Budawang School
NSW Department of Education
15-Apr-2020

Air Quality Impact Assessment

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Client: NSW Department of Education

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			Name/Position	Signature
A	1-Oct-2020	Draft Report for Client Review	Kristen Clarke Principal Air Quality Scientist	
B	15-Apr-2021	Final Report	David Rollings Associate Director Air Quality	

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1.0 Introduction

AECOM Australia Pty Ltd (AECOM) has been commissioned to undertake an air quality impact assessment (AQIA) for the proposed Budawang School to be constructed at 17 Croobyar Rd, Milton NSW. The following report assesses the potential air quality emissions associated with the school construction activities and the possibility of amenity impacts on the school due to surrounding existing sources of air pollution.

The objective of the assessment is to address the requirements of the Secretary's Environmental Assessment Requirements (SEARs) issued by the NSW Department of Planning industry and Environment (DPIE) and demonstrate that air quality impacts are unlikely to occur.

1.1 Project Background

The former Shoalhaven Anglican School is to be redeveloped into the Budawang School. This school is to replace the old Budawang school which is capacity constrained and requires additional spaces to cater for local growth.

As part of the planning requirements for the development, it has been identified that an air quality assessment is needed to ensure that the construction works do not result in adverse impact on the surrounding environment and that the surrounding environment does not present an unacceptable risk to the ongoing use of the site as an school. In particular, the following scope items have been identified as required point of investigation for the study:

- A review into air quality legislation in NSW that applies to the proposed development;
- An analysis of existing air quality conditions at the proposed development site using onsite air quality monitoring and available monitoring station data from the surrounding area;
- Confirmation of local meteorological conditions to understand how dispersion maybe affected by local conditions;
- Analysis of the extent of potential construction and operational impacts from the site (assessed qualitatively); and
- Provision of recommendation(s) for management and mitigation measures to avoid, reduce and monitor likely development-related air quality impacts

Of note for this project is the consideration of the nearby hospital helipad and concrete batching plant, both of which produce air pollutants of concern to the school. Both activities will be considered as part of the assessment and the risk of adverse impacts qualitatively assessed. The outcome of the assessment will be an indication of the risk that these facilities pose to the school.

1.2 Project SEARs

In response to a proposal to construct the Budawang school at 17 Croobyar Rd, Milton NSW, SEARs were sought from NSW Department of Planning, Industry and the Environment (DPIE). The SEARs issued for the project included a range of key issues, which need to be addressed as part of the planning response. Specific requirements were listed in relation to air quality, which needed to be addressed by this assessment. The air quality related SEARs issued for this project are as follows:

10. Air

"Describe baseline conditions

Provide a description of existing air quality and meteorology, using existing information and site representative ambient monitoring data. This description should include the following parameters:

h. Dust deposition;

i. Air particulates, including $PM_{2.5}$ and PM_{10};

j. Odour."

Assess impacts

- *Identify all pollutants of concern and estimate emissions by quantity (and size for particles), source and discharge point.*
- *Estimate the resulting ground level concentrations of all pollutants. Where necessary (e.g. potentially significant impacts and complex terrain effects), use an appropriate dispersion model to estimate ambient pollutant concentrations. Discuss choice of model and parameters with the EPA.*
- *Describe the effects and significance of pollutant concentration on the environment, human health, amenity and regional ambient air quality standards or goals.*
- *Describe the contribution that the development will make to regional and global pollution, particularly in sensitive locations.*
- *For potentially odorous emissions provide the emission rates in terms of odour units (determined by techniques compatible with EPA procedures). Use sampling and analysis techniques for individual or complex odours and for point or diffuse sources, as appropriate. Note: With dust and odour, it may be possible to use data from existing similar activities to generate emission rates.*
- *Reference should be made to relevant guidelines, including but not limited to:*

  a. Approved Methods for the Modelling and Assessment of Air Pollutants in NSW (DEC, 2016);

  b. Approved Methods for the Sampling and Analysis of Air Pollutants in NSW (DEC, 2007);

  c. Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006);

  d. Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006);

  e. Load Calculation Protocol for use by holders of NSW Environment Protection Licences when calculating Assessable Pollutant Loads (DECC, 2009).

Describe management and mitigation measures

- *Outline specifications of pollution control equipment (including manufacturer's performance guarantees where available) and management protocols for both point and fugitive emissions. Where possible, this should include cleaner production processes.*

The project scope has been developed to address the requirements outlined above. The scope items described in **Section 1.3** outline the approach to the assessment and where in the document specific areas required by the SEARs have been addressed.

It should be noted however when describing the contribution that the development will make to regional and global pollution as listed in the SEARs above the assessment addresses the potential regional air quality impacts from the Proposal. As the Proposal involves the construction and operation of a small-scale school no global implications are anticipated and as such are not discussed further in this technical report.

1.3 Project Scope

The project scope has been developed in a staged approach to enable the comprehensive assessment of the air quality aspects of this project. The areas of concern addressed are as follows:

1. Potential dust effects of the school construction activities on the existing local receptors
2. Possible effects of the existing air pollutant sources on the future school; and
3. Details on the potential mitigation measures that may be implemented to prevent either the impacts from construction or from surrounding industry or air pollution sources.

The scope of work for the qualitative AQIA and the corresponding section of the report has been provided in **Table 1**.

Table 1 Project Scope and Corresponding Report Section

Project Scope Item	Report Section
Legislative Analysis	**Section 3.0**
Qualitative Construction Dust Assessment	**Section 7.1**
Reverse Amenity Assessment	**Section 7.2 – 7.5**
Environmental Analysis	**Section 5.0**
Mitigation and Management Measures	**Section 7.1.4**

In addition to the project scope, the items listed in the SEAR's have been identified and the section of the report where the items have been addressed have been identified in **Table 2**.

Table 2 Report Section where SEARs Requirements are Addressed

SEARs Item	Report Section
Describe baseline conditions	**Section 5.0**
Assess impacts	**Section 7.0**
Describe management and mitigation measures	**Section 7.1.4**

2.0 Project Description

The former Shoalhaven Anglican School located off Croobyar Road, Milton is to be developed into the Budawang School for Special Purposes (Budawang school). This school is to replace the old Budawang school which is capacity constrained and is in need to additional spaces to cater for local growth.

This new school is to cater for a range of purposes including:

- A new school will be developed to cater for 7 learning spaces for approximately 42 students. This will replace the existing Budawang school with the possibility of a masterplan to permit for future expansion to 10 learning spaces.
- Bringing Specialist Secondary facilities back to use on the site following the former Shoalhaven Anglican schools' closure. This would require an upgrade to the existing secondary spaces on the site which would be operated as a multi-faceted school to be used by Ulladulla High School, Milton Public School, Ulladulla Public School and Budawang school. The school facilities would focus on vocational and specialist teaching spaces to complement existing curriculum offering (subject to appropriate school operating model being developed).
- Functional upgrade of the early year's facility located on the site for a childcare facility for 20 students. This facility will either be operated by the Department or leased to a potential operator.
- Hydrotherapy pool and a wellbeing hub for joint use of Budawang school student and the local community.

2.1 Site Location and Context

The Budawang school site is to be located on land legally designated as Lot 200 DP1192140, local address 17 Croobyar Rd, Milton NSW (see **Figure 1** below). The Site is situated on the southern boundary of the Milton township, which is part of the City of Shoalhaven Local Government Area (LGA). More broadly, the Site is located approximately 5.5 km northwest of the Ulladulla Central Business District (CBD) and approximately 2.5km west of Mollymook. The Site is also located approximately 80 m west of the Princes Highway, which is the main road into the Milton / Ulladulla / Mollymook region.

The Site is adjacent to commercial properties further to the west and residential properties to the north, east, and immediately adjacent to the site's western boundary and is located within an RU1 zoned area under the Shoalhaven Local Environmental Plan 2014 (Shoalhaven LEP). The surrounding areas contain a mix of R1 / R2 General and Low Density Residential Zoning, SP2 / SP3 Special Activities and Infrastructure zoning and IN2 Light Industrial Zoning.

The surroundings of the Site are characterised by a mixture of low-density residential housing and larger area residential or commercial developments. The general character of the area is best described as residential.

The overall site area to be developed is approximately 1.3 ha, with a northern frontage facing Croobyar Road. The proposed school development will only occupy the north-eastern portion of the Site, and occupy approximately 17% of the total Site area (see **Figure 2** below).

Vehicular access to the Site is currently provided off Croobyar Road via an existing dual direction road historically used for the Shoalhaven Anglican School.

Figure 1 Proposed Site Locality Map

Figure 2 Budawang School Site Plan

2.2 Pollutants of Potential Concern

The Budawang school development is expected to only emit air pollutants during the construction period. The pollutants expected during construction are as follows:

- Construction Dust Pollutants:
  - Total Suspended Particulates (TSP)
  - Particulates with a diameter less than 10 microns (PM_{10})
- Construction Vehicle Emissions
  - Carbon Monoxide (CO)
  - Oxides of Nitrogen (NO_X)
  - Particulate Matter (PM_{10})
  - Particulate Matter ($PM_{2.5}$)

3.0 Air Quality Regulatory Framework

Legislation relating to projects contributing to air quality in NSW can be broadly divided into either federal or state-based legislation and consists of several distinct pieces of legislation that need to be considered. As an overview, the legislation applicable to air quality in NSW has been summarised in **Figure 3**.

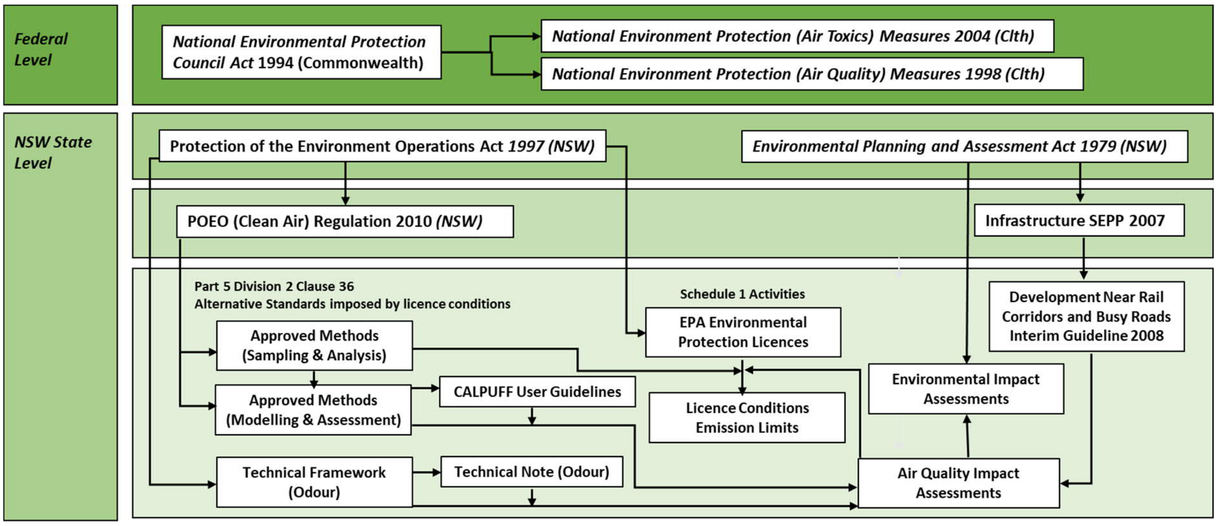


Figure 3 Air Quality Legislation relevant to NSW Impact Assessments

The following sections discuss the federal and state legislative instruments and outline how they relate to the school project.

3.1 Federal Legislation (National Environment Protection Measures)

National Environment Protection Measures (NEPMs) are broad framework-setting statutory instruments that outline agreed national objectives for protecting or managing particular aspects of the environment. Air quality from a federal perspective in NSW is governed by the *National Environment Protection (Ambient Air Quality) Measure (Clth)* (the Air Quality NEPM) as amended (2003). This NEPM provides guidance relating to air in the external environment, which does not include air inside buildings or structures.

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

- Carbon monoxide;
- Nitrogen dioxide;
- Sulfur dioxide;
- Particles as PM_{10} (particles with diameters less than or equal to 10 µm);
- Particles as $PM_{2.5}$ (particles with diameters less than or equal to 2.5 µm);
- Photochemical oxidants (as ozone); and
- Lead.

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

The ambient air quality standards defined in the Air NEPM are listed in **Table 3**, with future goals for $PM_{2.5}$ displayed in **Table 4**.

Table 3 NEPM Air Quality Standards

Item	Pollutant	Averaging period	Maximum concentration standard	Maximum allowable exceedances
1	Carbon monoxide	8 hours	9.0 ppm	1 day a year
2	Nitrogen dioxide	1 hour 1 year	0.12 ppm 0.03 ppm	1 day a year None
3	Photochemical oxidants (as ozone)	1 hour 4 hours	0.10 ppm 0.08 ppm	1 day a year 1 day a year
4	Sulfur dioxide	1 hour 1 day 1 year	0.20 ppm 0.08 ppm 0.02 ppm	1 day a year 1 day a year None
5	Lead	1 year	0.50 µg/m³	None
6	Particles as PM_{10}	1 day 1 year	50 µg/m³ 25 µg/m³*	None None
7	Particles as $PM_{2.5}$	1 day 1 year	25 µg/m³ 8 µg/m³	None None

Table 4 NEPM $PM_{2.5}$ goals by 2025

Pollutant	Averaging period	Maximum concentration
Particles as $PM_{2.5}$	1 day 1 year	20 µg/m³ by 2025 7 µg/m³ by 2025

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

The Air Toxics NEPM includes monitoring investigation levels for use in assessing the significance of monitored levels of air toxics with respect to human health. The monitoring investigation levels are levels of air pollution below which lifetime exposure, or exposure for a given averaging time, does not constitute a significant health risk. If these limits are exceeded in the short term, it does not mean that adverse health effects automatically occur; rather some form of further investigation by the relevant jurisdiction of the cause of the exceedance is required. The relevant monitoring investigation levels defined in the Air Toxics NEPM are listed in **Table 5**.

Table 5 Air Toxics NEPM Air Quality Monitoring Investigation levels

Pollutant	Averaging Period	Monitoring Investigation Level	Goal
Benzene	Annual average	0.003 ppm	8-year goal is to gather sufficient data nationally to facilitate development of a standard.
Benzo(a)pyrene as a marker for Polycyclic Aromatic Hydrocarbons	Annual average*	0.3 ng/m^3	8-year goal is to gather sufficient data nationally to facilitate development of a standard.
Formaldehyde	24 hours	0.04 ppm	8-year goal is to gather sufficient data nationally to facilitate development of a standard.
Toluene	24 hours Annual average	1 ppm 0.1 ppm	8-year goal is to gather sufficient data nationally to facilitate development of a standard.
Xylenes (as total of ortho, meta and para isomers)	24 hours Annual average	0.25ppm 0.2 ppm	8-year goal is to gather sufficient data nationally to facilitate development of a standard.

In 2018, the intention to vary the NEPM was announced to strengthen the standards for Ozone, Nitrogen Dioxide and Sulfur Dioxide. The proposed variation to the NEPM was released in 2019 followed by a period of public consultation into the justification for the changes to the NEPM. The proposed changes to the NEPM have been summarised in **Table 6** along with the proposed dates for implementation and the standards that have been removed (designated by standards which have been crossed out).

Table 6 Changes to Ozone, Nitrogen Dioxide and Sulfur Dioxide NEPM Standards

Pollutant	Averaging Period	Maximum Concentration Standard	Maximum Allowable Exceedances
Nitrogen dioxide	1 hour 1 year	~~0.12 ppm~~ -> 0.09 ppm ~~0.03 ppm~~ -> 0.019 ppm	~~1 day a year~~ ~~None~~
Photochemical oxidants (as ozone)	~~1 hour~~ 4 -> 8 hours	~~0.10 ppm~~ ~~0.08 ppm~~ -> 0.09 ppm	~~1 day a year~~ ~~1 day a year~~
Sulfur dioxide	1 hour 1 day ~~1 year~~	~~0.20 ppm~~ -> 0.10 ppm ~~0.08 ppm~~ -> 0.02 ppm ~~0.02 ppm~~	~~1 day a year~~ ~~1 day a year~~ ~~None~~

Standards outlined in **Table 6** will be further reduced from 2025 as shown in **Table 7**.

Table 7 Changes to Ozone, Nitrogen Dioxide and Sulfur Dioxide NEPM Standards from 2025

Item	Pollutant	Averaging Period	Maximum Concentration Standard
2	Nitrogen dioxide	1 hour 1 year	~~0.09 ppm~~ -> 0.08 ppm ~~0.019 ppm~~ -> 0.015 ppm
3	Sulfur dioxide	1 hour	~~0.20 ppm~~ -> 0.075 ppm
4	Particles as $PM_{2.5}$	1 day 1 year	~~25 µg/m³~~ -> 20 µg/m^3 ~~8 µg/m³~~ -> 7 µg/m^3

These changes to the existing NEPM standards do not have a direct impact on the project as the NEPM does not apply to individual projects within NSW. However, state based impact assessment criteria used by bodies like the NSW EPA have typically followed closely and changes to criteria defined by the NEPM and there is no reason to expect that changes to the NEPM would not result in changes to state base legislation which is applicable to individual projects. On this basis, it is considered prudent where applicable to assess projects that may be operational for significant periods of time against likely future criteria values.

As the Budawang school construction is unlikely to result in the emission of large quantities of $PM_{2.5}$, nitrogen dioxide, sulfur dioxide or ozone, the changes to the criteria are not considered relevant to this assessment.

3.2 NSW Air Quality Legislation

As shown in **Figure 3**, NSW has a multi-tiered approach to air quality legislation ranging from Acts to Regulations and air quality policies and guidance documents. The following sections outline the sections of the legislation and guidance that are relevant to this project.

3.2.1 Protection of the Environment Operations (POEO) Act 1997

The *Protection of the Environment Operations Act 1997 (NSW)* (POEO Act 1997) is the key piece of environmental protection legislation administered by the NSW EPA. The objective of the POEO Act 1997 is to achieve the protection, restoration and enhancement of the quality of the NSW environment; consolidating several NSW Environmental legislative requirements under the one Act. The Acts repealed as part of the implementation of the POEO include:

- Clean Air Act 1961;
- Clean Waters Act 1970;
- Environmental Offences and Penalties Act 1989;
- Noise Control Act 1975; and
- Pollution Control Act 1970.

The major feature of the legislation from the perspective of air quality is the integration of environmental protection licencing and the regulation of scheduled and non-scheduled activities within NSW. A non-scheduled activity is typically administered by local councils whereby scheduled activities are administered by EPA (although there are specific circumstances where EPA can regulate non-scheduled activities).

Given the school is not expected to generate air pollution and unlikely to exceed any trigger value for becoming a scheduled premise, the following general pollution clauses from the PEOE apply to this development:

- ***Section 124*** relates to the operation of plant (other than domestic plant) and the requirement to maintain the plant in an efficient manner and to operate the plant in a proper and efficient manner.
- ***Sections 125*** sets out the details of the offence that is caused by the improper operation or maintenance of plant that results in air pollution.
- ***Section 128*** relates to the standards of air pollutants being emitted from plant. In particular, the following points are important:
    - Air impurities must not be emitted in concentrations or rates in excess of the standards outlined in the regulations (Clean Air Regulation in this case)
    - The operator of a plant not covered by the regulation must operate a plant by such practical means as to minimise air pollution if neither the standard of concentration nor rate of emission prescribed by the regulation has been met.

Although applicable, it is considered unlikely that the planned school would be in a situation where plant would be required on site at such a magnitude that the above clauses would be relevant.

3.2.2 Protection of the Environment (Clean Air) Regulation 2010

The POEO (Clean Air) Regulation 2010 (Clean Air regulation) sits under the POEO Act 1997 and is the primary tool used by regulators within NSW to regulate the emissions from a range of activities. In particular, the regulation sets out requirements for emissions from the following:

- Wood heaters (Part 2 of the regulation)
- Fires (Part 3 of the regulation)

- Motor vehicles and fuels (Part 4 of the regulation)
- Industry (Part 5 of the regulation)

Part 5 of the regulation is the pertinent portion of the regulation in terms of the school given it is unlikely to be considered a scheduled premise. Part 5 sets out a range of important areas of regulation pertaining to industrial premises, including:

- Sets emission standards for a variety of different industry types;
- Defines emission standards for non-scheduled premises;
- Outlines emission standards for specific pollution sources, such as afterburners, flares and vapour recovery units; and
- Defines the methods for the control of volatile organic liquids through storage, transfer and transportation for volatile fuels.

Given that the site will likely be classified as a non-scheduled premise, any emissions that may occur (however unlikely) from the school operations only need be compared with Schedule 6 of the Clean Air Regulation, which has been outlined in **Table 8**.

Table 8 Clean Air Regulation: Schedule 6 Standards of concentration for non-scheduled premises

Air Impurity	Activity or Plant	Group*	Concentration
Solid Particles	Any activity or plant (except as listed below)	Group A	400 mg/m^3
		Group B	250 mg/m^3
		Group C	100 mg/m^3
Smoke	Any activity or plant in connection with which liquid or gaseous fuel is burnt	Group A, B or C	Ringelmann 1 or 20% opacity
* Given that the school is a new development, the activity would be defined as Group C			

3.2.3 NSW EPA and Department of Planning Industry and Environment Air Quality Guidance

There are a variety of different guidance documents published by the NSW government. These have been discussed in the following section.

Approved Methods Document

NSW EPA enforce the requirements of the above acts and regulations. To aid in the development of air quality assessments and to ensure consistent methods are used to quantify emissions and demonstrate compliance with the act and regulations, the EPA has published Approved Methods for both dispersion modelling and air pollutant sampling methods. These documents are:

- Approved Methods for the Sampling and Analysis of Air Pollutants in NSW, (DEC, 2007); and
- Approved Methods for the Modelling and Assessment of Air Pollutants in NSW, (EPA, 2016).

Along with the methods for the measurement and assessment of air emissions, the Approved Methods for Modelling also include pollutant criteria against which modelling predictions are compared when assessing the impact from a development.

Development near rail corridors and busy roads – interim guideline

NSW Government also provides guidance document for the regulation of development near rail corridors and busy roads. The DPIE's *Development Near Rail Corridors and Busy Roads – Interim Guideline* (DoP 2008) (the Guideline) supports the specific rail and road provisions of the *State Environmental Planning Policy (Infrastructure) 2007* (NSW). The aim of the Guideline is to aid in the reduction of health impacts of both noise and air quality impacts on sensitive adjacent development by assisting in the planning, design and assessment of development in or adjacent to rail corridors and busy roads.

Given the proximity of the school to rail or roadways, roadways would be the only potential source of pollution potentially affecting the school site (nearest railway over 50 km to the north). In relation to roads, there are a large number of roads close to the school location. To enable the determination of whether the DPIE document is relevant, the definition of a busy road needs to be considered. A busy road is defined as follows:

- A freeway, tollway or a transitway or any other road with an average annual traffic (AADT) volume of more than 40,000 vehicles;
- Any other road with an AADT volume of more than 20,000 vehicles; or
- Any other road with a high level of truck movements or bus traffic.

Where relevant, the following assessment addresses requirements in the Approved Methods for Modelling and the DPIE Roads and Railways documents.

Odour Regulation

Regulation of odour within NSW is undertaken through the implementation of the odour technical framework as outlined in the following documents:

- Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006);
- Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW (DEC, 2006);

The framework is a technical reference document which provide guidance for industry, developers, planners, regulators and specialists on the assessment and management of odours in NSW. The framework includes (NSW EPA, 2006):

- the legislation that applies to odour assessment and management in NSW;
- a process for assessing odour impacts from new developments
- a system to help protect the environment and community from odours while enabling fair and equitable outcomes for odour-emitting activities.

Load Calculation protocol

As part of the requirements of holding an Environmental Protection Licence (EPL), there is a requirement to submit annual environmental returns as defined by the Load Calculation Protocol for use by holders of NSW Environment Protection Licences when calculating Assessable Pollutant Loads (DECC, 2009). This document outlines the methodology for calculating the load based emissions required as part of the EPL returns.

4.0 Assessment Criteria

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

The NSW EPA have released assessment criteria as part of their Approved Methods document (EPA 2016). The pollutant specific criteria and corresponding averaging period for individual pollutants are shown in **Table 9**. Assessment of the impacts from the individual pollutants is based on the pollutant type. For the pollutants listed in **Table 9,** the assessable location is either at sensitive receptor locations (e.g. residential property) or “at or beyond” a facility boundary.

Given that the operation of the Budawang development i.e. low-level construction activities with no ongoing significant air pollution sources, dispersion modelling has not been undertaken. As such, the comparison of emissions from the school development with EPA criteria has not been undertaken. Criteria listed in **Table 9** represent pollutants that are expected to be present in background concentrations in the ambient environment and are relevant for the construction period of the school.

Table 9 Air Quality Impact Assessment Criteria

Compound	Averaging Period	Criteria ($\mu g/m^3$)	Source
TSP[1]	Annual Average	8	NSW Approved Methods
PM_{10}[1]	24 Hour Maximum	25	NSW Approved Methods
	Annual Average	8	NSW Approved Methods
$PM_{2.5}$ Particulates[2]	24 Hour Maximum	25	NSW Approved Methods
	Annual Average	8	NSW Approved Methods
Nitrogen Dioxide[2]	1 Hour Maximum	246	NSW Approved Methods
	Annual Average	62	NSW Approved Methods
Carbon Monoxide[2]	1 Hour Maximum	30,000	NSW Approved Methods
	8 Hour Maximum	10,000	NSW Approved Methods

[1] Main particulate emissions expected on the site during construction
[2] Very low levels of these pollutants expected from heavy vehicle use on-site

5.0 Existing Environment

5.1 Meteorology

The Bureau of Meteorology (BOM) operate a network of meteorological data monitoring stations across Australia. The closest station to the Budawang school site is located at Lighthouse Oval, Ulladulla, approximately 6km to the southeast of the school. The station has been in place since January 1991 and is considered to be a good long-term data set to use as the basis of the analysis of weather patterns in the region. The location of the school in relation to the BOM monitoring station in Ulladulla is shown in **Figure 4**.

Figure 4 Location of BOM Ulladulla Monitoring Station and Proximity to school

The SEARs outlined in **Section 1.2** require the analysis of the on-site meteorology as part of the baseline analysis of the site. In the absence of site-specific meteorological observations, a meteorological dataset has been prepared using a combination of regional meteorological observations from Bureau of Meteorology (BoM) stations, databases of terrain and land use, as well as gridded meteorological data from the CSIRO TAPM prognostic meteorological model. The following section provides a brief overview of each of the processes.

5.1.1 Meteorological Modelling

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

TAPM

The Air Pollution Model (TAPM) is a prognostic meteorological and air pollution model developed by CSIRO. The model can be used to predict three-dimensional meteorology, including terrain-induced circulations and is connected to databases of terrain, vegetation and soil type, leaf area index, sea-surface temperature, and synoptic-scale meteorological analyses for various regions around the world. TAPM was used in this assessment to generate individual upper air meteorological file for input into the CALMET model.

The initial and lateral boundary conditions for the TAPM simulation use 6-hourly three-dimensional analysis fields from the Global Forecast System. Settings within the TAPM model have been outlined in **Table 10**.

Table 10 TAPM Settings

Parameter	Setting
TAPM Version	4.0.5
Grid centre coordinates (km UTM)	266.189, 6107.306
Date parameters	2018 01 01 to 2018 12 31
Number of grid points	nx = 40
	ny = 40
Grid spacing	Outer = 30,000 m
	Inner = 1,000 m
Number of grid domains	4
Number of vertical grid levels	nz = 25
Observation file	Not used
Locations of upper air data extracted for CALMET (km UTM)	265.189, 6090.306; 266.189, 6099.306; and 272.189, 6112.306.

CALMET

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

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

Table 11 CALMET modelling parameters for the project domain

Parameter	Value
Meteorological grid domain	70 km x 70 km
Meteorological grid resolution	250 metre resolution (280 x 280 grid cells)
Reference grid coordinate (SW corner)	231.000 km E, 6071.800 km S
Cell face heights in vertical grid (m)	0,20,40,80,160,320,640,1200,2000,3000,4000
Simulation length	1 year (2018)
Surface meteorological stations	Ulladulla (BoM) Nerriga (BoM) Jervis Bay (BoM) Jervis Bay (Point Perpendicular) (BoM) Nowra RAN Air Station (BoM)
Upper air meteorology	3 x TAPM derived up.dat files
CALMET Modelling Mode	Observations mode
Terrain data	Terrain elevations were extracted from NASA Shuttle Radar Topography Mission Version 3 data set (SRTM1 30 metre resolution).
Land use Data	Site-specific data based on USGS land use codes and ABARES Land use Data
Wind field guess	Compute internally
Seven critical CALMET parameters	TERRAD = 3.5 km RMAX1 = 5 km RMAX2 = 10 km R1 = 2 km R2 = 5 km IEXTRP = -4 BIAS = -1,-0.5,0,0.5,1,1,1,1,1,1 (biased toward surface station observations at lower levels)

BoM Surface Station Meteorological Analysis

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

The school site has five surface observation stations in the general area within about 45 km. The location of the stations considered for this project has been provided in **Table 12**.

Table 12 Ulladulla Area Surface Station Locations used in the model

Weather Station	Operator	Easting (km UTM)	Northing (km UTM)	Distance from Project Location (km)
Ulladulla	BoM	271.297	6083.736	5.87
Nerriga	BoM	234.100	6110.829	40.32
Jervis Bay	BoM	290.233	6108.560	30.45
Jervis Bay (Point Perpendicular)	BoM	299.905	6114.372	41.59
Nowra RAN Air Station	BoM	274.922	6130.071	42.45

A review of five years of meteorological data from the BoM Ulladulla met station between 2015 to 2019 was carried out to determine a representative year of data for use in the CALMET modelling. Consideration was given to a range of different parameters for the selected year (2018), including wind speed, percentage of calms and a comparison of the 2018 calendar year to the long-term BOM Ulladulla trends over 10 years. Additionally, an analysis of the Southern Oscillation Index (SOI) was undertaken to ensure the year of meteorological data selected for the model was not adversely impacted by either an El Nino or La Nina event. The data analysis is presented in **Table 13**. The data comparison shows that there were only minor differences between the calms and wind speeds across the different years. The major difference noted was in the SOI, which, except for 2018, showed no significant El Nino or La Nina conditions. On this basis, it was considered that 2018 was the most appropriate year for further analysis.

Table 13 Multi-Year Meteorological Data Analysis – Ulladulla BOM Station

Ulladulla BoM data	Calm (%)	Wind Speed (m/s) #	Calm (%)	Wind Speed (m/s) #	Calm (%)	Wind Speed (m/s) #	SOI Avg.
	9:00 AM		3:00 PM		All Hours		
10-year trend	1.6	3.2	0.6	4.1	3.1	3.2	-
2015	1.4	3.3	0.0	4.2	2.9	3.4	-11.2
2016	1.6	3.1	0.5	4.0	3.4	3.1	-3.08
2017	1.9	3.2	1.4	4.1	4.5	3.2	2.15
2018	1.4	3.4	0.6	4.2	4.0	3.3	0.95
2019	2.5	3.1	0.5	4.0	4.0	3.1	-7.03

Average wind speed

A comparison of 2015 to 2019 wind speed and calms frequency data by hour of day for the BoM Ulladulla station is shown in **Figure 5**. This plot also shows that there is only a minor difference in average wind speeds and calm frequency from year to year. Night-time hours are characterised by a high frequency of calms and lower wind speeds. Daytime conditions show a much lower frequency of calms with higher winds speeds. The chosen year for modelling, 2018, shows slightly higher wind speeds during the day and a slightly higher frequency of calms during the early morning compared with the other years. However, the differences are not great when compared with other years or the longer-term conditions.

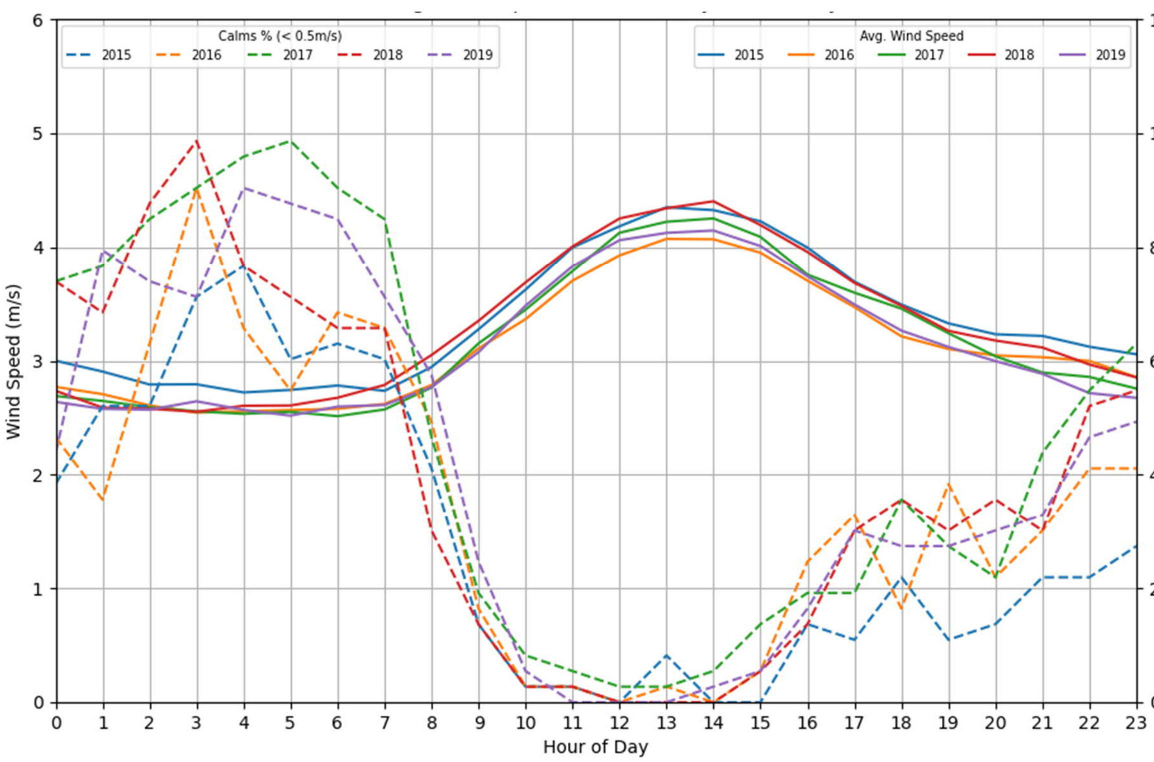


Figure 5 **Analysis of Wind Speeds for BOM Ulladulla Monitoring Station**

5.1.2 Budawang school Meteorological Analysis

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

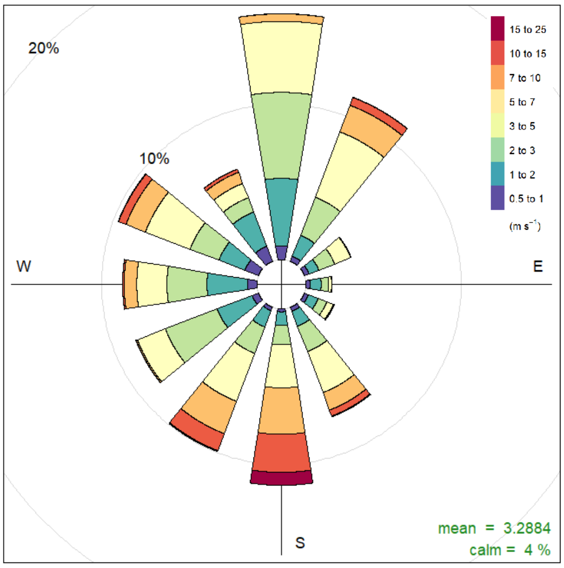
- Wind Speed and direction
- Temperature
- Mixing height (measure of potential for inversions); and
- Stability Class

Wind Speed and Direction

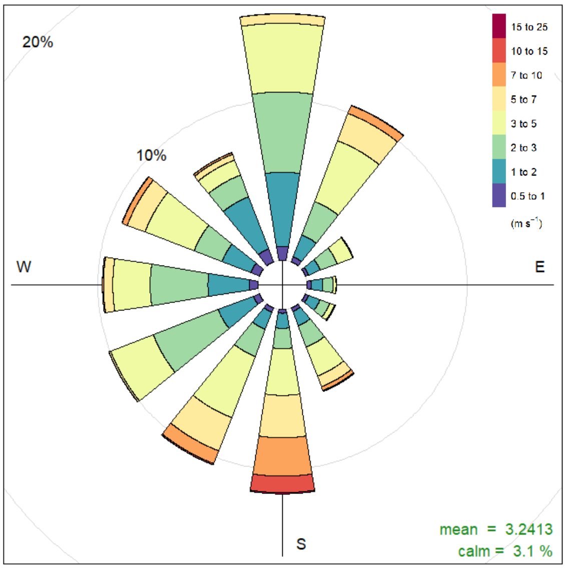
Wind predictions were extracted from CALMET at the school site for reference against longer term (2010 to 202019) regional observations at the BOM Ulladulla station. The following wind roses present a comparison between the two data sets.

Annual winds for the CALMET data at the school site are compared against winds at the BOM Ulladulla station (2010 to 2019) in **Figure 6**. Average wind speeds are slightly higher in the CALMET data but are consistent between the two stations. There are only minor differences in the direction of the predominant winds, with the CALMET data showing a slightly stronger southerly component than the BOM Ulladulla station. The annual frequency of calms for the CALMET data (4.0 %), which is slightly higher than that for BOM Ulladulla station (3.1%). This higher calm percentage is consistent with the school location being situated further from the coast than the BOM Ulladulla station.

Overall, the wind roses show a pattern consistent with other locations along the NSW South Coast.

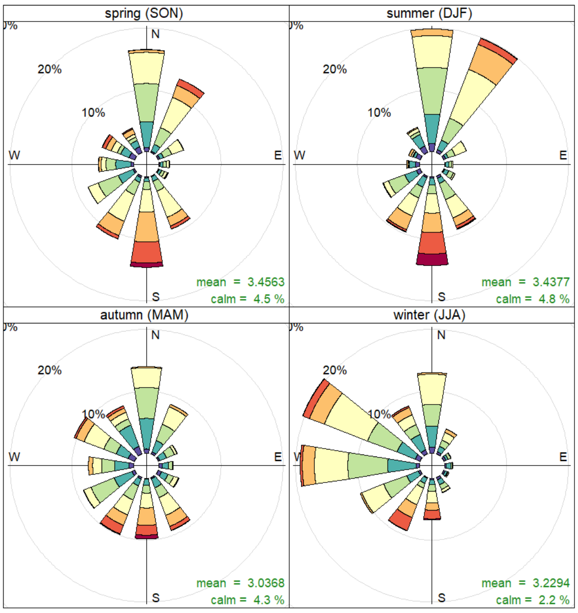


Budawang school (CALMET)

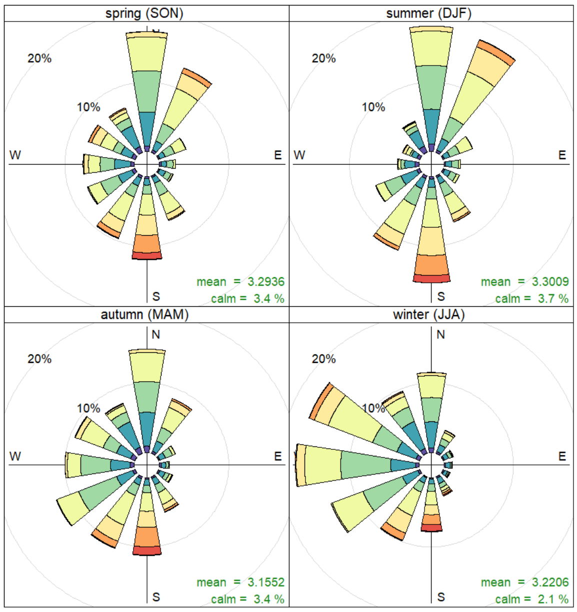


Ulladulla (BOM)

Figure 6 Annual Wind Roses for Budawang school Location and BOM Ulladulla monitoring station



Budawang school (CALMET)



Ulladulla (BOM)

Figure 7 Seasonal Wind Roses for Budawang school Location and BOM Ulladulla monitoring station

Temperature

Temperature data is estimated within CALMET for each hour of the meteorological data set. A plot of the temperature data predicted by CALMET at ground level at the school site is presented in **Figure 8**. The results are consistent with expected long-term observations as shown in **Table 14**.

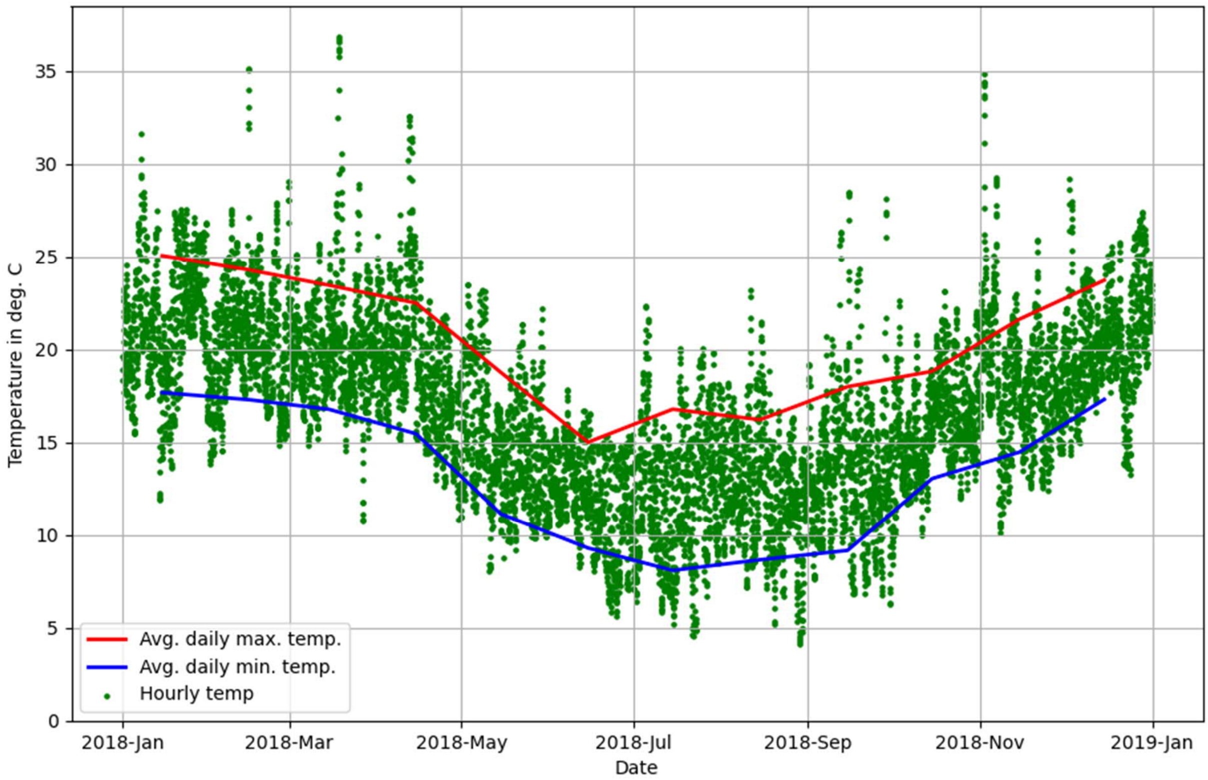


Figure 8 Predicted Temperature Data at Budawang school

Mixing Height

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

Mixing heights are estimated within CALMET for stable and convective conditions (respectively), with a minimum mixing height of 50m. **Figure 9** presents mixing height statistics by hour of day across the meteorological dataset, as generated by CALMET at the Project site. These results are consistent with general atmospheric processes that show increased vertical mixing with the progression of the day, as well as lower mixing heights during the night. Peak mixing heights observed in the data set of up to 3000m are consistent with typical ranges for mixing heights in Australia during the daytime.

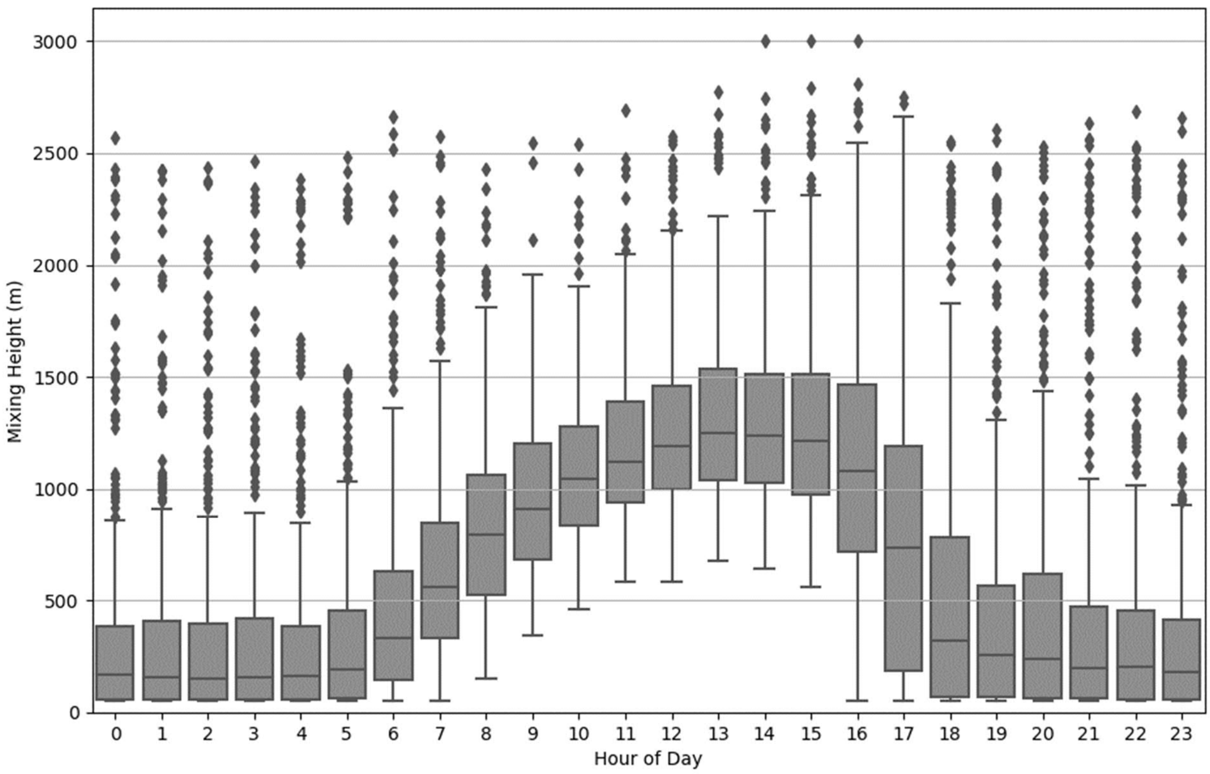


Figure 9 Predicted Mixing Height Data at Budawang school

Atmospheric Stability

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

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

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

Figure 10 presents an analysis of stability class frequency against wind speed for the CALMET data. The pattern shown in the figure is representative of a coastal area and confirms a typical distribution for stability class at different wind speeds. Lower wind speeds are dominated by moderately stable conditions, and high winds speeds are dominated by neutral conditions.

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

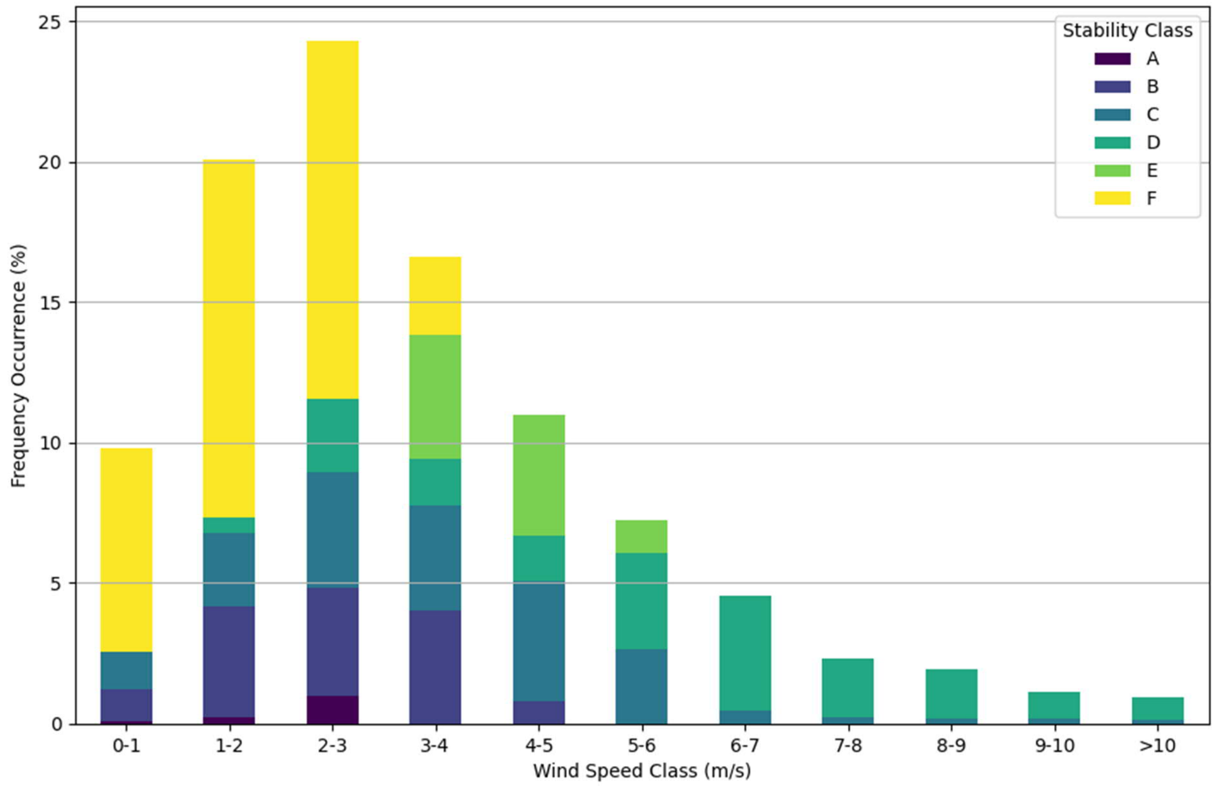


Figure 10 Predicted Stability Class Data at different wind speed classes at Budawang school

Figure 11 presents an analysis of CALMET stability class data by hour of the day. The data shows that night-time hours are dominated by moderately stable conditions, day time hours are dominated by slightly and moderately unstable conditions.

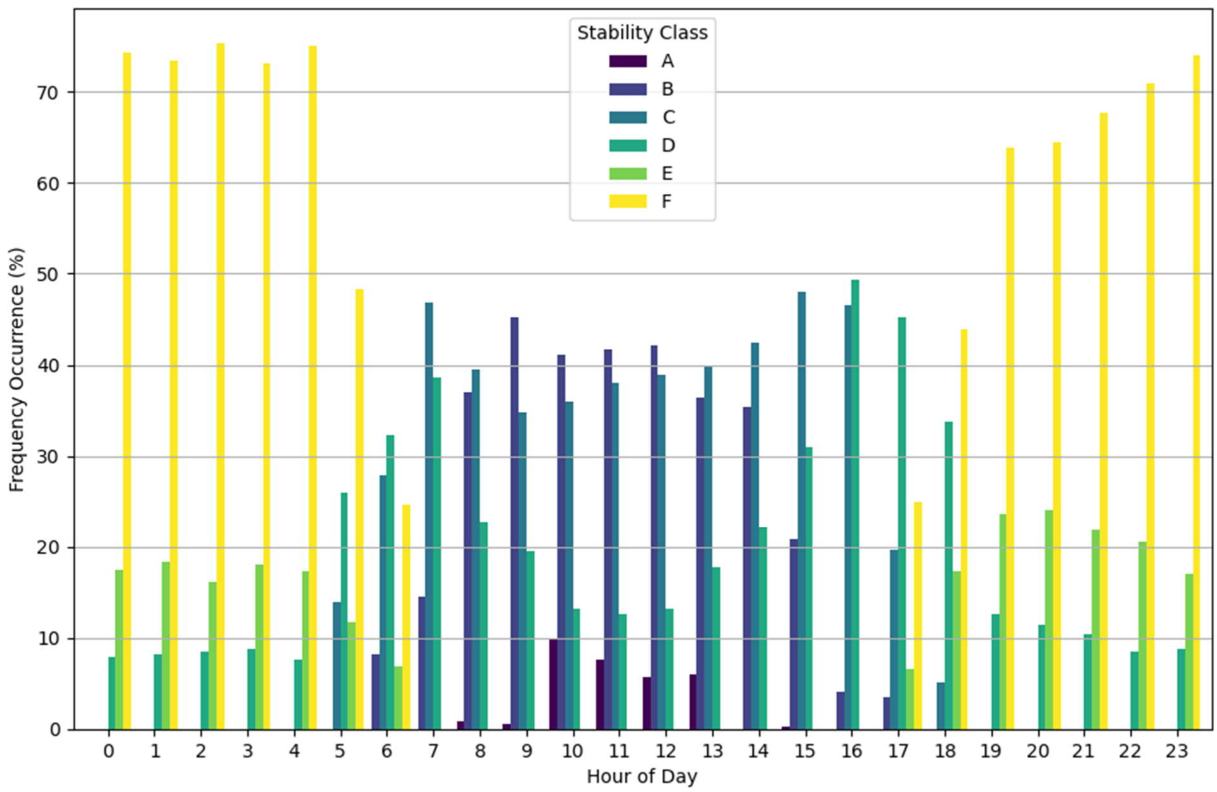


Figure 11 Predicted Stability Class Data at different times of day at Budawang school

Long Term Meteorological Data Summary - Ulladulla

A summary of the long-term data recorded at BOM Ulladulla (from 2010 – 2020) has been extracted and is shown below in **Table 14**.

The warmest temperatures occur between December and March with a mean maximum temperature of 24.3°C occurring in January and the mean minimum temperature of 8.9°C recorded in the winter months, with the lowest average minimum temperature occurring in July.

The highest average rainfall is recorded in February, with August, September and December being the driest months. Winds are predominantly from the northwest at 9 am, with less frequent winds from the east and south-east. Winds are predominantly from the East at 3 pm, with less frequent winds observed from the south to south-east.

Table 14 BoM Ulladulla Climate Statistics Summary

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann	Start Year	End Year
Mean maximum temperature (Degrees C)	24.3	24.2	23.4	21.5	19.2	16.9	16.5	17.3	19.2	20.7	21.7	23.1	20.7	1991	2020
Mean minimum temperature (Degrees C)	17.5	17.7	16.5	14.1	11.8	9.9	8.9	9.2	10.8	12.4	14.2	16	13.2	1991	2020
Highest temperature (Degrees C)	44.5	40	38	34.5	27.2	23.5	25.8	27.9	32.3	36.1	40	40.3	44.5	1991	2020
Lowest temperature (Degrees C)	10.6	10.3	10	8.1	5.9	3.3	2.5	3.4	3.7	4.8	6.3	7.9	2.5	1991	2020
Mean rainfall (mm)	87.1	125	110.3	98.1	93.2	120.1	80.1	73.1	72.6	81	83.4	71	1076.2	1994	2020
Mean number of days of rain	12.8	13.1	12.9	11.6	9	10.7	8.1	7.5	9.7	10.7	13.4	12.3	131.8	1994	2020
Mean 9am temperature (Degrees C)	20.5	20.5	19.6	18.1	15.6	13.2	12.5	13.6	15.5	17.1	17.6	19.4	16.9	1991	2010
Mean 9am relative humidity (%)	77	80	76	69	68	67	63	60	63	66	73	74	70	1991	2010
Mean 9am wind speed (km/h)	13.7	13.7	12.3	12.9	12.4	13.6	13.3	13.5	14.6	14.5	14.9	14.2	13.6	1991	2010
Mean 3pm temperature (Degrees C)	22.5	22.9	22.1	19.9	17.7	15.6	15	15.9	17.2	18.5	19.5	21.2	19	1991	2010
Mean 3pm relative humidity (%)	71	73	70	67	64	62	59	56	60	63	67	71	65	1991	2010
Mean 3pm wind speed (km/h)	19.8	19.3	18.4	17.8	16.4	16.3	16.3	18.1	19.2	20.1	21.2	20.1	18.6	1991	2010

5.2 Terrain and Land Use

The terrain immediately surrounding the proposed school location is best described as gently undulating coastal hinterland. More broadly speaking, the region is dominated by elevated terrain rising to the west of the coastal hinterland. The terrain elevations increase from approximately 50m above sea level to between 500m and 700m above sea level approximately 13km inland from the ocean. Terrain around the school location is shown below in **Figure 12**.

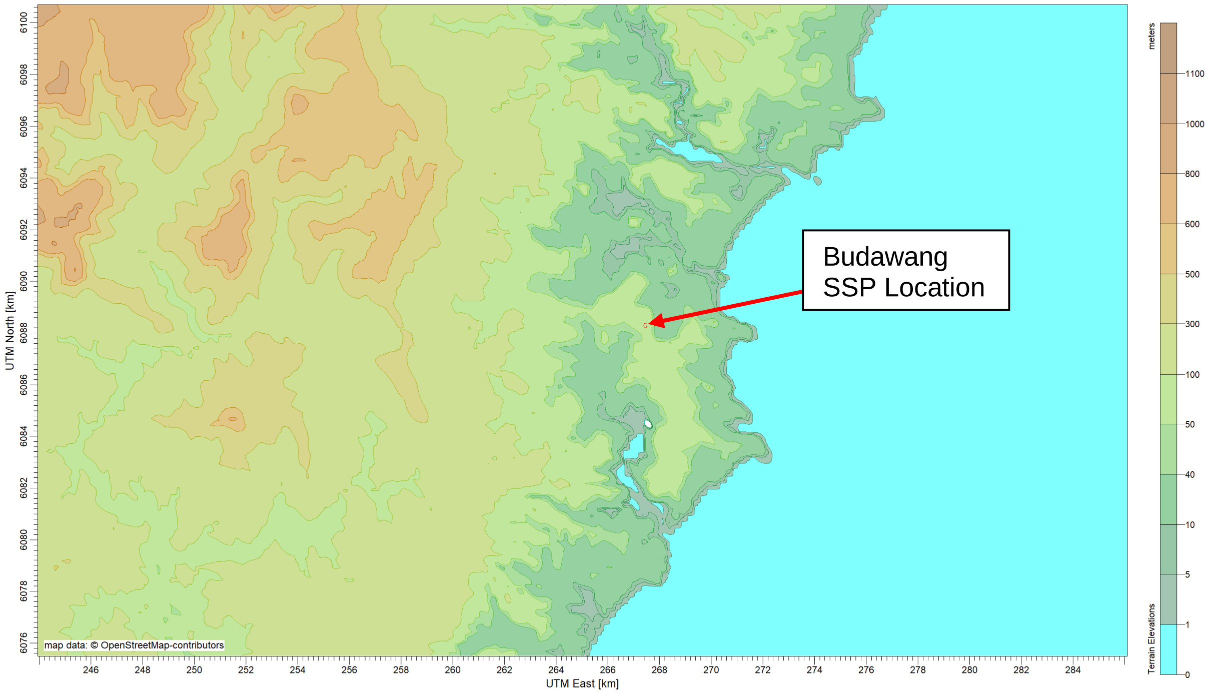


Figure 12 Terrain Elevations in the Greater Ulladulla Region

Land use in the area surround the school was considered when examining the meteorology at Milton. Land use data was required as part of the development of the CALMET meteorology and was extracted using GIS techniques from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES) “Catchment Scale Land Use of Australia”, December 2018 version. Data was validated using with recent satellite imagery which showed a good match with the ABARES data across the Milton and greater Ulladulla region. Land use data used in the modelling is shown in **Figure 13**.

Land use in the region surrounding Milton and the school is characterised by predominantly agricultural land and forest land interspersed with small residential areas. The largest residential area in the region is the Ulladulla / Mollymook township on the coast and the Milton township approximately 3.5km to the west of the coastline. The land use in the area is considered unlikely to have a major effect on the meteorology at the SP location, which would be expected to be dominated by the broader scale regional winds in the area.

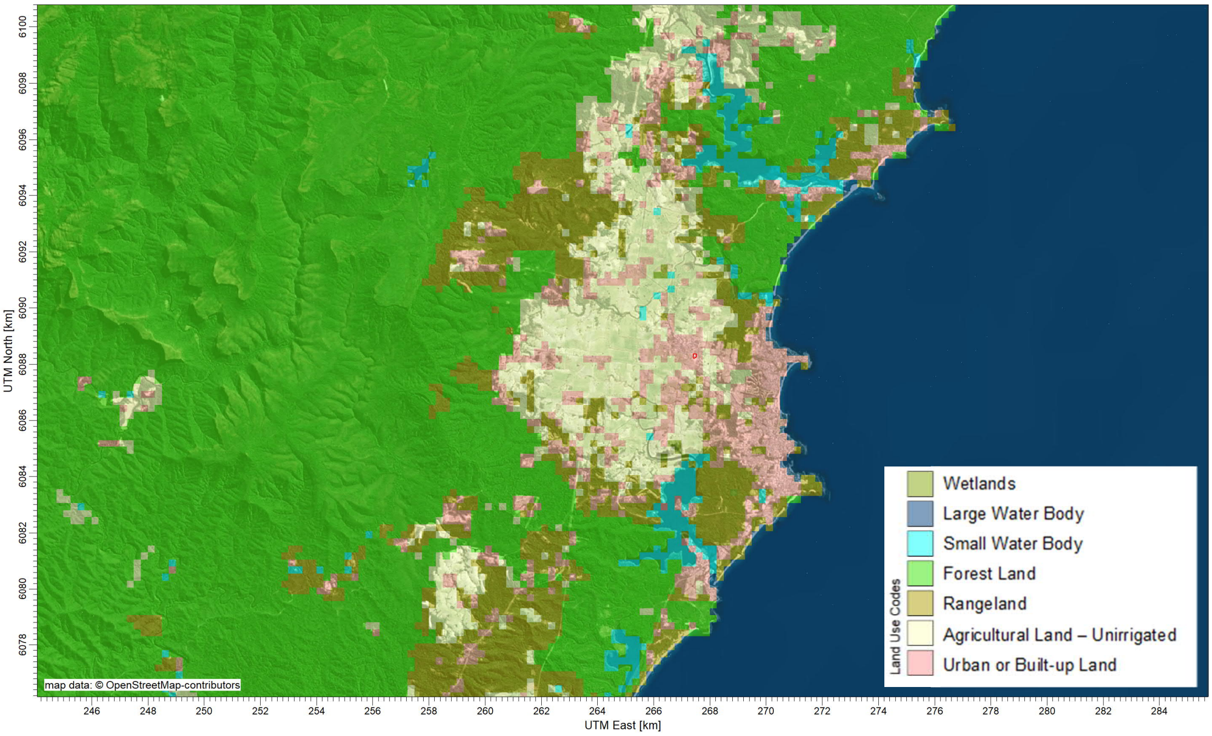


Figure 13 Land use in the Greater Ulladulla Region

5.3 Existing Air Quality

The pollutants of prime interest in NSW are ozone, NO_2 and particulates, with regional levels of certain pollutants approaching or exceeding the national standards prescribed in the National Environment Protection Measure for Ambient Air Quality (NEPM). When operating, the Budawang school is not expected to generate significant levels of air pollution. The only pollutants expected as a result of the school development are related to its construction period and consist of particulate emissions from construction activities and very minor contribution of vehicle emissions from any heavy vehicles needed for the site works. This assessment will not be assessing the emissions from the site quantitatively and as such the background pollutant concentrations are not required to enable a cumulative assessment. However, to understand the potential background pollution concentrations, an analysis of available pollutant data was undertaken to try and understand the existing pollutant levels in the Ulladulla region.

Background air pollution is characterised through ambient monitoring undertaken at locations throughout NSW by the NSW Environment, Energy and Science (EES) under the NSW DPIE. As outline above, the closest monitoring station to the Budawang school is the Albion Park South monitoring station situated at Terry Reserve, Albion Park, approximately 88km to the north northeast of the school location. Although this location is a significant distance from the school location and is likely representative of the conditions of the Illawarra escarpment area, it is the closest station to the school site which is both coastal and is not in a highly developed residential area (such as the stations further north in Wollongong). As a result, this location is considered the most appropriate monitoring station for use in an analysis of likely pollutant levels at the school location and has been used to define the likely background pollutant levels.

The Albion Park South station measures a range of pollutants relevant to this study including:

- Oxides of Nitrogen (including Nitrogen Dioxide);
- PM_{10} particulate matter; and
- $PM_{2.5}$ particulate matter.

Data covering the last five calendar years for the Albion Park South monitoring station have been extracted from the EES online data portal and haven been summarised in **Table 15**. Data trends for the extracted period have also been shown in **Figure 14** to **Figure 16**.

Table 15 Albion Park South Ambient Monitoring Data Summary

Pollutant	Averaging Period	Concentration (µg/m³)				
		2015	2016	2017	2018	2019[1]
Nitrogen Dioxide	1 Hour Max	96.4	88.1	77.9	80.0	84.1
	Annual Average	7.1	7.7	7.4	8.2	7.8
PM_{10}	24 Hour Maximum	41.2	43.1	44.6	**94.4**	**104.2**
	24 Hr Criteria Exceedances	0	0	0	2	15
	Annual Average	14.0	14.9	15.3	17.8	19.6
$PM_{2.5}$	24 Hour Maximum	21.1	**30.6**	19.3	**29.4**	**49.4**
	24 Hr Criteria Exceedances	0	2	0	1	12
	Annual Average	6.4	7.1	6.7	6.8	8.6

[1] 2019 data was adversely affected by bushfires from later September 2019 and averages and maxima should be treated with caution as they are not representative of long term conditions.
Bold entries denote exceedances of the NSW EPA criteria for that particular pollutant.

Monitoring data from the Albion Park South EES station show that nitrogen dioxide levels in the ambient environment are well below NSW EPA criteria, with the maximum 1 hour NO_2 concentration consisting of only 39% of the criteria. The annual average NO_2 concentration across the last 5 years was also found to be under 14% of the EPA criterion.

Minor seasonal trends in pollutant concentration were observed for NO_2, with higher concentrations of both pollutants noted during winter and lower concentrations noted in Summer. No significant change to the NO_2 concentrations were noted for the bushfire period of 2019. These seasonal trends and event concentrations follow the expected seasonal pollution patterns and as such the NO_2 data is considered reasonable for use in the assessment. It should be noted that the Albion Park South station is located on the southern extent of the Wollongong residential area which has a much higher population bases and associated vehicular usage rate. This would be expected to result in the Albion Park South area having a higher NO_2 concentration than the Ulladulla region and the concentrations at Milton would be expected to be lower than the levels outlined above in **Table 15**.

Particulate concentrations show that levels of dust in the ambient environment around Albion Park South area are elevated with exceedances of short-term PM_{10} and $PM_{2.5}$ criteria noted in both 2018 and 2019. These exceedances are attributed to unusual events like bushfires (particularly in 2019) and dust storms which occurred in both 2018 and 2019. Particulate concentrations during unusual events should not be used as indicators of long term peak particulate concentrations and compliance with EPA criteria.

A strong seasonal trend for was observed for PM_{10} particulates between 2015 and 2019, with higher concentrations observed during summer and lower concentration observed during winter. This trend was not observed to the same extent for $PM_{2.5}$ which had an overall consistent concentration across most the year with only a very slight seasonal trend observed. Both PM_{10} and $PM_{2.5}$ concentrations showed very high concentrations and exceedances during the 2019 bushfire season which are not representative of long-term conditions.

The particulate concentrations at Milton are likely to be similar to or lower than the monitored concentrations at Albion Park South given the school sites distance to the ocean being similar to the Albion Park South monitoring station's distance from the ocean (sea spray expected to be a significant contributor to particulate concentrations close to the coast) and the nature of the area surrounding the monitoring station i.e. predominantly residential land use.

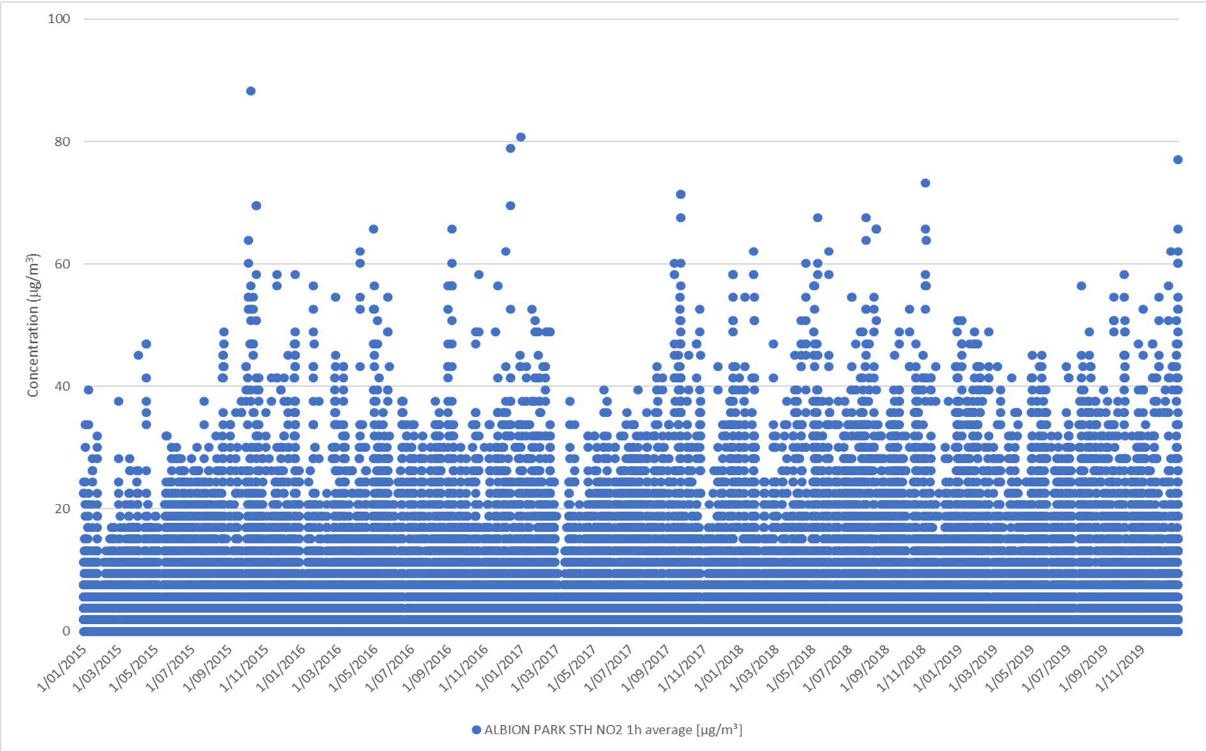


Figure 14 Background NO_2 Concentrations

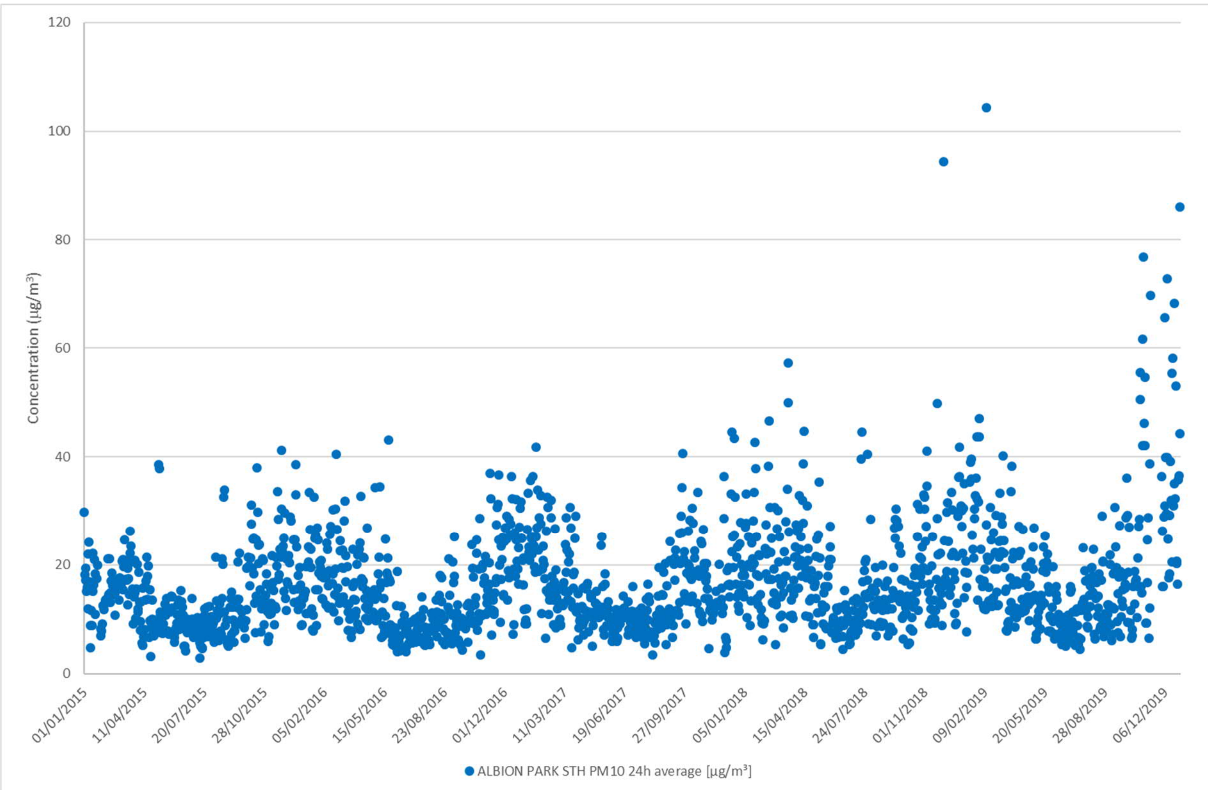


Figure 15 Background PM_{10} concentrations

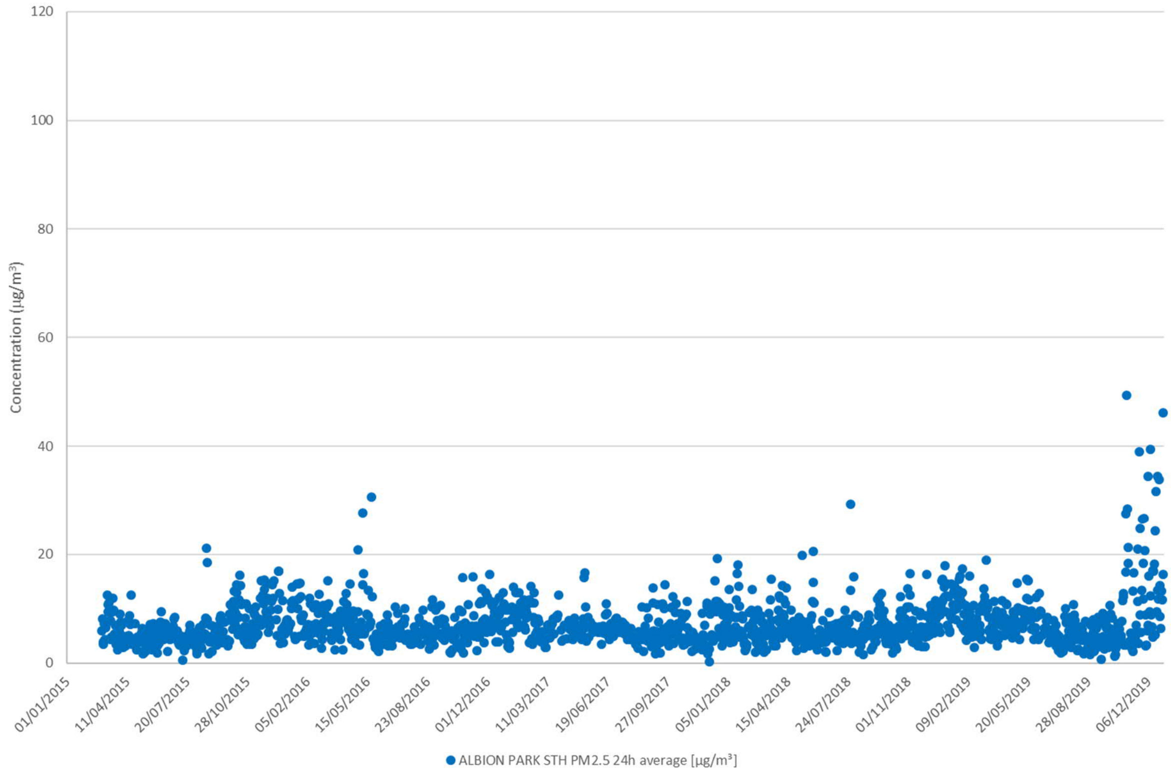


Figure 16 Background $PM_{2.5}$ concentrations

6.0 Construction Assessment Methodology

6.1 Overview

The Budawang school construction project would be expected to only generate a small amount of construction dust and vehicle emissions. Potential impacts from dust generation during construction have been assessed using the UK Institute of Air Quality Management (IAQM), 2014 *Guidance on the assessment of dust from demolition and construction*. This document provides a qualitative risk assessment process for the potential unmitigated impact of dust generated from demolition, earthmoving and construction activities.

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

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

6.2 Construction assessment

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

This assessment is based on estimated construction and demolition volumes and equipment usage for a building of the size of the Budawang school.

6.2.1 Step 1 – Screening Assessment

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

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

6.2.2 Step 2 – Dust Risk Assessment

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

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

Step 2A – Dust Emission Magnitude

Dust emission magnitudes are estimated according to the scale of works being undertaken classified as small, medium or large. The IAQM guidance provides examples of demolition, earthworks, construction and trackout to aid classification (refer **Table 16**).

Table 16 Classification criteria for small, medium and large demolition and construction activities

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

Step 2B – Sensitivity of Surrounding Area

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

Sensitivity of the area to dust soiling and human health effects

The IAQM methodology classifies the sensitivity of an area to dust soiling and human health impacts due to particulate matter effects as high, medium, or low. The classification is determined by a matrix for both dust soiling and human health impacts (refer **Table 17** and **Table 18** respectively). Factors used in the matrix tables to determine the sensitivity of an area are as follows:

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

Table 17 Surrounding area sensitivity to dust soiling effects on people and property

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

The IAQM guidance provides human health sensitivities for a range of annual average PM_{10} concentrations (i.e. >32, 28-32, 24-28 and <24 µg/m^3). It is noted in the IAQM guidance that the human health sensitivities are tied to criteria from different jurisdictions (UK and Scotland). The annual average PM_{10} criteria for Australia differ from the UK and Scotland and as such concentrations corresponding to the risk categories need to be modified to match Australian conditions.

The annual average criterion for PM_{10} in NSW is 25µg/m³ (refer **Section 4.0**) and therefore the scaled criteria for NSW is:

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

The background PM_{10} concentrations in the region surrounding the Project are outlined in **Section** 5.3 and fit within the lowest PM_{10} category (<19µg/m³ concentration range). Note that 2019 annual average data is not used for this assessment as it is heavily influenced by the 2019 bushfire period and is not considered representative of long-term conditions.

Table 18 provides the IAQM guidance sensitivity levels for human health impacts for the ranges outlined above for the annual average PM_{10} concentrations and highlights (in bold outline) the relevant range for NSW.

Table 18 Surrounding area sensitivity to human health impacts for annual average PM_{10} concentrations

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

The sensitivity for each construction activity defined by the IAQM guidance is assessed for the school building site. This results in a sensitivity rating for the construction footprint along with ratings for portions of the construction footprint for each construction activity. The ratings depend on the sensitivity of the receptors and the distance from the edge of the construction footprint. As shown in **Table 17** and **Table 18** the greater the distance from the construction footprint (the source), the lower the rating. The highest rating achieved is adopted as the final rating for that group of receptors.

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

Sensitivity of area to ecological impacts

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

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

The sensitivity of an ecological area to impacts is assessed using the criteria listed in **Table 19**.

Table 19 Sensitivity of an area to ecological impacts

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

Given the nature of the area surrounding the school construction activity, ecological impacts are considered unlikely and have not been considered further by this assessment.

Step 2C – Unmitigated Risks of Impacts

The dust emission magnitude as determined in Step 2A is combined with the sensitivity as determined in Step 2B to determine the risk of dust impacts with no mitigation applied. **Table 20** provides the risk ranking for dust impacts from construction activities for each scale of activity as listed in **Table 16**.

Table 20 Risk of dust impacts (for dust soiling and human health impacts)

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

6.2.3 Step 3 – Management Strategies

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

6.2.4 Step 4 – Reassessment

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

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

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

7.0 Impact Assessment

7.1 Construction Assessment

The exact quantities for excavation and the number of on-site vehicles etc are not yet known for this project. However to allow an estimate of the likely dust impacts from construction, a best estimate based on experience at other locations and the size of the proposed construction have been used to predict the magnitude of impacts outlined in **Section 7.1.2**.

7.1.1 Stage 1 Screening Assessment

An initial screening assessment was undertaken to identify whether there were any human receptors within 350m of the boundary or within 50m of the route used by construction vehicles. A 350m screening line was drawn from the expected school construction site boundary which is shown in **Figure 17**. This line shows that there are a large number of residential receptors within the 350m line and as such a Stage 2 assessment was triggered.

Figure 17 350m Receptor Screening Line

7.1.2 Stage 2 Assessment

The Stage 2 assessment considers the school construction footprint as shown as a green outline in **Figure 17**. The construction activities, while expected to be significant, are not expected to represent a large-scale construction site with only limited excavations works required to get the site into a position where construction can occur. The construction magnitudes and the potential risks associated with dust soiling and due to PM10 concentration have been discussed below.

Construction Activity Magnitudes

The construction activity magnitudes and dust sensitivities for the different construction activities are provided in **Table 21** and are based on the following assumptions:

- Demolition volume was estimated to be less than 20,000m^3 of construction material.
- Earthworks expected at the site are as follows:

  - Area of site works of ~8,800m^2[2];
  - Number of heavy earthmoving vehicles active at any one time of between 5-10; and
  - The volume of material removed from site was estimated to be less than 20,000 tonnes.
- Construction activities for the school buildings was estimated to be less than 25,000m^3 of building volume.
- Trackout for the site was estimated to consist of less than 10 heavy duty vehicle loads per day during the construction period.

These are estimates based on experience with similar projects. The estimates may need to be refined once the construction plans have been finalised. It is not expected however that major changes to the above assumptions would occur that would change the overall findings of the study.

Risk Associated with Dust Soiling

The school is situated immediately to the south of the main Milton township with several residential properties also bordering the eastern boundary of the school. Given the proximity of the school construction site to the township, are a large number of highly sensitivity residential buildings within 350m from the construction site boundary. Given the proximity of the receptors to the construction area, the number of receptors and the risk ratings have been determined depending on the distance from the boundary as follows:

- High Sensitivity Receptors
  - <20m from the construction site boundary – 1-10 receptors = Medium Risk
  - <50m from the construction site boundary – 10-100 receptors = Medium Risk
  - <100m from the construction site boundary – 10-100 receptors = Low Risk
  - <350m from the construction site boundary – >100 receptors = Low Risk
  - Overall the risk to High Sensitivity receptors is classed as Medium
- High Sensitivity Receptors
  - No receptors within 20m of the construction site boundary, hence the risk rating is Low
- Low sensitivity receptor risk rating is Low.

Overall, the risk rating for dust soiling is Medium based on the High Sensitivity receptor ratings.

Risk Associated with Exposure to PM_{10} Particulates

As detailed in **Section 5.2**, the background annual average PM_{10} concentration likely around the site is 17.8μg/m^3. The risk to human health from exposure to PM_{10} particulates has been determined based around distance to receptors as follows:

- High Sensitivity Receptors
  - <20m from the construction site boundary – 1-10 receptors = Low Risk
  - <50m from the construction site boundary – 10-100 receptors = Low Risk
  - <100m from the construction site boundary – 10-100 receptors = Low Risk
  - <350m from the construction site boundary – >100 receptors = Low Risk
  - Overall the risk to High Sensitivity receptors is classed as Low
- High Sensitivity Receptors
  - No receptors within 20m of the construction site boundary, hence the risk rating is Low
- Low sensitivity receptor risk rating is Low.

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[2] Area of proposed earthworks has been conservatively estimated and assumed to cover the total area of the SSP site.

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

Overall Dust Risk Ratings

The potential risks for the overall project were found to be "Medium" to "Negligible" for construction activities.

Table 21 Summary of unmitigated risk assessment for school construction activities

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

* Earthworks dust emission potential based on a combined classification of Large, Medium and Small for total site area, number of active heavy earthmoving vehicles and total mass of material moved respectively.

Given the unmitigated risk rating of negligible to medium, standard mitigation measures designed to minimise the generation of dust on construction sites are recommended.

7.1.3 Non-Construction Source Emissions

The source of non-construction dust emissions during the school construction phase would be due to the combustion of diesel fuel by heavy vehicles, mobile construction equipment and stationary equipment such as diesel generators. Emissions are expected to depend on the nature of the emissions source i.e. size of the equipment, usage rates, duration of operation etc. Pollutants emitted by construction vehicles include carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), nitrous oxides (NO_2), sulphur dioxide (SO_2), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs).

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

7.1.4 Construction Mitigation Measures

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

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

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

The performance outcomes would be addressed through the development of a Construction Air Quality Management Plan (CAQMP). A list of mitigation measures which may be implemented to achieve the above performance outcomes are provided below in **Table 22**. Note that this list of measures represent a minimum requirement for the Project and additional measures may be required to further reduce potential dust emissions.

Table 22 Mitigation Measures

ID	Performance outcome to be achieved	Mitigation measure
AQ1	• No visible dust moving off-site • No soil trackout onto public roads • No complaints from receptors in relation to dust emissions	Daily construction activities should be planned to consider the expected weather conditions for each workday. Regular dust observations to be undertaken of active excavation or stockpiling areas. Aim is to ensure visible dust is not moving offsite and that any areas needing additional measured be identified early. Records of observations should be compiled to enable the demonstration that dust is being managed in an ongoing manner. Records should include (as a minimum) the following: • observation date and time • area being inspected • level of dust being generated • meteorological conditions when observation occurred • mitigation measures undertaken.
AQ2	• No visible dust moving off-site.	Minimise exposed surfaces, such as stockpiles and cleared areas, including partial covering of stockpiles where practicable.
AQ3	• No visible dust moving off-site.	Implement dust suppression measures on exposed surfaces, such as watering of exposed soil surfaces, dust mesh, water trucks and sprinklers to minimise dust generation.
AQ4	• No visible dust moving off-site.	Implement dust suppression measures, such as watering, water trucks and sprinklers to minimise dust generation during demolition activities.
AQ5	• No soil trackout onto public roads.	Establish defined site entry and exit points to minimise tracking of soil on surrounding roads. Use wheel washes or shaker grids where the risk of off-site trackout of dirt is identified.
AQ6	• No visible dust moving off-site • No soil trackout onto public roads.	Cover heavy vehicles entering and leaving the site to prevent material escaping during transport.
AQ7	• No visible dust moving off-site • No unnecessary vehicle combustion emissions.	Keep vehicles and construction equipment operating on site well maintained and turned off when not operating (minimise idling on the site).
AQ8	• No visible dust moving off-site.	Minimise the handling of spoil when excavating and loading of vehicles.

7.1.5 Determination of Significant Effects

As indicated in the IAQM documentation, "*For almost all construction activity, the aim should be to prevent significant effects on receptors through the use of effective mitigation. Experience shows that this is normally possible. Hence the residual effect will normally be 'not significant'*". With the implementation of mitigation measures, the Medium and Low risks indicated above is expected to be reduced to produce a residual effect which is not significant.

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

7.2 DPIE Development near rail corridors and busy roads

Given the proximity of the school to rail or roadways, roadways would be the only potential source of pollution potentially affecting the school site (nearest railway being over 50 km to the north).

To enable the determination of whether the Guideline is relevant to the school location, the definition of a "busy road" needs to be understood. A busy road is defined as follows:

- A freeway, tollway or a transitway or any other road with an average annual traffic (AADT) volume of more than 40,000 vehicles; `
- Any other road with an AADT volume of more than 20,000 vehicles; or
- Any other road with a high level of truck movements or bus traffic.

Section 4 of the Guideline provides consideration for how to identify the potential for vehicle exhausts to impact on development adjacent to roadways and how to address potential air quality issues from vehicle exhausts for development near busy roads at the design stage. Section 4.4 of the Guideline lists the triggers for when air quality should be a design consideration for developments and provides guidance on design considerations that may be taken into account to mitigate air quality impacts. These triggers and are provided in **Table 23**.

Table 23 Triggers for Air Quality as a Design Consideration (DoP 2008)

Trigger	Design Consideration (Y/N)	Comment
Within 10 metres of a congested collector road (traffic speeds of less than 40 km/hr at peak hour) or a road grade > 4% or heavy vehicle percentage flows > 5%,	No	• Closest major road to the school location is the Princes highway located over 80m to the east of the site.
Within 20 metres of a freeway or main road (with more than 2500 vehicles per hour, moderate congestions levels of less than 5% idle time and average speeds of greater than 40 km/hr)	No	• No freeways close to the school site • Closest major road to the school location is the Princes highway located over 80m to the east of the site.
Within 60 metres of an area significantly impacted by existing sources of air pollution (road tunnel portals, major intersection / roundabouts, overpasses or adjacent major industrial sources)	No	• No road tunnel portals, major intersection / roundabouts, overpasses or adjacent major industrial sources close to the school.
As considered necessary by the approval authority based on consideration of site constraints, and associated air quality issues	No	• No constraints identified.

Based on **Table 23** development of the site would not trigger the need to consider air quality impacts from vehicle emissions at the design stage of the development. In addition, as all of the roads are considered to be small, low volume suburban streets, they do not meet the criteria listed in the Guideline for a busy road. On this basis, the school location is not subject to the requirements of this document.

7.3 Effects of Surrounding Land Uses

There are two existing activities surrounding the school location that have the potential to affect air quality at the school site. These two activities are the helipad operated by the Milton Ulladulla Hospital and the cement batching plant situated approximately 200m and 300m to the west of the school respectively.

Buffer distances are commonly used to minimise the potential for land use planning conflicts between industry and residential or other sensitive land uses (such a schools). While buffer distances are not published in any NSW government document, buffer distances have been listed by the South Australian and Victorian governments for their jurisdictions. The two documents referenced in relation to buffer distances are:

- Evaluation distances for effective air quality and noise management, SA EPA, 2016; and
- Evaluation distances for effective air quality and noise management, ERM, 2018 (prepared for the Victorian Government).

Relevant buffer distances and accompanying notes or clarifications have been provided below for the SA and Vic documents in **Table 24** and **Table 25** respectively.

Table 24 SA Buffer Distance Guidance Values

Activity	Evaluation Distance (m)	Comments
Concrete Batching Works:	200	Dust generation at concrete batching facilities usually results from vehicle movements on unsealed working areas, disturbance by vehicles of cement and aggregate dust on the ground, blow-outs from cement storage silos, and vehicle loading and unloading. Further, dust issues off-site can arise if mud or cement and aggregate dust is dragged by trucks from the site and dries on the adjoining roadway. There is potential for dust generation with delivery of sand and aggregates, cement, and fly ash (a cementitious material used to enhance the quality of concrete and similar to cement), loading of the aggregate weigh-hoppers, and loading of the trucks.

Table 25 Victorian EPA Buffer Distances

Activity	Clause 52.10 Threshold Distance (m)	EPA Guidance (m)
Concrete Batching Works:	300	100 (if >5000 tonnes per annum)

The concrete batching plant buffer distances listed above in **Table 24** and **Table 25** suggest a buffer distance of between 100m and 300m is appropriate for a concrete batching plant. The distance between the school and the batching plant is approximately 300m suggesting that there is a sufficient buffer between the batching plant and the planned school.

The helipad situated approximately 200m to the west of the school serves as a multi-use heliport, serving as the main Milton Ulladulla hospital helipad location and a range of other uses such as fire-fighting and other commercial uses. Dust from helipads is caused by engine emissions and the downdraft from the helicopter rotors entraining dust in the air flow generated by the landing and taking off from the pad.

One of the primary factors affecting the potential for dust generation from helicopter usage is whether the area around the helipad is sealed or has the potential to generate dust. An analysis of the helipad close to the school (as shown in **Figure 18**) shows that the helipad itself is concrete with the area surrounding the pad being well grassed with a single lane sealed road leading off Croobyar Road to the Helipad.

In addition to the low potential for significant dust generation events when landing, the helipad is situated a significant distance away from the school with a series of buildings and vegetative barriers between the helipad and school.

Given the lack of unsealed surfaces, the distance from the helipad to the school and the low relative frequency of use expected for the helipad, dust generation and adverse impacts as a result of the generated dust are expected to be very low.

The effect of engine emissions is also expected to be low given the low frequency of use at the site and the expected short duration of helicopter visits to the helipad.

Figure 18 Ulladulla Hospital helipad location and access road

7.4 Potential for Reverse Amenity Impacts

This section of the report provides a reverse amenity impact assessment for the proposed school Amendment in relation to potential air quality impacts. Reverse amenity impacts occur when a new development is built close to an existing development resulting in impacts from the existing development on the new development that was not there prior to the new developments construction e.g. a residential development being built close to an existing sewerage treatment plant resulting in complaints in relation to the odour from the treatment plant.

The proposed development introduces additional sensitive receptors (i.e. new school users of the SPP) to the receiving environment that have been potential impacted by existing air emission sources. The site previously housed the former Shoalhaven Anglican School and is considered to represent a similar land use, which is also considered to be a highly sensitive receptor. Given the existing site sensitivity, the surrounding land uses would already have been required to minimise potential air quality impacts on the site. Additionally existing potential sources of air pollution in the area, such as the helipad and small concrete batching plant (as discussed above in **Section 7.3**), are a significant distance from the edge of the SPP. As such, reverse amenity air pollution impacts are not expected to occur.

7.5 Potential for Odour Impacts

An analysis of the area surrounding the proposed school location did not identify any potential odour sources that have the potential to impact on the operation of the school. In particular, sources that may affect the site include things like sewerage odour, industrial odours and intensive agricultural odours were not identified within 1km of the site (keeping in mind that most of the population of Milton is within 1km of the school and any odour issues would be affecting the township to the same degree as they would affect the school).

Odour complaint data is another area that has the potential to identify locations where odour may be a problem. City of Shoalhaven council was contacted, and odour complaint data queried to identify whether there were any odour complaint data relevant to the school location. No odour complaint data was received from City of Shoalhaven council; however, based on surrounding land uses it is unlikely that Council would receive a high number of complaints relating to odour emissions within the study area.

Given the lack of potential sources and the nature of the area surrounding the school location, odour is not expected to be a cause for concern for the school.

8.0 Conclusion

An air quality assessment of the proposed construction of the proposed Budawang school in Milton, NSW was undertaken. This assessment considered the risk of construction dust along with the potential for reverse amenity impacts associated with the operation of the school.

The IAQM construction dust assessment methodology was used to assess the expected risks associated with the construction of the school. This assessment identified an unmitigated risk of low to negligible for all aspects of the construction activities. With mitigation measures included in the consideration of construction dust, the risk of impacts is expected to fall to negligible for all activities.

The reverse amenity of the proposed school was assessed to determine whether the construction of the school may result in the users of the site being affected by sources of air pollution that are already in the area of the school. The aspects considered included the existing industrial development (small concrete batching plant) and helipad to the west of the school, the proximity of the school to existing large road networks and whether there were any existing odour sources able to be identified in the school area.

Following the examination of the above air quality characteristics, it was concluded that the construction of the school was unlikely to result in adverse impacts on the surrounding environment and that the existing air quality was unlikely to adversely affect the operation of the school.

9.0 References

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

DEC (2006), Assessment and Management of Odour from Stationary Sources in NSW;

DEC (2006), Technical Notes: Assessment and Management of Odour from Stationary Sources in NSW;

DECC (June 2009), *Load Calculation Protocol*

DPIE (2008), *Development near rail corridors and busy roads – interim guideline*

EPA (2017), *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales*.

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

NEPC (2003), *National Environment Protection (Ambient Air Quality) Measure (Clth)*

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

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

NSW Government, (2014), *Shoalhaven Local Environmental Plan 2014*

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