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Sovereign Park, The Hill

Construction Air Quality Assessment

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Quality Control

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THE PROPOSAL	Final	NP, MD	MD	GCG
EXISTING CONDITIONS	Final	NP, MD	MD	GCG
METHODOLOGY	Final	NP, MD	MD	GCG
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Final Authority

This report must by regarded as draft until the above study components have been each marked as final, and the document has been signed and dated below.

***pp*. M. Doyle** **4 August 2021**

Non-Technical Summary

Crescent Newcastle Pty Ltd has engaged Northstar Air Quality Pty Ltd to perform a construction air quality assessment for the Sovereign Park development at 11-17 Mosbri Crescent, The Hill NSW.

The purpose of this assessment is to identify and examine whether the potential impacts of the construction of the Proposal (including demolition and grouting of mine voids) may adversely affect local air quality, and to identify management and mitigation measures which would be applied to manage any risks to nearby sensitive receptor locations.

To allow assessment of the level of air quality risk associated with the construction related activities associated with the Proposal, a risk-based assessment has been performed. For this risk assessment, Northstar has adapted a methodology presented in the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management. This approach is widely used across Australia and in NSW when assessing the potential impacts associated with construction proposals.

The assessment has identified a number of sensitive receptor locations near to the Proposal site, with the closest being approximately 2 metres from the site boundary. Air quality data from the Newcastle Department of Planning, Industry and Environment Air Quality Monitoring Station has been adopted to determine a background air quality environment (i.e. the conditions to be expected without the Proposal). The highest of the last five-years of measured air quality data has been adopted to provide a conservative assessment. The meteorology of the area has also been reviewed which indicates that in general, winds would act to disperse any generated particulate matter away from residential locations to the west and north of the Proposal site towards the public recreation areas to the east and south-east of the Proposal site.

The assessment indicates that without appropriate mitigation measures during construction, risks to health and dust soiling may be high. A comprehensive range of management and mitigation measures are presented within the assessment which would act to reduce that risk to a negligible level. These measures can be considered to represent best practice for construction sites, should be documented within the Construction Environment Management Plan for the Proposal and also be subject to appropriate review and audit as required through conditions of consent.

Given the level of unmitigated risk associated with the Proposal, it is recommended that a campaign of air quality monitoring is performed throughout the construction period, to provide real-time information to the contractor as to whether the management measures deployed through the Construction Environment Management Plan are acting to appropriately mitigate any air quality risks to nearby sensitive receptors. The campaign monitoring data may also be used to provide the community and Council with evidence of effective emission control.

The report is based on preliminary estimates of programme and equipment, which may be subject to change as required to meet regulatory requirements of Subsidence Advisory NSW or other regulatory requirements.

Contents

Tables

Figures

1. INTRODUCTION

Crescent Newcastle Pty Ltd has engaged Northstar Air Quality Pty Ltd (Northstar) to perform a construction air quality assessment for the Sovereign Park development (the Proposal) at 11-17 Mosbri Crescent, The Hill NSW (the Proposal site).

This study presents an assessment of the risks to local air quality associated with the activities associated with the construction of the Proposal. Best practice emission controls are identified to mitigate / minimise any significant sources of emissions.

1.1 Approach to Assessment

The purpose of this report is to examine and identify whether the impacts of the demolition, grouting of mine voids, and construction of the Proposal may adversely affect local air quality. Within this report, these activities have generally been grouped and termed more holistically as 'construction activities'. The mitigation measures identified do however consider individual activities as presented in **Section 5**.

To allow assessment of the level of risk associated with those activities in relation to air quality, a risk-based assessment has been performed. For this risk assessment, Northstar has adapted a methodology presented in the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM)[1]. Reference should be made to **Appendix D** for the methodology. This approach is widely used across Australia and in NSW when assessing the potential impacts associated with construction proposals.

The aim of the IAQM methodology is to determine a risk to air quality health and dust soiling impacts, should those construction activities not be controlled (mitigated). Based on the level of unmitigated risk, a range of control measures are identified. Should those controls be adopted, then the residual level of risk associated with air quality health and dust soiling impacts should be negligible.

[1] www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

2. THE PROPOSAL

The following provides a description of the Proposal site and the potential emissions to air which would be anticipated to be associated with the Proposal.

2.1 Environmental Setting

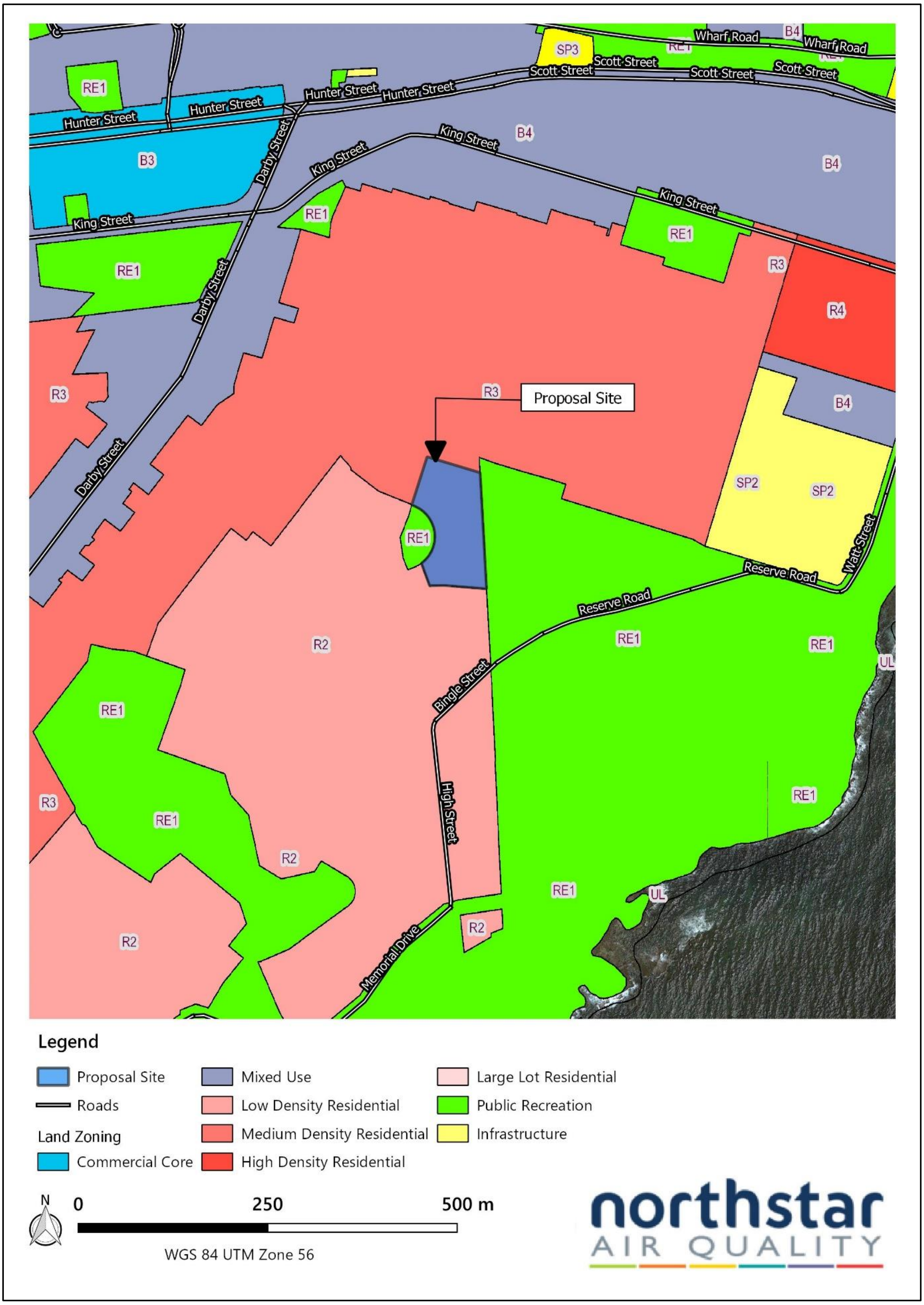
The Proposal site is located at 11-17 Mosbri Crescent, The Hill NSW occupying Lot 1 of Deposited Plan 204077. The Proposal site is located within the Local Government Area (LGA) of Newcastle. A map illustrating the location of the Proposal site is presented in **Figure 1**.

The area surrounding the Proposal site is largely residential with land occupied by the Proposal site being zoned as R3 (Large Lot Residential) and lands located to the east and west zoned as RE1 (Public Recreation) as presented in **Figure 2**. The closest residential property is approximately 2 metres (m) to the west of the Proposal site as seen in **Figure 3**.

Figure 1 Proposal site location

Source: Northstar Air Quality

Figure 2 Land use surrounding the Proposal site



Source: Northstar Air Quality

2.2 Specific Details

The proposed development entails the construction of one hundred and seventy-two (172) residential dwellings. The works associated with the proposed development include:

- Demolition of the existing NBN television studio building and associated carparking.
- Clearing of site and bulk excavation and mines remediation.
- Construction of eleven (11) two-storey townhouses fronting Mosbri Crescent and concrete basement car park.
- Construction of Block A consisting of nine (9) residential levels and a West wing consisting of six (6) residential levels.
- Construction of Block B consisting of seven (7) residential levels and roof top communal open space, with nine (9) two-storey integrated townhouses facing the internal courtyard.
- Construction of Block C consisting of five (5) residential levels.
- Interconnected double level concrete car parking servicing Blocks A, B and C with 2 levels of basement.
- Pedestrian path, providing connection from Mosbri Crescent to Kitchener Parade.
- Landscaping, communal open space and associated signage.
- Services and site infrastructure.

As part of the above works, the proponent proposes to perform grouting of mine voids for stabilisation purposes at the Proposal site. The process of those specific activities performed onsite is detailed below:

- 111 holes with a diameter of 115 millimetre (mm) will be drilled at the Proposal site to a depth of approximately 40 m to 90 m to access the mine voids;
- Cement batching will be performed onsite using fly ash and cement in a mobile batching plant; and,
- Cement/grout will then be pumped into the mine voids.

Demolition activities are anticipated to be performed over a period of 4 months, grouting of unused mine voids over a period of 5 months, and building and construction of the Proposal over a period of 24 months.

The proponent has proposed to stockpile fly ash for mine grouting and associated spoil material inside the existing NBN studio building at the Proposal site. It is therefore assumed that the demolition of the studio building will be performed after the grouting of mine voids has been completed.

Construction activities will take place from 7.00 am to 5.00 pm, Monday to Friday and from 7.00 am to 1.30 pm on Saturdays. No works will be performed on Sundays or public holidays.

The report is based on preliminary estimates of programme and equipment, which may be subject to change as required to meet regulatory requirements of Subsidence Advisory NSW or other regulatory requirements.

2.3 Identified Potential for Emissions to Air

Given the nature of the Proposal outlined briefly above, emissions to air would be likely to be generated as described below.

2.3.1 Demolition and Construction Phase

Construction of the Proposal would involve demolition of existing structures, bulk earthworks, and construction of residential developments as outlined in **Section 2.2**.

The total volume of the construction required for the Proposal is anticipated to be approximately 132 500 cubic metres (m^3), assuming a combined total footprint of the residential development of 6 090 square metres (m^2) and a maximum building height of 27 m (ranging from 6.5 m to 27 m).

An indicative list of plant and equipment that may be used during the demolition and construction phase of the Proposal includes:

- Excavators;
- Front End Loaders;
- Graders;
- Light vehicles;
- Heavy vehicles;
- Drills;
- Pneumatic hand or power tools;
- Cranes;
- Commercial vans; and
- Cherry pickers.

Emissions of particulate matter (dust) may be anticipated during the demolition and construction phases through the activities of excavation, storage, movement, and handling of materials. Localised engine-exhaust emissions from construction machinery and vehicles may also be experienced, but given the scale of the proposed works, fugitive dust emissions would have the greatest potential to give rise to downwind air quality impacts.

The assessment of the potential impacts upon local air quality, resulting from demolition and construction activities is presented in **Section 5**.

2.3.2 Grouting of Mine Voids

The anticipated plant and equipment to be used during the grouting of mine voids include:

- Truck and dog vehicles to bring materials to site and remove spoil;
- Drilling rig;
- Cement truck;
- Front end loader;
- Mobile cement silo; and
- Mobile batching plant.

Activity rates associated with the equipment and operations associated with the grouting of mine voids are provided below.

The proposed grouting of mine voids may potentially generate emissions of particulate matter. The identified processes which may result in the emissions of particulate matter to air during the grouting of mine voids include:

- Materials handling;
- Materials processing;
- Haulage; and
- Wind erosion.

Once again, localised engine-exhaust emissions from machinery and vehicles associated with the grouting of mine voids may also be experienced, but given the scale of the proposed works, fugitive dust emissions would have the greatest potential to give rise to downwind air quality impacts.

Materials Handling

A drilling rig is intended to be used at the Proposal site to drill boreholes for grout filling. The proponent has anticipated that in accordance with the drilling specifications outlined in **Section 2.2**, the total surface area to be drilled at the Proposal site will be approximately 12 m^2, amounting to less than 1 % of the total site area.

The grout used to fill the drilling holes is proposed to be mixed at the Proposal site using fly ash and cement. Fly ash is expected to be delivered to the Proposal site using truck and dog vehicles and cement will be delivered using a cement truck. The cement will be stored at the Proposal site in a mobile cement silo prior to cement batching activities.

Front end loaders will be used to move materials around the Proposal site, to trucks, and for any stockpile management activities.

Materials Processing (Cement Batching)

Cement batching is anticipated to be performed onsite using fly ash and cement using a mobile batching plant. Ash material used as part of the Proposal will meet the requirements of the *NSW EPA Coal Ash Order* (NSW EPA, 2014).

Estimations for the amount of grout to be pumped into the mine voids as provided by the proponent are outlined in **Table 1**.

Table 1 Estimation of grout required for the Proposal

Requirements	Grout Volume (m^3)
Borehole seam	20 800
Yard seam	2 000
Total estimated grout required	**20 800**

Haulage

A number of heavy vehicles will be required as part of the Proposal including:

- Truck and dogs; and
- Cement truck.

It is anticipated that heavy vehicle movements on paved road surfaces at the Proposal site may result in emissions of wheel generated dust. The haulage route onsite is expected to be approximately 45 m in length from the site entrance to the north-western corner of the NBN studio building. Heavy vehicle movements required for the Proposal are presented in **Table 2**.

Table 2 Heavy vehicle movements required for the Proposal

Vehicle		Number of Movements	
		Day	Week
Cement truck		1	6
Truck and dogs	Ash delivery	10	60
	Removal of spoil	Not required daily	1 to 2

Wind Erosion

Stockpiles will be required at the Proposal site for the storage of fly ash to be used in the cement batching process. Stockpiles of spoil material generated through drilling would also be required, given that this material would not be removed on a daily basis.

It is anticipated that stockpiles of fly ash and spoil material will be located inside the existing NBN television studio building for the duration of mine grouting works. The enclosure of stockpiles and implementation of other management measures will significantly reduce the potential for wind generated dust to impact land uses surrounding the Proposal site.

The assessment of the potential impacts upon local air quality, resulting from grouting of mine voids is presented in **Section 5**.

3. EXISTING CONDITIONS

3.1 Surrounding Land Sensitivity

Air quality assessments typically use a desk-top mapping study to identify 'discrete receptor locations', which are intended to represent a selection of locations that may be susceptible to changes in air quality. In broad terms, the identification of sensitive receptors refers to places at which humans may be present for a period representative of the averaging period for the pollutant being assessed. Typically, these locations are identified as residential properties although other sensitive land uses may include schools, medical centres, places of employment, recreational areas or ecologically sensitive locations.

It should be noted that this assessment does not include any modelling of pollutants, however, sensitive receptors have been identified to provide a characterisation of the sensitivity of the local area.

The sensitive receptors identified in this study are presented in **Figure 3** and **Table 3**.

Table 3 Discrete sensitive receptor locations used in the study

Rec. ID	Address	Land Use	Location (m, UTM 56)	
			Eastings	Northings
R1	9 Mosbri Crescent, The Hill	Residential	385 592	6 355 664
R2	12 Mosbri Crescent, The Hill	Residential	385 584	6 355 631
R3	19 Mosbri Crescent, The Hill	Residential	385 602	6 355 563
R4	11 Hillview Crescent, The Hill	Residential	385 629	6 355 537
R5	99 Wolfe Street, The Hill	Residential	385 788	6 355 662
R6	59 Brown Street, The Hill	Residential	385 701	6 355 717
R7	48 Brown Street, The Hill	Educational (High School)	385 652	6 355 726
R8	41 Kitchener Parade, the Hill	Residential	385 593	6 355 688

The nearest residence (R1) is located approximately 2 m to the west of the Proposal site, with the nearest school (R7) located 22 m to the north.

Figure 3 Sensitive receptors surrounding the Proposal site

Source: Northstar Air Quality

3.2 Topography

The elevation of the Proposal site is approximately 34 m Australian Height Datum (AHD). No significant topographical features are present between the Proposal site and the nearest sensitive receptor locations.

3.3 Meteorology

The meteorology experienced within an area can govern the generation (in the case of wind dependent emission sources), dispersion, transport and eventual fate of pollutants in the atmosphere. A review of available meteorological data in the vicinity of the Proposal site identified that the closest Bureau of Meteorology (BoM) automatic weather stations (AWS) was located approximately 2.4 kilometres (km) from the Proposal site. The review also identified a NSW Department of Planning, Industry and Environment (DPIE) air quality monitoring station (AQMS) at Newcastle, located at about 1.7 km from the Proposal site. An analysis of five-years of meteorological data (2016 – 2020) from the DPIE Newcastle AQMS has been presented in **Appendix B**.

The wind roses presented in **Appendix B** show predominant north-westerly winds in all years examined. These would generally act to disperse any generated particulate matter away from sensitive receptor locations to the west and north of the Proposal site towards the public recreation areas to the east and south-east of the Proposal site.

3.4 Air Quality

The air quality experienced at any location will be a result of emissions generated by natural and anthropogenic sources on a variety of scales (local, regional and global). The relative contributions of sources at each of these scales to the air quality at a location will vary based on a wide number of factors including the type, location, proximity and strength of the emission source(s), prevailing meteorology, land uses and other factors affecting the emission, dispersion and fate of those pollutants.

When assessing the impact of any particular source of emissions on the potential air quality at a location, the impact of all other sources of an individual pollutant should also be assessed. This 'background' (sometimes called 'baseline') air quality will vary depending on the pollutants to be assessed and can often be characterised by using representative air quality monitoring data.

The AQMS operated by NSW DPIE at Newcastle was considered most reflective of conditions at the Proposal site.

The background air quality at Newcastle AQMS was analysed for the most recent five years of data (2016-2020) to assess the air quality characteristics of the Proposal site. The summary shows periodic exceedance (non-attainment) of the 24-hour average PM_{10} and $PM_{2.5}$ criteria in most measurement years. This is not unexpected and is typical of most monitoring stations. The exceedances are typically associated with sporadic regional pollutant events, such as bushfires and dust storms. Further details are provided in **Appendix C**.

Appendix C presents a five-year average PM_{10} concentration. For the purposes of defining the existing air quality environment of the area, the highest of those annual mean values (28.4 $\mu g \cdot m^{-3}$ in 2019) has been used in the risk-based assessment presented in **Section 5**.

4. METHODOLOGY

Construction phase activities have the potential to generate short-term emissions of particulates. Generally, these are associated with uncontrolled (or 'fugitive') emissions and are typically experienced by neighbours as amenity impacts, such as dust deposition and visible dust plumes, rather than associated with health-related impacts. Localised engine-exhaust emissions from construction machinery and vehicles may also be experienced, but given the very minor scale of the proposed works, fugitive dust emissions would have the greatest potential to give rise to downwind air quality impacts.

Modelling of dust from construction Proposals is generally not considered appropriate, as there is a lack of reliable emission factors from construction activities upon which to make predictive assessments, and the rates would vary significantly, depending upon local conditions. In lieu of a modelling assessment, the construction-phase impacts associated with the Proposal have been assessed using a risk-based assessment procedure. The advantage of this approach is that it determines the activities that pose the greatest risk, which allows the Construction Environmental Management Plan (CEMP) to focus controls to manage that risk appropriately and reduce the impact through proactive management.

For this risk assessment, Northstar has adapted a methodology presented in the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management (IAQM)[2]. Reference should be made to **Appendix D** for the methodology.

Briefly, the adapted method uses a six-step process for assessing dust impact risks from construction activities, and to identify key activities for control, as illustrated in **Figure 4**.

Grouting of mine voids is acknowledged not to be a 'usual' construction activity. However, the composite parts of that activity (i.e. drilling, batching of cement, material handling, haulage, storage of material) would be anticipated during most construction projects. The IAQM construction dust risk assessment process is therefore considered to appropriately represent the risks associated with that specific phase of construction activities, occurring as part of the Proposal.

[2] www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

Figure 4 Construction phase impact risk assessment methodology

Step 1
- SCREENING
- A simple screening step accounting for seperation distance between the sources and the receptors

Step 2
- RISK FROM CONSTRUCTION ACTIVITIES
- Assess risk from activities based on the scale and nature of the works, which determines the potential dust emission magnitude

Step 3
- SENSITIVITY OF THE AREA
- Assess risk of dust effects from activities based on the sensitivity of the area surrounding dust-generating activities

Step 4
- RISK ASSESSMENT (PRE-MITIGATION)
- Based upon Steps 2 and 3, determine risks associated with the construction activities

Step 5
- IDENTIFY MITIGATION
- Based upon the risks assessed at Step 4, identify appropriate mitigation measures to control the risks

Step 6
- RISK ASSESSMENT (POST-MITIGATION)
- Based upon the mitigation measures identified at Step 5, reassess risk

5. CONSTRUCTION AIR QUALITY ASSESSMENT

The methodology used to assess construction phase risk is discussed in **Section 4** and **Appendix D**.

Briefly, after 'Step 1 Screening' (which excludes those receptors that are sufficiently distanced from construction phase activities to not warrant further assessment) *risk* is determined by the product of *receptor sensitivity* and the identified *magnitude of impacts* associated with the construction phase activities (construction, track-out, demolition and earthworks [as applicable]). The definitions used to screen receptors, determine receptor sensitivity and the magnitude of impacts are all presented in **Appendix D.**

5.1 Screening Based on Separation Distance

The screening criteria applied to the identified sensitive receptors, are whether they are located in excess of:

- 50 m from the route used by construction vehicles on public roads.
- 350 m from the boundary of the site.
- 500 m from the site entrance.
- Track-out is assumed to affect roads up to 100 m from the site entrance.

Further to the above distance-based screening criteria, the construction activities are screened by the required construction activities.

Table 4 overleaf presents the identified discrete sensitive receptors, with the corresponding estimated screening distances as compared to the screening criteria.

Table 4 Construction phase impact screening criteria distances

Rec	Location	Land Use	Screening Distance (m)		
			Boundary (350m)	Site Entrance (500m)	Construction route (50m)
R1	9 Mosbri Crescent, The Hill	residential	2	20	20
R2	12 Mosbri Crescent, The Hill	residential	20	20	13
R3	19 Mosbri Crescent, The Hill	residential	6	98	70
R4	11 Hillview Crescent, The Hill	residential	8	125	95
R5	99 Wolfe Street, The Hill	residential	107	211	211
R6	59 Brown Street, The Hill	residential	29	138	138
R7	48 Brown Street, The Hill	residential	22	108	108
R8	41 Kitchener Parade, the Hill	educational	8	42	42

With reference to **Table 4**, sensitive receptors are noted to be within the screening distance boundaries and therefore require further assessment as summarised in **Table 5**.

Table 5 Application of Step 1 Screening

Construction Impact	Screening Criteria	Step 1 Screening	Comments
Demolition	350 m from boundary 500 m from site entrance	Not screened	Receptors identified within the screening distance
Earthworks	350 m from boundary 500 m from site entrance		
Construction	350 m from boundary 500 m from site entrance		
Trackout	100 m from site entrance		
Construction Traffic	50 m from roadside		

5.2 Impact Magnitude

The footprint of the Proposal site (the area affected) is estimated as being approximately 12 235 m^2 (1.2 hectares [ha]) in area.

The Proposal would involve demolition of existing structures (approximately 19 625 m^3) within the area, grouting of mine voids, earthworks for the Proposal site area and the construction of a number of structures with an approximate (total) building volume of 132 500 m^3.

The assumed supply route around the Proposal site during construction works may be up 1 000 m in two-way length. It is anticipated that more than 15 heavy vehicle movements per day would be required each day to service the Proposal site. For the purposes of the assessment, the route for construction traffic to/from the Proposal site is assumed to be along Mosbri Crescent towards Swan Street.

Based upon the above assumptions and the assessment criteria presented in **Appendix D**, the dust emission magnitudes are as presented in **Table 6**.

Table 6 Construction phase impact categorisation of dust emission magnitude

Activity	Dust Emission Magnitude
Demolition	Medium
Earthworks and enabling works (incl. mine grouting)	Large
Construction	Large
Track-out	Medium
Construction traffic routes	Large

5.3 Sensitivity of an Area

5.3.1 Land Use Value

The assessment criteria as described in **Section 4**, including the conditions pertaining to land use value of the area surrounding the Proposal site, is provided in detail in **Appendix D** of this report.

The maximum land use value across the identified receptors has been taken forward to be conservative. The land use value is concluded to be *high* for health impacts and for dust soiling, given the distance between the receptors and the Proposal site and the nature of receptors surrounding the site and the PM_{10} annual average concentration of 28.4 $\mu g \cdot m^{-3}$ as reported in **Section 3.4**.

5.3.2 Sensitivity of an Area

The assessment criteria as described in **Section 4**, including the conditions pertaining to sensitivity of the area surrounding the Proposal site, is provided in detail in **Appendix D** of this report.

The sensitivity of the surrounding area to health effects is determined to be *high* and to dust soiling may be identified as being *medium*. The assumed existing background annual average PM_{10} concentrations (measured at Newcastle in 2019) are outlined in **Appendix C**.

5.4 Risk (Pre-Mitigation)

Given the sensitivity of the identified receptors is classified as 'medium' for dust soiling, and 'high' for health effects, and the dust emission magnitudes for the various construction phase activities as shown in **Table 6**. The resulting risk of air quality impacts (without mitigation) is as presented in **Table 7**.

Table 7 Risk of air quality impacts from construction activities

Impact	Sensitivity of Area	Dust Emission Magnitude					Preliminary Risk				
		Demolition	Earthworks	Construction	Track-out	Const. Traffic	Demolition	Earthworks	Construction	Track-out	Const. Traffic
Dust Soiling	med	med	large	large	med	large	med	high	high	med	high
Human Health	high	med	large	large	med	large	med	high	high	med	high

Note: med. = medium, scr. = screened

The risks summarised in **Table 7** show that there is a *high* risk of adverse dust soiling and human health impacts at sensitive receptors, if no mitigation measures were to be applied to control emissions associated with earthworks, construction activities and construction traffic. Track-out and demolition activities are associated with a *medium* risk of dust soiling impacts and human health impacts.

5.5 Identified Mitigation

The following represents a selection of recommended mitigation measures recommended by the IAQM methodology for the levels of risk presented in **Table 7**. Additional measures have been included which represent best practice controls associated with the individual elements which would constitute grouting of mine voids. A detailed review of the recommendations would be performed once details of the construction phase are available.

Table 8 lists the relevant mitigation measures identified which are associated with the risks presented in **Table 7**, and have been presented as follows:

- **N** = not required (although they may be implemented voluntarily).
- **D** = desirable (to be considered as part of the Construction Environment Management Plan (CEMP) but may be discounted if justification is provided).
- **R** = highly recommended (to be implemented as part of the CEMP and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

Table 8 Site-specific management measures

Identified Mitigation		
1	Communications	
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	R
1.2	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	R
1.3	Display the head or regional office contact information.	R
1.4	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	R
2	Site Management	
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	R
2.2	Make the complaints log available to the local authority when asked.	R

Identified Mitigation		
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	R
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	R
3	**Monitoring**	
3.1	Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary.	R
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to the local authority when asked.	R
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	R
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	R
4	**Preparing and Maintaining the Site**	
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	R
4.2	Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site.	R
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	R
4.4	Avoid site runoff of water or mud.	R
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	R
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	R
4.7	Cover, seed or fence stockpiles to prevent wind erosion	R
5	**Operating Vehicle/Machinery and Sustainable Travel**	
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	R

Identified Mitigation		
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	R
5.3	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable	R
5.4	Impose and signpost a maximum-speed-limit of 25 $km \cdot h^{-1}$ on surfaced and 15 $km \cdot h^{-1}$ on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate	R
5.4	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	R
5.5	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	R
6	**Operations**	
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	R
6.2	Apply a suitable dust management technique (e.g. dust filters, water sprays) during drilling activities	R
6.3	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	R
6.4	Use enclosed chutes and conveyors and covered skips	R
6.5	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.	R
6.6	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	R
7	**Waste Management**	
7.1	Avoid bonfires and burning of waste materials.	R
8	**Measures Specific to Demolition**	
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D
8.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	R
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	R

Identified Mitigation		
8.4	Bag and remove any biological debris or damp down such material before demolition.	R
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	D
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	D
8.7	Only remove the cover in small areas during work and not all at once	D
9	**Measures Specific to Construction**	
8.1	Avoid scabbling (roughening of concrete surfaces) if possible	R
8.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place	R
8.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	R
8.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	D
8.5	During batching of cement or concrete on site, apply water sprays when loading dusty materials	R
8.6	Store larger quantities of fine material in 3-sided enclosures with suitable covering or tarps for use after hours and during high wind speeds	R
10	**Measures Specific to Track-Out**	
10.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	R
10.2	Avoid dry sweeping of large areas.	R
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	R
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	R
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	R
10.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	R
10.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	R
10.8	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	R
10.9	Access gates to be located at least 10 m from receptors where possible.	R
11	**Specific Measures to Construction Traffic (adapted)**	

Identified Mitigation		
11.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable.	R
11.2	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	R
11.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	R
11.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	R
11.5	Record all inspections of haul routes and any subsequent action in a site log book.	R

Notes D = desirable (to be considered), R = highly recommended (to be implemented), N = not required (although can be voluntarily implemented)

5.6 Risk (Post-Mitigation)

For almost all construction activity, the adapted methodology notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation and experience shows that this is normally possible.

Given the size of the Proposal site, the distance to sensitive receptors and of the activities to be performed, the CEMP/DMP will be required to include all of the measures outlined in **Table 8**. Residual impacts associated with fugitive dust emissions from the Proposal would be anticipated to be negligible, should those measures be included. Careful implementation of the mitigation measures should act to ensure that risks are minimised.

6. CONCLUSION

Crescent Newcastle Pty Ltd has engaged Northstar Air Quality Pty Ltd to perform a construction air quality assessment for the Sovereign Park development at 11-17 Mosbri Crescent, The Hill NSW.

The purpose of the assessment is to identify and examine whether the potential impacts of the construction of the Proposal (including demolition and grouting of mine voids) may adversely affect local air quality, and to identify management and mitigation measures which would be applied to manage any risks to nearby sensitive receptor locations.

To allow assessment of the level of air quality risk associated with the construction related activities associated with the Proposal, a risk-based assessment has been performed. For this risk assessment, Northstar has adapted a methodology presented in the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* developed in the United Kingdom by the Institute of Air Quality Management. This approach is widely used across Australia and in NSW when assessing the potential impacts associated with construction proposals.

The assessment has identified a number of sensitive receptor locations near to the Proposal site, with the closest being approximately 2 m from the site boundary. Air quality data from the Newcastle Department of Planning, Industry and Environment Air Quality Monitoring Station has been adopted to determine a background air quality environment (i.e. the conditions to be expected without the Proposal). The highest of the last five-years of measured air quality data has been adopted to provide a conservative assessment. The meteorology of the area has also been reviewed which indicates that in general, winds would act to disperse any generated particulate matter away from residential locations to the west and north of the Proposal site towards the public recreation areas to the east and south-east of the Proposal site.

The assessment indicates that without appropriate mitigation measures during construction, risks to health and dust soiling may be high. A comprehensive range of management and mitigation measures are presented within the assessment which would act to reduce that risk to a negligible level. These measures can be considered to represent best practice for construction sites, should be documented within the Construction Environment Management Plan for the Proposal and also be subject to appropriate review and audit as required through conditions of consent.

Given the level of unmitigated risk associated with the Proposal, it is recommended that a campaign of air quality monitoring is performed throughout the construction period, to provide real-time information to the contractor as to whether the management measures deployed through the Construction Environment Management Plan are acting to appropriately mitigate any air quality risks to nearby sensitive receptors. The campaign monitoring data may also be used to provide the community and Council with evidence of effective emission control.

The report is based on preliminary estimates of programme and equipment, which may be subject to change as required to meet regulatory requirements of Subsidence Advisory NSW or other regulatory requirements.

7. REFERENCES

IAQM. (2014). *Guidance on the assessment of dust from demolition and construction.*

NSW EPA. (2014). *Resource Recovery Order under Part 9, Clause 93 of the Protection of the Environment Operations (Waste) Regulation 2014 - The Coal Ash Order 2014.*

APPENDIX A

Report Units and Common Abbreviations

Units Used in the Report

All units presented in the report follow the International System of Units (SI) conventions, unless derived from references using non-SI units. In this report, units formed by the division of SI and non-SI units are expressed as a negative exponent, and do not use the solidus (/) symbol. For example:

- 50 micrograms per cubic metre would be presented as 50 $\mu g \cdot m^{-3}$ and not 50 $\mu g/m^3$; and,
- 0.2 kilograms per hectare per hour would be presented as 0.2 $kg \cdot ha^{-1} \cdot hr^{-1}$ and not 0.2 kg/ha/hr.

Table A1 Common abbreviations

Abbreviation	Term
AHD	Australian height datum
AQMS	air quality monitoring station
AWS	automated weather station
BoM	Bureau of Meteorology
DPIE	NSW Department of Planning, Industry and Environment
EETM	emission estimation technique manual
EPA	Environmental Protection Authority
$mg \cdot m^{-3}$	milligram per cubic metre of air
$\mu g \cdot m^{-3}$	microgram per cubic metre of air
NEPM	National Environment Protection Measure
OEH	NSW Office of Environment and Heritage
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 µm or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 µm or less
TSP	total suspended particulates
US EPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator

APPENDIX B

Meteorology

Local meteorological data is monitored by the Bureau of Meteorology (BoM) and the NSW Department of Planning, Industry and Environment (DPIE). A review of available meteorological data found that the NSW DPIE AQMS at Newcastle was the most representative of the conditions at the Proposal site located approximately 1.7 km away.

A summary of the meteorological stations reviewed in this assessment is provided in **Table B1** and **Figure B1.**

Table B1 Details of meteorological monitoring surrounding the Proposal site

Site Name	Bom /DPIE Operated	Approximate Location (UTM)		Approximate Distance
		mE	mS	km
Newcastle AQMS	DPIE	383 902	6 355 509	1.7
Newcastle Nobbys Signal Station AWS	BoM	387 640	6 357 116	2.4
Carrington AQMS	DPIE	384 340	6 358 040	2.7
Stockton AQMS	DPIE	386 279	6 358 925	3.3

Figure B1 Meteorological stations surrounding the Proposal site

Annual wind roses for the most recent years of data for Newcastle AQMS (2016 to 2020) are presented in **Figure B2** and the annual wind speed distribution is displayed in **Figure B3**.

The wind roses indicate that from 2016 to 2020, winds at Newcastle AQMS are predominantly experienced from the southwest with north-easterly components also evident.

The majority of wind speeds experienced at the Newcastle AQMS between 2016 and 2020 are generally in the range 0.5 metres per second ($m \cdot s^{-1}$) to 5.5 $m \cdot s^{-1}$ with the highest wind speeds (greater than 8 $m \cdot s^{-1}$) occurring from north-westerly directions. Winds of this speed are rare and occur during 0.3 % of the observed hours during the years. Calm winds (<0.5 $m \cdot s^{-1}$) are more common and occur more than 6.1% of hours across the years.

Figure B3 Annual wind roses 2016 to 2020, Newcastle AQMS Station

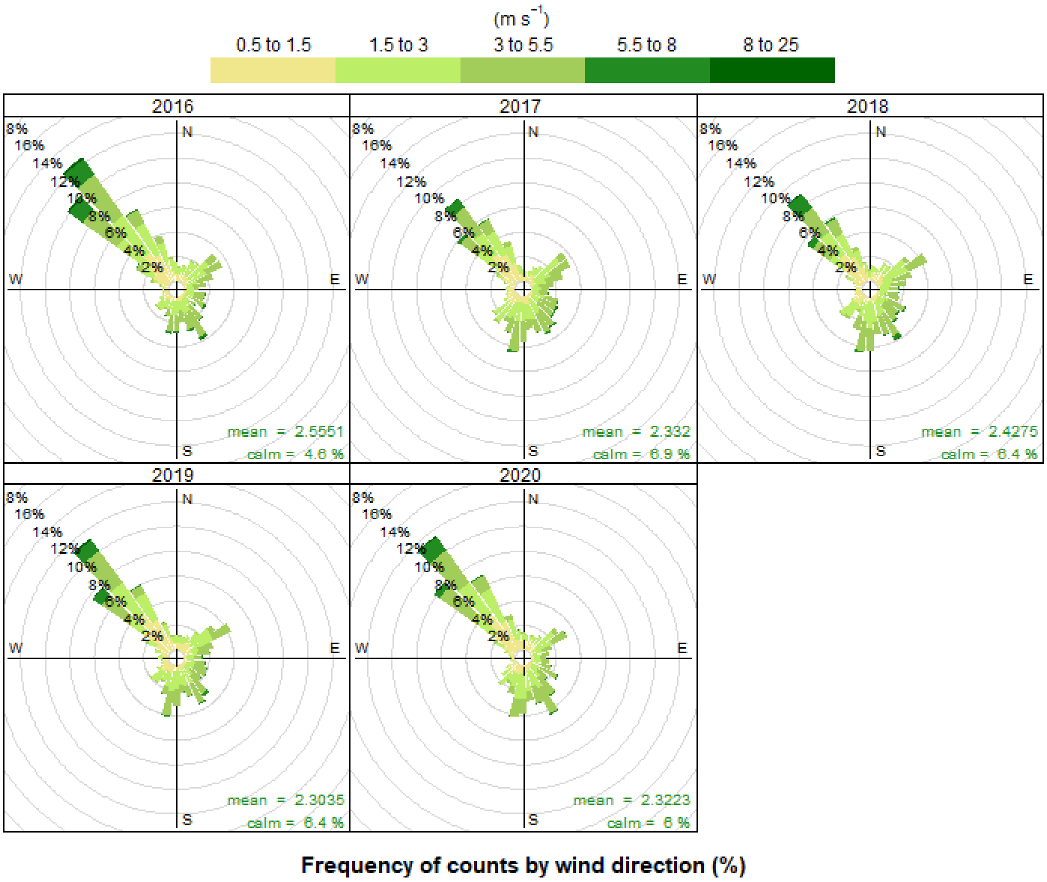
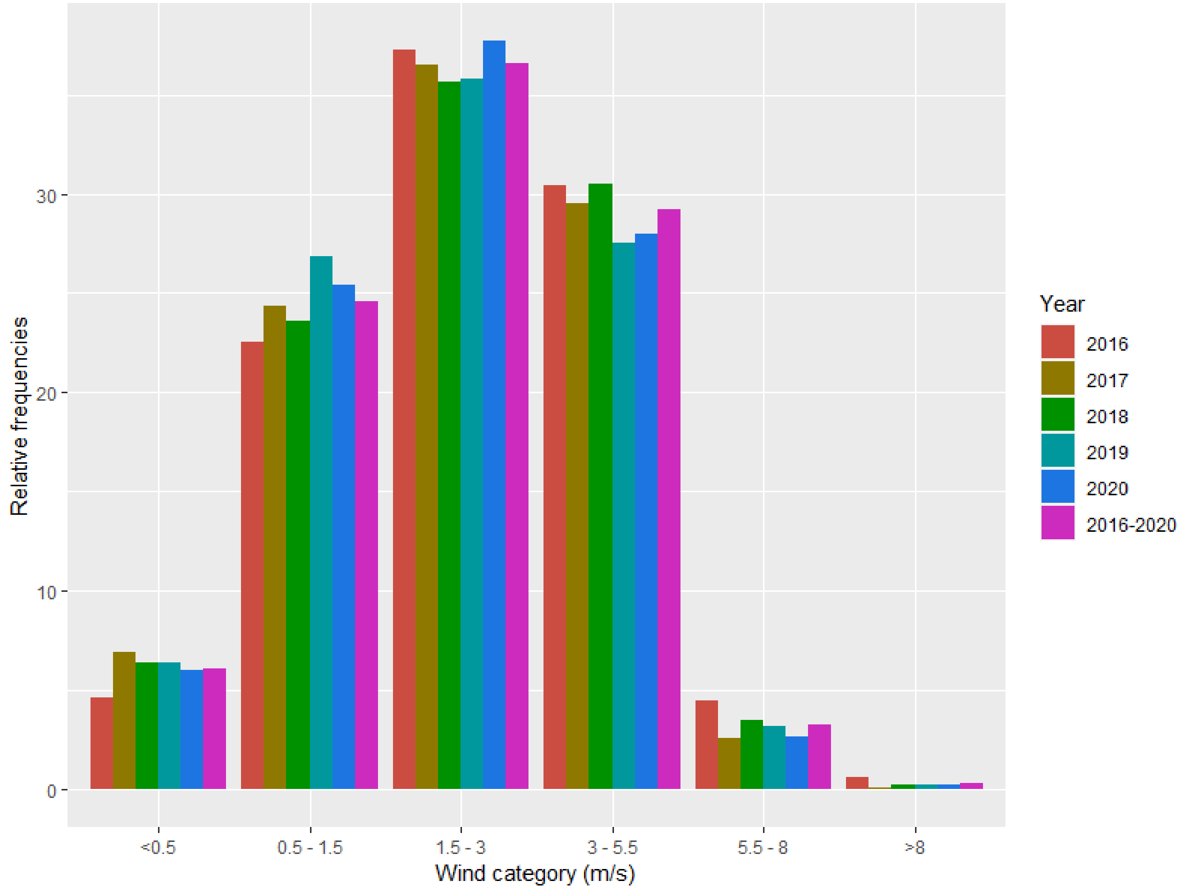


Figure B5 Annual wind speed distribution, Newcastle AQMS



APPENDIX C

Background Air Quality Data

Air quality data presented in this Appendix is not used in a quantitative manner in this assessment and is provided for context only.

Air quality monitoring is performed by the NSW Department of Planning, Industry and Environment (DPIE) at three air quality monitoring station (AQMS) within a 5 km radius of the Proposal site. Details of the monitoring performed at these AQMS is presented in **Table B1** and their locations are illustrated in **Figure B1**.

Table B1 Details of closest AQMS surrounding the Proposal site

AQMS Location	Distance to Site (km)	Screening Parameters Measurements		
		PM_{10}	$PM_{2.5}$	TSP
Newcastle AQMS	1.7	✓	✓	×
Carrington AQMS	2.7	✓	✓	×
Stockton AQMS	3.3	✓	✓	×

Figure B1 Locations of closest AQMS surrounding the Proposal site

Based on the sources of AQMS data available and their proximity to the Proposal site, Newcastle was selected as the candidate source of AQMS data for use in this assessment.

Summary statistics are for PM_{10} and $PM_{2.5}$ data are presented in **Table B2**.

Table B2 PM_{10} and $PM_{2.5}$ statistics 2016-2020

AQMS	Newcastle	
Years	2016-2020	
Pollutant	PM_{10}	$PM_{2.5}$
Averaging Period	24-hour	24-hour
Data Points (number)	1794	1695
Mean (µg·m^{-3})	23.9	8.4
Standard Deviation (µg·m^{-3})	12.6	6.7
Skew[1]	3.1	6.1
Kurtosis[2]	17.7	57.7
Minimum (µg·m^{-3})	3.2	-0.3
Percentiles (µg·m-3)		
1	7.0	2.1
5	9.9	3.2
10	12.0	3.8
25	16.6	5.2
50	21.7	7.1
75	28.3	10.0
90	36.1	12.9
95	42.9	15.7
97	48.5	19.1
98	56.9	24.1
99	77.2	36.3
Maximum	146.0	95.5
Data Capture (%)	98.19%	92.78%

Notes: **1:** Skew represents an expression of the distribution of measured values around the derived mean. Positive skew represents a distribution tending towards values higher than the mean, and negative skew represents a distribution tending towards values lower than the mean. Skew is dimensionless.

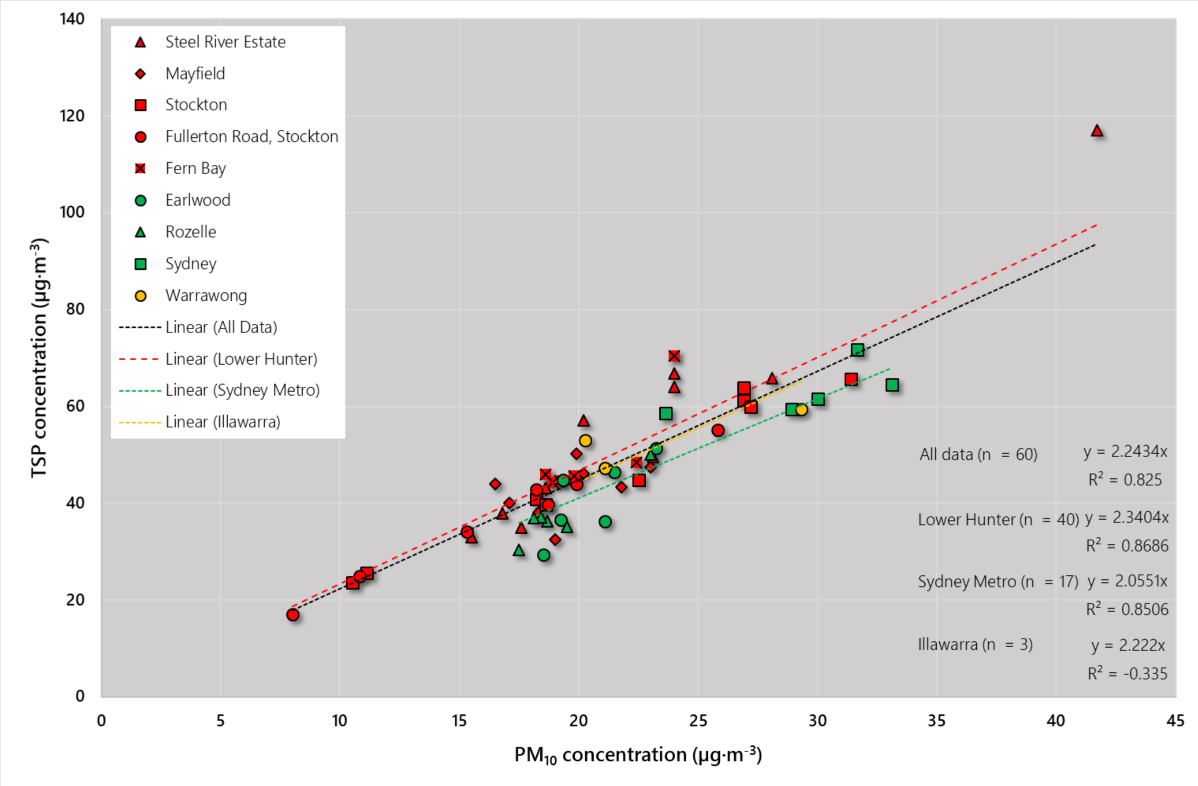
2: Kurtosis represents an expression of the value of measured values in relation to a normal distribution. Positive skew represents a more peaked distribution, and negative skew represents a distribution more flattened than a normal distribution. Kurtosis is dimensionless.

Concentrations of TSP are not measured by the NSW DPIE at any AQMS surrounding the Proposal site. An analysis of co-located measurements of TSP and PM_{10} in the Lower Hunter (1999 to 2011), Illawarra (2002 to 2004), and Sydney Metropolitan (1999 to 2004) regions is presented in **Figure B1**.

The analysis concludes that, on the basis of the measurements collected across NSW between 1999 to 2011, the derivation of a broad TSP:PM_{10} ratio of 2.3404 : 1 (i.e. PM_{10} represents ~43 % of TSP) is appropriate to be applied to measurements in the Lower Hunter.

In the absence of any more specific information, this ratio has been adopted within this assessment. These estimates have not been adjusted for background exceedances.

Figure B1 Co-located TSP and PM_{10} measurements, Lower Hunter, Sydney Metro and Illawarra



Similarly, no dust deposition data is available for the area surrounding the Proposal site. The incremental impact criterion of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ as outlined within the Approved Methods has been adopted which effectively provides a background deposition level of 2 $g{\cdot}m^{-2}{\cdot}month^{-1}$ (the total allowable deposition being 4 $g{\cdot}m^{-2}{\cdot}month^{-1}$).

A summary of background air quality data for the site for the years 2016-20120 is presented in **Table B3**.

Graphs presenting the daily varying PM_{10} and $PM_{2.5}$ data recorded at Newcastle AQMS for the years 2016-2020 are presented in **Figure B2** and **Figure B3**, respectively.

Table B3 Summary of background air quality data (Newcastle 2016-2020)

Pollutant	TSP (µg·m^{-3})	PM_{10} (µg·m^{-3})	$PM_{2.5}$ (µg·m^{-3})
Averaging Period	Annual	24-Hour	24-Hour
Data Points (number)	1794	1794	1695
Mean	55.9	23.9	8.4
Standard Deviation	-	12.6	6.7
Skew[1]	-	3.1	6.1
Kurtosis[2]	-	17.7	57.7
Minimum	-	3.2	-0.3
Percentiles (µg·m^{-3})			
1	-	7.0	2.1
5	-	9.9	3.2
10	-	12.0	3.8
25	-	16.6	5.2
50	-	21.7	7.1
75	-	28.3	10.0
90	-	36.1	12.9
95	-	42.9	15.7
97	-	48.5	19.1
98	-	56.9	24.1
99	-	77.2	36.3
Maximum	55.9	146.0	95.5
Data Capture (%)	98.19%	98.19%	92.78%

Figure B2 PM_{10} measurements, Newcastle 2016-2020

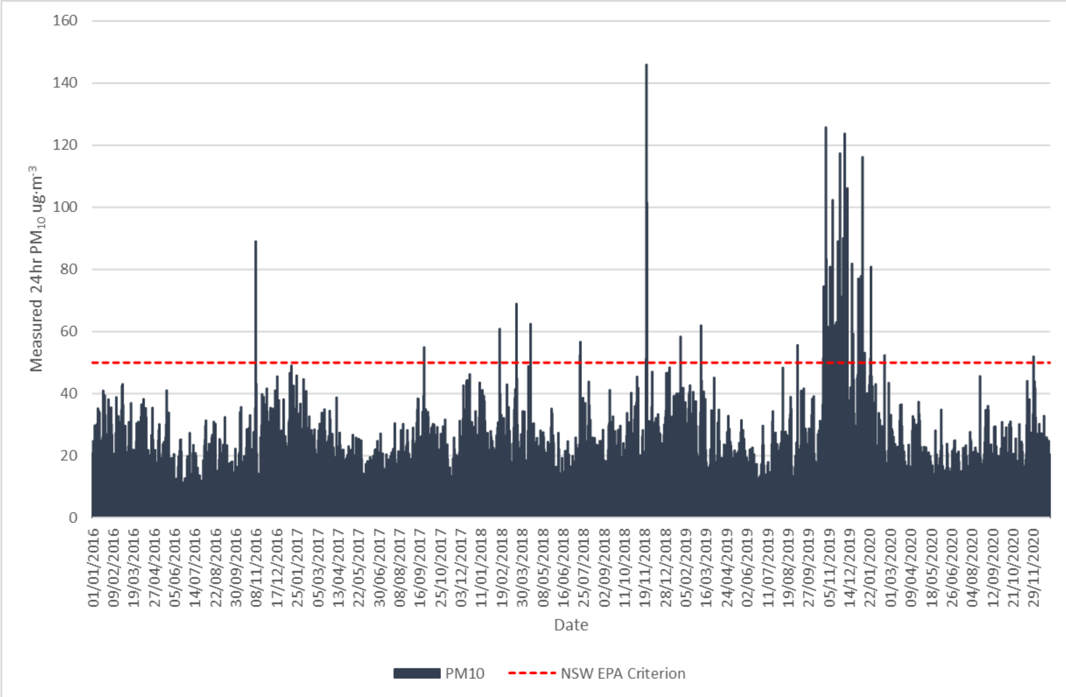
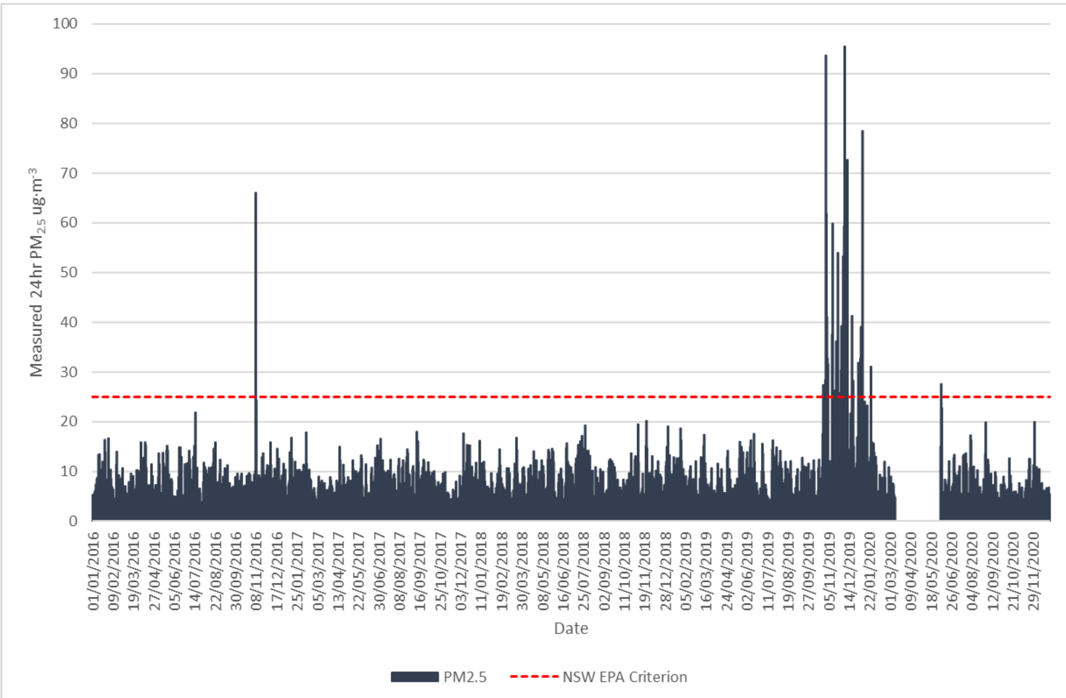


Figure B3 $PM_{2.5}$ measurements, Newcastle 2016-2020



APPENDIX D

Construction Phase Risk Assessment Methodology

Provided below is a summary of the risk assessment methodology used in this assessment. It is based upon IAQM (2016) *Guidance on the assessment of dust from demolition and construction* (version 1.1), and adapted by Northstar Air Quality.

Adaptions to the Published Methodology Made by Northstar Air Quality

The adaptions made by Northstar Air Quality from the IAQM published methodology are:

- **PM_{10} criterion:** an amended criterion representing the annual average PM_{10} criterion relevant to Australia rather than the UK;
- **Nomenclature:** a change in nomenclature from "receptor sensitivity" to "land use value" to avoid misinterpretation of values attributed to "receptor sensitivity" and "sensitivity of the area" which may be assessed as having different values;
- **Construction traffic:** the separation of construction vehicle movements as a discrete risk assessment profile from those associated with the 'on-site' activities of demolition, earthworks and construction. The IAQM methodology considers four risk profiles of: "demolition", "earthworks", "construction" and "trackout". The adaption by Northstar Air Quality introduces a fifth risk assessment profile of "construction traffic" to the existing four risk profiles; and,
- **Tables:** minor adjustments in the visualisation of some tables.

Step 1 – Screening Based on Separation Distance

The Step 1 screening criteria provided by the IAQM guidance suggests screening out any assessment of impacts from construction activities where sensitive receptors are located:

- more than 350 m from the boundary of the site;
- more than 50 m from the route used by construction vehicles on public roads; and,
- more than 500 m from the site entrance.

This step is noted as having deliberately been chosen to be conservative and would require assessments for most developments.

Step 2 – Risk from Construction Activities

Step 2 of the assessment provides "dust emissions magnitudes" for each of the dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles) and construction traffic.

The magnitudes are: Large; Medium; or Small, with suggested definitions for each category as follows:

Dust Emission Magnitude Activities

Activity	Large	Medium	Small
Demolition			
- total building volume*	• >50 000 m^3	• 20 000 m^3 to 50 000 m^3	• <20 000 m^3
- demolition height	• > 20m AGL	• 10 m and 20 m AGL	• <10 m AGL
- onsite crushing	• yes	• no	• no
- onsite screening	• yes	• no	• no
- demolition of materials with high dust potential	• yes	• yes	• no
- demolition timing	• any time of the year	• any time of the year	• wet months only
Earthworks			
- total area	• >10 000 m^2	• 2 500 m^2 to 10 000 m^2	• <2 500 m^2
- soil types	• potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size	• moderately dusty soil type (e.g. silt)	• soil type with large grain size (e.g. sand
- heavy earth moving vehicles	• >10 heavy earth moving vehicles active at any time	• 5 to 10 heavy earth moving vehicles active at any one time	• <5 heavy earth moving vehicles active at any one time
- formation of bunds	• >8m AGL	• 4m to 8m AGL	• <4m AGL
- material moved	• >100 000 t	• 20 000 t to 100 000 t	• <20 000 t
- earthworks timing	• any time of the year	• any time of the year	• wet months only
Construction			
- total building volume	• 100 000 m^3	• 25 000 m^3 to 100 000 m^3	• <25 000 m^3
- piling	• yes	• yes	• no
- concrete batching	• yes	• yes	• no
- sandblasting	• yes	• no	• no
- materials	• concrete	• concrete	• metal cladding or timber
Trackout (within 100 m of construction site entrance)			
- outward heavy vehicles movements per day	• >50	• 10 to 50	• <10
- surface materials	• high potential	• moderate potential	• low potential
- unpaved road length	• >100m	• 50m to 100m	• <50m

Activity	Large	Medium	Small
Construction Traffic (from construction site entrance to construction vehicle origin)			
Demolition traffic - total building volume	• >50 000 m^3	• 20 000 m^3 to 50 000 m^3	• <10 000 m^3
Earthworks traffic - total area	• >10 000 m^2	• 2 500 m^2 to 10 000 m^2	• <2 500 m^2
Earthworks traffic - soil types	• potentially dusty soil type (e.g. clay which would be prone to suspension when dry due to small particle size	• moderately dusty soil type (e.g. silt)	• soil type with large grain size (e.g. sand)
Earthworks traffic - material moved	• >100 000 t	• 20 000 t to 100 000 t	• <20 000 t
Construction traffic - total building volume	• 100 000 m^3	• 25 000 m^3 to 100 000 m^3	• <25 000 m^3
Total traffic - heavy vehicles movements per day when compared to existing heavy vehicle traffic	• >50% of heavy vehicle movement contribution by Proposal	• 10% to 50% of heavy vehicle movement contribution by Proposal	• <10% of heavy vehicle movement contribution by Proposal

Step 3 – Sensitivity of the Area

Step 3 of the assessment process requires the sensitivity of the area to be defined. The sensitivity of the area takes into account:

- The specific sensitivities that identified land use values have to dust deposition and human health impacts;
- The proximity and number of those receptors locations;
- In the case of PM_{10}, the local background concentration; and
- Other site-specific factors, such as whether there are natural shelters such as trees to reduce the risk of wind-blown dust.

Land Use Value

Individual receptor locations may be attributed different land use values based on the land use of the land, and may be classified as having high, medium or low values relative to dust deposition and human health impacts (ecological receptors are not addressed using this approach).

Essentially, land use value is a metric of the level of amenity expectations for that land use.

The IAQM method provides guidance on the land use value with regard to dust soiling and health effects and is shown in the table below. It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

IAQM Guidance for Categorising Land Use Value

Value	High Land Use Value	Medium Land Use Value	Low Land Use Value
Health effects	• Locations where the public are exposed over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). *Examples: Residential properties, hospitals, schools and residential care homes.*	• Locations where the people exposed are workers, and exposure is over a time period relevant to the air quality objective for PM_{10} (in the case of the 24-hour objectives, a relevant location would be one where individuals may be exposed for eight hours or more in a day). *Examples: Office and shop workers, but would generally not include workers occupationally exposed to PM_{10}.*	• Locations where human exposure is transient. *Examples: Public footpaths, playing fields, parks and shopping street.*

Value	High Land Use Value	Medium Land Use Value	Low Land Use Value
Dust soiling	• Users can reasonably expect a high level of amenity; or • The appearance, aesthetics or value of their property would be diminished by soiling, and the people or property would reasonably be expected to be present continuously, or at least regularly for extended periods as part of the normal pattern of use of the land. *Examples: Dwellings, museums, medium and long term car parks and car showrooms.*	• Users would expect to enjoy a reasonable level of amenity, but would not reasonably expect to enjoy the same level of amenity as in their home; or • The appearance, aesthetics or value of their property could be diminished by soiling; or • The people or property wouldn't reasonably be expected to be present here continuously or regularly for extended periods as part of the normal pattern of use of the land. *Examples: Parks and places of work.*	• The enjoyment of amenity would not reasonably be expected; or • Property would not reasonably be expected to be diminished in appearance, aesthetics or value by soiling; or • There is transient exposure, where the people or property would reasonably be expected to be present only for limited periods of time as part of the normal pattern of use of the land. *Examples: Playing fields, farmland (unless commercially-sensitive horticultural), footpaths, short term car parks and roads.*

Sensitivity of the Area

The assessed land use value (as described above) is then used to assess the *sensitivity of the area* surrounding the active construction area, taking into account the proximity and number of those receptors, and the local background PM_{10} concentration (in the case of potential health impacts) and other site-specific factors.

Additional factors to consider when determining the sensitivity of the area include:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local meteorological data which accurately represent the area; and if relevant, the season during which the works would take place;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

Sensitivity of the Area - Health Impacts

For high land use values, the method takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account, and professional judgement may be used to determine alternative sensitivity categories, taking into account the following:

- any history of dust generating activities in the area;
- the likelihood of concurrent dust generating activity on nearby sites;
- any pre-existing screening between the source and the receptors;
- any conclusions drawn from analysing local / seasonal meteorological data;
- any conclusions drawn from local topography;
- duration of the potential impact, as a receptor may become more sensitive over time; and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Land Use Value	Annual Mean PM_{10} Concentration ($\mu g \cdot m^{-3}$)	Number of Receptors[a]	Distance from the Source (m)[b]				
			<20	<50	<100	<200	<350
High	>30	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	26 – 30	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	22 – 26	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	≤22	>100	Medium	Low	Low	Low	Low
		10-100	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Medium	-	>10	High	Medium	Low	Low	Low
	-	1-10	Medium	Low	Low	Low	Low
Low	-	>1	Low	Low	Low	Low	Low

Note: (a) Estimate the total within the stated distance (e.g. the total within 350 m and not the number between 200 and 350 m), noting that only the highest level of area sensitivity from the table needs to be considered. In the case of high sensitivity areas with high occupancy (such as schools or hospitals) approximate the number of people likely to be present. In the case of residential dwellings, just include the number of properties.

(b) With regard to potential 'construction traffic' impacts, the distance criteria of <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

Sensitivity of the Area - Dust Soiling

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in the table below

IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

Land Use Values	Number of receptors[a]	Distance from the source (m)[b]			
		<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

Note: (a) Estimate the total number of receptors within the stated distance. Only the highest level of area sensitivity from the table needs to be considered.

(b) With regard to potential 'construction traffic' impacts, the distance criteria of <20m and <50m from the source (roadside) are used (i.e. the first two columns only). Any locations beyond 50m may be screened out of the assessment (as per Step 1) and the corresponding sensitivity is negligible'.

Step 4 - Risk Assessment (Pre-Mitigation)

The matrices shown for each activity determine the risk category with no mitigation applied.

Risk of dust impacts from earthworks

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Earthworks**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Risk of dust impacts from construction activities

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Construction**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Risk of dust impacts from demolition activities

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Demolition**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Risk of dust impacts from trackout (within 100m of construction site entrance)

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Trackout**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Risk of dust impacts from construction traffic (from construction site entrance to origin)

Sensitivity of Area	Pre-Mitigated Dust Emission Magnitude (**Construction Traffic**)		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

Step 5 – Identify Mitigation

Once the risk categories are determined for each of the relevant activities, site-specific management measures can be identified based on whether the site is a low, medium or high risk site.

The identified mitigation measures are presented as follows:

- **N** = not required (although they may be implemented voluntarily)
- **D** = desirable (to be considered as part of the CEMP, but may be discounted if justification is provided);
- **R** = highly recommended (to be implemented as part of the CEMP, and should only be discounted if site-specific conditions render the requirement invalid or otherwise undesirable).

The table below presents the complete mitigation table, not that assessed as required for any specific project or activity:

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
1	Communications			
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.	N	R	R
1.1	Display the name and contact details of person(s) accountable for air quality and dust issues on the site boundary. This may be the environment manager/engineer or the site manager.	R	R	R
1.2	Display the head or regional office contact information.	R	R	R
1.3	Develop and implement a Dust Management Plan (DMP), which may include measures to control other emissions, approved by the relevant regulatory bodies.	D	R	R
2	Site Management			
2.1	Record all dust and air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.	R	R	R
2.2	Make the complaints log available to the local authority when asked.	R	R	R
2.3	Record any exceptional incidents that cause dust and/or air emissions, either on- or offsite, and the action taken to resolve the situation in the log book.	R	R	R
2.4	Hold regular liaison meetings with other high-risk construction sites within 500 m of the site boundary, to ensure plans are coordinated and dust and particulate matter emissions are minimised. It is important to understand the interactions of the off-site transport/ deliveries which might be using the same strategic road network routes.	N	N	R

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
3	Monitoring			
3.1	Undertake daily on-site and off-site inspections where receptors (including roads) are nearby, to monitor dust, record inspection results, and make the log available to the local authority when asked. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100m of site boundary.	D	D	R
3.2	Carry out regular site inspections to monitor compliance with the dust management plan / CEMP, record inspection results, and make an inspection log available to the local authority when asked.	R	R	R
3.3	Increase the frequency of site inspections by the person accountable for air quality and dust issues on site when activities with a high potential to produce dust are being carried out and during prolonged dry or windy conditions.	R	R	R
3.4	Agree dust deposition, dust flux, or real-time continuous monitoring locations with the relevant regulatory bodies. Where possible commence baseline monitoring at least three months before work commences on site or, if it a large site, before work on a phase commences.	N	R	R
4	Preparing and Maintaining the Site			
4.1	Plan site layout so that machinery and dust causing activities are located away from receptors, as far as is possible.	R	R	R
4.2	Erect solid screens or barriers around dusty activities or the site boundary that they are at least as high as any stockpiles on site.	R	R	R
4.3	Fully enclose site or specific operations where there is a high potential for dust production and the site is active for an extensive period.	D	R	R
4.4	Avoid site runoff of water or mud.	R	R	R
4.5	Keep site fencing, barriers and scaffolding clean using wet methods.	D	R	R
4.6	Remove materials that have a potential to produce dust from site as soon as possible, unless being re-used on site. If they are being re-used on-site cover as described below	D	R	R
4.7	Cover, seed or fence stockpiles to prevent wind erosion	D	R	R
5	Operating Vehicle/Machinery and Sustainable Travel			
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	R	R	R
5.2	Ensure all vehicles switch off engines when stationary - no idling vehicles	R	R	R
5.3	Avoid the use of diesel or petrol-powered generators and use mains electricity or battery powered equipment where practicable	R	R	R

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
5.4	Impose and signpost a maximum-speed-limit of 25 km·h^{-1} on surfaced and 15 km·h^{-1} on unsurfaced haul roads and work areas (if long haul routes are required these speeds may be increased with suitable additional control measures provided, subject to the approval of the nominated undertaker and with the agreement of the local authority, where appropriate	D	D	R
5.5	Produce a Construction Logistics Plan to manage the sustainable delivery of goods and materials.	N	R	R
5.6	Implement a Travel Plan that supports and encourages sustainable travel (public transport, cycling, walking, and car-sharing)	N	D	R
6	Operations			
6.1	Only use cutting, grinding or sawing equipment fitted or in conjunction with suitable dust suppression techniques such as water sprays or local extraction, e.g. suitable local exhaust ventilation systems	R	R	R
6.2	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/ mitigation, using non-potable water where possible and appropriate	R	R	R
6.3	Use enclosed chutes and conveyors and covered skips	R	R	R
6.4	Minimise drop heights from conveyors, loading shovels, hoppers and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate	R	R	R
6.5	Ensure equipment is readily available on site to clean any dry spillages, and clean up spillages as soon as reasonably practicable after the event using wet cleaning methods.	D	R	R
7	Waste Management			
7.1	Avoid bonfires and burning of waste materials.	R	R	R
8	Measures Specific to Demolition			
8.1	Soft strip inside buildings before demolition (retaining walls and windows in the rest of the building where possible, to provide a screen against dust).	D	D	R
8.2	Ensure effective water suppression is used during demolition operations. Hand held sprays are more effective than hoses attached to equipment as the water can be directed to where it is needed. In addition, high volume water suppression systems, manually controlled, can produce fine water droplets that effectively bring the dust particles to the ground.	R	R	R
8.3	Avoid explosive blasting, using appropriate manual or mechanical alternatives.	R	R	R
8.4	Bag and remove any biological debris or damp down such material before demolition.	R	R	R

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
8.5	Re-vegetate earthworks and exposed areas/soil stockpiles to stabilise surfaces as soon as practicable.	N	D	R
8.6	Use Hessian, mulches or trackifiers where it is not possible to re-vegetate or cover with topsoil, as soon as practicable.	N	D	R
8.7	Only remove the cover in small areas during work and not all at once	N	D	R
9	Measures Specific to Construction			
9.1	Avoid scabbling (roughening of concrete surfaces) if possible	D	D	R
9.2	Ensure sand and other aggregates are stored in bunded areas and are not allowed to dry out, unless this is required for a particular process, in which case ensure that appropriate additional control measures are in place	D	R	R
9.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	N	D	R
9.4	For smaller supplies of fine power materials ensure bags are sealed after use and stored appropriately to prevent dust	N	D	D
10	Measures Specific to Track-Out			
10.1	Use water-assisted dust sweeper(s) on the access and local roads to remove, as necessary, any material tracked out of the site.	D	R	R
10.2	Avoid dry sweeping of large areas.	D	R	R
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	R	R
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	R	R	R
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	D	R	R
10.6	Install hard surfaced haul routes, which are regularly damped down with fixed or mobile sprinkler systems, or mobile water bowsers and regularly cleaned.	N	R	R
10.7	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site where reasonably practicable).	D	R	R
10.8	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, wherever site size and layout permits.	N	R	R
10.9	Access gates to be located at least 10 m from receptors where possible.	N	R	R
11	Specific Measures to Construction Traffic (adapted)			
5.1	Ensure all on-road vehicles comply with relevant vehicle emission standards, where applicable	R	R	R

Identified Mitigation		Unmitigated Risk		
		Low	Medium	High
8.3	Ensure bulk cement and other fine powder materials are delivered in enclosed tankers and stored in silos with suitable emission control systems to prevent escape of material and overfilling during delivery.	N	D	R
10.3	Ensure vehicles entering and leaving sites are covered to prevent escape of materials during transport.	D	R	R
10.4	Inspect on-site haul routes for integrity and instigate necessary repairs to the surface as soon as reasonably practicable.	R	R	R
10.5	Record all inspections of haul routes and any subsequent action in a site log book.	D	R	R

Step 6 – Risk Assessment (post-mitigation)

Following Step 5, the residual impact is then determined.

The objective of the mitigation is to manage the construction phase risks to an acceptable level, and therefore it is assumed that application of the identified mitigation would result in a *low* or *negligible* residual risk (post mitigation).