APPENDIX J

Air Quality Impact Assessment
(SLR Consulting Pty Ltd)

SIX MILE CREEK DAM

Safety Upgrade Project
Air Quality Impact Assessment

Prepared for:

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1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been commissioned by SMEC Australia Pty Ltd (SMEC) on behalf of Seqwater to prepare an Air Quality Impact Assessment (AQIA) of activities associated with the Six Mile Creek Dam (also known as the Lake Macdonald Dam) Upgrade. An AQIA is a required component of the Impact Assessment Report (IAR).

The proposed works include:

- Staged and temporary lowering of the dam's water level to allow for construction works;
- Construction of a temporary coffer dam to enable removal of the dam's spillway;
- Construction of a replacement spillway;
- Reconstructing the existing earth embankments; and
- Potential construction of a saddle dam.

This assessment has been prepared to provide an assessment of potential impacts on air quality from emissions of dust, odour and other air pollutants associated with the construction phase of the Six Mile Creek Dam Upgrade.

The assessment comprised the following:

- Identify nearby sensitive receptors and land-use;
- Characterise the existing background air quality, focussing on concentrations of suspended particulate matter and dust deposition rates, based on the surrounding land use and publicly available data for similar sites in Australia;
- Characterise the meteorological and climatic features of the site with the potential to impact on the generation and dispersion of air emissions during the construction works;
- Perform a qualitative assessment of potential health and nuisance impacts associated with fugitive dust emissions from the construction activities;
- Perform a qualitative assessment of potential off-site odour impacts due to the exposure of vegetation when the water level within the dam is lowered; and
- Based on the level of risk, recommend mitigation measures to mitigate off-site impacts, including recommendations for a construction phase air quality monitoring program, if appropriate.

2 Project Description

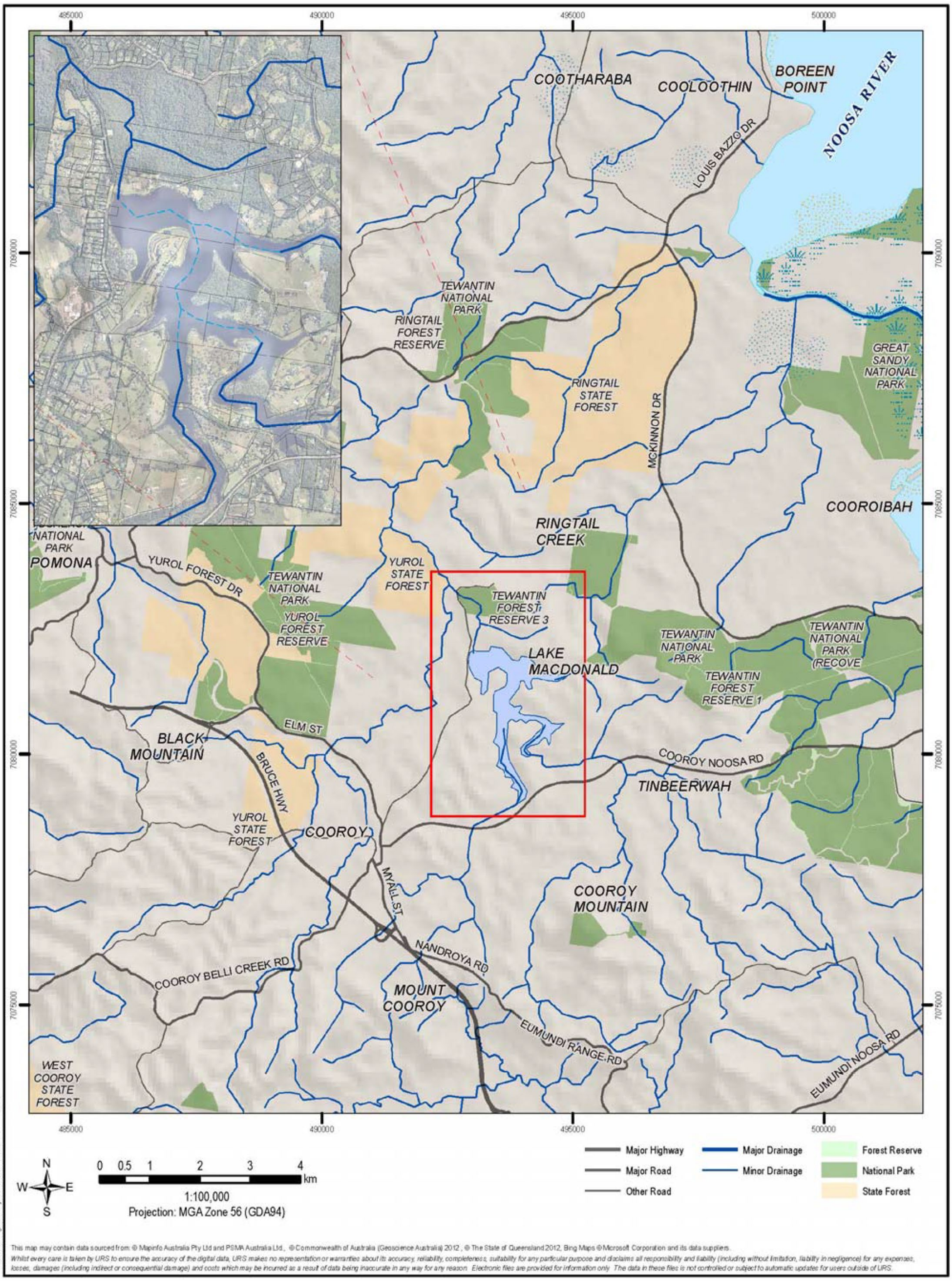
2.1 Project Overview

Six Mile Creek Dam, located on Lake Macdonald on the Sunshine Coast in Noosa Shire (see **Figure 1**), requires an upgrade ("the Project") to meet performance requirements of the Queensland dam safety regulations into the future. The upgrade will involve lowering the lake (impoundment) level to facilitate construction, removal of the existing spillway, construction of a new concrete spillway founded on weathered rock, and reconstructing the existing earth embankments.

The construction works have been split into two stages:

- **Stage 1 - Early package works (site establishment and dewatering):**
  - Clearing and grubbing of laydown and construction plant areas.
  - Demolition of some existing on-site buildings.
  - Formation of on-site construction roads.
  - Delivery of fill and formation of pads for laydown and construction plant areas, and delivery of equipment and materials.
  - Installation and commissioning of a concrete batch plant (CBP), diesel generators (if required) and dewatering pumps.
  - Preparation of working platform on the demolished spillway, at new spillway level, to allow for spillway foundation works and to allow for channelling of catchment low flows through the site.
  - Excavation of the existing spillway structure and preparation of a working platform on the demolished spillway, at the new spillway level, to allow for spillway foundation works as well as channelling of catchment low flows through the work site.
  - Lowering of Lake Macdonald water level using dewatering pumps, including associated fish salvage.
- **Stage 2 - Dam construction and site rehabilitation**:
  - Foundation works (concrete aggregates and rip rap materials to be imported from off-site).
  - Eastern embankment construction, including demolition of the existing embankment, foundation improvement works to address seepage, piping and liquefaction risks, and major reconstruction of a flatter embankment section with a reduced slope.
  - Western embankment construction, including demolition of the existing embankment to natural foundation level and reconstructing a simpler section for ease of construction, while addressing seepage and piping risks.
  - Potential construction of a saddle dam on Collwood Road (if needed) which would involve building up a 100 – 150 m section of Collwood Road immediately east of Noosa WTP by 1 m – 2 m via an earthen embankment to ensure flood waters are channelled through the new dam spillway, rather than shortcutting through a low section.
  - Decommissioning and removal of construction infrastructure including the CBP, rehabilitation and landscaping.

Figure 1 Regional Location of Lake Macdonald and the Project Area



2.2 Construction Methodology

The overall layout of the construction areas is shown in **Figure 2**, and an overview of key stages of the proposed construction methodology, including anticipated equipment and truck movements for each of these elements is summarised in **Table 1** (Stage 1) and **Table 2** (Stage 2).

There will be a requirement for a CBP on site as part of construction activities for the Project, specifically during construction of the spillway foundation. The CBP will be located immediately east of the Noosa Water Treatment Plant as shown in **Figure 2**. The CBP will have a throughput capacity of 50 m^3 per hour and operating hours will be limited to:

- 6:30 am to 6:30 pm Monday to Friday; and
- 6:30 am to 4:00 pm on Saturdays.

The CBP will have the capacity to store two weeks' worth of materials including 3,500 m^3 of stone aggregate, 2,500 m^3 of sand and cement powder in vertical silos. It is anticipated that the CBP will be removed following completion of the spillway, and strength concrete will be acquired off-site.

Figure 2 Proposed Site Layout

Table 1 Overview of Expected Project Construction Methodology, Facilities and Equipment - Stage 1

Activity	Approximate Duration	Typical Equipment	Estimated Truck Movements
Early Package Works			
Mobilisation	5 days	1 x 50T hydraulic truck crane	5 off-site semi-truck loads per day
Clearing for stockpiles	10 days	1 x D6 dozer 1x CAT 140G 1 x CAT 20T w tree cutter	39 off-site Truck and Dog trailer loads per day
Supply of road base materials	11 days	1 x CAT 140G Roller 14,000 L water cart	8 off-site Truck and Dog trailer loads per day
Lake drawdown	33 days	Pumps (85 kW) submersible 1,200 kVA generator(s) 6 x Pontoon anchors Work boat	
Sheet pile coffer dam	5 days	1 x 100T Crawler with vibrating head	21 on-site truck movements per day
Demolition of spillway and training walls	28 days	3 x 60T excavator 1 x CAT988 front end loader 1 x 40T articulated dump truck 8 x Tipper	1 off-site Truck and Dog trailer load per day 37 on-site truck movements per day

SOURCES: WTP: *Work Methodology Statement – Appendix 9 Construction Methodology Summary* (21 September 2017)
WTP: *Project Construction Logistics Plan* (13 June 2018)

Table 2 Overview of Expected Project Construction Methodology, Facilities and Equipment - Stage 2

Activity	Approximate Duration	Typical Equipment	Estimated Truck Movements
Stage 2 - Dam Construction and Site Rehabilitation			
Caisson pile, excavation and mass concrete	105 days	3 x 120T piling rigs 2 x 30T excavator 3 x 40 articulated dump trucks 3 x 10T excavators w rock blade 3 x 30T excavators w clam shell 2 x 40T excavators w vibrating needles 2 x snorkel pumps Concrete batch plant	31 off-site Truck and Dog trailer loads per day
Demolition of right bank Demolition of left bank	Right: 20 days Left: 15 days	2 x 55T excavators 6 x 40T articulated dump trucks 1 x front end loader CAT 988 1 x 140G grader 1 x 14,000L water cart	Right: 168 on-site truck movements per day Left: 10 on-site truck movements per day
Construction of right bank and earth dam Construction of left bank	Right: 30 days Left: 25 days	1 x 45T excavator 3 x 40T articulated dump trucks 1 x D6 dozer 1 x 140M grader 2 x 14,000L water cart 2 x skid steer 1 x CAT 815 2 x sheep foot roller	Right: 98 on-site truck movements per day Left: 10 on-site truck movements per day
Demobilisation	5 days	1 x 50T hydraulic truck crane	25 off-site semi-trailer loads per day to transport equipment

SOURCES: WTP: *Work Methodology Statement – Appendix 9 Construction Methodology Summary* (21 September 2017)
WTP: *Project Construction Logistics Plan* (13 June 2018)

Four proposed stockpile locations have been included in the site layout:

- Stockpile 1 - Has the capacity to hold approximately 40,380 m^3 of excavated material, with a 10,500 m^2 footprint.
- Stockpile 2 - Has the capacity to hold approximately 10,880 m^3 of excavated material, with a 3,024 m^2 footprint.
- Reserve Stockpile Area 1 - Has the capacity to hold approximately 5,400 m^3 of excavated material (1,632 m^2 footprint).
- Reserve Stockpile Area 2 - Has the capacity to hold approximately 7,120 m^3 of excavated material (1,880 m^2 footprint).

A 1,200 kVA diesel-powered generator will be required for the dewatering pumps. This generator is most likely to be located to the south of the left embankment.

Access to the site for construction will primarily be as follows:

- Trucks accessing the site from either the north or south will access via Cooroy and via Elm Street. This route is believed to have the capacity and strength to sustain the volume of truck movements anticipated for this project and gives direct access to Lake Macdonald Drive and Collwood Road.
- Trucks accessing the site via Collwood Road would exit through the site via Lake Macdonald Drive as two-way traffic is not possible on Collwood Road.

2.3 Construction Schedule

The program for construction and operation of the Project will be dependent on the selected contractor and dam safety requirements. However, the preliminary program is expected to comprise the following:

- Mobilisation and site establishment;
- Lake drawdown;
- Secant pile, excavate pile caissons and mass concrete backfill;
- Right/left banks; and
- Commissioning and site disestablishment.

This schedule indicates that the major earthworks and other construction activities with the potential for significant dust emissions are expected to occur over a period of approximately 18 to 24 months.

Standard hours of operation during the project would be six-days per week, 6:30 am to 6:30 pm Monday to Friday and 6:30 am to 4:00 pm on Saturdays, with no work to be carried out on Sunday or public holidays.

There is likely to be the need for extended work hours from time to time for critical construction activities. These activities are likely to include things such as mass concrete pours and demolition works where the embankment has not been secured and are critical for public safety. It is envisaged that prior to these activities being undertaken, outside of normal work hours, there would be an assessment of the works and mitigation proposed to minimise the impact on surrounding residents, particularly with regards to noise, vibration and light impacts.

In addition to the assessment, notification would be provided to the affected residents informing them of the upcoming works and likely impact this may have on the amenity in the area and proposed mitigation the project is carrying out to address the likely impact.

3 Factors Affecting Air Quality

3.1 Environmental Values of Air

The Department of Environment and Science[1] (DES) Guideline *Application requirements for activities with impacts to air* (DES, 2017) lists the environmental values of air that need to be protected as.

- Human health and wellbeing;
- Health and biodiversity of ecosystems;
- Impacts on agriculture; and
- Aesthetics of the environment, including the appearance of buildings, structures and other property (eg odour, dust, visibility reducing particles).

In relation to human health and wellbeing, the Guideline states:

> *The impact of air emissions on human health and wellbeing can range from causing nuisance or inconvenience, to causing significant health impacts and even death. To determine the potential impact of air emissions consideration must be given to:*
>
> - *the chemical and physical properties of air emissions*
> - *the concentration and quantity of contaminants released*
> - *the effect of this release on ambient ground level concentrations of contaminants.*

In relation to impacts on ecosystems, the Guideline states:

> *If a proposal involves the release of contaminants to air in a location where natural ecosystems may be affected (e.g. adjacent to national parks), the applicant must identify whether emissions are at levels that may impact on the health and biodiversity of the ecosystem.*

The most significant emissions to air associated with the proposed Project activities will be emissions of particulate matter from the excavation, handling and transport of soil and rocks, as well as from wind erosion of disturbed soils. The potential impacts of emissions of particulate matter of air quality are discussed in **Section 3.2**

The proposed construction activities will also give rise to emissions of products of fuel combustion from mobile equipment including excavators, dozers and haul trucks, as well as the generator(s) used to power the dewatering pumps. These emissions include sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), volatile organic compounds (VOCs) and fine particulate matter.

Emissions from the trucks and other mobile plant will occur over a relatively large area and will vary spatially and temporally during the course of the works. The 1,200 kVA diesel generator(s) used to power the dewatering pumps however, will be located in a fixed location so the emissions from the generator exhaust will be emitted as a static, fixed point source.

The Project also has potential to give rise to odorous emissions as a result of lowering the water level in Lake Macdonald and exposing normally inundated soil and aquatic vegetation.

[1] Formerly the Department of Environment and Heritage Protection (DEHP)

3.2 Particulate Matter

3.2.1 Suspended Particulate Matter

Airborne contaminants that can be inhaled directly into the lungs can be classified on the basis of their physical properties as gases, vapours or particulate matter. In common usage, the terms “dust” and “particulates” are often used interchangeably. The term “particulate matter” refers to a category of airborne particles, typically less than 30 microns (µm) in diameter and ranging down to 0.1 µm and is termed total suspended particulate (TSP).

Emissions of particulate matter less than 10 and 2.5 microns (µm) in diameter (referred to as PM_{10} and $PM_{2.5}$ respectively) are considered important pollutants due to their ability to penetrate into the respiratory system. In the case of the $PM_{2.5}$ category, recent health research has shown that this penetration can occur deep into the lungs. Potential adverse health impacts associated with exposure to PM_{10} and $PM_{2.5}$ include increased mortality from cardiovascular and respiratory diseases, chronic obstructive pulmonary disease and heart disease, and reduced lung capacity in asthmatic children.

3.2.2 Deposited Particulate Matter

Section 3.2.1 is concerned in large part with the health impacts of particulate matter. Nuisance impacts need also to be considered, mainly in relation to deposited dust. Dust can cause nuisance by settling on surfaces and possessions, affecting visibility and contaminating tank water supplies. High rates of dust deposition can also adversely affect vegetation by blanketing leaf surfaces.

Ambient dust deposition rates are measured by means of a collection gauge, which catches the dust settling over a fixed surface area and over a period of about 30 days.

3.3 Products of Combustion

The products of combustion that would be emitted by diesel-powered plant and equipment utilised during the construction works include oxides of nitrogen (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), Volatile Organic Compounds (VOCs) and particulate matter.

The impacts of particulate matter are discussed above.

The gaseous compounds emitted by diesel combustion sources with the greatest potential for downwind air quality impacts are NO_x, CO and SO_2. If these pollutants are present in air in sufficiently high enough concentrations, they have the potential to give rise to adverse health effects, particularly respiratory impacts and exacerbation of pre-existing respiratory conditions such as asthma.

VOCs from diesel-powered trucks and generators etc are emitted in relatively low concentrations and would not have potential to give rise to off-site air quality impacts during this Project and have not been considered further.

3.4 Odour

The sensory perception of odours can be characterised by four major attributes or dimensions:

- **Detectability** (or odour threshold) refers to the minimum concentration of odorant stimulus necessary for detection in some specified percentage of the test population. The odour concentration of a sample can be characterised by the number of dilutions to reach this detection threshold.
- **Intensity** refers to the perceived strength or magnitude of the odour sensation. Intensity increases linearly with the logarithm of the odour concentration.
- **Hedonic tone** is a judgement of the relative pleasantness or unpleasantness of an odour.
- **Odour quality** is simply a qualitative description of what the odour smells like.

Odour nuisance results when people are affected by an odour they can perceive in their living environment, at home, at work, or during recreational activities, and:

- The appraisal of the odour is negative;
- The perception occurs repeatedly;
- It is difficult to avoid perception of the odour; and
- People believe that the odour has a negative effect on their well-being.

People's perception of odour is closely tied to the way they value their environment. Attitudes towards the source, the inevitability of the exposure and the aesthetic expectations regarding their environment are some of the less tangible factors relevant to the probability of experiencing nuisance.

4 Regulatory Framework

4.1 Queensland Environmental Protection (Air) Policy 2008

The *Environmental Protection Act 1994* (EP Act) and the *Environmental Protection (Air) Policy 2008* (EPP (Air)) provides for the management and regulation of commercial and industrial air emissions that could adversely impact on sensitive receptors.

There is a general environmental duty to prevent and minimise environmental harm under section 319 of the EP Act. The EP Act specifically states:

> *A person must not carry out an activity that causes, or is likely to cause, environmental harm unless the person takes all reasonable and practicable measures to prevent or minimise the harm (the general environment duty).*

To decide the measures required to meet the general environmental duty in accordance with the EP Act, regard must be had to:

- The nature of the harm or potential harm;
- The sensitivity of the receiving environment;
- The current state of technical knowledge for the activity;
- The current state of successful application of the different measures that might be taken; and
- The financial implications of the different measures as they would relate to the type of activity.

4.1.1 Environmental Values

The environmental values listed in the EPP (Air) that are to be enhanced or protected under the policy are:

- The qualities of the air environment that are conducive to protecting the health and biodiversity of ecosystems; and
- The qualities of the air environment that are conducive to human health and wellbeing; and
- The qualities of the air environment that are conducive to protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and
- The qualities of the air environment that are conducive to protecting agricultural use of the environment.

Air quality objectives are set out in the EPP (Air) to protect these environmental values, as discussed below.

4.1.2 Air Quality Objectives

State air quality guidelines are published in Schedule 1 of the EPP (Air). The air quality goals prescribed for the key pollutants of concern in this study (particulate matter) are shown in **Table 3**.

Table 3 EPP (Air) 2008 Ambient Air Quality Objectives for Particulate Matter

Indicator	Environmental Value	Air Quality Objectives μg/m³ at 0°C	Averaging Period	Allowable Exceedances
PM_{10}	Health and wellbeing	50	24 Hours	5 days/year
$PM_{2.5}$	Health and wellbeing	25	24 Hours	-
		8	Annual	-
TSP	Health and wellbeing	90	Annual	-

4.1.3 Management Hierarchy

Section 9 of the EPP (Air) sets out a management hierarchy for all activities involving air emissions:

- Firstly - avoid (eg using technology that avoids air emissions);
- Secondly - recycle (eg re-using air emissions in another industrial process);
- Thirdly - minimise (eg treating air emissions before disposal); and
- Fourthly - manage (eg locating an activity that releases air emissions in a suitable area to minimise the impact of the air emissions).

4.2 National Environment Protection Measure for Ambient Air

The air quality goals currently prescribed in the National Environment Protection (Ambient Air Quality) Measure (NEPC, 2016) (hereafter the NEPM (Ambient Air)) for particulate matter are shown in **Table 4**. There is no criterion specified in the NEPM (Ambient Air) for deposited dust.

Table 4 NEPM (Ambient Air) 2016 Ambient Air Quality Standards for Particulate Matter

Indicator	Maximum Concentration Standard (μg/m³ at 0°C)	Averaging Period	Maximum Allowable Exceedances
PM_{10}	50	24 hours	None
	25	Annual	None
$PM_{2.5}$	25	24 hours	None
	8	Annual	None

The objective of the NEPM (Ambient Air) is to provide a representative measure of regional air quality, rather than for the standards to be used as project-specific targets. Although the NEPM (Ambient Air) is not considered strictly applicable to construction projects it is recognised that projects should work towards achieving the NEPM (Ambient Air) goals. However, given the expected duration of the construction works and the location of residences near the Project area, it is considered appropriate to adopt these goals as part of the environmental performance criteria for the Project.

4.3 Guideline: Application Requirements for Activities with Impacts to Air

The DES Guideline *Application requirements for activities with impacts to air* (DES, 2017), outlines the information to be provided to support an environmental authority application for activities with impacts to air. A summary of the information requirements is listed below along with where they are addressed in this report.

- Describe what the area surrounding the site is used for (e.g. residences, schools, offices, hospitals, commercial, industrial or agricultural purposes) and identify the distance to any sensitive places (**Section 5.2**).
- Provide a scaled map showing the location of sensitive receptors in relation to the site boundary and proposed activities (**Section 5.2**).
- Provide a description of the site topography and built environment (including features such as hills, valleys, buildings or thick stands of vegetation) and how they may affect the way that air contaminants are dispersed in the environment (**Section 5.1**).
- Describe the prevailing wind direction and speed (**Section 5.3**).
- Provide a general description of ambient air quality at the location of the proposed activity. This should include a description of any nearby activities that may emit air pollutants (including odour, dust, smoke and other contaminants) (**Section 5.4**).
- Provide a scaled plan showing the layout of the site and the location of all sources of air emissions.
- Describe the characteristics, including physical properties and chemical composition, of emissions from each source. Where the chemical composition of an emission is not known (e.g. dust emissions from unsealed areas), the applicant should describe the characteristics of the release to the best of their knowledge (**Sections 3.2**, **3.3** and **3.4**).
- For each emission source, describe how contaminants will or may be released (**Section 3.1**).
- Identify 'worst case' emissions (e.g. those that may occur during commissioning, start-up, shutdown, or maintenance and emergencies outside of normal operating conditions) (**Sections 2.2** and **7**).
- Describe what impact air emissions from the proposed activity will have on each of the environmental values identified for the site and receiving environment (**Section 6**).

4.4 Guideline: Odour Impact Assessment from Developments

The DES guideline, *Odour Impact Assessment from Developments* (DES, 2013), states that proponents of new developments or modifications to existing facilities that may give rise to noxious or offensive odours need to determine the sensitivity of the receiving environment to such odours and demonstrate the use of best practice environmental management techniques to manage odours. In addition, it states that the assessment of the risk of odour nuisance is one of the 'standard criteria' that must be considered when developments are assessed under the *Environmental Protection Act 1994*.

Odour impact assessment criteria are set out in the guideline for use in atmospheric dispersion modelling studies. However, as the potential strength and extent of odour emissions from the Project cannot be quantified, an odour dispersion modelling study cannot be performed and odour impact assessment criteria are not useful in assessing or managing odour impacts from the Project. Possible mitigation measures to minimise the potential for odour nuisance impacts are instead presented in **Section 7.1**.

4.5 Dust Deposition

There are no national air quality guideline values for the nuisance dust effect that can be used to assess the impact of dust on the receiving environment. However, there are a number of criteria commonly used by regulatory agencies in Australia. Generally, the criteria have been derived from subjective observations and investigation of dust levels and nuisance effects. A dust deposition limit of 120 milligrams per square metre per day ($mg/m^2/day$), averaged over 1 month, when monitored in accordance with '*AS3580.10.1 Methods for sampling and analysis of ambient air – Determination of Particulates – Deposited Matter – Gravimetric method of 1991*', is frequently used in Queensland for nuisance impacts in residential areas.

5 Receiving Environment

5.1 Surrounding Land Use and Topography

The Project location, inundation footprint and land use is not proposed to change from the existing Six Mile Creek Dam and associated water impoundment (Lake Macdonald).

The area surrounding the Project site can be roughly divided into two areas:

- Upstream land is characterised by undulating pasture and a high proportion of semi-rural residential land-uses.
- Downstream land is characterised by minor rural and semi-rural residential properties, and large areas under forest and sections of Tewantin National Park.

There are several biodiversity values identified in the vicinity of Six Mile Creek Dam, particularly on downstream land, including wetlands, Tewantin National Park and conservation corridors. Tewantin National Park comprises numerous protected areas within the region, the closest of which is immediately north of the site (see **Figure 3**).

The topography surrounding the Project area is relatively flat. There are no major topographical features in the surrounding region that would be expected to significantly affect wind patterns across the Project area. In the vicinity of the Project construction site, the left embankment will provide some sheltering and visual screening for residents on Lake Macdonald Drive to the south of the spillway, however residents north of the spillway would be directly exposed to emissions from the site under southeasterly and easterly wind conditions.

5.2 Sensitive Receptors

The DES Guideline *Application requirements for activities with impacts to air* (DES, 2017) provides guidance on the definition of sensitive receptors, as follows:

A sensitive place could include but is not limited to:

- *a dwelling, residential allotment, mobile home or caravan park, residential marina or other residential premises*
- *a motel, hotel or hostel*
- *a kindergarten, school, university or other educational institution*
- *a medical centre or hospital*
- *a protected area under the Nature Conservation Act 1992, the Marine Parks Act 2004 or a World Heritage Area*
- *a public park or garden*
- *a place used as a workplace including an office for business or commercial purposes. states:*

'If a proposal involves the release of contaminants to air in a location where natural ecosystems may be affected (e.g. adjacent to national parks), the applicant must identify whether emissions are at levels that may impact on the health and biodiversity of the ecosystem.'

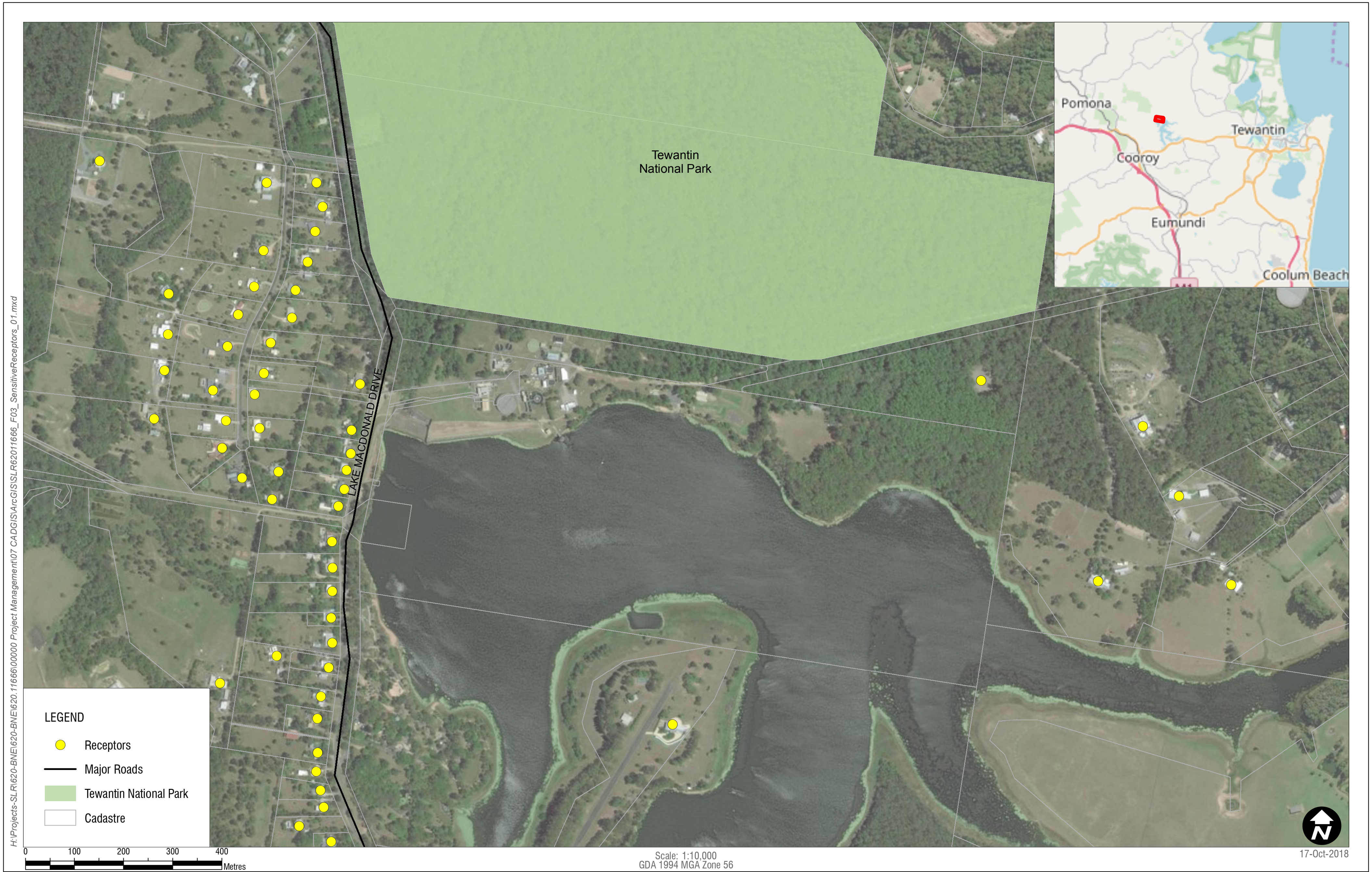
The Project is surrounded by a semi-rural residential area (Lake Macdonald suburb) directly to the west, with small-lot rural residential properties located along Lake Macdonald Drive (see **Figure 3**). The closest residences to the Project construction area are located:

- Approximately 30 m to the west of the left embankment;
- Approximately 210 m to the west of the area in which the CBP may be located; and
- Approximately 215 m to the west of the closest proposed stockpile area.

Other potentially-affected residential receptors include:

- Residences in the vicinity of Collwood Road, east of the Project construction site, which could experience dust emissions from vehicle movements on the gravel road; and
- Residences adjacent to the lake, which could experience odour emissions due to lowering of the water level.

In addition, Tewantin National Park needs to be considered as a sensitive receptor, particularly in terms of potential impacts on vegetation associated with elevated levels of dust deposition.



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Six Mile Creek Dam Safety Upgrade Project
Sensitive Receptors

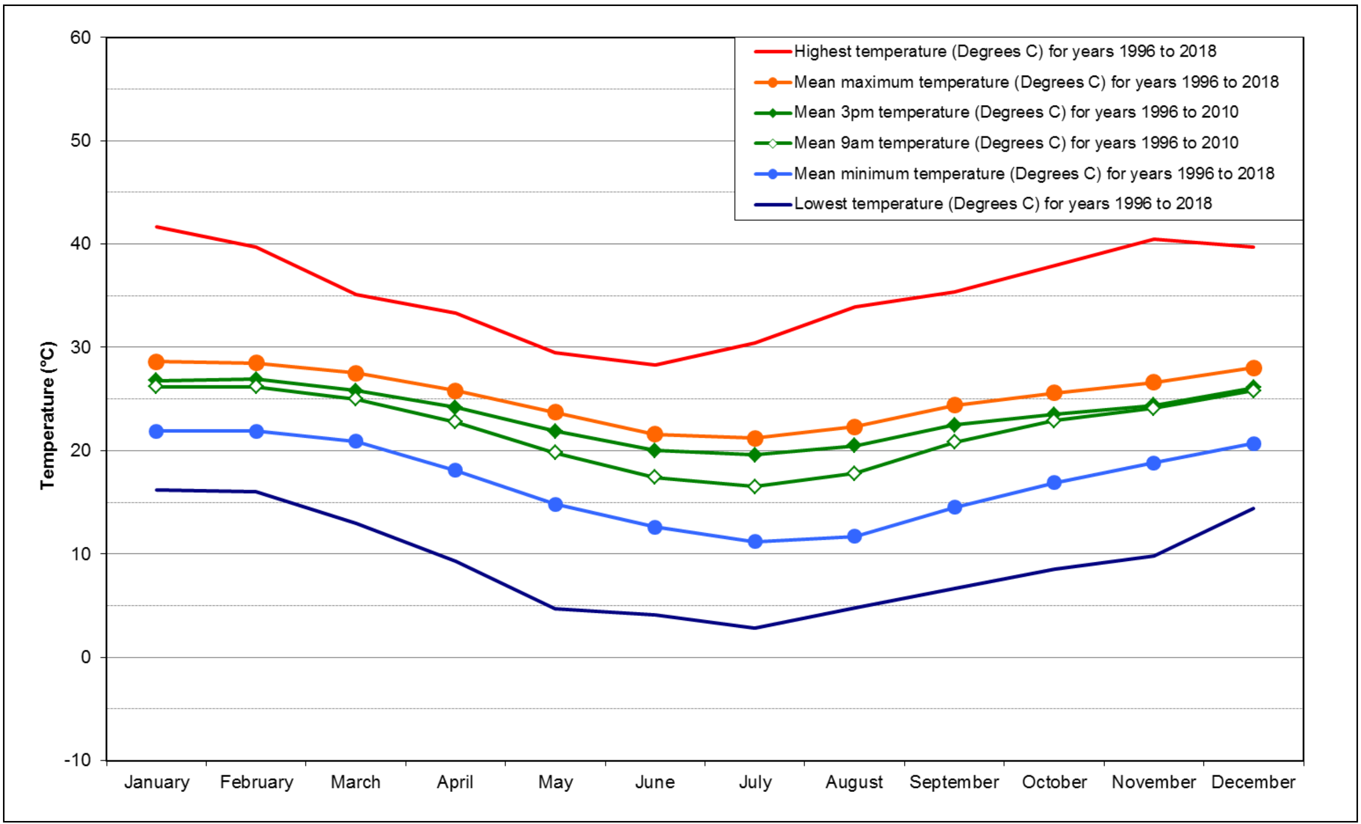
Figure 3

5.3 Meteorology and Climatology

The nearest available meteorological monitoring stations operated by the Bureau of Meteorology (BoM) collecting data suitable for use in a quantitative air dispersion modelling study is located at Tewantin RSL Park (Station 40908), 10 km east of Six Mile Creek Dam. Wind speed and wind direction, rainfall, temperature and relative humidity data are available from the Tewantin RSL Park BoM weather station for the period 1995 to 2018.

Monthly mean maximum and minimum temperatures recorded at Tewantin RSL Park (1996 – 2018) are presented in **Figure 4**. This data shows that average maximum temperatures in the region approach 30°C during summer. During the winter months, the average maximum temperature falls to about 21°C. Average minimum temperatures range from 22°C in summer to 11°C in winter.

Figure 4 Monthly Average Minimum and Maximum Temperatures - Tewantin RSL Park



Annual and seasonal wind roses for the five year period 2013-2017 (inclusive), compiled from data recorded by the Tewantin RSL Park AWS are presented in **Figure 5**. The wind roses show the frequency of occurrence of winds by direction and strength. The bars correspond to the 16 compass points (degrees from North). The bar at the top of each wind rose diagram represents winds blowing from the north (i.e. northerly winds), and so on. The length of the bar represents the frequency of occurrence of winds from that direction, and the widths of the bar sections correspond to wind speed categories, the narrowest representing the lightest winds. Thus it is possible to visualise how often winds of a certain direction and strength occur over a long period, either for all hours of the day, or for particular periods during the day.

The annual wind rose for the period January 2013 to February 2018 indicates the predominant wind directions in the area are from the south, with a low frequency of winds from the east. The annual frequency of calm wind conditions was recorded to be approximately 13%.

The seasonal wind roses for the period indicate that:

- In summer, winds are predominantly from the southeast quadrant, with negligible winds from the western quadrant. Calms were recorded to occur 6% of the time and the average wind speed was 3.4 m/s.
- In autumn, winds generally become lighter and are predominantly blow from the south and southeast, with very few winds from the northwest and northeast quadrants. Calms were recorded for 15% of the time and the average wind speed was 2.6 m/s.
- In winter, winds are predominantly from the south and south-southwest, with a low frequency of winds from other directions. Calms were recorded for approximately 21% of the time during the winter months and the average wind speed was 2.1 m/s.
- In spring, winds begin to strengthen again, and are much more variable in direction. Calms were recorded for 11% of the time and the average wind speed was 3 m/s.

From the long term wind patterns recorded by the Tewantin RSL Park AWS, and assuming that the same wind conditions will be experienced at Six Mile Creek Dam, it can be concluded that that the Project area is likely to be predominantly subjected to winds from south and southwest. Winds from the east, which would blow emissions from the construction works towards the nearest residences, occur approximately 20% – 30% of the time, with these winds generally being in the range of 3-8 m/s.

Monthly average rainfall data recorded at Tewantin RSL Park (1996 – 2018) are presented in **Figure 6**. The average annual rainfall was 1,569 mm over the period. Higher monthly rainfall rates occur in the summer, peaking in February.

Monthly average 9:00 AM and 3:00 PM relative humidity data recorded at Tewantin RSL Park (1996 – 2010) are presented in **Figure 7**. The humidity levels are relatively consistent throughout the year, and generally higher in the morning compared to the afternoon, particularly during winter. In spring, morning and afternoon humidity levels are very similar. Levels are highest in June and July (around 80% at 9:00 AM and 50% at 3:00 PM) and drop to their lowest levels in December and January (around 55% at 9:00 AM and 35% at 3:00 PM).

Figure 5 Annual and Seasonal Wind Roses - Tewantin RSL Park

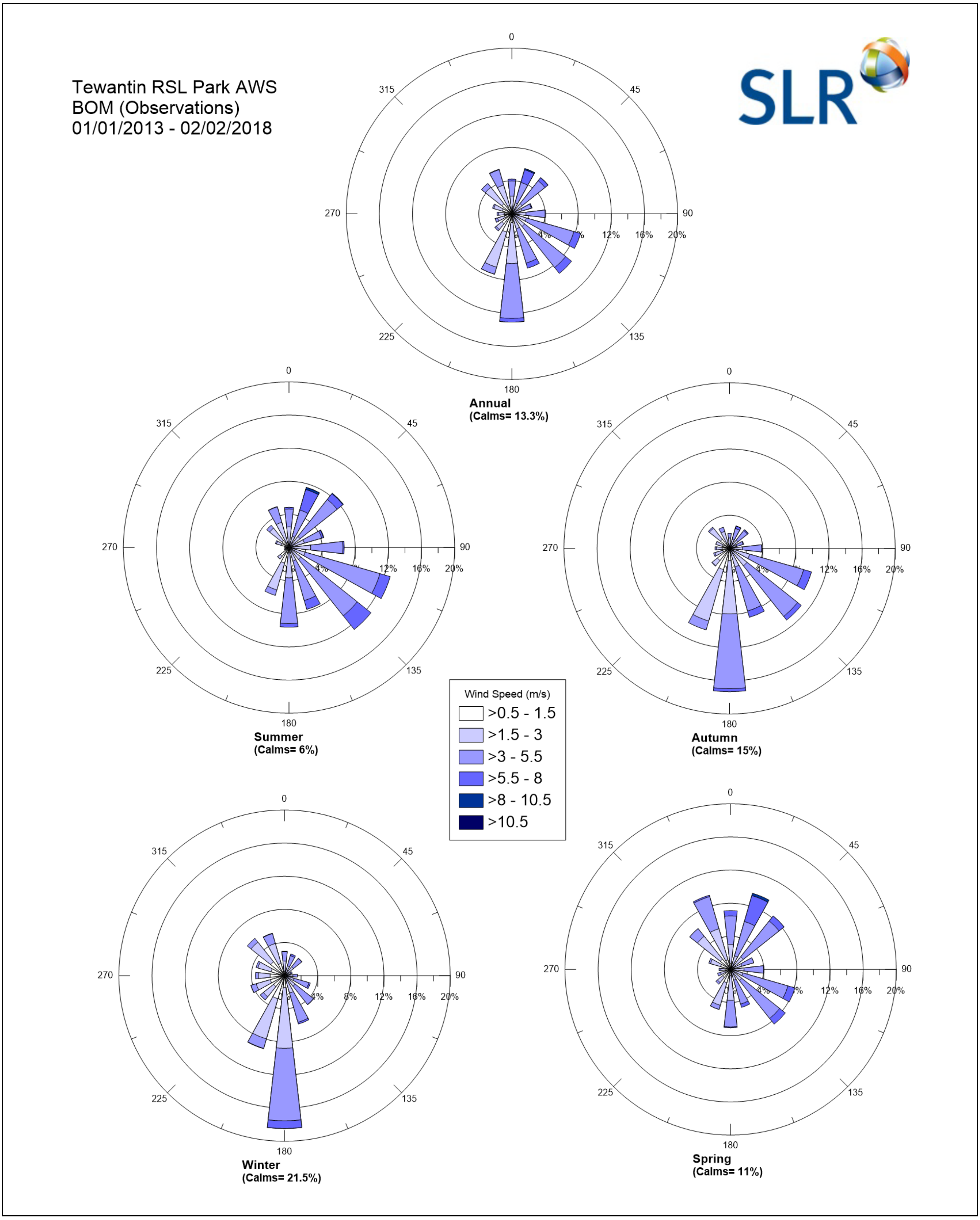


Figure 6 Monthly Average Rainfall Data - Tewantin RSL Park

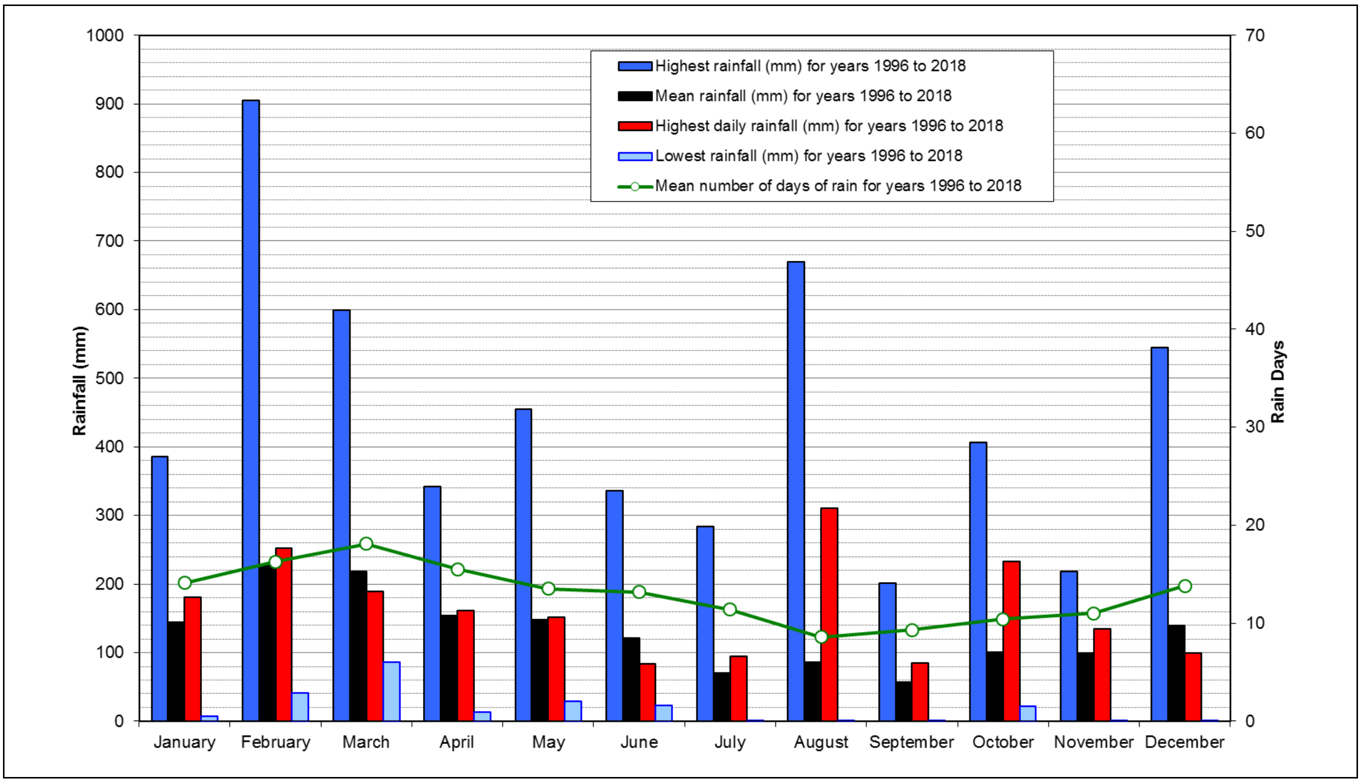
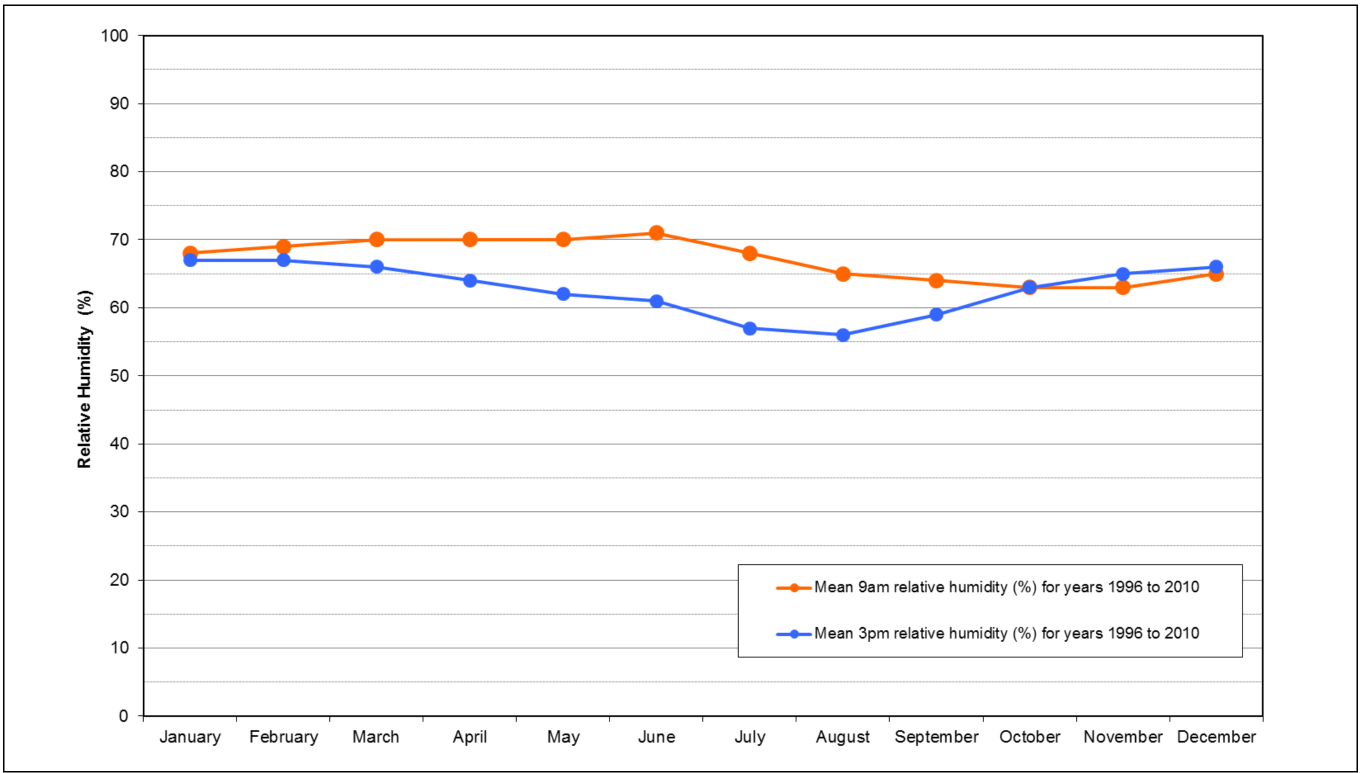


Figure 7 Monthly Average 9:00 AM and 3:00 PM Relative Humidity Data - Tewantin RSL Park



5.4 Existing Air Quality

Given the undeveloped nature and low population density of the surrounding area, the existing air quality at the Project site is expected to be good. There would be minimal emissions of vehicle emissions in the local area, with the Bruce Highway located more than 4.8 km to the southwest, and no significant industrial or commercial emissions sources have been identified in the surrounding area.

It is noted that there is a boiler installed at the Wimmers soft drink factory, located 1.3 km southwest of the Project construction site. While the size of the boiler is unknown, it is understood to be gas-fired, hence emissions of combustion products from this unit would not be expected to significantly impact on ambient pollutant concentrations at the nearest sensitive receptors to the Project. In addition, the relative location of this source to the Project construction site and identified sensitive receptor locations means that there is no potential for cumulative impacts; when the wind is blowing emissions from Wimmers northeast towards the receptors along Lake Macdonald Drive, any air emissions from the Project construction site will also be directed northeast away from those receptors.

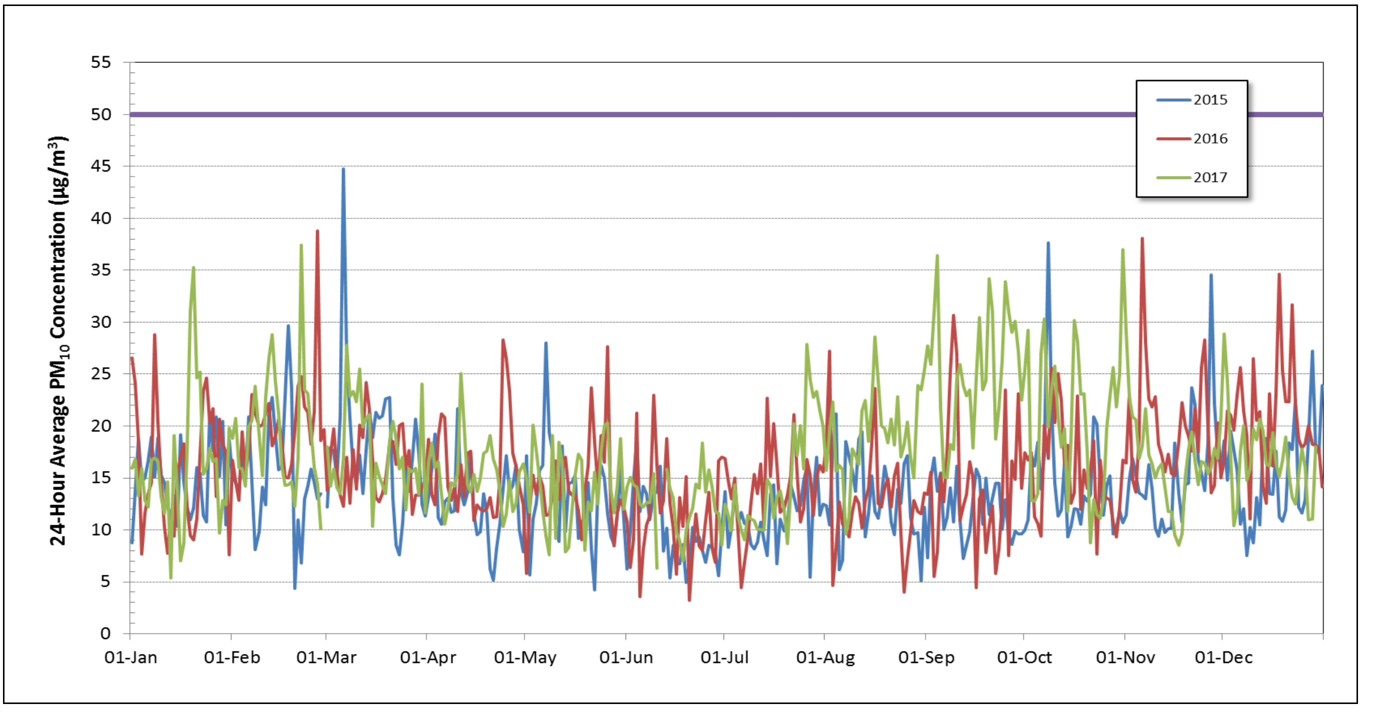
There is no site-specific air quality monitoring data available for the Project area, however the DES operates an ambient air quality monitoring station at the Mountain Creek Primary School, approximately 36 km to the southeast on the Sunshine Coast. The Mountain Creek air quality monitoring site was commissioned in July 2001 and measures PM_{10}, NO_X, ozone and meteorological variables.

The 24-hour average PM_{10} concentrations measured at the Mountain Creek air quality monitoring site over the last three years are presented in **Figure 8**. This plot shows that no exceedances of the NEPM (Ambient Air) standard for 24-hour average PM_{10} concentrations of 50 µg/m^3 were measured by this monitoring station during this period. The annual average PM_{10} concentrations measured were also below the NEPM (Ambient Air) standard for annual average PM_{10} concentrations of 25 µg/m^3, at:

- 2015: 13.8 µg/m^3;
- 2016: 15.9 µg/m^3; and
- 2017: 17.4 µg/m^3.

The Mountain Creek air quality monitoring station is located in a more urbanised environment than Six Mile Creek Dam and PM_{10} concentrations are likely to be lower in the Project area than the values shown in **Figure 8**. The average of the last three years' annual average background PM_{10} concentrations of 15.7 µg/m^3 has therefore been used as a conservative estimate in this assessment.

Figure 8 24-Hour Average PM_{10} Concentrations Measured at Mountain Creek (2015 –2017)



6 Air Quality Impact Assessment

6.1 Fugitive Dust

6.1.1 Human Health and Nuisance Impacts

For this AQIA, the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* (IAQM, 2014) developed in the United Kingdom by the Institute of Air Quality Management (IAQM) has been used to provide a qualitative risk assessment method to identify the level of dust control anticipated to be required for the Project to minimise the risk of adverse health or nuisance impacts for surrounding residents. The IAQM approach has been widely used in Australia for performing qualitative assessments of fugitive dust emissions from construction projects, and has been accepted by many regulatory authorities as a suitable approach in the absence of any Australian-based guidance.

The IAQM method uses a four-step process for assessing dust impacts from construction activities:

- **Step 1**: Screening based on distance to the nearest sensitive receptor; whereby the sensitivity to dust deposition and human health impacts of the identified sensitive receptors is determined.
- **Step 2**: Assess risk of dust effects from activities based on:
    a. the scale and nature of the works, which determines the potential dust emission magnitude; and
    b. the sensitivity of the area surrounding dust-generating activities.
- **Step 3**: Determine site-specific mitigation for remaining activities with greater than negligible effects.
- **Step 4**: Assess significance of remaining activities after management measures have been considered.

In the IAQM methodology, activities on construction sites are divided into four types to reflect their different potential impacts. These are:

- Demolition;
- Earthworks;
- Construction; and
- Trackout.

Trackout refers to the transport of dust and dirt from the construction/demolition site onto the public road network, where it may be deposited and then re-suspended by vehicles using the network. This arises when heavy duty vehicles leave the construction/demolition site with dusty materials, which may then spill onto the road, and/or when the tyres on these vehicles transfer dust and dirt onto the road having travelled over muddy ground on site.

Details of the IAQM Methodology are provided in **Appendix A**. The findings of the risk assessment are presented below.

6.1.1.1 Step 1 – Screening Based on Separation Distance

The screening criteria provided by the IAQM guidance suggest screening out any assessment of impacts from construction activities where sensitive receptors are located more than:

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

In the case of the proposed Six Mile Creek Dam upgrade works, the nearest sensitive receptors are located approximately 30 m from the site boundary and the site entrance. On this basis, further assessment is required.

6.1.1.2 Step 2a – Assessment of Scale and Nature of the Works

Key factors with the potential to influence the amount of dust that could potentially be generated by the proposed upgrade works include:

- A site footprint of approximately 170,000 m^2 (17 hectares);
- Total stockpile area of 17,000 m^2;
- Piling and an on-site concrete batch plant will be required; and
- Estimated peak off-site less than 50 Heavy Goods Vehicle (deliveries) movements per day (see **Section 2.2**, this does not include light vehicle movements).

When estimating the "building" volume for the demolition and construction activities, the concrete and other materials associated with the existing and proposed spillways has also been considered.

Based upon the scale and nature of the works proposed and the IAQM example definitions for demolition, earthworks, construction and trackout (refer **Appendix A**), the dust emission magnitudes have been conservatively classified for each activity as presented in **Table 5**.

Table 5 Categorisation of Dust Emission Magnitude

Activity	Dust Emission Magnitude	Basis of Categorisation (referencing the IAQM example definitions [1])
Demolition	Large	• Total volume of demolition materials, including the existing spillway and dam wall, will be well in excess of the 50,000 m^3 threshold • Works will include potentially dusty construction materials (eg concrete) • Demolition using excavators fitted with rock hammers • Demolition activities (ie, existing spillway etc) potentially up to 20 m above ground level (top of embankments)
Earthworks	Large	• Total site area greater than 10,000 m^2 • Potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size) • More than 10 heavy earth moving vehicles active at any one time • Formation of embankments greater than 8 m in height • Total material moved more than 100,000 tonnes
Construction	Large	• Total building volume greater than 100,000 m^3 • Piling • On-site concrete batching
Trackout	Large	• Close to 50 heavy vehicle movements per day • Greater than 100 m of unpaved road length.

[1] See **Appendix A**

6.1.1.3 Step 2b – Risk Assessment

Receptor Sensitivity

Based on the criteria listed in **Appendix A**, the sensitivity of the identified receptors in this study is concluded to be *high* for health impacts and *high* for dust soiling, as the receptors include residences where people may be reasonably expected to be present continuously as part of the normal pattern of land use.

Sensitivity of Surrounding Area

Using the classifications shown in **Appendix A**, the sensitivity of the surrounding area has been classified as:

- ‘Low’ for health effects; and
- ‘Medium’ for dust soiling.

This categorisation has been made taking into account the ‘high’ receptor sensitivity, number of sensitive receptors within 20 and 50 m of the site (1-10 houses and 10-100 houses respectively), and (for health impacts) the estimated annual mean background PM_{10} concentration of 15.7 µg/m^3 (refer **Section 5.4**).

Risk Assessment

Given the sensitivity of the surrounding area is classified as *'low'* for health effects and *'medium'* for dust soiling, and based on the dust emission magnitudes for the various construction phase activities as shown in **Table 5**, the resulting risk of air quality impacts ***if dust mitigation measures are not implemented*** is as presented in **Table 6**. The results indicate that there is:

- A *'high'* risk of adverse dust soiling impacts occurring at off-site receptor locations if no mitigation measures were to be applied to control emissions from demolition activities and a *'medium'* risk of dust soiling impacts from earthworks, construction and trackout; and
- A *'medium'* risk of adverse health impacts occurring at off-site receptor locations if no mitigation measures were to be applied to control emissions from demolition activities but a *'low'* risk of dust soiling impacts from earthworks, construction and trackout.

Table 6 Risk of Air Quality Impacts from Proposed Dam Upgrade Activities

Impact	Sensitivity of Area	Dust Emission Magnitude				Preliminary Risk			
		Demolition	Earthworks	Construction	Trackout	Demolition	Earthworks	Construction	Trackout
Dust Soiling	Medium	Large	Large	Large	Large	High	Medium	Medium	Medium
Human Health	Low					Medium	Low	Low	Low

6.1.1.4 Step 3 – Site-Specific Mitigation Measures

The mitigation measures recommended as *highly recommended* (H) or *desirable* (D) by the IAQM methodology for a development shown to have the above risks of adverse impacts have been reviewed and all practical and relevant measures have been included in **Section 7.1** for implementation during the works, as appropriate.

6.1.1.5 Step 4 – Residual Impacts

For almost all construction activity, the IAQM Method notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation, and that experience shows that this is normally possible. Given that water should be readily available for dust suppression when required (either from the lowered lake or from on-site settling basins for construction erosion and sediment control purposes), residual impacts associated with fugitive dust emissions are expected to be able to be reduced to acceptable levels. A monitoring programme is recommended in **Section 7.2** to assist in the effective management of off-site dust impacts.

6.1.2 Impacts on Vegetation

The above risk assessment focus on potential impacts on human health and amenity levels for surrounding residents. As noted in **Section 3.2.2** the potential effects on surrounding vegetation needs to be considered, given the site's proximity to Tewantin National Park.

A review of a number of studies into damage to vegetation from dust soiling has been performed (Farmer, 1993) that showed that impacts vary considerably between species and with different dust types. Indicative dust deposition rates at which there is an increased risk of damage to plants were derived as part of the Social and Environmental Impact Assessment for the Simandou Railway project based on a review of criteria used internationally for dust deposition nuisance and harm to vegetation. The criteria derived from this review are shown in **Table 7**.

Table 7 Estimated Significance Criteria for Dust Deposition Rates Based on Damage to Plants

Annual Mean Deposition Rate	Effect
< 350 mg/m^2/day	Damage to plants unlikely to occur
350 - 650 mg/m^2/day	Damage to plants possible
650 - 950 mg/m^2/day	Damage to plants probable
950 - 1,190 mg/m^2/day	Damage to plants highly probable
< 1,190 mg/m^2/day	Severe damage to plants

SOURCE: (Rio Tinto, 2012)

Approximately 850 m of the site boundary will abut Tewantin National Park, as well as a 1.2 km unsealed section of Collwood Road that will be used for site access. Based on SLR's experience monitoring dust deposition rates in the vicinity of construction sites and mines, levels greater than 350 mg/m^2/day (equivalent to 10.5 g/m^2/month) could potentially occur near the site boundary and immediately adjacent to Collwood Road during peak activity periods if adequate mitigation measures are not implemented, particularly given the predominant southerly wind direction. Mitigation measures to minimise the potential for damage to vegetation are presented in **Section 7.1**. Given that adequate water will be available on site to use for dust suppression, it is expected that off-site dust deposition rates would be able to be effectively controlled. Any localised impacts of dust from the construction works on vegetation along the site boundary would be temporary, and once the works are complete it is expected to recover relatively quickly.

6.2 Combustion Products

Emissions of combustion products from mobile plant and equipment will occur over large areas and will vary spatially and temporally during the course of the works. Based on the equipment numbers and activity rates proposed in **Table 1** and **Table 2**, there is no potential for exceedances of air quality criteria for SO_2, NO_2, CO or VOCs to occur at the nearest sensitive receptor locations as a result of emissions from mobile plant and equipment used during the works.

The 1,200 kVA diesel generator(s) used to power the dewatering pumps however, will be located in a fixed location so the emissions from the generator exhaust will be emitted as a static, fixed point source. There is therefore potential for elevated concentrations of air pollutants to occur in the immediate vicinity of the generator(s). This is most appropriately managed by appropriate siting of these units, which will also assist in addressing potential noise impacts. Given the anticipated size of the generator(s), it is recommended that it be located at least 100 m from the nearest sensitive receptor

6.3 Odour

Dewatering/lake lowering is anticipated to occur during May – August 2019. This will result in exposed aquatic plants, and some fish that can't be salvaged, decaying and anaerobic muds being exposed. As discussed in **Section 4.4**, it is not possible to quantify the potential frequency, duration or intensity of odour emissions from Lake Macdonald when the water level is lowered. The total duration from lowering of the water level until the re-inundation of Lake Macdonald once the works are completed is anticipated to be a two year period, however the greatest potential for odour to be generated will be during the lowering and immediately after. As the sediments dry out, plants decay and desiccate, and grasses become established on the beds, it can be expected that odours will reduce. On this basis it is estimated that June - December 2019 would be the peak period of potential odour generation.

Given that the odours that will potentially occur as a result of the Project will be temporary in nature, of organic origin and would be associated with necessary upgrade works to ensure the safety of the dam, it can be expected that there would be an higher level of tolerance of the odours by surrounding residents compared to (for example) a permanent and/or industrial-type odour source.

Recommended mitigation measures to reduce the potential for odour emissions, and to manage residents' expectations and effectively respond to complaints, are provided in **Section 7.1**.

7 Mitigation and Monitoring

7.1 Mitigation Measures

Recommended mitigation measures to minimise impacts associated with air emissions from the Six Mile Creek Dam upgrade works are listed below.

ID	Mitigation Measure
1	**Communications**
1.1	Develop and implement a stakeholder communications plan that includes community engagement before work commences on site.
1.2	Display the name and contact details of person(s) accountable for air quality and dust issues, and/or the available platforms for providing feedback/complaints, on the site boundary.
2	**Site Management**
2.1	Record all dust, odour and other air quality complaints, identify cause(s), take appropriate measures to reduce emissions in a timely manner, and record the measures taken.
2.2	Make the complaints log available to the regulatory authorities upon request.
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.
2.4	Carry out daily site inspections to monitor compliance with the dust management plan, record inspection results, and make an inspection log available to the regulatory authorities upon request.
2.5	Undertake weekly off-site visual inspections to monitor dust. Record inspection results and make the log available to the regulatory authorities upon request. This should include regular dust soiling checks of surfaces such as street furniture, cars and window sills within 100 m of site boundary.
2.6	Ensure relevant personnel are provided with adequate environmental awareness and training covering air quality management and monitoring.
3	**Site Preparation and Layout**
3.1	Erect solid screens or barriers around dusty activities or the site boundary that are at least as high as any stockpiles on site.
3.2	Keep the size of cleared areas to a minimum to limit exposed areas available for dust emissions by wind erosion.
3.3	Retain existing vegetation, where practical, between construction activities and sensitive receivers to reduce particulate concentrations and dust deposition rates at receivers.
3.4	Install barriers alongside roads to deter driving off nominated access roads
4	**General Operations**
4.1	Keep site fencing, barriers and scaffolding clean using wet methods.
4.2	Avoid site runoff of water or mud. Remove silt and other materials from around any erosion control structures following any significant rain event (>10mm) to ensure deposits do not become a dust source.
4.3	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.
4.4	Fence stockpiles (eg 3-sided enclosures where practicable) to prevent wind erosion.
4.5	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

ID	Mitigation Measure
4.6	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.
4.7	Ensure an adequate water supply on the site for effective dust/particulate matter suppression/mitigation at all times, using non-potable water where possible and appropriate.
4.8	Use water sprays to control dust from unsealed traffic areas on site, particularly during periods of unfavourable wind conditions (winds greater than 5 m/s) and with particular focus on haul roads located near residents.
4.9	Review the need to cease or relocate dust producing activities during strong wind conditions.
4.10	Any fuel storage and handling areas are to be located as far as practicable away from sensitive receptor locations. Fuel/chemical storage areas are to be appropriately bunded and spill kits are to be strategically located to ensure timely clean-up should accidental spills/leaks occur.
4.11	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.
4.12	Ensure bagged supplies of fine powder materials are sealed after use and stored appropriately to prevent dust.
4.13	Ensure emissions controls are installed on the Concrete Batch Plant (ie electrostatic precipitator (ESP) to be installed on the hopper vent) to minimise particulate emissions, and ensure that they are operated effectively at all times.
4.14	Maintain and operate plant and equipment at the project site in a proper and efficient condition/manner.
5	**Demolition**
5.1	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.
6	**Earthworks**
6.1	Use water sprays to control dust from earthworks activities, particularly during periods of unfavourable wind conditions (winds greater than 5 m/s).
6.2	Minimise drop heights from loading shovels and other loading or handling equipment and use fine water sprays on such equipment wherever appropriate.
7	**Trackout**
7.1	Implement regular watering along unsealed section of Collwood Road (eastern site access) when in use for heavy vehicle movements.
7.2	Use water-assisted dust sweeper(s) on the sealed access and local roads, to remove, as necessary, any material tracked out of the site.
7.3	Avoid dry sweeping of large areas
7.4	Cover haul truck loads when travelling on public roads; the load must be lower than the sides of the truck and the truck is to be free of loose mud and dirt before entering public roads.
7.5	Implement a wheel washing system (with rumble grids to dislodge accumulated dust and mud prior to leaving the site) where reasonably practicable.
7.6	Ensure there is an adequate area of hard surfaced road between the wheel wash facility and the site exit, as far as the site size and layout permits.
7.7	Hydro-mulch, mulch, hydro-seed or stabilisation spray should be applied to batters adjacent to haul roads to stabilise these areas and minimise wind-blown dust.

ID	Mitigation Measure
8	**Combustion Emissions**
8.1	Prepare an implement a traffic management plan to manage the sustainable delivery of goods and materials and to minimise queueing along local roads adjacent to residential properties.
8.2	Ensure all vehicles switch off engines where idling time on-site is likely to exceed two minutes.
8.3	Avoid the use of diesel or petrol powered generators and use mains electricity or battery powered equipment where practicable.
8.4	For the diesel powered generator required for the dewatering pumps, locate the unit as far from sensitive receptors as possible and ensure the exhaust emissions are discharged away from areas where workers or members of the public would be exposed to the plume.
9	**Odour**
9.1	Ensure a high level of communication with local residents regarding the potential for odours to be generated as a result of lowering the water level in Lake Macdonald.
9.2	Recovery of fish from the reservoir will minimise potential for odours relating to decomposition of dead fish.
9.3	Monitor, and if required, promote vegetation growth on the exposed banks to encourage drying out of the sediments /mud and promote aerobic conditions that may minimise offensive odour generation.

7.2 Recommended Monitoring Programme

In addition to the routine visual inspections noted in **Section 7.1**, **Table 8** outlines the recommended monitoring programme for the Project. This includes continuous monitoring of suspended particulate concentrations (as PM_{10}), along with wind speed and wind direction, to provide real-time data on dust levels. The continuous monitors should be configured with an automatic alarm system using short-term trigger levels (eg 150 µg/m^3 as a 1-hour average) to alert site staff (via email or SMS) that elevated concentrations are beginning to be detected, so that additional mitigation measures can be implemented.

Adverse results from any monitoring activity should be investigated by the contractor as soon possible to identify the cause and to take appropriate corrective action. The results of the monitoring should be reported to Seqwater on a monthly basis, demonstrating compliance with the following criteria:

- PM_{10}:
  - 24-hour average concentration - 50 µg/m^3
  - Annual average concentration - 25 µg/m^3
- Dust deposition:
  - Residential areas - 120 mg/m^2/day
  - Tewantin National Park - 350 mg/m^2/day

Any non-compliances should be identified and details provided regarding the cause and extent of the problem, and the remedial action taken.

Table 8 Recommended Monitoring Programme

Description	Parameter	Instrument	Methodology	Recommended Locations	Duration	Frequency
Deposited particulate	Dust deposition rate (mg/m^2/day, monthly average)	Dust Deposition gauges	▪ AS/NZS 3580.1.1:2016 ▪ AS/NZS 3580.10.1:2003	Three locations: ▪ North of main Contractor Facilities Area along boundary with Tewantin National Park; ▪ Northeast corner of Stockpile 1 along boundary with Tewantin National Park; and ▪ Western side of Lake Macdonald Dr in vicinity of site access road.	To start 3 months prior to mobilisation to provide local baseline, and continuously during the Project	Monthly samples
Suspended particulate	PM_{10} concentration (µg/m^3, 24 hr avg)	E-BAM or E-Sampler or BAM	▪ AS/NZS 3580.1.1:2016 ▪ AS/NZS 3580.9.11:2016	One location: ▪ Western side of Lake Macdonald Dr in vicinity of site access road.	To start 1 month prior to mobilisation to provide local baseline, and continuously during the Project	Continuous monitoring
		Low Volume sampler	▪ AS/NZS 3580.1.1:2016 ▪ AS/NZS 3580.9.9:2017	At monitoring locations to investigate dust complaints and/or high levels of observed dust	As required during construction	24 hour average samples
Meteorology	Wind speed/direction	Meteorological station	▪ AS/NZS 3580.14:2014	At the continuous PM_{10} monitoring site	To start 1 month prior to mobilisation to provide local baseline, and continuously during the Project	Continuous monitoring

7.3 Complaints Handling

A complaints handling system should be maintained to monitor complaints with all information relating to complaints kept in a complaints register maintained on site. The complaints register should note the following details at minimum for a complaint relating to air quality issues:

- Date and time that the complaint was made;
- Name and contact details of the complainant;
- Location where the air quality issue was noted;
- Weather conditions experienced on the day;
- The perceived (or assumed) cause of the air emissions giving rise to the complaint;
- On site activities taking place at the time of the complaint;
- Actions taken where site activities are determined to be the cause of the complaint;
- Sign-off by a responsible person; and
- Follow-up with the complainant.

In the event that a complaint is received, preliminary investigations will commence within 48 hours of receipt and adequate measures to identify and manage will be considered (including air monitoring).

8 Conclusions

SLR was commissioned by SMEC on behalf of Seqwater to prepare an AQIA of activities associated with the Six Mile Creek Dam (also known as the Lake Macdonald Dam) Upgrade. An AQIA is a required component of the Impact Assessment Report (IAR).

The activities proposed as part of the Project include:

- Staged and temporary lowering of the dam's water level to allow for construction works;
- Construction of a temporary coffer dam to enable removal of the dam's spillway;
- Construction of a replacement spillway;
- Reconstruction the existing earthen embankments; and
- Potential construction of a saddle dam.

Potential emissions to air associated with the proposed Project have been identified as follows:

- Emissions of particulate matter from the excavation, handling and transport of soil and rocks, as well as from wind erosion of disturbed soils.
- Emissions of products of fuel combustion from mobile equipment including excavators, dozers and haul trucks, as well as the generator(s) used to power the dewatering pumps.
- Odours emitted as a result of lowering the water level in Lake Macdonald and exposing normally inundated soil and aquatic vegetation.

The Project is surrounded by a semi-rural residential area (Lake Macdonald suburb) directly to the west, with small-lot rural residential properties located along Lake Macdonald Drive. The closest residences are located:

- Approximately 30 m to the west of the left embankment;
- Approximately 230 m to the west of the Contractor Facilities Area (in which the CBP will be located); and
- Approximately 215 m to the west of the closest proposed stockpile area.

In addition, Tewantin National Park needs to be considered as a sensitive receptor, particularly in terms of potential impacts on vegetation associated with elevated levels of dust deposition.

For this AQIA, the *IAQM Guidance on the Assessment of Dust from Demolition and Construction* (IAQM, 2014) has been used to provide a qualitative risk assessment method to identify the level of dust control anticipated to be required for the Project to minimise the risk of adverse health or nuisance impacts for surrounding residents. The findings of this risk assessment process are summarised as follows:

- The sensitivity of the surrounding area is classified as '*low*' for health effects and '*medium*' for dust soiling;
- The dust emission magnitudes for the various construction phase activities (demolition, earthworks, construction and trackout) are all classified as '*large*';

- On this basis, ***if dust mitigation measures are not implemented,*** there is:
  - A '*high'* risk of adverse dust soiling impacts occurring at off-site receptor locations if no mitigation measures were to be applied to control emissions from demolition activities and a '*medium'* risk of dust soiling impacts from earthworks, construction and trackout; and
  - A '*medium'* risk of adverse health impacts occurring at off-site receptor locations if no mitigation measures were to be applied to control emissions from demolition activities but a '*low'* risk of dust soiling impacts from earthworks, construction and trackout.

The assessment also concluded that, given the proximity of the active stockpiling areas, laydown areas, haul roads and CBP to Tewantin National Park, localised impacts on vegetation could potentially occur during peak activity periods if adequate mitigation measures are not implemented.

For almost all construction activity, the IAQM notes that the aim should be to prevent significant effects on receptors through the use of effective mitigation, and that experience shows that this is normally possible. Given that water should be readily available for dust suppression when required, residual impacts associated with fugitive dust emissions are expected to be able to be reduced to acceptable levels. A range of recommended control measures have been presented to minimise off-site impacts from dust emissions. This includes continuous monitoring of suspended particulate concentrations (as PM_{10}), along with wind speed and wind direction, to provide real-time data on dust levels. The continuous monitors should be configured with an automatic alarm system using short-term trigger levels (eg 150 $\mu g/m^3$ as a 1-hour average) to alert site staff (via email or SMS) that elevated concentrations are beginning to be detected, so that additional mitigation measures can be implemented.

Emissions of combustion products from mobile plant and equipment will occur over large areas and will vary spatially and temporally during the course of the works. Based on the equipment numbers and activity rates proposed, there is no potential for exceedances of air quality criteria for SO_2, NO_2, CO or VOCs to occur at the nearest sensitive receptor locations as a result of emissions from mobile plant and equipment used during the works. There is therefore potential for elevated concentrations of air pollutants to occur in the immediate vicinity of the 1200 kVA diesel generator(s) used to power the dewatering pumps. This is most appropriately managed by appropriate siting of these units, and it is recommended that it be located at least 100 m from the nearest sensitive receptor

It is not possible to quantify the potential frequency, duration or intensity odour emissions from Lake Macdonald when the water level is lowered and sediments and aquatic vegetation are exposed. The greatest potential for odour to be generated will be during the lowering and immediately after. As the sediments dry out, plants decay and desiccate, and grasses become established on the beds, it can be expected that odours will reduce. On this basis it is estimated that June - December 2019 would be the peak period of potential odour generation. Given that the odours that will potentially occur as a result of the Project will be temporary in nature, of organic origin and would be associated with necessary upgrade works to ensure the safety of the dam, it can be expected that there would be an higher level of tolerance of the odours by surrounding residents compared to (for example) a permanent and/or industrial-type odour source.

9 References

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APPENDIX A

IAQM Construction Dust Risk Assessment Methodology

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 will require assessments for most projects.

STEP 2A – ASSESSMENT OF SCALE AND NATURE OF THE WORKS

Step 2A of the assessment provides "dust emissions magnitudes" for each of four dust generating activities; demolition, earthworks, construction, and track-out (the movement of site material onto public roads by vehicles). The magnitudes are: *Large*; *Medium*; or *Small*, with example definitions for each category given as follows:

- Demolition:
    - ***Large***: Total building volume >50,000 m^3, potentially dusty construction material (e.g. concrete), on-site crushing and screening, demolition activities >20 m above ground level;
    - ***Medium***: Total building volume 20,000 m^3 – 50,000 m^3, potentially dusty construction material, demolition activities 10-20 m above ground level; and
    - ***Small***: Total building volume <20,000 m^3, construction material with low potential for dust release (e.g. metal cladding or timber), demolition activities <10m above ground, demolition during wetter months.
- Earthworks:
    - ***Large***: Total site area greater than 10,000 m^2, potentially dusty soil type (eg clay, which will be prone to suspension when dry due to small particle size), more than 10 heavy earth moving vehicles active at any one time, formation of bunds greater than 8 m in height, total material moved more than 100,000 t.
    - ***Medium***: Total site area 2,500 m^2 to 10,000 m^2, moderately dusty soil type (eg silt), 5 to 10 heavy earth moving vehicles active at any one time, formation of bunds 4 m to 8 m in height, total material moved 20,000 t to 100,000 t.
    - ***Small***: Total site area less than 2,500 m^2, soil type with large grain size (eg sand), less than five heavy earth moving vehicles active at any one time, formation of bunds less than 4 m in height, total material moved less than 20,000 t, earthworks during wetter months.
- Construction:
    - ***Large***: Total building volume greater than 100,000 m^3, piling, on site concrete batching; sandblasting.
    - ***Medium***: Total building volume 25,000 m^3 to 100,000 m^3, potentially dusty construction material (eg concrete), piling, on site concrete batching.
    - ***Small***: Total building volume less than 25,000 m^3, construction material with low potential for dust release (eg metal cladding or timber).

- Track-out:
  - ***Large***: More than 50 heavy vehicle movements per day, surface materials with a high potential for dust generation, greater than 100 m of unpaved road length.
  - ***Medium***: Between 10 and 50 heavy vehicle movements per day, surface materials with a moderate potential for dust generation, between 50 m and 100 m of unpaved road length.
  - ***Small***: Less than 10 heavy vehicle movements per day, surface materials with a low potential for dust generation, less than 50 m of unpaved road length.

STEP 2B – ASSESSMENT OF THE SENSITIVITY OF THE AREA

Step 2B 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 sensitive receptors have to dust deposition and human health impacts;
- The proximity and number of those receptors;
- 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.

Individual receptors are classified as having *high*, *medium* or *low* sensitivity to dust deposition and human health impacts (ecological receptors are not addressed using this approach). The IAQM method provides guidance on the sensitivity of different receptor types to dust soiling and health effects as summarised in **Table A-1** (IAQM, 2014). It is noted that user expectations of amenity levels (dust soiling) is dependent on existing deposition levels.

Table A-1 IAQM Guidance for Categorising Receptor Sensitivity

Value	High Sensitivity Receptor	Medium Sensitivity Receptor	Low Sensitivity Receptor
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.*
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 will generally not include workers occupationally exposed to PM10.*	Locations where human exposure is transient. *Examples: Public footpaths, playing fields, parks and shopping street.*

According to the IAQM methods, the sensitivity of the identified individual receptors (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 will take place;
- any conclusions drawn from local topography;

- the duration of the potential impact (as a receptor may be willing to accept elevated dust levels for a known short duration, or may become more sensitive or less sensitive (acclimatised) over time for long-term impacts); and
- any known specific receptor sensitivities which go beyond the classifications given in the IAQM document.

Dust Soiling

The IAQM guidance for assessing the sensitivity of an area to dust soiling is shown in **Table A-2**. The sensitivity of the area should be derived for each of activity relevant to the project (ie construction and earthworks).

Table A-2 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Soiling Effects

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

Note: Estimate the total number of receptors within the stated distance. Only the *highest level* of area sensitivity from the table needs to be considered. For example, if there are 7 high sensitivity receptors < 20m of the source and 95 high sensitivity receptors between 20 and 50 m, then the total of number of receptors < 50 m is 102. The sensitivity of the area in this case would be high.

Health Impacts

A modified version of the IAQM guidance for assessing the sensitivity of an area to health impacts is shown in **Table A-3**. For high sensitivity receptors, the IAQM methods takes the existing background concentrations of PM_{10} (as an annual average) experienced in the area of interest into account and is based on the air quality objectives for PM_{10} in the UK. As these objectives differ from the ambient air quality criteria adopted for use in this assessment (ie an annual average of 32 µg/m^3 for PM_{10} compared to 25 µg/m^3 used in Australia) the IAQM method has been modified slightly.

This approach is consistent with the IAQM guidance, which notes that in using the tables to define the *sensitivity of an area*, professional judgement may be used to determine alternative sensitivity categories, taking into account the following factors:

- 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 will take place;
- any conclusions drawn from local topography;
- duration of the potential impact; and
- any known specific receptor sensitivities which go beyond the classifications given in this document.

Table A-3 IAQM Guidance for Categorising the Sensitivity of an Area to Dust Health Effects

Receptor Sensitivity	Annual Mean PM_{10} Concentration	Number of Receptors [a,b]	Distance from the Source (m)				
			<20	<50	<100	<200	<350 m
High	<25 µg/m³	>100	High	High	High	Medium	Low
		10-100	High	High	Medium	Low	Low
		1-10	High	Medium	Low	Low	Low
	21-25 µg/m³	>100	High	High	Medium	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	High	Medium	Low	Low	Low
	17-21 µg/m³	>100	High	Medium	Low	Low	Low
		10-100	High	Medium	Low	Low	Low
		1-10	Medium	Low	Low	Low	Low
	<17 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
	21-25 µg/m³	>10	Medium	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	17-21 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
	<17 µg/m³	>10	Low	Low	Low	Low	Low
		1-10	Low	Low	Low	Low	Low
Low	-	≥1	Low	Low	Low	Low	Low

Notes: (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.

(b) In the case of high sensitivity receptors 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.

(c) The estimated background annual average PM_{10} concentration is taken from monitoring data as outlined within **Section** Error! Reference source not found..

Risk Assessment

The dust emission magnitude from Step 2a and the receptor sensitivity from Step 2b are then used in the matrices shown in **Table A-4** (demolition), **Table A-5** (earthworks and construction) and **Table A-6** (track-out) to determine the risk category with no mitigation applied.

Table A-4 Risk Category from Demolition

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Medium Risk
Medium	High Risk	Medium Risk	Low Risk
Low	Medium Risk	Low Risk	Negligible

Table A-5 Risk Category from Earthworks and Construction Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Medium Risk	Low Risk
Low	Low Risk	Low Risk	Negligible

Table A-6 Risk Category from Track-out Activities

Sensitivity of Area	Dust Emission Magnitude		
	Large	Medium	Small
High	High Risk	Medium Risk	Low Risk
Medium	Medium Risk	Low Risk	Negligible
Low	Low Risk	Low Risk	Negligible

STEP 3 - SITE-SPECIFIC 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.

STEP 4 – RESIDUAL IMPACTS

Following Step 3, the residual impact is then determined after management measures have been considered.

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