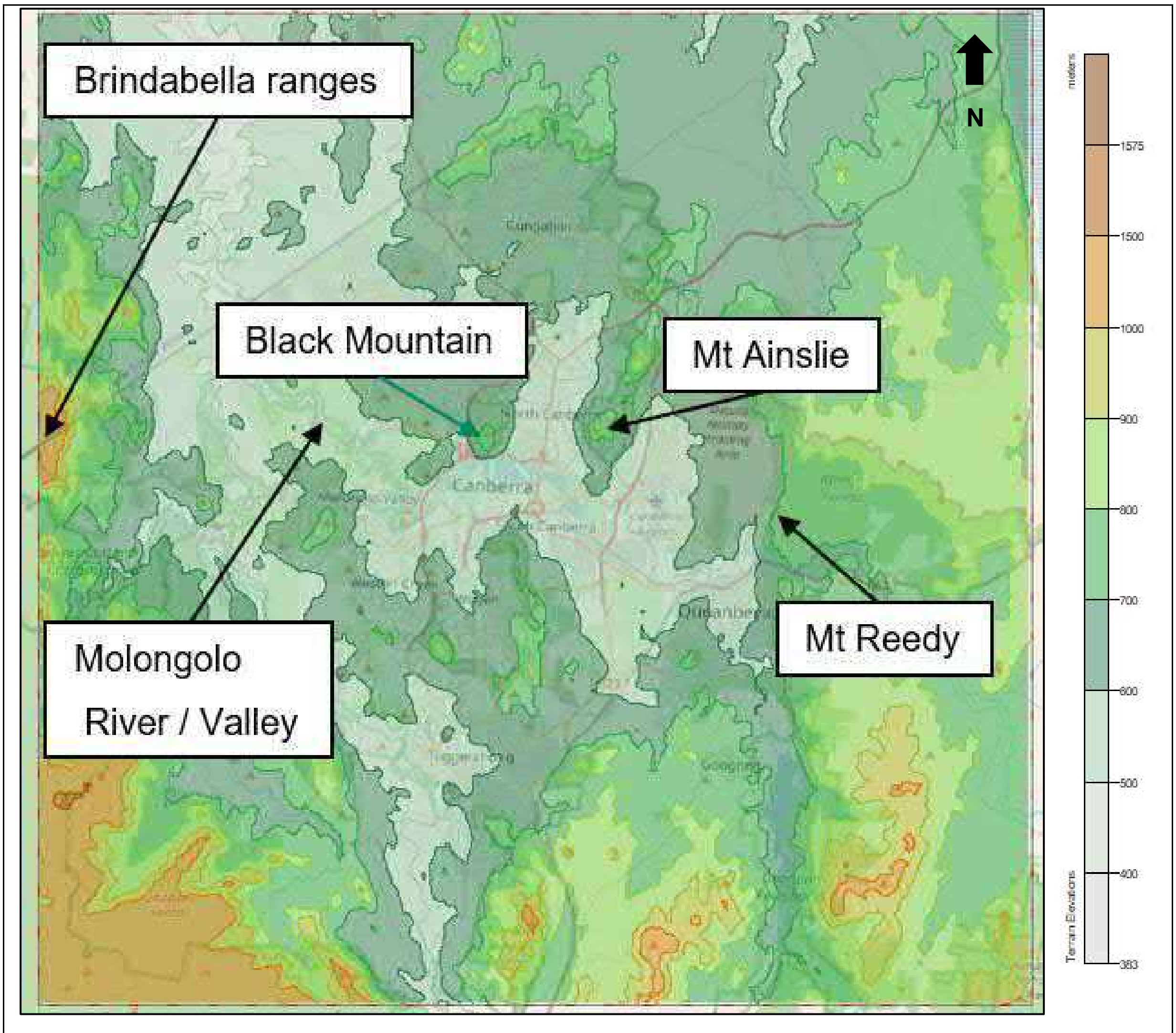


Figure 5-11 Terrain Elevations surrounding the Project

5.3 Meteorological model land use data

Land use in the area surrounding the Project site was considered when examining the regional meteorology. Land use data was required as part of the development of the CALMET meteorology and was extracted from the USGS global database for the Australasian region. Data was validated using with recent satellite imagery which showed a good match with the USGS data across the Canberra region.

Land use in the region immediately surrounding the Project site is characterised by a CBD setting, transitioning to residential dwellings further to the north. Immediately to the south is Lake Burley Griffin, with land use further south being commercial, industrial and residential. There are nature reserves near the Project site, with the Black Mountain reserve 2 km to the west and the Mount Ainslie reserve 2 km to the east. Further east and west are open plains which transition into the mountainous areas of the Brindabella Range to the west and the Kowen escarpment including Mount Reedy to the east.

5.3.1 Built urban environment

The Project is located within the CBD and surrounded by high density urban development; primarily commercial land use; carparks servicing the area and parkland. The Project construction footprint is bound by City Hill to the north. Nearby roads including London Circuit, Constitution Avenue and Edinburgh Avenue are generally lined with multistorey commercial buildings, and large car parking facilities servicing the area lie to the northwest and southwest of the site. The site is bound by Parkes Way to the south; with primarily parkland and recreational land uses to the south of the major roadway.

Generally, highly urbanised environments have the potential to influence local wind flows, particularly due to the presence of multistorey buildings where height aspects ratios are high forming urban canyons channelling winds along roads. These micro meteorological effects influence the dispersion of air pollutants, generally leading to higher concentrations of pollutants close to the source due to poor dispersal conditions.

Figure 5-12 shows the southern end of London Circuit, looking toward the north. There are several multistorey buildings surrounding London Circuit which have the potential to alter local wind flows, with potential blocking effects in some areas, and wind tunnelling in other areas, dependant on the direction and strength of the winds. It is important to note though that the while there are a number of multi storey buildings surrounding the construction footprint there are also a number of open areas including parkland and carparks, which would promote better dispersal of air pollutants.

Sensitive receptors in the surrounding area would primarily be commercial receptors; i.e places of work where people are likely to reside for 8 hours a day or more and transient receptors where limited exposure to air pollution is assumed such as parks, recreational areas and footpaths. Receptor sensitivity is further discussed in **Section 4.2.2.2** and the number and classification of sensitive receptors are provided in **Section 6.1.2**.

Figure 5-12 London Circuit and CBD buildings.

5.4 Existing air quality

The pollutants of prime interest in ACT are those specified in the ambient air quality NEPM are ozone, NO_2 and particulates, with regional levels of certain pollutants approaching or exceeding the national standards prescribed in the NEPM for Ambient Air Quality. The only pollutants expected as a result of the overall development are related to the demolition, earthworks and construction works, and consist primarily of particulate emissions from excavation activities and very minor contribution of vehicle emissions from heavy machinery and vehicles needed for the site works. 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 understand the existing pollutant levels in the Canberra region.

Background air pollution is characterised through ambient monitoring undertaken at three locations in Canberra by the ACT government. They are:

- Civic, approximately 150 m to the south-east of the southern end of the Project boundary
- Florey, approximately 10 km to the north-west of the Project
- Monash, approximately 15 km to the south of the Project.

The locations of the monitoring stations are shown below in **Figure 5-13**.

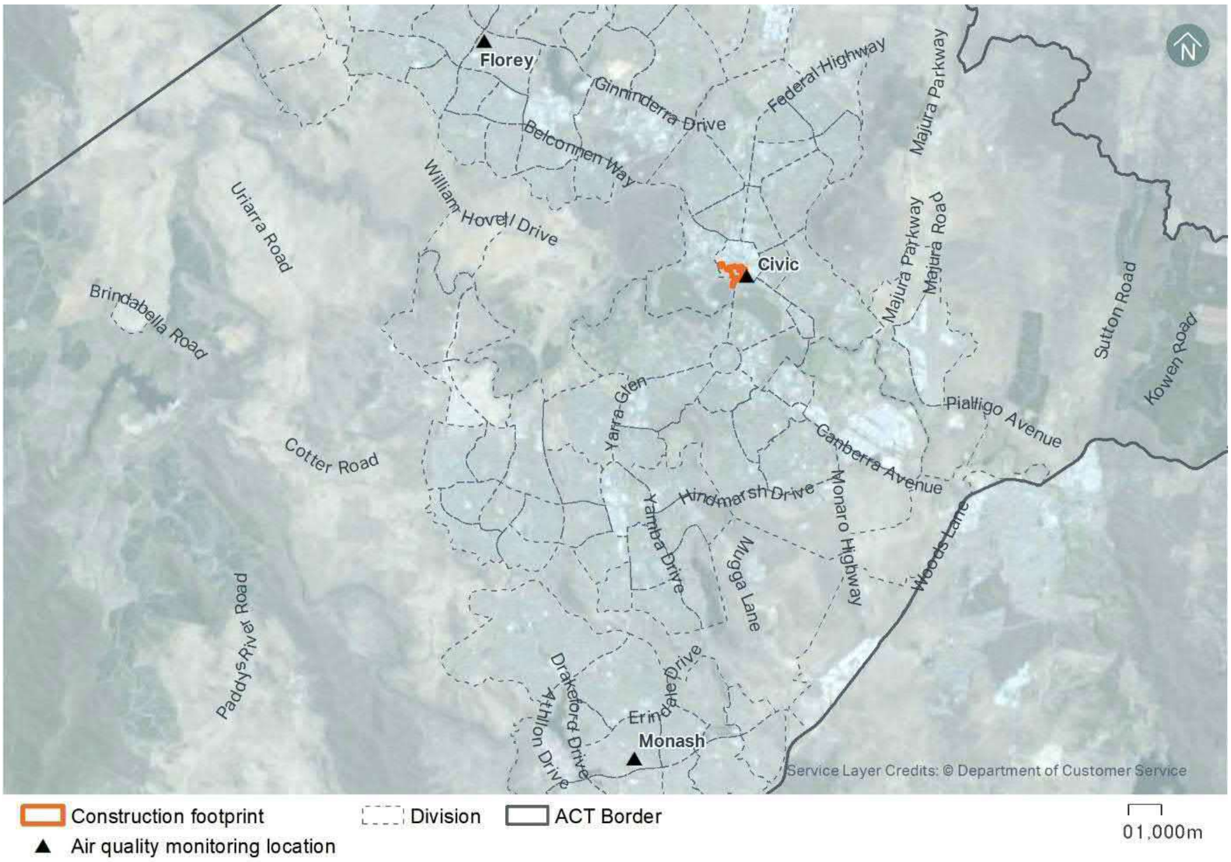


Figure 5-13 Air quality monitoring station locations

The three stations measure a range of pollutants relevant to this study including:

- NO_2 (except Civic)
- PM_{10} particulate matter
- $PM_{2.5}$ particulate matter.

The closest monitoring station to the Project site is the Civic monitoring station situated off Allara Street, Canberra, approximately 150 m to the south-east of the southern bounds of the Project. Given the proximity of Civic station to the Project site, this station is expected to provide the best representative data for the background pollutant levels in the Project area. It should be noted however that Civic station does not have recent NO_2 data necessitating the use of NO_2 data from the Florey and Monash station. Given the distance of the Project site to these two stations, NO_2 concentrations should be treated with caution.

The area surrounding the Monash monitoring station is known to have air quality issues with particulates, especially in the winter months associated with residential wood heaters and stable atmospheric conditions at night-time, generating temperature inversion layers. The temperature inversion layer traps pollution emitted in the night-time hours and prevents meaningful dispersion through until later in the morning when the inversion breaks up, resulting in higher levels of pollution during these times. Once the day warms up and the atmospheric stability becomes unstable, the pollutants disperse, and this cycle repeats daily in the colder months, however with some nights being worse than others as dictated by atmospheric stability.

$PM_{2.5}$ air quality data from Monash and Florey are not expected to be representative of the conditions at the Project site given the distance from the Project site and known localised air quality issues in the Monash area.

Data covering the last six calendar years for the Civic, Florey and Monash monitoring stations have been extracted from the ACT open data portal and have been summarised in **Table 5-5** to **Table 5-7**.

Table 5-5 Civic ambient monitoring data summary

Pollutant	Averaging period	Concentration (µg/m3)					
		2015	2016	2017	2018	2019[1]	2020[1]
PM_{10}	24 hour maximum	**51**	36	**54**	**168**	**349**	**1067**
	24 hour criteria exceedances	1	0	1	4	28	24
	Annual average	11.3	10.7	9.6	13.1	22.3	21.6
$PM_{2.5}$	24 hour maximum	14[2]	22	**54**	34	**230**	**923**
	24 hour criteria exceedances	0	0	1	1	28	21
	Annual average	6.0[2]	5.6	5.8	6.1	**12.1**	**14.3**

The reported dataset contained rolling 24-hour averages. Reported maximum daily values and number of exceedances have been based on the 24-hour rolling average recorded at 23 hours for each day.
[1] 2019 and 2020 data was adversely affected by bushfires from later September 2019 and averages and maxima should be treated with caution as they are not representative of long-term conditions.
[2] Insufficient data (data capture approximately 6-month period)
Bold entries denote exceedances of the NSW EPA criteria for that pollutant.

Table 5-6 Florey ambient monitoring data summary

Pollutant	Averaging period	Concentration (µg/m^3)					
		2015	2016	2017	2018	2019[1]	2020[1]
NO_2	1 hour max	62	82	82	82	**595**	**349**
	Annual average	10.2	9.4	10.4	9.8	10.2	8.2
PM_{10}	24 hour maximum	**54**	30	29	**146**	**341**	**1163**
	Annual average	10.6	10.0	9.9	12.1	23.6	24.0
$PM_{2.5}$	24 hour maximum	**25**	**28**	**25**	**26**	**315**	**1065**
	Annual average	6.6	7.1	7.2	7.1	**14.9**	**18.0**

The reported dataset contained rolling 24hour averages. Reported maximum daily values and number of exceedances have been based on the 24-hour rolling average recorded at 23 hrs for each day.
[1] 2019 and 2020 data was adversely affected by bushfires from later September 2019 and averages and maxima should be treated with caution as they are not representative of long-term conditions.

Pollutant	Averaging period	Concentration ($\mu g/m^3$)					
		2015	2016	2017	2018	2019[1]	2020[1]
Bold entries denote exceedances of the NSW EPA criteria for that pollutant.							

Table 5-7 Monash ambient monitoring data summary

Pollutant	Averaging period	Concentration ($\mu g/m^3$)					
		2015	2016	2017	2018	2019[1]	2020[1]
NO_2	1 hour max	62	82	82	82	**164**	**246**
	Annual average	9.0	8.3	9.4	8.2	9.3	8.3
PM_{10}	24 hour maximum	41	33	28	**135**	**311**	**1097**
	Annual average	9.8	9.8	9.8	11.8	18.9	22.6
$PM_{2.5}$	24 hour maximum	**34**	**34**	**36**	**31**	**232**	**1197**
	Annual average	7.3	7.0	7.9	6.9	**14.2**	**18.1**

The reported dataset contained rolling 24hour averages. Reported maximum daily values and number of exceedances have been based on the 24-hour rolling average recorded at 23 hours for each day.
[1] 2019 and 2020 data was adversely affected by bushfires from later September 2019 and averages and maxima should be treated with caution as they are not representative of long-term conditions.
Bold entries denote exceedances of the NSW EPA criteria for that pollutant.

Background NO_2, $PM_{2.5}$ and PM_{10} concentrations are presented in **Figure 5-14** to **Figure 5-18**. Although these figures include 2019 and 2020 data which was adversely affected by bushfires, the data has been excluded from analysis and conclusions as this data is not representative of long-term conditions. Monitoring data from the Florey and Monash stations show that NO_2 levels in the ambient environment are generally below the 1-hour and the annual average NEPM new standards of 31 and 164 $\mu g/m^3$, respectively. Recorded annual average concentrations are well below the NEPM standard with the highest annual average of 10.4 $\mu g/m^3$ recorded at Florey in 2017. Some spikes in the maximum 1-hour NO_2 concentration have been observed during late 2019, and early 2020 which are not consistent with long term trends.

Monitoring data from Civic station shows that $PM_{2.5}$ and PM_{10} are generally well below the NEPM goals, with seasonal variation clearly observed with both $PM_{2.5}$ and PM_{10} having higher concentrations in winter and lower in summer. In general, the winter peaks at Florey and Monash are higher than that of Civic and is likely be associated with increased wood heaters in the suburbs compared to the CBD. March 2018 shows elevated PM_{10} measurements across all three stations, and this was due to a severe dust storm. Particulate concentrations during unusual events should not be used as indicators of long-term peak particulate concentrations.

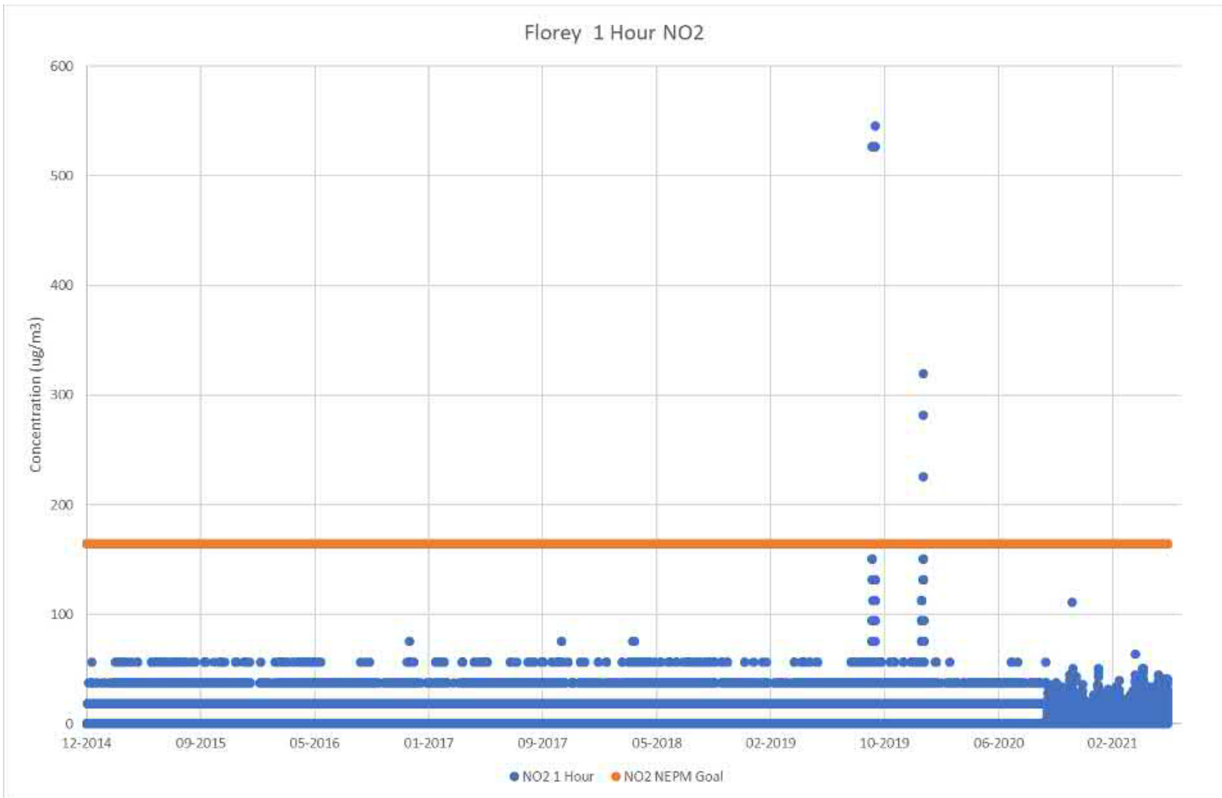


Figure 5-14 **Background NO_2 concentrations, Florey**

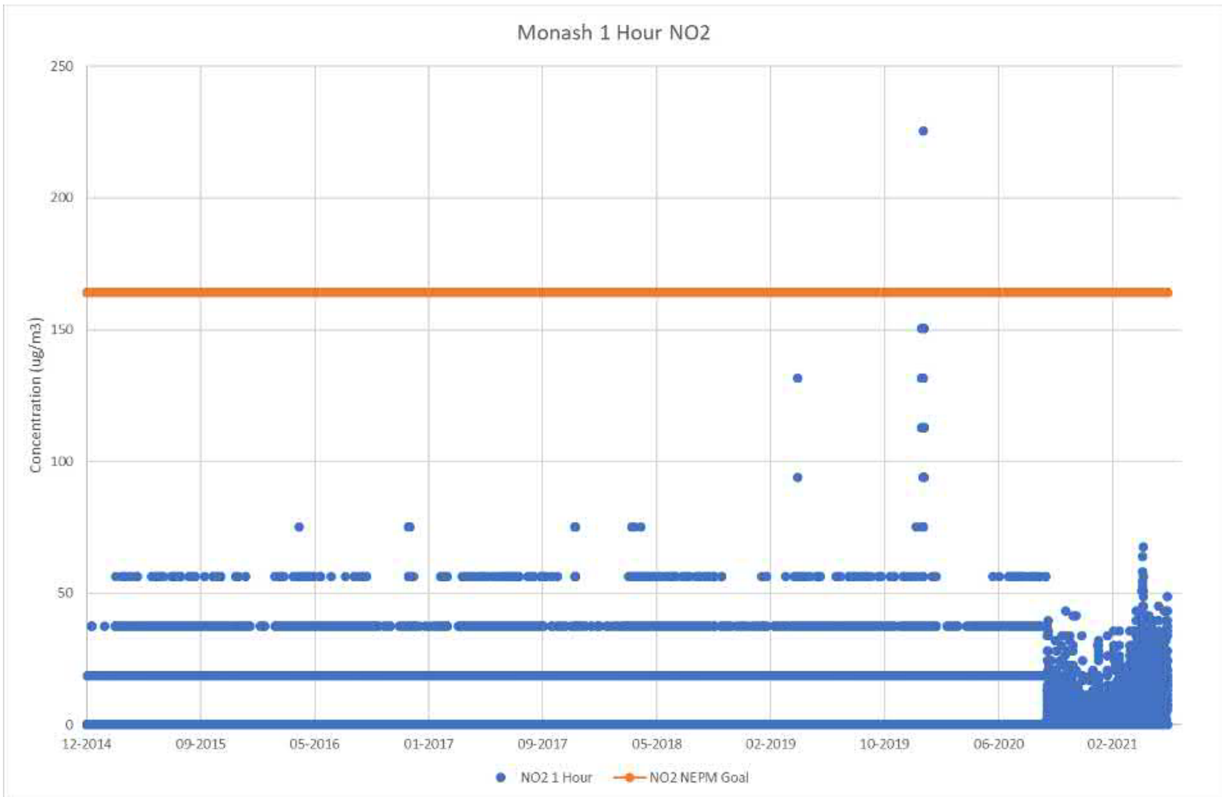


Figure 5-15 **Background NO_2 concentrations, Monash**

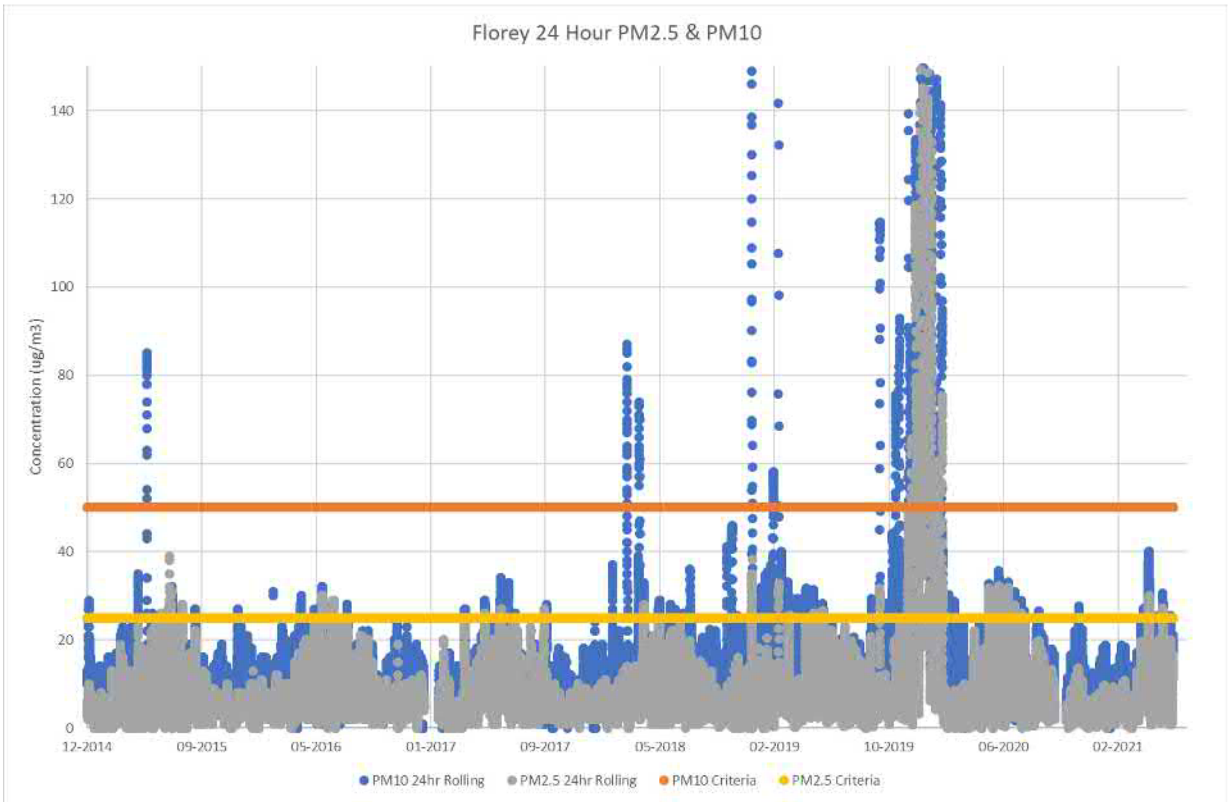


Figure 5-16 **Background PM$_{2.5}$ and PM$_{10}$ concentrations, Florey**

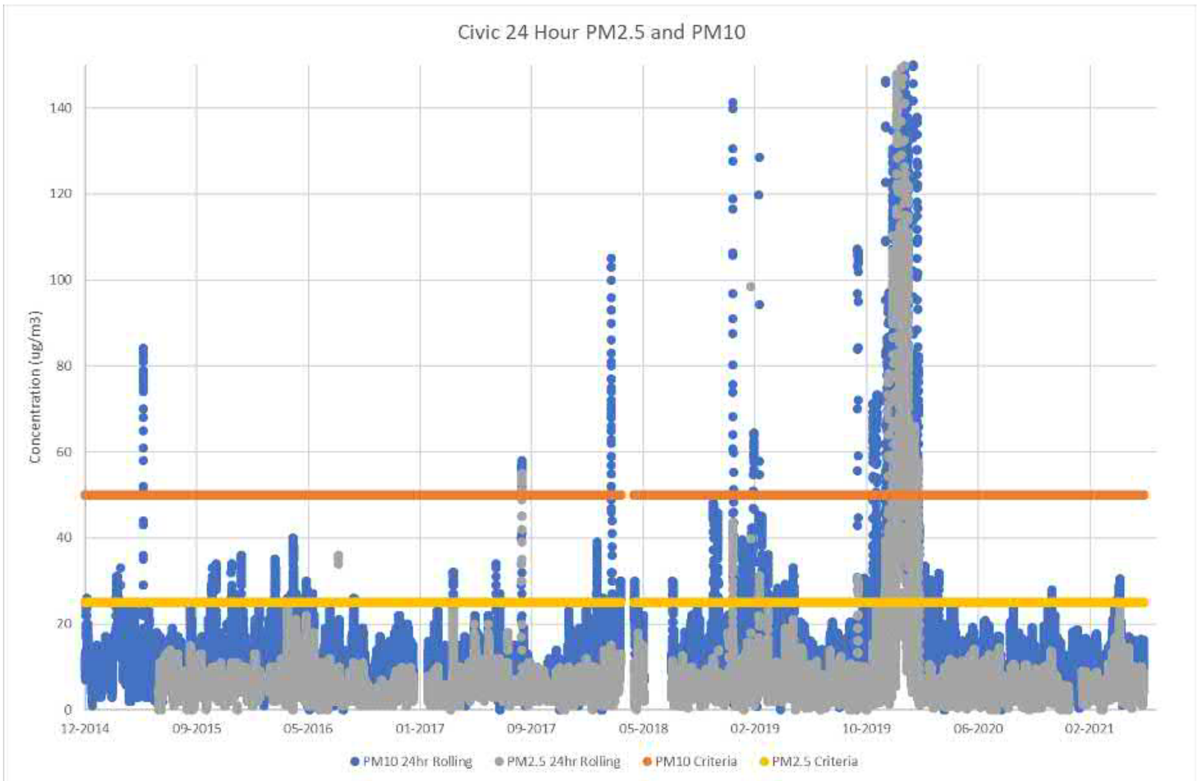


Figure 5-17 **Background PM$_{2.5}$ and PM$_{10}$ concentrations, Civic**

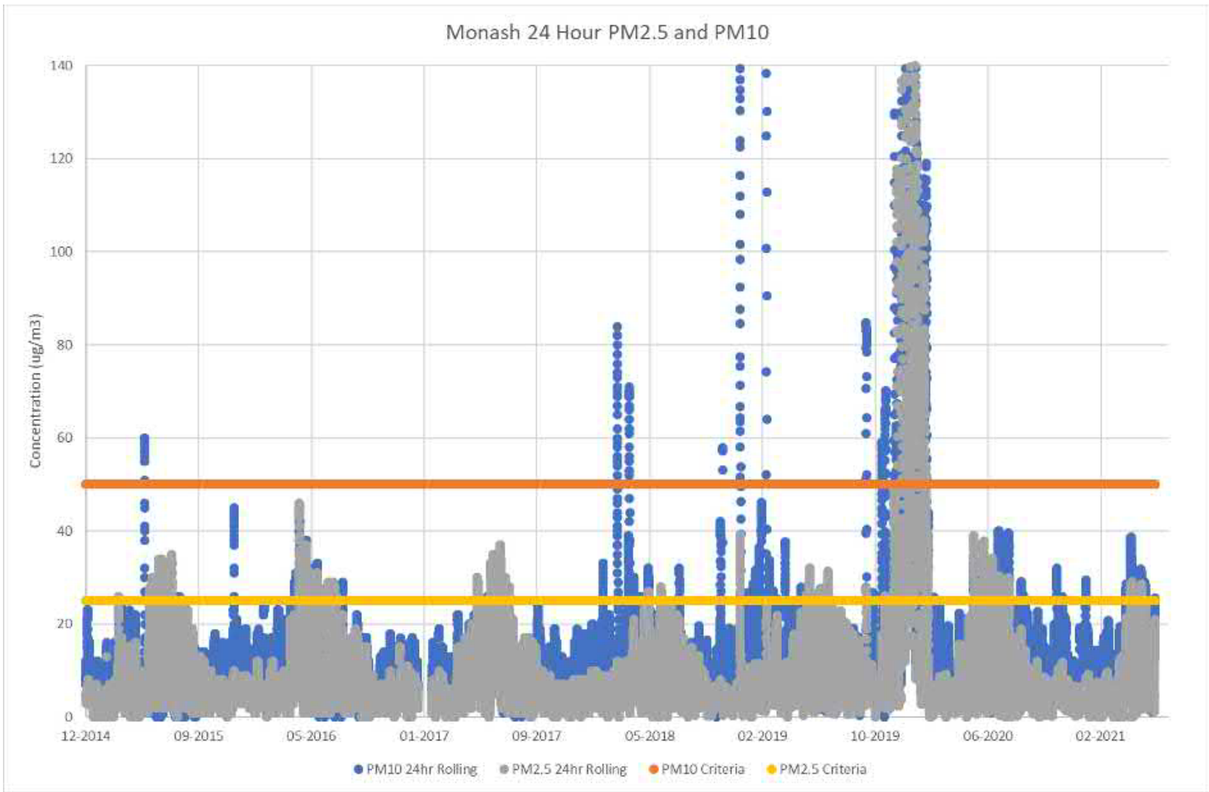


Figure 5-18 Background $PM_{2.5}$ and PM_{10} concentrations, Monash

6.0 Air quality impact assessment

6.1 Construction

The estimated quantities for the Project activities are discussed as follows.

Demolition

13,168 t or 5,692 m^3 total demolition works, consisting of:

- demolition of temporary sidetrack and onsite milling of existing road pavement
- removal of the bridge on Commonwealth Avenue
- removal of stormwater services.

Demolished materials are expected to be reused on site as fill where possible or practical and will reduce the amount of imported fill required.

The demolition phase of the works is planned to take place concurrently with the earthworks phase.

Earthworks

149,470 t or 71,487 m^3 of total earthworks activity, consisting of:

- 25,270 t or 11,487 m^3, consisting of excavating for stormwater services
- 138,000 t or 60,000 m^3, of bulk fill activity, which is reduced to approximately 54,000 m^3 or 124,200t due to the re-use of demolished materials.

Trackout

Trackout of dirt and dust is caused by trucks leaving the project site. To calculate the number of trucks required on the project, the following assumptions have been used:

- The total duration of construction is estimated to be 24 months, however the bulk filling phase will take place over 94 days
- A truck and dog has a capacity of 24 t.

It is estimated 5,175 truck and dogs will be required to import the amount of fill required, equivalent to 55 trucks per day, or 6 trucks per hour in peak periods.

These values have been utilised to allow an estimate of the likely dust impacts from the activities. An estimate of the proposed excavation activities have been used to predict the magnitude of impacts outlined in **Section 6.1.2**.

6.1.1 Stage 1 screening assessment

An initial screening assessment was undertaken to identify whether there were any human receptors within 350 m of the boundary or within 50 m of the route used by construction vehicles. A 350 m screening line was drawn around the project boundaries which is shown in **Figure 6-1** as yellow shading with the construction footprint indicated by the shaded area. This line shows that there are several human receptors within 350 m, and as such a Stage 2 assessment was deemed necessary.

Figure 6-1 Project construction footprint and 350 m receptor screening zone

6.1.2 Stage 2 assessment

The Stage 2 assessment considers the Project construction footprint shown as hatching in **Figure 6-1**.

The excavation activities are not expected to be significant due to the overall aim of the Project being to increase the ground level with fill. There will be some excavation associated with removing existing pavement and services prior to filling.

The construction magnitudes and the potential risks associated with dust soiling due to PM_{10} concentration have been discussed below.

6.1.2.1 Construction activity magnitudes

The construction activity magnitudes and dust sensitivities for the different construction activities are provided in **Table 6-3**. The magnitudes have been estimated based on IAQM guidance provided in **Table 4-1** and the following assumptions, derived from the most recent bill of quantities for the Project.

- Demolition quantities expected for the Project are:
  - Existing pavement milling on site was estimated to be 5,145 m^3
  - Existing bridge was estimated to be 277 m^3
  - Existing stormwater pipes and pits was estimated to be 270 m^3
  - Other minor demolition of street signs and lights are not expected to add significantly to the estimated total
  - The total of the above demolition is 5,692 m^3 which is classified as a small scale of works (less than 20,000 m^3 of construction material) as per the IAQM guidance presented in **Table 4-1**, however there will be on site milling of pavement which has the potential for dust release. Due to the onsite pavement milling the works have been categorised as ‘Large’.

- Earthworks quantities expected at the site are as follows:
  - The area of the project site is greater than 100,000 m^2, which is well above the 10,000 m^2 criteria in the IAQM guidance (presented in **Table 4-1**) equating to a 'Large' category for earthworks
  - The combined volume of material excavated and reused on site, and additional fill brought in is estimated to be 124,200 t, which is above the 100,000 t criteria in the IAQM guidance (presented in **Table 4-1**), equating to a 'Large' category for earthworks
  - The number of heavy earthmoving vehicles active at any one time was estimated at >10, equating to the category of 'Large'
  - Considering the above points, the earthworks have been categorised as 'Large'.
- Construction quantities expected at the site are as follows:
  - Pavement is estimated to be 11,736 m^3
  - The length of the road to be paved is approximately 2.2 km
  - Kerbs are estimated to be 155 m^3
  - Stormwater services is estimated to be 11,487 m^3
  - Paving are estimated to be 105 m^3
  - Footpaths are estimated to be 8 m^3
  - Onsite concrete or asphalt batching is not expected, therefore the potential for dust release is relatively low
  - The duration of the build is estimated to be two years.
  - The total estimated quantity is estimated to be 23,491 m^3, which is classified as a low potential for dust generation (less than 25,000 m^3) as per the IAQM guidance presented in **Table 4-1**, however the duration of the project is long, categorising the construction scale as 'Medium'.
- Trackout for the site was estimated to consist of 55-58 heavy duty vehicle loads per day during the construction period and therefore the trackout risk has been categorised as 'Large'.

The estimates above were current at the time of writing this report. The estimates may need to be refined once the construction plans have been finalised, however it is not expected that changes to the above assumptions would occur that would change the overall findings of the study.

6.1.2.2 Risk associated with dust soiling

The Project site is situated in a CBD setting, adjacent to city parks, hotels, hospitality venues, cultural centres, commercial buildings, government buildings, recreation facilities, long term car parking and residential premises. Given the range of land use within 350 m of the Project boundary, the majority of locations where people would be exposed to air pollution would be workers, where individuals may be exposed for eight hours or more in a day. These receptors would be of 'medium sensitivity' and other locations where exposure to air emissions would be transient, including public footpaths and parks, are considered 'low sensitivity'.

As discussed in **Section 4.2.2.2** under the IAQM Guidance sensitive receptors is defined as a property that may be impacted by dust.

The number of receptors and the risk ratings have been determined depending on the distance from the Project site boundary, as shown in **Figure 6-2** and **Table 6-1**.

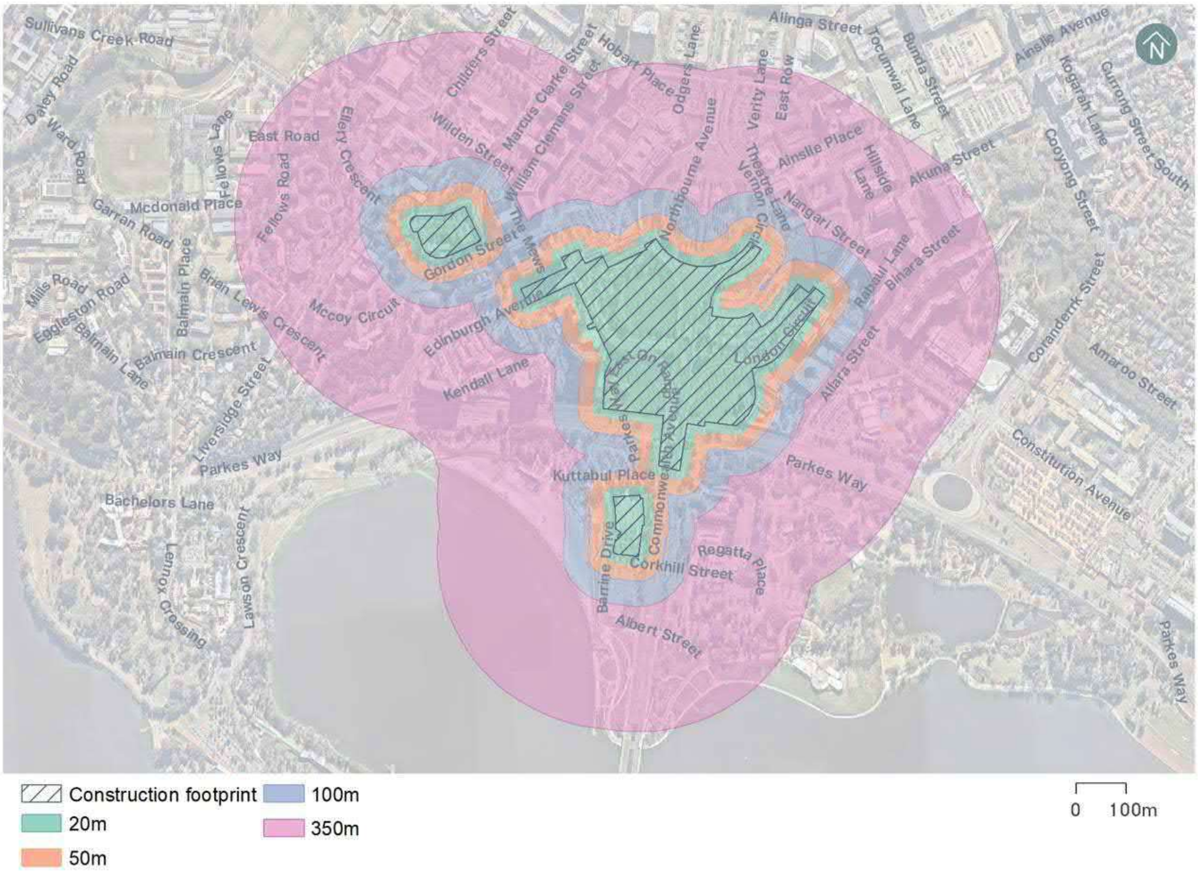


Figure 6-2 Distances from Project site and construction vehicles routes

Table 6-1 Assessment of sensitive receptor risk from dust spoiling

Receptor sensitivity	Distance from construction site boundary				< 50 m construction access route
	< 20 m	< 50 m	< 100 m	< 350 m	
High	Receptors generally limited to commercial premises; highly sensitive receptors within 350m of the construction site boundary are generally not present, hence the risk rating is Low				
Medium	**12** (Medium Risk)	**21** (Low Risk)	**33** (Low Risk)	**<100** (Low Risk)	**3** (Low Risk)
Low	**2** (Low Risk)	**2** (Low Risk)	**3** (Low Risk)	**6** (Low Risk)	**0** (Low Risk)
Notes: *Bold entries denote the number of receptors*					

Overall, the risk rating for dust soiling is medium based on the number of sensitivity receptors located with 20 m and 50 m of the Project site boundary.

6.1.2.3 Risk associated with exposure to PM_{10} particulates (human health)

As detailed in **Section 5.2**, the highest non-bushfire affected background annual average PM_{10} concentration round the site is 13.0 µg/m^3 from Civic station. The risk to human health from exposure to PM_{10} particulates has been determined based around distance to receptors is presented in **Table 6-2**.

Table 6-2 Assessment of human health risk to sensitive receptors

Receptor sensitivity	Distance from construction site boundary				< 50 m construction access route
	< 20 m	< 50 m	< 100 m	< 350 m	
High	Receptors generally limited to commercial premises; highly sensitive receptors have within 350m of the construction site boundary are generally not present, hence the risk rating is Low				
Medium	**12** (Low Risk)	**21** (Low Risk)	**33** (Low Risk)	**<100** (Low Risk)	**3** (Low Risk)
Low	**2** (Low Risk)	**2** (Low Risk)	**3** (Low Risk)	**6** (Low Risk)	**0** (Low Risk)
Notes: *Bold entries denote the number of receptors*					

The overall sensitivity to human health effects for annual average PM_{10} was rated as low.

6.1.2.4 Ecological risk ratings

Ecological risks are linked to the presence of sensitive ecological receptors that may be affected by dust deposition. Ecological receptors are defined as habitats that may be sensitive to dust. As discussed in the Biodiversity Assessment for the Project beyond the boundaries of the Project area is predominantly a built urban environment, road network and some parklands.

The Biodiversity Assessment does note the presence of low-quality Golden Sun Moth (GSM), *Synemon plana* habitat. The GSM is listed as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) and endangered under the *Nature Conservation Act 2016* (ACT) within the construction footprint and surrounds. The Biodiversity Assessment notes that indirect disturbance of GSM habitat may occur as a result of dust emissions from construction however these impacts would be temporary and unlikely to result in ongoing disturbance to GSM habitat. Therefore a low impact on sensitive ecological communities is expected from the Project.

6.1.2.5 Overall dust risk ratings

The potential risks for the overall Project were found to range from Low to High, as summarised in **Table 6-3**.

Table 6-3 Summary of unmitigated risk assessment for the Project activities

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

Given the unmitigated risk ratings of Low to High for the Project, specific activity mitigation measures are recommended to reduce risk, as described in **Section 6.1.4**.

6.1.3 Combustion emissions

Air emissions during the Project works that are not related to dust would be due to the combustion of diesel fuel by heavy vehicles, mobile construction equipment and stationary equipment such as diesel generators. Emissions are expected to depend on the nature of the emissions source i.e. size of the equipment, usage rates, duration of operation etc. Pollutants emitted by construction vehicles include CO, particulate matter (PM_{10} and $PM_{2.5}$), nitrous oxides (N_2O, SO_2, volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs). There is also the potential for minor increases in vehicle emissions due to minor increased traffic delays during construction works on the surrounding road network as discussed in the Traffic and Transport Impact Assessment for the Project.

Given the expected scale of the infrastructure removal and remedial works, the typically transitory nature of construction site mobile equipment, vehicle numbers and the commonly applied mitigation measures expected to be incorporated into the operation of the equipment, adverse air quality impacts from the operation of construction equipment are not expected. On this basis, no further quantification of the potential impacts has been undertaken.

6.1.4 Construction mitigation measures

Emissions of air pollutants from construction activities can be mitigated using a range of physical or operational measures designed to minimise both the generation and transport of pollutants away from the source of the emissions. In terms of dust emissions from the construction activities, the objective of any mitigation measure is to ensure the constructions activities meet a range of air quality performance outcomes. If the outcomes are met, it is expected that the site would achieve an acceptable level of dust generation for the construction activities and minimise adverse impacts on surrounding receptors (receptors refer to residential premises, hospitals, schools etc).

The air quality performance outcomes for the construction phase of the Project are as follows:

- no visible dust moving across the project site footprint boundary
- no unnecessary vehicle combustion emissions
- no soil trackout onto public roads
- no complaints from receptors in relation to dust emissions.

The performance outcomes would be addressed through the development of a Construction Air Quality Management Plan (CAQMP). A list of mitigation measures which may be implemented to achieve the above performance outcomes are provided below in **Table 6-4** to **Table 6-8.**

Note that this list of measures represents a minimum requirement for the Project and additional measures may be required to further reduce potential dust emissions.

Table 6-4 Mitigation measures – general

ID	Performance outcome to be achieved	Mitigation measure
AQ1	• No visible dust moving across the project site footprint boundary • No complaints from receptors in relation to dust emissions	Plan site layout such that machinery and dust causing activities are located as far away from receptors as possible. Designated stockpile area should be situated as far as practice from the construction boundary and nearby sensitive receptors Limit stockpile heights based on stability; and avoid building steep sided stockpiles. Keep stockpiles for the shortest time possible and where practical. Cover, water or apply dust suppressant to stockpiles where practical to minimise dust, particularly during windy conditions. Only use petrol or diesel generators where mains power is not feasible.
AQ2	• No visible dust moving off-site • No soil trackout onto public roads • No complaints from receptors in relation to dust emissions	Daily construction activities should be planned to consider the expected weather conditions for each workday. Regular dust observations to be undertaken of active excavation or stockpiling areas. Aim is to ensure visible dust is not moving offsite and that any areas needing additional measured be identified early.

ID	Performance outcome to be achieved	Mitigation measure
		Records of observations should be compiled to enable the demonstration that dust is being managed in an ongoing manner. Records should include (as a minimum) the following: • observation date and time • area being inspected • level of dust being generated • meteorological conditions when observation occurred • mitigation measures undertaken, • increase frequency of inspections when activities of high dust generation potential Keep a record of any complaints, take appropriate measured in reasonable time, and record any outcomes and findings. Make the records available to the local authority is required. If any other significant development works within 500 m of the Project site encourage liaison between site managers to ensure dust management plans are compatible and to consider offsite transport effects.
AQ3	• No visible dust moving off-site.	Minimise exposed surfaces, such as stockpiles and cleared areas, including partial covering of stockpiles, watering or use of dust suppressants where practicable.
AQ4	• No visible dust moving off-site.	Implement dust suppression measures on exposed surfaces, such as watering of exposed soil surfaces, dust mesh, water trucks and sprinklers to minimise dust generation. Ensure water supply is adequate for mitigation measures in all locations.
AQ5	• No soil trackout onto public roads.	Establish defined site entry and exit points to minimise tracking of soil on surrounding roads. Shaker grid to be installed at the site exit to prevent trackout of spoil material. This is consistent with the site Erosion and Sediment Control Plan.
AQ6	• No visible dust moving off-site • No soil trackout onto public roads.	Cover heavy vehicles entering and leaving the site to prevent material escaping during transport.
AQ7	• No visible dust moving off-site • No unnecessary vehicle combustion emissions.	Keep vehicles and construction equipment operating on site well maintained and turned off when not operating (minimise idling on the site).
AQ8	• No visible dust moving off-site.	Minimise the handling of spoil when excavating and loading of vehicles.

Table 6-5 Mitigation measures – demolition

ID	Performance outcome to be achieved	Mitigation measure
AQD1	• No visible dust moving across the project site footprint boundary	• Ensure effective water suppression is used during demolition operations.
AQD2	• No visible dust moving across the project site footprint boundary	• Avoid explosive blasting, use appropriate manual or mechanical methods.

Table 6-6 Mitigation measures – earthworks

ID	Performance outcome to be achieved	Mitigation measure
AQE1	• No visible dust moving across the project site footprint boundary	• Revegetate exposed areas / stockpiles as soon as practicable to stabilise surfaces
AQE2	• No visible dust moving across the project site footprint boundary	• Keep works zones as small as practicable, i.e. don't disturb more ground than is necessary at one time

Table 6-7 Mitigation measures – construction

ID	Performance outcome to be achieved	Mitigation measure
AQC1	• No visible dust moving across the project site footprint boundary	• Avoid scabbling of concrete surfaces if possible
AQC2	• No visible dust moving across the project site footprint boundary	• Store sand and other aggregates in bunded areas and do not allow to dry out. If required to be dry use other mitigating measures
AQC3	• No soil trackout onto public roads	• Ensure cement and fine materials are delivered in enclosed tankers and stored in silos to prevent material escape. For smaller supplies reseal bags after use.

Table 6-8 Mitigation measures – trackout

ID	Performance outcome to be achieved	Mitigation measure
AQT1	• No soil trackout onto public roads	• Use water assisted dust sweepers on access and local roads
AQT2	• No visible dust moving across the project site footprint boundary	• Avoid dry sweeping of large areas
AQT3	• No soil trackout onto public roads	• Ensure vehicles entering and leaving site are covered during transport
AQT4	• No visible dust moving across the project site footprint boundary	• Inspect and maintain on site haul roads. Keep records of inspections and repairs
AQT5	• No visible dust moving across the project site footprint boundary	• Install hard surfaces haul routes, regularly moistened and cleaned
AQT6	• No soil trackout onto public roads	• Implement a wheel wash system with rumble grids prior to leaving site
AQT7	• No complaints from receptors in relation to dust emissions	• Access gates to be > 10 m from receptors where possible

6.1.5 Determination of significant effects

As indicated in the IAQM documentation, "*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'*". With the implementation of mitigation measures, the risks indicated above are expected to produce a residual effect which is not significant.

The final determination of "not significant" is dependent on the implementation of proper design and implementation of dust mitigation measures. To ensure the measures are adequately implemented, an air quality management plan needs to be developed as part of the construction planning documentation.

6.2 Operation

Following the completion of construction, all disturbed areas would be reinstated, and areas of exposed soil would be paved or vegetated. Further, no ongoing dust generating activities form part of the operational Project description.

The Project is not expected to generate additional traffic nor significantly affect the distribution of traffic on the road network, as such, the potential air quality emissions attributed to the operation of the Project would be negligible and would be unlikely to have any significant air quality impacts.

6.3 Air quality risk assessment

The risk assessment identified the risks associated with air quality as a result of the Project during construction and operation in accordance with the risk methodology detailed in **Section 4.4**. The initial and residual air quality risks associated with the Project are summarised in **Table 6-9**. The initial risk ratings presented consider an initial set of mitigation measures (where relevant) which are based on compliance with legislation and standard requirements that are typically incorporated into the delivery of infrastructure project of similar type, scale, and complexity. Risk ratings have been applied to each of the identified risk pathways assuming that these mitigation measures were in place.

Where initial risk ratings were categorised as medium or higher, additional mitigation measures were developed (where possible) to lower the residual risk.

Table 6-9 Air quality risks for construction and operation of the Project

Risk ID	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk		
				C	L	R		C	L	R
AQR1	Dust from site clearance and construction site establishment	Site clearance and construction site establishment activities result in the generation of dust resulting in poor air quality	Dust suppression should be used at construction areas as required as detailed in **Section 6.1.4**	Moderate	Possible	Medium	Vehicle and mobile plant equipment should be restricted within the construction footprint on designated roads and tracks Limit dust on unsealed access tracks by watering, using dust suppressants or spreading crushed rock. Vehicles speeds should be restricted to 40km/hr. Observational dust monitoring along the construction right of way and facilities should be undertaken. If dust is observed to leave the construction footprint works should be modified or stopped until dust hazard is reduced to a manageable level.	Moderate	Unlikely	Low
AQR2	Dust from construction activities	Construction activities (e.g. earthworks and vehicle movements) result in the generation of dust resulting in poor air quality	Dust suppression should be used at construction areas as required as detailed in **Section 6.1.4**	Moderate	Possible	Medium	Vehicle and mobile plant equipment should be restricted within the construction footprint on designated roads and tracks Limit dust on unsealed access tracks by watering, using dust suppressants or spreading crushed rock. Vehicles speeds should be restricted to 40 km/hr. Observational dust monitoring along the construction right of way and facilities should be undertaken. If dust is observed to leave the construction footprint works should be modified or stopped until dust hazard is reduced to a manageable level.	Moderate	Unlikely	Low

Risk ID	Risk name	Risk pathway	Initial mitigation measure	Initial risk			Additional mitigation measure	Residual risk		
				C	L	R		C	L	R
AQR3	Extreme weather (hot windy conditions)	Climatic conditions result in the generation of dust leading to poor air quality conditions.	Dust suppression should be used at construction areas as required as detailed in **Section 6.1.4**	Moderate	Possible	Medium	Weather conditions should be monitored for extreme and/or wind events and works should be modified. Observational dust monitoring along the construction right of way and facilities should be undertaken. If dust is observed to leave the construction footprint works should be modified or stopped until dust hazard is reduced to a manageable level.	Moderate	Unlikely	Low
AQR4	Handling and removal of spoil/earthworks	Increased dust emissions near the construction worksite (within urban environment) due to earthworks leading to generation of dust and poor air quality conditions.	Dust suppression should be used at construction areas as required as detailed in **Section 6.1.4**	Moderate	Possible	Medium	Cover heavy vehicles entering and leaving the site to prevent material escaping during transport. Minimise exposed surface areas where possible Implement dust suppression measures on exposed surfaces, such as watering of exposed soil surfaces, dust mesh, water trucks and sprinklers to minimise dust generation Observational dust monitoring along the construction right of way and facilities should be undertaken. If dust is observed to leave the construction footprint works should be modified or stopped until dust hazard is reduced to a manageable level.	Moderate	Unlikely	Low
AQR5	Combustion emissions from construction activities	Construction equipment vehicles result in generation of combustion emissions resulting in poor air quality.	Construction vehicles and mobile plant equipment should be maintained in good condition to minimise spills and air pollution that may cause nuisance as detailed in **Section 6.1.4**	Minor	Unlikely	Low	No additional mitigation measures identified	Minor	Unlikely	Low

7.0 Conclusion

A qualitative air quality impact assessment of Project construction was undertaken in accordance with the IAQM, 2014 *Guidance on the assessment of dust from demolition and construction*. The four-step risk-based assessment of dust emissions found that dust impacts from the project were determined to be not significant provided that standard dust mitigation measures are implemented a Construction Air Quality Management Plan is administered.

A risk assessment of air quality impacts from Project construction was also undertaken. Given that potential air quality risks associated with infrastructure projects are well known and can generally be managed using standard industry safeguard procedures the potential risks for the Project are considered low to very low.

The potential air quality emissions attributed to the operation of the Project would be negligible and, when compared to the existing environment, would be unlikely to have any significant air quality impacts.

In summary potential air quality attributed to the construction and operation of the Project are unlikely to have any significant impacts.

8.0 References

Commonwealth of Australia (2021) National Greenhouse Accounts Factors, Australian National Greenhouse Accounts (August 2021), Australian Government, Department of Industry, Science, Energy and Resources

DEC (2007), *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*.

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ERM, (2018), *Evaluation distances for effective air quality and noise management*.

NEPC (2021), *National Environment Protection (Ambient Air Quality) Measure (Clth)*

NSW Government, (1997), *Protection of the Environment Operations Act 1997 (NSW)*

NSW Government, (2010), *POEO (Clean Air) Regulation 2010*

Transport Authorities Greenhouse Group (TAGG) (2013); Greenhouse Gas Assessment Workbook for Road Projects.

UK Institute of Air Quality Management (IAQM), (2014), *Guidance on the assessment of dust from demolition and construction*

Appendix A

Infrastructure Sustainability Council (ISC) criteria

Appendix A Infrastructure Sustainability Council (ISC) criteria

The Infrastructure Sustainability Council (ISC) Infrastructure Sustainability (IS) rating scheme is Australia's only comprehensive rating scheme for evaluating sustainability for infrastructure. The RLC and Light Rail to Woden projects are seeking to achieve 'Leading' Design and As-Built IS ratings. As part of this process, alignment with the environmental design credit Env-4 (air quality) is required. This report seeks to align with the IS criteria and additional guidance where relevant to the scope of the assessment.

Table A-1 outlines specific requirements as part of Env-4 to demonstrate achievement of the required target levels and where these are addressed in this report.

Table A-1 ISC requirements

ISCA requirement	Section addressed / comment
DL1.1 Baseline studies of existing air quality have been carried out for the Project.	Baseline study provided in **Section 5.4**
DL1.2 Modelling and /or predictions for air quality impacts have been developed for construction and operation phases of the Project	Qualitative air quality construction impact assessment undertaken as described in **Section 6.0**. No operational impacts are anticipated for this stage of the project, but further assessment would be required for the next stage of the project.
DL1.3 Air quality goals are identified for the project.	Relevant ambient air quality criteria are provided in **Section 4.3**. Performance outcomes for construction are also provided in **Section 6.1.4**.
Baseline studies must be undertaken by a suitably qualified professional to identifying the pre-exiting air quality prior to the project commencing.	Baseline study provided in **Section 5.4**.
Air quality predictions must be established for the construction and operation phases of the Project, and consider a comparison against the baseline data. Predictions must be developed by a suitably qualified professional and incorporate all equipment proposed to be used through the construction and operation of the Project that could result in air quality impacts.	Qualitative air quality construction impact assessment undertaken as described in **Section 6.0**. No operational impacts are anticipated for this stage of the Project, but further assessment would be required for the next stage of the Project.
Predictions must factor in sensitive receivers and the increased impact that air quality may have on them.	Air quality impact assessment assess the sensitivity of the area to health and dust soiling based on the proximity of sensitive receptors in **Section 6.0**.
Predictions must be incorporated, and influence air quality goals established in DL1.3.	Qualitative impact assessment only, results of the assessment in **Section 6.1.5** indicate that provided standard mitigation measures are applied no significant air quality impacts are anticipated.
Air quality goals must be established for the Project taking into account the baseline data established in DL1.1. The goals must be SMART (specific, measurable, achievable, relevant and time-bound) and must align with a no net impact outcome. The evidence for this criterion must include:	Qualitative impact assessment only, results of the assessment in **Section 6.1.5** indicate that provided standard mitigation measures are applied as identified in **Section 6.1.4** no significant air quality impacts are anticipated. Performance outcomes for construction are also provided in **Section 6.1.4.**

ISCA requirement	Section addressed / comment
• Any assumptions made, with relevant calculations, • The methodology used to develop the goals, • Background information demonstrating how the goals align with the intended outcome/s, and • How the baseline assessment has been incorporated.	
The measures implemented/adopted to meet the goals identified in DL1.2 must be detailed for construction and operation. The measures identified for construction and operational phases must be implemented.	Construction mitigation measures to manage potential air quality impacts are detailed in **Section 6.1.4**. No operational impacts are anticipated for this stage of the Project, but further assessment would be required for the next stage of the Project.
Where works are deemed unavoidable or essential, suitable control measures must be used to ensure that the impact is minimised as much as is feasible and reasonable. A schedule for all planned works with appropriate approvals process and identified control measures must be provided as evidence during the design phase.	Construction mitigation measures to manage potential air quality impacts are detailed in **Section 6.1.4**. A Construction Air Quality Management Plan would need to be prepared prior to commencement of construction works.
Monitoring requirements of air quality must be included in relevant management plans for construction and operation & maintenance manuals for the operational phase (where required). These must include the frequency, duration and locations of monitoring, any relevant triggers (e.g. high-risk activities) and the parameters to be monitored. Justification of the frequency and duration of monitoring during the construction phase must be included and be sufficient to appropriately review the efficacy of control measures implemented.	Construction mitigation measures to manage potential air quality impacts are detailed in **Section 6.1.4**. A Construction Air Quality Management Plan would need to be prepared prior to commencement of construction works.
DL2.1 Modelling demonstrates no recurring or major exceedances of air emission or air quality goals.	Qualitative impact assessment only, results of the assessment in **Section 6.1.5** indicate that provided standard mitigation measures are applied no significant air quality impacts are anticipated. No operational impacts are anticipated for this stage of the Project, but further assessment would be required for the next stage of the Project.
Where exceedances are predicted, these must be clearly identified with the appropriate control measures to limit the scale of the impact.	Qualitative impact assessment only, results of the assessment in **Section 6.1.5** indicate that provided standard mitigation measures are applied no significant air quality impacts are anticipated.
A report must be provided with interpretation of the results and appropriate justification provided for any divergences from the monitoring plan developed during design.	A Construction Air Quality Management Plan would need to be prepared prior to commencement of construction works.

ISCA requirement	Section addressed / comment
DL3.1 Modelling demonstrates no exceedances of air emission or air quality goals.	Qualitative impact assessment only, results of the assessment in **Section 6.1.5** indicate that provided standard mitigation measures are applied no significant air quality impacts are anticipated.
Modelling and/or predictions must demonstrate no exceedances of air emissions or air quality goals set in DL1.3	Qualitative impact assessment only, results of the assessment in **Section 6.1.5** indicate that provided standard mitigation measures are applied no significant air quality impacts are anticipated.